Appendix 1E

Comments from Individuals and Responses

This section contains copies of comment letters from individuals on the Draft Environmental Impact Statement (EIS) for the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP). Each comment in the comment letters was assigned a number, in sequential order. The numbers were combined with the last name of the individual (example: Bartlett 1). The comments with the associated responses are arranged alphabetically by last name, and appear in the chapter in that order.

Copies of the comments are provided in Section 1E.1. Responses to each of the comments follow the comment letters, and are numbered in accordance with the numbers assigned in the letters. None of the comments from individuals included large attachments.

1E.1 Comments and Responses

The individuals listed in Table 1E.1 provided comments on the Draft EIS.

Table 1E.1. Individuals Providing Comments on the Draft Environmental Impact Statement

Abbreviation	Commenter
Bartlett	John Bartlett
Brobeck 1	James Brobeck
Brobeck 2	James Brobeck
Cardella	Nicolas Cardella
Cartwright	Ken Cartwright
Hoover	Michael Hoover
McDaniel	Daniel McDaniel
St. Amant	Tony St. Amant
Todenhagen	Nora Todenhagen

1E.1.1 John Bartlett

---------- Forwarded message ----------
From: **John Bartlett** <aufever@gmail.com>
Date: Fri, Jul 31, 2015 at 1:27 PM
Subject: Re; Salmon and Smelt Biologic Opinions
To: bcnelson@usbr.gov

Bartlett 1

The main problem is not with the salmon or smelt, but how the Striped Bass are managed. The California Department of Fish and Game in the past changed the daily limits to lower and the minimum size longer to increase the size and population of Striped Bass, while doing nothing to increase their food supply, so they eat what's available, Salmon Smolts and Delta Smelt. The main problem is the Striped Bass and how DFG manages the fishery. I have fished both coasts and fresh and salt water.

John Bartlett
1574 Bluejay Circle
Hanford, Ca. 93230
aufever@gmail.com

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Ben Nelson

Natural Resources Specialist

Bureau of Reclamation, Bay-Delta Office

916-414-2424

1E.1.1.1 Responses to Comments from John Bartlett

Bartlett 1: Two of the alternatives evaluated in the EIS, Alternatives 3 and 4, included modifications of the striped bass bag limits to reduce the predation potential on native species, as described in Sections 3.4.5.2 and 3.4.6.2 of Chapter 3, Description of Alternatives.

1E.1.2 James Brobeck – Number 1 Comment

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Public Meetings
Draft Environmental Impact Statement
for the Coordinated Long-Term Operation
of the Central Valley Project
and State Water Project

Thursday, September 10, 2015
Red Bluff Community Center
1500 S. Jackson St
Red Bluff, CA 96080
6:00 P.M.

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Reported By: Priscilla Steele, CSR No. 14052

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PUBLIC COMMENT SESSION

JAMES BROBECK: I'm a water policy analyst for Aqualliance; one word with one A in the middle. It's an

Brobeck1 1

Page 1

Brobeck1 1 continued

organization.

Brobeck1 2

My first comment is that the comment period needs to be extended. This is a voluminous document, and it was not distributed in a timely manner. I've been able to review some of it online, but online is very un-user-friendly as far as searching because it comes in so many segments. And it took over a week to receive one of these CDs in the mail for the entire project. I'm just getting one right now for the first time, leaving me two weeks to review this and compose legitimate comments. So I am asking the Bureau to extend the comment period another 30 days and to ask the Court for flexibility in issuing the FEIS and the record of decision, that the artificial deadline for the ROD makes it impossible for the public to fully analyze the alternatives and to compose valid comments. Would like to see a 30-day, if not a 60-day extension.

Brobeck1 3

I was very concerned that the presentation tonight gave the purpose of the action as what appeared to be maintaining the status quo on water deliveries, in contradiction to the hydrologic reality of the system.

The presentation disfavored reasonable reductions that would have perhaps protected the fishery, in favor of meeting so-called obligations to deliver water. I say "so-called" because these are not obligations. The Bureau is required to balance the public trust with the desires of the contract of those receiving the water. And the operations of the water projects have been in favor of the contractors, to the disadvantage of the public trust as clearly evidenced by the destruction of the delta smelt,

Brobeck1 3 continued

the destruction of the salmon in the Sacramento River.

Brobeck1 4

I'm outraged that last year's operations wiped out the winter and spring salmon before they spawned. And it appears that mismanagement is going to replicate the destruction of this year's salmon population, leading to a probable extinction of this species.

Brobeck1 5

I'm amazed that Alternative 1 and 4 are being presented, the alternatives the contractors sent because they clearly violate the court orders to protect the public trust.

Brobeck1 6

I think that this process is invalidated by the failure of the Department of Water Resources to create a CEQA equivalent document. There is no CEQA equivalent document for this project. There needs to be because the State Water Project is integral. This is the coordinated SDWP, State Department of Water Resources. And the CVP is the federal part. So here we are having the feds come up

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with a draft document, but there is no document to cover the state side of it. There needs to be a sequel equivalent analysis.

Brobeck1 7

I'm upset that the Bureau's presentation tonight obfuscated the fact that the lawsuits they cited were lawsuits that were being presented by state water contractors. That obfuscation is unnecessary. It's important to know who is pushing this process. And it's not the public. It's a very small portion of the California population. The state water contractors and settlement contractors were the ones pushing to eliminate the BO and the RPA.

Brobeck1 8

The Central Valley Hydrologic model ends in 2003, omitting the most current 12 years. The model is therefore completely inadequate, and any

Brobeck1 8 continued

091015 Hearing.txt

conclusions from the model are as well.

NORA TODENHAGEN: My concern with the project and the alternatives is that they are based on what is, really, incomplete data. We don't have a true analysis of the water coming into the systems if we assume continuation of the streams and tributaries, which have been drained due to groundwater extraction.

Also, the model on which these decisions or alternatives are based dates only to 2003. So that all of the data information on groundwater and surface water interactions from 2003 to the present has not been used in

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creating these proposals.

JAMES BROBECK: Aqualliance is very concerned that the cumulative impacts to the aquifer system resulting from integrating the groundwater into the state water supply through groundwater substitution water transfers. And continued expansion of groundwater-dependent irrigated agriculture is not being revealed or analyzed. The inevitable de-watering of tributaries and extirpation of groundwater-dependent ecosystems, such as Valley Oak Groves, needs to be revealed and analyzed. For the Bureau to analyze only impacts associated with their demand on the groundwater to facilitate water deliveries throughout the state is unacceptable, if not illegal.

(Whereupon, the public comment session concluded at 7:45 p.m.)

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1E.1.2.1 Responses to Comments from James Brobeck at the Public Meeting held in Red Bluff on September 10, 2015

Brobeck 1 1: Comment noted.

Brobeck 1 2: At the time the request for extension of the public review period was submitted, the Amended Judgement dated September 30, 2014 issued by the United States District Court for the Eastern District of California (District Court) in the *Consolidated Delta Smelt Cases* required Reclamation to issue a Record of Decision by no later than December 1, 2015. Due to this requirement, Reclamation did not have sufficient time to extend the public review period. On October 9, 2015, the District Court granted a very short time extension to address comments received during the public review period, and requires Reclamation to issue a Record of Decision on or before January 12, 2016. This current court ordered schedule does not provide sufficient time for Reclamation to extend the public review period.

Brobeck 1 3: The purpose of the action, as described in Chapter 2, Purpose and Need, of the EIS, is not biased because it includes a provision to enable Reclamation and DWR to satisfy their contractual obligations to the fullest extent possible in accordance with the authorized purposes of the CVP and SWP, as well as the regulatory limitations on CVP and SWP operations, including applicable state and federal laws and water rights.

Brobeck 1 4:

The population of winter-run Chinook salmon is at extreme risk. NMFS recently named Sacramento River winter-run Chinook salmon as one of the eight species most at-risk of extinction in the near future. Last year (2014), due to a lack of ability to regulate water temperatures in the Sacramento River in September and October, water temperature rose to greater than 60°F. This reduced early life stage survival (eggs and fry) from Keswick to Red Bluff from a recent average of approximately 27 percent (egg-to-fry survival estimates averaged 26.4 percent for winter-run Chinook salmon in 2002-2012) down to 5 percent in 2014. Consequently, 95 percent of the year class of wild winter-run Chinook was lost last year. Additional information regarding key components of the 2015 Shasta Temperature Management Plan is provided at: http://www.usbr.gov/mp/drought/docs/shasta-temp-mgmt-plan-key-components-06-18-15.pdf.

The 2014 spawning run of spring-run Chinook salmon returning to the upper Sacramento River system also experienced significant impacts due to drought conditions as well as elevated temperatures on the Sacramento River and other tributaries. Similar to winter-run, spring-run eggs in the Sacramento River experienced significant and potentially complete mortality due to high water temperatures downstream of Keswick Dam starting in early September 2014 when water temperatures exceeded 56° F. Extremely few juvenile spring-run Chinook salmon were observed this year migrating downstream of the Sacramento River during high winter flows, when spring-run originating from the upper Sacramento River, Clear Creek, and other northern tributaries are typically observed, indicating that the population was significantly impacted. Similar concerns for spring-run exist this year as for winter-run. While spring-run have greater distribution and inhabit locations in addition to the Sacramento River, conditions on those streams are also expected to be poor due to the drought. The conservation of storage expected as a result of the changes requested in the Temporary Urgency Change (TUC) Permit submitted by Reclamation and DWR in response to drought conditions are expected to also benefit spring-run this year. Additional information regarding CVP and SWP operations under a TUC Order issued on July 3, 2015, by the State Water Resources Control Board is provided at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order070315.pdf.

Brobeck 1 5: Alternatives 1 through 4 were selected as part of the range of alternatives evaluated in the EIS, as described in Section 3.4 of Chapter 3, Description of Alternatives. The commenter's opposition to Alternatives 1 through 4 is acknowledged.

Brobeck 1 6: The District Court required Reclamation to prepare a NEPA document upon the provisional acceptance of the RPA actions in the 2008 USFWS BO and 2009 NMFS BO. Reclamation is the lead agency for this action and the environmental document; therefore, the environmental document is being prepared only under the National Environmental Policy Act. Several State of California agencies are cooperating agencies for this EIS. Because compliance with the California Environmental Quality Act (CEQA) would be under DWR's purview, Reclamation consulted with DWR on this comment. On October 5, 2015, DWR provided the following response: "The District Court required Reclamation to comply with NEPA on the provisional acceptance of the RPA actions. There is no action for the State of California requiring California Environmental Quality Act (CEQA) review."

Brobeck 1 7: Recent ESA consultation activities and court rulings are discussed in Section 1.2.3.2 of Chapter 1, Introduction, of the EIS.

Brobeck 1 8: The CVHM model was used to support the EIS groundwater program because it was deemed to have the greatest resolution (vertically and spatially) and more robust calibration than any of the other available Central-Valley wide models. While the CVHM model simulation period ends at the end of 2003, none of the Central-Valley wide models that simulate groundwater conditions for more recent periods post-2003 were available or deemed adequate for the analysis at the time of preparation of the EIS. The 1961 through 2003 time period simulated by CVHM includes varying hydrologic conditions that range from extreme dry periods (such as 1987-92) and extreme wet periods (1983).

1E.1.3 James Brobeck – Number 2 Comment

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Public Meetings
Draft Environmental Impact Statement
for the Coordinated Long-Term Operation
of the Central Valley Project
and State Water Project

Thursday, September 10, 2015
Red Bluff Community Center
1500 S. Jackson St
Red Bluff, CA 96080
6:00 P.M.

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Reported By: Priscilla Steele, CSR No. 14052

Brobeck2 1

JAMES BROBECK: Aqualliance is very concerned that the cumulative impacts to the aquifer system resulting from integrating the groundwater into the state water supply through groundwater substitution water transfers. And continued expansion of groundwater-dependent irrigated agriculture is not being revealed or analyzed. The inevitable de-watering of tributaries and extirpation of groundwater-dependent ecosystems, such as Valley Oak Groves, needs to be revealed and analyzed. For the Bureau to analyze only impacts associated with their demand on the groundwater to facilitate water deliveries throughout the state is unacceptable, if not illegal.

(Whereupon, the public comment session concluded at 7:45 p.m.)

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1E.1.3.1 Responses to Comments from James Brobeck at the Public Meeting held in Red Bluff on September 10, 2015

Brobeck 2 1: The cumulative effects analysis discussion in Chapter 7, Groundwater Resources and Groundwater Quality, has been modified to provide more discussion of the potential effects of future projects.

1E.1.4 Nicolas Cardella

---------- Forwarded message ----------
From: **Nicolas Cardella** <ncardella@prlawcorp.com>
Date: Tue, Sep 22, 2015 at 5:05 PM
Subject: Question re Draft EIS for Coordinated Long-Term Operation of the CVP and SWP
To: bcnelson@usbr.gov
Cc: Alex Peltzer <apeltzer@prlawcorp.com>

Mr. Nelson:

Cardella 1

My name is Nicolas Cardella. We met at the Draft EIS presentation in Los Banos and I promised to write you a letter thanking you for all your hard work on the Draft EIS on condition that it be framed and prominently displayed in the Bay-Delta office. I would like to take this opportunity to assure you that I have not forgotten my promise. Regrettably, however, this is not that letter. For now, I have a question regarding the Draft EIS that I was hoping you could help me with.

Cardella 2

Chapter 5 shows the changes in CVP water deliveries under the Alternatives as compared to the No Action Alternative and the Second Basis of Comparison. For each comparison, the San Joaquin River Exchange Contractors, which are described as a "South of Delta" contractor, are shown to experience no change in CVP water deliveries. See Table 5.26 (5-93), 5.43 (5-122), 5.60 (5-150), 5.77 (5-176), 5.94 (5-203), 5.111 (5-231). My understanding is that the Exchange Contractors ordinarily receive water from the Delta but can, under certain circumstances, receive water from the San Joaquin and Kings Rivers. So my question is this: Are these tables saying that there would be no change to the Exchange Contractors' deliveries *from the Delta*, or that there would be no change to the Exchange Contractors' water deliveries *from all available sources*?

My concern is whether there has been some consideration of impacts to other CVP contractors resulting from the Exchange Contractors receipt of water from the San Joaquin and Kings Rivers, rather than the Delta.

Best,
Nic

Nicolas R. Cardella
Peltzer & Richardson LC
100 Willow Plaza, Suite 309, Visalia, CA 93291

P: 559-358-2713
E: ncardella@prlawcorp.com

1E.1.4.1 Responses to Comments from Nicolas Cardella

Cardella 1: Comment noted.

Cardella 2: The EIS analysis assumes all water deliveries to the San Joaquin River Exchange Contractors are conveyed through the Delta; and water deliveries from Millerton Lake would be similar under all alternatives and the Second Basis of Comparison in all water year types. However, it is recognized that during extreme droughts, water can be delivered to the San Joaquin River Exchange Contractors from Millerton Lake and CVP deliveries to users along the Friant and Madera canals can be reduced. Droughts have occurred throughout California's history, and are constantly shaping and innovating the ways in which Reclamation and DWR balance both public health standards and urban and agricultural water demands while protecting the Delta ecosystem and its inhabitants. The most notable droughts in recent history are the droughts that occurred in 1976-77, 1987-92, and the ongoing drought. More details have been included in Section

5.3.3 of Chapter 5, Surface Water Resources and Water Supplies, in the Final EIS to describe historical responses by CVP and SWP to these drought conditions, including recent deliveries of CVP water to the San Joaquin River Exchange Contractors.

1E.1.5 Ken Cartwright

To - Bureau of Reclamation

Subject: "Biologial opinions"

Cartwright 1

The opinions are designed to Keep water away from the Farmers in the valley, the environmentalist could care Less about the salmon OR smelt, thats the tool they use to Keep water away from Farmers.

to solve the water problem in Calif, hang the environmentalist and the fight for water is over. The environ have put thousands of people out of work and could Less.

Ken Cartwright
168 maple WAY
Hanford Ca. 93230

916-414-2439

1E.1.5.1 Responses to Comments from Ken Cartwright

Cartwright 1: Commenter's opposition to the biological opinions is noted. The EIS alternatives presented in Chapter 3, Description of Alternatives, represent a range of operations that result in different amounts of water for use by municipal, agricultural, and environmental beneficial uses in the CVP and SWP service areas and in water bodies affected by CVP and SWP operations.

1E.1.6 Michael Hoover

9/3/2015 DEPARTMENT OF THE INTERIOR Mail - Re: Comment for Reclamation

BISON CONNECT

Nelson, Benjamin <bcnelson@usbr.gov>

Re: Comment for Reclamation

Sierzputowski, Janet <jsierzputowski@usbr.gov> Mon, Aug 3, 2015 at 3:40 PM
To: mhoover27@comcast.net
Cc: Janet Sierzputowski <JSierzputowski@usbr.gov>, Benjamin Nelson <bcnelson@usbr.gov>

Good afternoon, Mr. Hoover.

Thank you very much for your email and for your close attention to detail as you were reading the article in the Hanford Sentinel. We will contact the newspaper and request a correction. Please note that the paper is not obliged to actually make the requested correction, but hopefully they will.

Sincerely, Janet 08/03/15

Janet Sierzputowski, Public Affairs Specialist
Bureau of Reclamation, Mid-Pacific Region
2800 Cottage Way, MP-140, Sacramento, CA 95825
Office 916-978-5112, Cell 916-943-6944

> From Michael Hoover (mhoover27@comcast.net) on 08/03/2015 at 01:08:38MSGBODY:
> Please note the following misinformation provided by the Hanford Sentinel:
>
> Feds seek input on salmon, smelt 'biological opinions' -- The federal Bureau of Reclamation wants public input on two fish "biological" opinions that affect the agricultural and municipal water supply coming from the Central Valley Project and the State Water Project. http://hanfordsentinel.com/news/local/fed-seek-input-on-salmon-smelt-biological-opinions/article_6fb7718d-423c-5398-99fe-675a30524995.html
>
> Agencies request public comment on their analyses as provided in a NEPA document prior to any associated decision, not on the validity of Biological Opinions as required by law. This is a legal issue that should be discussed with your Solicitor and clarified for and in the Hanford Sentinel.
>
> Previous Page: http://www.usbr.gov/main/comments.cfm

Hoover 1

1E.1.6.1 Responses to Comments from Michael Hoover

Hoover 1: Comment noted.

1E.1.7 Daniel McDaniel

Daniel A. McDaniel
Post Office Box 1461
Stockton, California 95201

September 29, 2015

Via Email bcnelson@usbr.gov
and First Class Mail

Ben Nelson
Bay-Delta Office
U.S. Bureau of Reclamation
801 I Street, Suite 140
Sacramento, Ca 95814-2536

Re: Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Dear Mr. Nelson:

Please accept these comments on the Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project ("DEIS"). McDaniel 1

I have lived, worked, and recreated in the Delta region for my entire life. My family settled in the Central Valley in the 1800's. I have a special attachment to the Delta as a place. The lands and waterways within the Delta are dedicated to a multitude of uses, including agricultural, residential, recreational, environmental, and various commercial uses. The Delta is a home to over a half million people, with an annual economic output in excess of $26 billion per year as of 2008, and a multitude of species.

I am uniquely qualified to comment on the DEIS, since I have witnessed the Delta suffer the consequences of excessive state and federal project diversions and exports from the Delta, which are increased due to the coordinated operations of the state and federal projects. I recall when the Delta was a much healthier place when I was a child, in the 1950's.

Ben Nelson
September 29, 2015
Page 2

1. The Alternatives Should Include Independent Project Operation Without Coordinated Operations.

The most obvious alternative, operation of the projects without coordination, appears to have been overlooked or avoided. Operations without coordination would provide the only real alternative which could avoid the application of the biological opinions. The DEIS should have analyzed the separate operations of the projects without any coordination, and analyzed those operations as against the need for coordinated operations under the requirements imposed by the biological opinions. In particular, increased instream flows in the Delta in the absence of coordinated operations should be analyzed. McDaniel 2 McDaniel 3

2. Failure to evaluate the project and all alternatives for consistency and compliance with the CVPIA.

The CVPIA provides a clear mandate in section 3406(b) to the Bureau to conform its operations with all obligations under state and federal laws in effect at the time of enactment in 1992. That section also includes the fish doubling goal. McDaniel 4

The DEIS should include an analysis of how operations will achieve and enable compliance with the CVPIA, including but not limited to the doubling goals for all anadromous fish as specifically defined by the CVPIA to include Striped Bass and American Shad. The Anadromous Fish Restoration Program established a doubling goal for Striped Bass of 2,500,000 fish. The deadline for achieving that has long passed, yet Striped Bass are in catastrophic decline. The DEIS fails to mention any meaningful efforts being made to achieve the doubling goal, despite being 14 years overdue. The DEIS should evaluate the project and the alternatives for consistency and compliance with all CVPIA obligations, and all CVPIA objectives and goals.

3. Failure to Determine, Consider, Evaluate, and Mitigate Predation on Striped Bass.

As Striped Bass are an important sport fishing asset entitled to special attention and protection under the CVPIA, predation on Striped Bass by other species should be analyzed considered, evaluated and mitigated against. The DEIS notes the importance to Striped Bass of the salinity gradient and predation upon other species, but fails to consider predation upon Striped Bass by mammals, birds, and other fish. Further, the DEIS fails to analyze and to consider mitigation of salinity impacts on Striped Bass. McDaniel 5 McDaniel 6

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Ben Nelson
September 29, 2015
Page 3

Thank you for the opportunity to comment on the DEIS. We look forward to the receipt of a revised DEIS.

Very truly yours,

DANIEL A. McDANIEL

1E.1.7.1 Responses to Comments from Daniel McDaniel

McDaniel 1: Comment noted.

McDaniel 2: As described in Section 3.3.1 of Chapter 3, Description of Alternatives, in the EIS, Reclamation and California Department of Water Resources (DWR) are required to operate the CVP and SWP, respectively, in a coordinated manner under the conditions of the Coordinated Operations Agreement (COA). This agreement was signed by the United States Congress and the California Legislature in 1986 to define operational procedures and formulas to share joint responsibilities for meeting Delta standards and other legal uses of water in the Delta watershed. Therefore, all alternatives must include the coordinated long-term operation of the CVP and SWP.

McDaniel 3: Operations under the range of EIS alternatives result in a range of Delta inflows and Delta outflows, as shown in Figures 5.59 through 5.61 (Sacramento River at Freeport) and Figures 5.74 through 5.76 (Delta outflow) of Chapter 5, Surface Water Resources and Water Supplies. Additional details are provided in Appendix 5A, Section C, CalSim II and DSM2 Model Results.

McDaniel 4: A footnote has been added to Table 9.1 in Chapter 9, Fish and Aquatic Resources, of the EIS, to identify the fish species that are a focus of Section 3406(b)(1) of the Central Valley Project Improvement Act. Additional text also has been added in the impact assessment sections of Chapter 9 to indicate that increased bag limits for striped bass under Alternatives 3 and 4 could affect the ability to meet Section 3406(b)(1) goals for striped bass.

McDaniel 5: The continued operation of the CVP and SWP would not result in changes to land use or levees with terrestrial resources that support mammals, birds, and amphibians that prey upon striped bass during some of their life stages. Therefore, these terrestrial resources in relation to striped bass were not described in detail in the EIS because there would be no changes between the alternatives.

McDaniel 6: As described in Section 9.3.4.4.1 of Chapter 9, Fish and Aquatic Resources, of the EIS, most Striped Bass spawning occurs upstream of the salinity zone, and the adult Striped Bass move into the brackish and salt water of the Delta and San Francisco Bay in the summer and fall. Changes in the salinity zone between the alternatives are most evident in the fall months with smaller changes in April and May based upon conditions under the No Action Alternative and Alternatives 2 and 5, as compared to conditions under Alternatives 1, 3, and 4, as shown in the location of X2 (see Figures conditions C-16.2.1 through 16.2.6 of Appendix 5A, Section C, CalSim II and DSM2 Model Results).

The text has been modified in Section 9.4 of Chapter 9, Fish and Aquatic Resources, in the Final EIS to address the relationship of salinity gradients and abundance of Striped Bass.

1E.1.8 Tony St. Amant

From: **Tony St. Amant** <tsainta@hotmail.com>
Date: Fri, Sep 18, 2015 at 1:40 PM
Subject: DEIS Extension
To: bcnelson@usbr.gov

Dear Mr.Nelson,

St. Amant 1

Please extend for 30 days the comment period for the Bureau of Reclamation's Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft Environmental Impact Statement (DEIS). This is a particularly complicated topic and with the concurrent comment period on the DEIS/EIR for the California Water Fix (formerly BDCP), additional time to review this project is needed.

Tony St. Amant

Chico

Thanks,

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Ben Nelson

Natural Resources Specialist

Bureau of Reclamation, Bay-Delta Office

916-414-2424

1E.1.8.1 Responses to Comments from Tony St. Amant

St. Amant 1: At the time the request for extension of the public review period was submitted, the Amended Judgement dated September 30, 2014 issued by the United States District Court for the Eastern District of California (District Court) in the *Consolidated Delta Smelt Cases* required Reclamation to issue a Record of Decision by no later than December 1, 2015. Due to this requirement, Reclamation did not have sufficient time to extend the public review period. On October 9, 2015, the District Court granted a very short time extension to address comments received during the public review period, and requires Reclamation to issue a Record of Decision on or before January 12, 2016. This current court ordered schedule does not provide sufficient time for Reclamation to extend the public review period.

1E.1.9 Nora Todenhagen

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Public Meetings
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Thursday, September 10, 2015
Red Bluff Community Center
1500 S. Jackson St
Red Bluff, CA 96080
6:00 P.M.

---o0o---

Reported By: Priscilla Steele, CSR No. 14052

Togenhagen 1

NORA TODENHAGEN: My concern with the project and the alternatives is that they are based on what is, really, incomplete data. We don't have a true analysis of the water coming into the systems if we assume continuation of the streams and tributaries, which have been drained due to groundwater extraction.

Also, the model on which these decisions or alternatives are based dates only to 2003. So that all of the data information on groundwater and surface water interactions from 2003 to the present has not been used in

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creating these proposals.

1E.1.9.1 Responses to Comments from Nora Todenhagen at the Public Meeting held in Red Bluff on September 10, 2015

Todenhagen 1: The CVHM model was used to support the EIS groundwater program because it was deemed to have the greatest resolution (vertically and spatially) and more robust calibration than any of the other available Central-Valley wide models. While the CVHM model simulation period ends at the end of 2003, none of the Central-Valley wide models that simulate groundwater conditions for more recent periods post-2003 were available or deemed adequate for the analysis at the time of preparation of the EIS. The 1961 through 2003 time period simulated by CVHM includes varying hydrologic conditions that range from extreme dry periods (such as 1987-92) and extreme wet periods (such as 1983).

Appendix 3A

No Action Alternative: Central Valley Project and State Water Project Operations

3A.1 Overview of the Central Valley Project and State Water Project

The Central Valley Project (CVP), operated by Bureau of Reclamation (Reclamation), and the State Water Project (SWP), operated by the California Department of Water Resources (DWR), are major interbasin water storage and delivery systems that divert water from the Sacramento River and San Joaquin River watersheds. These facilities also divert water from the southern portion of the Sacramento–San Joaquin River Delta (Delta) to areas located south and west of the Delta. Their operations store water, and divert and re-divert CVP and/or SWP water that has been stored in upstream reservoirs. The CVP and SWP operate pursuant to water right permits and licenses issued by the State Water Resources Control Board (SWRCB). These permits and licenses allow for appropriation of specific quantities of water for diversion to storage, releases from that storage later in the year, and/or direct diversion. As conditions of the water right permits and licenses, the CVP and SWP are required by SWRCB to meet specific water quality objectives. As a result, Reclamation and DWR closely coordinate CVP and SWP operations to meet these conditions.

The CVP was originally authorized by the Rivers and Harbors Act of 1935. It was reauthorized by the Rivers and Harbors Act of 1937 and again by the Central Valley Project Improvement Act (CVPIA) in 1992. The CVP is composed of nine divisions: Shasta and Trinity River Divisions, Sacramento River Division, American River Division, Delta Division, East Side Division, West San Joaquin Division, Friant Division, and the San Felipe Division. The CVP is composed of some 18 reservoirs with a combined storage capacity of more than 11 million acre-feet (MAF), 11 power plants, and more than 500 miles of major canals and aqueducts. These various facilities are generally operated as an integrated project, although they are authorized and categorized in divisions. Authorized project purposes include river regulation; flood control; navigation; provision of water for irrigation and domestic uses; fish and wildlife mitigation, protection, restoration, and enhancement; and power generation. However, not all facilities are operated to meet all of these purposes. As initially authorized, the primary CVP purpose was to provide water for irrigation throughout California's Central Valley. The CVPIA has amended CVP authorizations to include fish and wildlife mitigation, protection, and restoration; domestic uses; fish and wildlife enhancement; and power generation. The CVP's major storage facilities are Shasta Lake, Trinity

Lake, Folsom Reservoir, and New Melones Reservoir. The upstream reservoirs release water for delivery to in-basin users, flows in Delta tributaries to meet Delta water quality objectives and outflow criteria, and for delivery of CVP water through the C.W. Jones Pumping Plant (Jones Pumping Plant) to storage in San Luis Reservoir (jointly operated by Reclamation and DWR) or delivery through the Delta Mendota Canal (DMC).

The Burns-Porter Act, approved by the California voters in November 1960 (Water Code Sec. 12930-12944), authorized issuance of bonds for construction of the SWP. The principal facilities of the SWP are Oroville Reservoir and related facilities, San Luis Dam and related facilities, Delta facilities, the California Aqueduct, and North and South Bay Aqueducts. The SWP stores and distributes water for agricultural and municipal and industrial (M&I) uses in the northern Central Valley, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and Southern California. Other project functions include flood control, water quality maintenance, power generation, recreation, and fish and wildlife enhancement. In general, water is released from storage facilities for delivery to in-basin users, into Delta tributaries to meet Delta water quality objectives and outflow criteria, and for delivery of SWP water through the Harvey O. Banks Pumping Plant (Banks Pumping Plant) to storage in San Luis Reservoir or delivery through the California Aqueduct.

3A.2 Coordinated Operation of the Central Valley Project and State Water Project

The CVP and SWP are operated in accordance with the Coordinated Operation Agreement adopted by the Federal and state government and water rights permits issued by the SWRCB.

3A.2.1 Coordinated Operation Agreement

Reclamation and DWR have built water storage and water delivery facilities in the Central Valley in order to deliver water to CVP and SWP (Project) contractors, including senior water rights holders. Reclamation and DWR water rights are conditioned by SWRCB to protect the beneficial uses of water within the CVP and SWP and jointly for the protection of beneficial uses in the Sacramento Valley and the Sacramento–San Joaquin Delta Estuary. Reclamation and DWR coordinate and operate the CVP and SWP to meet water right and contract obligations upstream of the Delta, Delta water quality objectives, and CVP and SWP water right and contract obligations that depend upon diversions from the Delta.

The Coordinated Operation Agreement (COA), signed in 1986, defines the project facilities and their water supplies, coordinates operational procedures, identifies formulas for sharing joint responsibilities for meeting Delta standards (as the standards existed in SWRCB Water Right Decision 1485 [D-1485]) and other legal uses of water, identifies how unstored flow would be shared, establishes a framework for exchange of water and services between the CVP and SWP, and provides for periodic review of the agreement. DWR and Reclamation have operational arrangements to accommodate new facilities, water quality and flow objectives, the CVPIA, and Federal Endangered Species Act (ESA), but the COA has not been formally modified.

3A.2.1.1 Obligations for 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 SWRCB Decision 1485 (D-1485) Delta standards (D-1485 ordered the CVP and SWP to guarantee certain conditions for water quality for agricultural, M&I, and fish and wildlife beneficial uses). Each project is obligated to ensure water is available for these uses, but the degree of obligation is dependent on several factors and changes throughout the year, as described below.

Balanced water conditions are defined in the COA as periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flows approximately equals the water supply needed to meet Sacramento Valley in-basin uses plus exports. Excess water conditions are periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses plus exports. Reclamation's Central Valley Operations Office (CVOO) and DWR's SWP Operations Control Office (SWPOCO) jointly decide when balanced or excess water conditions exist.

During excess water conditions, sufficient water is available to meet all beneficial needs, and the CVP and SWP are not required to make additional releases. In excess water conditions, water accounting is not required and some of the excess water is available to CVP water contractors, SWP water contractors, and users located upstream of the Delta. However, during balanced water conditions, CVP and SWP share the responsibility in meeting in-basin uses.

When water must be withdrawn from reservoir storage to meet in-basin uses, 75 percent of the responsibility is borne by the CVP and 25 percent is borne by the SWP. When unstored water is available for export (i.e., Delta exports exceed storage withdrawals while balanced water conditions exist), the sum of CVP stored water, SWP stored water, and the unstored water for export is allocated 55/45 to the CVP and SWP, respectively. The percentages and ratios included in the COA were derived from negotiations between Reclamation and DWR for SWRCB D-1485 standards and CVP and SWP annual supplies existing at the time and projected into the future. Reclamation and DWR have continued to apply these ratios as new SWRCB standards and other statutory and regulatory changes have been adopted.

3A.2.1.2 Accounting and Coordination of Operations

Reclamation and DWR coordinate on a daily basis to determine target Delta outflow for water quality, reservoir release levels necessary to meet in-basin demands, schedules for joint use of the San Luis Unit facilities, and for the use of each other's facilities for pumping and wheeling.

During balanced water conditions, daily water accounting is maintained for the CVP and SWP obligations. This accounting allows for flexibility in operations and avoids the necessity of daily changes in reservoir releases that originate several days' travel time from the Delta. It also means 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 accounting language of the COA provides the mechanism for determining the responsibility of each project for Delta outflow influenced standards; however, real-time operations dictate actions. For example, conditions in the Delta can change rapidly. Weather conditions combined with tidal action can quickly affect Delta salinity conditions, and therefore, the Delta outflow required to maintain standards. If, in this circumstance, it is decided 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. Lake Oroville water releases require about 3 days to reach the Delta, while water released from Shasta Lake requires 5 days to travel from Keswick Reservoir to the Delta. As water from the other reservoirs arrives in the Delta, Folsom Reservoir releases can be adjusted downward. Any imbalance in meeting each Project's initial shared obligation would be captured by the COA accounting.

Reservoir release changes are one means of adjusting to changing in-basin conditions. Increasing or decreasing project exports can also immediately achieve changes to Delta outflow. As with changes in reservoir releases, imbalances in meeting each project's initial shared obligations are captured by the COA accounting.

During periods of balanced water conditions, when real-time operations dictate project actions, an accounting procedure tracks the initial sharing water obligations of the CVP and SWP. The CVP and SWP produce daily and accumulated accounting balances. The account represents the imbalance resulting from actual coordinated operations compared to the initial COA sharing of obligations and supply. The project that is "owed" water (i.e., either CVP or SWP 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 duration of balanced water conditions varies from year to year. Some very wet years have had no periods of balanced conditions, while very dry years have had long continuous periods of balanced conditions, and still other years may have had several periods of balanced conditions interspersed with excess water conditions. Account balances continue from one balanced water condition through the excess water condition and into the next balanced water condition. When the Project that is owed water enters into flood control operations, Shasta Lake and Folsom Reservoir for the CVP and Lake Oroville for the SWP, the accounting is zeroed out for that Project.

3A.2.1.3 Changes in Coordinated Operation Since 1986

Implementation of the COA principles has continuously evolved since 1986 as changes have occurred to CVP and SWP facilities, to Project operations criteria, and to the overall physical and regulatory environment in which the coordination of CVP and SWP operations takes place. Since 1986, new facilities have been incorporated into the operations that were not part of the original COA. New water quality objectives (SWRCB Water Quality Control Plan [WQCP] for the Bay-Delta in 1995 and 2006, as implemented through Water Right Decision 1641 [D-1641]) have been adopted by SWRCB; the CVPIA has changed how the CVP is operated; and finally, ESA responsibilities have affected both the CVP and SWP operations. The following describes the significant changes that have occurred since 1986. Included after each item is an explanation of how it relates to the COA and its general effect on the accomplishments of the Projects.

3A.2.1.3.1 Sacramento River Temperature Control Operations

Water temperature control operations have changed the pattern of storage and withdrawal of storage at Shasta Lake, Trinity Lake, and Whiskeytown Reservoir, for the purpose of improving temperature control and managing coldwater pool resources in the facilities. Water temperature operations have also constrained rates of flow and changes in rates of flow below Keswick Dam, in keeping with water temperature requirements. Such constraints have reduced the CVP's ability to respond efficiently to changes in Delta export or outflow requirements. Periodically, temperature requirements have caused the timing of the CVP releases to be significantly mismatched with Delta export capability, resulting in loss of water supply. The installation of a Shasta Lake temperature control device has significantly improved Reclamation's ability to match reservoir releases and Delta needs.

3A.2.1.3.2 Bay-Delta Accord, and Subsequent SWRCB Implementation of D-1641

The 1994 Bay-Delta Accord committed the CVP and SWP to a set of Delta habitat-protective objectives that were eventually incorporated into the 1995 Bay-Delta Water Quality Control Plan (WQCP), and later, along with the temporary Vernalis Adaptive Management Plan (VAMP) (since expired), were implemented through SWRCB D-1641 which amended the water rights of the

Projects. The actions taken by the CVP and SWP in implementing SWRCB D-1641 significantly reduced the export water supply of both Projects.

As described previously, Project operators must coordinate the day-to-day operations of the CVP and SWP to comply with the Projects' water right permits. The 1986 COA sharing formula has been used by Project operators for SWRCB D-1641 Delta outflow and salinity-based standards. SWRCB D-1641 contains significant new "export limitation" criteria such as the export to inflow (E/I) ratios. The 1986 COA framework neither contemplated nor addressed the application of such criteria to CVP and SWP permits. In most cases, when the E/I restrictions control Project operations, operators attempt is made to even out the rate of export over the restricted period. In some cases, a seasonal time shift of the SWP exports can help facilitate an equitable sharing of responsibilities. Until the COA is updated to reflect SWRCB D-1641 conditions, Project operators must continually work on a case-by-case basis in order to meet the Projects' water right requirements.

3A.2.1.3.3 North Bay Aqueduct

The North Bay Aqueduct (NBA) is a SWP feature that can convey up to about 175 cubic feet per second (cfs) diverted from the SWP's Barker Slough Pumping Plant. NBA diversions are conveyed to SWP water contractors in Napa and Solano Counties. The diversion is currently treated as an in-basin demand shared by both Projects.

3A.2.1.3.4 Freeport Regional Water Project

The Freeport Regional Water Project is a new facility that diverts up to a maximum of 286 cfs from the Sacramento River near Freeport for use in Sacramento County and by East Bay Municipal Utility District (EBMUD). EBMUD diverts water pursuant to its amended contract with Reclamation. The County diverts under their water rights and a CVP water service contract supply. This facility was not in the 1986 COA, and the diversions result in an increase of in-basin demands. The diversion is currently treated as an in-basin demand shared by both Projects.

3A.2.1.3.5 Loss of 195,000 Acre-Feet of D-1485 Condition 3 Replacement Pumping

The 1986 COA affirmed the SWP's commitment to provide replacement capacity at Banks Pumping Plant to the CVP at times when it would not reduce SWP yield, to make up for May and June pumping reductions at Jones Pumping Plant as imposed by striped bass protections under SWRCB D-1485 in 1978. In the evolution of COA operations since 1986, SWRCB D-1485 was superseded by SWRCB D-1641, and SWP water demand growth and other pumping constraints have reduced the available surplus capacity at Banks Pumping Plant. The CVP has not received replacement pumping since 1993. Since then there have been (and in the current operations environment there will continue to be) many years in which the CVP would be limited by insufficient Delta export capacity to convey its water supply. The loss of up to 195,000 acre-feet of replacement pumping capacity has diminished the water delivery anticipated by the CVP water users that receive water diverted from the Delta under the 1986 COA framework. The diminished water delivered results in an allocation, or charge, to CVPIA (b)(2) water.

3A.2.2 State Water Resources Control Board Water Rights

3A.2.2.1 Decision 1641

SWRCB adopted the 1995 WQCP on May 22, 1995, which was implemented, in part, through the SWRCB D-1641. SWRCB D-1641 (adopted on December 29, 1999 and revised on March 15, 2000) amends certain terms and conditions of the SWP and CVP water rights to impose flow and water quality objectives to assure protection of beneficial uses in the Delta and Suisun Marsh. SWRCB also grants conditional changes to points of diversion for each project with SWRCB D-1641.

The requirements in SWRCB D-1641 address the standards for fish and wildlife protection, M&I water quality, agricultural water quality, and Suisun Marsh salinity. These objectives include specific 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 the wetness of the year.

SWRCB D-1641 also authorizes the SWP and CVP to jointly use each other's points of diversion in the southern Delta, with conditional limitations and required response coordination plans. This is described below in more detail. SWRCB D-1641 modified the Vernalis salinity standard under SWRCB Decision 1422 (D-1422) to the corresponding Vernalis salinity objective in the 1995 WQCP.

3A.2.2.2 Joint Points of Diversion

SWRCB D-1641 granted Reclamation and DWR the ability to divert water at either Project's south Delta intakes under certain conditions. The SWRCB conditioned the use of Joint Point of Diversion (JPOD) capabilities based on staged implementation and conditional requirements for each stage of implementation. The stages of JPOD in SWRCB D-1641 are:

- Stage 1—for water service to Cross Valley contractors, San Joaquin Valley National Cemetery and Musco Family Olive Company, and to recover export reductions taken to benefit fish.
- Stage 2—for any purpose authorized under the current Project water right permits.
- Stage 3—for any purpose authorized, up to the physical capacity of the diversion facilities.

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

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

Any JPOD diversion that causes the Delta to change from excess to balanced conditions is junior to Contra Costa Water District's (CCWD) water right permits for the Los Vaqueros Project. The SWRCB D-1641 also required that JPOD diversions not result in an upstream shift in the X2 location (where 2 parts per thousand salinity isopleth measured at 1 meter from the channel bottom occurs) west of certain compliance locations.

Stage 2 has an additional requirement to complete an operations plan that would protect fish and wildlife and other legal users of water. This is commonly known as the Fisheries Response Plan. A Fisheries Response Plan was approved by SWRCB in February 2007.

Stage 3 has an additional requirement to protect water levels in the southern Delta under the operational conditions of Phase II of the South Delta Improvements Program, along with an updated companion Fisheries Response Plan.

Reclamation and DWR intend to apply all response plan criteria consistently for JPOD uses as well as water transfer uses.

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 the 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 water transfers.
- 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.

3A.2.2.3 Revisions to the SWRCB Bay-Delta Water Quality Control Plan

SWRCB undertook a proceeding under its water quality authority to amend the WQCP adopted in 1978 and amended in 1991 and in 1995. The SWRCB conducted a series of workshops in 2004 and 2005 to receive information on specific topics addressed in the WQCP.

The SWRCB adopted a revised WQCP on December 13, 2006. There were no changes to the Beneficial Uses from the 1995 Plan to the 2006 Plan, nor were any new water quality objectives adopted in the 2006 WQCP. A number of changes were made simply for readability. Consistency changes were also made to assure that sections of the WQCP reflected the current physical condition or current regulation.

The SWRCB "is in the process of developing and implementing updates to the WQCP and flow objectives for priority tributaries to the Delta to protect beneficial uses in the Bay-Delta watershed. Phase 1 of this work involves updating San Joaquin River flow and southern Delta water quality requirements included in the WQCP. Phase 2 involves other comprehensive changes to the WQCP to protect beneficial uses not addressed in Phase 1. Phase 3 involves changes to water rights and other measures to implement changes to the WQCP from Phases 1 and 2. Phase 4 involves developing and implementing flow objectives for priority Delta tributaries outside of the WQCP updates" (State Water Resources Control Board 2014).

3A.2.3 2008 U.S. Fish and Wildlife Service and 2009 National Marine Fisheries Service Biological Opinions on the Coordinated Operation of CVP and SWP

The most recent BOs regarding the long-term coordinated operation of the CVP and SWP were issued by the USFWS and NMFS in 2008 and 2009, respectively. Each BO included a Reasonable and Prudent Alternative (RPA). In December 2008, USFWS issued a BO for Delta Smelt and their critical habitat, and Reclamation provisionally accepted and implemented the BO, including the RPA. In June 2009, NMFS issued a new BO for Sacramento River winter-run Chinook Salmon, Central Valley spring-run Chinook Salmon, Central Valley Steelhead, Southern Distinct Population Segment of North American Green Sturgeon, and Southern Resident Killer Whales and their critical habitat, and Reclamation provisionally accepted and implemented the BO, including the RPA. Under the 2008 USFWS and 2009 NMFS BOs, CVP and SWP operations include the previous operational requirements of SWRCB D-1641 and additional operational requirements, as described below.

3A.3 Operations Real-Time Decision Making

The goals for real-time decision making to assist fishery management are to minimize adverse effects for listed species while meeting permit requirements and contractual obligations for water deliveries.

Real-time decision making is a process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. High uncertainty exists regarding real time conditions that can change management decisions on methods to balance operations to meet beneficial uses in 2030.

Sources of uncertainty include the following.

- Hydrologic conditions
- Ocean conditions
- Listed species (presence, distribution, habitat, and other factors)
- Ecological conditions

3A.3.1 Process for Real-Time Decision Making

Decisions regarding CVP and SWP operations to avoid and minimize adverse effects on listed species must consider factors that include public health, safety, and water supply reliability. To facilitate such decisions, Reclamation and DWR (Project Agencies) and the fishery agencies (consisting of USFWS, NMFS, and the California Department of Fish and Wildlife [CDFW]) have developed and refined a set of processes for various fish species to collect data, disseminate information, develop recommendations, make decisions, and provide transparency. This process consists of three types of groups that meet on a recurring basis (Table 3A.1):

- The management team is made up of management staff from Reclamation, DWR, and the fishery agencies. SWRCB participates in management team meetings.
- Information teams are teams whose role is to disseminate and coordinate information among agencies and stakeholders.
- Fisheries and operations technical teams are made up of technical staff from state and Federal agencies.

These teams review the most up-to-date data and information on fish status and Delta conditions, and develop recommendations that fishery agencies' management can use in identifying actions to protect listed species.

The process to identify actions to protect listed species varies to some degree among species but abides by the following general outline. A Fisheries or Operations Technical Team compiles and assesses current information regarding species, such as stages of reproductive development, geographic distribution, relative abundance, and physical habitat conditions. It then provides a recommendation to the agency with statutory obligation to enforce protection of the species in question. The agency's staff and management reviews the recommendation and uses it as a basis for developing, in cooperation with Reclamation and DWR, a modification of water operations that would minimize adverse effects on listed species by the Projects. If the Project Agencies do not agree with the action, then the fishery agency(ies) would advise the Project

Agencies that the water management activity considered may cause harm to the listed species beyond that contemplated in the existing BO. Certain actions may require input from the SWRCB to assess impacts to the beneficial uses of the project water because actions can also affect the Projects' ability to comply with state water rights. In the event it is not possible or appropriate to refine the action, given the available resources, the Project Agencies would consult with the fishery agency(ies). The outcomes of protective actions that are implemented are monitored and documented, and this information informs future recommended actions.

Table 3A.1 Real-Time Decision Making Groups

Team Name	Abbreviation	Composition
Water Operations Management Team	WOMT	Reclamation, DWR, USFWS, NMFS, and CDFW. SWRCB participates
CALFED Bay-Delta Program (CALFED) Ops Group	CALFED Ops Group	Reclamation, DWR (Project Agencies), fishery agencies, SWRCB staff, and the USEPA
Data Assessment Team	DAT	Technical staff members from the Project Agencies and fishery agencies; stakeholders
Operations and Fishery Forum	OFF	Contact persons for their respective agencies or interest groups; works in concert with CALFED Ops Group
B2 Interagency Team	(b)(2)IT	Technical staff members from the Project Agencies
Sacramento River Temperature Task Group	SRTTG	Multiagency group
Smelt Working Group	SWG	USFWS, CDFW, DWR, USEPA, and Reclamation
Delta Condition Team	DCT	Scientists and engineers from the state and federal agencies, water contractors, and environmental groups
Delta Operations Salmonid and Sturgeon	DOSS	Reclamation, DWR, CDFW, USFWS, SWRCB, USGS, USEPA, and NMFS
American River Group	ARG	Reclamation, USFWS, NMFS, CDFW, and the Water Forum
Delta Cross Channel Project Work Team	DCC Project Work Team	Multiagency group
Stanislaus Operations Team	OT	To be developed as part of the New Melones revised plan of operations

3A.3.1.1 Salmon Decision Process

The Salmon Decision Process is used by the fishery agencies and Project operators to facilitate the often complex coordination issues surrounding Delta Cross Channel (DCC) gate operations and the purposes of fishery protection closures, Delta water quality, and/or export reductions. Inputs such as fish life stage and size development, current hydrologic events, fish indicators (such as the Knight's Landing Catch Index and Sacramento Catch Index), and salvage at the export facilities, as well as current and projected Delta water quality conditions, are used to determine potential DCC closures and/or export reductions. The Salmon Decision Process includes "Indicators of Sensitive Periods for Salmon," such as hydrologic changes, detection of spring-run salmon or spring-run salmon surrogates at monitoring sites or the salvage facilities, and turbidity increases at monitoring sites, which trigger the Salmon Decision Process. The coordination process has worked well during the recent fall and winter DCC operations and is expected to be used in the present or modified form in the future.

3A.3.2 Groups Involved in Real-Time Decision Making and Information Sharing

3A.3.2.1 Management Team

The Water Operations Management Team (WOMT) is composed of representatives from Reclamation, DWR, USFWS, NMFS, and CDFW. SWRCB participates in discussions. This management-level team was established to facilitate timely decision-support and decision making at the appropriate level. The WOMT first met in 1999, continues to meet to make management decisions. Although the goal of WOMT is to achieve consensus on decisions, the participating agencies retain their authorized roles and responsibilities.

3A.3.2.2 Information Teams

3A.3.2.2.1 CALFED Ops and Subgroups

The CALFED Bay-Delta Program (CALFED) Ops Group consists of the Project Agencies, the fishery agencies, SWRCB staff, U.S. Environmental Protection Agency (USEPA), and stakeholders. The CALFED Ops Group generally meets eight times a year in a public setting so that the agencies can inform each other and stakeholders about current operations of the CVP and SWP, implementation of the CVPIA and state and federal endangered species acts, and additional actions to contribute to the conservation and protection of state- and federally listed species. The CALFED Ops Group held its first public meeting in January 1995, and during the next six years the group developed and refined its process. The CALFED Ops Group has been recognized within SWRCB D-1641, and elsewhere, as one forum for coordination on decisions to exercise certain flexibility that has been incorporated into the Delta standards for protection of beneficial uses (e.g., E/I ratios, and some DCC closures). Several teams were established through the CALFED Ops Group process. These teams are described below.

3A.3.2.2.2 Data Assessment Team

The Data Assessment Team (DAT) consists of technical staff members from the Project Agencies and fishery agencies as well as stakeholders. The DAT meets frequently during the fall, winter, and spring. The purpose of the meetings is to coordinate and disseminate information and data among agencies and stakeholders that is related to water Project operations, hydrology, and fish surveys in the Delta.

3A.3.2.2.3 Operations and Fishery Forum

The Operations and Fishery Forum (OFF) was established as an ad-hoc stakeholder-driven process to disseminate information regarding recommendations and decisions about the operations of the CVP and SWP. OFF members are considered the contact persons for their respective agencies or interest groups when information regarding take of listed species, or other factors or urgent issues need to be addressed by the CALFED Ops Group. Alternatively, the CALFED Ops Group may direct the OFF to develop recommendations on operational responses for issues of concern raised by member agencies.

3A.3.2.3 B2 Interagency Team

The B2 Interagency Team [(b)(2)IT] was established in 1999 in accordance with CVPIA and consists of technical staff members from the Project Agencies. CALFED recognized this group to facilitate coordinated operations. The (b)(2)IT meets weekly to discuss implementation of Section 3406 (b)(2) of the CVPIA, which defines the dedication of CVP water supply for environmental purposes. It communicates with WOMT to ensure coordination with the other operational programs or resource-related aspects of Project operations, including flow and temperature issues.

3A.3.3 Operations and Fisheries Technical Teams

Several fisheries-specific teams have been established to provide guidance and recommendations on current operations (flow and temperature regimes), as well as resource management issues. These teams include the following.

3A.3.3.1 The Sacramento River Temperature Task Group

The Sacramento River Temperature Task Group (SRTTG) is a multiagency group formed pursuant to SWRCB Water Rights Orders 90-5 and 91-1, to assist with improving and stabilizing the Chinook Salmon population in the Sacramento River. Annually, Reclamation develops temperature operation plans for the Shasta and Trinity divisions of the CVP. These plans consider impacts on winter-run and other races of Chinook Salmon and associated Project operations. The SRTTG meets initially in the spring to discuss biological, hydrologic, and operational information, objectives, and alternative operations plans for temperature control. Once the SRTTG has recommended an operation plan for temperature control, Reclamation then submits a report to SWRCB, generally on or before June 1 each year.

After implementation of the operation plan, the SRTTG may perform additional studies. It holds meetings as needed, typically monthly through the summer and into fall, to develop revisions based on updated biological data, reservoir temperature profiles, and operations data. Updated plans may be needed for summer operations to protect winter-run, or in fall for the fall-run spawning season. If there are any changes in the plan, Reclamation submits a supplemental report to SWRCB.

3A.3.3.2 Smelt Working Group

The Smelt Working Group (SWG) consists of representatives from USFWS, CDFW, DWR, USEPA, and Reclamation. USFWS chairs the group, and a member is assigned by each agency. The SWG evaluates biological and technical issues regarding Delta Smelt and develops recommendations for consideration by USFWS. Since longfin smelt became a state candidate species in 2008, the SWG has also developed recommendations for CDFW to minimize adverse effects on longfin smelt.

The SWG compile and interpret the latest near real-time information regarding state- and federally listed smelt, such as stages of development, distribution, and salvage. After evaluating available information, if the SWG members agree that a protection action is warranted, the SWG submit its recommendations in writing to USFWS and CDFW.

The SWG may meet at any time at the request of USFWS, but generally meets weekly during the months of January through June, when smelt salvage at the CVP and SWP has occurred historically.

3A.3.3.3 Delta Condition Team

The existing SWG and WOMT advise USFWS on smelt conservation needs and water operations. In addition, a Delta Condition Team (DCT), consisting of scientists and engineers from the state and federal agencies, water contractors, and environmental groups, meet weekly to review the real time operations and Delta conditions, including data from new turbidity monitoring stations and new analytical tools such as the Delta Smelt behavior model. The members of the DCT provide their individual information to the SWG and the Delta Operations Salmonid and Sturgeon (DOSS) workgroup. SWG meet later on the day the DCT meets to assess risks to Delta Smelt based upon Delta conditions and the other factors set forth above. The SWG and individual members of the DCT may provide, in accordance with a process provided by the WOMT, their information to the WOMT for its consideration in developing a recommendation to the Project Agencies for actions to protect Delta Smelt and other listed fish. The WOMT supply information for Project Agencies to consider, including impacts on other species and on water supply.

3A.3.3.4 Delta Operations Salmonid and Sturgeon Workgroup

The DOSS workgroup is a technical team with relevant expertise from Reclamation, DWR, CDFW, USFWS, SWRCB, U.S. Geological Survey (USGS), USEPA, and NMFS that provides advice to WOMT and to NMFS on issues related to fisheries and water resources in the Delta and recommendations on measures to reduce adverse effects of Delta operations of the CVP and SWP to salmonids and Green Sturgeon. The purpose of DOSS is to provide recommendations for real-time management of operations to WOMT and NMFS; annually review Project operations in the Delta and the collected data from the different ongoing monitoring programs; and coordinate with the SWG to maximize benefits to all listed species.

3A.3.3.5 American River Group

In 1996, Reclamation established a working group for the Lower American River, known as the American River Group (ARG). Although open to the public, the ARG meetings generally include representatives from several agencies and organizations with ongoing concerns and interests regarding management of the Lower American River. The formal members of the group are Reclamation, USFWS, NMFS, CDFW, and the Water Forum.

The ARG convenes monthly or more frequently if needed, with the purpose of providing fishery updates and reports for Reclamation to help manage operations at Folsom Dam and Reservoir for the protection of fishery resources in the Lower American River, and with consideration of its other intended purposes (e.g., water and power supply).

3A.3.3.6 Delta Cross Channel Project Work Team

The DCC Project Work Team is a multiagency group. Its purpose is to determine and evaluate the effects of DCC gate operations on Delta hydrodynamics, water quality, and fish migration.

3A.4 Central Valley Project

3A.4.1 Project Management Objectives

Facilities are operated and maintained by local Reclamation area offices, with operations overseen by the CVOO at the Joint Operations Center in Sacramento, California. The CVOO is responsible for recommending CVP operating policy, developing annual operating plans, coordinating CVP operations with the SWP and other entities, establishing CVP-wide standards and procedures, and making day-to-day operating decisions.

3A.4.1.1 Central Valley Project Improvement Act

Public Law 102-575 (Reclamation Projects Authorization and Adjustment Act of 1992) was passed on October 30, 1992. Included in the law was Title 34, the Central Valley Project Improvement Act. The CVPIA amended previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water supply uses, and fish and wildlife enhancement as having an equal priority with power generation. Among the changes mandated by the CVPIA are:

- Dedicating 800 thousand acre-feet (TAF) annually to fish, wildlife, and habitat restoration
- Authorizing water transfers outside the CVP service area
- Facilitating water transfers
- Implementing an anadromous fish restoration program
- Creating a restoration fund financed by water and power users
- Providing for the Shasta Temperature Control Device
- Implementing fish passage measures at Red Bluff Pumping Plant
- Calling for planning to increase the CVP yield
- Mandating firm water supplies for Central Valley wildlife refuges
- Improving the Tracy Fish Collection Facility (TFCF)
- Meeting Federal trust responsibility to protect fishery resources (Trinity River)

The CVPIA is being implemented as authorized. The Final Programmatic Environmental Impact Statement (PEIS) for the CVPIA analyzed projected conditions in 2022, 30 years from the CVPIA's adoption in 1992. The Final PEIS was released in October 1999 and the CVPIA Record of Decision (ROD) was signed on January 9, 2001. The CVPIA BOs were issued on November 21, 2000.

3A.4.1.1.1 CVPIA Section 3406 (b)(2)

On May 9, 2003, the DOI issued its Decision on Implementation of Section 3406 (b)(2) (Decision) of the CVPIA. Dedication of CVPIA (b)(2) water occurs when Reclamation takes a fish, wildlife or habitat restoration action based on recommendations of USFWS (and in consultation with NMFS and CDFW), pursuant to Section 3406 (b)(2). Dedication and management of CVPIA (b)(2) water may also assist in meeting SWRCB WQCP fishery objectives and helps meet the needs of fish listed under the ESA as threatened or endangered since the enactment of the CVPIA.

The Decision describes the means by which the amount of dedicated CVPIA (b)(2) water is determined. Planning and accounting for CVPIA (b)(2) actions are done cooperatively and occur primarily through weekly meetings of the (b)(2)IT. The (b)(2)IT formulates recommendations for implementing upstream and Delta actions with CVP delivery capability. Actions usually take one of two forms—instream flow augmentation below CVP reservoirs or CVP Jones Pumping Plant pumping reductions in the Delta.

3A.4.2 Water Service Contracts, Allocations, and Deliveries

3A.4.2.1 Water Needs Assessment

Water needs assessments have been performed for each CVP water contractor eligible to participate in the CVP long-term contract renewal process. Water needs assessments confirm a contractor's past beneficial use and determine future CVP water supplies needed to meet the contractor's anticipated future demands. The assessments are based on a common methodology used to determine the amount of CVP water needed to balance a contractor's water demands with available surface and groundwater supplies.

3A.4.2.2 Water Allocation—CVP

In most years, the combination of carryover storage and runoff into CVP reservoirs and the Central Valley is not sufficient to provide the water to meet all CVP contractors' contractual demands. Since 1992, increasing constraints placed on operations by legislative and ESA requirements have removed significant operational flexibility to deliver water to all CVP contractors located both to the north and south of the Delta.

The water allocation process for the CVP begins in the fall when preliminary assessments are made of the next year's water supply possibilities, given current storage conditions combined with a range of hydrologic conditions. These preliminary assessments may be refined as the water year progresses. Beginning February 1, forecasts of water year runoff are prepared using precipitation to date, snow water content accumulation, and runoff to date. All of CVP's Sacramento River Settlement water rights contracts and San Joaquin River Exchange contracts require that contractors be informed no later than February 15 of any possible deficiency in their supplies. In recent years, February 20 has been the target date for the first announcement of all CVP contractors' forecasted water allocations for the upcoming contract year. Forecasts of runoff and operations plans are updated at least monthly between February and May.

Reclamation uses the 90 percent probability of exceedance forecast as the basis of water allocations. Furthermore, NMFS reviews the operations plans devised to support the initial water allocation, and any subsequent updates to them, for sufficiency with respect to the criteria for Sacramento River temperature control.

3A.4.2.3 CVP Municipal and Industrial Water Shortage Operational Assumptions

Reclamation is in the process of revising the current 2001 draft M&I water shortage policy. A draft EIS was released for public review in 2014. A description of 2001 draft M&I water shortage policy is provided below.

3A.4.2.3.1 Draft 2001 Municipal and Industrial Water Shortage Policy

The CVP has 253 water supply contracts (including water service contracts and Sacramento River Settlement Contracts). These water service contracts have had varying water shortage provisions (e.g., in some contracts, M&I and agricultural users have shared shortages equally; in most of the larger M&I contracts, agricultural water has been shorted 25 percent of its contract water before M&I water was shorted, after which both types of water contractors experience shortages with agricultural users experiencing greater shortages than M&I users, as described below).

The M&I minimum shortage allocation described above does not apply to contracts for the (1) Friant Division, (2) New Melones interim supply, (3) Hidden and Buchanan Units, (4) Cross Valley contractors, (5) Wildlife refuges, (6) San Joaquin River Exchange contractors, and (7) Sacramento River Settlement contractors. These contracts have separate shortage-related contractual provisions.

There is a minimum shortage allocation for M&I water supplies of 75 percent of a contractor's historical use (i.e., the last 3 years of water deliveries unconstrained by the availability of CVP water). Historical use can be adjusted for growth, extraordinary water conservation measures, and use of non-CVP water as those terms are defined in the proposed policy. Before the M&I water allocation is reduced, the irrigation water allocation would be reduced below 75 percent of contract water.

When the allocation of irrigation water is reduced below 25 percent of contract water, Reclamation would reassess the availability of CVP water and CVP water demand; however, due to limited water supplies during these times, M&I water allocation may be reduced below 75 percent of adjusted historical use during extraordinary and rare times such as prolonged and severe drought. Under these extraordinary conditions, allocation percentages for both South of Delta and North of Delta irrigation contractors are reduced below 25 percent to zero while the M&I contractors are reduced below 75 percent to 50 percent by the same increment, as described below.

Reclamation would attempt to deliver CVP water to all M&I contractors at not less than a public health and safety level if CVP water is available, if an emergency situation exists, but not exceeding 75 percent of contract total (and taking into consideration water supplies available to the M&I contractors from other sources). This is in recognition, however, that the M&I allocation may, nevertheless, fall to 50 percent as the irrigation allocation drops below 25 percent and approaches zero due to limited CVP supplies.

- Allocation Assumptions for Below Normal, Above Normal, and Wet Years:
  - Agricultural 100 percent to 75 percent — M&I is at 100 percent
  - Agricultural 70 percent — M&I 95 percent
  - Agricultural 65 percent — M&I 90 percent
  - Agricultural 60 percent — M&I 85 percent
  - Agricultural 55 percent — M&I 80 percent
  - Agricultural 50 to 25 percent — M&I 75 percent

- Allocation Assumptions for Dry and Critical Years:
  - Agricultural 20 percent M&I 70 percent
  - Agricultural 15 percent M&I 65 percent
  - Agricultural 10 percent M&I 60 percent
  - Agricultural 5 percent M&I 55 percent
  - Agricultural 0 percent M&I 50 percent

3A.4.3 Project Facilities

3A.4.3.1 Trinity River Division Operations

The Trinity River Division, completed in 1964, includes facilities to store and regulate water in the Trinity River, as well as facilities to divert water to the Sacramento River Basin. The Trinity River Division includes the Trinity River and Dam, Lewiston Dam, Whiskeytown Reservoir and Dam, Clear Creek, and Spring Creek and Debris Dam. Trinity Dam is located on the Trinity River and regulates the flow from a drainage area of approximately 720 square miles. The dam was completed in 1962, forming Trinity Lake, which has a maximum storage capacity of approximately 2.4 MAF.

Water is diverted from the Trinity River at Lewiston Dam via the Clear Creek Tunnel and passes through the Judge Francis Carr Powerhouse as it is discharged into Whiskeytown Lake on Clear Creek. From Whiskeytown Lake, water is released through the Spring Creek Power Conduit to the Spring Creek Power Plant and into Keswick Reservoir. All of the water diverted from the Trinity River, plus a portion of Clear Creek flows, is diverted through the Spring Creek Power Conduit into Keswick Reservoir.

Spring Creek also flows into the Sacramento River and enters at Keswick Reservoir. Flows on Spring Creek are partially regulated by the Spring Creek Debris Dam. Historically (1964–1992), an average annual quantity of 1,269 TAF of water has been diverted from Whiskeytown Lake to Keswick Reservoir. This annual quantity is approximately 17 percent of the flow measured in the Sacramento River at Keswick.

The mean annual inflow to Trinity Lake from the Trinity River is about 1.2 MAF per year. Historically, an average of about two-thirds of the annual inflow has been diverted to the Sacramento River Basin (1991–2003).

3A.4.3.1.1 Safety of Dams at Trinity Reservoir

Periodically, increased water releases are made from Trinity Dam consistent with Reclamation Safety of Dams criteria intended to prevent overtopping of Trinity Dam. Although flood control is not an authorized purpose of the Trinity River Division, flood control benefits are provided through normal operations.

The Safety of Dams release criteria specify that Carr power plant capacity be used as a first preference destination for Safety of Dams releases made at Trinity Dam. Trinity River releases are made as a second preference destination. During significant Northern California high-water flood events, the Sacramento River water stages are also often at concern levels. Under such high-water conditions, the water that would otherwise move through the Carr power plant is routed to the Trinity River. Total river releases are capped at 11,000 cfs from Lewiston Dam (under Safety of Dams criteria) due to local high water concerns in the floodplain and local bridge flow capacities. The Safety of Dams criteria provide seasonal storage targets and recommended releases November 1 to March 31. During the May 2006 event, the river flows were over 10,000 cfs for several days as part of the fishery restoration flows.

3A.4.3.1.2 Fish and Wildlife Requirements on Trinity River

Based on the Trinity River Main-stem Fishery Restoration ROD, dated December 19, 2000, 368.6 TAF to 815 TAF is allocated annually for Trinity River flows, depending on water year type. This amount is scheduled in coordination with USFWS to best meet habitat, temperature, and sediment transport objectives in the Trinity Basin.

Temperature objectives for the Trinity River are set forth in SWRCB Water Rights Order 90-5, as summarized in Table 3A.2. These objectives vary by reach and by season. Between Lewiston Dam and Douglas City Bridge, the daily average temperature should not exceed 60 degrees Fahrenheit (°F) from July 1 to September 14, and 56°F from September 15 to September 30. From October 1 to December 31, the daily average temperature should not exceed 56°F between Lewiston Dam and the confluence of the North Fork Trinity River. Reclamation consults with USFWS in establishing a schedule of releases from Lewiston Dam that can best achieve these objectives.

For the purpose of determining the Trinity Basin water year type, forecasts using the 50 percent exceedance as of April 1 are used. There are no make-up or increases for flows forgone if the water year type changes up or down from an earlier 50 percent forecast. In the modeling, actual historic Trinity inflows were used rather than a forecast. There is a temperature curtain in Lewiston Reservoir that provides for temperature management for the diversions to Clear Creek Tunnel.

Table 3A.2 Water Temperature Objectives for the Trinity River during the Summer, Fall, and Winter as Established by the California Regional Water Quality Control Board North Coast Region

Date	Temperature Objective (°F)	
	Douglas City (RM 93.8)	North Fork Trinity River (RM 72.4)
July 1 through September 14	60	–
September 15 through September 30	56	–
October 1 through December 31	–	56

3A.4.3.1.3 Transbasin Diversions

Diversion of Trinity water to the Sacramento Basin 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. The amounts of the Trinity exports are determined by subtracting Trinity River scheduled flow and targeted carryover storage from the forecasted Trinity water supply.

The seasonal timing of Trinity exports is a result of determining how to make best use of a limited volume of Trinity export (in concert with releases from Shasta Lake) to help conserve cold water pools and meet temperature objectives on the upper Sacramento and Trinity Rivers, as well as power production economics. A key consideration in the export timing determination is the thermal degradation that occurs in Whiskeytown Lake due to the long residence time of transbasin exports in the lake.

To minimize the thermal degradation effects, transbasin export patterns are typically scheduled by an operator to provide an approximate 120 TAF volume to occur in late spring to create a thermal connection to the Spring Creek Powerhouse before larger transbasin volumes are scheduled to occur during the hot summer months. Typically, the water flowing from the Trinity Basin through Whiskeytown Lake must be sustained at fairly high rates to avoid warming and to function most efficiently for temperature control. The time period for which effective temperature control releases can be made from Whiskeytown Lake may be compressed when the total volume of Trinity water available for export is limited.

Export volumes from Trinity are made in coordination with the operation of Shasta Lake. Other important considerations affecting the timing of Trinity exports are based on the utility of power generation and allowances for normal maintenance of the diversion works and generation facilities.

Trinity Lake historically reached its greatest storage level at the end of May. With the present pattern of prescribed Trinity releases, maximum storage may occur by the end of April or in early May.

Reclamation maintains at least 600 TAF in Trinity Reservoir, except during the 10 to 15 percent of the years when Shasta Lake is also drawn down. Reclamation addresses end-of-water-year carryover on a case-by-case basis in dry and critically dry water year types with USFWS and NMFS through the WOMT and (b)(2)IT processes.

3A.4.3.1.4 Whiskeytown Reservoir Operations

Whiskeytown Reservoir is normally operated to (1) regulate inflows for power generation and recreation; (2) support upper Sacramento River temperature objectives; and (3) provide for releases to Clear Creek consistent with the CVPIA Anadromous Fish Restoration Program (AFRP) objectives. Although it stores up to 241 TAF, this storage is not normally used as a source of water supply. Two temperature curtains in Whiskeytown Reservoir were installed in 1993 to pass cold water through the reservoir and to help regulate the temperature range requirements of salmon eggs and sac-fry. The curtains were made of reinforced rubber sheets that form a continuous barrier under the water. The Oak Bottom Temperature Control Curtain or OBTCC is located in the upstream portion of the reservoir and causes inflowing cold water to sink to the bottom. The OBTCC was originally 600 feet long and reached a depth of 40 feet. However, the OBTCC was damaged and cannot be fully deployed. The curtain is estimated to be repaired by 2030 under the No Action Alternative, depending on available funding and subject to environmental compliance requirements. The Spring Creek curtain is located near Whiskeytown Dam to maximize cold water flows through the intakes into the Spring Creek Power Conduit. It was damaged significantly, and was replaced in 2011.

Implementation of 2009 National Marine Fisheries Service Biological Opinion

In accordance with the 2009 NMFS BO RPA Action I.1.5, Reclamation is required to manage Whiskeytown Lake releases to meet daily water temperatures in Clear Creek at Igo of:

- 60° F from June 1 through September 15
- 56° F from September 15 through October 31

3A.4.3.1.5 Historic Spillway Flows below Whiskeytown Lake

Whiskeytown Lake is annually drawn down by approximately 35 TAF of storage space during November through April to regulate flows for power generation. Heavy rainfall events occasionally result in spillway discharges to Clear Creek, as shown in Table 3A.3 below.

Table 3A.3 Days of Spilling below Whiskeytown and 40-30-30 Index from Water Year 1978 to 2012

Water Year	Days of Spilling	40-30-30 Index
1978	5	AN
1979	0	BN
1980	0	AN
1981	0	D
1982	63	W
1983	81	W
1984	0	W
1985	0	D
1986	17	W
1987	0	D
1988	0	C
1989	0	D
1990	8	C

Water Year	Days of Spilling	40-30-30 Index
1991	0	C
1992	0	C
1993	10	AN
1994	0	C
1995	14	W
1996	0	W
1997	5	W
1998	8	W
1999	0	W
2000	0	AN
2001	0	D
2002	0	D
2003	8	AN
2004	0	BN
2005	0	AN
2006	4	W
2007	0	D
2008	0	C
2009	0	D
2010	6	BN
2011	0	W
2012	0	BN

Notes: W = Wet Year Water Year Type; AN = Above Normal Water Year Type; BN = Below Normal Water Year Type; D = Dry Water Year Type; and C = Critical Dry Water Year Type.

Operations at Whiskeytown Lake during flood conditions are complicated by its operational relationship with the Trinity River, Sacramento River, and Clear Creek. On occasion, imports of Trinity River water to Whiskeytown Reservoir may be suspended to avoid aggravating high flow conditions in the Sacramento Basin. Joint temperature control objectives also similarly interact among the Trinity River, Clear Creek, and Sacramento River.

3A.4.3.1.6 Fish and Wildlife Requirements on Clear Creek

CVPIA (b)(2) operations and water rights permits issued by the SWRCB for diversions from Trinity River and Clear Creek specify minimum downstream releases from Lewiston and Whiskeytown Dams, respectively. The following agreements govern releases from Whiskeytown Lake.

- A 1960 Memorandum of Agreement (MOA) with CDFW established minimum flows to be released to Clear Creek at Whiskeytown Dam, as summarized in Table 3A.4.

- A 1963 release schedule for Whiskeytown Dam was developed with USFWS and implemented, but never finalized. Although this release schedule was never formalized, Reclamation has used this flow schedule for minimum flows since May 1963.
- Water rights permit modification in 2002 that allowed release of water from Whiskeytown Lake into Clear Creek for the purposes of maintenance of fish and wildlife resources as provided for in Provision 2.1 of Instream Flow Preservation Agreement by and among Reclamation, USFWS, and DFW, dated August 11, 2000.
- Dedication of (b)(2) water on Clear Creek provides instream flows below Whiskeytown Dam greater than the minimum flows (that would have occurred under pre-CVPIA conditions). Instream flow objectives are usually taken from the AFRP plan, in consideration of spawning and incubation of fall-run Chinook Salmon. Augmentation in the summer months is usually in consideration of water temperature objectives for steelhead and in late summer for spring-run Chinook Salmon.

Table 3A.4 Minimum Flows at Whiskeytown Dam

Period	Minimum flow (cfs)
1960 MOA with CDFW	
January 1–February 28(29)	50
March 1–May 31	30
June 1–September 30	0
October 1–October 15	10
October 16–October 31	30
November 1–December 31	100
1963 USFWS Proposed Normal year flow	
January 1–October 31	50
November 1–December 31	100
1963 USFWS Proposed Critical year flow	
January 1–October 31	30
November 1–December 31	70
2002 Water Right Modification for Critical year flow	
January 1–October 31	50
November 1–December 31	70

The 2009 NMFS BO RPA requires Reclamation to release spring attraction flows for adult spring-run Chinook Salmon (Action I.1.1) and channel maintenance flows in Clear Creek (Action I.1.2); and to continue gravel augmentation programs initiated under CVPIA. The spring attraction flows are to be released from Whiskeytown Lake into Clear Creek in at least two pulse flows of at least 600 cfs, each lasting at least 3 days, in May and June.

Under the 2009 NMFS BO RPA, the channel maintenance flows are to be released at a minimum flow of 3,250 cfs for 24 hours, which exceeds the 1,240 cfs capacity of the Whiskeytown Dam outlet to Clear Creek. This action is to occur seven times in a ten year period. Therefore, to provide channel maintenance flows, the Whiskeytown Lake water elevation must be increased to provide flow of water over the Glory Hole inlet. The Glory Hole is designed to operate with the higher water elevations expected during flood events. However, during non-flood periods, raising the water elevations and operating the Glory Hole inlet can cause safety concerns for recreationists along the Whiskeytown Lake shoreline.

3A.4.3.1.7 Spring Creek Debris Dam Operations

The Spring Creek Debris Dam (SCDD) is a feature of the Trinity Division of the CVP. It was constructed to regulate runoff containing debris and acid mine drainage from Spring Creek, a tributary to the Sacramento River that enters Keswick Reservoir. The SCDD can store approximately 5.8 TAF of water. Operation of SCDD and Shasta Dam has allowed some control of the toxic wastes with dilution criteria. 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. The MOU identifies agency actions and responsibilities, and establishes release criteria based on allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam.

The MOU states that Reclamation agrees to operate to dilute releases from SCDD (according to the criteria and schedules provided), that such operation would not cause flood control parameters on the Sacramento River to be exceeded, and would not unreasonably interfere with other Project requirements as determined by Reclamation. The MOU also specifies a minimum schedule for monitoring copper and zinc concentrations at SCDD and in the Sacramento River below Keswick Dam. Reclamation has primary responsibility for the monitoring; however, CDFW and RWQCB also collect and analyze samples on an as-needed basis. Due to more extensive monitoring, improved sampling and analysis techniques, and continuing cleanup efforts in the Spring Creek drainage basin, Reclamation now operates SCDD to target the more stringent Central Valley Region Water Quality Control Board Plan (CVRWQCB Basin Plan) criteria in addition to the MOU goals. Instead of the total copper and total zinc criteria contained in the MOU, Reclamation operates SCDD releases and Keswick dilution flows to not exceed the CVRWQCB Basin Plan standards of 0.0056 milligrams per liter (mg/L) dissolved copper and 0.016 mg/L dissolved zinc. Release rates are estimated from a mass balance calculation of the copper and zinc in the debris dam release and in the river.

In order to minimize the build-up of metal concentrations in the Spring Creek arm of Keswick Reservoir, releases from the debris dam are coordinated with releases from the Spring Creek Power Plant to keep the Spring Creek arm of Keswick Reservoir in circulation with the main water body of Keswick Lake.

The operation of SCDD is complicated during major heavy rainfall events. SCDD reservoir can fill to uncontrolled spill elevations in a relatively short time period, anywhere from days to weeks. Uncontrolled spills at SCDD can occur during major flood events on the upper Sacramento River and also during localized rainfall events in the Spring Creek watershed. During flood control events, Keswick releases may be reduced to meet flood control objectives at Bend Bridge when storage and inflow at Spring Creek Reservoir are high.

Because SCDD releases are maintained as a dilution ratio of Keswick releases to maintain the required dilution of copper and zinc, uncontrolled spills can and have occurred from SCDD. In this operational situation, high metal concentration loads during heavy rainfall are usually limited to areas immediately downstream of Keswick Dam because of the high runoff entering the Sacramento River, adding dilution flow. In the operational situation when Keswick releases are increased for flood control purposes, SCDD releases are also increased in an effort to reduce spill potential.

In the operational situation when heavy rainfall events would fill SCDD and Shasta Lake would not reach flood control conditions, increased releases from CVP storage may be required to maintain desired dilution ratios for metal concentrations. Reclamation has voluntarily released additional water from CVP storage to maintain release ratios for toxic metals below Keswick Dam. Reclamation has typically attempted to meet the CVRWQCB Basin Plan standards but these releases have no established criteria and are dealt with on a case-by-case basis. Since water released for dilution of toxic spills is likely to be in excess of other CVP requirements, such releases increase the risk of a loss of water for other beneficial purposes.

3A.4.3.2 Shasta Division and Sacramento River Division

The CVP's Shasta Division includes facilities that conserve water in the Sacramento River for:

- Flood control
- Navigation maintenance
- Agricultural water supplies
- M&I water supplies
- Hydroelectric power generation
- Conservation of fish in the Sacramento River
- Protection of the Delta from intrusion of saline ocean water.

The Shasta Division includes Shasta Dam, Lake, and Power Plant; Keswick Dam, Reservoir, and Power Plant, and the Shasta Temperature Control Device.

The Sacramento River Division was authorized after completion of the Shasta Division. The Sacramento River Division includes facilities for the diversion and conveyance of water to CVP contractors on the west side of the Sacramento River. The division includes the Sacramento Canals Unit, which was authorized in 1950 and consists of the Red Bluff Pumping Plant, the Corning Pumping Plant, and the Corning and Tehama-Colusa Canals. Total authorized diversions for the Sacramento River Division are approximately 2.8 MAF. Historically the total diversion has varied from 1.8 MAF in a critically dry year to the full 2.8 MAF in a wet year, including diversions by Sacramento River Settlement contractors and CVP water service contractors. Sacramento River Settlement contractors divert water under their own water rights and through their own facilities.

The Sacramento Canals Unit was authorized to supply irrigation water to over 200,000 acres of land in the Sacramento Valley, principally in Tehama, Glenn, Colusa, and Yolo counties. Black Butte Dam, which is operated by the U.S. Army Corps of Engineers (USACE), also provides supplemental water to the Tehama-Colusa Canals as it crosses Stony Creek. The operations of the Shasta and Sacramento River divisions are presented together because of their operational inter-relationships.

Shasta Dam is located on the Sacramento River just below the confluence of the Sacramento, McCloud, and Pit Rivers. The dam regulates the flow from a drainage area of approximately 6,649 square miles. Shasta Dam was completed in 1945, forming Shasta Lake, which has a maximum storage capacity of 4.552 MAF. Water in Shasta Lake is released through or around the Shasta Power Plant to the Sacramento River, where it is re-regulated downstream by Keswick Dam. A small amount of water is diverted directly from Shasta Lake for M&I uses by local communities.

Keswick Reservoir was formed by the completion of Keswick Dam in 1950. It has a capacity of approximately 23.8 TAF and serves as an afterbay for releases from Shasta Dam and for discharges from the Spring Creek Power Plant. All releases from Keswick Reservoir are made to the Sacramento River from Keswick Dam. The dam has a fish trapping facility that operates in conjunction with the Coleman National Fish Hatchery on Battle Creek.

3A.4.3.2.1 Flood Control

Flood control objectives for Shasta Lake require that releases be restricted to quantities that would not cause downstream flows or stages to exceed specified levels. These include a flow of 79,000 cfs at the tailwater of Keswick Dam, and a stage of 39.2 feet in the Sacramento River at Bend Bridge gauging station, which corresponds to a flow of approximately 100,000 cfs. Flood control operations are based on regulating criteria developed by the USACE pursuant to the provisions of the Flood Control Act of 1944. Maximum flood space reservation is 1.3 MAF, with variable storage space requirements based on an inflow parameter.

Flood control operation at Shasta Lake requires forecasting runoff conditions into Shasta Lake and runoff conditions of unregulated creek systems downstream from Keswick Dam as far in advance as possible. A critical element of upper Sacramento River flood operations is the local runoff entering the Sacramento River between Keswick Dam and Bend Bridge.

The unregulated creeks (major creek systems are Cottonwood Creek, Cow Creek, and Battle Creek) in this reach of the Sacramento River can be very sensitive to a large rainfall event and produce high rates of runoff into the Sacramento River in short time periods. During large rainfall and flooding events, the local runoff between Keswick Dam and Bend Bridge can exceed 100,000 cfs.

The travel time required for release changes at Keswick Dam to affect Bend Bridge flows is approximately 8 to 10 hours. If the total flow at Bend Bridge is projected to exceed 100,000 cfs, the release from Keswick Dam is decreased to maintain Bend Bridge flow below 100,000 cfs. As the flow at Bend Bridge is projected to recede, the Keswick Dam release is increased to evacuate water stored in the flood control space at Shasta Lake. Changes to Keswick Dam releases are scheduled to minimize rapid fluctuations in the flow at Bend Bridge.

The flood control criteria for Keswick releases specify that releases should not be increased more than 15,000 cfs or decreased more than 4,000 cfs in any 2-hour period. The restriction on the rate of decrease is intended to prevent sloughing of saturated downstream channel embankments caused by rapid reductions in river stage. In rare instances, the rate of decrease may have to be accelerated to avoid exceeding critical flood stages downstream.

3A.4.3.2.2 Fish and Wildlife Requirements in the Sacramento River

Reclamation operates the Shasta, Sacramento River, and Trinity River divisions of the CVP to meet (to the extent possible) the provisions of SWRCB Order 90-05. An April 5, 1960, MOA between Reclamation and CDFW originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. The agreement provided for minimum releases into the natural channel of the Sacramento River at Keswick Dam for normal and critically dry years (Table 3A.5). Since October 1981, Keswick Dam has operated based on a minimum release of 3,250 cfs for normal years from September 1 through the end of February, in accordance with an agreement between Reclamation and CDFW. This release schedule was included in SWRCB Order 90-05, which maintains a minimum release of 3,250 cfs at Keswick Dam and Red Bluff Pumping Plant from September through the end of February in all water years except critically dry years.

Table 3A.5 Minimum Flow Requirements and Objectives (cfs) on the Sacramento River below Keswick Dam

Period	MOA	Water Rights 90-5	MOA and Water Rights 90-5
Water Year Type	**Normal**	**Normal**	**Critically Dry**
January 1–February 28(29)	2,600	3,250	2,000
March 1–March 31	2,300	2,300	2,300
April 1–April 30	2,300	2,300	2,300
May 1–August 31	2,300	2,300	2,300
September 1–September 30	3,900	3,250	2,800
October 1–November 30	3,900	3,250	2,800
December 1–December 31	2,600	3,250	2,000

The 1960 MOA between Reclamation and CDFW provides that releases from Keswick Dam (from September 1 through December 31) are made with minimum water level fluctuation or change to protect salmon to the extent compatible with other operations requirements.

Reclamation usually attempts to reduce releases from Keswick Dam to the minimum fishery requirement by October 15 each year and to minimize changes in Keswick releases between October 15 and December 31. Releases may be increased during this period to meet downstream needs such as higher outflows in the Delta to meet water quality requirements, or to meet flood control requirements. Releases from Keswick Dam may be reduced when downstream tributary inflows increase to a level that would meet flow needs. Reclamation attempts to establish a base flow that minimizes release fluctuations to reduce impacts to fisheries and bank erosion from October through December.

The Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991 changed agricultural water diversion practices along the Sacramento River and has affected Keswick Dam release rates in the fall. This program is generally known as the Rice Straw Decomposition and Waterfowl Habitat Program. Prior to this change, the preferred method of clearing fields of rice stubble was to systematically burn it. Today, rice field burning has been phased out due to air quality concerns and has been replaced in some areas by a program of rice field flooding that decomposes rice stubble and provides additional waterfowl habitat. The result has been an increase in water demand to flood rice fields in October and November, which has increased the need for higher Keswick releases in all but the wettest of fall months.

3A.4.3.2.3 Minimum Flow for Navigation as Measured at Wilkins Slough

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 references to Sacramento River Division operations in the River and Harbors Act of 1935 and the Rivers and Harbors Act of 1937. Currently, there is no commercial traffic between Sacramento and Chico Landing, and USACE has not dredged this reach to preserve channel depths since 1972. However, long-time water users diverting from the river have set their pump intakes just below this level and cannot easily divert when lower river elevations occur with lower flows. Therefore, the CVP is operated to meet the navigation flow requirement of 5,000 cfs to Wilkins Slough, (gauging station on the Sacramento River), under all but the most critical water supply conditions, to facilitate pumping and use of screened diversions.

At flows below 5,000 cfs at Wilkins Slough, diverters have reported increased pump cavitation as well as greater pumping head requirements. Diverters are able to operate for extended periods at flows as low as 4,000 cfs at Wilkins Slough, but pumping operations become severely affected and some pumps become inoperable at flows lower than this. Flows may drop as low as 3,500 cfs for short periods while changes are made in Keswick releases to reach target levels at Wilkins Slough, but using the 3,500 cfs rate as a target level for an extended period would have major impacts on diverters.

Implementation of 2009 National Marine Fisheries Service Biological Opinion

The 2009 NMFS BO Action I.4 required Reclamation to evaluate approaches to provide minimum flows at Wilkins Slough of less than 5,000 cfs.

3A.4.3.2.4 Water Temperature Operations in the Upper Sacramento River

Water temperature on the Sacramento River system is influenced by several factors, including the relative water temperatures and ratios of releases from Shasta Dam and from the Spring Creek Power Plant. The temperature of water released from Shasta Dam and the Spring Creek Power Plant is a function of the reservoir temperature profiles at the discharge points at Shasta and Whiskeytown, the depths from which releases are made, the seasonal management of the deep cold water reserves, ambient seasonal air temperatures and other climatic conditions, tributary accretions and water temperatures, and residence time in Keswick, Whiskeytown and Lewiston Reservoirs, and in the Sacramento River. Water temperature in the upper Sacramento River is governed by current water rights permit requirements.

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 that Reclamation shall 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 fisheries. The optimal control point is the Red Bluff Pumping Plant.

Under the orders, the water temperature compliance point may be modified when the objective cannot be met at Red Bluff Pumping Plant. In addition, SWRCB Order 90-05 modified the minimum flow requirements initially established in the

1960 MOA for the Sacramento River below Keswick Dam. The water right orders also recommended the construction of a Shasta Temperature Control Device (TCD) to improve the management of the limited cold water resources.

Pursuant to SWRCB Orders 90-05 and 91-01, Reclamation configured and implemented the Sacramento-Trinity Water Quality Monitoring Network to monitor temperature and other parameters at key locations in the Sacramento and Trinity Rivers. SWRCB orders also required Reclamation to establish the SRTTG to formulate, monitor, and coordinate temperature control plans for the upper Sacramento and Trinity Rivers. This group consists of representatives from Reclamation, SWRCB, NMFS, USFWS, CDFW, Western, DWR, and the Hoopa Valley Indian Tribe.

Each year, with finite cold water resources and competing demands usually an issue, the SRTTG devise operation plans with the flexibility to provide the best protection consistent with the CVP's temperature control capabilities and considering the annual needs and seasonal spawning distribution monitoring information for winter-run and fall-run Chinook Salmon. In every year since SWRCB issued the orders, those plans have included modifying the Red Bluff Pumping Plant compliance point to make best use of the cold water resources based on the location of spawning Chinook Salmon. These modifications occurred in 2012. Reports are submitted periodically to SWRCB over the temperature control season defining our temperature operation plans. SWRCB has overall authority to determine if the plan is sufficient to meet water right permit requirements.

Implementation of 2009 National Marine Fisheries Service Biological Opinion

The 2009 NMFS BO RPA Action I.2.1 requires Reclamation to achieve the following carryover storage performance measures for Shasta Lake to maintain the cold water volume needed to meet downstream temperature requirements.

- 87 percent of the years: 2,200 TAF end-of-September storage
- 82 percent of the years: .2,200 TAF end-of-September storage and 3,800 TAF end-of-April storage in following year
- 40 percent of the years: 3,200 TAF end-of-September storage

The 2009 NMFS BO RPA requires Reclamation to achieve the following temperature requirements over a ten year running average.

- 95 percent of the years: Clear Creek temperature compliance
- 85 percent of the years: Ball's Ferry temperature compliance
- 40 percent of the years: Jelly's Ferry temperature compliance
- 15 percent of the years: Bend Bridge temperature compliance

From November through February, if the end-of-September storage in Shasta Lake is equal to or greater than 2,400 TAF by October 15, Reclamation is required to work with NMFS, and CDFW to develop a release schedule that would consider the need to maintain flood control space in Shasta Lake (which results in a maximum storage of 3,250 TAF at the end-of-November), and a the need to provide stable Sacramento River flows and elevations during this period. If the end-of-September storage in Shasta Lake is between 1,900 and 2,400 TAF, a monthly release schedule for this period must be developed to consider maintaining Keswick Reservoir releases between 3,250 and 7,000 cfs; flows to support fall-run Chinook Salmon in accordance with the CVPIA AFRP guidelines; and provide for conservative Keswick Reservoir releases in drier years. If end-of-September storage in Shasta Lake is less than 1,900 TAF, Keswick Reservoir releases are reduced to 3,250 cfs in early October unless the flows are needed for temperature compliance, and if needed, reduce discretionary deliveries; and develop projected monthly deliveries for the period to maintain releases of 3,250 cfs, and if needed, reduce CVP and SWP Delta exports to meet Delta outflow and other legal requirements.

From April 15 through May 15, water temperatures are to be maintained at 56° F between Ball's Ferry and Bend Bridge. In addition, in March, Reclamation uses projections of CVP water availability, based upon a 90 percent forecast, to project the ability to meet temperature compliance at Ball's Ferry and achieve an end-of-September storage in Shasta Lake of 2,200 TAF. If the projections indicate that only one of the objectives can be met, releases from Keswick Reservoir would be reduced to 3,250 cfs unless another release pattern is agreed upon with NMFS. The release pattern would consider actions to maintain monthly average flows for Reclamation's non-discretionary delivery obligations; provide flows for the biological needs of spring life stages of species addressed in the 2009 NMFS BO; and approaches, including reductions in Delta exports, to meet Delta outflow and other legal requirements while not reducing Keswick Reservoir releases. If the projections indicate that the Clear Creek temperature compliance point or the 1,900 TAF end-of-September Shasta Lake storage cannot be met, Reclamation would develop a plan to manage the cold water pool in Whiskeytown Reservoir and Shasta Lake through several operational changes, including a reduction in the Wilkins Slough flow criteria (discussed above) to 4,000 cfs.

For operations from May 15 through October, Reclamation would develop a Temperature Management Plan to achieve temperatures of 56° F or less at compliance locations between Ball's Ferry and Bend Bridge.

3A.4.3.2.5 Shasta Temperature Control Device

Construction of the TCD at Shasta Dam was completed in 1997. This device is designed for greater flexibility in managing the cold water reserves in Shasta Lake while enabling hydroelectric power generation to occur and to improve salmon habitat conditions in the upper Sacramento River. The TCD is also designed to enable selective release of water from varying lake levels through the power plant in order to manage and maintain adequate water temperatures in the Sacramento River downstream of Keswick Dam.

Prior to construction of the Shasta TCD, Reclamation released water from Shasta Dam's low-level river outlets to alleviate high water temperatures during critical periods of the spawning and incubation life stages of the winter-run Chinook Salmon stock. The release of water through the low-level river outlets was a major facet of Reclamation's efforts to control upper Sacramento River temperatures from 1987 through 1996. Releases through the low-level outlets bypass the power plant and result in a loss of hydroelectric generation at the Shasta Power Plant.

The seasonal operation of the TCD is generally as follows: during mid-winter and early spring the highest possible elevation gates are utilized to draw from the upper portions of the lake to conserve deeper colder resources (Table 3A.6). During late spring and summer, the operators begin the seasonal progression of opening deeper gates as Shasta Lake elevation decreases and cold water resources are utilized. In late summer and fall, the TCD side gates are opened to utilize the remaining cold water resource below the Shasta Power Plant elevation in Shasta Lake.

Table 3A.6 Shasta Temperature Control Device Gates with Elevation and Storage

TCD Gates	Shasta Elevation with 35 feet of Submergence (feet)	Shasta Storage (MAF)
Upper Gates	1,035	~3.65
Middle Gates	935	~2.50
Pressure Relief Gates	840	~0.67
Side Gates	720*	~0.01

Note:
*Low level intake bottom

The seasonal progression of the Shasta TCD operation is designed to maximize the conservation of cold water resources deep in Shasta Lake, until the time the resource is of greatest management value for fishery management purposes. Recent operational experience with the Shasta TCD has demonstrated significant operational flexibility improvement for cold water conservation and upper Sacramento River water temperature and fishery habitat management purposes. Recent operational experience has also demonstrated the Shasta TCD has significant leaks that are inherent to TCD design. Also, operational uncertainties cumulatively impair the seasonal performance of the Shasta TCD to a greater degree than was anticipated in previous analysis and modeling used to describe long-term Shasta TCD benefits.

3A.4.3.2.6 CVPIA 3406 (b)(2) Operations on the Upper Sacramento River

Dedication of (b)(2) water on the Sacramento River provides instream flows below Keswick Dam greater than those that would have occurred under pre-CVPIA conditions, e.g., the fish and wildlife requirements specified in SWRCB Order 90-5 and the temperature criteria formalized in the 1993 NMFS winter-run Chinook Salmon BO as the base. Instream flow objectives from October 1 to April 15 (typically April 15 is when water temperature objectives for winter-run Chinook Salmon become the determining factor) are usually selected to minimize dewatering of redds and provide suitable habitat for salmonid spawning, incubation, rearing, and migration.

3A.4.3.2.7 Anderson-Cottonwood Irrigation District Diversion Dam

Anderson Cottonwood Irrigation District (ACID) holds senior water rights and has diverted into the ACID Canal for irrigation along the west side of the Sacramento River between Redding and Cottonwood since 1916. The United States and ACID signed a contract providing for Project water service and agreement on diversion of water. ACID diverts to its main canal (on the right bank of the river) from a diversion dam located in Redding about 5 miles downstream from Keswick Dam.

Close coordination between Reclamation and ACID is required for regulation of river flows to ensure safe operation of ACID's diversion dam during the irrigation season. The irrigation season for ACID runs from April through October.

Keswick release rate decreases required for the ACID operations are limited to 15 percent in a 24-hour period and 2.5 percent in any one hour. Therefore, advance notification is important when scheduling decreases to allow for the installation or removal of the ACID diversion dam.

Red Bluff Pumping Plant

The Red Bluff Pumping Plant and Fish Screen were completed in August 2012 to replace the Red Bluff Diversion Dam and improve fish passage conditions on the Sacramento River at Red Bluff, California. The facility includes a 1,118-foot-long flat-plate fish screen, intake channel, 2,500 cfs capacity pumping plant and discharge conduit to divert water from the Sacramento River into the Tehama-Colusa and Corning canals.

In 2011, the dam gates were permanently placed in the open position for free migration of fish while ensuring continued water deliveries by way of the Red Bluff Pumping Plant.

3A.4.3.2.8 Tehama-Colusa Canal Authority Operations

The intake for the Tehama-Colusa Canal and the Corning Canal is located on the Sacramento River approximately 2 miles southeast of Red Bluff. Water is diverted through fish passage facilities along the Sacramento River and lifted by a 2,500 cfs pumping plant into a settling basin for continued conveyance in the Tehama-Colusa Canal and the Corning Canal. Reclamation operates the pumping plant in accordance with BOs issued by USFWS and NMFS specifically for the Red Bluff Pumping Plant.

The Tehama-Colusa Canal is a lined canal extending from the settling basin 111 miles south from the Red Bluff Pumping Plant and provides irrigation service on the west side of the Sacramento Valley in Tehama, Glenn, Colusa, and northern Yolo counties. Construction of the Tehama-Colusa Canal began in 1965, and it was completed in 1980.

The Corning Pumping Plant lifts water approximately 56 feet from the screened portion of the settling basin into the unlined, 21 mile-long Corning Canal. The Corning Canal was completed in 1959, to provide water to the CVP contractors in Tehama County that could not be served by gravity from the Tehama-Colusa Canal. The Tehama-Colusa Canal Authority (TCCA) operates both the Tehama-Colusa and Corning canals.

3A.4.3.3 American River Division

Reclamation's Folsom Reservoir, the largest reservoir in the American River watershed, has a capacity of 967 TAF. Folsom Dam, located approximately 30 miles upstream from the confluence with the Sacramento River, is operated as a major component of the CVP. The American River Division includes facilities that provide conservation of water on the American River for flood control, fish and wildlife protection, recreation, protection of the Delta from intrusion of saline ocean water, irrigation and M&I water supplies, and hydroelectric power generation. Initially authorized features of the American River Division included Folsom Dam, Lake, and Power Plant; Nimbus Dam and Power Plant, and Lake Natoma.

Table 3A.7 provides Reclamation's annual water deliveries for the period 2000 through 2010 in the American River Division. The totals reveal an increasing trend in water deliveries over that period. For this EIS under the No Action Alternative, the American River Division water demands are modeled assuming that water users can utilize their full contract/agreement values with average annual deliveries of about 800 TAF per year. However, the American River contractors are not currently using this volume. The modeled deliveries vary depending on modeled annual water allocations. The "present level of American River water demands" has been previously modeled at 325 TAF/year based upon information collected over 10 years ago. The recently completed Urban Water Management Plans (UWMPs) for the American River water users indicate that the current average annual water use is about 500 TAF/year. It is anticipated that due to fast growth and new water agreements, the actual usage (as projected by the UWMPs) could increase to about 650 to 800 TAF/year over the next 10 years, depending upon growth rates and implementation of water demand reduction measures.

Table 3A.7 Annual Water Delivery—American River Division

Year	Water Delivery (TAF)*
2000	174
2001	223
2002	221
2003	270
2004	266
2005	297
2006	280
2007	113
2008	233
2009	260
2010	125
2011	269
2012	279

Notes:
* Annual Water Delivery data has been enhanced and the annual totals include CVP contracts, water rights (including water rights for the City of Sacramento), and other deliveries (e.g., Folsom South Canal losses).

TAF = thousand acre-feet

Releases from Folsom Dam are re-regulated approximately 7 miles downstream by Nimbus Dam. This facility is also operated by Reclamation as part of the CVP. Nimbus Dam creates Lake Natoma, which serves as a forebay for diversions to the Folsom South Canal. This CVP facility serves water to M&I users in Sacramento County. Releases from Nimbus Dam to the American River pass through the Nimbus Power Plant, or, at flows in excess of 5,000 cfs, the spillway gates.

Although Folsom Reservoir is the main storage and flood control reservoir on the American River, numerous other small non-federal reservoirs in the upper basin provide hydroelectric generation and water supply. None of the upstream reservoirs have any specific flood control responsibilities. The total upstream reservoir storage above Folsom Reservoir is approximately 820 TAF. Ninety percent of this upstream storage is contained by five reservoirs: French Meadows (136 TAF); Hell Hole (208 TAF); Loon Lake (76 TAF); Union Valley (271 TAF); and Ice House (46 TAF). Reclamation has agreements with the operators of some of these reservoirs to coordinate operations for releases.

French Meadows and Hell Hole reservoirs, located on the Middle Fork of the American River, are owned and operated by the Placer County Water Agency (PCWA). The PCWA provides wholesale water to agricultural and urban areas within Placer County. For urban areas, PCWA operates water treatment plants and sells wholesale treated water to municipalities that provide retail delivery to their customers. The cities of Rocklin and Lincoln receive water from PCWA, Loon Lake, and Union Valley and Ice House reservoirs on the South Fork of the American River, are all operated by the Sacramento Municipal Utilities District (SMUD) for hydropower purposes.

3A.4.3.3.1 Flood Control

Flood control requirements and regulating criteria are specified by the USACE and described in the Folsom Dam and Lake, American River, California Water Control Manual (U.S. Army Corps of Engineers 1987). Flood control objectives for the Folsom unit require that the dam and lake be operated to:

- Protect the City of Sacramento and other areas within the Lower American River floodplain against reasonable probable rain floods.
- Control flows in the American River downstream from Folsom Dam to existing channel capacities, insofar as practicable, and reduce flooding along the lower Sacramento River and in the Delta in conjunction with other CVP Projects.
- Provide the maximum amount of water conservation storage without impairing the flood control functions of the reservoir.
- Provide the maximum amount of power practicable and be consistent with required flood control operations and the conservation functions of the reservoir.

From June 1 through September 30, no flood control storage restrictions exist. From October 1 through November 16 and from April 20 through May 31, reserving storage space for flood control is a function of the date only, with full flood reservation space required from November 17 through February 7. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and current hydrologic conditions in the basin.

If the inflow into Folsom Reservoir causes the storage to encroach into the space reserved for flood control, releases from Nimbus Dam are increased. Flood control regulations prescribe the following releases when water is stored within the flood control reservation space.

- Maximum inflow (after the storage entered into the flood control reservation space) of as much as 115,000 cfs, but not less than 20,000 cfs, when inflows are increasing.
- Releases would not be increased more than 15,000 cfs or decreased more than 10,000 cfs during any two-hour period.
- Flood control requirements override other operational considerations in the fall and winter period. Consequently, short-term changes in river releases may occur.

In February 1986, the American River Basin experienced a significant flood event. Folsom Dam and Folsom Reservoir moderated the flood event and performed the flood control objectives, but with serious operational strains and concerns in the Lower American River and for the overall protection of the communities in the floodplain areas. A similar flood event occurred in January 1997. Since then, significant review and enhancement of Lower American River flooding issues have occurred and are ongoing. A major element of those efforts has been the Sacramento Area Flood Control Agency (SAFCA)-sponsored flood control plan diagram for Folsom Reservoir.

Since 1996, Reclamation has operated according to modified flood control criteria, which reserve 400 to 670 TAF of flood control space in Folsom Reservoir in combination with three upstream reservoirs. This flood control plan, which provides additional protection for the Lower American River, is implemented through an agreement between Reclamation and SAFCA. The terms of the agreement allow some of the empty reservoir space in Hell Hole, Union Valley, and French Meadows to be treated as if it were available in Folsom Reservoir.

The SAFCA release criteria are generally equivalent to the USACE plan, except the SAFCA diagram may prescribe flood releases earlier than the USACE plan. The SAFCA diagram also relies on Folsom Dam outlet capacity to make the earlier flood releases. The outlet capacity at Folsom Dam is currently limited to 32,000 cfs based on lake elevation. However, in general the SAFCA plan diagram provides greater flood protection than the existing USACE plan for communities in the American River floodplain.

Required flood control space under the SAFCA diagram begin to decrease on March 1. Between March 1 and April 20, the rate of filling is a function of the date and available upstream space. As of April 21, the required flood reservation is about 225 TAF. From April 21 to June 1, the required flood reservation is a function of the date only, with Folsom Reservoir storage permitted to fill completely on June 1.

Reclamation and USACE are jointly working on construction of an auxiliary spillway at Folsom Dam that would assist in meeting the established flood damage reduction objectives for the Sacramento area while continuing to preserve and expedite safely passing the Probable Maximum Flood. This project is commonly referred as the Joint Federal Project. Other partners in this project include DWR and SAFCA.

USACE (and Reclamation as the National Environmental Policy Act [NEPA] cooperating agency) is also undertaking a Folsom Dam Reoperation Study to develop, evaluate, and recommend changes to the flood control operations of the Folsom Dam project that would further the goal of reduced flood risk for the Sacramento area. Operational changes may be necessary to fully realize the flood risk reduction benefits of the additional operational capabilities created by completion of the Joint Federal Project, and the increased system capabilities provided by the implemented and authorized features of the Common Features

Project (a project being carried out by USACE and designed to strengthen the American River levees so they can safely pass a flow of 160,000 cfs); and those anticipated to be provided by completion of the authorized Folsom Dam Mini-Raise Project. The Folsom Dam Reoperation Study would also consider improved forecasts from the National Weather Service. Once a modified flood operation plan is complete, USACE, in cooperation with Reclamation (and DWR as the California Environmental Quality Act [CEQA] lead and SAFCA as the local partner), would consult with USFWS and NMFS relative to any changes to American River and/or system-wide CVP operations that may result.

Additional information related to the flood control criteria for Folsom Dam operations is included by reference to documents prepared by the USACE and SAFCA.

3A.4.3.3.2 Fish and Wildlife Requirements in the Lower American River

The minimum allowable flows in the Lower American River are defined by SWRCB Water Right Decision 893 (D 893), which states that, 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 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.

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 [FMS]). Reclamation began operating to the FMS immediately thereafter. The modeling assumptions herein include the operational components of the minimum Lower American River flows, consistent with the proposed FMS. The Sacramento Area Water Forum is currently investigating a revised FMS to better address temperature concerns on the Lower American River. Environmental compliance documentation is currently in the early stages of development. The FMS flows may be met by releases of water pursuant to Section 3406 (b)(2) of the CVPIA, if necessary.

Use of additional (b)(2) flows above the proposed flow standard is envisioned only on a case-by-case basis. Such additional use of (b)(2) flows would be subject to available resources and such use would be coupled with plans to not intentionally cause significantly lower river flows later in a water year. This case-by-case use of additional (b)(2) for minimum flows is not included in the modeling results.

Water temperature control operations in the Lower American River are affected by many factors and operational tradeoffs. These include available cold water resources, Nimbus release schedules, annual hydrology, Folsom power penstock shutter management flexibility, Folsom Dam Urban Water Supply TCD management, and Nimbus Hatchery considerations. Shutter and TCD management provide the majority of operational flexibility used to control downstream temperatures.

During the late 1960s, Reclamation designed a modification to the trashrack structures to provide selective withdrawal capability at Folsom Dam. Folsom Power Plant is located at the foot of Folsom Dam on the right abutment. Three 15-foot-diameter steel penstocks for delivering water to the turbines are embedded in the concrete section of the dam. The centerline of each penstock intake is at elevation 307.0 feet and the minimum power pool elevation is 328.5 feet. A reinforced concrete trashrack structure with steel trashracks protects each penstock intake.

The steel trashracks, located in five bays around each intake, extend the full height of the trashrack structure (between 281 and 428 feet). Steel guides were attached to the upstream side of the trashrack panels between elevation 281 and 401 feet. Forty-five 13-foot steel shutter panels (nine per bay), which are operated by a gantry crane, were installed in these guides to select the level of withdrawal from the reservoir. The shutter panels are attached to one another, in a configuration starting with the top shutter, in groups of three, two, and four.

Selective withdrawal capability on the Folsom Dam Urban Water Supply Pipeline (also known as the TCD) became operational in 2003. The centerline to the 84-inch-diameter Urban Water Supply intake is at elevation 317 feet. An enclosure structure extending from just below the water supply intake to an elevation of 442 feet was attached to the upstream face of Folsom Dam. A telescoping control gate allows for selective withdrawal of water anywhere between 331 and 401 feet elevation under normal operations.

The current objectives for water temperatures in the Lower American River address the needs for steelhead incubation and rearing during the late spring and summer, and for fall–run Chinook Salmon spawning and incubation starting in late October or early November.

A major challenge is determining the starting date at which time the objective is met. Establishing the start date requires a balancing between forecasted release rates, the volume of available cold water, and the estimated date at which time Folsom Reservoir turns over and becomes isothermic. Reclamation works to provide suitable spawning temperatures as early as possible (after November 1) to help avoid temperature related pre-spawning mortality of adults and reduced egg viability. Operations are balanced against the possibility of running out of cold water and increasing downstream temperatures after spawning is initiated and creating temperature-related effects on eggs already in the gravel.

In any given year at Folsom Reservoir, the available cold water resources needed to meet the stated water temperature goals are often insufficient. Only in wetter hydrologic conditions is the volume of cold water resources available sufficient to meet all the water temperature objectives. Therefore, significant operations tradeoffs and flexibilities are part of an annual planning process for coordinating an operation strategy that realistically manages the limited cold water resources available. Reclamation's coordination on the planning and management of cold water resources is done through the (b)(2)IT and ARG groups discussed above.

The management process begins in the spring as Folsom Reservoir fills. All penstock shutters are put in the down position to isolate the colder water in the reservoir below an elevation of 401 feet. The reservoir water surface elevation must be at least 25 feet higher than the sill of the upper shutter (426 feet) to avoid cavitation of the power turbines. The earliest this can occur is in the month of March, due to the need to maintain flood control space in the reservoir during the winter. The pattern of spring run-off is then a significant factor in determining the availability of cold water for later use. Folsom Reservoir inflow temperatures begin to increase and the lake starts to stratify as early as April. By the time the reservoir is filled or reaches peak storage (sometime in the May through June period), the reservoir is highly stratified, with surface waters too warm to meet downstream temperature objectives. There are, however, times during the filling process when use of the spillway gates can be used to conserve cold water.

In the spring of 2003, high inflows and encroachment into the allowable storage space for flood control required releases that exceeded the available capacity of the power plant. Under these conditions, Folsom Dam standard operations involve the use of the river outlets that draw upon the cold water pool. Reclamation reviewed the release requirements, Safety of Dams issues, reservoir water temperature conditions, and the cold water pool benefits, and determined that the spillway gates should be used to make the incremental releases above power plant capacity, thereby conserving cold water for later use. The ability and necessity to take similar actions are evaluated on a case-by-case basis.

The annual temperature management strategy and challenge is to balance conservation of cold water for later use in the fall with the more immediate needs of steelhead during the summer. The planning and forecasting process for the use of the cold water pool begins in the spring as Folsom Reservoir fills. Actual Folsom Reservoir cold water resource availability becomes significantly more defined through the assessment of reservoir water temperature profiles and more definite projections of inflows and storage. Technical modeling analysis begins in the spring for the projected Lower American River water temperature management plan. The significant variables and key assumptions in the analysis include:

- Cold Water Pool volume in March
- Starting reservoir temperature conditions
- Forecasted inflow and outflow quantities
- Assumed meteorological conditions

- Assumed inflow temperatures
- Assumed Folsom Dam Water Supply Intake TCD operations

A series of TCD shutter management scenarios are then incorporated into a model to gain a better understanding of the potential for meeting water temperature needs for both over-summer rearing steelhead and spawning Chinook Salmon in the fall. Most annual strategies contain significant tradeoffs and risks for water temperature management for steelhead and fall-run Chinook Salmon goals and needs due to the frequently limited coldwater resource. The planning process continues throughout the summer. New temperature forecasts and operational strategies are updated as more information on actual operations and ambient conditions is gained.

Meeting both the summer steelhead and fall salmon temperature objectives without negatively impacting other CVP project purposes requires the final shutter pull be reserved for use in the fall to provide suitable fall-run Chinook Salmon spawning temperatures. In most years, the volume of cold water is not sufficient to support strict compliance with the summer water temperature target at the downstream end of the compliance reach at the Watt Avenue Bridge; while at the same time reserving adequate water for fall releases to protect fall-run Chinook Salmon, or in some cases, continuing to meet steelhead over-summer rearing objectives later in the summer. A strategy used under these conditions is to allow the annual compliance location water temperatures to warm towards the upper end of the annual water temperature design value before making a shutter pull. This management flexibility is essential to the annual management strategy to extend the effectiveness of cold water management through the summer and fall months.

The Folsom Water Supply Intake TCD has provided additional flexibility to conserve cold water for later use. As anticipated, the TCD has been operated during the summer months and delivers water that is slightly warmer than that which could be used to meet downstream temperatures (60°F to 62°F), but not so warm as to cause significant treatment issues.

Water temperatures feeding the Nimbus Fish Hatchery were historically too high for hatchery operations during some dry or critical years. Water temperatures in the Nimbus Hatchery are generally in the desirable range of 42°F to 55°F, except for the months of June, July, August, and September. When temperatures get above 60°F during these months, the hatchery must begin to treat the fish with chemicals to prevent disease. When temperatures reach the 60°F to 70°F range, treatment becomes difficult and conditions become increasingly dangerous for the fish. In years when mean daily water temperatures are forecast to approach 70°F, a significant number of steelhead may be released early in the summer. Stocked fish have the opportunity to find suitable rearing habitat within the river and reduced densities result in lower mortality in the group of fish that remain in the hatchery.

Reclamation operates Nimbus Dam Fish Hatchery to maintain the health of the hatchery fish while minimizing the loss of the coldwater pool for fish spawning in the river during fall. Evaluation of Nimbus Dam operations is done on a case-by-case basis and is different in various months and year types. Water temperatures above 70°F in the hatchery usually mean the fish need to be moved to another hatchery or released to the river. The real-time implementation of flow objectives and meeting SWRCB D-1641 Delta standards with the limited water resources of the Lower American River requires a significant coordination effort to manage the cold water resources at Folsom Dam and Reservoir. Reclamation consults with USFWS, NMFS, and CDFW through (b)(2)IT when these types of difficult decisions are needed. In addition, Reclamation communicates with the ARG on real-time data and operational tradeoffs.

A fish diversion weir at the hatcheries blocks Chinook Salmon from continuing upstream and guides them to the hatchery fish ladder entrance. The fish diversion weir consists of eight piers on 30-foot spacing, including two riverbank abutments. Fish rack support frames and walkways are installed each fall using an overhead cable system. A pipe rack is then put in place to support the pipe pickets (0.75-inch steel rods spaced on 2.5-inch centers). The pipe rack rests on a submerged steel I-beam support frame that extends between the piers and forms the upper support structure for a rock-filled crib foundation. The rock foundation has deteriorated with age and is subject to annual scour, which can leave holes in the foundation that allow fish to pass if left unattended. Reclamation released the final environmental documentation in August 2011 that selected an alternative to extend the existing fishway up to Nimbus Dam as the solution to the issues associated with the weir. Construction of the new fishway is expected to be completed by 2030.

Fish rack supports and pickets are installed during early to mid-September of each year to correspond with the beginning of the fall-run Chinook Salmon spawning season. A release equal to or less than 1,500 cfs from Nimbus Dam is required for safety and to provide full access to the fish rack supports. It takes six people approximately 3 days to install the fish rack supports and pickets. In years after high winter flows have caused active scour of the rock foundation, a short period (less than 8 hours) of lower flow (approximately 500 cfs) is needed to remove debris from the I-beam support frames, seat the pipe racks, and fill holes in the rock foundation. Complete installation can take up to 7 days, but is generally completed in less time. The fish rack supports and pickets are usually removed at the end of fall-run Chinook Salmon spawning season (mid-January) when flows are less than 2,000 cfs. If Nimbus Dam releases are expected to exceed 5,000 cfs during the operational period, the pipe pickets are removed until flows decrease.

As described previously, Folsom Reservoir also is operated to release water to meet Delta water quality and flow objectives to improve fisheries conditions, including releases for salinity objectives. Weather conditions combined with tidal action can quickly affect Delta salinity conditions, and therefore, the Delta outflow required to maintain joint standards. If, in this circumstance, it is decided the reasonable course of action is to increase upstream reservoir releases, then the response would likely be to increase Folsom Reservoir releases first because the released water would reach the Delta before flows released from other CVP and SWP reservoirs. Lake Oroville water releases require about 3 days to reach the Delta, while water released from Shasta Lake requires 5 days to travel from Keswick Reservoir to the Delta. As water from the other reservoirs arrives in the Delta, Folsom Reservoir releases can be adjusted downward. These operational practices can reduce the amount of water in Folsom Reservoir, especially during a water year with limited snowpack. The water released from Folsom Reservoir cannot be replaced during the late winter and spring months if the snowpack is not adequate. When these conditions occur, there is a possibility of reduced water deliveries to CVP water service contractors that rely solely upon American River water supplies, including El Dorado County Water Agency, El Dorado Irrigation District, Sacramento Municipal Utility District, cities of Roseville and Folsom, PCWA, San Juan Water District, and Sacramento County Water Agency.

3A.4.3.3.3 CVPIA 3406 (b)(2) Operations on the Lower American River

Dedication of (b)(2) water on the American River provides instream flows below Nimbus Dam greater than those that would have occurred under pre-CVPIA regulations, e.g., the fish and wildlife requirements previously mentioned in the American River Division. Instream flow objectives from October through May generally aim to provide suitable habitat for salmon and steelhead spawning, incubation, and rearing, while considering impacts. Instream flow objectives for June to September endeavor to provide suitable flows and water temperatures for juvenile steelhead rearing, while balancing the effects on temperature operations into October and November.

Flow Fluctuation and Stability Concerns

Through CVPIA, Reclamation has funded studies by CDFW to better define the relationships of Nimbus release rates and rates of change criteria in the Lower American River to minimize the negative effects of necessary Nimbus release changes on sensitive fishery objectives. Reclamation is presently using draft criteria developed by CDFW. The draft criteria have helped reduce the incidence of anadromous fish stranding relative to past historic operations.

The primary operational coordination for potentially sensitive Nimbus Dam release changes is conducted through the (b)(2)IT process. The ARG is another forum to discuss criteria for flow fluctuations. Since 1996 the group has provided input on a number of operational issues and has served as an aid towards adaptively managing releases, including flow fluctuation and stability, and managing water temperatures in the Lower American River to meet the needs of salmon and steelhead.

3A.4.3.4 Delta Division and West San Joaquin Division

3A.4.3.4.1 CVP Facilities

The CVP's Delta Division consists of the DCC, the Contra Costa Canal and Pumping Plants, Contra Loma Dam, Martinez Dam, the Jones Pumping Plant (formerly Tracy Pumping Plant), the TFCF, and the DMC. Collectively these facilities divert water for irrigation and M&I use to the San Francisco Bay Area, the Central Valley, and for transport to Southern California. The DCC is a controlled diversion channel between the Sacramento River and Snodgrass Slough. The CCWD diversion facilities use CVP water resources to serve district customers directly and to operate CCWD's Los Vaqueros Project. The Jones Pumping Plant diverts water from the Delta to the head of the DMC.

3A.4.3.4.2 Delta Cross Channel Operations

The DCC is a gated diversion channel in the Sacramento River near Walnut Grove and Snodgrass Slough. Flows into the DCC from the Sacramento River are controlled by two 60-foot by 30-foot radial gates. When the gates are open, water flows from the Sacramento River through the cross channel to channels of the lower Mokelumne and San Joaquin Rivers toward the interior Delta. The DCC operation improves water quality in the interior Delta by improving circulation patterns of good quality water from the Sacramento River towards Delta diversion facilities.

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 southern Delta, and (3) reduce salt water 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. 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.

Flow rates through the gates are determined by Sacramento River stage and are not affected by export rates in the south Delta. The DCC also serves as a link between the Mokelumne River and the Sacramento River for small craft, and is used extensively by recreational boaters and fishermen whenever it is open. Because alternative routes around the DCC are quite long, Reclamation tries to provide adequate notice of DCC closures so boaters may plan for the longer excursion.

SWRCB D-1641 DCC standards provide for closure of the DCC gates for fisheries protection at certain times of the year. From November through January, the DCC may be closed for up to 45 days for fishery protection purposes. From February 1 through May 20, the gates are closed for fishery protection purposes. The gates may also be closed for 14 days for fishery protection purposes during the May 21 through June 15 time period. Reclamation determines the timing and duration of the closures after discussion with USFWS, CDFW, and NMFS. These discussions occur through WOMT as part of the weekly review of CVP and SWP operations.

WOMT typically relies on monitoring for fish presence and movement in the Sacramento River and Delta, the salvage of salmon at the Tracy and Skinner facilities, and hydrologic cues when considering the timing of DCC closures. However, the overriding factors are current water quality conditions in the interior and western Delta. From mid-June to November, Reclamation usually keeps the gates open on a continuous basis. The DCC is also usually opened for the busy recreational Memorial Day weekend, if this is possible from a fishery, water quality, and flow standpoint.

The Salmon Decision Process is used by the fishery agencies and Project operators to facilitate the often complex coordination issues surrounding DCC gate operations and the purposes of fishery protection closures, Delta water quality, and/or export reductions. Inputs such as fish life stage and size development, current hydrologic events, fish indicators (such as the Knight's Landing Catch Index and Sacramento Catch Index), and salvage at the export facilities, as well as current and projected Delta water quality conditions, are used to determine potential DCC closures and/or export reductions. The Salmon Decision Process includes "Indicators of Sensitive Periods for Salmon," such as hydrologic changes, detection of spring-run salmon or spring-run salmon surrogates at monitoring sites or the salvage facilities, and turbidity increases at monitoring sites, which trigger the Salmon Decision Process.

Implementation of 2009 National Marine Fisheries Service Biological Opinion

The 2009 NMFS BO RPA Action IV.1.2 requires Reclamation to close the DCC for additional days from October 1 through November 30; December 1 through December 14, unless closures cause adverse impacts on water quality conditions; and December 15 through January 31, if fish are present.

3A.4.3.4.3 Jones Pumping Plant

The CVP and SWP use the Sacramento River, San Joaquin River, and Delta channels to transport water to export pumping plants located in the south Delta. The CVP's Jones Pumping Plant, located about 5 miles north of Tracy, has six available pumps. The Jones Pumping Plant 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. With the completion of the Delta-Mendota Canal/California Aqueduct Intertie (described under Joint Project Facilities), this capacity is no longer limited. At the head of the intake channel, louver screens (that are part of the TFCF) intercept fish, which are then collected, held, and transported by tanker truck to release sites far away from the pumping plants. The CVP uses two release sites, one on the Sacramento River near Horseshoe Bend and the other on the San Joaquin River immediately upstream of the Antioch Bridge.

3A.4.3.4.4 Tracy Fish Collection Facility

The TFCF is located in the south-west portion of the Delta and uses behavioral barriers consisting of primary and secondary louvers, to guide entrained fish into holding tanks before transport by truck to release sites within the Delta. The TFCF was designed to handle smaller fish (<200 millimeters [mm]) that would have difficulty fighting the strong pumping plant induced flows since the intake is essentially open to the Delta and also impacted by tidal action.

The primary louvers are located in the primary channel just downstream of the trashrack structure. The secondary louvers are located in the secondary channel just downstream of the traveling water screen. 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 so as to prevent most fish from passing between them and instead 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. Also, 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 eight parts per thousand salt solution to reduce stress.

When south Delta hydraulic conditions allow, and within the original design criteria for the TFCF, the louvers are operated with the D-1485 objectives of achieving water approach velocities: for striped bass of approximately 1 foot per second (ft/s) from May 15 through October 31, and for salmon of approximately 3 feet/second (ft/s) from November 1 through May 14.

Fish passing through the facility are sampled at intervals of no less than 20 minutes every 2 hours when listed fish are present, generally December through June. When few fish are present, sampling intervals are 10 minutes every 2 hours. 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 millimeter (mm) larval Delta Smelt detection.

CDFW is leading studies of fish survival during the collection, handling, transportation, and release process, examining Delta Smelt injury, stress, survival, and predation. Thus far it has presented initial findings at various interagency meetings (Interagency Ecological Program [IEP], Central Valley Fish Facilities Review Team, and American Fisheries Society) showing relatively high survival and low injury. DWR has concurrently been conducting focused studies examining the release phase of the salvage process including a study examining predation at the point of release and a study examining injury and survival of Delta Smelt and Chinook Salmon through the release pipe. Based on these studies, improvements to release operations and/or facilities, including improving fishing opportunities in Clifton Court Forebay (CCF) to reduce populations of predator fish, are being implemented.

CDFW and USFWS evaluated pre-screen loss and facility/louver efficiency for juvenile and adult Delta Smelt at the Skinner Fish Facility of the SWP (described in Section 5, State Water Project). DWR also conducted pre-screen loss and facility efficiency studies for steelhead.

3A.4.3.4.5 Contra Costa Water District Diversion Facilities

The CCWD diverts water from the Delta for irrigation and M&I uses under its CVP contract and under its own water right permits and license, issued by SWRCB. CCWD's water system includes the Mallard Slough, Rock Slough, Old River, and Middle River (on Victoria Canal) intakes; the Contra Costa Canal and shortcut pipeline; and the Los Vaqueros Reservoir. The Rock Slough Intake facilities, the Contra Costa Canal, and the shortcut pipeline are owned by Reclamation, and operated and maintained by CCWD under contract with Reclamation. Reclamation completed construction of a fish screen at the Rock Slough intake in 2011; testing and the transfer of operation and maintenance of the fish screen to CCWD is ongoing. Mallard Slough Intake, Old River Intake, Middle River Intake, and Los Vaqueros Reservoir are owned and operated by CCWD.

The Mallard Slough Intake is located at the southern end of a 3,000-foot-long channel running south from Suisun Bay, near Mallard Slough (across from Chipps Island). The Mallard Slough Pump Station was refurbished in 2002, which included constructing a positive barrier fish screen at this intake. The Mallard Slough Intake can pump up to 39.3 cfs. CCWD's water right license and permit (License No. 10514 and Permit No. 19856) authorize diversions of up to 26,780 acre-feet per year at Mallard Slough. However, this intake is rarely used due to the generally high salinity at this location. Pumping at the Mallard Slough Intake since 1993 has on average accounted for about 3 percent of CCWD's total diversions. When CCWD diverts water at the Mallard Slough Intake, CCWD reduces pumping of CVP water at its other intakes.

The Rock Slough Intake is located about four miles southeast of Oakley, where water flows through a positive barrier fish screen into the earth-lined portion of the Contra Costa Canal. The fish screen at this intake was constructed by Reclamation in accordance with the CVPIA and the 1993 USFWS BO for the Los Vaqueros Project to reduce take of fish through entrainment at the Rock Slough Intake. The Canal connects the fish screen at Rock Slough to Pumping Plant 1, approximately four miles to the west. The Canal is earth-lined and open to tidal influence for approximately 3.7 miles from the Rock Slough fish screen. Approximately 0.3 miles of the Canal immediately east (upstream) of Pumping Plant 1 have been encased in concrete pipe, the first portion of the CCWD's Contra Costa Canal Encasement Project to be completed. When fully completed, the Canal Encasement Project would eliminate tidal flows into the Canal because the encased pipeline would be located below the tidal range elevation. Pumping Plant 1 has capacity to pump up to 350 cfs into the concrete-lined portion of the Canal. Diversions at Rock Slough Intake are typically taken under CVP contract. CCWD may divert approximately 30 percent to 50 percent of its total supply through the Rock Slough Intake depending upon water quality there.

Construction of the Old River Intake was completed in 1997 as a part of the Los Vaqueros Project. The Old River Intake is located on Old River near State Route 4. The intake has a positive-barrier fish screen and a pumping capacity of 250 cfs, and can pump water via pipeline either to the Contra Costa Canal or to Los Vaqueros Reservoir. Diversions at Old River to the Contra Costa Canal are typically taken under CVP contract. Pumping to storage in Los Vaqueros Reservoir is limited to 200 cfs by the terms of the Los Vaqueros Project BOs and by SWRCB Decision 1629, SWRCB water right decision for the Los Vaqueros Project (Permit 20749). Diversions to storage in Los Vaqueros Reservoir are typically taken under CVP contract or under the Los Vaqueros water right permit. The CCWD's water diversions that are not made at Rock Slough diverted at the Middle River and Old River intakes, as determined primarily by the CCWD water quality goals, described below.

In 2010, CCWD completed construction of the Middle River Intake (formerly referred to as Alternative Intake Project) on Victoria Canal. The Middle River Intake has a capacity of 250 cfs capacity, with positive-barrier fish screens and a conveyance pipeline to CCWD's existing conveyance facilities. Similar to the Old River Intake, the Middle River Intake can be used either to pump to the Contra Costa Canal or to fill the Los Vaqueros Reservoir. Diversions to the Contra Costa Canal are typically taken under CVP contract, while diversions to storage in the Los Vaqueros Reservoir can be taken either under CVP contract or under CCWD's Los Vaqueros water right (Permit 20749). The effects of the Middle River Intake on Delta Smelt are covered by the April 27, 2007 USFWS BO (amended on May 16, 2007). Effects on salmonids and Green Sturgeon are covered by the July 13, 2007 NMFS BO for this intake project.

CCWD operates the Middle River Intake together with its other 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 BOs for the Middle River Intake and the Los Vaqueros Project. The Middle River Intake was built as a project to improve the water quality delivered to the CCWD service area, and does not increase CCWD's average annual diversions from the Delta. However, it can alter the timing and pattern of CCWD's diversions, because Middle River Intake salinity tends to be lower in the late summer and fall than salinity at CCWD's other intakes. This allows CCWD to decrease winter and spring diversions while still meeting water quality goals in the summer and fall through use of the new intake.

Los Vaqueros Reservoir is an off-stream reservoir in the Kellogg Creek watershed to the west of the Delta. Originally constructed as a 100 TAF reservoir in 1997 as part of the Los Vaqueros Project, the facility is used to improve delivered water quality and emergency storage reliability for CCWD's customers. Los Vaqueros Reservoir is filled with Delta water from either the Old River Intake or the Middle River Intake, when salinity in the Delta is low. When Delta salinity is high, typically in the fall months, CCWD releases low salinity water from Los Vaqueros Reservoir to blend with direct diversions from the Delta to meet CCWD water quality goals. Releases from Los Vaqueros Reservoir are conveyed to the Contra Costa Canal via a pipeline.

In 2012, Los Vaqueros Reservoir was expanded from 100 TAF to a total storage capacity of 160 TAF to provide additional water quality and water supply reliability benefits, and maintain the initial functions of the reservoir. With the expanded reservoir, CCWD's average annual diversions from the Delta remain the same as they were with the 100 TAF reservoir. A feasibility study is ongoing to evaluate whether an additional expansion of this reservoir is in the federal interest.

CCWD diverts approximately 127 TAF per year in total. Approximately 110 TAF is CVP contract supply. 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. 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 and a concurrent 30-day period during which CCWD halts all diversions from the Delta, provided that Los Vaqueros Reservoir storage is above emergency levels. 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. CCWD coordinates the filling of Los Vaqueros Reservoir with Reclamation and DWR to avoid water supply impacts on other CVP and SWP customers. During the no-diversion period, CCWD customer demand is met by releases from Los Vaqueros Reservoir.

In addition to the existing 75-day no-fill period (March 15 to May 31) and the concurrent no-diversion 30 day period, CCWD operates to an additional term in the Incidental Take Permit issued by CDFW. Under this term, CCWD shall not divert water to storage in Los Vaqueros Reservoir for 15 days from February 14 through February 28, provided that reservoir storage is at or above 90 TAF on February 1. If reservoir storage is at or above 80 TAF on February 1, but below 90 TAF, CCWD shall not divert water to storage in Los Vaqueros Reservoir for 10 days from February 19 through February 28. If reservoir storage is at or above 70 TAF on February 1, but below 80 TAF, CCWD shall not divert water to storage in Los Vaqueros Reservoir for 5 days from February 24 through February 28. These dates can be changed to better protect Delta fish species, at the direction of CDFW.

CCWD's operation of the diversion, storage, and conveyance facilities to divert water under CCWD's water rights meets the permitting requirements of the ESA through BOs issued by USFWS and NMFS that are specific to the CCWD system. The NMFS BO issued on March 18, 1993 and USFWS BO issued on September 9, 1993 address the operation of the Los Vaqueros Project, including the Los Vaqueros Reservoir and the Mallard Slough, Rock Slough, and Old River intakes. NMFS BO 2005/00122 issued on July 13, 2007, and USFWS BO issued on April 27, 2007 and amended on May 16, 2007, address the Middle River Intake operations. Concurrence that expansion of Los Vaqueros Reservoir to 160 TAF is not likely to adversely affect listed Delta fish species was provided by NMFS on October 15, 2010 and USFWS on November 1, 2010.

3A.4.3.4.6 Water Demands—Delta Mendota Canal and San Luis Unit

Water demands for the DMC and San Luis Unit are primarily composed of three separate types: CVP water service contractors, exchange contractors, and wildlife refuge contractors. Distinct relationships exists between Reclamation and each of these three groups. Exchange contractors "exchanged" their senior rights to water in the San Joaquin River for a CVP water supply generally provided from the Delta. Reclamation thus guaranteed the exchange contractors a firm water supply from the Delta or the San Joaquin River of 840 TAF per annum, with a maximum reduction under the Shasta critical year criteria to an annual water supply of 650 TAF.

Conversely, water service contractors do not have water rights senior to CVP. Agricultural water service contractors also receive their supply from the Delta, but their supplies are subject to the availability of CVP water supplies that can be developed and reductions in contractual supply can be as high as 100 percent. The CVP also contracts with refuges to provide water supplies to specific managed lands for wildlife purposes. These contracts may be reduced under Shasta critical year criteria up to 25 percent.

To achieve the best operation of the CVP, it is necessary to combine the contractual demands of these three types of contractors to achieve an overall pattern of requests for water. In most years, sufficient supplies are not available to meet all water demands because of reductions in CVP water supplies due to restricted Delta pumping capability. In some dry or critically dry years, water deliveries are limited because there is insufficient storage in northern CVP reservoirs to meet all instream fishery objectives, including water temperatures, and to make additional water deliveries via the Jones Pumping Plant. The scheduling of water demands, together with the scheduling of the releases of water supplies from the northern CVP to meet those demands, is a CVP operational objective that is intertwined with the Trinity, Sacramento, and American River operations.

3A.4.3.4.7 CVPIA 3406 (b)(2) Operations in the Delta

Export curtailments at the CVP Jones Pumping Plant and increased CVP reservoir releases required to meet SWRCB D-1641, as well as direct export reductions for fishery management using dedicated (b)(2) water at the CVP Jones Pumping Plant, is determined in accordance with the Interior Decision on Implementation of Section 3406 (b)(2) of the CVPIA. Direct Jones Pumping Plant export curtailments for fishery management protection is based on coordination with the weekly (b)(2)IT meetings and vetted through WOMT, as necessary.

3A.4.3.4.8 Implementation of 2008 USFWS and 2009 NMFS Biological Opinions

The 2008 USFWS BO and the 2009 NMFS BO restrict CVP and SWP diversions to reduce reverse flows in Old and Middle rivers (OMR). The 2008 USFWS BO also includes criteria for fall Delta outflow. The 2009 NMFS BO includes criteria for a San Joaquin River I:E ratio (Action IV.2.1), and additional criteria for closure of the Delta Cross Channel Gates.

2008 USFWS BO OMR Criteria

The 2008 USFWS BO limits reverse OMR flows as prescribed in the following three actions.

- Action 1: to protect adult Delta Smelt migration and entrainment. Limits exports so that the average daily OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent).
  - December 1 to December 20 – Based upon turbidity data from turbidity stations (Prisoner’s Point, Holland Cut, and Victoria Canal) and salvage data from CVP and SWP fish handling facilities at the south Delta intakes, and other parameters important to the protection of Delta Smelt including, but not limited to, preceding conditions of X2, Fall Midwater Trawl (FMWT) Survey, and river flows.
  - After December 20 – The action would begin if the 3 day average turbidity at Prisoner’s Point, Holland Cut, and Victoria Canal exceeds 12 nephelometric turbidity units (NTU).
  - Triggers are based on:
    - Three-day average of 12 NTU or greater at all three turbidity stations; or
    - Three days of Delta Smelt salvage after December 20 at either facility or cumulative daily salvage count that is above a risk threshold based upon the “daily salvage index” approach reflected in a daily salvage index value of greater than or equal to 0.5 (daily Delta Smelt salvage is greater than one-half prior year FMWT index value). The window for triggering Action 1 concludes when either off-ramp condition described below is met. These off-ramp conditions may occur without Action 1 ever being triggered. If this occurs, then Action 3 is triggered, unless the Service concludes on the basis of the totality of available information that Action 2 should be implemented instead.

  - Action 1 offramps when water temperature reaches 12 degrees Celsius (°C) based on a three station daily mean at the temperature stations: Mossdale, Antioch, and Rio Vista; or the onset of spawning based upon the presence of spent females in the Spring Kodiak Trawl Survey or at the CVP or SWP fish handling facilities.

- Action 2: to protect adult Delta Smelt migration and entrainment. An action implemented using an adaptive process to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions. The range of net daily OMR flows would be no more negative than -1,250 to -5,000 cfs. Depending on extant conditions, specific OMR flows within this range are recommended by the USFWS Smelt Working Group (SWG) from the onset of Action 2 through its termination. The SWG would provide weekly recommendations based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS makes the final determination.

  - Action 2 begins immediately following Action 1. If Action 1 is not implemented based upon triggers, the SWG may recommend a start date for Action 2.

  - Action 2 is suspended when whenever a 3-day flow average is greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and 10,000 cfs in San Joaquin River at Vernalis. Once such flows have abated, the OMR flow requirements of Action 2 are restarted.

  - Offramps for Action 2 are related to water temperature reaches 12°C based on a three-station daily average at the temperature stations: Rio Vista, Antioch, and Mossdale; or the onset of spawning based upon the presence of a spent female in the Spring Kodiak Trawl Survey or at the CVP or SWP fish handling facilities.

- Action 3: to protect larval and juvenile Delta Smelt. Minimize the number of larval Delta Smelt entrained at the facilities by managing the hydrodynamics in the Central Delta flow levels pumping rates spanning a time sufficient for protection of larval Delta Smelt. Net daily OMR flow would be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable requirement for OMR. Depending on extant conditions, specific OMR flows within this range are recommended by the SWG from the onset of Action 3 through its termination.

  - Action 3 begins when temperature reaches 12°C based on a three-station average at the temperature stations: Mossdale, Antioch, and Rio Vista; or onset of spawning based upon the presence of a spent female in the Spring Kodiak Trawl Survey or at the CVP or SWP fish handling facilities.

- Action 3 offramps by June 30; or if water temperature reaches a daily average of 25°C for three consecutive days 10 at Clifton Court Forebay.

2009 NMFS BO OMR Criteria

The 2009 NMFS BO includes OMR criteria (Action IV.2.3) to protect juvenile salmonids during winter and spring emigration downstream into the San Joaquin River, and to increase survival of salmonids and Green Sturgeon entering the San Joaquin River from Georgiana Slough and the lower Mokelumne River by reducing the potential for entrainment at the south Delta intakes. The action is implemented from January 1 through June 15 to limit negative flows to -2,500 to -5,000 cfs in Old and Middle Rivers, depending on the presence of salmonids. The reverse flow would be managed within this range to reduce flows toward the pumps during periods of increased salmonid presence. The negative flow objective within the range shall be determine based on the following decision tree:

Date	Action Triggers	Action Responses
January 1 – June 15	January 1 – June 15	-5,000 cfs
January 1 – June 15 First Stage Trigger (increasing level of concern)	Daily SWP/CVP older juvenile loss density (fish per TAF) 1) is greater than incidental take limit divided by 2000, with a minimum value of 2.5 fish per TAF, or 2) daily loss is greater than daily measured fish density divided by 12 TAF, or 3) Coleman National Fish Hatchery coded wire tag late-fall run or Livingston Stone National Fish Hatchery coded wire tag winter-run cumulative loss greater than 0.5%, or 4) daily loss of wild steelhead (intact adipose fin) is greater than the daily measured fish density divided by 12 TAF.	-3,500 cfs for minimum of 5 days; and up to -5,000 cfs other times
January 1 – June 15 Second Stage Trigger (analogous to high concern level)	Daily SWP/CVP older juvenile loss density (fish per TAF) is 1) greater than incidental take limit divided by 1000, with a minimum value of 2.5 fish per TAF, or 2) daily loss is greater than daily fish density divided by 8 TAF, or 3) Coleman National Fish Hatchery coded wire tag late-fall run or Livingston Stone National Fish Hatchery coded wire tag winter-run cumulative loss greater than 0.5%, or 4) daily loss of wild steelhead (intact adipose fin) is greater than the daily measured fish density divided by 8 TAF.	-2,500 cfs for minimum of 5 days; and up to -5,000 cfs other times
End of Triggers	Continue action until June 15 or until average daily water temperature at Mossdale is greater than 72°F (22°C) for 7 consecutive days (1 week), whichever is earlier.	No OMR restriction.

2009 NMFS BO San Joaquin River Inflow:Export Ratio

The 2009 NMFS BO Action IV.2.1 requires south Delta exports to be reduced during April and May to protect emigrating steelhead from the lower San Joaquin River into the south Delta channels and intakes. The inflow:export ratio from April 1 through May 31 specifies that Reclamation operates the New Melones Reservoir to maintain the 2009 NMFS BO flow schedule for the Stanislaus River at Goodwin in accordance with Action III.1.3 and Appendix 2-E of the BO. In addition, the CVP and SWP pumps are operated to meet the following ratios, based upon a 14-day running average.

San Joaquin Valley Classification	San Joaquin River flow at Vernalis (cfs):CVP and SWP combined export ratio (cfs)
Critically dry	1:1
Dry	2:1
Below normal	3:1
Above normal	4:1
Wet	4:1
Vernalis flow equal to or greater than 21,750 cfs	Unrestricted exports until flood recedes below 21,750 cfs.

During multiple dry years, the ratio would be limited to 1:1 if the New Melones Index related to storage is less than 1,000 TAF and the sum s of the “indicator” numbers established for water year classifications in SWRCB D-1641 (based on the San Joaquin Valley 60-20-20 Water Year Classification in SWRCB D-1641) is greater than 6 for the past two years and the current year. The indicator numbers are 1 for a critically dry year, 2 for a dry year, 3 for a below normal year, 4 for an above normal year, and 5 for a wet year.

Implementation of the inflow:export ratio under all conditions would allow a minimum pumping rate of 1,500 cfs to meet public health and safety needs of communities that solely rely upon water diverted from the CVP and SWP pumping plants.

2008 USFWS BO Fall X2 Criteria

The 2008 USFWS BO also includes an additional Delta salinity requirement in September through November in wet and above normal water years (Action 4). This requirement is frequently referred to as “Fall X2.” The action requires that in September and October, 2 Practical Salinity Units (psu) salinity is maintained at 74 kilometers (km) during wet years, and 81 km during above normal water years when the preceding year was wet or above normal based upon the Sacramento Basin 40-30-30 index in the SWRCB D-1641. In November of these years, there is no specific X2 requirement, however there is a requirement that all inflow into SWP and CVP upstream reservoirs be conveyed downstream to augment delta outflow to maintain X2 at the locations in September and October.

If storage increases during November under this action, the increased storage volume is to be released in December in addition to the requirements under SWRCB D-1641 net Delta Outflow Index.

3A.4.3.5 East Side Division

The East Side Division encompasses the Stanislaus and San Joaquin River Systems and includes New Melones Dam, Tulloch Dam, Goodwin Dam, and smaller Diversion Dams and associated Reservoirs.

3A.4.3.5.1 Factors Influencing New Melones Operations

The Stanislaus River originates in the western slopes of the Sierra Nevada and drains a watershed of approximately 900 square miles. The average unimpaired runoff in the basin is approximately 1.2 MAF per year; the median historical unimpaired runoff is 1.1 MAF per year. Snowmelt from March through early July contributes the largest portion of the flows in the Stanislaus River, with the highest runoff occurring in the months of April, May, and June. New Melones Reservoir is located approximately 60 miles upstream from the confluence of the Stanislaus River and the San Joaquin River.

Water Development Prior to Federal Actions

Agricultural water supply development in the Stanislaus River watershed began in the 1850s and has significantly altered the basin's hydrologic conditions. Prior to 1856, the San Joaquin Water Company constructed a diversion dam on the Stanislaus River immediately downstream of the present day location of Tulloch Dam and used the diversion dam to distribute water for irrigation and other uses in the Knights Ferry Area. Beginning in 1856, a series of water and power companies constructed several water supply and power facilities in the Stanislaus River watershed.

The San Joaquin Water Company was sold to the Tulloch family in the late 1800s, and in 1910, Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID) bought the Tulloch water rights and physical distribution system. In 1913, OID and SSJID jointly constructed Goodwin Diversion Dam, an 80-foot tall double concrete arch dam, to divert Stanislaus River water (up to 1,816.6 cfs daily) into their respective canals for distribution into their respective service areas for irrigation. Despite its height, Goodwin Diversion Dam is a re-operating reservoir, not a storage reservoir, because a full reservoir is needed to allow diversion to these canals.

To address their lack of storage, OID and SSJID joined with The Pacific Gas and Electric Company (PG&E) in 1925 to construct the Melones Dam and Powerhouse (110 TAF capacity) approximately 12.3 river miles upstream of the Goodwin Diversion Dam. Water released from Melones was diverted at Goodwin Diversion Dam for delivery into OID and SSJID's distribution systems.

In 1955, OID and SSJID agreed to construct three new facilities, including the Donnells Dam and Reservoir (64,500 TAF capacity) and Beardsley Dam and Reservoir (97.5 TAF capacity) upstream of Melones Dam, and the Tulloch Dam and Reservoir (54.663 TAF capacity), downstream of Melones Dam. Construction of the three facilities, collectively referred to as the Tri-Dam Project, was completed in 1957 and the facilities became operational in 1958. As part of the construction of the Tri-Dam project, Goodwin Diversion Dam was raised to create an afterbay to regulate discharge from Tulloch. From 1985–1990, the Calaveras County Water District constructed the North Fork Stanislaus Hydroelectric Project, which included the construction of New Spicer Reservoir (189 TAF capacity) in 1989. This was a joint development project by Northern California Power Agency (NCPA) and Calaveras County Water District. Calaveras County Water District is the licensee and NCPA is the project operator.

Twenty ungauged tributaries contribute flow to the lower portion of the Stanislaus River below Goodwin Dam. These streams provide intermittent flows, occurring primarily during the months of November through April. Agricultural return flows, as well as operational spills from irrigation canals receiving water from both the Stanislaus and Tuolumne Rivers, enter the lower portion of the Stanislaus River. In addition, a portion of the flow in the lower reach of the Stanislaus River originates from groundwater accretions. There are also approximately 48 TAF of annual riparian water rights in the Stanislaus River downstream of Goodwin Dam.

Federal Water Development

In the Flood Control Act of December 1944, Congress authorized construction of a dam to replace Melones Dam to help alleviate serious flooding problems along the Stanislaus and Lower San Joaquin Rivers. In the Flood Control Act of October 1962, Congress reauthorized the project, and expanded it to be a multipurpose facility to be built by USACE and operated by the Secretary of the Interior as the New Melones Unit of the Eastside Division of the CVP. Dam and reservoir construction began in 1966 and, after being halted from 1972 to 1974, was completed by USACE in 1978, with a storage capacity of 2.4 MAF.

In 1972, Reclamation applied for the assignment of two state-filed water rights and two new water rights for the New Melones Project. These applications were protested by several parties and mostly resolved through protest settlement agreements. In 1973, SWRCB Decision 1422 (D-1422) initially approved less than 600 TAF in storage for power, senior water rights, water quality, and fish and wildlife protection and enhancement, citing a lack of demonstrated demand and protection of upstream recreation as a reason not to grant consumptive use rights for new demands without further demonstration of a demand for this water.

To demonstrate the consumptive use demands, in 1980 Reclamation produced a Stanislaus River Water Allocation and an EIS for the proposed water allocation of the New Melones Unit. The documents describe preferred and alternative boundaries of the Stanislaus River Basin, the anticipated project yield for 2020 conditions, the current and anticipated future needs of such basin, the determination of an available “interim” supply until the full buildup of in-basin needs, and an anticipated “firm yield” once full in-basin demand was established. The ROD described that New Melones Reservoir would generate a water supply yield of 230 TAF in 2000, and 180 TAF in 2020; assuming maximum annual releases of 70 TAF for water quality and 98 TAF for downstream fishery. For the interim supply, 85 TAF would be available in the year 2000, diminishing to zero at full in-basin demand. For the firm supply, the Secretary determined that there would be 49 TAF available in 2020 after in-basin demands were met. In 1983, Reclamation entered into a long-term water service contract with Central San Joaquin Water Conservation District for 49 TAF of firm supply and an interim supply of 31 TAF, and a long-term water service contract totaling 75 TAF of interim water with Stockton East Water District (SEWD). Reclamation then successfully applied to have D-1422 amended to allow up to full storage for demonstrated power and consumptive use demands in the same year, and New Melones briefly filled to its capacity of 2.4 MAF for the first time.

In 1984, Reclamation applied for the assignment of the direct diversion portion of one of the state water right filings, to be able to serve contracts water at times when New Melones is filling. The application was again protested, with protests largely settled through protest settlement agreements. The direct diversion right was granted in D-1616 in 1988. D-1616 continued water quality requirements and included a new fish and wildlife protest settlement agreement. A later revision added a requirement to study downstream steelhead/trout needs.

In 1995 and in 2000, water rights decisions related to updates of the San Francisco Bay/Sacramento–San Joaquin River Delta Water Quality Control Plan (WQCP) added flow requirements at Vernalis and partial responsibility for interior Delta water quality to CVP water rights.

Flood Control

The New Melones Reservoir flood control operation is coordinated with the operation of Tulloch Reservoir. The flood control objective is to maintain flood flows at the Orange Blossom Bridge at less than 8,000 cfs. When possible, however, releases from Tulloch Dam are maintained at levels that would not result in long-term downstream flows in excess of 1,500 cfs because of the past reported potential for seepage in agricultural lands adjoining the river associated with flows above this level. Up to 450 TAF of the 2.4 MAF storage volume in New Melones Reservoir is dedicated for flood control and 10 TAF of Tulloch Reservoir storage is set aside for flood control. Based upon the flood control diagrams prepared by USACE, part or all of the dedicated flood control storage may be used for conservation storage (storing allocated, excess waters), depending on the time of year and the current flood hazard.

Current Water Rights Requirements for New Melones 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 CVPIA.

Terms and conditions of Reclamation's water rights define the limitations within which Reclamation can directly divert water or divert water to storage, after senior water rights and in-basin demands are met. Senior water rights are both current and future upstream water right holders (whose priority is reserved in

D-1422 and D-1616 and through protest settlement agreements with Tuolumne and Calaveras Counties), and current downstream water right holders and riparian rights (whose priorities are either senior to Reclamation or senior to appropriative rights in general, respectively). In-basin, instream demands include water quality and flow in the lower Stanislaus River and in part in the lower San Joaquin River and Delta (in that the Stanislaus River contributes to these systems). Downstream demands are first met, to the degree possible, by bypassing natural inflow through New Melones Reservoir. When natural flow is insufficient, stored water is released to meet demands specified either through calculated riparian demand, downstream instream objectives, or protest settlement agreements. Whenever possible, multiple demands are met with the same flow.

Senior Water Rights: Protest Settlement Agreements

Reclamation's application for assignment of state water right filings in the early 1970s was protested by future in-basin users, senior water rights holders, and the CDFW. To resolve the senior water rights' protest, Reclamation entered into a 1972 Agreement and Stipulation with OID, and SSJID. The 1972 Agreement and Stipulation specifies that it satisfies the yield for consumptive purposes of the OID and SSJID water rights on the Stanislaus River, through the provision of up to a maximum of 654 TAF per year of either natural inflow to New Melones Reservoir or water stored in New Melones for diversion at Goodwin Dam for direct use by OID and SSJID and for storage in Woodward Reservoir (36 TAF capacity).

In 1988, following a year of low inflow to New Melones Reservoir, the Agreement and Stipulation among Reclamation, OID, and SSJID was renegotiated, resulting in an agreement that depended less on actual inflow and more on Reclamation's storage in New Melones, in order to provide a more reliable, albeit slightly smaller maximum, supply. The 1988 agreement commits Reclamation to provide water in accordance with a formula based on inflow and storage of up to 600 TAF each year for diversion at Goodwin Dam by OID and SSJID to meet their demands. The 1988 Agreement and Stipulation created a "conservation account" in which the difference between the entitled quantity and the actual quantity diverted by OID and SSJID in a year may be carried over for use in subsequent years, depending on storage/flood control conditions in New Melones. This conservation account has a maximum volume of 200 TAF, and withdrawals are constrained by criteria in the agreement.

In-Basin Requirements: Fish and Wildlife in the Lower Stanislaus River

Based on a protest settlement agreement between Reclamation and CDFW, SWRCB D-1422 required Reclamation to bypass or release 98 TAF of water per year (69 TAF in critical years) through New Melones Reservoir to the Stanislaus River on a distribution pattern to be specified each year by CDFW for fish and wildlife purposes. Based on a second protest settlement agreement in 1987, SWRCB D-1616 as amended required increased releases from New Melones to enhance fishery resources for an interim period, during which habitat requirements were to be better defined and a study of Chinook Salmon fisheries on the Stanislaus River would be completed.

During the study period, releases for instream flows were to range from 98.3 to 302.1 TAF per year. The exact quantity to be released each year was to be determined based on a formulation involving storage, projected inflows, projected water supply, water quality demands, projected CVP contractor demands, and target carryover storage. Because of dry hydrologic conditions during the 1987 to 1992 drought period, the ability to provide increased releases was limited. USFWS published the results of a 1993 study, which recommended a minimum instream flow on the Stanislaus River of 155.7 TAF per year for spawning and rearing (Aceituno 1993).

The study period is near completion with all but one study (outlined in the 1987 agreement) completed at the time of this document. Once this study period is completed, Reclamation is required to present the SWRCB with a revised plan of operations that incorporates the findings from the studies. This new plan is explained below and will replace the former CDFW downstream release requirements.

In-Basin Requirements: Fish and Wildlife in the Lower San Joaquin River

SWRCB 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. These flows are summarized in Table 3A.8.

Table 3A.8 San Joaquin Base Flows-Vernalis

Water Year Class	February–June Flow (cfs)*
Critical	710–1,140
Dry	1,420–2,280
Below Normal	1,420–2,280
Above Normal	2,130–3,420
Wet	2,130–3,420

Note:
*The higher flow required when X2 is required to be at or west of Chipps Island.

In-Basin Requirements: Water Quality in the Lower Stanislaus River

Reclamation’s New Melones water rights require that water be bypassed through or released from New Melones Reservoir to maintain applicable dissolved oxygen (DO) standards to protect the salmon fishery in the Stanislaus River. The 2004 San Joaquin Basin 5C Plan (Central Valley Regional Water Quality Control Board) designates the lower Stanislaus River with cold water and spawning beneficial uses, which have a general water quality objective of no less than 7 mg/L DO. This objective is therefore applied through the water rights to the Stanislaus River near Ripon.

Although not part of the No Action Alternative, Reclamation is evaluating studies to support moving the DO compliance point upstream to Orange Blossom Bridge. The location would better correspond to steelhead rearing in the spring and summer months. If movement of the DO compliance point appears adequately protective, Reclamation would petition the SWRCB to modify New Melones water rights accordingly. The movement of the compliance point is considered in Alternative 3 in this EIS.

In-Basin Requirements: Water Quality in the Lower San Joaquin River

SWRCB D-1422 required Reclamation to operate New Melones to maintain average monthly levels of 500 parts per million (ppm) total dissolved solids (TDS) in the San Joaquin River at Vernalis as it enters the Delta. SWRCB D-1641 modified the water quality objectives at Vernalis to include the irrigation and non-irrigation season objectives contained in the 1995 WQCP: average monthly electric conductivity (EC) of 0.7 milliSiemens per centimeter (mS/cm) during the months of April through August and 1.0 mS/cm during the months of September through March.

1997 New Melones Interim Plan of Operations

In 1997, Reclamation developed the Interim Plan of Operations as a joint effort with USFWS and in conjunction with the Stanislaus River Basin Stakeholders (SRBS). The process of developing the plan began in 1995 with a goal to develop a long-term management plan with clear operating criteria, given a fundamental recognition by all parties that New Melones Reservoir water supplies are over-committed on a long-term basis, and consequently, unable to meet all the potential beneficial uses designated as purposes.

In 1996, the focus shifted to the development of an interim operations plan for 1997 and 1998. At an SRBS meeting on January 29, 1997, a final interim plan of operation was agreed to in concept. The Interim Plan of Operation (IPO) was transmitted to the SRBS on May 1, 1997. Although meant to be a short-term plan for non-low periods only, it continued to be the guiding operations criteria in effect for the annual planning to meet multiple beneficial uses from New Melones Reservoir storage. The plan limited released water based on the available water supply, known as the New Melones Index, as summarized in Tables 3A.9 and 3A.10.

Table 3A.9 Inflow/Storage Characterization for the New Melones IPO

Annual Water Supply Category	March–September Forecasted Inflow Plus End of February Storage (TAF)
Low	0–1,400
Medium-low	1,400–2,000
Medium	2,000–2,500
Medium-high	2,500–3,000
High	3,000–6,000

The IPO suggested available quantities for various categories of water supply based on storage and projected inflow, as summarized in Table 3A.10. The annual water categories are for in-stream fishery enhancement (1987 CDFW Agreement and CVPIA Section 3406(b)(2) management), SWRCB D-1641 San Joaquin River water quality requirements (Water Quality), SWRCB D-1641 Vernalis flow requirements (Bay-Delta), and use by CVP contractors.

Table 3A.10 New Melones Modified IPO Flow Objectives (in TAF)

Storage Plus Inflow		Fishery		Vernalis Water Quality		Bay-Delta		CVP Contractors	
From	To	From	To	From	To	From	To	From	To
1,400	2,000	98	125	70	80	0	0	0	0
2,000	2,500	125	345	80	175	0	0	0	59
2,500	3,000	345	467	175	250	75	75	90	90
3,000	6,000	467	467	250	250	75	75	90	90

Although SEWD/CSJWCD agreed to this plan for a 2-year period, they subsequently successfully litigated against Reclamation. As a consequence, Reclamation is now required to provide the full contract amount to the CVP contractors except during times of drought. This plan also assumed that the full responsibility of Vernalis objectives would fall to the Stanislaus River and New Melones Reservoir rather than be divided up among the other San Joaquin tributaries.

Water Temperatures

Water temperatures in the lower Stanislaus River are affected by many factors and operational tradeoffs. These include available cold water resources in New Melones reservoir, Goodwin release rates for fishery flow management, ambient air conditions, and residence time in Tulloch Reservoir, as affected by local irrigation demand.

CVPIA 3406 (b)(2) Operations on the Stanislaus River

2009 NMFS BO RPA flows described below are often accounted for dedication of (b)(2) water on the Stanislaus River below Goodwin Dam in addition to the CDFW requirements discussed previously in the East Side Division.

Implementation of 2009 National Marine Fisheries Service Biological Opinion

The 2009 NMFS BO RPA requires Reclamation to adaptively manage flows to meet minimum instream flow, ramping flow, pulse flow, floodplain inundation, and geomorphic and function flow patterns, through the following actions.

- Minimum base flows to optimize available steelhead habitat for adult migration, spawning, and juvenile rearing by water year type, as measured downstream of Goodwin Dam, as specified in Appendix 2-E of the 2009 NMFS BO RPA.

- Fall pulse flows to improve instream conditions.
- Winter instability flows to simulate natural variability in the winter hydrograph and to enhance access to varied rearing habitats.
- Channel forming and maintenance flows in the 3,000 to 5,000 cfs range in above normal and wet years to maintain spawning and rearing habitat quality after March 1 to protect incubating eggs and to provide outmigration flow cues and late spring flows.
- Outmigration flow cues to enhance likelihood of anadromy.
- Late spring flows for conveyance and maintenance of downstream migratory habitat quality in the lowest reaches and into the Delta.

Flows also are released to meet the following temperature requirements (see 2009 NMFS BO RPA for exception criteria) to protect steelhead.

- October 1 (or initiation of fall pulse flow) through December 31: 56° F at Orange Blossom Bridge
- January 1 through May 31: 52° F at Knights Ferry and below 55° F at Orange Blossom Bridge
- June 1 through September 30: 65° F at Orange Blossom Bridge

Reclamation also is required to evaluate an approach to operate New Melones Reservoir flow releases to achieve floodplain inundation flows and improved freshwater migratory habitat for steelhead.

3A.4.3.6 San Felipe Division

Construction of the San Felipe Division of the CVP was authorized in 1967. The San Felipe Division initiated operation in 1987 and provides a water supply in the Santa Clara Valley in Santa Clara County and the north portion of San Benito County.

The San Felipe Division delivers both irrigation and M&I water supplies. Water is delivered within the service areas not only by direct diversion from distribution systems, but also through instream and offstream groundwater recharge operations conducted by local water users. A primary purpose of the San Felipe Division in Santa Clara County is to provide supplemental water to help prevent land surface subsidence in the Santa Clara Valley. The majority of the water supplied to Santa Clara County is used for M&I purposes, either pumped from the groundwater basin or delivered from treatment plants. In San Benito County, a distribution system was constructed to provide water to about 19,700 arable acres.

The San Felipe Division facilities that serve Santa Clara and San Benito Counties include 54 miles of tunnels and conduits, two large pumping plants, and one reservoir (San Justo Reservoir in San Benito County). CVP water is conveyed from the Delta through the DMC, O'Neill Forebay, and San Luis Reservoir. A maximum of 480 cfs is lifted from San Luis Reservoir by the Pacheco Pumping Plant's twelve 2,000-horsepower pumps to a height varying from 85 to 300 feet into a regulating tank. Water flows from the regulating tank by gravity through the 5.2-mile long Pacheco Tunnel and 7.9-mile long Pacheco Conduit. The Pacheco Conduit terminates at a bifurcation structure, where the water is conveyed into Santa Clara and San Benito Counties.

In Santa Clara County, water flows from the bifurcation structure into the 1-mile long Santa Clara Tunnel. Water flows by gravity from the tunnel into a 20-mile long Santa Clara Conduit to the Coyote Pumping Plant for distribution of CVP water within Santa Clara County. In San Benito County, water flows from the bifurcation structure to the 19.1-mile long Hollister Conduit with a maximum capacity of approximately 93 cfs, terminating at the San Justo Reservoir.

Santa Clara Valley Water District operates the San Felipe Division facilities except for the Hollister Conduit and San Justo Reservoir, which are operated by San Benito County Water District under operating agreements with Reclamation.

The 9.906 TAF-capacity San Justo Reservoir is located about 3 miles southwest of the city of Hollister. The San Justo Dam is an earthfill structure 141 feet high with a crest length of 722 feet. This facility includes a dike structure 66 feet high with a crest length of 918 feet. This reservoir regulates San Benito County Water District's CVP water supplies, allows pressure deliveries to some of the agricultural lands in the service area, and provides storage for peaking of agricultural water.

3A.4.3.7 Friant Division

As described previously, Friant Division operations are not analyzed in this EIS. The information included below provides an understanding of how the Friant Division operations affect CVP and SWP operations.

Historically, this division was hydrologically disconnected from the rest of the CVP except in very wet years and was not integrated into the CVP Operations Criteria and Plan (OCAP). Friant Dam is located on the San Joaquin River, 25 miles northeast of Fresno where the San Joaquin River exits the Sierra Nevada foothills and enters the Central Valley. The drainage basin is 1,676 square miles with an average annual runoff of 1,774 TAF. Completed in 1942, the dam is a concrete gravity structure, 319 feet high, with a crest length of 3,488 feet. Although the dam was completed in 1942, it was not placed into full operation until 1951. The reservoir, Millerton Lake, first stored water on February 21, 1944. It has a total capacity of 524 TAF, a surface area of 4,900 acres, and is approximately 15 miles long. The lake's 45 miles of shoreline varies from gentle slopes near the dam to steep canyon walls farther inland. The reservoir provides boating, fishing, picnicking, and swimming.

The dam provides flood control on the San Joaquin River, provides downstream releases to meet senior water rights requirements above Mendota Pool, and provides conservation storage as well as diversion into Madera and Friant-Kern

Canals. Water is delivered to 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 water right holding located about 40 miles downstream of Friant Dam near Gravelly Ford. Before October 1, 2009, and the initiation of Interim Flows for the San Joaquin River Restoration Program (SJRRP), the Friant Division was generally hydrologically disconnected from the Delta. The San Joaquin River was dewatered in two reaches between Friant Dam and the confluence of the Merced River, except under flood conditions.

Flood control storage space in Millerton Lake is based on a complex formula, which considers upstream storage in the Southern California Edison reservoirs, forecasted snowmelt, and time of year. Flood management releases occur approximately every 3 years and are managed based on downstream channel design flow of approximately 8,000 cfs, to the extent possible. Under flood conditions, water is diverted into two bypass channels that carry flood flows to near the confluence of the Merced River. Flows staying in the mainstem are diverted into the Mendota Pool, and may be used to meet irrigation demands there.

3A.4.3.8 San Joaquin River Restoration Program

In 2006, parties to *NRDC, et al., v. Rodgers, et al.*, executed a stipulation of settlement that called for a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of the Merced River and a self-sustaining Chinook Salmon fishery while reducing or avoiding adverse water supply impacts. The SJRRP implements the Settlement consistent with the San Joaquin River Restoration Settlement Act in Public Law 111-11. Consultation with NMFS and USFWS under the ESA on implementation of the Settlement has occurred as part of the SJRRP and would continue to occur to evaluate the effects of implementation of settlement actions on listed species. USFWS issued a Programmatic BO (PBO) for the implementation of the SJRRP on August 21, 2012 and NMFS issued a PBO on September 18, 2012. The programmatic Biological Opinions include project-level consultation for SJRRP flow releases of up to 1,660 cfs from Friant Dam down the San Joaquin River. Programmatic ESA coverage is provided in both the USFWS and NMFS PBOs for flow releases from Friant Dam up to 4,500 cfs and all physical restoration and water management actions listed in the Settlement. Future flow increases from Friant Dam in excess of 1,660 cfs for the SJRRP would need to be coordinated and consulted on with the appropriate regulatory agencies to ensure ESA compliance.

The Settlement-required flow targets for releases from Friant Dam include six water year types for releases depending upon available water supply as measures of inflow to Millerton Lake. The releases from Friant Dam include the flexibility to reshape and retime releases forwards or backwards by 4 weeks during the spring and fall pulse periods. Flood flows may potentially occur and meet or exceed the Settlement flow targets. If flood flows meet the Settlement flow targets, then Reclamation would not release additional water. The San Joaquin River channel downstream of Friant Dam currently lacks the capacity to convey flows to the Merced River and releases are limited accordingly. Reclamation has initiated planning and environmental compliance activities to improve river channel conveyance and allow for the full release of SJRRP flows. Diversions and infiltration losses reduce the amount of Settlement flows reaching the San Joaquin and Merced River confluence. Flows that reach the Merced confluence are assumed to continue to the Delta.

3A.5 State Water Project

DWR holds contracts with 29 public agencies in Northern, Central, and Southern California for water supplies from the SWP. Water stored in the Lake Oroville facilities, along with excess water available in the Delta, is captured in the Delta and conveyed through several facilities to SWP water contractors.

The SWP is operated to provide flood control and water for agricultural, M&I, recreational, and environmental purposes. Water is conserved in Lake Oroville and released to serve three Feather River area water contractors and two water contractors served from the NBA, and 24 SWP contractors in the SWP service areas in the south San Francisco Bay Area, San Joaquin Valley, and Southern California. In addition to pumping water released from Lake Oroville, the Banks Pumping Plant diverts natural inflow available in the Delta.

3A.5.1 Project Management Objectives

The SWP is managed to maximize the capture of usable Delta supplies released from Lake Oroville storage as well as surplus supplies available in the Delta. The maximum daily pumping rate at Banks Pumping Plant is controlled by a combination of SWRCB D-1641, the requirements contained in the BOs, the adaptive management process, and permits issued by USACE that regulate the rate of diversion of water into CCF for pumping at Banks Pumping 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. 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. Additionally, the SWP has a permit to export an additional 500 cfs between July 1 and September 30 based upon on Project losses for same water year to protect listed fish.

The CCF radial gates are closed during critical periods of the ebb/flood tidal cycle to protect water levels relied upon by local agricultural water diverters in the south Delta area.

Banks Pumping Plant is operated to minimize the impact on power loads on the California electrical grid to the extent practical, using CCF as a holding reservoir to allow that flexibility. Generally more pump units are operated during off-peak periods and fewer during peak periods. Because the installed capacity of the pumping plant is 10,300 cfs, the plant can be operated to reduce power grid impacts by running all available pumps at night and fewer during the higher energy-demand hours, even when CCF is diverting the maximum daily permitted rate.

There are some water years (primarily wetter years) when excess conditions exist for a sufficient portion of the year such that enough water can be diverted from the Delta to fill the SWP south of Delta reservoirs and meet all SWP Contractor demands without maximizing Banks Pumping Plant pumping capability every day of the year. However, CCF operations are more often supply limited. Under these conditions, CCF is typically operated to maximize the water captured, subject to the limitations of water quality, Delta standards, and a host of other variables, to meet SWP demands and fill storage south of the Delta.

San Luis Reservoir is an offstream storage facility located along the California Aqueduct downstream of Banks Pumping Plant. San Luis Reservoir is used by both Projects to augment deliveries to their contractors and water contractors during periods when Delta pumping is insufficient to meet downstream demands.

DWR stores water in San Luis Reservoir when Banks Pumping Plant pumping exceeds SWP Contractor demands, and releases water to the California Aqueduct system when Banks Pumping Plant pumping is insufficient to meet demands. The reservoir allows the SWP to meet peak-season demands that supplies available at Banks Pumping Plant.

San Luis Reservoir is generally filled in the spring or even earlier in some years. When all SWP demands are met, including diversion to storage facilities south of the Delta, and Table A demands, and the Delta is in excess conditions, DWR would use available excess pumping capacity at Banks Pumping Plant to make excess water supplies, called Article 21 water under the long-term SWP water supply contracts, available to the SWP Contractors.

Article 21 describes the conditions under which water can be delivered in addition to the amounts specified in Table A of the contracts.

Article 21 provides, in part: “Each year from water sources available to the project, the State shall make available and allocate interruptible water to contactors. Allocations of interruptible water in any one year may not be carried over for delivery in a subsequent year, nor shall the delivery of water in any year impact a contractor’s approved deliveries of annual [Table A water] or the contractor’s allocation of water for the next year. Deliveries of interruptible water in excess of a contractor’s annual [Table A water] may be made if the deliveries do not adversely affect the State’s delivery of annual [Table A water] to other contractors or adversely affect project operations…”

Unlike Table A water, which is an allocated annual SWP supply made available for scheduled delivery throughout the year, Article 21 water is an interruptible water supply made available only when certain conditions exist. However, while not a dependable supply, Article 21 water is an important part of the total SWP supplies provided to the SWP contractors. As with all SWP water, Article 21 water is pumped consistent with the existing terms and conditions of SWP water rights permits, and is pumped from the Delta under the same environmental, regulatory, and operational constraints that apply to all SWP operations.

When Article 21 water is only available as long as the required conditions exist as determined by DWR. Since Article 21 deliveries are in addition to scheduled Table A deliveries, this supply is delivered to SWP contractors that can, on relatively short notice, put it to beneficial use. SWP contractors have used Article 21 water to meet needs such as additional short-term irrigation demands, replenishment of local groundwater basins, short-term substitution of local supplies and storage in local surface reservoirs for later use by the requesting SWP contractor, all of which provide SWP contractors with opportunities for better water management through more efficient coordination with their local water supplies. Allocated Article 21 water to a SWP contractor cannot be transferred.

Article 21 water is typically offered to SWP contractors on a short-term (daily or weekly) basis when all of the following conditions exist: the SWP share of San Luis Reservoir is physically full, or projected to be physically full; other SWP reservoirs south of the Delta are at their storage targets or the SWP conveyance capacity to fill these reservoirs is maximized; the Delta is in excess condition; current Table A and SWP operational demands are being fully met; and Banks Pumping Plant has export capacity beyond that which is needed to meet all Table A and other SWP operational demands. The increment of available unused Banks Pumping Plant capacity is offered as the Article 21 delivery capacity. SWP contractors then indicate their desired rate of delivery of Article 21 water. DWR allocates the available Article 21 water in proportion to the requesting SWP contractors annual Table A amounts if requests exceed the amount offered. Deliveries can be discontinued at any time when SWP operations change. In the modeling for Article 21, deliveries are only made in months when the SWP share of San Luis Reservoir is full. In actual operations, Article 21 may be offered a short period in advance of actual filling.

By April or May, demands from both agricultural and M&I SWP Contractors usually exceed the pumping rate at Banks, and releases from San Luis Reservoir to the SWP facilities are needed to supplement the Delta pumping at Banks Pumping Plant to meet SWP contractor demands for Table A water

During the summer period, DWR is also releasing water from Lake Oroville to supplement Delta inflow and allow Banks Pumping Plant to export the stored Lake Oroville water to help meet demand. These releases are scheduled to maximize export capability and gain maximum benefit from the stored water while meeting fish flow requirements, temperature requirements, Delta water quality, and all other applicable standards in the Feather River and the Delta.

DWR must balance storage between Lake Oroville and San Luis Reservoirs carefully to meet flood control requirements, Delta water quality and flow requirements, and optimize the supplies to its SWP water contractors consistent with all environmental constraints. Lake Oroville may be operated to move water through the Delta to San Luis Reservoir via Banks Pumping Plant under different schedules depending on Delta conditions, reservoir storage volumes, and storage targets. Predicting those operational differences is difficult, as the decisions reflect operator judgment based on many real-time factors as to when to move water from Lake Oroville to San Luis Reservoir.

The SWP share of San Luis Reservoir is drawn down to meet SWP contractor demands and usually reaches its low point in late August or early September. From September through early October, demand for deliveries usually drops below the capacity of Banks Pumping Plant to divert from the Delta, and DWR can begin diverting water to San Luis Reservoir to begin refilling the reservoir. Unregulated flow reaching the Delta typically continues to decline throughout the fall until the first major storms occur, typically last fall or winter. Once the fall and winter storms increase runoff into the Delta, Banks Pumping Plant can increase its pumping rate and, in all but the driest years, eventually fill the state portion of San Luis Reservoir before April of the following year.

3A.5.2 Water Service Contracts, Allocations, and Deliveries

The following discussion presents DWR’s practices for determining the overall amount of Table A water that can be allocated annually and the allocation process itself. Many variables control how much water the SWP can capture and provide to its SWP water contractors for beneficial use.

The allocations are developed from analysis of a broad range of variables that include the following.

- Volume of water stored in Lake Oroville.
- Flood operation restrictions at Lake Oroville.
- Volume of water stored in Lake Oroville.
- End-of- year target for water stored in Lake Oroville.
- Volume of water stored in San Luis Reservoir.
- End-of-month targets for water stored in San Luis Reservoir.
- Snow survey results.
- Forecasted runoff.
- Feather River flow requirements for fish habitat.
- Feather River service area delivery obligations.
- Anticipated Feather River downstream of Lake Oroville.
- Anticipated depletions in the Sacramento River basin.

- Anticipated Delta flow and water quality requirements.
- Precipitation and streamflow conditions since the last snow surveys and forecasts.
- SWP water contract delivery requests and delivery patterns.

From these and other variables, DWR staff estimates the SWP water supply available to meet Table A water deliveries SWP contractors and other SWP needs. The initial allocation announcement by the Director of DWR is made by December 1 of each year. The allocation of water is made with a conservative assumption of future precipitation, and generally in graduated steps, carefully avoiding over-allocating water before the hydrologic conditions are well defined for the year. The allocation of the available SWP supply to the SWP contractors is based on the SWP contractors' initial requests for Table A water. As the year proceeds and more information is available on the hydrologic conditions, the SWP contractors may revise their initial Table A water requests considering their actual local supplies.

Other influences affect the accuracy of estimates of annual demand for Table A water and the resulting allocation percentage. One factor is the contractual ability of SWP contractors to carry over allocated but undelivered Table A from one year to the next if capacity is available in San Luis Reservoir. SWP contractors would generally use their carryover supplies early in the calendar year if it appears that the capacity would be needed for SWP operations. Carryover supplies left in San Luis Reservoir by SWP contractors may result in higher storage levels in San Luis Reservoir at December 31 than would have occurred in the absence of carryover. The carryover program, when available, provides an opportunity for the SWP contractors to temporarily store allocated Table A water outside their service area. As Project pumping for SWP operations fills the SWP share of San Luis Reservoir, the SWP contractors are notified to take or lose their carryover supplies. If the SWP contractors are unable to take delivery of any of their carryover water, the carryover water converts to Project water as San Luis Reservoir fills. Article 21 water may become\s available for delivery to SWP Contractors if the demand for SWP operations are met.

The total water exported from the Delta and delivered by the SWP in any year is a function of a number of variables beyond those listed above that help determine Table A allocations.

The total amount of Article 21 water delivered does not provide a measure of the change in Delta diversions attributable to Article 21 deliveries. Instead, one must analyze the total exports from the Delta.

3A.5.2.1 Monterey Agreement

In 1994, DWR and certain representatives of the SWP water contractors negotiated a set of principles designed to modify the long-term SWP water supply contracts. This set of principles, which came to be known as the Monterey Agreement, helped to settle long-term water allocation disputes and to establish new water management strategies for the SWP. An Environmental Impact Report (EIR) was prepared on the Monterey Agreement and certified in 1995. Following certification of the EIR, 27 of the 29 SWP water contractors incorporated most of the principles into a contract amendment which is known as the Monterey Amendment. The Monterey Amendment was implemented in 1996. The 1995 EIR was subject to judicial challenge. In 2000, the EIR was found to be inadequate. DWR, the SWP water contractors, and the plaintiffs entered into a Settlement Agreement in 2003. As a result of the Settlement Agreement, the Court issued an order in June 2003 that the EIR be decertified and that DWR prepare a new EIR. The order also required DWR to continue to operate the SWP in accordance with the Monterey Amendment as it had done since 1996 and in accordance with the Settlement Agreement. A draft of the new EIR was released in October 2007. After incorporating over 600 comments, the final EIR was filed with the State Clearinghouse on May 5, 2010. After considering the final EIR and the alternatives, DWR approved the proposed project of continuing to operate under the existing Monterey Amendment and Settlement Agreement. The EIR, and the validity of the Monterey Amendment, was challenged in June 2010 and the issues raised in the complaints are currently being litigated.

3A.5.3 Project Facilities

3A.5.3.1 Oroville Field Division

Oroville Dam and related facilities comprise a multipurpose project. The reservoir stores winter and spring runoff, which is released into the Feather River to meet the Project's needs, Delta water quality, and fish and wildlife protection. It also provides p electrical generation, including pumpback operations, 750 TAF of flood control storage, and recreation opportunities.

The Oroville Project facilities include two small embankments, Bidwell Canyon and Parish Camp Saddle Dams and Oroville Dam which forms Lake Oroville. The lake has a surface area of 15,810 acres, a 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.

A maximum of 17,400 cfs can be released through the Edward Hyatt Power Plant, located underground near the left abutment of Oroville Dam. Three of the six units are conventional generators driven by vertical-shaft, Francis-type turbines. The other three are motor-generators coupled to Francis-type, reversible pump turbines. The latter units allow pumped storage operations. The intake structure has an overflow type shutter system that determines the level from which water is drawn.

Approximately 4 miles downstream of Oroville Dam and Edward Hyatt Power Plant is the Thermalito Diversion Dam. 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 Hyatt 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. Water released to generate power in excess of local and downstream requirements is conserved in storage and, at times, pumped back through both power plants into Lake Oroville during off-peak hours. Energy price and availability are the two main factors that determine if a pumpback operation is economical. Pumpback operation typically occur during off-peak hours when energy prices are lower. 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.

Five agricultural districts divert water directly from the Thermalito Afterbay under the terms of water right settlement agreement with DWR. The diversion facilities replace the historic river diversion used by the local districts prior to the construction of the Thermalito Complex. The total capacity of afterbay diversions during peak demands is 4,050 cfs.

The Feather River Fish Hatchery (FRFH), mitigation for the construction of Oroville Dam, rears Chinook Salmon and steelhead and is operated by CDFW. The NMFS FERC BO is being developed at this time, and is considered to be implemented under all of the alternatives and the Second Basis of Comparison in this EIS. Both indirect and direct take resulting from FRFH operations will be authorized through Section 4(d) of the Endangered Species Act, in the form of NMFS-approved Hatchery and Genetic Management Plans (HGMPs). DWR and CDFW are jointly preparing HGMPs for the spring and fall-run Chinook Salmon and steelhead production programs at the Feather River Fish Hatchery.

3A.5.3.1.1 Current Operations—Minimum Flows and Temperature Requirements

Operation of Lake Oroville would continue under existing criteria until DWR receives the new FERC license. The temperature of the water released from Oroville Dam is designed to meet the temperature requirements for the FRFH, under the August 1983 CDFW Agreement titled Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife, and for Robinson Riffle while also conserving the coldwater pool in Lake Oroville. Current operation indicates that water temperatures at Robinson Riffle are almost always met when the hatchery objectives are met.

Water is withdrawn from Lake Oroville at depths that provide sufficiently cold water to meet the FRFH and Robinson Riffle temperature targets. The reservoir depth from which water is released initially determines the river temperatures, but atmospheric conditions, which fluctuate from day to day, influence downstream river temperatures. Altering the reservoir release depth requires installation or removal of shutters at the intake structures. Shutters are held at the minimum depth necessary to release water that meets the FRFH and Robinson Riffle criteria. In order to conserve the coldwater pool during dry years, DWR strives to meet the Robinson Riffle temperatures by increasing releases to the low flow channel (LFC) rather than releasing colder water.

Additionally, DWR maintains a minimum flow of 600 cfs within the Feather River LFC as required by the 1983 CDFW Agreement (except during flood events when 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 (HFC), 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 percent of normal. When the April-to-July unimpaired runoff is less than 55 percent of normal, the minimum flow requirements are 1,000 cfs from March to September and 1,200 cfs from October to February (Table 3A.11). The 1983 CDFW Agreement also 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 percent.

In addition, according to the 1983 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.

Table 3A.11 Combined Minimum Instream Flow Requirements in the Feather River below Thermalito Afterbay Outlet When Lake Oroville Elevation is Projected to be Greater vs. Less than 733 Feet in the Current Water Year

Conditions	Period	Minimum Flows (cfs)
When Lake Oroville Elevation is Projected to be Greater Than 733 feet and the Preceding Water Year's April–July Water Conditions are > 55 percent of Normal[a]	October–February	1,700
	March	1,700
	April–September	1,000
When Lake Oroville Elevation is Projected to be Greater Than 733 feet and the Preceding Water Year's April–July Water Conditions are < 55 percent of Normal[a]	October–February	1,200
	March	1,000
	April–September	1,000
When Lake Oroville Elevation is Projected to be Less Than 733 feet in the Current Water Year[b]	October–February	900 < flow < 1,200
	March	750 < flow < 1,000
	April–September	750 < flow < 1,000

Notes:

a. Normal is defined as the Mean April–July Unimpaired Runoff of the Feather River near Oroville of 1,942 TAF (1911–1960).

b. In accordance with FERC's Order Amending License dated September 18, 1984, Article 53 was amended to provide a third tier of minimum flow requirements defined as follows: If the April 1 runoff forecast in a given water year indicates that, under normal operation of Project 2100, the reservoir level would be drawn to elevation 733 feet (approximately 1,500 TAF), releases for fish life in the above schedule may suffer monthly deficiencies in the same proportion as the respective monthly deficiencies imposed upon deliveries of water for agricultural use from the Project. However, in no case shall the fish water releases in the above schedule be reduced by more than 25 percent.

Current operations of the Oroville Facilities are governed by water temperature requirements at two locations: the FRFH and in the LFC at Robinson Riffle. DWR has taken various temperature management actions to achieve the water temperature requirements, including curtailing pumpback operations, removing shutters at the intakes of the Hyatt Pumping-Generating Plant, releasing flow through the river valves (for FRFH only), and redirecting flows at the Thermalito Diversion Dam to the LFC (for Robinson Riffle only).

To date, the river valves have been used infrequently. Prior to 1992, they were used twice: first in 1967 during the initial construction of the dam, and second in 1977 during the drought of record. Since 1992, the river valves have only been used for temperature control: in 2001, 2002, and 2008. DWR plans to manage its cold water storage and its intake shutters in order to meet its temperature obligations. Other than local diversions, outflow from the Oroville Project is to the Feather River at the LFC and Thermalito Afterbay. Combined outflow typically varies from spring seasonal highs averaging 8,000 cfs to between 1,200 cfs and 2,400 cfs in the fall. The average annual outflow from the Project is in excess of 3 MAF to support downstream water supply, environmental, and water quality needs.

Table 3A.12 shows an example of releases from Oroville Project Facilities for various downstream uses during dry hydrologic conditions (Water Years [WYs] 2008 and 2009). As a practical matter, water supply is released for exports only after all other Project obligations are met, including Delta requirements and deliveries to local settlement contractors. A portion of the water released for minimum instream requirements and may be exported in the Delta for other water supply purposes.

Table 3A.12 Historical Records of Releases from the Oroville Facilities in 2008 and 2009, by Downstream Use

Downstream Use	Water Year 2008 Release		Water Year 2009 Release	
	Volume (TAF)	Percentage	Volume (TAF)	Percentage
Feather River Service Area	1,039	47	1,077	40
Instream and Delta Requirements	1,043	47	1,140	42
Flood Management	0	0	0	0
Support of Exports	130	6	506	19
Total	**2,212**	**100**	**2,723**	**100**

Source: DWR SWP Operations Control Office.

3A.5.3.1.2 Low Flow Channel

The 1983 Agreement specifies that DWR release a minimum of 600 cfs into the Feather River from the Thermalito Diversion Dam for fishery purposes. This is the total volume of flows from the diversion dam outlet, diversion dam power plant, and FRFH pipeline.

3A.5.3.1.3 High Flow Channel

Based on the 1983 Agreement, Table 3A.13 summarizes the minimum flow requirement for the HFC when releases would not draw Lake Oroville below elevation 733 feet above mean sea level (ft msl).

Table 3A.13 High Flow Channel Minimum Flow Requirements as Measured Downstream from the Thermalito Afterbay Outlet

Forecasted April-through-July Unimpaired Runoff (Percent of Normal*)	Minimum Flow in HFC (cfs) October through February	Minimum Flow in HFC (cfs) March	Minimum Flow in HFC (cfs) April through September
55 percent or greater	1,700	1,700	1,000
Less than 55 percent	1,200	1,000	1,000

Source: 1983 Agreement.

Notes:
* The preceding water year's unimpaired runoff shall be reported in Licensee's Bulletin 120, Water Conditions in California-Fall Report. The term "normal" is defined as the April-through-July mean unimpaired runoff near Oroville of 1,942 TAF in the period of 1911 through 1960.

HFC = High Flow Channel.

If the April 1 forecast in a given water year indicates that Lake Oroville would be drawn down to elevation 733 feet mean sea level, minimum flows in the HFC may be diminished on a monthly average basis, in the same proportion as the respective monthly deficiencies imposed on deliveries for agricultural use of the Project. However, in no case shall the minimum flow releases be reduced by more than 25 percent. If between October 15 and November 30, the highest total 1-hour flow exceeds 2,500 cfs, DWR shall maintain a minimum flow within 500 cfs of that peak flow, unless such flows are caused by flood flows, or an inadvertent equipment failure or malfunction.

3A.5.3.2 Temperature Requirements

3A.5.3.2.1 Low Flow Channel

NMFS has established a water temperature requirement for steelhead trout and spring-run Chinook Salmon at Feather River RM 61.6 (Robinson Riffle in the LFC) from June 1 through September 30. The water temperature should be maintained at less than or equal to 65°F on a daily average basis.

3A.5.3.2.2 High Flow Channel

While no numeric temperature requirement currently exists for the HFC, the 1983 Agreement requires DWR to provide suitable Feather River water temperatures for fall-run salmon not later than September 15, and to provide for suitable water temperatures below the Thermalito Afterbay Outlet for shad, striped bass, and other warm water fish between May 1 and September 15.

Current FRFH intake water temperature, as required by the 1983 CDFW and DWR Agreement and the FERC license are in Table 3A.14.

Table 3A.14 Feather River Fish Hatchery Temperature Requirements

Period	Temperature (°F) (±4°F Allowed)
April 1 – November 30	
April 1–May 15	51
May 16–May 31	55
June 1–June 15	56
June 16–August 15	60
August 16–August 31	58
September 1–September 30	52
October 1–November 30	51
December 1–March 31	No greater than 55

3A.5.3.3 Flood Control

Flood control operations at Oroville Dam are conducted in coordination with DWR's Flood Operations Center and in accordance with the requirements set forth by USACE. The Federal Government shared the expense of Oroville Dam, which provides up to 750 TAF of flood control space. The spillway is located on the right abutment of the dam and has two separate elements: a controlled gated outlet and an emergency uncontrolled spillway. The gated control structure releases water to a concrete-lined chute that extends to the river. The uncontrolled emergency spill flows over natural terrain.

3A.5.3.4 Feather River Ramping Rate Requirements

Maximum allowable ramp-down release requirements are intended to prevent rapid reductions in water levels that could potentially cause redd 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 3A.15.

Table 3A.15 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.

3A.5.3.4.1 Federal Energy Regulatory Commission Relicensing of the Oroville Project

Until FERC issues the new license for the Oroville Project, DWR will not significantly change the operations of the facilities. When the FERC license is issued, it is assumed that the future flows will remain the same downstream of Thermalito Afterbay Outlet.

The original FERC license to operate the Oroville Project expired in January 2007. Since then, annual licenses have been issued, with DWR operating to the existing FERC license. FERC continues to issue an annual license until it is prepared to issue the new 50-year license. To prepare for the expiration of the FERC license, DWR began working on the relicensing process in 2001. As part of the process, DWR entered into an SA, signed in 2006, with state, federal, and local agencies, SWP water contractors, non-governmental organizations, Tribal governments, and others to implement improvements within the FERC boundary. The FERC boundary includes all of the Oroville Project facilities, extends upstream into the tributaries of Lake Oroville, includes portions of the LFC on the lower Feather River and downstream of the Thermalito Afterbay Outlet into the HFC. In addition to the SA, a Habitat Expansion Agreement was negotiated to address the fish passage issue over Oroville Dam and NMFS and USFWS's Section 18 Authority under the Federal Power Act.

FERC prepared a Final EIS for the Oroville FERC re-licensing and completed it in 2007. A Final EIR was prepared by DWR and completed in 2008. A draft BO was prepared by NMFS in 2009 but is not yet final. SWRCB issued the Clean Water Act Section 401 Certification (401 Certification) for the project in 2010. The new FERC license has not been adopted, but is anticipated to include the FERC license terms and conditions, the 401 Certification, and the terms and conditions therein; DWR will also comply with the requirements in the NMFS BO.

The new FERC license may include most if not all of the commitments from the SA. The SA does not change the flows in the HFC although there would be a proposed increase in minimum flows in the LFC. The SA includes habitat restoration actions such as side-channel construction, structural habitat improvement such as boulders and large woody debris, spawning gravel augmentation, a fish counting weir, riparian vegetation and floodplain restoration, and facility modifications to improve coldwater temperatures in the low and high flow channels. The SA, EIR, and the FERC Biological Assessment provide substantial detail on the SA restoration actions in the Lower Feather River.

3A.5.3.4.2 Minimum Flows in the Low Flow and High Flow Channels

The SA requires a minimum flow of 700 cfs to be released into the LFC. The minimum flow is 800 cfs from September 9 to March 31 of each year to accommodate spawning of anadromous fish, unless the NMFS, USFWS, CDFW, and SWRCB provide a written notice that a lower flow (between 700 cfs and 800 cfs) substantially meets the needs of anadromous fish. If DWR receives such a notice, it may operate consistent with the revised minimum flow. HFC flows would remain the same as the existing license, consistent with the 1983 DWR and CDFW Operating Agreement to continue to protect Chinook Salmon from redd dewatering (A108.2 of the SA [Appendix C]).

3A.5.3.4.3 Water Temperatures for the Feather River Fish Hatchery

When the FERC license is issued, DWR would use the temperatures in Table 3A.16 as targets, and would seek to achieve them through the use of operational measures described below.

Table 3A.16 Maximum Mean Daily Temperatures

Period	Maximum Mean Daily Temperature (°F)
September 1–September 30	56
October 1–May 31	55
June 1–August 31	60

The maximum mean daily temperatures are calculated by adding the hourly temperatures achieved each day and dividing by 24. DWR would strive to meet maximum mean daily temperatures through operational changes including but not limited to (1) curtailing pump-back operation; (2) removing shutters on Hyatt intake; and (3) altering river valve refurbishment. DWR would consider the use of the river valve up to a maximum of 1500 cfs; however these flows need not exceed the actual flows in the HFC, and should not be less than those specified in HFC minimum flows described above, which would not change with the new FERC license. During this interim period, DWR would not be in violation if the maximum mean daily temperatures are not achieved through operational changes.

Prior to FERC license implementation, DWR agreed to begin the necessary studies for the refurbishment or replacement of the river valve. On October 31, 2006, DWR submitted to specific agencies a Reconnaissance Study of Facilities Modification to address temperature habitat needs for anadromous fisheries in the LFC and the HFC. Under the provisions of SA Appendix B Section B108(a), DWR has begun a study to evaluate whether to refurbish or replace the river valve that may at times be used to provide cold water for the FRFH.

Upon completion of facilities modification(s) as provided in A108, and no later than the end of year ten following license issuance, the temperatures would become requirements, and DWR would not exceed the maximum mean daily temperatures for the remainder of the License term, except in Conference Years as referenced in A107.2(d).

During the term of the FERC license, DWR would not exceed the hatchery water temperatures in Table 3A.17. There would be no minimum temperature requirement except for the period of April 1 through May 31, during which the temperatures would not fall below 51°F.

Table 3A.17 Hatchery Water Temperatures

Period	Maximum Hatchery Water Temperature (°F)
September 1–September 30	56
October 1–November 30	55
December 1–March 31	55
April 1–May 15	55
May 16–May 31	59
June 1–June 15	60
June 16–August 15	64
August 16–August 31	62

Upon completion of facilities modification(s) as provided in A108 (discussed below), DWR may develop a new table for hatchery temperature requirements that is at least as protective as Table 3A.17. If a new table is developed, it would be developed in consultation with the Ecological Committee, including specifically USFWS, NMFS, CDFW, SWRCB, and RWQCBs. The new table would be submitted to FERC for approval, and upon approval shall become the temperature requirements for the hatchery for the remainder of the license term.

During Conference Years, as defined in A108.6, DWR would confer with USFWS, NMFS, CDFW, and SWRCB to determine proper temperature and hatchery disease management goals.

3A.5.3.4.4 Water Temperatures in the Lower Feather River

Under the SA, DWR is committing to a Feasibility Study and Implementation Plan to improve temperature conditions (facilities modification[s]) for spawning, egg incubation, rearing and holding habitat for anadromous fish in the LFC and HFC (A108.4). The Plan would recommend a specific alternative for implementation and would be prepared in consultation with the resource agencies.

Prior to the facilities modification(s) described in Article A108.4, if DWR does not achieve the applicable Robinson Riffle temperature (specified in Table 2-22 of the FERC license agreement) upon release of the specified minimum flow, DWR would singly, or in combination with other parties, perform the following actions:

- Curtail pump-back operation.
- Remove shutters on Hyatt Intake.
- Increase flow releases in the LFC up to a maximum of 1500 cfs, consistent with the minimum flow standards in the HFC and temperature targets specified in Table 2-22 of the FERC license agreement; and if the temperatures are not met there is no license violation.

If in any given year DWR anticipates that these measures would not achieve the temperatures in Table 3A.18, Low Flow Channel as Measured at Robinson Riffle, DWR would consult with the NMFS, USFWS, CDFW, and SWRCB to discuss potential approaches to best managing the remaining coldwater pool in Lake Oroville, which may result in changes in the way Licensee performs actions (1), (2), and (3) listed above.

Table 3A.18 Low Flow Channel as Measured at Robinson Riffle

Month	Daily Mean Value Temperature (°F)
January	56°F
February	56°F
March	56°F
April	56°F
May 1–15	56–63°F*
May 16–31	63°F
June 1–15	63°F
June 16–30	63°F
July	63°F
August	63°F
September 1–8	63–58°F*
September 9–30	58°F
October	56°F
November	56°F
December	56°F

Note:
* Indicates a period of transition from the first temperature to the second temperature.

After completing the facilities modification(s), DWR would no longer be required to perform the measures listed in (1), (2), and (3), unless temperatures in Table 3A.17, Hatchery Water Temperatures, are exceeded. DWR would operate the Project to meet temperature requirements, unless it is a Conference Year. The proposed water temperature objectives, measured at the southern FERC project boundary, would be evaluated for potential water temperature improvements in the HFC. DWR would study options for facilities modification(s) to achieve those temperature benefits.

There would be a testing period of at least 5 years to determine whether the HFC temperature benefits are being realized. At the end of the testing period, DWR would prepare a testing report that may recommend changes in the facilities, compliance requirements for the HFC and the definition of Conference Years (those years where DWR may have difficulties in achieving the temperature requirements due to hydrologic conditions.) The challenges of implementing temperatures objectives would require the phased development of water temperature objectives and likely, a revision to the objectives prior to values in Table 3A.19, High Flow Channel as Measured at Downstream Project Boundary, becoming a compliance obligation.

Table 3A.19 High Flow Channel as measured at Downstream Project Boundary

Month	Daily Mean Value Temperature (°F)
January	56
February	56
March	56
April	61
May	64
June	64
July	64
August	64
September	61
October	60
November	56
December	56

3A.5.3.4.5 Habitat Expansion Agreement

The Habitat Expansion Agreement is a component of the 2006 SA to address DWR obligations in regard to blockage and fish passage issues related to the construction of Oroville Dam. Because it deals with offsite mitigation, it will not be included in the new FERC license.

Construction of the Oroville Facilities and PG&E's construction of other hydroelectric facilities on the upper Feather River tributaries blocked passage and reduced available habitat for ESA listed anadromous salmonids Central Valley spring-run Chinook Salmon and steelhead. The reduction in spring-run habitat resulted in spatial overlap with fall-run Chinook Salmon and has led to increased redd superimposition, competition for limited habitat, and genetic introgression. FERC relicensing of hydroelectric projects in the Feather River basin has focused attention on the desirability of expanding spawning, rearing and adult holding habitat available for Central Valley spring-run Chinook Salmon and steelhead. The SA Appendix F includes a provision to establish a habitat enhancement program with an approach for identifying, evaluating, selecting and implementing the most promising action(s) to expand such spawning, rearing and adult holding habitat in the Sacramento River Basin as a contribution to the conservation and recovery of these species. The specific goal of the Habitat Expansion Agreement is to expand habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 spring-run or steelhead for spawning (Habitat Expansion

Threshold). The population size target of 2,000 to 3,000 spawning individuals was selected because it is approximately the number of spring-run Chinook Salmon and steelhead that historically migrated to the upper Feather River. Endangered species issues will be addressed and documented on a specific project basis for any restoration actions chosen and implemented under the Habitat Expansion Agreement.

3A.5.3.4.6 Anadromous Fish Monitoring on the Lower Feather River

Until the new FERC license is issued and until a new monitoring program is adopted, DWR will continue to monitor anadromous fish in the Lower Feather River. As required in the SA (Article A101), within 3 years following the FERC license issuance, DWR will develop a comprehensive Lower Feather River Habitat Improvement Plan that will provide an overall strategy for managing the various environmental measures developed for implementation, including the implementation schedules, monitoring, and reporting. Each of the programs and components of the Lower Feather River Habitat Improvement Plan will be individually evaluated to assess the overall effectiveness of each action within the Lower Feather River Habitat Improvement Plan.

3A.5.3.5 Delta Field Division

SWP facilities in the southern Delta include CCF, John E. Skinner Fish Facility, and the Banks Pumping Plant. CCF is a 31 TAF reservoir located in the southwestern edge of the Delta, about 10 miles northwest of the city of Tracy. 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.

3A.5.3.5.1 John E. Skinner Delta Fish Protective Facility

The John E. Skinner Delta Fish Protective Facility is located west of the CCF, 2 miles upstream of the Banks Pumping Plant. The Skinner Fish 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 towards 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.

3A.5.3.5.2 Harvey O. Banks Pumping Plant

The Banks Pumping Plant is in the south Delta, about 8 miles northwest of Tracy 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. The nominal capacity of the Banks Pumping Plant is 10,300 cfs.

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

500 cfs Diversion Increase During July, August, and September

During the months of July, August, and September, the maximum allowable daily diversion rate into CCF was increased from 13,870 acre-feet to 14,860 acre-feet and 3-day average diversions from 13,250 acre-feet to 14,240 acre-feet (500 cfs per day equals 990 acre-feet per day). The increase in diversions was permitted in 2000, and was recently extended through 2016. The purpose of this diversion increase into CCF for use by the SWP is to recover export reductions made due to actions taken to benefit fisheries resources. The increased diversion rate does not result in any increase in water supply deliveries above those that would occur in the absence of the increased diversion rate. This increased diversion over the 3-month period could result in an amount not to exceed 90 TAF each year.

Variations to hydrologic conditions coupled with regulatory requirements may limit the ability of the SWP to fully utilize the proposed increased diversion rate. Also, facility capabilities may limit the ability of the SWP to fully utilize the increased diversion rate.

Implementation of this action is contingent on meeting the following conditions.

- The increased diversion rate would not result in greater annual SWP water supply allocations than would occur in the absence of the increased diversion rate. Water pumped due to the increased capacity would only be used to offset reduced diversions that occurred or would occur because of actions taken to benefit fisheries.
- Use of the increased diversion rate would be in accordance with all terms and conditions of existing BOs governing SWP operations.
- All three temporary agricultural barriers (Middle River, Old River near Tracy and Grant Line Canal) must be in place and operating when SWP diversions are increased.

Between July 1 and September 30, if the combined salvage of listed fish species reaches a level of concern, the relevant fish regulatory agency would determine whether the 500 cfs increased diversion is or continues to be implemented.

Other SWP-operated facilities in and near the Delta include the NBA, the South Bay Aqueduct (SBA), the Suisun Marsh Salinity Control Gates (SMSCG), Roaring River Distribution System (RRDS), and up to four temporary barriers in the south Delta.

3A.5.3.5.3 Clifton Court Forebay

Clifton Court Forebay Aquatic Weed Control Program

Dense growth of submerged aquatic weeds in CCF, predominantly Egeria densa, can cause severe head loss and pump cavitation at Banks Pumping Plant when the stems of rooted plants break free, combine into "mats," and drift into the trash racks. This mass of uprooted and broken 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. 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 all results in a reduction in the volume of water diverted by the SWP. Algal blooms in CCF are also problematic because they degrade drinking water quality through tastes and odors and production of algal toxins.

Beginning in 1995, DWR applied copper-based herbicide complexes to control aquatic weeds and algal blooms in CCF. These herbicides included copper sulfate pentahydrate, Komeen,® and Nautique®. These herbicides were applied on an as-needed basis. Komeen® is a chelated copper herbicide (copper-ethylenediamine complex and copper sulfate pentahydrate) and Nautique® is a copper carbonate compound (see Sepro product labels).

The operational procedures for aquatic herbicide applications in CCF include:

- Apply aquatic pesticides as needed between July 1 and August 31.
- Monitor the salvage of listed fish at the Skinner Facility prior to the application of the herbicides in CCF.
- Close the radial intake gates at the entrance to CCF 24 hours prior to the application of herbicides to allow fish to move out of the proposed treatment areas and towards the salvage facility.
- The radial gates would remain closed for 24 hours after treatment to allow for at least 24 hours of contact time between the herbicide and the treated vegetation in the forebay. Gates would be reopened after a minimum of 48 hours.
- Komeen® would be applied by boat, starting at the shore and moving sequentially farther offshore in its application. Application would be made by a certified water contractor under the supervision of a California Certified Pest Control Advisor.
- Application of the herbicides would be to the smallest area possible that provides relief to SWP operations.

- Monitoring of the water column concentrations of copper is proposed during and after herbicide application. No monitoring of the copper concentration in the sediment or detritus is proposed.

Due to concerns that the pesticide treatments may adversely affect Green Sturgeon, during 2006 DWR ceased using aquatic pesticides and employed the use of a mechanical aquatic weed harvester.

If DWR resumes herbicide treatments in the CCF, they would occur only in July and August on an as-needed basis dependent upon the level of vegetation biomass in the enclosure. It is not possible to predict future CCF conditions with climate change. However, the frequency of herbicide applications is not expected to occur more than twice per year, as demonstrated by the history of past applications. Herbicides are typically 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 towards their roots for overwintering senescence.

Aquatic weed management problems in CCF have historically been limited to about 700 acres of the 2,180 total water surface acres. Application of the herbicide during 1995–2006 was limited to only those areas in CCF that require treatment. The copper-based herbicides, Komeen® or Nautique, were applied by helicopter or boat to only those portions where aquatic weeds presented a management problem to the State.

Historically, algal problems in CCF have been caused by attached benthic cyanobacteria that produce unpleasant tastes and odors in the domestic drinking water derived from the SWP operations. Copper sulfate is applied to the nearshore areas of CCF when results of solid phase microextraction (American Public Health Association, American Water Works Association, and Water Environment Federation 2005) analysis exceed the control tolerances (2-methylisoborneol [MIB] < 5 nanograms per liter [ng/L] and geosmin < 10 ng/L are not detected by consumers in drinking water supplies) (California Department of Water Resources 2013). Geosmin and MIB are natural byproducts of algal chlorophyll production. Highest biomass of taste- and odor-producing cyanobacteria was present in the nearshore areas but not limited to shallow benthic zone. Historically, application areas varied considerably based on the extent of the algal infestation in CCF.

DWR receives Clean Water Act pollutant discharge coverage under the National Pollutant Discharge Elimination System (NPDES) Permit No. CAG990005 (General Permit) issued by SWRCB for application of aquatic pesticides to the SWP's aqueducts, forebays, and reservoirs. SWRCB functions as the USEPA's non-federal representative for implementation of the Clean Water Act in California.

A Mitigated Negative Declaration was prepared by DWR to comply with CEQA requirements associated with regulatory requirements established by SWRCB. DWR, a public entity, was granted a Section 5.3 Exception by SWRCB (Water

Quality Order 2004-0009-DWQ). Under the exception, DWR is not required to meet the copper limitation in receiving waters defined in DWR's Aquatic Pesticide Application Plan as occurring on an as-needed basis during the year, after other options have been exhausted.

3A.5.3.5.4 Proposed Measures to Reduce Fish Mortality

DWR plans to implement a number of projects to reduce fish mortality, including (1) implementing the CCF Fishing Facility Project, (2) improving fish conditions at the Curtis Landing Fish Release Site, (3) constructing a Fish Science Building for fish studies, (4) building two new release sites, (5) developing a CVP and SWP coordinated fish release plan, and (6) improving herbicide application procedures to protect listed species.

DWR plans to implement the CCF Fishing Facility Project to reduce salmon and steelhead pre-screen losses in CCF by (a) building a concrete support pad to improve crane maintenance of the radial gates, (b) improve angler access and conditions to reduce the number of predators affecting listed species, and (c) increase security operations.

DWR plans to rebuild the Curtis Landing fish release site to reduce salmon predation by; (a) building a larger pump to more effectively flush salvaged fish, (b) screening the water pump to prevent fish entrainment, and (c) building two release sites with improved facilities to improve fish releases and lengthen time between using repeated release sites.

DWR plans to open a Fish Science Building and storage warehouse at Skinner Fish Salvage Facility in order to conduct fisheries studies in support of improving endangered species protection for the State Water Project. The facilities would support; (a) the CCF Predation Study, (b) the Skinner Release Site Efficiency Study, (c) Acoustic Tagging Study, and (d) future studies related to the State Water Project.

DWR plans to build two new fish release sites that will help lengthen out the rotation time between release locations and will assist in reducing listed species predation at release sites. Facilities were created at Little Baja and Manzo Ranch on Sherman Island.

If DWR resumes application of Komeen® (copper-ethylenediamine complex) or similar aquatic herbicides, it would be applied according to the manufacturer's instructions, following the operational procedures described in Table P-24, Section 6.6.3 of the 2009 NMFS BO, and in accordance with state and federal law. CCF elevation would be raised to +2 feet above mean sea level for an average depth of about 6 feet within the maximum 700-water surface acre treatment zone. The herbicide would be applied at a rate of 13 gallons per surface acre to achieve a final operational concentration in the water body of 0.64 mg/L Cu2+ (640 parts per billion [ppb]). The application rate of 13 gallons per surface acre is calculated based on mean depth. The product label allows applications up to 1 mg/L (1,000 ppb or 1 ppm). DWR would apply Komeen® in accordance with the product label that states, "If treated water is a source of potable water, the residue of copper must not exceed 1 ppm (mg/L)."

In 2005, 770 surface acres were treated with Komeen®. CCF has a mean depth of 6 feet at 2 feet above mean sea level; thus the volume treated was 4,620 af.

The calculated concentration of Cu2+ for the 2005 application was 0.65 mg/L Cu2+. The copper level required to control Egeria densa (the main component of the CCF aquatic plant community) is 0.5–0.75 mg/L Cu2+. Source: Komeen® Specimen Label.

Toxicity testing and literature review of LC-50 levels for salmon, steelhead, Delta Smelt, and Green Sturgeon were conducted. Copper-complexes are generally much less toxic to fish than the inorganic copper salts, including copper sulfate. Once applied, the initial stock copper concentration is reduced rapidly by dilution, plant uptake, and adsorption to particulate matter. The half-life for the commercial copper-complexes is very short for the copper-EDA complexes (0.07 to 0.18 days). Komeen® applied according to the Specimen Label (SePro Corporation) in the receiving water would achieve final concentration levels. Based on the treatment elevation of +2 feet, only about 20 percent (4,630 af) of the 22,665 acre-feet CCF would be treated. If herbicide treatments resume, the copper would be applied beginning on one side of the CCF allowing fish to move out of the treatment area. In addition, Komeen® would be applied from boats at a slower rate than in previous years when a helicopter was used.

3A.5.3.6 South Bay Aqueduct

The SBA conveys water from the Delta through over 40 miles of pipelines and canals to the Zone 7 Water Agency, Alameda County, and Santa Clara Valley Water Districts, which in turn provide service to the cities of Livermore, Dublin, Pleasanton, San Ramon, Freemont, Newark, Union City, Milpitas, Santa Clara, and San Jose. The SBA was the first conveyance facility constructed for the SWP and was designed for a capacity of 300 cfs. The facility is currently being upgraded to increase the capacity to 430 cfs to meet Zone 7 Water Agency's future needs and provide operational flexibility to reduce SWP peak power consumption. Modeling of this facility uses the full 430 cfs capacity.

3A.5.3.7 North Bay Aqueduct Intake at Barker Slough

The Barker Slough Pumping Plant (BSPP) diverts water from Barker Slough into the NBA for delivery to the Solano County Water Agency (SCWA) and the Napa County Flood Control and Water Conservation District (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. Delta Smelt monitoring is required at Barker Slough.

The existing NBA system has several existing and potential future limitations, as described in the following section.

3A.5.3.7.1 Existing Limitations

Water Quality

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.

Pumping Restrictions

The NBA SWP water contractors have an existing water supply through the NBA of 131,181 acre-feet per year based on existing contracts and water right settlements. The 2008 USFWS BO limited the total SWP annual diversion at the BSPP to approximately 71 TAF. In 2009, an incidental take permit issued CDFW for the preservation of longfin smelt populations imposed further pumping restrictions at the BSPP of a maximum of 50 cfs (7-day average flows) during dry and critical dry years from January 15 to March 31.

Water Supply Delivery Limitations

The NBA system had the design capacity of 175 cfs, provided all 10 pumps were installed at BSPP. There are currently only nine pumps (seven large, two small) at BSPP. Installation of the tenth pump was deferred, resulting in the current design capacity of 162.5 cfs. However, until late 2011, the system delivered a maximum of only 140 cfs due to thick bio-film growth on the interior of the NBA pipeline, which reduced the effective diameter of the pipe. In October 2011, maximum allowable pumping at BSPP was further reduced to keep the pressure in the pipeline within acceptable limits.

3A.5.3.7.2 Potential Future Limitations

Pumping Restrictions

The pumping capacity of the existing NBA system could be subjected to additional restrictions in the future. In June 2009, NMFS issued a BO that included determinations for winter and spring-run Chinook Salmon, Central Valley Steelhead and North American Green Sturgeon of the southern distinct population segment. State and federal agencies working on ways to improve the Delta ecosystem and water supply conveyance, including work under the Bay Delta Conservation Plan (BDCP), have identified the Yolo Bypass and Cache Slough Complex as important Wetlands Restoration Opportunity Areas. Implementing these developing strategies would likely support increases in Delta Smelt, longfin smelt and salmonid populations in the Barker Slough area. The increased presence of these listed species could result in further pumping restrictions at the BSPP as resource agencies work to balance ecosystem restoration and water supply delivery goals.

Projected Water Delivery Demands

The NBA SWP water contractors project that by 2030 they would need the NBA to deliver their total water supply of 131,181 af/year (compared to current withdrawal of 71 TAF/year). To meet projected future demand, required peak flow through the NBA is estimated at 240 cfs.

3A.6 Coordinated Facilities of the CVP and SWP

3A.6.1 Joint Project Facilities

3A.6.1.1 Suisun Marsh

Since the early 1970s, the California Legislature, SWRCB, Reclamation, CDFW, Suisun Resource Conservation District (SRCD), DWR, and other agencies have worked to preserve beneficial uses of Suisun Marsh in mitigation for perceived impacts of reduced Delta outflow on the salinity regime. Early on, salinity standards were set by SWRCB to protect alkali bulrush production, a primary waterfowl plant food. The most recent standard under SWRCB D-1641 acknowledges that multiple beneficial uses deserve protection.

A contractual agreement among DWR, Reclamation, CDFW, and 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 Suisun Marsh Preservation Agreement (SMPA) requires DWR and Reclamation to meet salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements. In addition to the contractual agreement, SWRCB D-1485 codified salinity standards in 1978, which have been carried forward to SWRCB D-1641.

There are two primary physical mechanisms for meeting salinity standards set forth in SWRCB D-1641 and the SMPA: (1) the 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 early 1980s and have proven to be a highly reliable method for meeting standards. However, since Delta outflow cannot be actively managed by the Suisun Marsh Program, Marsh facility operations must be adaptive in response to changing salinity levels in the Delta.

3A.6.1.1.1 Suisun Marsh Wildlife Habitat Management, Preservation, and Restoration Plan

Reclamation, USFWS, CDFW, and federal and state agencies developed the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (SMP). The SMP is to restore 5,000 to 7,000 acres of managed wetland activities in 30 years. The SMP preserves and enhances managed seasonal wetlands, implement a comprehensive levee protection/improvement program, and protect ecosystem and drinking water quality, while restoring habitat for tidal marsh-dependent sensitive species.

In June of 2013, USFWS issued a BO on the SMP based on the project description that includes program-level tidal wetland restoration of 5,000 to 7,000 acres. An overview of the expected outcomes of tidal restoration is presented, but specific site locations and other details are not included. As sites are identified, and there is sufficient detail about the nature, scope, location, and timing of the restoration actions, the USFWS will review that information. If the site-specific tidal restoration plans are consistent with the SMP and USFWS-issued biological opinions, USFWS will append the project to the PBO and provide an incidental take statement. If a tidal restoration project has potential effects on listed species beyond those analyzed in the PBO, planning efforts for those projects will include site-specific consultation under the ESA with USFWS.

Requirements for proposed tidal marsh restoration project to be appended to the PBO are as follows. The proposed tidal marsh restoration project must:

- Be within the SMP area.
- Not exceed the acreage evaluated in the SMP; Note, this project dos not preclude additional restoration activities from occurring in Suisun Marsh that are not specifically addressed in this BO. Separate environmental permitting would be needed for these projects.
- Follow the SMP site selection considerations.
- Follow the conservation measures and reporting (per the PBO).
- Be reviewed and approved by USFWS and CDFW.
- Be reviewed by the Suisun Adaptive Management Advisory Team and the SMP Principals.

3A.6.1.1.2 Suisun Marsh Salinity Control Gates

The SMSCG are located on Montezuma Slough about two miles downstream from the confluence of the Sacramento and San Joaquin Rivers, near Collinsville. The objective of Suisun Marsh Salinity Control Gate 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.

When Delta outflow is low to moderate and the gates are not operating, tidal flow past the gate is approximately 5,000 to 6,000 cfs while the net flow is near zero. When operated, flood tide flows are arrested while ebb tide flows remain in the range of 5,000 to 6,000 cfs. The net flow in Montezuma Slough becomes approximately 2,500 to 2,800 cfs. The USACE permit for operating the SMSCG requires that it be operated between October and May only when needed to meet Suisun Marsh salinity standards. Historically, the gate has been operated as early as October 1, although in some years (e.g., 1996) the gate was not operated at all. When the channel water salinity decreases sufficiently below the salinity standards, or at the end of the control season, the project provides unrestricted movement through Montezuma Slough. Details of annual gate operations can be found in *Summary of Salinity Conditions in Suisun Marsh During Water Years* 1984–1992 (California Department of Water Resources 1994), or the Suisun Marsh Monitoring Program Data Summary produced annually by DWR's Division of Environmental Services.

The approximately 2,800 cfs net flow induced by SMSCG operation is effective at moving the salinity downstream in Montezuma Slough. Salinity is reduced by roughly 100 percent at Belden's Landing, and by lesser amounts farther west along Montezuma Slough. At the same time, the salinity field in Suisun Bay moves upstream as net Delta outflow (measured nominally at Chipps Island) is reduced by gate operation. Net outflow through Carquinez Strait is not affected.

The SMSCG are operated during the salinity control season, which spans from October to May. Operational frequency is affected by hydrologic conditions, weather, Delta outflow, tide, fishery considerations, and other factors. The gates have also been operated for scientific studies. After discussions with NMFS based on study findings, the boat lock portion of the gate is now held open at all times during SMSCG operation to allow for continuous salmon passage opportunity. Adaptive management of the gates continues to improve and salinity standards have been met with less frequent gate operation since 2006. In low outflow years gate operation was used from 35 to 42 days. The operation was limited to 17 to 69 days in 2009, 2010, 2011 and 2013. Assuming no significant long-term changes in the drivers mentioned above, it is expected that gate operations will remain at current levels (17 to 69 days per year) except perhaps during the most critical hydrologic conditions and other conditions that affect Delta outflow.

3A.6.1.1.3 SMSCG Fish Passage Study

The SMSCG were constructed and operate under USACE Permit 16223E58, which includes a special condition to evaluate the nature of delays to migrating fish. Ultrasonic telemetry studies in 1993 and 1994 showed that the physical configuration and operation of the gates during the control season have a negative effect on adult salmonid passage (Tillman et al. 1996; Edwards et al. 1996).

The Department coordinated additional fish passage studies in 1998, 1999, 2001, 2002, 2003, and 2004. Migrating adult fall-run Chinook Salmon were tagged and tracked by telemetry in the vicinity of the SMSCG to assess potential measures to increase the salmon passage rate and decrease salmon passage time through the gates.

Results in 2001, 2003, and 2004 indicate that leaving the boat lock open during the Control Season when the flashboards are in place at the SMSCG and the radial gates are tidally operated provides a nearly equivalent fish passage to the non-control season configuration when the flashboards are out and the radial gates are open. This approach minimizes delay and blockage of adult Sacramento River winter-run Chinook Salmon, Central Valley spring-run Chinook Salmon, and Central Valley Steelhead migrating upstream during the Control Season while the SMSCG is operating. However, the boat lock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility.

Reclamation and DWR are continuing to coordinate with the SMSCG Steering Committee in identifying water quality criteria, operational rules, and potential measures to facilitate removal of the flashboards during the control season that would provide the most benefit to migrating fish. However, the flashboards would not be removed during the control season unless it was certain that standards would be met for the remainder of the control season without the flashboards installed.

3A.6.1.1.4 Roaring River Distribution System

The RRDS was constructed during 1979 and 1980 as part of the Initial Facilities in the Plan of Protection for the Suisun Marsh. The system was constructed to provide lower salinity water to 5,000 acres of private 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. Motorized slide gates in Montezuma Slough and flap gates in the pond control flows through the culverts into the pond. A manually operated flap gate and flashboard riser are located at the confluence of Roaring River and Montezuma Slough to allow drainage back into Montezuma Slough for controlling water levels in the distribution system and for flood protection. DWR owns and operates this drain gate to ensure the Roaring River levees are not compromised during extremely high tides.

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. Managed wetlands north and south of the RRDS receive water, as needed, through publicly and privately owned turnouts on the system.

The intake to the RRDS is screened to prevent entrainment of fish larger than approximately 25 mm. DWR designed and installed the screens based on CDFW criteria. The screen is a stationary vertical screen constructed of continuous-slot stainless steel wedge wire. All screens have 3/32 inch slot openings. After the listing of Delta Smelt, RRDS diversion rates have been controlled to maintain an average approach velocity below 0.2 ft/s at the intake fish screen. Since 1996, the motorized slide gates have been operated remotely to allow hourly adjustment of gate openings to maximize diversion throughout the tide.

DWR conducts routine maintenance of the system, primarily maintaining the levee roads and fish screens. RRDS, like other levees in the marsh, have experienced subsidence since it was constructed in 1980. In 1999, DWR restored all 16 miles of levees to design elevation as part of damage repairs following the 1998 flooding in Suisun Marsh. In 2006, portions of the north levee were repaired to address damage following the January 2006 flooding.

3A.6.1.1.5 Morrow Island Distribution System

The Morrow Island Distribution System (MIDS) was constructed in 1979 and 1980 in the southwestern Suisun Marsh as part of the Initial Facilities in the Plan of Protection for the Suisun Marsh. The contractual requirement for Reclamation and DWR is to provide water to the ownerships 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 through three 48-inch culverts. Drainage water from Morrow Island is discharged into Grizzly Bay by way of the C-Line Outfall (two 36-inch culverts) and into the mouth of Suisun Slough by way of the M-Line Outfall (three 48-inch culverts), rather than back into Goodyear Slough. This helps prevent increases in salinity due to drainage water discharges into Goodyear Slough. The M-Line ditch is approximately 1.6 miles long and the C-Line ditch is approximately 0.8 miles long.

The 1997 USFWS BO issued for dredging of the facility included a requirement for screening the diversion to protect Delta Smelt. DWR and Reclamation are currently analyzing conservation alternatives to a fish screen in coordination with USFWS and CDFW to meet BO requirements.

Studies suggest that Goodyear Slough is a marginal, rarely used habitat for special-status fishes. Therefore, implementing other tidal restoration projects elsewhere may be more beneficial and practical than fish screening. Restoration of tidal wetland ecosystems is expected to aid in the recovery of several listed and special status species within the marsh and improve food availability for Delta Smelt and fish.

There are currently no plans to modify operations.

3A.6.1.2 South Delta Temporary Barriers Project

DWR initiated the South Delta Temporary Barrier Project (TBP) in 1991. Permit extensions under Section 404 of the Clean Water Act were granted in 1996, 2001, 2008 and 2011, when DWR obtained permits to extend the Temporary Barriers Project through 2016. The current TBP PBO issued in 2014 by USFWS to USACE allows for permit issuance for construction and demolition through 2017. This allows the USACE to issue a 5-year 505 permit for the agricultural barriers and Head of Old River Barrier. NMFS issued annual BOs to USACE to provide incidental take coverage for permitting the construction of the TBP in 2011 and 2012. In 2013 a PBO was issued to USACE providing incidental take coverage for permitting through 2017. State permits including the Incidental Take Permit and Streambed Alteration Agreement from CDFW and the 401 Water Quality Certification from the Regional Water Quality Control Board, provide coverage through 2016. The project consists of four rock barriers across south Delta channels. In various combinations, these barriers improve water levels and San Joaquin River salmon migration in the south Delta. The existing TBP consists of installation and removal of temporary rock barriers at the following locations.

- Middle River near 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 DMC intake.
- Grant Line Canal near Tracy Boulevard Bridge, about 400 feet east of Tracy Boulevard Bridge.
- The head of Old River at the confluence of Old River and San Joaquin River.

The barriers on Middle River, Old River near Tracy, and Grant Line Canal are flow control facilities designed to improve water levels for agricultural diversions and are in place during the irrigation season. South Delta Temporary Barriers are operated based on San Joaquin flow conditions. Head of Old River Barrier is only installed from September 16th to November 30th and is no longer installed in the spring months per 2008 USFWS Delta Smelt BO Action 5. Operation of the agricultural barriers at Middle River and Old River near Tracy can begin as early as April 15. From May 16 to May 31 (if the barrier at the head of Old River is removed) the tide gates are tied open in the barriers in Middle River and Old River near Tracy. After May 31, the barriers in Middle River, Old River near Tracy, and Grant Line Canal are permitted to be operational until they are completely removed by November 30.

During the spring, the barrier at the head of Old River is designed to reduce the number of out-migrating salmon smolts entering Old River. During the fall, this barrier is designed to improve flow and DO conditions in the San Joaquin River for the immigration of adult fall-run Chinook Salmon. The barrier at the head of Old River barrier is typically in place from April 15 to May 15 for the spring, and from early September to late November for the fall. Installation and operation of the barrier at the head of Old River also depends on the San Joaquin River flow conditions.

In addition to permitting construction and removal of the barriers, the permits also give DWR coverage for scientific studies that may take endangered fish species. According to NMFS and USFWS BO requirements, actions for each upcoming year—including barrier type, timing, and any scientific studies planned—must be submitted to the USACE by October 1 of each year. USACE requests of NMFS and USFWS that the actions for the upcoming year be appended to the PBOs.

In 2009 and 2010, an experimental non-physical barrier was installed in lieu of the HOR spring rock barrier with the intention of deterring out-migrating juvenile salmonids from entering Old River. This experimental barrier is a patented technology using sound and light as a deterrent. Although high flows prohibited installation of the non-physical barrier in 2011, a without-barrier study of predator behavior was conducted. In 2012, a rock barrier with eight culverts was installed in the spring as a component of a fish-monitoring study designed to inform export operations. The rock barrier with eight culverts is expected to be installed each spring unless installation is prevented by high flows in the San Joaquin River, or if new studies conclude the spring HOR barrier does not provide salmonid protections previously assumed.

To improve water circulation and quality, DWR in coordination with the South Delta Water Agency and Reclamation, began in 2007 to manually tie open the culvert flap gates at the Old River near Tracy barrier to improve water circulation and untie them when water levels fell unacceptably. This operation is expected to continue in subsequent years as needed to improve water quality. In addition, DWR consulted with USACE and received USFWS and NMFS approval to raise the Middle River weir height by 1 foot. The weir height will be raised during the summer irrigation season only after Delta Smelt concerns have passed. The requested modification was approved late in the 2010 irrigation season. The weir was raised in 2012. It was not raised in 2011 due to high flow conditions in the south Delta.

In the absence of permanent operable gates, the TBP would continue as planned and permitted. Computer model forecasts, real-time monitoring, and coordination with local, state, and federal agencies and stakeholders would help determine if the temporary rock barriers operations need to be modified during the transition period.

3A.6.1.2.1 Conservation Strategies and Mitigation Measures

DWR has complied with the various measures and conditions required by regulatory agencies under past and current permits to avoid, minimize, and compensate for the TBP impacts. An ongoing monitoring plan is implemented each year the barriers are installed and an annual monitoring report is prepared to summarize the activities. The monitoring elements include fisheries monitoring and water quality analysis, salmon smolt survival investigations, barrier effects on SWP and CVP entrainment, Swainson’s Hawk monitoring, water elevation, water quality sampling, and hydrologic modeling. DWR operates fish screens to offset TBP impacts at Sherman Island. Studies of predator behavior in the vicinity of the non-physical barrier began in 2011 as required by CDFW.

The 2008 NMFS BO for the TBP requires a fisheries monitoring program using biotelemetry techniques to examine the movements and survival of juvenile salmon and juvenile steelhead through the channels of the south Delta. The BO also requires that predation effects associated with the barriers be examined. Information gained as part of the 2009 pilot study was used to develop the full scale study that started in 2010. 2011 was the third and final year of the studies mandated in the 2008 BO. Any future telemetry studies at the barriers would be required from a subsequent BO.

The CDFW incidental take permit provides California Endangered Species coverage through 2016. This permit requires 6 acres of shallow water habitat that have been provided through a purchase from the Wildlands Liberty Island mitigation bank.

3A.6.2 Delta-Mendota Canal/California Aqueduct Intertie

The DMC/California Aqueduct Intertie was completed in 2012. The project consists of a pumping plant and pipeline connections between the DMC and the California Aqueduct. The DMC/California Aqueduct Intertie Pumping Plant is located at DMC milepost 7.2 where the DMC and the California Aqueduct are about 500 feet apart.

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 Intertie allows flow in both directions, which would provide additional flexibility to both CVP and SWP operations. The Intertie includes a pumping plant at the DMC that allows up to 467 cfs to be pumped from the DMC to the California Aqueduct. Up to 900 cfs can be conveyed from the California Aqueduct to the DMC using gravity flow.

The DMC/California Aqueduct Intertie is operated by the San Luis and Delta-Mendota Water Authority (Authority). Agreements between Reclamation, DWR, and the Authority identify the responsibilities and procedures during operation of the DMC/California Aqueduct Intertie.

3A.6.2.1 Operations

The DMC/California Aqueduct Intertie can be used under three different scenarios:

- Up to 467 cfs may be pumped from the DMC to the California Aqueduct to ease DMC conveyance constraints and help meet water supply demands of CVP contractors. This would allow Jones Pumping Plant to pump to its design capacity of up to 4,600 cfs, subject to all applicable export pumping restrictions for water quality and fishery protections.
- Up to 467 cfs may be pumped from the 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 the DMC using gravity flow to minimize impacts on water deliveries due to temporary restrictions in flow or water levels on the lower California Aqueduct (south of

the Intertie) or the upper DMC (north of the Intertie) for system maintenance or for an emergency shutdown.

The DMC/California Aqueduct Intertie provides operational flexibility between the DMC and California Aqueduct. It would not result in any changes to authorized pumping capacity at Jones Pumping Plant or Banks Pumping Plant.

Water conveyed at the DMC/California Aqueduct Intertie to minimize reductions to water deliveries during system maintenance or an emergency shutdown on the DMC or California Aqueduct can include pumping of CVP water at Banks Pumping Plant or SWP water at Jones Pumping Plant through use of JPOD. In accordance with COA Articles 10(c) and 10(d), JPOD may be used to replace conveyance opportunities lost because of scheduled maintenance, or unforeseen outages. Use of JPOD for this purpose can occur under Stage 2 operations defined in SWRCB D-1641, or could occur as a result of a SWRCB Temporary Urgency request. Use of JPOD in this case does not result in any net increase in allowed exports at CVP and SWP export facilities. When in use, water within the DMC is conveyed to the California Aqueduct via the Intertie to O'Neill Forebay.

3A.6.3 Transfers

California Water Law and the CVPIA promote water transfers as important water resource management measures to address water shortages provided certain protections to source areas and users are incorporated into the water transfer. Parties seeking water transfers generally acquire water from sellers who have available surface water who can make the water available through releasing previously stored water, pump groundwater instead of using surface water; fallow crops or substitute a crop that uses less water in order to reduce normal consumptive use of surface diversions.

Water transfers (addressed in this document) occur when a water right holder within the Sacramento-San Joaquin River watershed undertakes actions to make water available for transfer. The SWP does not address the upstream operations that may be necessary to make water available for transfer. Nor does this document address the impacts of water transfers on terrestrial species.

Transfers requiring export from the Delta are done at times when pumping and conveyance capacity at the CVP or SWP export facilities is available to move the water to the buyer. Additionally, Reclamation and DWR must coordinate review of the transfer proposals and Project operations to assure that the Projects are not impacted including the ability to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way. To avoid impacts to Delta water quality the individual transfer is assessed a carriage water loss to account for flows required to avoid impacts to Delta water quality or flow objectives. All transfers would be in accordance with all existing regulations and requirements.

Purchasers of water for transfers may include Reclamation, CVP water contractors, DWR, SWP water contractors, other State and Federal agencies, and other parties. Reclamation and DWR have operated water acquisition programs in the past to provide water for environmental programs and additional supplies to CVP water contractors, SWP water contractors, and other parties. Past transfer programs include the following.

- DWR administered the 1991, 1992, 1994, and 2009 Drought Water Banks and Dry Year Programs in 2001 and 2002.
- Reclamation operated a forbearance program in 2001 by purchasing CVP contractors' water in the Sacramento Valley for CVPIA instream flows, and to augment water supplies for CVP contractors south of the Delta and wildlife refuges. Reclamation administers the CVPIA Water Acquisition Program for Refuge Level 4 supplies and fishery instream flows.
- DWR is a signatory to the Yuba River Accord Water Transfer Agreement through 2025 that provides fish flows on the Yuba River and also water supply that is exported at DWR and Reclamation Delta facilities for the CVP and SWP operations and for the SWP and CVP contractors.
- In the past, CVP contractors and SWP water contractors have independently acquired water and arranged for pumping and conveyance through SWP and CVP facilities.

3A.6.3.1 Lower Yuba River Accord

The Lower Yuba River Accord (Yuba Accord) consists of three sets of agreements designed to protect and enhance fisheries resources in the Lower Yuba River, increase local water supply reliability, provide DWR with increased operational flexibility for protection of Delta fisheries resources, and provide added dry-year water supplies to CVP and SWP water contractors. These agreements are:

- The Lower Yuba River Fisheries Agreement (Fisheries Agreement).
- Agreements for the Conjunctive Use of Surface and Groundwater Supplies (Conjunctive Use Agreements).
- Agreement for the Long-term Purchase of Water from Yuba County Water Agency by DWR (Water Purchase Agreement).

The Fisheries Agreement is the cornerstone of the Yuba Accord. It was developed by state, federal, and consulting fisheries biologists, fisheries advocates, policy representatives, and the Yuba County Water Agency (YCWA). Compared to the interim flow requirements of the SWRCB Revised Water Right Decision 1644 (RD-1644), the Fisheries Agreement establishes higher minimum instream flows during most months of most water years.

To assure that YCWA's water supply reliability is not reduced by the higher minimum instream flows and water transfers, it and seven of its member units have signed conjunctive use agreements. These agreements establish a conjunctive use program that facilitates the integration of the surface water and groundwater supplies of the seven local irrigation districts and mutual water companies that YCWA serves in Yuba County. Integration of surface water and groundwater allows YCWA to increase the efficiency of its water management.

Under the Water Purchase Agreement, DWR administers the water transfer activities. The Water Transfer Agreement allows DWR to purchase water from YCWA to generally offset water costs resulting from export restrictions in winter and spring each year to benefit Delta Smelt and out-migrating San Joaquin River salmonids. This quantity of water is known as "Component 1 Water" under the Water Purchase Agreement and is quantified as the first 60 TAF of surface water above a defined baseline that Yuba releases each year. Assuming a 20 percent carriage water cost, approximately 48 TAF would reach the export pumps to produce a mitigation offset of approximately 48 TAF of reduced exports.

Additional water supplies purchased by the SWP water contractors and/or CVP contractors under the Water Purchase Agreement are administered by DWR as a water transfer program in drier years. These supplies include: (a) Component 2 water (15 TAF per year [TAF/yr] in Dry Years and up to 30 TAF/yr in Critical Years); (b) Component 3 water (up to 40 TAF/yr in specified lower SWP or CVP allocation years); and (c) Component 4 water (additional water that YCWA makes available from surface-water supplies and its groundwater substitution program). The San Luis and Delta-Mendota Water Authority is a Participating Contractor to provide benefits to certain of its member CVP contractors.

CEQA review for all of the Yuba Accord agreements (Fisheries, Water Purchase, and Conjunctive Use) was completed in 2007 and these agreements were fully executed between late 2007 and early 2008. SWRCB approved the instream flow schedules and water transfer aspects of the Yuba River Accord, with some corrections, on March 18, 2008. The Fisheries Agreement will terminate when FERC issues a new long-term FERC license for the Yuba River Development Project (which will be sometime after April 30, 2016 when the present license expires). The Water Purchase Agreement will terminate on December 31, 2025, but the amounts of water that YCWA will transfer under the agreement after FERC issues a new long-term license for the Yuba River Development Project will be subject to negotiation by the parties to the agreement. The Conjunctive Use Agreements will terminate when the Fisheries Agreement and Water Purchase Agreement terminate. It is assumed in this EIS that the existing or similar agreements will be renewed by 2030.

3A.6.3.2 Transfer Capacity

It is expected that water transfer programs for environmental and water supply augmentation will continue in some form, and that in most years (all but the driest), the scope of annual water transfers of water exported through the Delta will be limited by available Delta pumping capacity, and exports for transfers will be limited to the months of July-September. As such, looking at an indicator of available transfer capacity in those months is one way of estimating an upper boundary to the effects of transfers on an annual basis.

The CVP and SWP may provide Delta export pumping for transfers using pumping capacity at Banks and Jones pumping plants beyond that which is being used to deliver Project water supply, up to the diversion capacity, consistent with existing operational and regulatory restrictions.

The surplus capacity available for transfers varies a great deal with hydrologic conditions. In general, as hydrologic conditions get wetter, surplus capacity diminishes because the CVP and SWP are more fully using export pumping capacity for Project supplies. The CVP's Jones Pumping Plant has little surplus capacity, except in the driest hydrologic conditions. The SWP has the most surplus capacity in critical and some dry years, less or sometimes none in most median hydrologic conditions, and some surplus again in some above normal and wet years when demands may be lower because some water users may have alternative supplies.

The availability of water for transfer and the demand for transferred water may also vary with hydrologic conditions. Accordingly, since many transfers are negotiated between willing buyers and sellers under prevailing market conditions, price of water also may be a factor determining how much is transferred in any year. This document does not attempt to identify how much of the available and useable surplus export capacity of the CVP and SWP would actually be used for transfers in a particular year, but given the recent history of water transfer programs and requests for individual water transfers, trends suggest a growing reliance on transfers to meet dry year water demands.

Under both the present and future conditions, capability to export transfers would often be capacity-limited, except in Critical and some Dry years. In Critical and some Dry years, both Banks and Jones pumping plants would likely have surplus capacity for transfers. As a result, export capacity is less likely to limit transfers in these years. During such years, low Project exports and high demand for water supply could make it possible to transfer significant amounts of transfer water when upstream water supplies are available.

3A.6.4 Proposed Exports for Transfers

Although transfers may occur at any time of year, the 2008 USFWS BO and 2009 NMFS BO address proposed exports for transfers during only the months July through September. For transfers outside those months, or in excess of the maximum amounts (listed below), separate consultations would be required with the USFWS and NMFS. Based on the estimates of available capacity for export of transfers during July through September, and in recognition of the many other possible operational contingencies and constraints that may limit actual use of that capacity for transfers, as follows.

- Critical Water Year: Maximum Transfer Amount is 600 TAF
- Dry Water Year following Critical Water Year: Maximum Transfer Amount is 600 TAF
- Dry Water Year following Dry Water Year: Maximum Transfer Amount is 600 TAF
- All Other Water Years: Maximum Transfer Amount is 360 TAF

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Appendix 4A

Federal and State Policies and Regulations

4A.1 Federal Policies and Regulations

Federal policies and regulations presented in this appendix are related to requirements that affect surface water, biological, energy, agricultural, air quality, and cultural resources. Federal policies and regulations that affect operations of the Central Valley Project are included in Appendix 3A, No Action Alternative: Central Valley Project and State Water Project Operations, and are not included in this appendix.

4A.1.1 Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972, also known as the Clean Water Act (CWA), established the institutional structure for the U.S. Environmental Protection Agency (USEPA) to regulate discharges of pollutants into the waters of the United States, establish water quality standards, conduct planning studies, and provide funding for specific grant projects. The Clean Water Act was further amended through the Clean Water Act of 1977 and the Water Quality Act of 1987. The California State Water Resources Control Board (SWRCB) has been designated by the USEPA along with the nine Regional Water Quality Control Boards (RWQCBs) to develop and enforce water quality objectives and implementation plans in California, as described below under Section 4A.2, State Policies and Regulations.

Section 401 of the CWA requires water discharges into navigable waters of the United States to apply for a Federal license or permit and to certify that the discharge will be in compliance with specified provisions of the CWA. Federal permits that are issued related to disturbance of waters of the United States (such as streams and wetlands) also require a Water Quality Certification in accordance with CWA Section 401. In California, Section 401 water quality certifications are issued by the RWQCB and/or the SWRCB, in accordance with the California Code of Regulations Title 23, sections 3836, 3855, and 3856.

Section 402 established the National Pollutant Discharge Elimination System (NPDES) permit program to regulate point-source and nonpoint-source discharges of pollutants into waters of the United States. An NPDES permit sets specific discharge limits for point and nonpoint sources discharging pollutants into waters of the United States and establishes monitoring and reporting requirements. The NPDES permits are issued for long-term discharges, including discharges from treatment plants, and temporary discharges, such as discharges during construction activities (e.g., General Permit for Storm Water Discharges Associated with Construction Activities).

Section 404 requires the U.S. Army Corps of Engineers (USACE) to issue permits for discharge of dredge or fill material into navigable waters, their tributaries, and associated wetlands. Activities regulated by 404 permits include, but are not limited to, dredging, bridge construction, flood control actions, and some fishing operations.

Section 303 requires preparation of basin plans that designate the beneficial uses of waters within each watershed basin and identify water quality objectives designed to protect the beneficial uses. Under Section 303(d), the USEPA identifies and ranks waterbodies for which existing pollution controls are insufficient to attain or maintain water quality standards based upon information prepared by all states, territories, and authorized Indian tribes. This list of impaired waters for each state comprises the state's 303(d) list. Each state must establish priority rankings and develop Total Maximum Daily Loads (TMDLs) for all impaired waters. TMDLs calculate the greatest pollutant load that a waterbody can receive and still meet water quality standards and designated beneficial uses.

The National Toxics Rule was established by USEPA in 1992 to provide ambient water quality criteria for priority toxic pollutants to protect aquatic life and human health in accordance with CWA Section 303.

The Secretary of the Interior established the first antidegradation policy in 1968. In 1975, USEPA included the antidegradation requirements in the Water Quality Standards Regulation (40 Code of Federal Regulations [CFR] 130.17, 40 CFR 55340-41). The requirements were included in the 1987 CWA amendment in Section 303(d)(4)(B). The Federal antidegradation policy requires states to develop regulations to allow increases in pollutant loadings or changes in surface water quality only if: (1) existing surface water uses are maintained and protected, and established water quality requirements are met; (2) if water quality requirements cannot be maintained by a project, water quality must be maintained to fully protect "fishable/swimmable" uses and other existing uses; and (3) for Outstanding National Resource Waters water quality criteria where "States may allow some limited activities which result in temporary and short-term changes in water quality" (Water Quality Standards Regulations) but would not impact existing uses or special use of these waters.

4A.1.2 Federal Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The SDWA authorizes USEPA to set national health-based standards for drinking water to protect against both naturally occurring and human-made contaminants that may be found in drinking water. The law was amended in 1986 and 1996, and requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells.

4A.1.3 U.S. Army Corps of Engineers Public Notice 5820A

Section 10 of the Rivers and Harbors Act of 1899 requires that a letter of permission or permit be obtained from the USACE for the construction of structures in, over, or under; excavation of material from; and deposition of material into navigable waters of the United States regulated by USACE. "Navigable waters of the United States" is defined as those waters subject to the ebb and flow of the tide shoreward to the mean high-water mark or those that are used, have been used in the past, or may be susceptible to use in interstate or foreign commerce.

4A.1.4 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act, as amended in 1964, was enacted to protect fish and wildlife when Federal actions result in the control or modification of a natural stream or body of water. The statute requires Federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife resources. Consultation and coordination with the U.S. Fish and Wildlife Service (USFWS) and state fish and game agencies are required to address ways to prevent loss of and damage to fish and wildlife resources and to further develop and improve these resources.

4A.1.5 Endangered Species Act

The Federal Endangered Species Act (ESA) applies to proposed Federal, state, and local projects that may result in the "take" of a fish or wildlife species that is federally listed as threatened or endangered and to actions that are proposed to be authorized, funded, or undertaken by a Federal agency and that may jeopardize the continued existence of any federally listed fish, wildlife, or plant species or which may adversely modify or destroy designated critical habitat for such species. "Take" is defined under the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct" (16 United States Code [U.S.C.] Section 1532(19)). Under Federal regulations, "harm" is defined as "an act which actually kills or injures wildlife," including significant habitat modification or degradation where it actually results, or is reasonably expected to result, in death or injury to wildlife by substantially impairing essential behavioral patterns, including breeding, feeding, sheltering, spawning, rearing, and migrating (50 CFR sections 17.3, 222.102). "Harass" is defined similarly broadly. If there is a potential that implementing a project would result in take of a federally listed species, either a habitat conservation plan (HCP) and incidental take permit, under Section 10(a) of the ESA, or a Federal interagency consultation, under Section 7 of the ESA, is required.

Under the ESA, the National Marine Fisheries Service (NMFS) has jurisdiction over anadromous fish, marine fish and reptiles, and most marine mammals, and the USFWS has jurisdiction over all other species, including all terrestrial and plant species, freshwater fish species, and a few marine mammals (such as the California sea otter). Listed species within the project area are described in subsequent sections of this appendix.

Besides listing species within their respective jurisdictions as threatened or endangered, issuing incidental take permits, and conducting interagency consultations, USFWS and NMFS also are charged with designating "critical habitat" for threatened and endangered species, which the ESA defines as (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to a species' conservation, and those features may require special management considerations or protection, and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation of the species (16 U.S.C. Section 1532(5)(A)). USFWS and NMFS also prepare draft recovery plans for the listed species.

4A.1.5.1 NMFS Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead

The NMFS Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead provides a roadmap that describes the steps, strategy, and actions recommended to return winter-run Chinook Salmon, spring-run Chinook Salmon, and Steelhead to viable status in the Central Valley, thereby ensuring their long-term persistence and evolutionary potential. The general near-term strategic approach to recovery includes the following elements:

- Secure all extant populations.
- Begin collecting distribution and abundance data for Steelhead in habitats accessible to anadromous fish.
- Minimize straying from hatcheries to natural spawning areas.
- Conduct critical research on fish passage above rim dams, reintroductions, and climate change.

The long-term approach to recovery includes the following elements:

- Ensure that every extant diversity group has a high probability of persistence.
- Until all evolutionarily significant unit viability criteria have been achieved, no population should be allowed to deteriorate in its probability of persistence.
- High levels of recovery should be attempted in more populations than identified in the diversity group viability criteria because not all attempts will be successful.
- Individual populations within a diversity group should have persistence probabilities consistent with a high probability of diversity group persistence.
- Within a diversity group, the populations to be restored/maintained at viable status should be selected.

- Allow for normative metapopulation processes, including the viability of core populations, which are defined as the most productive populations.
- Allow for normative evolutionary processes, including the retention of genetic diversity and an increase in genetic diversity through the addition of viable populations in historical habitats.
- Minimize susceptibility to catastrophic events.

4A.1.5.2 USFWS Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes

The Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes, released in 1996, addresses the recovery needs for several fishes that occupy the Sacramento-San Joaquin Delta, including Delta Smelt, Sacramento Splittail, Longfin Smelt, Green Sturgeon, Chinook Salmon (spring-run, late fall-run, and San Joaquin fall-run), and Sacramento Perch (believed to be extirpated). The objective of the plan is to establish self-sustaining populations of these species that will persist indefinitely. This objective would be accomplished by managing the estuary to provide better habitat for aquatic life in general and for the fish addressed by the plan. Recovery actions include tasks such as increasing freshwater flows; reducing fish entrainment losses to water diversions; reducing the effects of dredging, contaminants, and harvest; developing additional shallow-water habitat, riparian vegetation zones, and tidal marsh; reducing effects of toxic substances from urban nonpoint sources; reducing the effects of introduced species; and conducting research and monitoring.

4A.1.6 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act (Public Law 104 to 297), requires that all Federal agencies consult with NMFS on activities or proposed activities authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat (EFH) for commercially managed marine and anadromous fish species. EFH includes specifically identified waters and substrate necessary for fish spawning, breeding, feeding, or growing to maturity. EFH also includes all habitats necessary to allow the production of commercially valuable aquatic species, to support a long-term sustainable fishery, and to contribute to a healthy ecosystem (16 U.S.C. Section 1802(10)).

In addition to riverine reaches supporting Chinook Salmon, the Pacific Fishery Management Council (PFMC) has designated the Sacramento-San Joaquin Delta (Delta), San Francisco Bay, and Suisun Bay as EFH to protect and enhance habitat for coastal marine fish and macroinvertebrate species that support commercial fisheries such as Pacific salmon. Chinook Salmon and Coho Salmon are Actively Managed Species under the Pacific Coast Salmon Plan. Because EFH applies only to commercial fisheries, Chinook and Coho Salmon habitats are included, but not those of Steelhead.

Three fishery management plans—Pacific Salmon, Coastal Pelagic, and Groundfish—have been issued by the PFMC for several species that occur in the project area. The Northern Anchovy and Starry Flounder are identified by the PFMC as Monitored Species in the Coastal Pelagic Species Fishery Management Plan and the Pacific Coast Groundfish Fishery Management Plan, respectively, and are subject to EFH consultation as a result. Pacific Sardine are classified as an Actively Managed Species in the Coastal Pelagic Species Fishery Management Plan.

4A.1.7 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) was enacted in 1972. All marine mammals are protected under the MMPA. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. It defines "take" to mean "to hunt harass, capture, or kill" any marine mammal or attempt to do so. Exceptions to the moratorium can be made through permitting actions for take incidental to commercial fishing and other nonfishing activities; for scientific research; and for public display at licensed institutions such as aquaria and science centers.

4A.1.8 National Invasive Species Act of 1996

The National Invasive Species Act (Public Law 104-332) reauthorizes and amends the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 to mandate regulations to reduce environmental and economic impacts from invasive species and to prevent introduction and spread of aquatic nuisance species, primarily through ballast water. As the primary Federal law regulating ballast water discharges, the act calls primarily for voluntary ballast water exchange by vessels entering the United States after operating outside the 200-nautical-mile Exclusive Economic Zone of the United States.

The authority to regulate ballast water discharges in the United States has recently shifted to include the USEPA in addition to the U.S. Coast Guard. Since February 2009, the USEPA must regulate ballast water and other discharges incidental to normal vessel operations under Section 402 of the CWA. U.S. Coast Guard regulations, developed under authority of the revised and reauthorized act, also require ballast water management (i.e., ballast water exchange) for vessels entering United States waters from outside the Exclusive Economic Zone, with certain exceptions. The act also authorized funding for research on aquatic nuisance species prevention and control in San Francisco Bay, the Delta, the Pacific Coast, and other areas of the United States.

4A.1.8.1 Executive Order 13112: Invasive Species

Executive Order (EO) 13112 (February 3, 1999) directs all Federal agencies to prevent and control the introduction and spread of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their effects on economic, ecological, and human health. The executive order was intended to build on existing laws, such as National Environmental Policy Act (NEPA), the

Nonindigenous Aquatic Nuisance Prevention and Control Act, the Lacey Act, the Plant Pest Act, the Federal Noxious Weed Act, and the ESA. EO 13112 established a national Invasive Species Council made up of Federal agencies and departments, and a supporting Invasive Species Advisory Committee composed of state, local, and private entities. The Invasive Species Council and Advisory Committee oversee and facilitate implementation of the executive order, including preparation and revision of the National Invasive Species Management Plan.

4A.1.9 Wild and Scenic Rivers Act

Congress created the National Wild and Scenic Rivers Act in 1968 (Public Law 90-542; U.S.C. 1271 et seq.) to preserve rivers and outstanding natural, cultural, or recreational features in a free-flowing condition. High priority is placed on visual resource management of these rivers to preserve or restore their scenic characteristics. Under this act, a Federal agency may not assist the construction of a water resources project that would have a direct and adverse effect on the free-flowing, scenic, and natural values of a wild or scenic river. If the project would affect the free-flowing characteristics of a designated river or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area, such activities should be undertaken in a manner that would minimize adverse impacts and should be developed in consultation with the National Park Service.

4A.1.10 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) implements a series of international treaties that provide migratory bird protection. The MBTA authorizes the Secretary of the Interior to regulate the taking of migratory birds, and the act provides that it shall be unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird" (16 U.S.C. Section 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the MBTA was published in the March 10, 2010, *Federal Register* (*Federal Register*, Volume 75, page 9282 [75 FR 9282]).

4A.1.10.1 Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

EO 13186 (January 10, 2001) directs Federal agencies that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement a memorandum of understanding with USFWS to promote the conservation of migratory bird populations. The memorandum of understanding should include implementation actions and reporting procedures that would be followed through each agency's formal planning process, such as resource management plans and fisheries management plans.

4A.1.10.2 North American Waterfowl Management Plan and Central Valley Joint Venture

In 1986, the North American Waterfowl Management Plan (NAWMP) was signed by the United States and Canada. It provides a broad framework for waterfowl management through 2000 and includes recommendations for wetland and upland habitat protection, restoration, and enhancement. Implementing the NAWMP is the responsibility of designated joint ventures. The Central Valley Habitat Joint Venture, formally organized in 1988, was one of the original six priority joint ventures formed under the NAWMP. Renamed the Central Valley Joint Venture in 2004, it is composed of 21 Federal and state agencies, conservation organizations, and Pacific Gas and Electric Company (PG&E).

4A.1.11 Executive Order 11990: Protection of Wetlands

EO 11990 (May 24, 1977) established the protection of wetlands and riparian systems as the official policy of the Federal government. It requires all Federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

4A.1.12 Federal Power Act

The Federal Power Act, 16 U.S.C. § 791-828(c), passed in 1920 and amended in 1935 and 1986, created what is now the Federal Energy Regulatory Commission (FERC), an independent regulatory agency that oversees the natural gas, oil, and electricity markets, regulates the transmission and sale of these energy resources (except for oil), provides licenses for non-federal hydroelectric plants, and addresses environmental matters arising in any of the areas above. The agency is governed by a five-member commission appointed by the President with the advice and consent of the Senate. The Electric Consumers Protection Act of 1986 amended the Federal Power Act of 1920 to require FERC to give equal consideration to non-power-generating values such as the environment, recreation, fish, and wildlife, as is given to power and development objectives when making hydroelectric project licensing decisions.

4A.1.13 Western Area Power Administration

The Western Area Power Administration (Western) is one of four power marketing administrations within the U.S. Department of Energy that markets and transmits electricity from multi-use water projects to retail power distribution companies and public authorities. Western markets and delivers hydroelectric power and related services within a 15-state region of the central and western United States. The transmission system carries electricity from 55 hydropower plants operated by Reclamation, USACE, and the International Boundary and Water Commission. Together, these plants have a capacity of 10,600 megawatts.

Western sells excess Central Valley Project (CVP) capacity and energy that are supplementary to CVP internal needs to municipal utilities, irrigation districts, and institutions and facilities such as wildlife refuges, schools, prisons, and military bases at rates designed to recover CVP costs. As part of its marketing function, Western ensures that CVP project use loads are met at all times by using a mix of generation resources including CVP generation and other purchased resources. In marketing power surplus to the CVP project needs, Western follows a formal procedure for allocating CVP energy to preference customers.

Preference power customers have 20-year contracts for their share of the CVP energy that is in excess of CVP needs.

In addition to preference power customers, there are also first preference customers. First preference customers are a special class of customers who are statutorily entitled to up to 25 percent of the generation built in their counties. The two CVP projects whose enabling legislation provided for first preference power are New Melones Dam, located in Tuolumne and Calaveras counties, and Trinity and Lewiston dams, located in Trinity County.

4A.1.14 Farmland Protection Policy Act

The Farmland Protection Policy Act (FPPA) directs Federal agencies to consider the effects of Federal programs or activities on farmland, and ensure that such programs, to the extent practicable, are compatible with state, local, and private farmland protection programs and policies. The FPPA is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. It assures that, to the extent possible, Federal programs are administered to be compatible with state, local units of government, and private programs and policies to protect farmland. Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. Activities that may be subject to the FPPA include (among others) reservoir and hydroelectric projects, Federal agency projects that convert farmland, and other projects completed with Federal assistance. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) implements the FPPA. The NRCS has established a rating process under the FPPA to assess options for land use on an evaluation of productivity weighed against commitment to urban development.

4A.1.15 Coastal Zone Management Act

Congress passed the Coastal Zone Management Act (CZMA) in 1972 in response to the challenges of growth in coastal areas of the United States. The act is intended to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The CZMA is administered by the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (OCRM), and provides incentives for states to manage and protect their coastal resources. The CZMA encourages states to prepare coastal zone management programs that meet specified requirements and submit them to the OCRM for approval. States with approved coastal management programs become eligible for Federal funding assistance and other benefits. Applicants for Federal permits and licenses and Federal agencies proposing specific activities in the coastal zone are required by the CZMA to obtain a consistency certification from the state's coastal management agency.

The California Coastal Commission is the lead agency for the Coastal Zone Management Program in California. In California, the Coastal Zone Management Program includes the Pacific Ocean coast and the area within San Francisco Bay and Suisun Marsh under the jurisdiction of the San Francisco Bay Conservation and Development Commission.

4A.1.16 Federal Water Project Recreation Act

The Federal Water Project Recreation Act (16 U.S.C. sections 460(L)(12)–460(L)(21)) declares the intent of Congress that recreation and fish and wildlife enhancement be given full consideration as purposes of Federal water development projects if non-federal public bodies agree to: (1) bear not less than one-half the separable costs allocated for recreational purposes or 25 percent of the cost for fish and wildlife enhancement; (2) administer project land and water areas devoted to these purposes; and (3) bear all costs of operation, maintenance and replacement. Where Federal lands or authorized Federal programs for fish and wildlife conservation are involved, cost-sharing is not required.

This act also authorizes the use of Federal water project funds for land acquisition in order to establish refuges for migratory waterfowl when recommended by the Secretary of the Interior, and authorizes the Secretary to provide facilities for outdoor recreation and fish and wildlife at all reservoirs under Department of the Interior (DOI) control, except those within national wildlife refuges.

4A.1.17 Federal Land and Water Conservation Fund Act

The Land and Water Conservation Fund was established by Congress in 1964 and is administered by the National Park Service. The fund provides money to Federal, state, and local agencies as well as to six territories to purchase lands, waters, and wetlands for the benefit of all Americans. Lands and waters purchased through the Land and Water Conservation Fund are used to:

- Provide recreational opportunities
- Provide clean water
- Preserve wildlife habitat
- Enhance scenic vistas
- Protect archaeological and historical sites
- Maintain the pristine nature of wilderness areas

4A.1.18 Bureau of Land Management Resource Management Plans

Under the Federal Land Policy and Management Act of 1976, DOI Bureau of Land Management (BLM) is responsible for managing public lands for multiple uses and sustained yield, ensuring that the scenic values of these public lands are considered, and avoiding land uses that may have negative impacts. Resource management plans for public lands are developed to guide BLM actions to protect ecological and scientific values; preserve public lands in their natural condition, where appropriate; provide food and habitat for fish and wildlife and domestic animals; provide for outdoor recreation and human occupancy and use; and recognize the nation's need for natural resources from the public lands, such as minerals, food, timber, and fiber.

4A.1.19 Federal Clean Air Act

National air quality policies are regulated through the Federal Clean Air Act (CAA) of 1970 and its 1977 and 1990 amendments. Basic elements of the CAA include national ambient air quality standards (NAAQS) for criteria air pollutants, hazardous air pollutants standards, state attainment plans, motor vehicle emissions standards, stationary source emissions standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

4A.1.19.1 National Ambient Air Quality Standards and Federal Air Quality Designations

Pursuant to the CAA, the USEPA establishes NAAQS for ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur oxides (SOx), particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), and lead (Pb). These pollutants are referred to as criteria pollutants because numerical health-based criteria have been established that define acceptable levels of exposure for each pollutant.

The USEPA has revised the NAAQS several times since their original implementation and will continue to do so as the health effects of exposure to pollution are better understood. As new NAAQS are adopted, ambient air quality monitoring data are reviewed by the regulatory agencies for each geographic area, and the USEPA uses the findings to designate the area's pollutant-specific attainment status.

The USEPA designates areas as attainment, nonattainment, or unclassified for individual criteria pollutants depending on whether the area achieves (i.e., attains) the applicable NAAQS for each pollutant. An area can be designated as attainment for one pollutant (for example, NO_2) and nonattainment for others (for example, O_3 and PM_{10}). Areas that lack monitoring data are designated as unclassified areas. Unclassified areas are treated as attainment areas for regulatory purposes.

For some pollutants, there are numerous classifications of the nonattainment designation, depending on the severity of an area's nonattainment status. For example, the O_3 nonattainment designation has eight subclasses: basic, transitional, marginal, moderate, serious, severe 15, severe 17, and extreme.

Under the 1977 CAA amendments, states (or areas within states) with ambient air quality concentrations that do not meet the NAAQS are required to develop and maintain state implementation plans (SIPs). These plans constitute a federally enforceable definition of the state's approach and schedule for the attainment of the NAAQS.

Areas that were designated as nonattainment in the past but have since achieved the NAAQS are further classified as attainment maintenance areas. The maintenance classification remains in effect for 20 years from the date when the area is determined by the USEPA to meet the NAAQS. States must obtain USEPA approval of maintenance plans to ensure continued attainment over these 20-year time frames.

4A.1.19.2 Federal General Conformity Requirements

The 1977 CAA amendments state that the Federal government is prohibited from engaging in, supporting, providing financial assistance for, licensing, permitting, or approving any activity that does not conform to an applicable SIP. In the 1990 CAA amendments, the USEPA included provisions requiring Federal agencies to ensure that actions undertaken in nonattainment or attainment maintenance areas are consistent with applicable SIPs. The process of determining whether a Federal action is consistent with applicable SIPs is called "conformity" determination.

These conformity provisions were put in place to ensure that Federal agencies would contribute to and not undermine efforts to attain the NAAQS. The USEPA has issued two conformity regulations: (1) a transportation conformity regulation that applies to transportation plans, programs, and projects and (2) a general conformity regulation that applies to all other Federal actions. A conformity determination is a process that demonstrates how an action would conform to the applicable SIP, and is required only for the project alternative that is ultimately selected and approved. If a project's emissions cannot be reduced sufficiently and if air dispersion modeling cannot demonstrate conformity, then either a plan for mitigating or a plan for offsetting the emissions would need to be developed. The general conformity determination is submitted in the form of a written finding that is issued after a minimum 30-day public comment period on the draft determination.

The USEPA general conformity regulation applies only to Federal actions that result in emissions of "nonattainment or maintenance pollutants" or their precursors in federally designated nonattainment or maintenance areas. The general conformity regulation establishes a process to demonstrate that Federal actions would be consistent with applicable SIPs and would not cause or contribute to new violations of the NAAQS, increase the frequency or severity of existing violations of the NAAQS, or delay the timely attainment of the NAAQS. The emission thresholds that trigger requirements of the general conformity regulation for Federal actions emitting nonattainment or maintenance pollutants, or their precursors, are called *de minimis* levels.

4A.1.19.3 Prevention of Significant Deterioration/New Source Review and New Source Performance Standards

The CAA and amendments also include regulations intended to prevent significant deterioration of air quality in attainment or maintenance areas, to provide for New Source Review (NSR) of major sources and modifications in nonattainment areas, and to establish emission performance standards for new stationary sources or New Source Performance Standards (NSPS). Federal Prevention of Significant Deterioration (PSD)/NSR regulations apply to major stationary sources of emissions in attainment and maintenance areas. NSPS apply to various types of new, modified, or reconstructed emissions units, and apply to such units regardless of whether these units are located at facilities that are "major" sources of emissions for PSD/NSR purposes.

4A.1.19.4 Federal Regulations for Hazardous Air Pollutants

Hazardous air pollutants (HAPs) are defined as air pollutants that may cause serious human health effects, including mortality, but which are not regulated through issuance of a national ambient air quality standard.

The USEPA has developed regulations to evaluate and, if necessary, mitigate HAPs emissions sources. Prior to the 1990 CAA amendments, the USEPA established pollutant-specific National Emission Standards for Hazardous Air Pollutants (NESHAPs). NESHAPs were established for benzene, vinyl chloride, radionuclides, mercury, asbestos, beryllium, inorganic arsenic, radon 222, and coke oven emissions. The 1990 CAA amendments list 189 total pollutants that are defined as HAPs. For this list of pollutants, the USEPA is required to set standards for categories and subcategories of sources that emit HAPs, rather than for the pollutants themselves. USEPA began issuing the new standards, referred to as Maximum Achievable Control Technology (MACT) standards, in November 1994. NESHAPs set before 1991 remain applicable.

The applicability of MACT standards is typically determined by each facility's Potential To Emit (PTE) HAPs from all applicable sources. The facility-wide PTE HAP applicability threshold values are 10 tons per year (tpy) for a single HAP and 25 tpy for any two or more HAPs.

4A.1.19.5 Federal Standards for Mobile Sources

The USEPA's Office of Transportation and Air Quality regulates air pollution from motor vehicles and engines and the fuels used to operate them. The USEPA defines "mobile sources" to include cars, light-duty trucks, heavy-duty trucks, buses, recreational vehicles (such as dirt bikes and snowmobiles), farm and construction machines, lawn and garden equipment, marine engines, aircraft, and locomotives.

Starting in the 1970s, the USEPA has established progressively more stringent standards for CO, hydrocarbons, nitrogen oxides (NOx), and particulate matter (PM) emissions from on-road vehicles. Since the early 1990s, USEPA has developed similar standards for non-road engines and equipment, and also set tighter limits on sulfur allowed in fuels used for mobile sources. Emission standards set limits on the amount of pollution a vehicle or engine can emit, and are designed to force future vehicles and engines to meet stricter standards.

4A.1.20 Federal Policies and Regulations for Greenhouse Gas Emissions

Currently, no Federal regulations or standards specifically regulate greenhouse gas (GHG) emissions for the purposes of addressing climate change. The Council on Environmental Quality (CEQ) has issued draft NEPA guidance on GHG and climate change. USEPA, through the CAA, regulates emissions of certain GHGs through its mobile source standards and stationary source permitting regulations. The U.S. Supreme Court in Massachusetts v. USEPA (Supreme Court Case 05-1120) found that USEPA has the authority to list GHGs as pollutants and to regulate emissions of GHGs under the CAA.

4A.1.20.1 CEQ Guidance Related to Greenhouse Gas Emissions

The CEQ has issued updated draft NEPA guidance on the consideration of the effects of climate change and GHG emissions. Issued on December 18, 2014, this guidance advises Federal agencies that they should consider the GHG emissions caused by Federal actions, adapt their actions to consider climate change effects throughout the process, and address these issues in their agency procedures. Where applicable, the scope of the NEPA analysis should cover the GHG emissions effects of a proposed action and alternative actions, as well as the relationship of climate change effects, on a proposed action or alternatives. The CEQ guidance is still considered draft as of the writing of this document and is not an official CEQ policy document.

4A.1.20.2 Mandatory Greenhouse Gas Reporting Rule

On September 22, 2009, USEPA released its final Greenhouse Gas Reporting Rule (Reporting Rule). The Reporting Rule applies to most entities that emit 25,000 metric tpy of carbon dioxide equivalents (CO2e) or more. Starting in 2010, owners of facilities of sufficient size were required to submit an annual GHG emissions report with detailed calculations of GHG emissions from specified sources, such as stationary source fuel combustion. The Reporting Rule mandates recordkeeping, and administrative requirements allow USEPA to verify the annual GHG emissions reports.

4A.1.20.3 Environmental Protection Agency Endangerment and Cause and Contribute Findings

On December 7, 2009, the USEPA Administrator signed two distinct findings regarding GHGs under Section 202(a) of the CAA:

- **Endangerment Finding:** The Administrator found that the current and projected atmospheric concentrations of six key GHGs (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) threaten the public health and welfare of current and future generations.
- **Cause or Contribute Finding:** The Administrator found that the combined emissions of GHGs from new motor vehicles and new motor vehicle engines contribute to GHG pollution, which threatens public health and welfare.

In addition, USEPA has formally recognized climate change as a threat to water supply in their National Water Program strategy for response to climate change.

4A.1.20.4 Greenhouse Gas Tailoring Rule

On May 13, 2010, the USEPA issued the Tailoring Rule to address GHG emissions from stationary sources under the CAA permitting programs for major sources. This final rule set the thresholds for Steps 1 and 2 of a phase-in approach to regulating GHG emissions under the PSD/NSR and Title V Operating Permit programs. Neither of these major source permitting programs is applicable to the Transfer Project or the Proposed Project or any of the alternatives.

4A.1.20.4.1 Light-Duty Vehicle Greenhouse Gas Emission Standards and Fuel Economy Standards

On May 7, 2010, the USEPA and the National Highway and Traffic Safety Administration issued a joint final rule for Light-Duty Vehicle GHG Emission Standards and Corporate Average Fuel Economy Standards. The standards have been developed to reduce GHG emissions from mobile sources and improve fuel economy.

4A.1.21 Antiquities Act of 1906

The Antiquities Act of 1906 (16 U.S.C. sections 431–433) was the first Federal legislation promulgated to protect cultural resources on Federal lands. The act establishes a permit program for qualified institutions and provides fines or imprisonment for unpermitted persons convicted of appropriating, excavating, injuring, or destroying historic or prehistoric resources or objects of antiquity on lands controlled or managed by the Federal government.

4A.1.22 The Archaeological Resources Protection Act of 1979

The Archaeological Resources Protection Act of 1979 (16 U.S.C. sections 470aa-470mm) was adopted to strengthen the enforcement and penalties of the Antiquities Act. It regulates and permits the excavation of archaeological sites on Federal and Indian lands, and governs the removal and management of archaeological collections from these sites. It allows for enforcement of criminal and civil penalties against those who loot, vandalize, or illegally buy or sell archaeological resources (defined as items of at least 100 years of age).

4A.1.23 National Historic Preservation Act of 1966

Section 106 of the National Historic Preservation Act of 1966 (NHPA) and its implementing regulations (36 CFR Part 800) require Federal agencies to consider the effects of their undertakings on cultural resources that are, or that may be, eligible for listing in the National Register of Historic Places (NRHP) and to afford the Advisory Council on Historic Preservation an opportunity to comment. NRHP-eligible resources are considered to be "significant." The criteria used to evaluate eligibility for listing in the NRHP are further discussed in the next subsection.

The Section 106 process that is typically associated with NEPA compliance requires consultation of the Federal lead agency with other Federal, state, and local agencies, the Advisory Council on Historic Preservation, the State Historic Preservation Officer, Indian tribes, and interested members of the public, such as historical societies. Throughout the Section 106 process, the Federal lead agency and consulting parties work together to identify adverse impacts on sites of cultural significance or historic properties, and seek ways to avoid, minimize, or mitigate the adverse effects. A Memorandum of Agreement or Programmatic Agreement is issued by the participating parties that includes the measures agreed upon to avoid or reduce (i.e., mitigate) adverse effects. For large or complex undertakings, a Programmatic Agreement may also be negotiated to develop a phased approach to historic properties management or alternative Section 106 processes through consultations. Thus, impacts to cultural resources that are identified in a NEPA document are addressed through Section 106.

Section 110 of the NHPA sets out the broad responsibilities of Federal agencies for identifying and protecting historic properties under their jurisdiction, and for avoiding unnecessary damage to them. It is intended to ensure that an historic preservation program is fully integrated into the ongoing program of each Federal agency. Section 110 allows the costs of preservation activities as eligible project costs in all undertakings conducted or assisted by a Federal agency. Federal agencies are directed to withhold grants, licenses, approvals, or other assistance to applicants who intentionally damage or adversely affect historic properties in an effort to avoid the Section 106 process.

4A.1.24 National Register of Historic Places

The NRHP was authorized under the NHPA to identify, evaluate, and protect historic and archaeological resources. The National Park Service, under the Secretary of the Interior, administers the NRHP through the consultation and review functions of the Advisory Council on Historic Preservation. Properties listed in the NRHP include districts, sites, buildings, structures, and objects that are significant to American history, architecture, archaeology, engineering, and culture. These resources contribute to an understanding of the historical and cultural foundations of the nation. The NRHP eligibility criteria are presented in 36 CFR Section 60.4.

4A.1.25 American Indian Religious Freedom Act

The American Indian Religious Freedom Act of 1978 protects the rights of Native Americans to freedom of expression of traditional religions (24 U.S.C. Section 1996). This act established "the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions… including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites."

4A.1.26 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act provides a systematic process for determining the rights of lineal descendants and recognized Indian tribes and Native Hawaiian organizations to claim and recover Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony. Native American descendants, tribes, and organizations are to be consulted when such items are inadvertently discovered or intentionally excavated on Federal or tribal lands. Regulations in 43 CFR Part 10, Section 10.4, outline requirements for notification of inadvertent discoveries, ceasing activity, consultation, disposition of the items, and resumption of activity. The act also covers claims and recovery of Native American human remains and burial artifacts held by the Federal government or federally funded museums.

4A.1.27 Indian Trust Asset Policies

Indian trust assets (ITAs) are legal interests in property held in trust by the U.S. Government for federally-recognized Indian tribes or individual Indians. An Indian trust has three components: (1) the trustee, (2) the beneficiary, and (3) the trust asset. ITAs can include land, minerals, federally-reserved hunting and fishing rights, federally-reserved water rights, and in-stream flows associated with trust land. Beneficiaries of the Indian trust relationship are federally-recognized Indian tribes with trust land; the U.S. is the trustee. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the U.S. The characterization and application of the U.S. trust relationship have been defined by case law that interprets Congressional acts, executive orders, and historical treaty provisions.

The Federal government, through treaty, statute, or regulation, may take on specific, enforceable fiduciary obligations that give rise to a trust responsibility to federally-recognized tribes and individual Indians possessing trust assets. Courts have recognized an enforceable Federal fiduciary duty with respect to Federal supervision of Indian money or natural resources, held in trust by the Federal government, where specific treaties, statutes or regulations create such a fiduciary duty.

Consistent with President William J. Clinton's 1994 memorandum, "Government-to-Government Relations with Native American Tribal Governments," Bureau of Reclamation (Reclamation) assesses the effect of its programs on tribal trust resources and federally-recognized tribal governments. Reclamation is tasked to actively engage federally-recognized tribal governments and consult with such tribes on government-to-government level when its actions affect ITAs (*Federal Register*, Vol. 59, No. 85, May 4, 1994, pages 22951–22952). The DOI Departmental Manual Part 512.2 ascribes the responsibility for ensuring protection of ITAs to the heads of bureaus and offices. DOI is required to carry out activities in a manner that protects ITAs and avoids adverse effects whenever possible.

4A.1.28 Indian Sacred Sites on Federal Land

EO 13007 provides that in managing Federal lands, each Federal agency with statutory or administrative responsibility for management of Federal lands shall, to the extent practicable and as permitted by law, accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and avoid adversely affecting the physical integrity of such sacred sites.

4A.1.29 Federal Policies and Regulations Related to Environmental Justice

4A.1.29.1 Executive Order 12898

EO 12898, issued by President Clinton in 1994, requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations….” In his memorandum transmitting EO 12898 to Federal agencies, President Clinton further specified that, “each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act [NEPA] of 1969.” Guidance on how to implement EO 12898 and conduct an Environmental Justice analysis has been issued by the President’s Council on Environmental Quality.

4A.1.29.2 Title VI of the Civil Rights Act of 1964

Title VI of the Civil Rights Act of 1964 states that “No person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.” Title VI bars intentional discrimination, but also unjustified disparate impact discrimination resulting from policies and practices that are neutral on their face (i.e., there is no evidence of intentional discrimination) but have the effect of discrimination on protected groups.

4A.1.29.3 Council on Environmental Quality Guidance for Environmental Justice

The CEQ issued guidance in 1997 entitled “Environmental Justice: Guidance under the National Environmental Policy Act” that established the role of EO 12898 as it relates to actions subject to NEPA. The guidance also established the criteria for identifying environmental justice populations and how to consider the involvement of environmental justice groups throughout phases of the NEPA process.

4A.2 State Policies and Regulations

State policies and regulations presented in this appendix are related to requirements that affect surface water, biological, energy, agricultural, air quality and cultural resources. State policies and regulations that affect operations of the Central Valley Project and State Water Project are included in Appendix 3A, No Action Alternative: Central Valley Project and State Water Project Operations, and are not included in this appendix.

4A.2.1 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) established surface water and groundwater quality guidelines and provided the authority for the SWRCB to protect the state’s surface water and groundwater. Nine RWQCBs have been established to oversee and implement specific water quality activities in their geographic jurisdictions.

The Porter-Cologne Act also requires that each RWQCB develop basin plans that establish and periodically review the beneficial uses and water quality objectives for groundwater and surface waterbodies within its jurisdiction. Water quality objectives developed by the regional boards provide specific water quality guidelines to protect groundwater and surface water to maintain designated beneficial uses. The SWRCB, through its RWQCBs, is the permitting authority in California to administer NPDES permits and Waste Discharge Requirements permits for regulation of waste discharges in the respective jurisdictions.

4A.2.1.1 Regional Water Quality Control Board Basin Plans

The RWQCBs are required to formulate and adopt basin plans for all areas under their jurisdiction under the Porter-Cologne Act. Each basin plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the basin plans.

Section 13050(f) of the Porter-Cologne Act lists the beneficial uses of the waters of the state that may be protected against water quality degradation, which include but are not limited to: domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. Basin plans must designate and protect beneficial uses in the region. A uniform list of beneficial uses is defined by the SWRCB; however, each RWQCB may identify additional beneficial uses specific to local waterbodies.

Basin plans must adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the CWA. These water quality standards include: designated beneficial uses; water quality objectives to protect the beneficial uses; implementation of the Federal and state policies for antidegradation; and general policies for application and implementation.

The basin plans are subject to modification, considering applicable laws, policies, technologies, water quality conditions, and priorities. Basin plans must be assessed every 3 years for the appropriateness of existing standards and evaluation and prioritization of basin planning issues. In California, however, waterbodies are assessed every 2 years for CWA 303(d) and 305(b) requirements. Revisions are accomplished through basin plan amendments. Once a basin plan amendment is adopted in noticed public hearings, it must be approved by the SWRCB Office of Administrative Law and, in some cases, the USEPA.

4A.2.1.2 State Antidegradation Policy

California's Antidegradation Policy, formally known as the Statement of Policy with Respect to Maintaining High Quality Waters in California (State Water Board Resolution No. 68-16), restricts degradation of surface waters and groundwaters. In particular, this policy protects waterbodies where existing quality is higher than necessary for the protection of beneficial uses. Under the Antidegradation Policy, any actions that can adversely affect water quality in all surface waters and groundwaters must:

- Meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that a pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the people of the state will be maintained;

- Not unreasonably affect present and anticipated beneficial use of the water; and
- Not result in water quality less than that prescribed in water quality plans and policies.

The state Antidegradation Policy meets the requirements of the Federal antidegradation policy.

4A.2.1.3 California Toxics Standards

The Policy for Implementing Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California is referred to as the State Implementation Policy. This state policy for water quality control, adopted by the SWRCB on March 2, 2000, and effective by May 22, 2000, applies to discharges of toxic pollutants into the inland surface waters, enclosed bays, and estuaries of California subject to regulation under the State's Porter-Cologne Act (Division 7 of the Water Code) and the Federal CWA. Such regulation may occur through the issuance of NPDES permits, or other relevant regulatory approaches. The policy establishes: (1) implementation provisions for priority pollutant criteria promulgated by the USEPA through the National Toxics Rule (40 CFR 131.36) (promulgated on December 22, 1992, and amended on May 4, 1995) and through the California Toxics Rule (40 CFR 131.38) (promulgated on May 18, 2000, and amended on February 13, 2001), and for priority pollutant objectives established by RWQCBs in their water quality control plans; (2) monitoring requirements for 2,3,7,8-tetrachlorodibenzodioxin equivalents; and (3) chronic toxicity control provisions. In addition, this policy includes special provisions for certain types of discharges and factors that could affect the application of other provisions in the policy.

The California Toxics Rule is applicable to all state waters, as are the USEPA advisory National Recommended Water Quality Criteria. Central Valley and Delta areas are subject to the 2006 Bay-Delta Water Quality Control Plan, and the Central Valley, Tulare Basin, and San Francisco Bay regional plans. Freshwater criteria apply to waters of salinity less than 1 parts per thousand 95 percent or more of the time, seawater criteria are for water greater than 10 parts per thousand 95 percent or more of the time, and estuarine waters use the more stringent of the two possible criteria, in absence of estuary-specific criteria.

The regulation of mercury contamination is approached through bioaccumulation to fish. In addition to fish fillets protective of human health, the Delta TMDL recommended concentration for mercury in small, whole-body fish to be protective of wildlife is not to exceed 0.03 mg/kg mercury wet weight. Although selenium is regulated through water quality standards, fish and bird egg tissue concentration benchmarks have been developed for use in San Francisco Bay and Delta TMDLs.

For evaluation of risks to human health, analyses of fish fillets are most common and were used in California to establish Fish Contaminant Goals and Advisory Tissue Levels, although the fish should be analyzed in the form that people may eat (for example, for some species or ethnic groups, whole-body analyses may be appropriate).

4A.2.1.4 Long-term Irrigated Lands Regulatory Program

The SWRCB and the RWQCBs implement the Irrigated Lands Regulatory Program to regulate discharges to prevent agricultural runoff from impairing surface waters. To protect these waters, the SWRCB and the RWQCBs issue conditional waivers of waste discharge requirements to growers that contain conditions requiring water quality monitoring of receiving waters and corrective actions when impairments are found.

4A.2.1.5 Nonpoint Source Implementation and Enforcement Policy

California’s Nonpoint Source Implementation and Enforcement Policy describes how its nonpoint source plan is to be implemented and enforced, in compliance with Section 319 of the CWA, Coastal Zone Act Reauthorization Amendments, and the Porter-Cologne Act. In contrast to point-source pollution that enters waterbodies from discrete conveyances, nonpoint-source pollution enters waterbodies from diffuse sources, such as land runoff, seepage, or hydrologic modification. Nonpoint-source pollution is controlled through implementation of management measures. The nonpoint source program contains recommended management measures for developing areas and construction sites, as well as wetland and riparian areas. Requirements for soil erosion and sediment controls to prevent nonpoint-source sediment discharges to waterways may be incorporated into permits issued by the San Francisco Bay Conservation and Development Commission or other regulatory entities.

4A.2.1.6 California 303(d)/305(b) Integrated Report

The California 303(d)/305(b) Integrated Report is updated biennially, as required by the USEPA, for inclusion in the USEPA’s national Water Quality Inventory Report to Congress. The report is composed of the current California 303(d) list and all current listing decisions for contaminants in impaired waterbodies. The statewide report is the compilation of 303(d)/305(b) Integrated Reports submitted by each RWQCB. The final California 303(d) list must be submitted to and approved by the USEPA before it becomes effective.

4A.2.1.7 Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS)

In 2006, the Central Valley RWQCB, the SWRCB, and stakeholders began a joint effort to address salinity and nitrate problems in California's Central Valley and adopt long-term solutions that will lead to enhanced water quality and economic sustainability. This effort is referred to as the CV-SALTS Initiative. The goal of CV-SALTS is to develop a comprehensive region-wide Salt and Nitrate Management Plan (SNMP) describing a water quality protection strategy that will be implemented through a mix of voluntary and regulatory efforts. The SNMP may include recommendations for numeric water quality objectives, beneficial use designation refinements, and/or other refinements, enhancements, or basin plan revisions. The SNMP will serve as the basis for amendments to the three basin plans that cover the Central Valley Region (the Sacramento River and San Joaquin River Basin Plan, the Tulare Lake Basin Plan, and the Sacramento/San Joaquin Rivers Bay-Delta Plan). The Basin Plan Amendments will likely establish a comprehensive implementation plan to achieve water quality objectives for salinity (including nitrate) in the region's surface waters and groundwater, and the SNMP may include recommendations for numeric water quality objectives, beneficial use designation refinements, and/or other refinements, enhancements, or basin plan revisions.

4A.2.2 California Safe Drinking Water Act

In 1976, California enacted its own Safe Drinking Water Act, requiring the Department of Public Health Services to regulate drinking water, including setting and enforcing Federal and state drinking water standards, administering water quality testing programs, and administering permits for public water system operations. The Federal Safe Drinking Water Act allows the state to enforce its own standards in lieu of the Federal standards so long as they are at least as protective as the Federal standards. Substantial amendments to the California Act in 1989 incorporated the new Federal Safe Drinking Water Act requirements into California law, provided for the state to set more stringent standards, and recommended public health levels for contaminants

4A.2.2.1 Central Valley Regional Water Quality Control Board Drinking Water Policy

A multi-year effort is underway to develop a drinking water policy for surface waters in the Central Valley. As water flows out of the Sierra foothills and into the valley, pollutants from a variety of urban, industrial, agricultural, and natural sources affect the quality of water, which leads to drinking water treatment challenges and potential public health concerns. Existing policies and plans lack water quality objectives for several known drinking water constituents of concern, such as disinfection byproduct precursors and pathogens, and do not include implementation strategies to provide effective source water protection. The Central Valley RWQCB committed to development of the Policy in Resolution R5-2004-0091 and later in Resolution R5-2010-0079. The 2010 Resolution also documented progress to date, provided direction for future actions and set deadlines for interim deliverables associated with policy development by July 2013.

4A.2.3 Area of Origin Groundwater Statute

California Water Code 1220 prohibits the pumping of groundwater "for export within the combined Sacramento and Delta–Central Sierra Basins…unless the pumping is in compliance with a groundwater management plan that is adopted by [county] ordinance." The statute enables, but does not require, the board of supervisors of any county within any part of the combined Sacramento and Delta–Central Sierra Basin to adopt groundwater management plans (GWMPs).

4A.2.4 Groundwater Management Act

Assembly Bill (AB) 3030 (1992, California Water Code sections 10750–10756) enables water agencies to develop and implement GWMPs to manage the groundwater resources in the jurisdiction of the participating parties. The state does not maintain a statewide program or mandate its implementation, but the legislation provides the guidelines and common framework through which groundwater management can be implemented. Groundwater management legislation was amended in 2002 with the passage of Senate Bill (SB) 1938, which provided additional groundwater management components supporting eligibility to obtain public funding for groundwater projects. In 2000, AB 3030 enabled the development of the Local Groundwater Assistance grant program to support local water agencies developing groundwater management programs.

4A.2.5 Groundwater Basin Adjudication Processes

Basin adjudications occur through a court decision at the end of a lawsuit. The final court decision determines the groundwater rights of all the groundwater users overlying the basin. In addition, the court decides who the extractors are and how much groundwater those well owners are allowed to extract, and appoints a Watermaster whose role is to ensure that the basin is managed in accordance with the court's decree. The Watermaster must report periodically to the court. There are currently 23 adjudicated groundwater basins in California, most of which are located in Southern California.

4A.2.6 California Statewide Groundwater Elevation Monitoring Program

SBX7 6, enacted in November 2009, mandates a statewide groundwater elevation monitoring program to track seasonal and long-term trends in groundwater elevations in California's groundwater basins. This amendment to the Water Code requires the collaboration between local monitoring entities and Department of Water Resources (DWR) to collect groundwater elevation data. To achieve this goal, DWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) Program to establish a permanent, locally managed program of regular and systematic monitoring in all of the state's alluvial groundwater basins.

The law requires that local agencies monitor and report the elevation of their groundwater basins. DWR is required by the law to establish a priority schedule for monitoring groundwater basins, and to report to the Legislature on the findings from these investigations (Water Code Section 10920 et seq.). DWR is developing an online system for a monitoring entity to submit groundwater elevation data, which will be compatible with DWR's Water Data Library.

4A.2.7 Sustainable Groundwater Management Act

In September 2014, the Sustainable Groundwater Management Act (SGMA) was enacted. The SGMA establishes a new structure for locally managing California's groundwater in addition to existing groundwater management provisions established by AB 3030 (1992), SB 1938 (2002), and AB 359 (2011), as well as SBX7 6 (2009).

The SGMA includes the following key elements:

- Provides for the establishment of a Groundwater Sustainability Agency (GSA) by one or more local agencies overlying a designated groundwater basin or subbasin, as established by DWR Bulletin 118-03.
- Requires all groundwater basins found to be of "high" or "medium" priority to prepare Groundwater Sustainability Plans (GSPs).
- Provides for the proposed revisions, by local agencies, to the boundaries of a DWR Bulletin 118 basin, including the establishment of new subbasins.
- Provides authority for DWR to adopt regulations to evaluate GSPs, and review the GSPs for compliance every 5 years.
- Requires DWR to establish best management practices and technical measures for GSAs to develop and implement GSPs.
- Provides regulatory authorities for the SWRCB for developing and implementing interim GWMPs under certain circumstances (such as lack of compliance with development of GSPs by GSAs).

The SGMA defines sustainable groundwater management as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." Undesirable results are defined as any of the following effects.

- Chronic lowering of groundwater levels (not including overdraft during a drought if a basin is otherwise managed).
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The SGMA requires the formation of GSPs in groundwater basins or subbasins that DWR designates as medium or high priority based upon groundwater conditions identified using the CASGEM results by 2022. Sustainable groundwater operations must be achieved within 20 years following completion of the GSPs.

4A.2.8 California Endangered Species Act

California Fish and Game Code sections 2050–2115.5, otherwise known as the California Endangered Species Act (CESA), state that all native species of fish, wildlife, and plants that are in danger of or threatened with extinction because their habitats are threatened with destruction, adverse modification, or severe curtailment, or because of overexploitation, disease, predation, or other factors, are of ecological, educational, historical, recreational, aesthetic, economic, and scientific value to the people of the state. The CESA also states that the conservation, protection, and enhancement of these species and their habitat is of statewide concern (Fish and Game Code Section 2051).

An "Endangered" species is a native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant that is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes including loss of habitat, change in habitat, overexploitation, predation, competition, or disease (Fish and Game Code Section 2062). A "threatened" species is a native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant that, although not currently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts (Fish and Game Code Section 2067). The California Fish and Game Commission is responsible for listing species under CESA, and the California Department of Fish and Wildlife (DFW) is responsible for implementing and enforcing and issuing permits under CESA.

CESA strictly prohibits the "take" of any threatened or endangered fish, wildlife or plant species or species listed as threatened or endangered under CESA. Under Section 2081 of the Fish and Game Code, an incidental take permit from DFW is required for projects that could result in the "take" of a species that is state-listed as threatened or endangered, or that is a candidate for listing. Under CESA, "take" is defined as an activity that would directly or indirectly kill an individual of a species, but the definition does not include "harm" or "harass," as the definition of ESA does. As a result, the threshold for take under CESA may be higher than under the ESA.

Under Fish and Game Code Section 2080.1, applicants can notify DFW that they have been issued an incidental take statement/permit pursuant to the ESA for species that are listed under both the ESA and CESA, and can request a consistency determination. If DFW determines that the conditions specified in the Federal incidental take statement/permit are consistent with CESA, a consistency determination can be issued, which allows for incidental take under CESA under the same provisions as under the Federal incidental take statement/permit.

4A.2.9 Natural Community Conservation Planning Act

Sections 2800–2835 of the Fish and Game Code, otherwise known as the Natural Community Conservation Planning Act (NCCP Act), detail the state's policies on the conservation, protection, restoration, and enhancement of the state's natural resources and ecosystems. The intent of the legislation is to provide for conservation planning as an officially recognized policy that can be used as a tool to eliminate conflicts between the protection of the state's natural resources and the need for growth and development. In addition, the legislation promotes conservation planning as a means of coordination and cooperation among private interests, agencies, and landowners, and as a mechanism for multi-species and multi-habitat management. The NCCP Act provides an alternative means for DFW to authorize the incidental take of species listed as threatened or endangered or which are candidates for listing under CESA.

4A.2.10 California Fish and Game Code Section 1600 (Streambed Alterations)

Sections 1600–1616 of the Fish and Game Code state that it is unlawful for any person or agency to (1) substantially divert or obstruct the natural flow of the bed, channel, or bank of any river, stream, or lake; (2) substantially change the bed, channel, or bank of any river, stream, or lake; (3) use any material from the bed, channel, or bank of any river, stream, or lake; or (4) deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake in California, without first notifying DFW. With certain exceptions, a Streambed Alteration Agreement must be obtained if DFW determines that substantial adverse effects on existing fish and wildlife resources are expected to occur. The Streambed Alteration Agreement must include measures designed to protect the affected fish and wildlife and associated riparian resources. The regulatory definition of a stream is a body of water that flows at least periodically or intermittently through a bed or channel having banks, and that body of water supports wildlife, fish, or other aquatic life. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation. DFW's jurisdiction within altered or artificial waterways is based on the value of those waterways to fish and wildlife.

4A.2.11 California Wild and Scenic Rivers Act

In addition to the National Wild and Scenic Rivers System, California has its own system of protected rivers. The California Wild and Scenic Rivers System consists of rivers and river segments established by legislative action because of the scenic, recreational, fishery, or wildlife values that the rivers or segments possess in their free-flowing condition. Sections 5093.50–5093.70 of the Public Resources Code, as established by the Wild and Scenic Rivers Act in 1972, with amendments, state that: "It is the policy of the State of California that certain rivers which possess extraordinary scenic, recreational, fishery, or wildlife values will be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state." The California Natural Resources Agency must coordinate activities involving the State Wild and Scenic Rivers with Federal, state, and local agencies.

All rivers designated as wild, scenic, or recreational by the Federal or state government are regarded as having high scenic quality. The Lower American River, from Nimbus Dam to the Sacramento River, and portions of the Trinity River, downstream of Lewiston Dam, have been designated under both the National and California Wild and Scenic Rivers Systems. The Lower American

River is listed by the California Natural Resources Agency as "recreational," with trail, boating, rafting, and fishing opportunities. The Trinity River downstream of Lewiston Dam is also listed by California as "recreational," offering fishing, rafting, kayaking, and canoeing.

4A.2.12 Heritage and Wild Trout Program

The California Fish and Game Commission established the Heritage and Wild Trout Program in 1971 to protect and enhance high quality wild strains of trout and their habitat. The program designates waters that are managed to protect the wild strains of trout. Generally, these areas are available for public fishing without overcrowding and are able to support naturally sustainable trout populations to allow for appropriate levels of fishing. Management plans are prepared for the designated wild trout waters to avoid planting of domestic strains of catchable-sized trout and minimize the potential for planting of hatchery-produced trout.

4A.2.13 The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act

The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (Fish and Game Code Section 6900-6903.5) was enacted in 1988 in response to DFW reporting that the natural production of salmon and steelhead in California had declined dramatically since the 1940s, primarily as a result of lost stream habitat on many streams in the state. The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act declares that it is the policy of the State of California to increase the state's salmon and steelhead resources, and directs DFW to develop a plan and program that strives to double the salmon and steelhead resources (Fish and Game Code Section 6902(a)). It is also the policy of the state that existing natural salmon and steelhead habitat shall not be diminished further without offsetting the impacts of lost habitat (Fish and Game Code Section 6902(c)).

4A.2.14 Marine Invasive Species Act

The Marine Invasive Species Act of 2003 (AB 433) revised and expanded the Ballast Water Management for Control of Nonindigenous Species Act of 1999 to more effectively address the threat of nonindigenous species introductions. The law charged the California State Lands Commission with oversight of the state's program to prevent or minimize the introduction of nonindigenous species from commercial vessels. The current State Lands Commission regulations provide vessel owners with various options for managing ballast water, including retention, exchange in mid-ocean waters, treatment, or discharge at the same location where the ballast water originated.

4A.2.15 California Aquatic Invasive Species Management Plan

Developed by the DFW Invasive Species Program, the California Aquatic Invasive Species Management Plan provides information that state agencies and other entities can use to collaborate on addressing aquatic invasive species. The plan proposes management actions for addressing aquatic invasive species threats to the state of California. It focuses on the nonnative algae, crabs, clams, fish, plants, and other species that continue to invade California's creeks, wetlands, rivers, bays, and coastal waters. The plan has the following eight major objectives.

- Improve coordination and collaboration among the people, agencies, and activities involved with aquatic invasive species.
- Minimize and prevent the introduction and spread of aquatic invasive species into and throughout the waters of California.
- Develop and maintain programs that ensure the early detection of new aquatic invasive species and the monitoring of existing aquatic invasive species.
- Establish and manage systems for rapid response and eradication.
- Control the spread of aquatic invasive species and minimize their impacts on native habitats and species.
- Increase education and outreach efforts to ensure awareness of aquatic invasive species threats and management priorities throughout California.
- Increase research on the baseline biology of aquatic invasive species, the ecological and economic impacts of invasions, and control options to improve management.
- Ensure state laws and regulations promote the prevention and management of aquatic invasive species introductions.

Each objective is supported by a series of strategic actions. The plan meets Federal requirements to develop statewide Nonindigenous Aquatic Nuisance Species Management Plans under Section 1204 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (amended as the National Invasive Species Act of 1996). Article 2, Section 64, of the Harbors and Navigation Code authorizes the California Department of Boating and Waterways to manage aquatic weeds impeding the navigation and use of state waterways.

4A.2.16 California Fish and Game Code—Native Plant Protection Act

Sections 1900–1913 of the Fish and Game Code codify the Native Plant Protection Act of 1977 (NPPA), which is intended to preserve, protect, and enhance endangered or rare native plants in the state. Under Section 1901, a species is endangered when its prospects for survival and reproduction are in immediate jeopardy from one or more causes. A species is rare when, although not threatened with immediate extinction, it is present in such small numbers throughout its range that it may become endangered if its environment worsens. The California Fish and Game Commission has the authority to designate native plants as "endangered" or "rare," and DFW has authority to implement and enforce the NPPA. Like CESA, the NPPA strictly prohibits the take of endangered and rare plant species. However, the NPPA contains certain exceptions to this take prohibition that are not included within CESA.

DFW maintains a Special Vascular Plants, Bryophytes, and Lichens List for California as part of the California Natural Diversity Database. The list is updated quarterly and is reviewed and updated by rare plant status review groups (more than 300 botanical experts from government, academia, nongovernment organizations, and the private sector) managed jointly by DFW and California Native Plant Society (CNPS). Plant species, subspecies, or varieties are assigned a California Rare Plant Rank (CRPR) based on their level of endangerment. Plants with CRPR 1A, 1B, or 2 meet the definitions of Section 1901 of the Fish and Game Code and may qualify for state listing. For plants with a CRPR 3 rank, DFW and CNPS lack sufficient information to assign them another code. CRPR 4 plants are those of limited distribution and/or those that are infrequently found within a broader range in California. CNPS believes that CNPR 3 and 4 plants are uncommon enough to justify their regular monitoring.

4A.2.17 California Fish and Game Code—Fully Protected Species

Sections 3505, 3511, 3513, 3800, 4700, 5050, and 5515 of the Fish and Game Code pertain to fully protected wildlife species (birds in Sections 3505 through 3800, mammals in Section 4700, reptiles and amphibians in Section 5050, and fish in Section 5515) and strictly prohibit the take of fully protected species. With certain narrow exceptions, DFW cannot issue a take permit for fully protected species; therefore, avoidance measures may be required to avoid take.

4A.2.18 California Energy Commission

California's primary energy policy and planning agency, the California Energy Commission, was created by the Legislature (the Warren-Alquist Act) in 1974. The California Energy Commission forecasts future energy needs, promotes energy efficiency and conservation by setting the state's appliance and building efficiency standards; supports public interest energy research; develops renewable energy resources and alternative renewable energy technologies for buildings, industry, and transportation; licenses thermal power plants that are 50 megawatts or larger; and plans and directs state response to energy emergencies.

4A.2.19 California Department of Conservation

The California Department of Conservation administers policies to promote environmental health, economic vitality, informed land use decisions, and management of the state's natural resources, including agricultural resources. One of the programs is implemented in accordance with the Williamson Act to discourage conversion of agricultural land to non-agricultural use by offering landowners tax incentives for entering into a minimum 10-year contract to preserve no less than 100 acres of agricultural land.

As part of the Land Inventory and Monitoring program, definitions were established for designations of Important Farmlands which include Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance. Farmland maps are created by the Farmland Mapping and Monitoring Program under the direction of the USDA. Prime Farmland is defined by soil quality, groundwater elevation, water supplies, flooding, erodibility, permeability, rock fragment content, and rooting depth to produce sustained high crop yields. Farmland of Statewide Importance includes lands not designated as Prime Farmland that have a good combination of most of the physical and chemical characteristics for the production of crops. Unique Farmland includes particular characteristics for high quality and/or high yield of a specific crop (e.g., rice).

4A.2.20 Delta Protection Act of 1992

The Delta Protection Act (Public Resources Code Section 21080.22) includes a series of findings and declarations related to the quality of the Delta environment and emphasizes the national, state, and local importance of protecting the unique resources of the Delta. The act mandated a state-level planning effort to address the needs of Delta communities. The Delta Protection Commission (DPC) was made a permanent state agency in 2000 because a need for continued planning and management was identified. The DPC has planning jurisdiction over portions of five counties: Contra Costa, Sacramento, San Joaquin, Solano, and Yolo. It was charged with developing a comprehensive regional plan to guide land use and resource management, including wildlife habitat and recreation. The resulting Land Use and Resource Management Plan for the Primary Zone of the Delta was initially adopted by the DPC in February 1995 and updated in November 2010. The plan has eight policy areas: Environment, Utilities and Infrastructure, Land Use and Development, Water and Levees, Agriculture, Recreation and Access, Marine Patrol, and Boater Education and Safety Programs. With the adoption of the management plan, all local governments with incorporated areas in the Delta Primary Zone must submit proposed amendments to their general plans to the DPC. The DPC then reviews the proposed amendments to ensure they are consistent with the Land Use and Resource Management Plan for the Primary Zone of the Delta.

4A.2.21 Sacramento-San Joaquin Delta Reform Act of 2009

In November 2009, the California Legislature enacted SBX7 1, one of several bills passed at that time related to water supply reliability, ecosystem health, and the Delta. SBX7 1 took effect on February 3, 2010. Division 35 of this legislation, also known as the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act), requires the development of a legally enforceable, comprehensive, long-term management plan for the Delta, referred to as the Delta Plan. The Delta Stewardship Council was established as an independent state agency by the Delta Reform Act.

The Delta Stewardship Council's primary responsibility is to develop, adopt, and implement the Delta Plan, a legally enforceable, comprehensive, long-term management plan for the Delta and the Suisun Marsh that achieves the coequal goals (Water Code Section 85300(a)) of (1) providing a more reliable water supply for California and (2) protecting, restoring and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place (Water Code Section 85054).

Achieving the coequal goals is a primary and fundamental purpose of the Delta Plan. Additionally, the Delta Reform Act (Water Code Section 85020 et seq.) states that the policy of the state is "to achieve the following objectives as inherent in the coequal goals for the management of the Delta:

- Manage the Delta's water and environmental resources and the water resources of the state over the long term.
- Protect and enhance the unique cultural, recreational, and agricultural values of the California Delta as an evolving place.
- Restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem.
- Promote statewide water conservation, water use efficiency, and sustainable water use.
- Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.
- Improve the water conveyance system and expand statewide water storage.
- Reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and investments in flood protection.
- Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives."

4A.2.22 McAteer-Petris Act and the San Francisco Bay Plan

The McAteer-Petris Act, enacted on September 17, 1965, was designed to preserve San Francisco Bay from indiscriminate filling and established the San Francisco Bay Conservation and Development Commission (BCDC) as a temporary state agency charged with preparing a plan for the long-term use of the bay and regulating development in and around the bay. To this end, BCDC prepared the San Francisco Bay Plan. In August 1969, the McAteer-Petris Act was amended to make BCDC a permanent agency and to incorporate the policies of the San Francisco Bay Plan into state law. Bay Plan maps and policies guide the protection of the San Francisco Bay and its tributary waterways, marshes, managed wetlands, salt ponds, and shoreline. Plan maps identify areas designated for "priority uses" that include wildlife refuges, waterfront parks, beaches, water-related industry, and ports. The Bay Plan also identifies other land designations, such as tidal marshes, salt ponds, and managed wetlands.

BCDC's Suisun Marsh Protection Plan contains findings that recognize the value of the aesthetic resources of the Suisun Marsh, as well as adjacent upland grasslands, cultivated areas, and seasonal marshes. The plan is intended "to preserve the integrity and assure continued wildlife use" and establishes that the Suisun Marsh "represents a unique and irreplaceable resource to the people of the state and nation." The plan includes specific building and landscape criteria for development along the eastern boundary of the Suisun Marsh in southern Solano County.

4A.2.23 State Lands Commission

The California State Lands Commission (SLC) was established in 1938 with authority under Division 6 of the California Public Resources Code. The SLC provides stewardship of the California lands and waterways entrusted to its care. Nearly 4 million acres of "sovereign lands" are owned by the state. This includes the beds of navigable streams, rivers, and lakes, tidal waterways, and tidelands up to the ordinary high water mark and submerged lands along the coastline extending from the shoreline out to 3 miles offshore. SLC may lease sovereign lands for any public trust purpose, including open space, fisheries, commerce, recreation, and navigation. A public or private entity must lease sites for marinas and recreational piers that are within sovereign lands. SLC also issues permits for dredging lands within its jurisdiction.

4A.2.24 California Mulford-Carrell Act

The 1969 Mulford-Carrell Act established the California Air Resources Board (ARB). The ARB's mission is to promote and protect public health, welfare, and ecological resources through improved air quality. The ARB oversees the activities of local and regional air quality districts.

4A.2.25 California Clean Air Act

The California Clean Air Act (CCAA) provides the state with a comprehensive framework for air quality planning regulation. Prior to passage of the act, Federal law contained the only comprehensive planning framework. The CCAA requires attainment of state ambient air quality standards by the earliest practicable date.

4A.2.25.1 California Ambient Air Quality Standards and State Air Quality Designations

The ARB administers air quality policy in California, establishes statewide standards, and administers the state's mobile-source emissions control program, which is described below. In addition, the ARB oversees air quality programs established by state statute. The ARB oversees programs to achieve the California Ambient Air Quality Standards (CAAQS), which were established in 1969 pursuant to the Mulford-Carrell Act. These standards are generally more stringent and apply to more pollutants than the NAAQS. In addition to the criteria pollutants, CAAQS have been established for visibility-reducing particulates, hydrogen sulfide, and sulfates.

4A.2.25.2 State Implementation Plans

Federal clean air laws require nonattainment areas with unhealthy levels of criteria air pollutants to develop plans to detail actions that will be undertaken to achieve the NAAQS. These comprehensive plans are known as State Implementation Plans, or SIPs. In addition, the CCAA requires local air districts in nonattainment areas of the state to prepare and maintain Air Quality Management Plans (AQMPs) to achieve compliance with CAAQS. These

AQMPs also serve as a basis for preparing the SIP for the state of California, which must ultimately be approved by the USEPA and codified in the CFR.

SIPs are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, and permitting), district rules, state regulations, and Federal control requirements. Many of California's SIPs rely on the same core set of control strategies, including emission standards for cars and heavy trucks, fuel standards and requirements, and limits on emissions from consumer products. State law establishes the ARB as the lead agency for all purposes related to the SIP. Local air districts and other agencies, such as the Bureau of Automotive Repair, prepare SIP elements and submit them to the ARB for review and approval. The ARB forwards SIP revisions to the USEPA for approval and publication in the *Federal Register*. CFR Title 40, Chapter I, Part 52, Subpart F, Section 52.220 lists all the items included in the California SIP. The promulgation of the new national 8-hour ozone standard and $PM_{2.5}$ standards has resulted in additional statewide air quality planning efforts. The California Regional Haze Plan has been drafted to reduce regional haze and improve visibility in national parks and wilderness areas. Many additional California SIP submittals are pending USEPA approval.

In addition to the SIPs aimed at attainment of the NAAQS, the CCAA requires nonattainment areas to achieve and maintain the CAAQS by the earliest practicable date. Local air districts must develop plans to attain the state ozone, CO, sulfur dioxide, and NO_2 standards. The CCAA also requires that, by the end of 1994 and once every 3 years thereafter, the local air districts must assess their progress toward attaining the air quality standards. The triennial assessment is to report the extent of air quality improvement and the amounts of emission reductions achieved from control measures for the preceding 3-year period. The districts must review and revise their attainment plans, if necessary, to correct for deficiencies in meeting progress, incorporate new data or projections, mitigate ozone transport, and expedite adoption of all feasible control measures. In addition to the triennial progress assessment requirement, local air districts must prepare an annual progress report and submit the report to the ARB by December 31 of each year. At a minimum, the annual progress report contains the proposed and actual dates for the adoption and implementation of each measure listed in the previous 3-year plan.

4A.2.25.3 Air Toxics Programs

In addition to the criteria pollutants, concern about non-criteria pollutants has increased in recent years. AB 1807 (the Tanner Bill, passed in 1983) established the California Air Toxics Program for identifying and developing emissions control and reduction methods for toxic air contaminants (TACs). The bill formally designated 18 substances as TACs. In 1993, the 189 HAPs identified by the USEPA were incorporated into California law as TACs. Other pollutants have been added more recently, such as PM emissions from diesel-fueled engines (diesel PM), designated by California as a carcinogen. The California Air Toxics Program also includes provisions for public awareness and risk reduction.

Local agencies, such as air districts, are responsible for evaluating and controlling TAC emissions, especially when these emissions are released from projects near sensitive receptors. For example, AB 3205 requires that new or modified sources of TACs near schools provide public notice to the parents of schoolchildren before a permit to emit air pollutants is issued. One air toxics control measure adopted by ARB in 2004 prohibited operation of diesel-fueled backup engines within 500 feet of a school during school hours, unless used in an emergency.

The Air Toxics "Hot Spots" Information and Assessment Act was enacted in September 1987. The act requires that toxic air emissions from stationary sources (facilities) be quantified and compiled into an inventory, that risk assessments be conducted according to methods developed by the California Office of Environmental Health Hazard Assessment, and that the public be notified of significant risks posed by nearby facilities. Facilities that pose a potentially significant health risk to the public are required to reduce their risks.

4A.2.25.4 Mobile-Source Emission Control Programs

The ARB is responsible for developing statewide programs and strategies to reduce the emission of smog-forming pollutants and TACs by mobile sources. To attain the CAAQS, the CCAA mandates that the ARB achieve the maximum degree of emission reductions from all on- and off-road mobile sources. On-road sources include passenger cars, motorcycles, trucks, and buses; off-road sources include heavy-duty construction equipment, recreational vehicles, marine vessels, lawn and garden equipment, and small utility engines. On-road vehicle emission control programs overseen by the ARB include vehicle inspections, idling restrictions, requirements for clean vehicle fleets, voluntary vehicle retirement programs, and engine emissions standards.

Additionally, exhaust emission standards have been adopted by the ARB and the USEPA for off-road engines. The ARB has extensive statewide programs underway to reduce diesel PM.

4A.2.26 State Policies and Regulations Related to Greenhouse Gas Emissions

A summary of state regulations and standards related to GHG emissions is provided below. California Senate and Assembly bills and executive orders, such as SB 1771, AB 1493, SB 1078, SB 107, EOs S-14-08 and S-1-07, SB 1368, SB 97, and SB 375 have been developed to define various aspects of GHG recordkeeping and implementation of GHG emission reduction measures, such as the California Renewables Portfolio Standard Program for statewide energy supplies and the Low Carbon Fuel Standard. These bills and orders are not discussed further in this document because they are not directly applicable to the Proposed Project or any of the alternatives. Other bills, executive orders, and plans, such as AB 32, EO S 3-05, the Climate Change Scoping Plan, the Climate Change Adaptation Strategy, and California Environmental Quality Act (CEQA) guidance, are discussed further. These bills and plans generally define the regulatory setting for projects that emit GHGs in California and describe regulatory agency goals for statewide GHG emissions reductions and climate change adaptation.

4A.2.26.1 Executive Order S-3-05 (California)

EO S-3-05 was signed into law in 2005 and calls for a reduction of GHG emissions to 2000 levels by 2010, a reduction of GHG emissions to 1990 levels by 2020, and a reduction of GHG emissions to 80 percent below 1990 levels by 2050. The order directs the California Environmental Protection Agency (CalEPA) Secretary to coordinate development and implementation of strategies to achieve the GHG reduction targets in conjunction with the Secretary of the Business, Transportation, and Housing Agency; the Secretary of the Department of Food and Agriculture; the Secretary of the Natural Resources Agency; the Chairperson of ARB; the Chairperson of the California Energy Commission; and the President of the California Public Utilities Commission. CalEPA developed the Climate Action Team made up of representatives from the agencies listed above to implement the strategies to reduce GHG emissions. The order also includes a requirement for CalEPA to report annually to the Governor and Legislature. The first report, Climate Action Team Proposed Early Actions to Mitigate Climate Change in California, was released in March 2006, and reports have been published each year since. ARB released its Expanded List of Early Action Measures in October 2007.

4A.2.26.2 California Global Warming Solutions Act of 2006 (Assembly Bill 32)

On September 20, 2006, California adopted the California Global Warming Solutions Act of 2006 (generally referred to as AB 32 and codified at Section 1, Division 25.5, and Section 38500 et seq. of the California Health & Safety Code). This law requires ARB to design and implement emission limits, regulations, and other measures such that statewide GHG emissions are reduced in a technologically feasible and cost-effective manner to 1990 levels by 2020 (representing a 25 percent reduction). AB 32 does not directly amend other environmental laws, such as CEQA. Instead, it creates a program to identify GHG sources, prioritize sources for regulation based on significance of contributions to California GHG emissions, and regulate priority sources. Under AB 32, ARB is required to complete certain actions. As of May 2012, ARB has:

- Determined that the statewide GHG emissions inventory in 1990 was approved as a statewide GHG emissions limit to be achieved by 2020.
- Identified significant sources or categories of sources of each GHG and established protocols and procedures for monitoring, quantifying, and reporting such emissions.
- Issued a scoping plan to achieve emission reductions from specific sources or categories of sources by January 1, 2009.
- Adopted and begun enforcement of regulations to implement a suite of discrete actions by January 1, 2010.

- Adopted GHG emissions limits and reduction measures by January 1, 2011.
- Enforced GHG emission limits and reduction measures, beginning on January 1, 2012.

California lead agencies have relied upon local air pollution control districts to provide guidance on the evaluation of air pollutants under CEQA. As a result of AB 32, both ARB and the local air districts will have regulatory jurisdiction over GHG emissions in California. AB 32 identifies ARB as the state agency responsible for the design and implementation of emissions limits, regulations, and other measures to meet targets.

In December 2007, ARB approved the 2020 emission limit (1990 level) of 427 million tpy CO2e of GHGs. The 2020 target requires the reduction of 169 million tpy CO2e, or approximately 30 percent below the state's projected "business-as-usual" 2020 emissions of 596 million tpy CO2e.

4A.2.26.3 Climate Change Scoping Plan

On December 11, 2008, pursuant to AB 32, ARB adopted the Climate Change Scoping Plan. This plan outlines how emissions reductions will be achieved from significant sources of GHGs via regulations, market mechanisms, and other actions. Six key elements, outlined in the scoping plan, are identified to achieve emissions reduction targets:

- Expand and strengthen existing energy efficiency programs and building and appliance standards;
- Achieve a statewide renewable energy mix of 33 percent;
- Develop a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;
- Establish targets for transportation-related GHG emissions for regions throughout California, and pursue policies and incentives to achieve those targets;
- Adopt and implement measures pursuant to existing state laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and
- Create targeted fees, including a public goods charge on water use, fees on high global warming potential gases, and a fee to fund the administrative costs of the state's long-term commitment to AB 32 implementation.

The Climate Change Scoping Plan also recommended 39 measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving our natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately impact low-income and minority communities. These measures also put the state on a path to meet the long-term 2050 goal of reducing California's GHG emissions to 80 percent below 1990 levels. In 2011, the Functional Equivalent Document for the Scoping Plan was amended.

The Scoping Plan was reapproved by the ARB on August 24, 2011, including the Final Supplement to the Functional Equivalent Document. According to the Final Supplement, the majority of additional measures in the Climate Change Scoping Plan were adopted (as of 2012) and are currently in place.

4A.2.26.4 Executive Order S-13-08, Climate Change Adaptation Strategy

EO S-13-08, issued November 14, 2008, directs the California Natural Resources Agency, DWR, Office of Planning and Research, California Energy Commission, SWRCB, State Parks Department, and California's coastal management agencies to participate in a number of planning and research activities to advance California's ability to adapt to the impacts of climate change. The order specifically directs agencies to work with the National Academy of Sciences to initiate the first California Sea Level Rise Assessment and to review and update the assessment every 2 years after completion, immediately assess the vulnerability of the California transportation system to sea level rise, and to develop a California Climate Change Adaptation Strategy.

Prepared in cooperation and partnership with multiple state agencies, the 2009 California Climate Adaptation Strategy summarizes the best known science on climate change impacts in seven specific sectors (public health, biodiversity and habitat, ocean and coastal resources, water management, agriculture, forestry, and transportation and energy infrastructure) and provides recommendations on how to manage those threats.

4A.2.26.5 California Greenhouse Gas Cap-and-Trade Program

On October 20, 2011, ARB adopted the final cap-and-trade program for California. The California cap-and-trade program creates a market-based system with an overall emissions limit for affected sectors. The program is currently proposed to regulate more than 85 percent of California's emissions and will stagger compliance requirements according to the following schedule: (1) electricity generation and large industrial sources by 2012; and (2) fuel combustion and transportation by 2015.

4A.2.27 California Register of Historical Resources

The California Register of Historical Resources (CRHR) includes resources that are listed in or formally determined eligible for listing in the NRHP and some California State Landmarks and Points of Historical Interest. Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified in a local historical resources inventory may be eligible for listing in the CRHR and are presumed to be significant resources for purposes of CEQA unless a preponderance of evidence indicates otherwise (California Public Resources Code Section 5024.1; Title 14, California Code of Regulations Section 4850). The eligibility criteria for listing in the CRHR are similar to those for NRHP listing but focus on the relevance of the resources to California history and heritage. A cultural resource may be eligible for listing in the CRHR if it has significance under one or more of the following criteria:

- Associated with events or patterns of events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States.
- Associated with the lives of persons important to local, California, or national history.
- Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master, or possesses high artistic values.
- Has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

To be eligible, a resource must also have integrity. The CRHR definition of "integrity" is slightly different than that for the NRHP. Integrity is defined as "the authenticity of a historical resource's physical identity evidenced by the survival of characteristics that existed during the resource's period of significance." The Office of Historic Preservation guidance further states that eligible resources must "retain enough of their historic character or appearance to be recognizable as historical resources and to convey the reasons for their significance" and lists the same seven aspects of integrity used for evaluating properties under the NRHP criteria. The CRHR's special considerations for certain property types are limited to: (1) moved buildings, structures, or objects; (2) historical resources achieving significance within the past 50 years; and (3) reconstructed buildings (14 California Code of Regulations Section 4852).

4A.2.28 Native American Heritage Commission

The duties and role of the Native American Heritage Commission (NAHC), which is located in Sacramento, are described in Public Resources Code (PRC) sections 5097.9 through 5097.991. State and local agencies are required by the PRC to cooperate with the NAHC regarding disposition of Native American resources.

The NAHC maintains a catalog of places of special religious or social significance to Native Americans. This database, known as the Sacred Lands File, includes information on known Native American graves and cemeteries on private lands and other places of cultural or religious significance to the Native American community.

The NAHC also performs other duties regarding the preservation and accessibility of sacred sites and burials and the disposition of Native American human remains and burial items as described below.

4A.2.29 California Public Resources Code and California Health and Safety Code Provisions Regarding Human Remains

In California, when human remains are discovered outside of a cemetery, the relevant county coroner determines whether the remains are archaeological in nature or represent evidence of a crime (which would require the coroner to determine cause of death). When the coroner determines that the remains are of prehistoric Native American origin, he or she contacts the NAHC (Health and Safety Code Section 7050.5(b) and (c)).

The following procedures only apply to Native American remains found in California on non-federal lands. When the NAHC receives notification of a discovery of Native American human remains from a county coroner, it notifies those persons it believes to be the most likely descendants of the deceased Native American. The descendants may, with the permission of the landowner or his or her authorized representative, inspect the site of the discovery of the Native American human remains and recommend to the owner or the person responsible for the excavation work means for treatment or disposition, with appropriate dignity, of the human remains and any associated grave goods. The descendants must complete their inspection and make recommendations or express preferences for treatment within 48 hours of being granted access to the site.

Upon the discovery of Native American remains, the landowner is required to ensure that the immediate vicinity of the find is not damaged or disturbed by further development activity until the most likely descendants make their recommendations. The landowner (and, necessarily, the archaeological team) must confer with the descendants on all reasonable options regarding the descendants' preferences for treatment. The preferences may include, but not be limited to, at the descendants' discretion, further archaeological excavation and scientific study of the remains, immediate removal by the descendants to a site of their choice for reburial in accordance with their traditions, or scientific exhumation and study followed by reburial by the descendants.

4A.2.30 Fire Hazard Severity Zones

In accordance with PRC sections 4201–4204 and Government Code sections 51175–51189, the California Department of Forestry and Fire Prevention (CAL FIRE) has mapped areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. The zones are referred to as Fire Hazard Severity Zones and represent the risks associated with wildland fires. Under CAL FIRE regulations, areas within very high fire-hazard risk zones must comply with specific building and vegetation requirements intended to reduce property damage and loss of life within these areas.

4A.2.31 Mosquito Abatement Act

In 1915, the State Legislature enacted the Mosquito Abatement Act, which allowed local mosquito abatement organizations to form into specific special districts. Mosquito abatement districts use a combination of abatement procedures to control mosquitoes. Generally, mosquito control methods used selectively, singly, or in combination include biological agents, such as mosquitofish, which eat mosquito larvae; source reductions, such as draining the waterbodies that produce mosquitoes; pesticides; ecological manipulations of mosquito breeding habitat; and public education on preventive measures.

4A.2.32 California Vector Control Laws and Regulations

In California, local vector control agencies have the authority to conduct surveillance for vectors, prevent the occurrence of vectors, and abate production of vectors (California Codes: Health and Safety Code Section 2040). Vector control agencies also have authority to participate in review, comment, and make recommendations regarding local, state, or Federal land use planning and environmental quality processes, documents, permits, licenses, and entitlements for projects and their potential effects with respect to vector production (California Codes: Health and Safety Code Section 2041).

Additionally, agencies have broad authority to influence landowners to reduce or "abate" the source of a vector problem. Actions may include imposing civil penalties of up to $1,000 per day plus costs associated with controlling the vector. Agencies have authority to "abate" vector sources on private and publicly owned properties (California Codes: Health and Safety Code sections 2060–2065).

Mosquito and vector control programs that enter into a cooperative agreement with the California Department of Health Services are exempted from some pesticide-related laws under Title 3 of the California Code of Regulations Section 6620. Specifically, these agencies are exempted from "Consent to Apply" (Title 3 California Code of Regulations Section 6616), "Notice" (Title 3 California Code of Regulations Section 6618), and the "Protection of Persons, Animals, and Property" (Title 3 California Code of Regulations Section 6614). Essentially, these provisions allow the vector control agency to apply a pesticide to a property in the interest of preserving the public health, without notifying or obtaining permission from the landowner beforehand.

A vector control technician working at a vector control agency must be a "certified technician" or work under the direct supervision of a "certified technician" to apply pesticides. Vector control technicians achieve certification through an examination process administered by the California Department of Health Services.

Vector control agencies cannot use any pesticide not registered for use in California, and are required to keep detailed records of each pesticide application, including date, location, and amount applied. All pesticides must be applied in accordance with the labeling of the product as registered with the USEPA.

4A.2.33 California Environmental Justice Policies

4A.2.33.1 Environmental Justice – Senate Bill 115

SB 115 established the State of California as the first state to define environmental justice. Senate Bill 115 defines environmental justice as "the fair treatment of people of all races, cultures and income with respect to development, adoption and implementation of environmental laws, regulations and policies." SB 115 added this language to California Government Code Section 65040.12 and to Division 34 of the Public Resources Code relating to environmental quality. Finally, it also established the Governor's Office of Planning and Research as the coordinating agency for state programs and requested that

CalEPA establish a model environmental justice policy for its boards, departments, and offices.

4A.2.33.2 California Natural Resources Agency Environmental Justice Policy

The California Natural Resources Agency defines "environmental justice" in a manner consistent with the State of California as "the fair treatment of people of all races, cultures and income with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." The agency states that its environmental justice policy is that the fair treatment of all people shall be considered during the planning, decision making, development, and implementation of its programs. The California Natural Resources Agency intends for its policy "to ensure that the public, including minority and low-income populations, are informed of opportunities to participate in the development and implementation of all Resources Agency programs, policies and activities, and that they are not discriminated against, treated unfairly, or caused to experience disproportionately high and adverse human health or environmental effects from environmental decisions."

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Appendix 5A

CalSim II and DSM2 Modeling

This appendix provides information about the methods and assumptions used for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) environmental consequences analysis using the CalSim II and DSM2 models. This appendix is organized in three main sections:

- CalSim II and DSM2 Modeling Methodology
- CalSim II and DSM2 Modeling Simulations and Assumptions
- CalSim II and DSM2 Modeling Results

An outline is provided at the beginning of each section.

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Appendix 5A, Section A

CalSim II and DSM2 Modeling Methodology

This section summarizes the modeling methodology used to analyze the No Action Alternative, Second Basis of Comparison, and other alternatives in this Environmental Impact Statement (EIS). It describes the overall analytical framework and contains descriptions of the key analytical tools and approaches used in the environmental consequences evaluation for the alternatives. Appendix 5A, Section A is organized as follows:

- Introduction
- Overview of the Modeling Approach
  - Analytical Tools
  - Key Components of the Analytical Framework
  - Climate Change and Sea-Level Rise
- Hydrology and System Operations
  - CalSim II
  - Artificial Neural Network for Flow-Salinity Relationship
  - Application of CalSim II to Evaluate EIS Alternatives
  - Output Parameters
  - Appropriate Use of CalSim II Results
  - Linkages to Other Models
- Delta Hydrodynamics and Water Quality
  - Overview of Hydrodynamics and Water Quality Modeling Approach
  - Delta Simulation Model (DSM2)
  - Application of DSM2 to Evaluate EIS Alternatives
  - Output Parameters
  - Modeling Limitations
  - Linkages to Other Models
- Climate Change and Sea-Level Rise
  - Climate Change
  - Sea-Level Rise
  - Incorporating Climate Change and Sea-Level Rise in EIS Simulations
  - Climate Change and Sea-Level Rise Modeling Limitations
- References

5A.A.1 Introduction

This EIS includes identifying effects of operations considered until Year 2030 and the hydrologic response of the system to those operations. For modeling purposes, the alternatives are simulated at Year 2030; and in the evaluation of all alternatives at Year 2030, climate change and sea-level rise of 15 centimeters (cm) were assumed to be inherent.

The analytical framework and the tools used for the environmental consequences analysis are described in this section. Modeling assumptions for all the alternatives are provided in Section B of this appendix.

5A.A.2 Overview of the Modeling Approach

To support the impact analysis of the alternatives, numerical modeling of physical variables (or "physically based modeling"), such as river flows and water temperature, is required to evaluate changes to conditions affecting resources in the Central Valley including the Sacramento-San Joaquin Delta (Delta). A framework of integrated analyses including hydrologic, operations, hydrodynamics, water quality, and fisheries analyses is required to provide information for the comparative National Environmental Policy Act (NEPA) assessment of several resources, such as water supply, surface water, groundwater, and aquatic resources.

The alternatives include operational changes in the coordinated operation of the Central Valley Project (CVP) and State Water Project (SWP). Both these operational changes and other external factors such as climate and sea-level changes influence the future conditions of reservoir storage, river flow, Delta flows, exports, water temperature, and water quality. Evaluation of these conditions is the primary focus of the physically based modeling analyses.

Figure 5A.A.1 shows the analytical tools applied in these assessments and the relationship between these tools. Each model included in Figure 5A.A.1 provides information to the subsequent model in order to provide various results to support the impact analyses.

Changes to the historical hydrology related to the future climate are applied in the CalSim II model and combined with the assumed operations for each alternative. The CalSim II model simulates the operation of the major CVP and SWP facilities in the Central Valley and generates estimates of river flows, exports, reservoir storage, deliveries, and other parameters.

Agricultural and municipal and industrial deliveries resulting from CalSim II are used for assessment of changes in groundwater resources and in agricultural, municipal, and regional economics. Changes in land use reported by the agricultural economics model are subsequently used to assess changes in air quality.

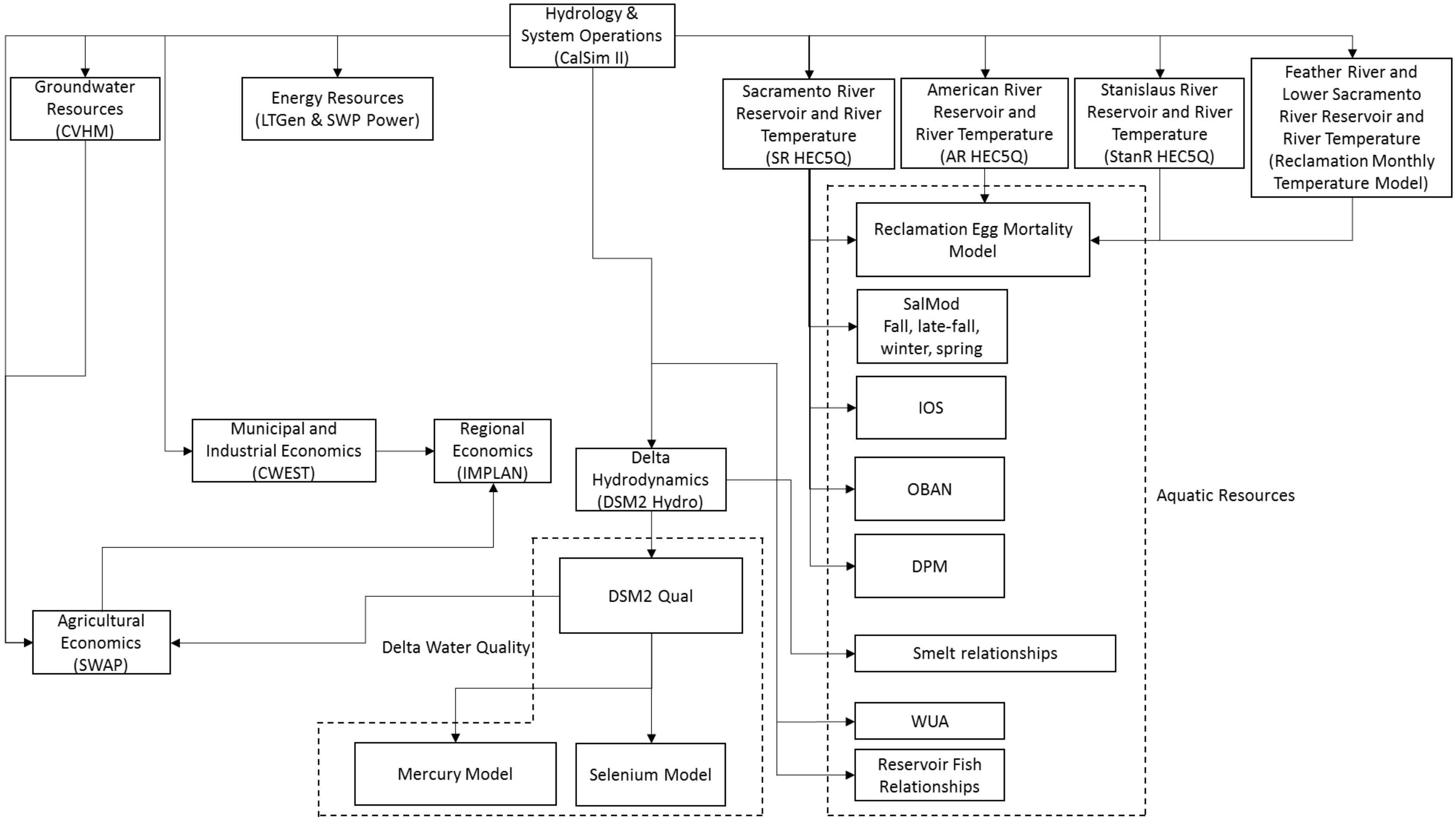


Figure 5A.A.1 Analytical Framework Used to Evaluate Impacts of the Alternatives

The Delta boundary flows and exports from CalSim II are used to drive the DSM2 Delta hydrodynamic and water quality models for estimating tidally based flows, stage, velocity, and salt transport within the estuary. DSM2 water quality and volumetric fingerprinting results are used to assess changes in concentrations of selenium and methylmercury in Delta waters.

Power generation models use CalSim II reservoir levels and releases to estimate power use and generation capability of the projects.

Temperature models for the primary river systems use the CalSim II reservoir storage, reservoir releases, river flows, and meteorological conditions to estimate reservoir and river temperatures under each scenario.

Results from these temperature models are further used as an input to fisheries models (e.g., SalMod, Reclamation Egg Mortality Model, and IOS) to assess changes in fisheries habitat due to flow and temperature. CalSim II and DSM2 results are also used for fisheries models (IOS, DPM) or aquatic species survival/habitat relationships developed based on peer-reviewed scientific publications.

The results from this suite of physically based models are used to describe the effects of each individual scenario considered in the EIS.

5A.A.2.1 Analytical Tools

A brief description of the hydrologic and hydrodynamic models discussed in Chapter 5, Surface Water Resources and Water Supplies, is provided below. All other subsequent models to CalSim II presented in the analytical framework are described in detail in appendices of the respective chapters where their results are used.

5A.A.2.1.1 CalSim II

The CalSim II planning model was used to simulate the coordinated operation of the CVP and SWP over a range of hydrologic conditions. CalSim II is a generalized reservoir-river basin simulation model that allows for specification and achievement of user-specified operating rules or goals (Draper et al. 2004). CalSim II represents the best available planning model for the CVP and SWP system operations and has been used in previous system-wide evaluations of CVP and SWP operations (Reclamation 2008a).

Hydrologic inputs to CalSim II include water diversion requirements (demands), stream accretions and depletions, rim basin inflows, irrigation efficiencies, return flows, non-recoverable losses, and groundwater operations. Sacramento Valley and tributary rim basin hydrologies are developed using a process designed to adjust the historical sequence of monthly stream flows over an 82-year period (1922 to 2003) to represent a sequence of flows at a particular level of development.

Adjustments to historical water supplies are determined by imposing a defined level of land use on historical meteorological and hydrologic conditions. The resulting hydrology represents the water supply available from Central Valley streams to the CVP and SWP at that defined level of development.

CalSim II produces outputs for river flows and diversions, reservoir storage, Delta-channel flows and exports, Delta inflow and outflow, deliveries to project and non-project users, and controls on project operations. Reclamation's 2008 Biological Assessment on the Continued Long-term Operations of the Central Valley Project and the State Water Project (2008 LTO BA) Appendix D provides more information about CalSim II (Reclamation 2008a). CalSim II output provides the basis for multiple other hydrologic, hydrodynamic, and biological models and analyses. CalSim II results feed into other models as described above.

5A.A.2.1.2 Artificial Neural Network for Flow-Salinity Relationships

An artificial neural network (ANN) that mimics the flow-salinity relationships as modeled in DSM2 and transforms this information into a form usable by the CalSim II model has been developed (Sandhu et al. 1999; Seneviratne and Wu, 2007). The ANN is implemented in CalSim II to constrain the operations of the upstream reservoirs and the Delta export pumps in order to satisfy particular salinity requirements in the Delta. The current ANN predicts salinity at various locations in the Delta using the following parameters as input: Sacramento River inflow, San Joaquin River inflow, Delta Cross Channel gate position, and total exports and diversions. Sacramento River inflow input accounts for Sacramento River flow, Yolo Bypass flow, and combined flow from the Mokelumne, Cosumnes, and Calaveras rivers (east side streams) andNorth Bay Aqueduct and Vallejo diversions. Total exports and diversions include SWP Banks Pumping Plant, CVP Tracy Pumping Plant, and Contra Costa Water District (CCWD) diversions including diversion to Los Vaqueros Reservoir. The ANN model approximates DSM2 model-generated salinity at the following key locations for the purpose of modeling Delta water quality standards: X2, Sacramento River at Emmaton, San Joaquin River at Jersey Point, Sacramento River at Collinsville, and Old River at Rock Slough. In addition, the ANN is capable of providing salinity estimates for Clifton Court Forebay, CCWD Alternate Intake Project, and Los Vaqueros diversion locations. A more detailed description of the ANNs and their use in the CalSim II model is provided in Wilbur and Munévar (2001). In addition, the California Department of Water Resources (DWR) Modeling Support Branch website (http://baydeltaoffice.water.ca.gov/modeling/) provides ANN documentation.

5A.A.2.1.3 DSM2

DSM2 is a one-dimensional hydrodynamic and water quality simulation model used to simulate hydrodynamics, water quality, and particle tracking in the Sacramento-San Joaquin Delta. DSM2 represents the best available planning model for Delta tidal hydraulic and salinity modeling. It is appropriate for describing the existing conditions in the Delta, as well as performing simulations for the assessment of incremental environmental impacts caused by future facilities and operations.

The DSM2 model has three separate components: HYDRO, QUAL, and PTM. HYDRO simulates velocities and water surface elevations and provides the flow input for QUAL and PTM. DSM2-HYDRO outputs are used to predict changes in flow rates and depths, and their effects on covered species, as a result of the EIS and climate change.

The QUAL module simulates fate and transport of conservative and non-conservative water quality constituents, including salts, given a flow field simulated by HYDRO. Outputs are used to estimate changes in salinity, and their effects on covered species, as a result of the EIS and climate change. The QUAL module is also used to simulate source water fingerprinting, which allows determining the relative contributions of water sources to the volume at any specified location. Reclamation's 2008 LTO BA Appendix F provides more information about DSM2 (Reclamation 2008b).

DSM2-PTM simulates pseudo 3-D transport of neutrally buoyant particles based on the flow field simulated by HYDRO. It simulates the transport and fate of individual particles traveling throughout the Delta. The model uses velocity, flow, and stage output from the HYDRO module to monitor the location of each individual particle using assumed vertical and lateral velocity profiles and specified random movement to simulate mixing. Additional information on DSM2 can be found on the DWR Modeling Support Branch website at http://baydeltaoffice.water.ca.gov/modeling/.

5A.A.2.2 Key Components of the Analytical Framework

Components of the EIS modeling relevant to Chapter 5, Surface Water Resources and Water Supplies, are described in this appendix in separate sections, including hydrology and systems operations modeling and delta hydrodynamics and water quality. Each section describes in detail the key tools used for modeling, data interdependencies, and limitations. It also includes descriptions of how the tools are applied in a long-term planning analysis such as evaluating the alternatives and describes any improvements or modifications performed for application in EIS modeling.

Section 5A.A.3, Hydrology and Systems Operations Modeling, describes the application of the CalSim II model to evaluate the effects of hydrology and system operations on river flows, reservoir storage, Delta flows and exports, and water deliveries. Section 5A.A.4, Delta Hydrodynamics and Water Quality, describes the application of the DSM2 model to assess effects of the operations considered in the EIS and resulting effects to tidal stage, velocity, flows, and salinity.

5A.A.2.3 Climate Change and Sea-Level Rise

The modeling approach applied for the EIS integrates a suite of analytical tools in a unique manner to characterize changes to the system from "atmosphere to ocean." Figure 5A.A.2 illustrates the general flow of information for incorporating climate and sea-level change in the modeling analyses. Climate and sea level can be considered the most upstream and most downstream boundary forcings on the system analyzed in the modeling for the EIS. However, these forcings are outside the influence of the EIS and are considered external forcings. The effects of these forcings are incorporated into the key models used in the analytical framework.

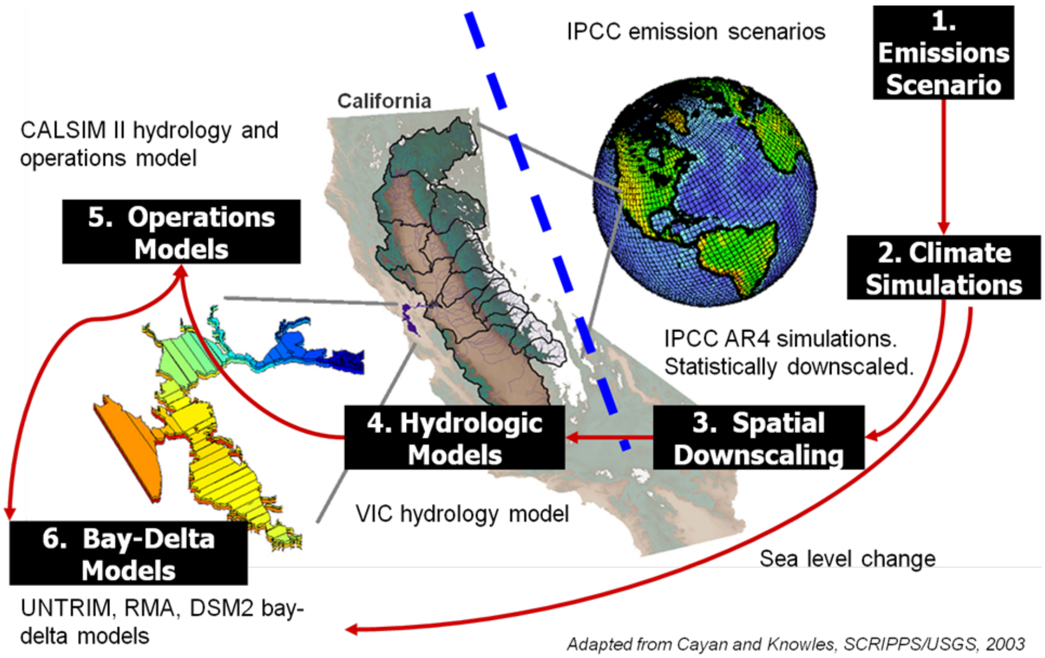


Figure 5A.A.2 Characterizing Climate Impacts from Atmosphere to Oceans

For the selected future climate scenario, regional hydrologic modeling was performed with the Variable Infiltration Capacity (VIC) hydrology model using temperature and precipitation projections of future climate. The VIC model (Liang et al. 1994; Liang et al. 1996; Nijssen et al. 1997) is a spatially distributed hydrologic model that solves the water balance at each model grid cell. The VIC model incorporates spatially distributed parameters describing topography, soils, land use, and vegetation classes. VIC is considered a macro-scale hydrologic model in that it is designed for larger basins with fairly coarse grids. In this manner, it accepts input meteorological data directly from global or national gridded databases or from general circulation model (GCM) projections. To compensate for the coarseness of the discretization, VIC is unique in its incorporation of subgrid variability to describe variations in the land parameters as well as precipitation distribution. Parameterization within VIC is performed primarily through adjustments to parameters describing the rates of infiltration and baseflow as a function of soil properties, as well as the soil layers depths. When simulating in water balance mode, as done for this California application, VIC is driven by daily inputs of precipitation, maximum and minimum temperature, and windspeed. The model internally calculates additional meteorological forcings such short-wave and long-wave radiation, relative humidity, vapor pressure and vapor pressure deficits. Rainfall, snow, infiltration, evapotranspiration, runoff, soil moisture, and baseflow are computed over each grid cell on a daily basis for the entire period of simulation. An offline routing tool then processes the individual cell runoff and baseflow terms and routes the flow to develop streamflow at various locations in the watershed.

In addition to a range of hydrologic process information, the VIC model generates natural stream flows under each assumed climate condition (DWR et al. 2013). Section 5A.A.5 provides more detailed information on climate change and sea-level rise modeling approach followed for the EIS.

5A.A.3 Hydrology and System Operations

The hydrology of the Central Valley and coordinated operation of the CVP and SWP systems is a critical element in any assessment of changed conditions in the Central Valley and the Delta. Changes to conveyance, flow patterns, demands, regulations, or Delta configuration will influence the operations of the CVP and SWP reservoirs and export facilities. The operations of these facilities, in turn, influence Delta flows, water quality, river flows, and reservoir storage. The interaction between hydrology, operations, and regulations is not always intuitive and detailed analysis of this interaction often results in new understanding of system responses. Modeling tools are required to approximate these complex interactions under future conditions.

This section describes in detail the use of CalSim II and the methodology used to simulate hydrology and system operations for evaluating the effects of the EIS.

5A.A.3.1 CalSim II

The CalSim II planning model was used to simulate the operation of the CVP and SWP over a range of regulatory conditions. CalSim II incorporates major CVP and SWP facilities as well as key local (or non-project) facilities. A list of major modeled facilities is located in Table 5A.B.20.

The CalSim II simulation model uses single time-step optimization techniques to route water through a network of storage nodes and flow arcs based on a series of user-specified relative priorities for water allocation and storage. Physical capacities and specific regulatory and contractual requirements are input as linear constraints to the system operation using the water resources simulation language (WRESL). The process of conveying water through the channels and storing water in reservoirs is performed by a mixed-integer linear-programming solver. For each time step, the solver maximizes the objective function to determine a solution that delivers or stores water according to the specified priorities and satisfies all system constraints. The sequence of solved linear-programming problems represents the simulation of the system over the period of analysis.

CalSim II includes an 82-year modified historical hydrology (water years 1922-2003) developed jointly by Reclamation and DWR. Water diversion requirements (demands), stream accretions and depletions, rim basin inflows, irrigation efficiencies, return flows, nonrecoverable losses, and groundwater operations are components that make up the hydrology used in CalSim II. Sacramento Valley and tributary rim basin hydrologies are developed using a process designed to adjust the historical observed sequence of monthly stream flows to represent a sequence of flows at a future level of development. Adjustments to historic water supplies are determined by imposing future level land use on historical meteorological and hydrologic conditions. The resulting hydrology represents the water supply available from Central Valley streams to the system at a future level of development. Figure 5A.A.3 shows the valley floor depletion regions, which represent the spatial resolution at which the hydrologic analysis is performed in the model.

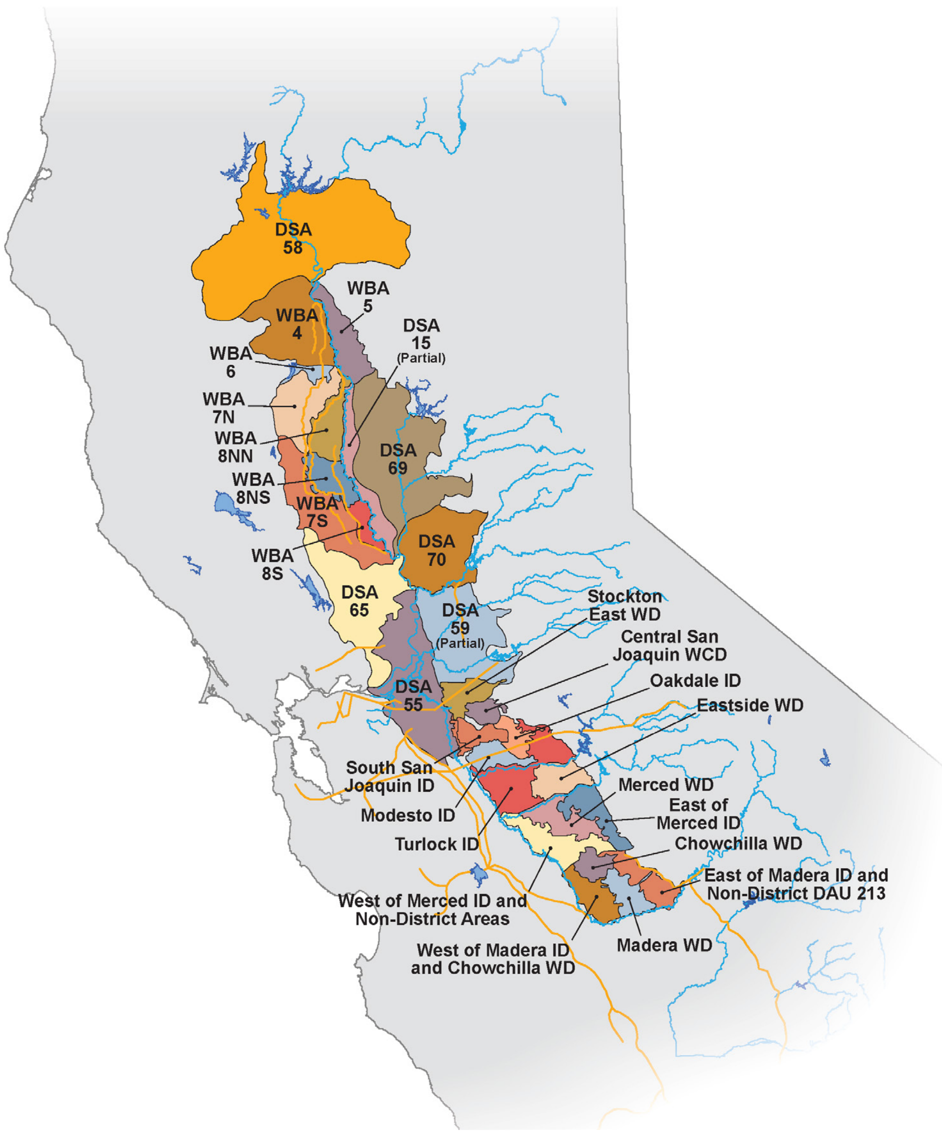


Figure 5A.A.3 CalSim II Depletion Analysis Regions

CalSim II uses rule-based algorithms for determining deliveries to north-of-Delta and south-of-Delta CVP and SWP contractors. This delivery logic uses runoff forecast information, which incorporates uncertainty and standardized rule curves. The rule curves relate storage levels and forecasted water supplies to project delivery capability for the upcoming year. The delivery capability is then translated into CVP and SWP contractor allocations that are satisfied through coordinated reservoir-export operations.

The CalSim II model utilizes a monthly time step to route flows throughout the river-reservoir system of the Central Valley. Although monthly time steps are reasonable for long-term planning analyses of water operations, a component of the EIS conveyance and conservation strategy includes operations that are sensitive to flow variability at scales less than monthly (i.e., the operation of the Fremont Weir). Initial comparisons of monthly versus daily operations at these facilities indicated that weir spills were likely underestimated and diversion potential was likely overstated using a monthly time step. For these reasons, a monthly to daily flow disaggregation technique was included in the CalSim II model for the Fremont Weir and the Sacramento Weir. The technique applies historical daily patterns, based on the hydrology of the year, to transform the monthly volumes into daily flows. Reclamation's 2008 LTO BA Appendix D provides more information about CalSim II (Reclamation 2008a).

5A.A.3.2 Artificial Neural Network for Flow-Salinity Relationship

Determination of flow-salinity relationships in the Sacramento-San Joaquin Delta is critical to both project and ecosystem management. Operation of the CVP and SWP facilities and management of Delta flows is often dependent on Delta flow needs for salinity standards. Salinity in the Delta cannot be simulated accurately by the simple mass-balance routing and coarse time step used in CalSim II. Likewise, the upstream reservoirs and operational constraints cannot be modeled in the DSM2 model. An ANN has been developed (Sandhu et al. 1999) that attempts to mimic the flow-salinity relationships as simulated in DSM2, but provide a rapid transformation of this information into a form usable by the CalSim II operations model. The ANN is implemented in CalSim II to constrain the operations of the upstream reservoirs and the Delta export pumps in order to satisfy particular salinity requirements. A more detailed description of the use of ANNs in the CalSim II model is provided in Wilbur and Munévar (2001).

The ANN developed by DWR (Sandhu et al. 1999, Seneviratne and Wu 2007) attempts to statistically correlate the salinity results from a particular DSM2 model run to the various peripheral flows (Delta inflows, exports, and diversions), gate operations, and an indicator of tidal energy. The ANN is calibrated or trained on DSM2 results that may represent historical or future conditions using a full-circle analysis (Seneviratne and Wu 2007). For example, a future reconfiguration of the Delta channels to improve conveyance may significantly affect the hydrodynamics of the system. The ANN would be able to represent this new configuration by being retrained on DSM2 model results that included the new configuration.

The current ANN predicts salinity at various locations in the Delta using the following parameters as input: Northern flows, San Joaquin River inflow, Delta Cross Channel gate position, total exports and diversions, Net Delta Consumptive Use (an indicator of the tidal energy), and San Joaquin River at Vernalis salinity.

Northern flows include Sacramento River flow, Yolo Bypass flow, and combined flow from the Mokelumne, Cosumnes, and Calaveras rivers (East Side Streams) minus North Bay Aqueduct and Vallejo exports. Total exports and diversions include SWP Banks Pumping Plant, CVP Jones Pumping Plant, and CCWD diversions, including diversions to Los Vaqueros Reservoir. A total of 148 days of values for each of these parameters is included in the correlation, representing an estimate of the length of memory of antecedent conditions in the Delta. The ANN model approximates DSM2 model-generated salinity at the following key locations for the purpose of modeling Delta water quality standards: X2, Sacramento River at Emmaton, San Joaquin River at Jersey Point, Sacramento River at Collinsville, and Old River at Rock Slough. In addition, the ANN is capable of providing salinity estimates for Clifton Court Forebay, and the CCWD Alternate Intake Project and Los Vaqueros diversion locations.

The ANN may not fully capture the dynamics of the Delta under conditions other than those for which it was trained. It is possible that the ANN will exhibit errors in flow regimes beyond those for which it was trained. Therefore, a new ANN is needed for any new Delta configuration or under sea-level rise conditions that may result in changed flow-salinity relationships in the Delta.

5A.A.3.3 Application of CalSim II to Evaluate EIS Alternatives

Typical long-term planning analyses of the Central Valley system and operations of the CVP and SWP have applied the CalSim II model to analyze system responses. CalSim II simulates future CVP and SWP project operations based on an 82-year monthly hydrology derived from the observed 1922-2003 period. Future land use and demands are projected for the appropriate future period. The system configuration of facilities, operations, and regulations forms the input to the model and defines the limits or preferences for operation. The configuration of the Delta, while not simulated directly in CalSim II, informs the flow-salinity relationships and several flow-related regressions for interior Delta conditions (e.g., X2 and OMR) included in the model. The CalSim II model is simulated for each set of hydrologic, facility, operations, regulations, and Delta configuration conditions. Some refinement of the CVP and SWP operations related to delivery allocations and San Luis target storage levels are generally necessary to have the model reflect suitable north-south reservoir balancing under future conditions. These refinements are generally made by experienced modelers in coordination with project operators.

The CalSim II model produces outputs of river flows, exports, water deliveries, reservoir storage, water quality, and several derived variables such as X2, Delta salinity, OMR (combined Old and Middle River flows), and QWEST (westerly flow on the San Joaquin River past Jersey Point). The CalSim II model is most appropriately applied for comparing one alternative to another and drawing comparisons among the results. This is the method applied for the EIS.

The No Action Alternative simulation assumes continuation of operations under the current regulatory environment with existing facilities for future climate and sea-level conditions (projected to the Year 2030).

The Second Basis of Comparison is developed due to the identified need during scoping comments for a basis of comparison to operations that would occur “without” the reasonable and prudent alternatives (RPAs). The Second Basis of Comparison assumptions do not include most of the RPAs. The Second Basis of Comparison does, however, include actions that are constructed (e.g., Red Bluff Pumping Plant), implemented (e.g., the Suisun Marsh Habitat Management, Preservation, and Restoration Plan), legislatively mandated (e.g., the San Joaquin River Restoration Plan), and have made substantial progress (e.g., Yolo Bypass Salmonid Habitat Restoration and Fish Passage).

Each alternative is compared to the No Action Alternative and the Second Basis of Comparison to evaluate areas in which the project changes conditions and the seasonality and magnitude of such changes. The change in hydrologic response or system conditions is important information that informs the impact analysis related to water-dependent resources in Sacramento-San Joaquin watersheds.

5A.A.3.3.1 ANN Retraining

ANNs are used for simulating flow-salinity relationships in CalSim II. They are trained on DSM2 outputs and therefore emulate DSM2 results. ANN requires retraining whenever the flow-salinity relationship in the Delta changes. As mentioned earlier, EIS analysis assumes a 15-cm sea-level rise. An ANN developed to simulate salinity conditions with 15-cm sea-level rise was developed by and obtained from DWR. The ANN retraining process is described in Section 5A.A.4.3.1.

5A.A.3.3.2 Incorporation of Climate Change

Climate and sea level change are incorporated into the CalSim II model in two ways: changes to the input hydrology and changes to the flow-salinity relationship in the Delta due to sea-level rise. In this approach, changes in runoff and stream flow are simulated through VIC modeling under representative climate scenarios. These simulated changes in runoff are applied to the CalSim II inflows as a fractional change from the observed inflow patterns (simulated future runoff divided by historical runoff). These fraction changes are first applied for every month of the 82-year period consistent with the VIC simulated patterns. A second order correction is then applied to ensure that the annual shifts in runoff at each location are consistent with that generated from the VIC modeling. A spreadsheet tool has been prepared to process this information and generate adjusted inflow time series records for CalSim II. Once the changes in flows have been resolved, water year types and other hydrologic indices that govern water operations or compliance are adjusted to be consistent with the new hydrologic regime. This spreadsheet tool has been updated for the EIS analysis to accommodate the needs of the CalSim II version used in this study.

The effect of sea-level rise on the flow-salinity response is incorporated in the respective ANN.

The following input parameters are adjusted in CalSim II to incorporate the effects of climate change:

- Inflow time series records for all major streams in the Central Valley
- Sacramento and San Joaquin valley water year types
- Runoff forecasts used for reservoir operations and allocation decisions
- Delta water temperature as used in triggering Biological Opinion Smelt criteria
- A modified ANN to reflect the flow-salinity response under 15-cm sea-level change

Section 5A.A.5 provides more detailed information on climate change and sea-level rise modeling approaches followed for the EIS.

The CalSim II simulations do not consider future climate change adaptations that may manage the CVP and SWP system in a different manner than today to reduce climate impacts. For example, future changes in reservoir flood control reservation to better accommodate a seasonally changing hydrograph may be considered under future programs, but are not considered under the EIS. Thus, the CalSim II EIS results represent the risks to operations, water users, and the environment in the absence of dynamic adaptation for climate change.

5A.A.3.4 Output Parameters

The hydrology and system operations models produce the following key parameters on a monthly time step:

- River flows and diversions
- Reservoir storage
- Delta flows and exports
- Delta inflow and outflow
- Deliveries to project and non-project users
- Controls on project operations

Some operations have been informed by the daily variability included in the CalSim II model for the EIS and, where appropriate, these results are presented. However, it should be noted that CalSim II remains a monthly model. The daily variability inputs to the CalSim II model help to better represent certain operational aspects, but the monthly results are utilized for water balance.

5A.A.3.5 Appropriate Use of CalSim II Results

CalSim II is a monthly model developed for planning level analyses. The model is run for an 82-year historical hydrologic period, at a projected level of hydrology and demands, and under an assumed framework of regulations. Therefore, the 82-year simulation does not provide information about historical conditions, but it does provide information about variability of conditions that would occur at the assumed level of hydrology and demand with the assumed operations, under the same historical hydrologic sequence. Because it is not a physically based model, CalSim II is not calibrated and cannot be used in a predictive manner. CalSim II is intended to be used in a comparative manner, which is appropriate for a NEPA analysis.

In CalSim II, operational decisions are made on a monthly basis, based on a set of predefined rules that represent the assumed regulations. The model has no capability to adjust these rules based on a sequence of hydrologic events such as a prolonged drought, or based on statistical performance criteria such as meeting a storage target in an assumed percentage of years.

Although there are certain components in the model that are downscaled to daily time step (simulated or approximated hydrology) such as an air-temperature-based trigger for a fisheries action, the results of those daily conditions are always averaged to a monthly time step (for example, a certain number of days with and without the action is calculated and the monthly result is calculated using a day-weighted average based on the total number of days in that month), and operational decisions based on those components are made on a monthly basis. Therefore, reporting sub-monthly results from CalSim II or from any other subsequent model that uses monthly CalSim results as an input is not considered an appropriate use of model results.

Appropriate use of model results is important. Despite detailed model inputs and assumptions, the CalSim II results may differ from real-time operations under stressed water supply conditions. Such model results occur due to the inability of the model to make real-time policy decisions under extreme circumstances, as the actual (human) operators must do. Therefore, these results should only be considered an indicator of stressed water supply conditions under that alternative, and should not be considered to reflect what would occur in the future. For example, reductions to senior water rights holders due to dead-pool conditions in the model can be observed in model results under certain circumstances. These reductions, in real-time operations, may be avoided by making policy decisions on other requirements in prior months. In actual future operations, as has always been the case in the past, the project operators would work in real time to satisfy legal and contractual obligations given the current conditions and hydrologic constraints. Chapter 5, Surface Water Resources and Water Supplies, provides appropriate interpretation and analysis of such model results. Section 5.3.3 of Chapter 5, describes historical responses by CVP and SWP to recent drought conditions.

Reclamation’s 2008 LTO BA Appendix W (Reclamation 2008c) included a comprehensive sensitivity and uncertainty analysis of CalSim II results relative to the uncertainty in the inputs. This appendix provides a good summary of the key inputs that are critical to the largest changes in several operational outputs. Understanding the findings from this appendix may help in better understanding the alternatives.

5A.A.3.6 Linkages to Other Models

The hydrology and system operations models generally require input assumptions relating to hydrology, demands, regulations, and flow-salinity responses. Reclamation and DWR have prepared hydrologic inputs and demand assumptions for a future (2030) level of development (future land use and development assumptions) based on historical hydroclimatic conditions. Regulations and associated operations are translated into operational requirements. The flow-salinity ANN, representing appropriate sea-level rise, is embedded into the system operations model.

As mentioned previously in this appendix, changes to the historical hydrology related to future climate are applied in the CalSim II model and combined with the assumed operations for each alternative. The CalSim II model simulates the operation of the major CVP and SWP facilities in the Central Valley and generates estimates of river flows, exports, reservoir storage, deliveries, and other parameters.

Agricultural and municipal and industrial deliveries resulting from CalSim II are used in other models for assessing changes to groundwater resources and agricultural, municipal, and regional economics. Changes in land use reported by the agricultural economics model are subsequently used to assess changes in air quality.

The Delta boundary flows and exports from CalSim II are then used to drive the DSM2 Delta hydrodynamic and water quality models for estimating tidally based flows, stage, velocity, and salt transport within the estuary. DSM2 water quality and volumetric fingerprinting results are used to assess changes in concentration of selenium and methylmercury in Delta waters.

Power generation models use CalSim II reservoir levels and releases to estimate power use and generation capability of the projects.

River and temperature models for the primary river systems use the CalSim II reservoir storage, reservoir releases, river flows, and meteorological conditions to estimate reservoir and river temperatures under each scenario.

Results from these temperature models are further used as an input to fisheries models (e.g., SalMod, Reclamation Egg Mortality Model, and IOS) to assess changes in fisheries habitat due to flow and temperature. CalSim II and DSM2 results are also used for fisheries models (IOS, DPM) or aquatic species survival/habitat relationships developed based on peer-reviewed scientific publications.

The results from this suite of physically based models are used to describe the effects of each individual scenario considered in the EIS.

5A.A.4 Delta Hydrodynamics and Water Quality

Hydrodynamics and water quality modeling is essential to understanding the impacts of operation of the CVP and SWP on the Delta. The analysis of the hydrodynamics and water quality changes as a result of operational changes is critical in understanding the impacts on the habitats, species, and water users that depend on the Delta.

This section describes the methodology used for simulating Delta hydrodynamics and water quality for evaluating the alternatives. It discusses the primary tool (DSM2) used in this process.

5A.A.4.1 Overview of Hydrodynamics and Water Quality Modeling Approach

There are several tools available to simulate hydrodynamics and water quality in the Delta. Some tools simulate detailed processes, but are computationally intensive and have long runtimes. Other tools approximate certain processes and have short runtimes, while only compromising slightly on the accuracy of the results. For a planning analysis, it is ideal to understand the resulting changes over several years to cover a range of hydrologic conditions. So, a tool that can simulate the changed hydrodynamics and water quality in the Delta accurately with a short runtime is desired. DSM2 is a one-dimensional hydrodynamics and water quality model that serves this purpose.

DSM2 has a limited ability to simulate two-dimensional features such as tidal marshes and three-dimensional processes such as gravitational circulation, which is known to increase with sea-level rise in the estuaries. Therefore, it must be recalibrated or corroborated based on a data set that accurately represents the conditions in the Delta under sea-level rise. Because the proposed conditions are hypothetical, the best available approach to estimate the Delta hydrodynamics is to simulate higher dimensional models that can resolve the two- and three-dimensional processes well. These models would generate the data sets needed to corroborate or recalibrate DSM2 under those conditions so that it can simulate the hydrodynamics and salinity transport with reasonable accuracy. For the purposes of this EIS, a DSM2 model that was corroborated for 15-cm sea-level rise is used.

5A.A.4.2 Delta Simulation Model

DSM2 is a one-dimensional hydrodynamics, water quality, and particle-tracking simulation model used to simulate hydrodynamics, water quality, and particle tracking in the Sacramento-San Joaquin Delta (Anderson and Mierzwa 2002). DSM2 represents the best available planning model for Delta tidal hydraulics and salinity modeling. It is appropriate for describing the existing conditions in the Delta, as well as performing simulations for the assessment of incremental environmental impacts caused by future facilities and operations. The DSM2 model has three separate components: HYDRO, QUAL, and PTM. HYDRO simulates one-dimensional hydrodynamics including flows, velocities, depth, and water surface elevations. HYDRO provides the flow input for QUAL and PTM. QUAL simulates one-dimensional fate and transport of conservative and non-conservative water quality constituents given a flow field simulated by HYDRO. PTM simulates pseudo 3-D transport of neutrally buoyant particles based on the flow field simulated by HYDRO.

DSM2 v8.0.6 was used in modeling of the EIS No Action Alternative, Second Basis of Comparison, and the other alternatives using a period of simulation consistent with the CalSim II model (water years 1922 to 2003).

DSM2 hydrodynamics and salinity (electrical conductivity, or EC) were initially calibrated in 1997 (DWR 1997). In 2000, a group of agencies, water users, and stakeholders recalibrated and validated DSM2 in an open process resulting in a model that could replicate the observed data more closely than the 1997 version (DSM2PWT 2001). In 2009, DWR performed a calibration and validation of DSM2 by including the flooded Liberty Island in the DSM2 grid, which allowed for an improved simulation of tidal hydraulics and EC transport in DSM2 (DWR 2009). The model used for evaluating the EIS scenarios was based on this latest calibration.

Simulation of dissolved organic carbon (DOC) transport in DSM2 was successfully validated in 2001 by DWR (Pandey 2001). The temperature and dissolved oxygen (DO) calibration was initially performed in 2003 by DWR (Rajbhandari 2003). Recent development efforts by Resource Management Associates, Inc. (RMA) in 2009 allowed for improved calibration of temperature, DO, and the nutrient transport in DSM2.

5A.A.4.2.1 DSM2-HYDRO

The HYDRO module is a one-dimensional, implicit, unsteady, open-channel flow model that DWR developed from FOURPT, a four-point finite difference model originally developed by the U.S. Geological Survey (USGS) in Reston, Virginia. DWR adapted the model to the Delta by revising the input-output system, including open-water elements, and incorporating water project facilities, such as gates, barriers, and the Clifton Court Forebay. HYDRO simulates water surface elevations, velocities, and flows in the Delta channels (Nader-Tehrani 1998). HYDRO provides the flow input necessary for QUAL and PTM modules.

The HYDRO module solves the continuity and momentum equations using a fully implicit scheme. These partial differential equations are solved using a finite difference scheme requiring four points of computation. The equations are integrated in time and space, which leads to a solution of stage and flow at the computational points. HYDRO enforces an “equal stage” boundary condition for all the channels connected to a junction. The model can handle both irregular cross-sections derived from the bathymetric surveys and trapezoidal cross-sections. Even though, the model formulation includes a baroclinic term, the density is generally held constant in the HYDRO simulations.

HYDRO allows the simulation of hydraulic gates in the channels. A gate may have several associated hydraulic features (e.g., radial gates, flash boards, and boat ramps), each of which may be operated independently to control flow. Gates can be placed either at the upstream or downstream end of a channel. Once the location of a gate is defined, the boundary condition for the gated channel is modified from “equal stage” to “known flow,” with the calculated flow. The gates can be opened or closed in one or both directions by specifying a coefficient of zero or one.

Reservoirs are used to represent open bodies of water that store flow. Reservoirs are treated as vertical-walled tanks in DSM2, with a known surface area and bottom elevation and are considered instantly well-mixed. The flow interaction between the open water area and one or more of the connecting channels is determined using the general orifice formula. The flow in and out of the reservoir is controlled using the flow coefficient in the orifice equation, which can be different in each direction. DSM2 does not allow the cross-sectional area of the inlet to vary with the water level.

DSM2 v8 includes a new feature called "operating rules" under which the gate operations or the flow boundaries can be modified dynamically when the model is running based on the current value of a state variable (flow, stage, or velocity). The change can also be triggered based on a time series that is not currently simulated in the model (e.g., daily averaged EC) or based on the current time step of the simulation (for example, a change can occur at the end of the day or end of the season). The operating rules include many functions that allow derivation of the quantities to be used as trigger from the model data or outside time series data. Operating rules allow a change or an action to occur when the trigger value changes from false to true.

5A.A.4.2.2 DSM2-QUAL

The QUAL module is a one-dimensional water quality transport model that DWR adapted from the Branched Lagrangian Transport Model originally developed by the USGS. DWR added many enhancements to the QUAL module, such as open water areas and gates. A Lagrangian feature in the formulation eliminates the numerical dispersion that is inherently in other segmented formulations, although the tidal dispersion coefficients must still be specified. QUAL simulates fate and transport of conservative and nonconservative water quality constituents given a flow field simulated by HYDRO. It can calculate mass transport processes for conservative and nonconservative constituents including salts, water temperature, nutrients, DO, and trihalomethane formation potential.

The main processes contributing to the fate and transport of the constituents include flow-dependent advection and tidal dispersion in the longitudinal direction. Mass-balance equations are solved for all quality constituents in each parcel of water using the tidal flows and volumes calculated by the HYDRO module. Additional information and the equations used are specified in the 19th annual progress report by DWR (Rajbhandari 1998).

The QUAL module is also used to simulate source water fingerprinting, which allows determining the relative contributions of water sources to the volume at any specified location. It is also used to simulate constituent fingerprinting, which determines the relative contributions of conservative constituent sources to the concentration at any specified location. For fingerprinting studies, six main sources are typically tracked: Sacramento River, San Joaquin River, Martinez, Eastside Streams (Mokelumne, Cosumnes and Calaveras combined), agricultural drains (all combined), and Yolo Bypass. For source water fingerprinting, a tracer with constant concentration is assumed for each source tracked, while the concentrations at other inflows are kept as zero. For constituent (e.g., EC) fingerprinting analysis, the concentrations of the desired constituent are specified at each tracked source, while the concentrations at other inflows are kept as zero (Anderson 2003).

5A.A.4.2.3 DSM2 Input Requirements

DSM2 requires input assumptions relating to physical description of the system (e.g., Delta channel, marsh, and island configuration); description of flow control structures such as gates; initial estimates for stage, flow, and EC throughout the Delta; and time-varying input for all boundary river flows and exports, tidal boundary conditions, gate operations, and constituent concentrations at each inflow. Figure 5A.A.4 illustrates the hydrodynamic and water quality boundary conditions required in DSM2. For long-term planning simulations, output from the CalSim II model generally provides the necessary input for the river flows and exports.

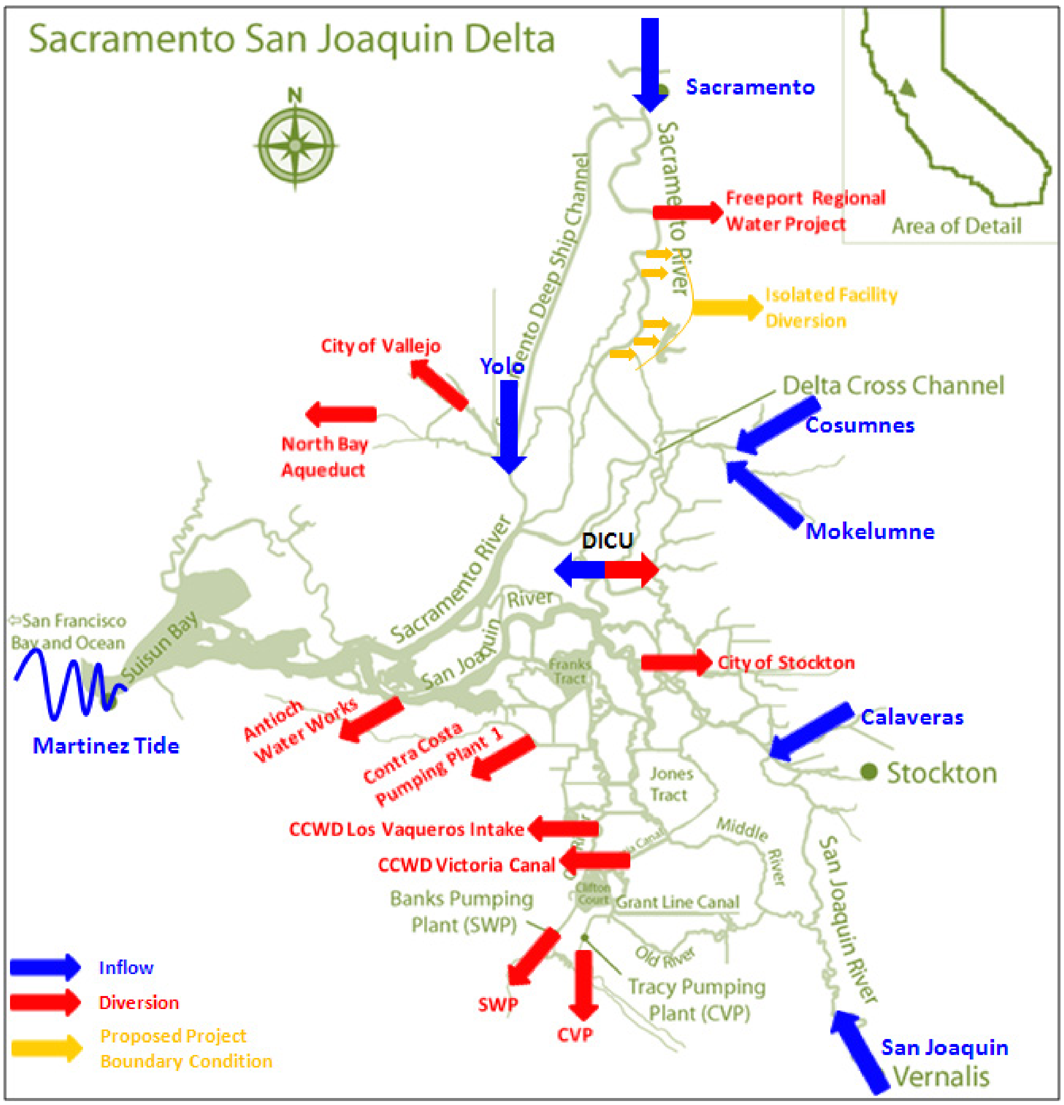


Figure 5A.A.4 Hydrodynamic and Water Quality Boundary Conditions in DSM2

Assumptions relating to Delta configuration and gate operations are directly input into the hydrodynamic models. Adjusted astronomical tide (Ateljevich 2001a) normalized for sea-level rise (Ateljevich and Yu 2007) is forced at the Martinez boundary. Constituent concentrations are specified at the inflow boundaries, which are estimated from either historical information or CalSim II results. The EC boundary condition at Vernalis is derived from the CalSim II results. The Martinez EC boundary condition is derived based on the simulated net Delta outflow from CalSim II and using a modified G-model (Ateljevich 2001b).

The major hydrodynamic boundary conditions are listed in Table 5A.A.1, and the locations at which constituent concentrations are specified for the water quality model are listed in Table 5A.A.2.

Table 5A.A.1 DSM2 HYDRO Boundary Conditions

Boundary Condition	Location/Control Structure	Typical Temporal Resolution
Tide	Martinez	15 minutes
Delta Inflows	Sacramento River at Freeport	1 day
	San Joaquin River at Vernalis	1 day
	Eastside Streams (Mokelumne and Cosumnes Rivers)	1 day
	Calaveras River	1 day
	Yolo Bypass	1 day
Delta Exports/Diversions	Banks Pumping Plant (SWP)	1 day
	Jones Pumping Plant (CVP)	1 day
	Contra Costa Water District Diversions at Rock Slough, Old River at Highway 4 and Victoria Canal	1 day
	North Bay Aqueduct	1 day
	City of Vallejo	1 day
	Antioch Water Works	1 day
	Freeport Regional Water Project	1 day
	City of Stockton	1 day
	Isolated Facility Diversion	1 day
Delta Island Consumptive Use	Diversion	1 month
	Seepage	1 month
	Drainage	1 month
Gate Operations	Delta Cross Channel	Irregular time series

Gate Operations (continued)	South Delta Temporary Barriers	Dynamically operated on 15-minute step
	Montezuma Salinity Control Gate	Dynamically operated on 15-minute step

Table 5A.A.2 DSM2 QUAL Boundary Conditions Typically Used in a Salinity Simulation

Boundary Condition	Location/Control Structure	Typical Temporal Resolution
Ocean Salinity	Martinez	15 minutes
Delta Inflows	Sacramento River at Freeport	Constant
	San Joaquin River at Vernalis	1 month
	Eastside Streams (Mokelumne and Cosumnes Rivers)	Constant
	Calaveras River	Constant
	Yolo Bypass	Constant
Delta Island Consumptive Use	Drainage	1 month (repeated each year)

Note: For other water quality constituents, concentrations are required at the same locations.

5A.A.4.3 Application of DSM2 to Evaluate EIS Alternatives

For EIS purposes, DSM2 was run for the 82-year period from water year 1922 to water year 2003 consistent with CalSim II, on a 15-minute time step. Inputs needed for DSM2—inflows, exports, and Delta Cross Channel (DCC) gate operations—were provided by the 82-year CalSim II simulations. The tidal boundary condition at Martinez was provided by an adjusted astronomical tide (Ateljevich and Yu 2007). Monthly Delta channel depletions (i.e., diversions, seepage, and drainage) were estimated using DWR’s Delta Island Consumptive Use model (Mahadevan 1995).

CalSim II provides monthly inflows and exports in the Delta. Traditionally, the Sacramento and San Joaquin river inflows are disaggregated to a daily time step for use in DSM2, either by applying rational histosplines or by assuming that the monthly average flow is constant over the whole month. The splines allow a smooth transition between the months. The smoothing reduces sharp transitions at the start of the month, but still results in constant flows for most of the month. Other inflows, exports, and diversions were assumed to be constant over the month.

DCC gate operation input in DSM2 is based on CalSim II output. For each month, DSM2 assumes the DCC gates are open for the "number of the days open" simulated in CalSim II, from the start of the month.

The operation of the south Delta temporary barriers is determined dynamically in using the operating rules feature in DSM2. These operations generally depend on the season, San Joaquin River flow at Vernalis, and tidal condition in the south Delta. Similarly, the Montezuma Slough salinity control gate operations are determined using an operating rule that sets the operations based on the season, Martinez salinity, and tidal condition in the Montezuma Slough.

For salinity, EC at Martinez is estimated using the G-model on a 15-minute time step, based on the Delta outflow simulated in CalSim II and the pure astronomical tide at Martinez (Ateljevich 2001a). The monthly averaged EC for the San Joaquin River at Vernalis estimated in CalSim II for the 82-year period is used in DSM2. For other river flows, which have low salinity, constant values are assumed. Monthly average values of the EC associated with Delta agricultural drainage and return flows were estimated for three regions in the Delta based on observed data identifying the seasonal trend. These values are repeated for each year of the simulation.

5A.A.4.3.1 ANN Retraining

ANNs are used for flow-salinity relationships in CalSim II. They are trained on DSM2 outputs and therefore emulate DSM2 functionality. ANN requires retraining whenever the flow-salinity relationship in the Delta changes. EIS analysis assumes 15-cm sea-level rise at Year 2030 that results in a different flow-salinity relationship in the Delta and therefore required an ANN retrained for the 15-cm sea-level rise by DWR Bay-Delta Modeling Support Branch staff.

The ANN retraining process involves the following steps:

- The DSM2 model is corroborated for each scenario (changed sea level or Delta physical configuration).
- A range of example long-term CalSim II scenarios is used to provide a range of boundary conditions for DSM2 models.
- Using the grid configuration and the correlations from the corroboration process, several 16-year planning runs are simulated based on the boundary conditions from the identified CalSim II scenarios to create a training data set for each new ANN.
- ANNs are trained using the Delta flows and DCC operations from CalSim II, EC results from DSM2, and the Martinez tide.
- The training data set is divided into two parts; one is used for training the ANN, and the other to validate.
- Once the ANN is ready, a full-circle analysis is performed to assess the performance of the ANN.

Detailed description of the ANN training procedure and the full-circle analysis is provided in DWR's 2007 annual report (Seneviratne and Wu 2007).

5A.A.4.4 Output Parameters

DSM2 HYDRO provides the following outputs on a 15-minute time step:

- Tidal flow
- Tidal stage
- Tidal velocity

The following variables can be derived from the above outputs:

- Net flows
- Mean sea level, mean higher high water, mean lower low water, and tidal range
- Water depth
- Tidal reversals
- Flow splits, etc.

DSM2 QUAL provides the following outputs on a 15-minute time step:

- Salinity (EC)
- DOC
- Source water and constituent fingerprinting

The following variables can be derived from the above QUAL outputs:

- Bromide, chloride, and total dissolved solids
- Selenium and mercury

In a planning analysis, the flow boundary conditions that drive DSM2 are obtained from the monthly CalSim II model. The agricultural diversions, return flows, and corresponding salinities used in DSM2 are on a monthly time step. The implementation of DCC gate operations in DSM2 assumes that the gates are open from the beginning of a month, irrespective of the water quality needs in the south Delta.

The input assumptions stated earlier should be considered when DSM2 EC results are used to evaluate performance of a baseline or an alternative against the standards. Even though CalSim II releases sufficient flow to meet the standards on a monthly average basis, the resulting EC from DSM2 may be over the standard for part of a month and under the standard for part of the month, depending on the spring/neap tide and other factors (for example, simplification of operations). It is recommended that the results are presented on a monthly basis. Frequency of compliance with a criterion should be computed based on monthly average results. Averaging on a sub-monthly (14-day or more) scale may be appropriate as long as the limitations with respect to the compliance of the baseline model are described in detail and the alternative results are presented as an incremental change from a baseline model.

In general, it is appropriate to present DSM2 QUAL results including EC, DOC, volumetric fingerprinting, and constituent fingerprinting on a monthly time step. When comparing results between two scenarios, computing differences based on these mean monthly statistics is appropriate.

5A.A.4.5 Modeling Limitations

DSM2 is a one-dimensional model with inherent limitations in simulating hydrodynamic and transport processes in a complex estuarine environment such as the Delta. DSM2 assumes that velocity in a channel can be adequately represented by a single average velocity over the channel cross-section, meaning that variations both across the width of the channel and through the water column are negligible. DSM2 does not have the ability to model short-circuiting of flow through a reach, where a majority of the flow in a cross-section is confined to a small portion of the cross-section. DSM2 does not conserve momentum at the channel junctions and does not model the secondary currents in a channel. DSM2 also does not explicitly account for dispersion due to flow accelerating through channel bends. It cannot model the vertical salinity stratification in the channels.

It has inherent limitations in simulating the hydrodynamics related to the open water areas. Since a reservoir surface area is constant in DSM2, it impacts the stage in the reservoir and thereby impacts the flow exchange with the adjoining channel. Due to the inability to change the cross-sectional area of the reservoir inlets with changing water surface elevation, the final entrance and exit coefficients were fine-tuned to match a median flow range. This causes errors in the flow exchange at breaches during the extreme spring and neap tides. Using an arbitrary bottom elevation value for the reservoirs representing the proposed marsh areas to get around the wetting-drying limitation of DSM2 may increase the dilution of salinity in the reservoirs. Accurate representation of tidal marsh areas, bottom elevations, location of breaches, breach widths, cross-sections, and boundary conditions in DSM2 is critical to the agreement of corroboration results.

For open waterbodies DSM2 assumes uniform and instantaneous mixing over the entire open water area. Thus, it does not account for any salinity gradients that may exist within the open waterbodies. Significant uncertainty exists in flow and EC input data related to in-Delta agriculture, which leads to uncertainty in the simulated EC values. Caution needs to be exercised when using EC outputs on a sub-monthly scale. Water quality results inside the waterbodies representing the tidal marsh areas were not validated specifically, and because of the bottom elevation assumptions, preferably should not be used for analysis.

5A.A.4.6 Linkages to Other Models

The Delta boundary flows and exports from CalSim II are used to drive the DSM2 Delta hydrodynamic and water quality models for estimating tidally based flows, stage, velocity, and salt transport within the estuary. DSM2 water quality and volumetric fingerprinting results are used to assess changes in concentration of selenium and methylmercury in Delta waters.

DSM2 results are also used for fisheries models (IOS, DPM) or aquatics species survival/habitat relationships developed based on peer-reviewed scientific publications.

5A.A.5 Climate Change and Sea-Level Rise

The EIS uses a representation of potential climate change and sea-level rise change in numerical models that simulate hydrologic and hydrodynamic conditions in the study area in addition to changes in river flows due to changes in operations and diversions. This approach is based upon the methods used in development of BDCP EIR/EIS (DWR et al 2013).

This section provides brief information on methods used for this EIS.

5A.A.5.1 Climate Change

A growing body of evidence indicates that Earth's atmosphere is warming. Records show that surface temperatures have risen about 0.7°C since the early twentieth century and that 0.5°C of this increase has occurred since 1978 (NAS 2006). Observed changes in oceans, snow and ice cover, and ecosystems are consistent with this warming trend (NAS 2006, IPCC 2007). The temperature of Earth's atmosphere is directly related to the concentration of atmospheric greenhouse gases. Growing scientific consensus suggests that climate change will be inevitable as the result of increased concentrations of greenhouse gases and related temperature increases (IPCC 2007, Kiparsky and Gleick 2003, Cayan et al. 2009, USGRP 2013).

Observed climate and hydrologic records indicate that more substantial warming has occurred since the 1970s and that this is likely a response to the increases in greenhouse gas (GHG) increases during this time. The recent suite of global climate models (GCMs), a part of the Coupled Model Intercomparison Project Phase 3 (CMIP3)[1] and Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), when simulated under future GHG emission scenarios and current atmospheric GHGs, exhibit warming globally and regionally over California. In the early part of the twenty-first century, the amount of warming produced by the higher-emission A2 scenario is not very different from the lower-emission B1 scenario, but becomes increasingly larger through the middle and especially the latter part of the century. Six GCMs selected for the 2009 scenarios project by the California Climate Action Team project a mid-century temperature increase of about 1°C to 3°C (1.8°F to 5.4°F), and an end-of-century increase from about 2°C to 5°C (3.6°F to 9°F) (Cayan et al. 2009). Precipitation in most of California is dominated by extreme variability, seasonally, annually, and over decade time scales. The GCM simulations of

[1] At the time of methods selection for the EIS, Coupled Model Intercomparison Project Phase 3 (CMIP3) projections were the most recently available ensembles. Even though Coupled Model Intercomparison Project Phase 5 (CMIP5) was released by the IPCC (after the methods selection for the EIS) in 2013, the use of CMIP3 ensembles are deemed appropriate because the differences in the projected changes in annual precipitation and temperature between the CMIP3 and CMIP5 projections are relatively small over the Central Valley by the end of 2030.

historical climate capture the historical range of variability reasonably well (Cayan et al. 2009), but historical trends are not well captured in these models. Projections of future precipitation are much more uncertain than those for temperature. As climate changes, California is expected to be subjected to alterations in natural hydrologic conditions, including changes in snow accumulation and stream flow availability.

5A.A.5.2 Sea-Level Rise

Global and regional sea levels have been increasing steadily over the past century and are expected to continue to increase throughout this century. Over the past several decades, sea level measured at tide gages along the California coast has risen at a rate of about 17 to 20 cm (6.7 to 7.9 inches) per century (Cayan et al. 2009). While there is considerable variability among the gages along the Pacific Coast, primarily reflecting local differences in vertical movement of the land and length of gage record, this observed rate in mean sea level is similar to the global mean trend (NOAA 2012). Global estimates of sea-level rise made in the most recent assessment by the IPCC (2007) indicate a range of 18 to 59 cm (7.1 to 23.2 inches) this century. However, since the release of the IPCC AR4, advances have occurred in the understanding of sea-level rise. These advances in the science have led to criticism of the approach used by the IPCC. Recent work by Rahmstorf (2007), Vermeer and Rahmstorf (2009), and others suggests that the sea-level rise may be substantially greater than the IPCC projections.

Empirical models based on the observed relationship between global temperatures and sea levels have been shown to perform better than the IPCC models in reconstructing recent observed trends. Rahmstorf (2007) and Vermeer and Rahmstorf (2009) demonstrated that such a relationship, when applied to the range of emission scenarios of IPCC (2007), results in a mid-range rise this century of 70 to 100 cm (28 to 39 inches), with a full range of variability of 50 to 140 cm (20 to 55 inches). The CALFED Science Program (CALFED 2007), State of California, and others have made assessments of the range of potential future sea-level rise throughout 21st century.

In 2011, the United States Army Corps of Engineers (USACE) issued guidance on incorporating sea-level change in civil works programs (USACE 2011). The guidance document reviews the existing literature and suggests use of a range of sea-level change projections, including the "high probability" of accelerating global sea-level rise. The ranges of future sea-level rise were based on the empirical procedure recommended by the National Research Council and updated for recent conditions (NRC 1987). The three scenarios included in the USACE guidance suggest end-of-century sea-level rise in the range of 50 to 150 cm (20 to 59 inches), consistent with the range of projections by Rahmstorf (2007) and Vermeer and Rahmstorf (2009). The USACE Bulletin expired in September 2013.[2]

[2] At the time of methods selection for the EIS, USACE 2011 was the most recent guidance. Current most recent guidance (USACE 2013) suggests evaluation of a low, medium, and high sea-level rise. The projected mean sea level rise ranges between 10 cm and 14 cm at 2030 relative to year 2000 based on the recent NRC

The recent NRC study (NRC 2012) on west coast sea-level rise relies on estimates of the individual components that contribute to sea-level rise and then sums those to produce the projections. The recent NRC sea-level rise projections for California have wider ranges, but the upper limits are not as high as those from Vermeer and Rahmstorf's (2009) global projections. The California State Sea-Level Rise Guidance Document (CO-CAT 2013) was updated in March 2013 with the scientific findings of the 2012 NRC report.

As sea-level rise progresses during the century, the hydrodynamics of the San Francisco Bay-Sacramento-San Joaquin Delta estuary will change, causing the salinity of water in the Delta estuary to increase. This increasing salinity will most likely have significant impacts on water management throughout the Central Valley and other regions of the state.

5A.A.5.3 Incorporating Climate Change and Sea-Level Rise in EIS Simulations

Incorporation of climate change in water resources planning continues to be an area of evolving science, methods, and applications. Several potential approaches exist for incorporating climate change in the resources impact analyses. Currently, there is no standardized methodology that has been adopted by either the State of California or the Federal agencies for use in impact assessments. The courts have ruled that climate change must be considered in the planning of long-term water management projects in California, but have not been prescriptive in terms of methodologies to be applied. Climate change could be addressed in a qualitative and/or quantitative manner, could focus on global climate model projections or recent observed trends, and could explore broader descriptions of observed variability by blending paleoclimate information into this understanding.

5A.A.5.3.1 Incorporating Climate Change

The climate change scenarios were developed from an ensemble of 112 bias-corrected, spatially downscaled GCM simulations from 16 climate models for SRES emission scenarios A2, A1B, and B1 from the CMIP3 that are part of the IPCC AR4. The future projected changes over the 30-year climatological period centered on 2025 (i.e., 2011-2040 to represent 2025 timeline) were combined with a set of historically observed temperatures and precipitation to generate climate sequences that maintain important multi-year variability not always reproduced in direct climate projections.

In an effort to summarize these 112 scenarios, five statistically representative climate change scenarios were developed to characterize the central tendency, and the range of the ensemble uncertainty.

(2012) study and using the USACE Sea Level Change Curve Calculator (2015.46) located at http://www.corpsclimate.us/ccaceslcurves.cfm. The mean projected sea-level rise is similar to the EIS assumption of 15 cm at Year 2030. Due to the considerable uncertainty in the future sea-level change projections and the state of sea-level rise science, the use of 15 cm sea-level rise for the EIS was deemed reasonable.

Since the ensemble is made up of many projections, it is useful to identify the median (50th percentile) change of both annual temperature and annual precipitation. In doing so, the state of climate change at this point in time can be broken into quadrants representing (1) drier, less warming, (2) drier, more warming, (3) wetter, more warming, and (4) wetter, less warming than the ensemble median (Q1 through Q4). In addition, a fifth region (Q5) can be described that samples from inner-quartiles (25th to 75th percentile) of the ensemble and represents a central region of climate change. In each of the five regions the sub-ensemble of climate change projections, made up of those contained within the region bounds, is identified. The Q5 scenario is derived from the central tending climate projections and thus favors the consensus of the ensemble.

Through extensive coordination with the State and Federal teams involved in the BDCP, the bounding scenarios Q1-Q4 were refined in April 2010 to reduce the attenuation of climate projection variability that comes about through the use of larger ensembles. A sensitivity analysis was prepared for the bounding scenarios (Q1-Q4) using sub-ensembles made up of different numbers of downscaled climate projections. The sensitivity analysis was prepared using a "nearest neighbor" (k-NN) approach. In this approach, a certain joint projection probability is selected based on the annual temperature change-precipitation change (i.e. 90th percentile of temperature and 90th percentile of precipitation change). From this statistical point, the "k" nearest neighbors (after normalizing temperature and precipitation changes) of projections are selected and climate change statistics are derived. Consistent with the approach applied in 2008 LTO BA, the 90th and 10th percentile of annual temperature and precipitation change were selected as the bounding points. The sensitivity analysis considered using the 1-NN (single projection), 5-NN (5 projections), and 10-NN (10 projections) sub-ensemble of projections. These were compared to the original quadrant scenarios which commonly are made up of 25-35 projections and are based on the direction of change from 50th percentile statistic. The very small ensemble sample sizes exhibited month by month changes that were sometimes dramatically different than that produced by adding a few more projections to the ensemble. The 1-NN approach was found to be inferior to all other methods for this reason. The original quadrant method produced a consensus direction of change of the projections, and thus produced seasonal trends that were more realistic, but exhibited a slightly smaller range due to the inclusion of several central tending projections. The 5-NN and 10-NN methods exhibited slightly wider range of variability than the quadrant method which was desirable from the "bounding" approach. In most cases the 5-NN and 10-NN projections were similar, although they differed at some locations in representation of season trend. The 10-NN approach was found to be preferable in that it best represented the seasonal trends of larger ensembles, retained much of the "range" of the smaller ensembles, and was guaranteed to include projections from at least two GCM-emission scenario combinations (in the CMIP3 projection archive, up to 5 projections – multiple simulations – could come from one GCM-emission scenario combination). The State and Federal representatives agreed to utilize the following climate scenario selection process for BDCP: (1) the use of the original quadrant approach for Q5 (projections within the 25th to 75th percentile bounding box) as it provides the best estimate of the consensus of climate projections and (2) the use of the 10-NN method to developing the Q1-Q4 bounding scenarios. An automated process was developed that generates the monthly and annual statistics for every grid cell within the Central Valley domain and identifies the members of the sub ensemble for consideration in each of the five scenarios.

For the purposes of this EIS, Q5 climate change scenario for the period centered on 2025 is used for all alternatives analyses and represents conditions at 2030. The Q5 scenario was derived from the central tending "consensus" of the climate projections and thus represents the median ensemble projection. Figures 5A.A.5 through 5A.A.8 present projected changes in temperature and precipitation for the 2025 timeline for select locations that represent Sacramento, San Joaquin, and Delta systems.

The modified temperature and precipitation inputs were used in the VIC hydrology model to simulate hydrologic processes on the 1/8th degree scale to produce watershed runoff (and other hydrologic variables) for the major rivers and streams in the Central Valley.

To compute watershed runoff, the VIC model was simulated in water balance mode. In this mode, a complete land surface water balance is computed for each grid cell on a daily basis for the entire model domain. Unique to the VIC model is its characterization of sub-grid variability. Sub-grid elevation bands enable more detailed characterization of snow-related processes. Five elevation bands are included for each grid cell. In addition, VIC also includes a sub-daily (1 hour) computation to resolve transients in the snow model. The soil column is represented by three soil zones extending from land surface in order to capture the vertical distribution of soil moisture. The VIC model represents multiple vegetation types as uses NASA's Land Data Assimilation System (LDAS) databases as the primary input data set.

The VIC model computes the water balance over each grid cell on a daily basis for the entire period of simulation. For the simulations performed for the BDCP, water balance variables such as precipitation, evapotranspiration, runoff, baseflow, soil moisture, and snow water equivalent were included as output. In order to facilitate understanding of these watershed process results, nine locations throughout the in the watershed were selected for more detailed review. These locations are representative points within each of the following hydrologic basins: Upper Sacramento River, Feather River, Yuba River, American River, Stanislaus River, Tuolumne River, Merced River, and Upper San Joaquin River. The flow in these main rivers were included in the Eight River Index which is the broadest measure of total flow contributing to the Delta. A ninth location was selected to represent conditions within the Delta.

Streamflow was routed to 21 locations that generally align with long-term gauging stations throughout the watershed. The flow at these locations also allowed for assessment of changes in various hydrologic indices used in water management in the Sacramento-San Joaquin Delta. Flows were output in both daily and monthly time steps. Only the monthly flows were used in subsequent analyses. It is important to note that VIC routed flows were considered “naturalized” in that they do not include effects of diversions, imports, storage, or other human management of the water resource. Figures 5A.A.9 through 5A.A.18 present projected changes in watershed runoff for the major rivers and streams in the Central Valley for the 2025 timeline.

These simulated changes in runoff were applied to the CalSim II inflows as a fractional change from the observed inflow patterns (simulated future runoff divided by historical runoff). These fraction changes were first applied for every month of the 82-year period consistent with the VIC simulated patterns. A second correction was then applied to ensure that the annual shifts in runoff at each location are consistent with that generated from the VIC modeling.

Once the changes in flows had been resolved, water year types and other hydrologic indices that govern water operations or compliance were adjusted to be consistent with the new hydrologic regime. The changes in reservoir inflows, key valley floor accretions, and water year types and hydrologic indices were translated into modified input time series for the CalSim II model.

For the BDCP EIR/EIS, the CalSim II model was simulated with each of the five climate change hydrologic conditions (including effects of sea level rise) in addition to the historical hydrologic conditions for the No Project/No Action Alternative and one other alternative to understand the sensitivity of projected operations to the range of climate change scenarios. The results of that analysis indicated that the incremental differences between the No Action Alternative and the other alternative were consistent at Q1 through Q5 conditions, although absolute values were different (DWR et al, 2013).

5A.A.5.3.2 Incorporation of Sea-Level Rise

For sea-level rise simulation, using the work conducted by Rahmstorf, it was assumed the projected sea-level rise at the early long-term timeline (2025) would be approximately 12 to 18 cm (5 to 7 inches). At the late long-term timeline (2060), the projected sea-level rise was assumed to be approximately 30 to 60 cm (12 to 24 inches).

These sea-level rise estimates were consistent with those outlined in the recent USACE guidance circular for incorporating sea-level changes in civil works programs (USACE 2013). Due to the considerable uncertainty in these projections and the state of sea-level rise science, it was proposed to use the mid-range of the estimates of 15 cm (6 inches) by 2025 and 45 cm (18 inches) by 2060.For the purposes of the EIS, the sea-level rise scenario for the period centered on 2025 is used (DWR et al. 2013). This period is considered because the EIS extends only up to 2030. These changes were simulated in Bay-Delta hydrodynamics models, and their effect on the flow-salinity relationship in the Bay-Delta was incorporated into CalSim II modeling through the use of ANNs that were developed for the BDCP EIR/EIS (DWR et al 2013) for the same sea-level rise and physical Delta conditions.

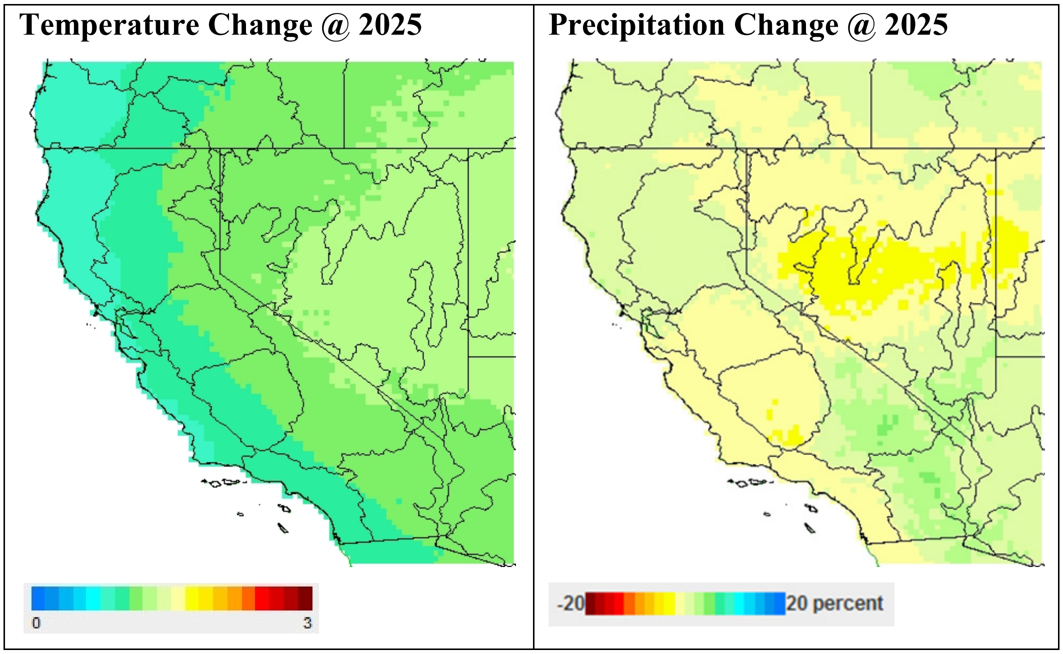
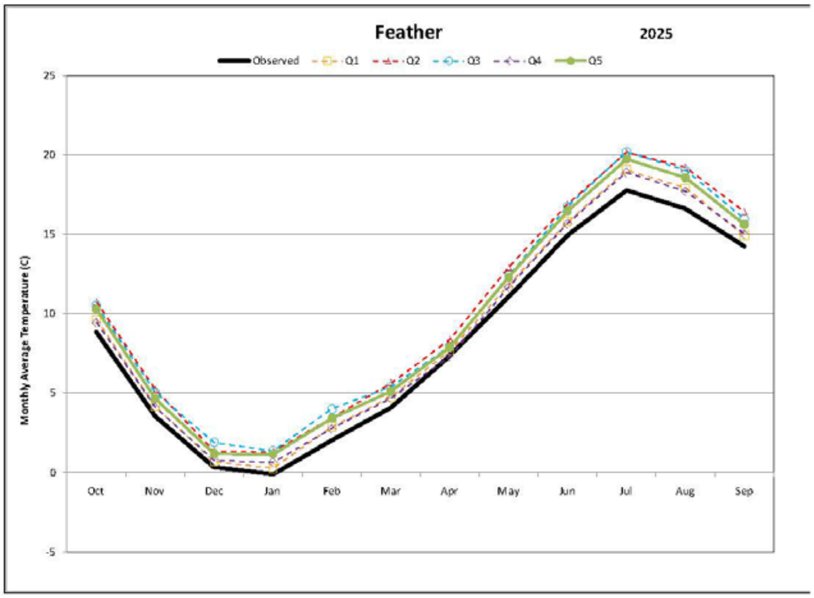


Figure 5A.A.5 Projected Changes in Annual Temperature (as degrees C) and Precipitation (as percent change) for the Period 2011-2040 (2025) as Compared to the 1971-2000 Historical Period

Derived from Daily Gridded Observed Meteorology (Maurer et al. 2002).



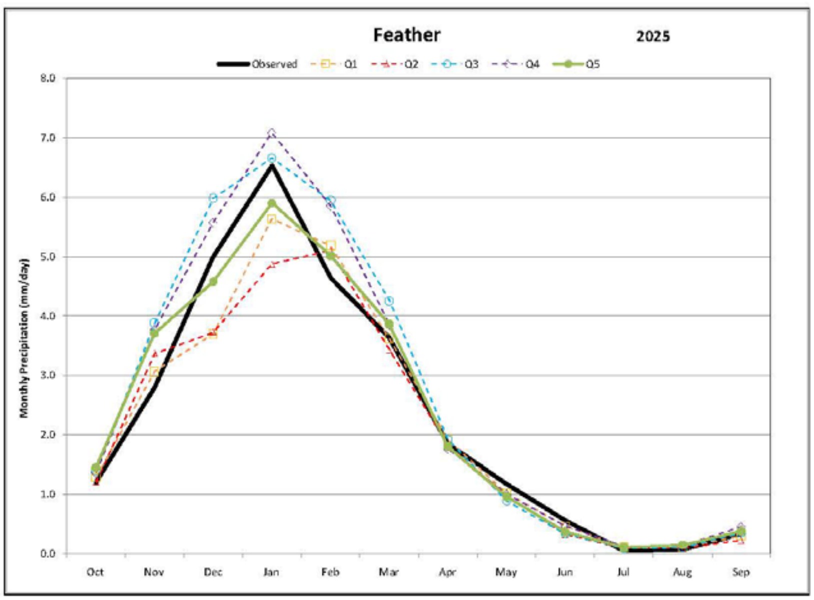


Figure 5A.A.6 Projected Changes in Seasonal Temperature (top) and Precipitation (bottom) for a Grid Cell in the Feather River Basin

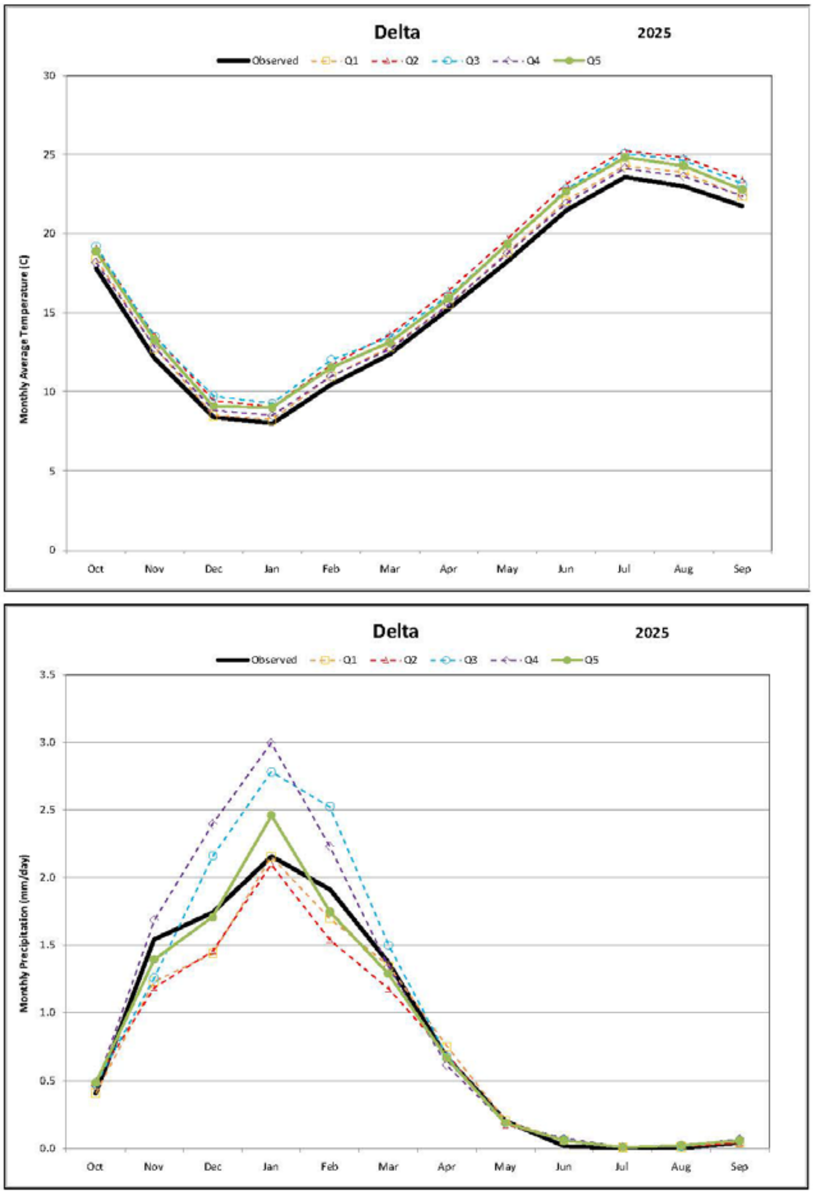


Figure 5A.A.7 Projected Changes in Seasonal Temperature (top) and Precipitation (bottom) for a Grid Cell in the Delta

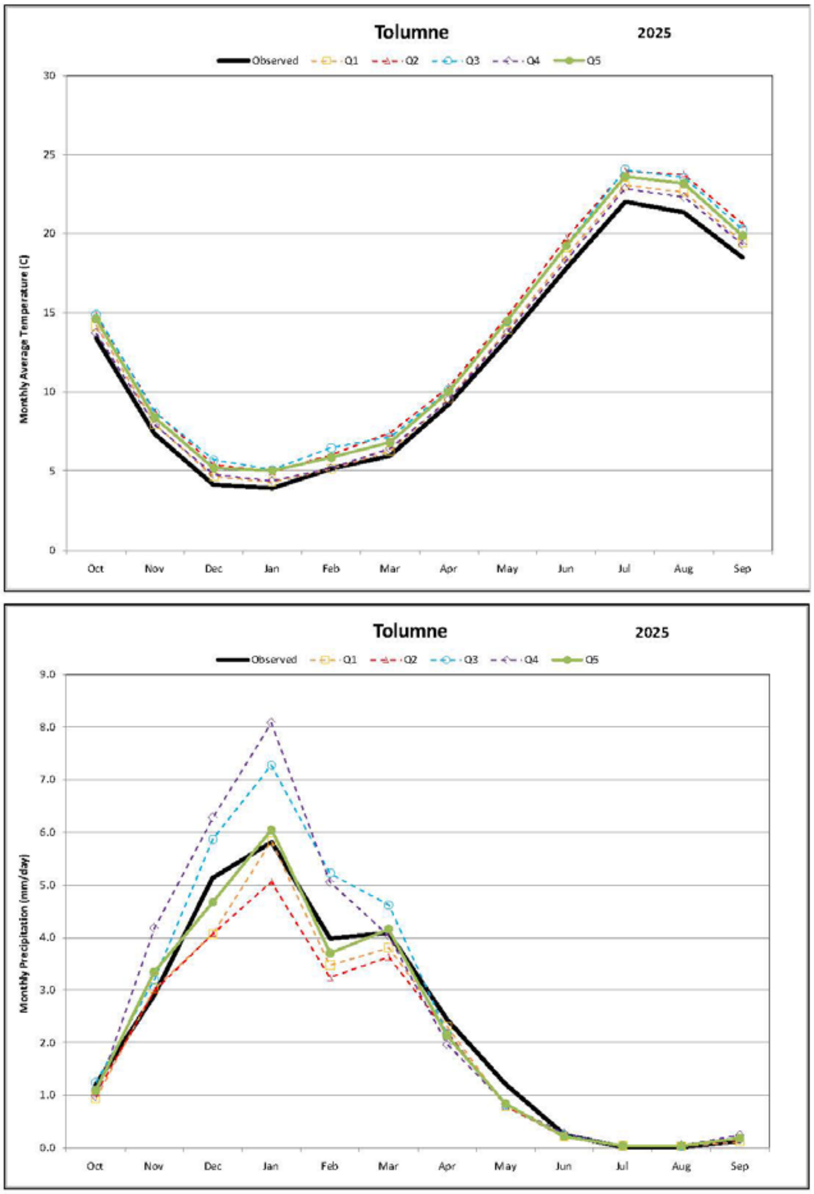


Figure 5A.A.8 Projected Changes in Seasonal Temperature (top) and Precipitation (bottom) for a Grid Cell in the Tuolumne River Basin

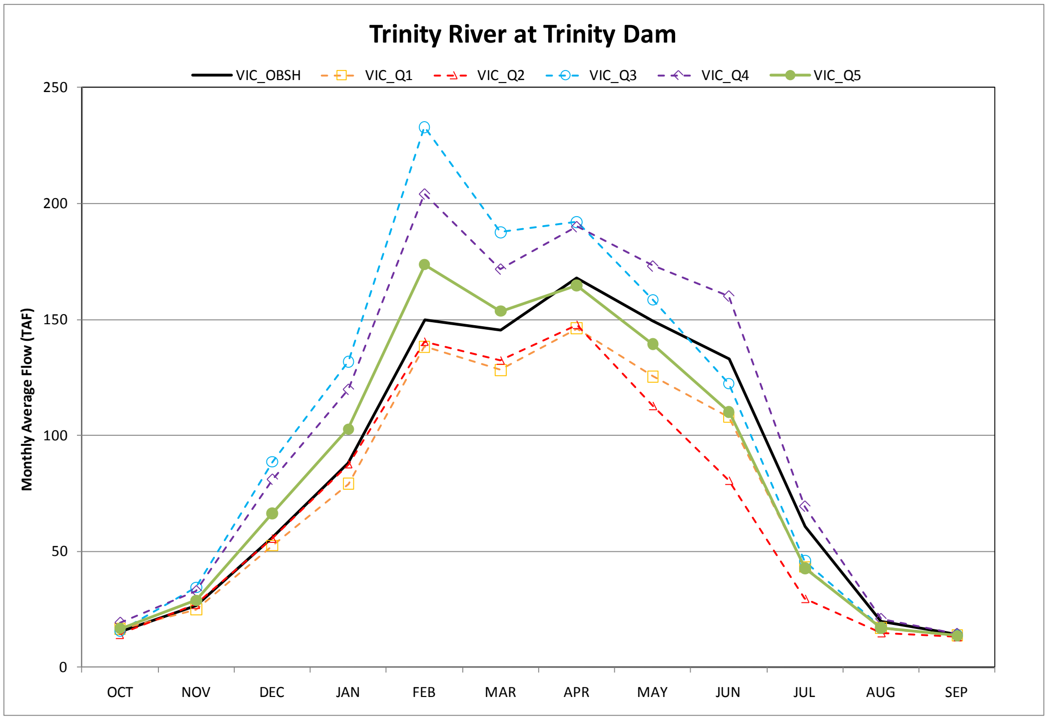


Figure 5A.A.9 Simulated Changes in Monthly Natural Streamflow for Trinity River at Trinity Dam (for the 2025 timeline)

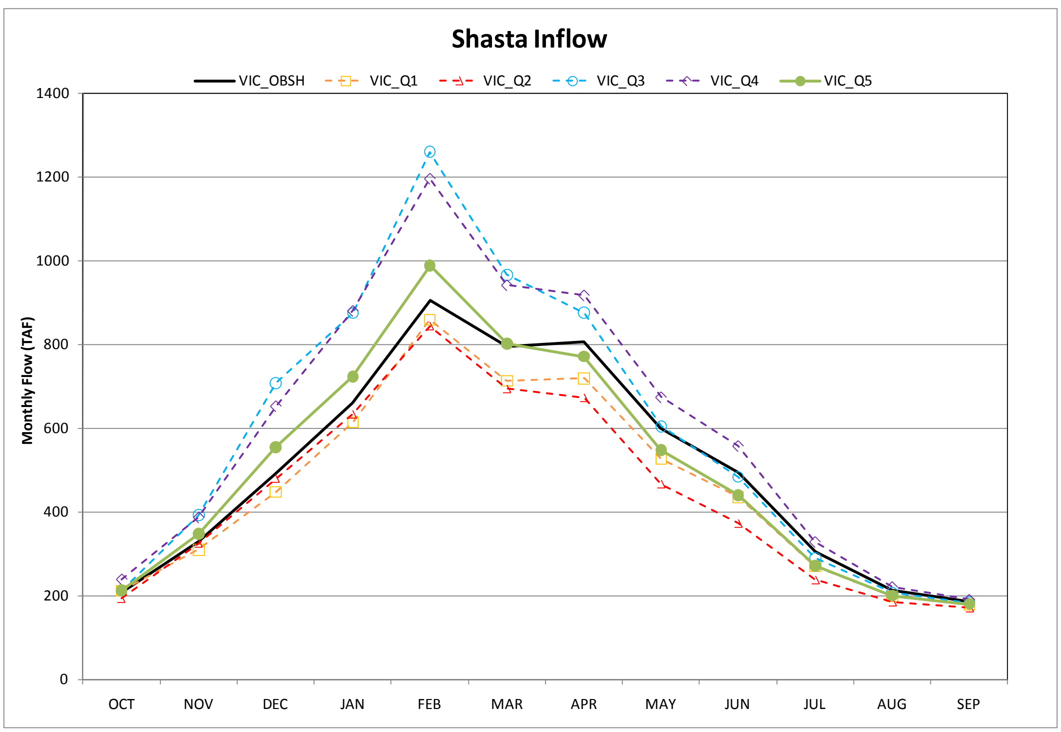


Figure 5A.A.10 Simulated Changes in Monthly Natural Streamflow for Shasta Inflow (for the 2025 timeline)

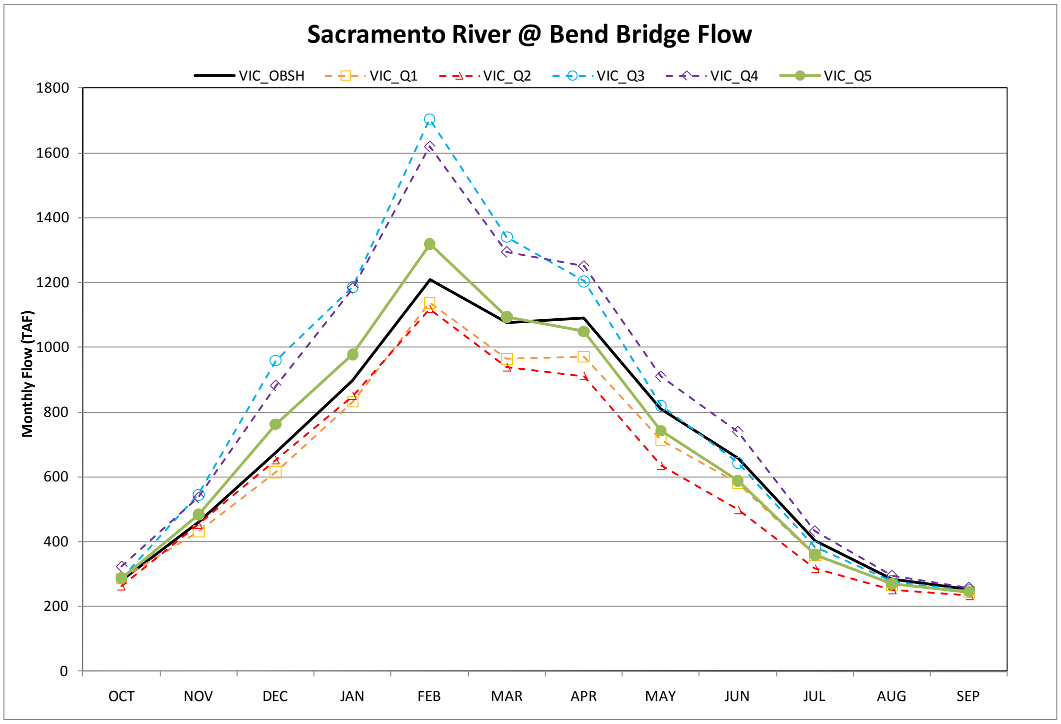


Figure 5A.A.11 Simulated Changes in Monthly Natural Streamflow for Sacramento River at Bend Bridge (for the 2025 timeline)

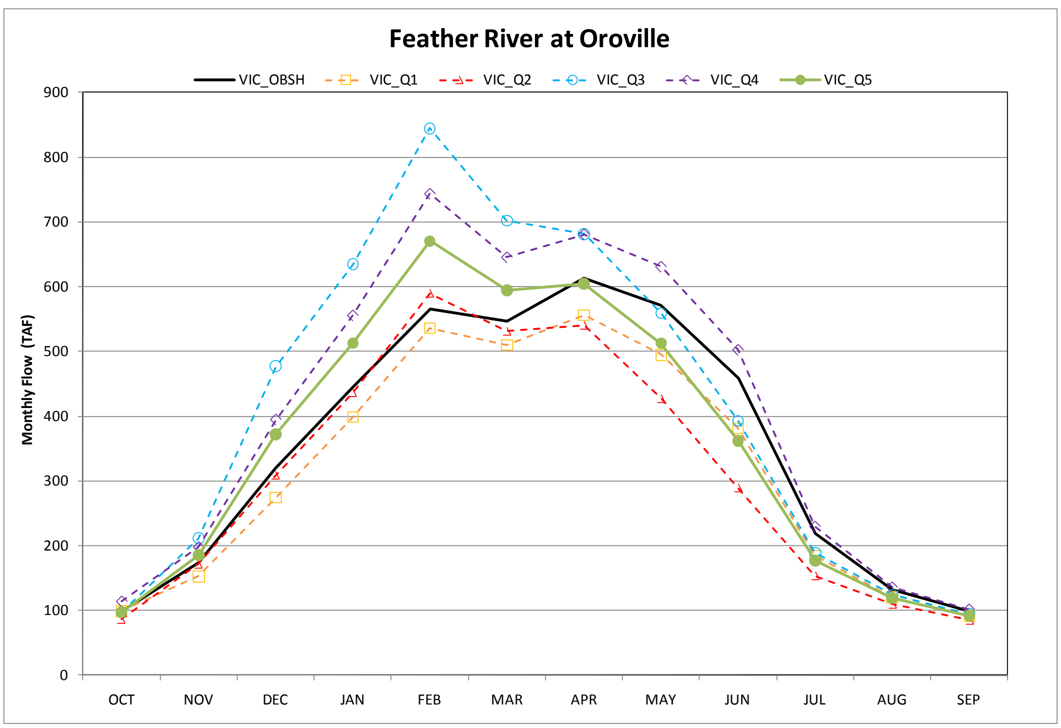


Figure 5A.A.12 Simulated Changes in Monthly Natural Streamflow for Feather River at Oroville (for the 2025 timeline)

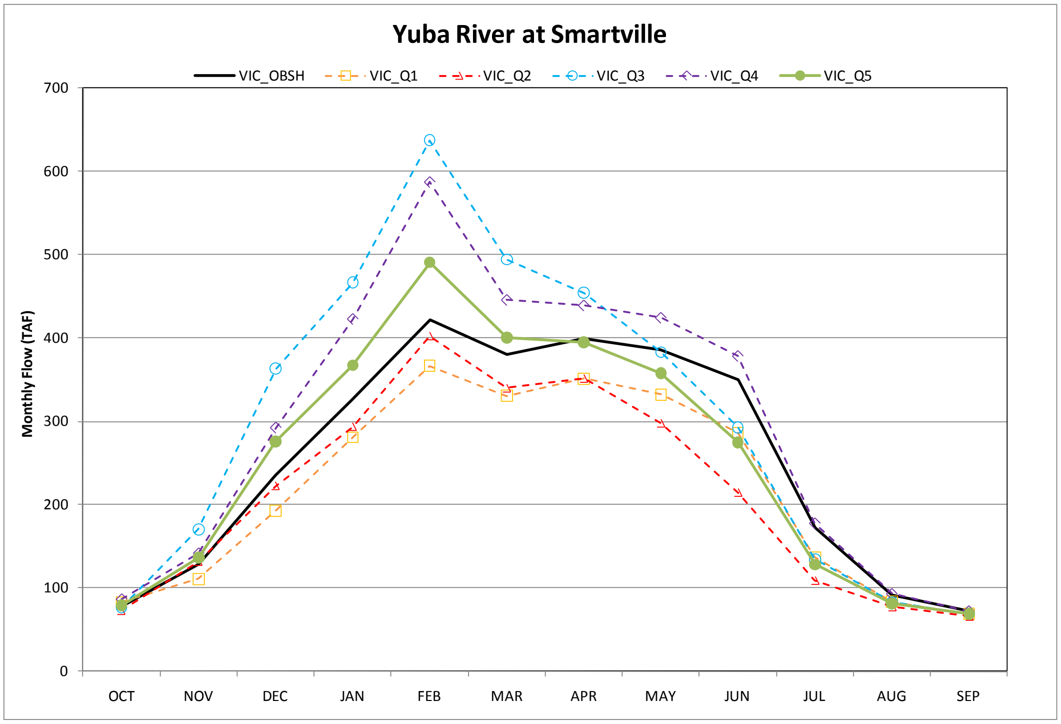


Figure 5A.A.13 Simulated Changes in Monthly Natural Streamflow for Yuba River at Smartville (for the 2025 timeline)

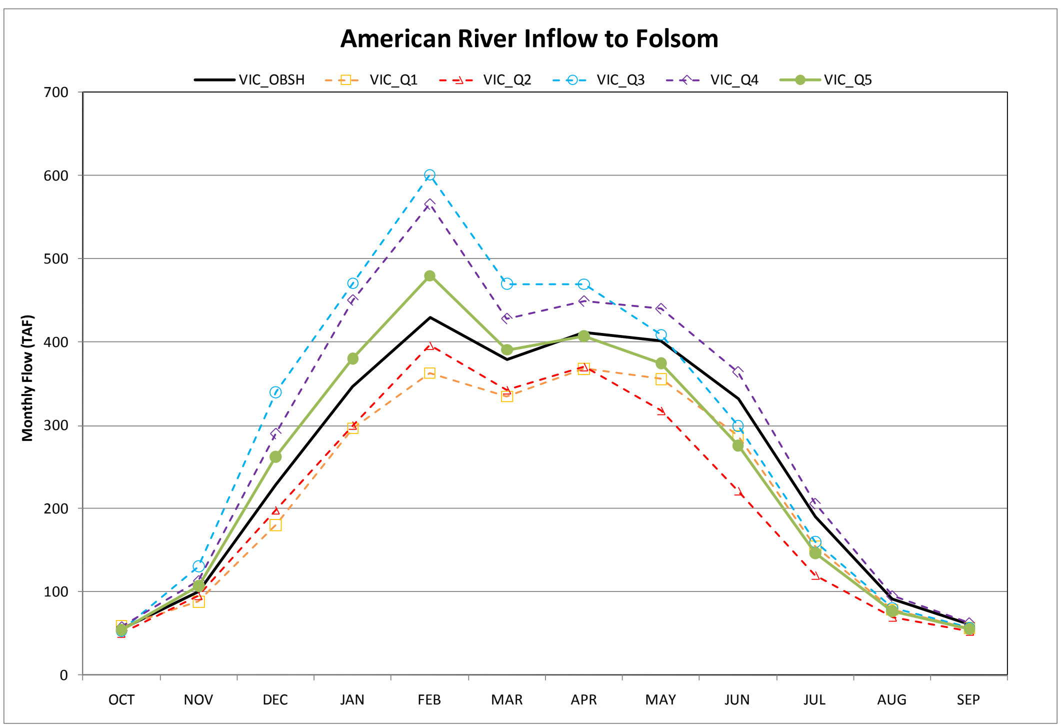


Figure 5A.A.14 Simulated Changes in Monthly Natural Streamflow for American River Inflow to Folsom (for the 2025 timeline)

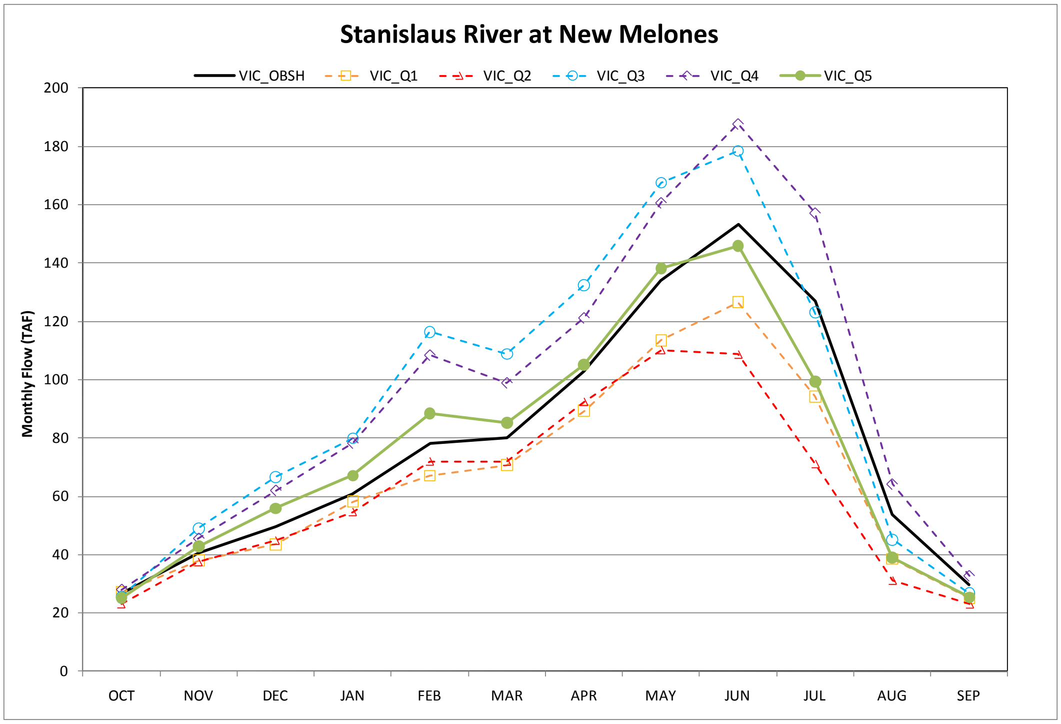


Figure 5A.A.15 Simulated Changes in Monthly Natural Streamflow for Stanislaus River at New Melones (for the 2025 timeline)

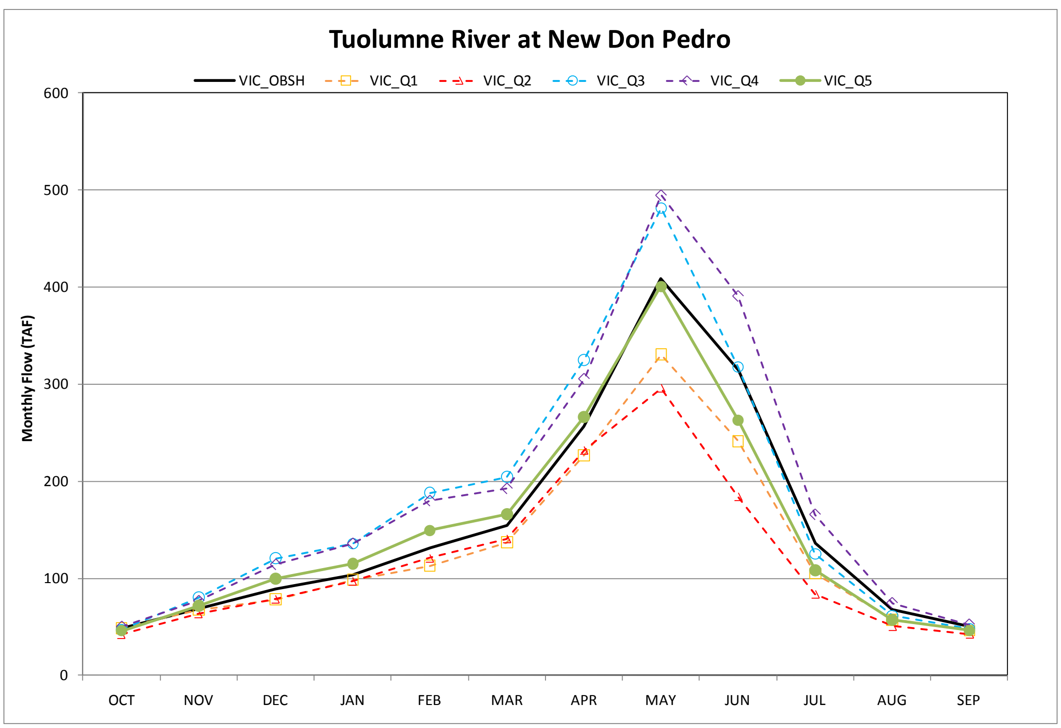


Figure 5A.A.16 Simulated Changes in Monthly Natural Streamflow for Tuolumne River at New Don Pedro (for the 2025 timeline)

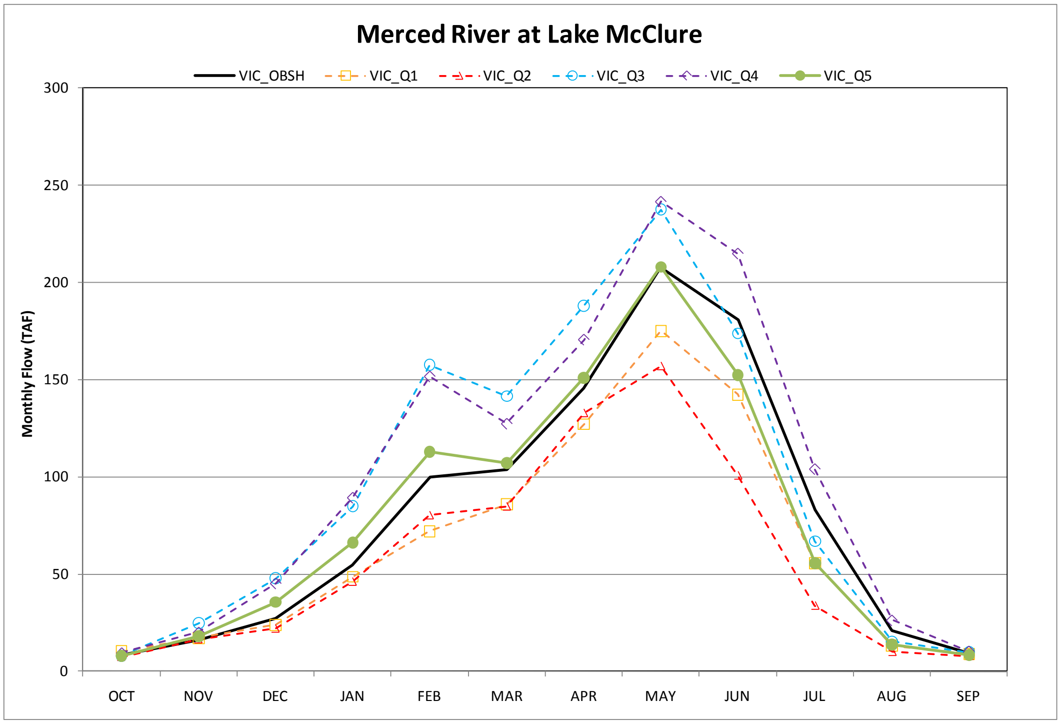


Figure 5A.A.17 Simulated Changes in Monthly Natural Streamflow for Merced River at Lake McClure (for the 2025 timeline)

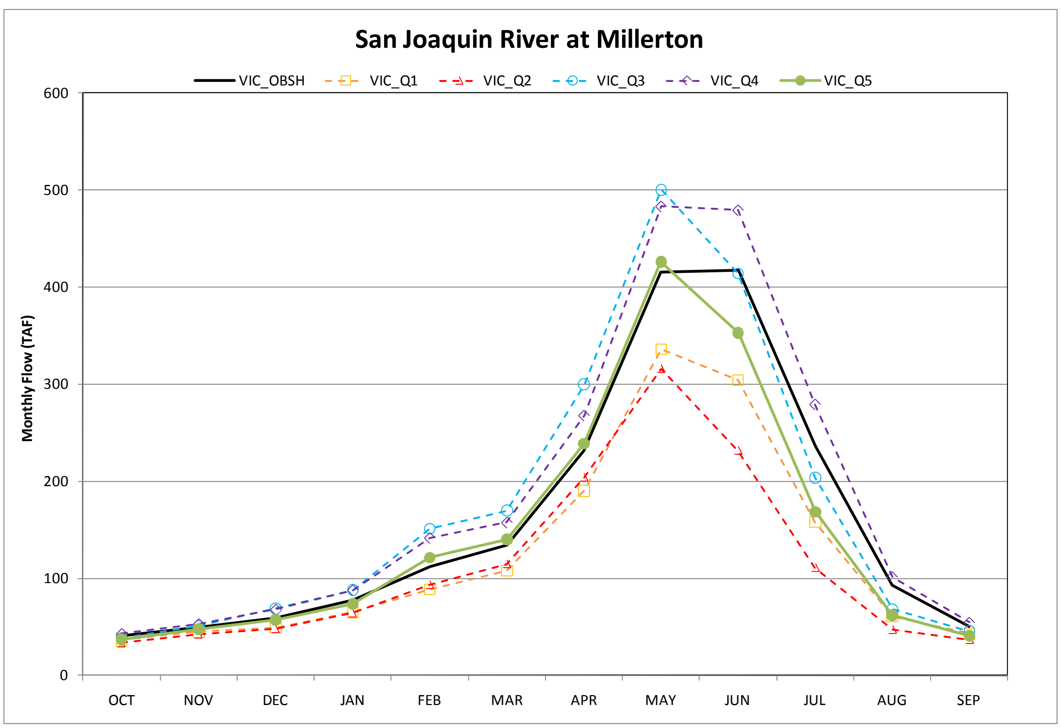


Figure 5A.A.18 Simulated Changes in Monthly Natural Streamflow for San Joaquin River at Millerton (for the 2025 timeline)

5A.A.5.4 Climate Change and Sea-Level Rise Modeling Limitations

GCMs represent different physical processes in the atmosphere, ocean, cryosphere, and land surface. GCMs are the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse gas concentrations. However, several of the important processes are either missing or inadequately represented in today's state-of-the-art GCMs. GCMs depict the climate using a three dimensional grid over the globe at a coarse horizontal resolution. A downscaling method is generally used to produce finer spatial scale that is more meaningful in the context of local and regional impacts than the coarse-scale GCM simulations.

In this study, downscaled climate projections using the Bias-correction and Spatial Disaggregation (BCSD) method is used (http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html#About). The BCSD downscaling method is well tested and widely used, but it has some inherent limitations such as stationary assumptions used in the BCSD downscaling method (Maurer et al. 2007; Reclamation 2013) and also due to the fact that bias correction procedure employed in the BCSD downscaling method can modify climate model simulated precipitation changes (Maurer and Pierce, 2014). The downscaling method also carries some of the limitations applicable to native GCM simulations.

A median climate change scenario that was based on more than a hundred climate change projections was used for characterizing the future climate condition for the purposes of the EIS. Although projected changes in future climate contain significant uncertainty through time, several studies have shown that use of the median climate change condition is acceptable (for example, Pierce et al. 2009). The median climate change is considered appropriate for the EIS because of the comparative nature of the NEPA analysis. Therefore, a sensitivity analysis using the different climate change conditions was not conducted for this study.

Projected change in stream flow is calculated using the VIC macroscale hydrologic model. The use of the VIC model is primarily intended to generate changes in inflow magnitude and timing for use in subsequent CalSim II modeling. While the model contains several sub-grid mechanisms, the coarse grid scale should be noted when considering results and analysis of local-scale phenomena. The VIC model is currently best applied for the regional-scale hydrologic analyses. There are several limitations to long-term gridded meteorology related to spatial-temporal interpolation due to limited availability of meteorological stations that provide data for interpolation. In addition, the inputs to the model do not include any transient trends in the vegetation or water management that may affect stream flows; they should only be analyzed from a "naturalized" flow change standpoint. Finally, the VIC model includes three soil zones to capture the vertical movement of soil moisture, but does not explicitly include groundwater. The exclusion of deeper groundwater is not likely a limiting factor in the upper watersheds of the Sacramento and San Joaquin river watersheds that contribute approximately 80 to 90 percent of the runoff to the Delta. However, in the valley floor, interrelation of groundwater and surface water management is considerable. Water management models such as CalSim II should be used to characterize the heavily "managed" portions of the system.

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Appendix 5A, Section B

CalSim II and DSM2 Modeling Simulations and Assumptions

This section summarizes the modeling simulations and assumptions for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 in this Environmental Impact Statement (EIS). Appendix 5A, Section B, is organized as follows:

- Introduction
- Assumptions for the No Action Alternative and Second Basis of Comparison Model Simulations
  - No Action Alternative
  - Second Basis of Comparison
- Assumptions for Alternatives Model Simulations
  - Alternative 3
  - Alternative 5
  - Summary of Alternatives Assumptions
- Timeframe of Evaluation
- No Action Alternative and Second Basis of Comparison Assumptions Tables
  - CalSim II Assumptions
  - (DSM2 Assumptions
- American River Demands
- Delivery Specifications
- U.S. Fish and Wildlife Service (USFWS) Reasonable and Prudent Alternative (RPA) Implementation
- National Marine Fisheries Service (NMFS) RPA Implementation
- References

5A.B1 Introduction

As described in Appendix 5A, Section A, modeling was prepared for evaluation of the alternatives considered in this EIS. This section describes the assumptions for the CalSim II and DSM2 modeling of the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

The following model simulations were prepared as the basis for evaluating the impacts of the other alternatives at 2030 projected conditions:

- No Action Alternative

- Second Basis of Comparison
- Alternative 1 – Same as the Second Basis of Comparison
- Alternative 2 – Only operational components of the No Action Alternative (same modeling assumptions as the No Action Alternative)
- Alternative 3 –Discussed further in this section
- Alternative 4 – Similar to Second Basis of Comparison with actions to improve aquatic resource conditions (same modeling assumptions as the Second Basis of Comparison)
- Alternative 5 – Discussed further in this section

The No Action Alternative and Second Basis of Comparison assumptions were developed by the Bureau of Reclamation (Reclamation). Alternative 2 assumptions were defined in the Notice of Intent. Assumptions for Alternatives 3, 4, and 5 were developed in consideration of comments received during the scoping process.

The No Action Alternative and Second Basis of Comparison models were developed by Reclamation. Other alternatives were simulated using these two CalSim II simulations and implementing changes in assumptions from either the No Action Alternative or the Second Basis of Comparison.

Alternative 1 and Alternative 4 modeling assumptions are the same as the Second Basis of Comparison, and Alternative 2 modeling assumptions are the same as the No Action Alternative; therefore, the assumptions for those alternatives will not be discussed separately in this document.

CalSim II and DSM2 model representation of the RPAs in the 2008 USFWS and 2009 NMFS Biological Opinions (BOs) is consistent with the model representation developed in 2009 through a coordinated process with the Federal and state agencies.

5A.B2 Assumptions for the No Action Alternative and the Second Basis of Comparison Model Simulations

This section presents the assumptions used in developing the CalSim II and DSM2 model simulations of the No Action Alternative and the Second Basis of Comparison for use in the EIS evaluation.

The assumptions were selected to satisfy National Environmental Policy Act requirements. The basis for these assumptions is described in Chapter 3, Description of Alternatives. Assumptions that were applied to the CalSim II and DSM2 modeling are included in the following section.

The No Action Alternative assumptions represent the continuation of existing policy and management direction at Year 2030 and include implementation of water operations components of the RPA actions specified in the 2008 USFWS BO and 2009 NMFS BO.

The Second Basis of Comparison was developed due to the identified need during scoping comments for a basis of comparison that would occur without the RPAs. The Second Basis of Comparison assumptions do not include most of the RPAs. They do, however, include actions that are constructed (e.g., Red Bluff Pumping Plant), implemented (e.g., Suisun Marsh Habitat Management, Preservation, and Restoration Plan), or legislatively mandated (e.g., San Joaquin River Restoration Plan), and those that have undergone a substantial degree of progress (e.g., Yolo Bypass Salmonid Habitat Restoration and Fish Passage).

The detailed assumptions used in developing CalSim II and DSM2 simulations of the No Action Alternative and Second Basis of Comparison are included in Section 5A.B.5. Additional information is provided in the table footnotes of each table. Table entries and footnotes make reference to supporting appendix sections and other documents.

5A.B2.1 No Action Alternative

The No Action Alternative was developed assuming projected Year 2030 conditions. The No Action Alternative assumptions include existing facilities and ongoing programs that existed as of March 28, 2012, publication date of the Notice of Intent. The No Action Alternative assumptions also include facilities and programs that received approvals and permits by March 2012 because those programs were consistent with the existing management direction of the Notice of Intent. The No Action Alternative models do not include any potential future habitat restoration areas due to the uncertainty on system effects depending on potential locations of such areas within the Delta.

The No Action Alternative includes projected climate change and sea-level rise assumptions corresponding to the Year 2030. Climate change results in the changes in the reservoir and tributary inflows included in CalSim II. The sea-level rise changes result in modified flow salinity relationships in the Delta. The climate change and sea-level rise assumptions at Year 2030 are described in detail in Section 5A.B.4. The CalSim II simulation for the No Action Alternative does not consider any adaptation measures that would result in managing the Central Valley Project (CVP) and State Water Project (SWP) system in a different manner than it is managed today to reduce climate impacts. For example, future changes in reservoir flood control reservation to better accommodate a seasonally changing hydrograph may be considered under future programs, but are not considered under the EIS.

5A.B2.1.1 CalSim II Assumptions for the No Action Alternative Hydrology

5A.B2.1.1.1 Inflows/Supplies

The CalSim II model includes the historical hydrology projected to Year 2030 under the climate change and with projected 2020 modifications for operations upstream of the rim reservoirs.

Level of Development

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

Demands, Water Rights, and CVP and SWP Contracts

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

Table 5A.B.1 below includes the summary of the CVP and SWP project demands in thousand acre feet (TAF) included under the No Action Alternative. A detailed description of American River demands assumed under the No Action Alternative is provided in Section 5A.B.7. For SWP entitlement contractors, full Table A demands are assumed every year. The demand assumptions are not modified for changes in climate conditions.

The detailed listing of CVP and SWP contract amounts and other water rights assumptions for the No Action Alternative are included in the delivery specification tables in Section 5A.B.9.

Table 5A.B.1 Summary of CVP and SWP Demands (TAF/Year) under No Action Alternative

Project Contractor Type	North-of-the-Delta	South-of-the-Delta
CVP Contractors		
Settlement/Exchange	2,194	840
Water Service Contracts	935	2,101
Agriculture	378	1,937
M&I	557	164
Refuges	189	281
SWP Contractors		

Project Contractor Type	North-of-the-Delta	South-of-the-Delta
Feather River Service Area	983	–
Table A	114	4,055
Agriculture	0	1,017
M&I	114	3,038

Notes:
Urban demands noted above are for full buildout conditions.
M&I = municipal and industrial

5A.B2.1.1.2 Facilities

CalSim II includes representation of all the existing CVP and SWP storage and conveyance facilities. Assumptions regarding selected key facilities are included in the callout tables in Section 5A.B.5.

CalSim II also represents the flood control weirs such as the Fremont Weir located along the Sacramento River at the upstream end of the Yolo Bypass. Rating curves for the existing weir are used to model the spills over the Fremont Weir. In addition, the No Action Alternative CalSim II model assumes an operable weir notch for the Fremont Weir as modeled in Alternative 4 in the Bay Delta Conservation Plan (BDCP) Environmental Impact Report/Environmental Impact Statement (EIR/EIS) (DWR, Reclamation, USFWS, and NMFS 2013).

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

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

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

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

Fremont Weir

Fremont Weir is a flood control structure located along the Sacramento River at the head of the Yolo Bypass. To enhance the potential benefits of the Yolo Bypass for various fish species, the Fremont Weir is assumed to be notched to provide increased seasonal floodplain inundation in all of the alternatives simulated for the EIS. It is assumed that an opening in the existing weir and operable gates are constructed at elevation 17.5 feet along with a smaller opening and operable gates at elevation 11.5 feet. Derivation of the rating curve for the elevation 17.5-feet opening used in the CalSim II model is described in Section 5A.B.4 of this appendix. The modeling approach used in CalSim II model to estimate the Fremont Weir spills using the daily patterned Sacramento River flow at Verona is provided in Section 5A.3.3.

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

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

SWP Banks Pumping Plant Capacity

SWP Banks pumping plant has an installed capacity of about 10,668 cfs (two units of 375 cfs, five units of 1,130 cfs, and four units of 1,067 cfs). The SWP water rights for diversions specify a maximum of 10,350 cfs, but the U.S. Army Corps of Engineers (USACE) permit for SWP Banks Pumping Plant allows a maximum pumping of 6,680 cfs. With additional diversions depending on Vernalis flows, the total diversion can go up to 8,500 cfs from December 15 to March 15. Additional capacity of 500 cfs (pumping limit up to 7,180 cfs) is allowed to reduce impact of NMFS BO Action 4.2.1 on the SWP.

Contra Costa Water District (CCWD) Intakes

The Contra Costa Canal originates at Rock Slough (about 4 miles southeast of Oakley) and terminates after 47.7 miles, at Martinez Reservoir. Historically, diversions at the unscreened Rock Slough facility (Contra Costa Canal Pumping Plant No. 1) have ranged from about 50 to 250 cfs. The canal and associated facilities are part of the CVP, but are operated and maintained by the Contra Costa Water District (CCWD). CCWD also operates a diversion on Old River and the Alternative Intake Project (AIP), the new drinking water intake at Victoria Canal, about 2.5 miles east of CCWD's intake on the Old River. CCWD can divert water to the Los Vaqueros Reservoir to store good quality water when available and supply to its customers.

5A.B2.1.1.3 Regulatory Standards

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

Decision 1641 (D-1641) Operations

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

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

Coordinated Operation Agreement (COA)

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

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

Central Valley Project Improvement Act (CVPIA) (b)(2) Assumptions

The previous 2008 OCAP BA modeling included a dynamic representation of Central Valley Project Improvement Act (CVPIA) 3406(b)(2) water allocation, management, and related actions (B2). The selection of discretionary actions for use of B2 water in each year was based on a May 2003 U.S. Department of the Interior (the Department) policy decision. The use of B2 water is assumed to continue in conjunction with the USFWS and NMFS BO RPA actions. The CalSim II implementation used for modeling for the EIS does not dynamically account for the use of (b)(2) water, but rather assumes predetermined USFWS BO upstream fish objectives for Clear Creek, Sacramento River below Keswick Dam, and American River below Nimbus Dam, and a pulse period exports limit. Other (b)(2) actions are assumed to be accommodated by USFWS and NMFS BO RPA actions for the American River, Stanislaus River, and Delta export restrictions.

Continued CALFED Agreements

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

One element of the EWA available assets is the Lower Yuba River Accord (LYRA) Component 1 water. In the absence of the EWA and implementation in CalSim II, the LYRA Component 1 water is assumed to be transferred to south-of-Delta SWP contractors to help mitigate the impact of the NMFS BO on SWP exports during April and May. An additional 500 cfs of capacity is permitted at

Banks Pumping Plant from July through September to export this transferred water.

USFWS BO Actions

The USFWS BO was released on December 15, 2008, in response to Reclamation's request for formal consultation with the USFWS on the coordinated operations of the CVP and SWP in California. To develop CalSim II modeling assumptions for the RPA documented in this BO, DWR led a series of meetings that involved members of fisheries and project agencies. This group has prepared the assumptions and CalSim II implementations to represent the RPA in the No Action Alternative CalSim II simulation. The following actions of the USFWS BO RPA have been included in the No Action Alternative CalSim II simulations:

- Action 1: Adult Delta Smelt migration and entrainment (RPA Component 1, Action 1 – First Flush)
- Action 2: Adult Delta Smelt migration and entrainment (RPA Component 1, Action 2)
- Action 3: Entrainment protection of larval and juvenile Delta Smelt (RPA Component 2)
- Action 4: Estuarine habitat during Fall (RPA Component 3)
- Action 5: Temporary spring Head of Old River barrier (HORB) and the Temporary Barrier Project (RPA Component 2)

A detailed description of the assumptions that have been used to model each action is included in the technical memorandum "Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies," prepared by an interagency working group under the direction of the lead agencies. Reference information for this technical memorandum is included in Section 5A.B.10.

NMFS BO Salmon Actions

The NMFS Salmon BO on long-term operations of the CVP and SWP was released on June 4, 2009. To develop CalSim II modeling assumptions for the RPAs documented in this BO, DWR led a series of meetings that involved members of fisheries and project agencies. This group has prepared the assumptions and CalSim II implementations to represent the RPA in the No Action Alternative CalSim II simulations for future planning studies. The following NMFS BO RPAs have been included in the No Action Alternative CalSim II simulations:

- Action I.1.1: Clear Creek spring attraction flows
- Action I.4: Wilkins Slough operations
- Action II.1: Lower American River flow management
- Action III.1.4: Stanislaus River flows below Goodwin Dam

- Action IV.1.2: Delta Cross Channel gate operations
- Action IV.2.1: San Joaquin River flow requirements at Vernalis and Delta export restrictions
- Action IV.2.3: Old and Middle River flow management

For Action I.2.1, which calls for a percentage of years that meet certain specified end-of-September and end-of-April storage and temperature criteria resulting from the operation of Lake Shasta, no specific CalSim II modeling code is implemented to simulate the performance measures identified.

A detailed description of the assumptions that have been used to model each action is included in the technical memorandum "Representation of National Marine Fisheries Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies," prepared by an interagency working group under the direction of the lead agencies. This technical memorandum is included in the Section 5A.B.9.

Water Transfers

Lower Yuba River Accord (LYRA)

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

Phase 8 transfers

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

Short-term or Temporary Water Transfers

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

5A.B2.1.1.4 Specific Regulatory Assumptions

Lower American Flow Management

The American River Flow Management Standard (ARFMS) is included in the No Action Alternative, the Second Basis of Comparison, and all other alternatives in the EIS (Reclamation 2006).

Delta Outflow (Flow and Salinity)

SWRCB D-1641:

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

USFWS BO (December 2008) Action 4:

USFWS BO Action 4 requires additional Delta outflow to manage X2 in the fall months following Wet and Above Normal years to maintain an average X2 for September and October no greater (more eastward) than 74 kilometers following

Wet years and 81 kilometers following Above Normal years. In November, the inflow to CVP and SWP reservoirs in the Sacramento Basin should be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up to the fall X2 target. This action is included in the No Action Alternative.

Combined Old and Middle River Flows

USFWS BO restricts south Delta pumping to preserve certain Old and Middle River (OMR) flows in three of its Actions: Action 1 to protect pre-spawning adult Delta Smelt from entrainment during the first flush, Action 2 to protect pre-spawning adults from entrainment and from adverse hydrodynamic conditions, and Action 3 to protect larval Delta Smelt from entrainment. CalSim II simulates these actions to a limited extent.

A brief description of USFWS BO Actions 1 through 3 implementations in CalSim II is as follows: Action 1 is onset based on a turbidity trigger that takes place during or after December. This action requires limit on exports so that the average daily OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent of the monthly criteria). Action 1 ends after 14 days of duration or when Action 3 is triggered based on a temperature criterion. Action 2 starts immediately after Action 1 and requires a range of net daily OMR flows to be no more negative than -1,250 to -5,000 cfs (with a 5-day running average within 25 percent of the monthly criteria). Action 2 continues until Action 3 is triggered. Action 3 also requires net daily OMR flow to be no more negative than -1,250 to -5,000 cfs based on a 14-day running average (with a simultaneous 5-day running average within 25 percent). Although the range is similar to Action 2, the Action implementation is different. Action 3 continues until June 30, or when water temperature reaches a certain threshold. A more detailed description of the implementation of these actions is provided in Section 5A.B.8.

NMFS BO Action 4.2.3 requires OMR flow management to protect emigrating juvenile winter-run, yearling spring-run, and Central Valley Steelhead within the lower Sacramento and San Joaquin rivers from entrainment into south Delta channels and at the export facilities in the south Delta. This action requires reducing exports from January 1 through June 15 to limit negative OMR flows to -2,500 to -5,000 cfs. CalSim II assumes OMR flows required in NMFS BO are covered by OMR flow requirements developed for Actions 1 through 3 of the USFWS BO as described in Section 5A.B.8.

South Delta Export-San Joaquin River Inflow Ratio

NMFS BO Action 4.2.1 requires exports to be capped at a certain fraction of San Joaquin River flow at Vernalis during April and May while maintaining a health and safety pumping of 1,500 cfs.

Exports at the South Delta Intakes

Exports at Jones and Banks Pumping Plant are restricted to their permitted capacities per SWRCB D-1641 requirements. In addition, the south Delta exports are subject to Vernalis flow-based export limits during April and May as required by Action 4.2.1. An additional 500 cfs pumping is allowed to reduce the impact of NMFS BO Action 4.2.1 on SWP during the July through September period.

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

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

Delta Water Quality

The No Action Alternative simulation includes SWRCB D-1641 salinity requirements. However, not all salinity requirements are included as CalSim II is not capable of predicting salinities in the Delta. Instead, empirically based equations and models are used to relate interior salinity conditions with the flow conditions. DWR's Artificial Neural Network (ANN) is used to predict and interpret salinity conditions at the Emmaton, Jersey Point, Rock Slough, and Collinsville stations. Emmaton and Jersey Point standards are for protecting water quality conditions for agricultural use in the western Delta, and they are in effect from April 1 to August 15. The electrical conductivity (EC) requirement at Emmaton varies from 0.45 millimhos per centimeter (mmhos/cm) to 2.78 mmhos/cm, depending on the water year type. The EC requirement at Jersey Point varies from 0.45 to 2.20 mmhos/cm, depending on the water year type. The Rock Slough standard is for protecting water quality conditions for municipal and industrial (M&I) use for water exported through the Contra Costa Canal. It is a year-round standard that requires a certain number of days in a year with chloride concentration less than 150 milligrams per liter. The number of days requirement is dependent upon the water year type. The Collinsville standard is applied during October through May months to protect water quality conditions for migrating fish species, and it varies between 12.5 mmhos/cm in May and 19.0 mmhos/cm in October.

The sea-level rise change assumed at the Year 2030 results in a modified flow-salinity relationship in the Delta. An ANN, which is capable of emulating DSM2 results under the 15-cm sea-level rise condition at the Year 2030 is used to simulate the flow-salinity relationship in CalSim II simulation for the No Action Alternative.

San Joaquin River Restoration Program

Friant Dam releases required by the San Joaquin River Restoration Program are included in the No Action Alternative, the Second Basis of Comparison, and all other alternatives. A more detailed description of the San Joaquin River Restoration Program is presented in Appendix 3A, "No Action Alternative: Central Valley Project and State Water Project Operations".

5A.B2.1.1.5 Operations Criteria

Fremont Weir Operations

To provide seasonal floodplain inundation in the Yolo Bypass, the 17.5- and the 11.5-foot elevation gates are opened between December 1 and March 31. This may extend to May 15, depending on hydrologic conditions and measures to minimize land use and ecological conflicts in the bypass. As a simplification for modeling, the gates are assumed opened until April 30 in all years. The gates are operated to limit maximum spill to 6,000 cfs until the Sacramento River stage reaches the existing Fremont Weir crest elevation. When the river stage is at or above the existing Fremont Weir crest elevation, the notch gates are assumed to be closed. While desired inundation period is on the order of 30 to 45 days, gates are not managed to limit to this range; instead, the duration of the event is governed by the Sacramento River flow conditions. To provide greater opportunity for the fish in the bypass to migrate upstream into the Sacramento River, the 11.5-foot elevation gate is assumed to be open for an extended period between September 15 and June 30. As a simplification for modeling, the period of operation for this gate is assumed to be September 1 to June 30. The spills through the 11.5-foot elevation gate are limited to 100 cfs.

Delta Cross Channel Gate Operations

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

NMFS BO Action 4.1.2 requires gates to be operated as described in the BO based on the presence of salmonids and water quality from October 1 through December 14; gates should be closed from December 15 to January 31, except short-term operations to maintain water quality. CalSim II includes the NMFS BO DCC gate operations in addition to the D-1641 gate operations. When the daily flows in the Sacramento River at Wilkins Slough exceed 7,500 cfs (flow assumed to flush salmon into the Delta), DCC is closed for a certain number of days in a month as described in Section B-11. From October 1 to December 14, if the flow trigger condition is such that additional days of DCC gates closure is called for, however water quality conditions are a concern and the DCC gates remain open, then Delta exports are limited to 2,000 cfs for each day in question.

Allocation Decisions

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

San Luis Operations

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

New Melones Operations

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

Fishery

In the No Action Alternative simulation, fishery flows refer to flow requirements of the 2009 NMFS BO Action III.1.3. These flows are patterned to provide fall attraction flows in October and outmigration pulse flows in spring months (April 15 through May 15 in all years), and total up to 98.9 TAF to 589.5 TAF annually depending on the hydrological conditions based on the New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) (Tables 5A.B.2 through 5A.B.4).

Table 5A.B.2 Annual Fishery Flow Allocation in New Melones

New Melones Water Supply Forecast (TAF)	Fishery Flows (TAF)
0 to 1,399.9	185.3
1,400 to 1,999.9	234.1
2,000 to 2,499.9	346.7
2,500 to 2,999.9	483.7
≥ 3,000	589.5

Table 5A.B.3 Monthly "Base" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Monthly Fishery Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-15	May 16–31	June	July	Aug.	Sept.
98.9	110	200	200	125	125	125	250	250	0	0	0	0
185.3	577.4	200	200	212.9	214.3	200	200	150	150	150	150	150
234.1	635.5	200	200	219.4	221.4	200	500	284.4	200	200	200	200
346.7	774.2	200	200	225.8	228.6	200	1,471.4	1,031.3	363.3	250	250	250
483.7	796.8	200	200	232.3	235.7	1,521	1,614.3	1,200	940	300	300	300
589.5	841.9	300	300	358.1	364.3	1,648.4	2,442.9	1,725	1,100	429	400	400

Table 5A.B.4 April 15 through May 15 "Pulse" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Fishery Pulse Flows (cfs)	Fishery Pulse Flows (cfs)
	April 15-30	May 1-15
185.3	687.5	666.7
234.1	1,000.0	1,000.0
346.7	1,625.0	1,466.7
483.7	1,212.5	1,933.3
589.5	925.0	2,206.7

Water Quality

Water quality releases include releases to meet the SWRCB D-1641 salinity objectives at Vernalis and the Decision 1422 (D-1422) dissolved oxygen objectives at Ripon.

The Vernalis water quality requirement (SWRCB D-1641) is an EC requirement of 700 and 1000 mmhos/cm for the irrigation (April through August) and non-irrigation (September through March) seasons, respectively.

Additional releases are made to the Stanislaus River below Goodwin Dam if necessary, to meet the D-1422 dissolved oxygen content objective. Surrogate flows representing releases for dissolved oxygen requirement in CalSim II are presented in Table 5A.B.5. The surrogate flows are reduced for critical years where New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) is less than 940 TAF. These flows are met through releases from New Melones without any annual volumetric limit.

Table 5A.B.5 Surrogate Flows for D1422 DO Requirement at Vernalis (TAF)

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

Bay-Delta Flows

Bay-Delta flow requirements are defined by D-1641 flow requirements at Vernalis (not including pulse flows during the April 15 through May 16 period). These flows are met through releases from New Melones without any annual volumetric limit.

D-1641 requires the flow at Vernalis to be maintained during the February through June period. The flow requirement is based on the required location of X2 and the San Joaquin Valley water year hydrologic classification (60-20-20 Index), as summarized in Table 5A.B.6.

Table 5A.B.6 Bay-Delta Vernalis Flow Objectives (average monthly cfs)

60-20-20 Index	Flow Required if X2 is West of Chipps Island	Flow required if X2 is East of Chipps Island
Wet	3,420	2,130
Above Normal	3,420	2,130
Below Normal	2,280	1,420
Dry	2,280	1,420
Critical	1,140	710

Water Supply

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

Water is provided to Oakdale ID and South San Joaquin ID in accordance with their 1988 Settlement Agreement with Reclamation (up to 600 TAF based on hydrologic conditions), limited by consumptive use. The conservation account of up to 200 TAF storage capacity defined under this agreement is not modeled in CalSim II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) for Stockton East WD and Central San Joaquin WCD (Table 5A.B.7) and are distributed throughout 1 year using monthly patterns.

Table 5A.B.7 CVP Contractor Allocations

New Melones Water Supply Forecast (TAF)	CVP Contractor Allocation (TAF)
<1,400	0
1,400 to 1,800	49
>1,800	155

5A.B2.1.2 DSM2 Assumptions for No Action Alternative

5A.B2.1.2.1 River Flows

For the No Action Alternative DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CalSim II.

5A.B2.1.2.2 Tidal Boundary

For the No Action Alternative, the tidal boundary condition at Martinez is based on an adjusted astronomical tide normalized for sea-level rise (Ateljevich and Yu 2007) and is modified to account for the sea-level rise using the correlations derived based on three-dimensional (UnTRIM) modeling of the Bay-Delta with sea-level rise at Year 2030.

5A.B2.1.2.3 Water Quality

Martinez EC

For the No Action Alternative, the Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim II and the pure astronomical tide (Ateljevich 2001), as modified to account for the salinity changes related to the sea-level rise using the correlations derived based on the three-dimensional (UnTRIM) modeling of the Bay-Delta with sea-level rise at Year 2030.

Vernalis EC

For the No Action Alternative DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CalSim II.

5A.B2.1.2.4 Morphological Changes

No additional morphological changes were assumed as part of the No Action Alternative simulation. The DSM2 model and grid developed as part of the 2009 recalibration effort (DWR 2009) was used for the No Action Alternative modeling.

5A.B2.1.2.5 Facilities

Delta Cross Channel

DCC gate operations are modeled in DSM2. The number of days in a month the DCC gates are open is based on the monthly time series from CalSim II.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River, and Grant Line Canal are included in the model. The fish barrier located at the Head of Old River is also included in the model.

Clifton Court Forebay Gates

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

5A.B2.1.2.6 Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. Head of Old River Barrier is assumed to be only installed from September 16 to November 30 and is not installed in the spring months, based on the USFWS BO Action 5. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16, and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Montezuma Salinity Control Gate

The radial gates in the Montezuma Slough Salinity Control Gate Structure are assumed to be tidally operating from October through February each year to minimize propagation of high salinity conditions into the interior Delta.

5A.B2.2 Second Basis of Comparison

The Second Basis of Comparison was developed assuming projected Year 2030 conditions. The Second Basis of Comparison assumptions include CVP and SWP operations prior to the RPAs, except for the ones that are constructed (e.g., Red Bluff Pumping Plant), implemented, legislatively mandated (e.g., San Joaquin River Restoration Plan), or that have undergone a substantial degree of progress (e.g., Yolo Bypass Salmonid Habitat and Fish Passage). Similar to the No Action Alternative, the Second Basis of Comparison models do not include any potential future habitat restoration areas due to the uncertainty of system effects depending on potential locations of such areas within the Delta.

The Second Basis of Comparison includes projected climate change and sea-level rise assumptions corresponding to the Year 2030. Change in climate results in the changes in the reservoir and tributary inflows are included in CalSim II. The sea-level rise changes result in modified flow-salinity relationships in the Delta. The climate change and sea-level rise assumptions at Year 2030 are described in detail in Section 5A.B.2. CalSim II simulation of the Second Basis of Comparison does not consider any adaptation measures that would result in managing the CVP and SWP system in a different manner than today to reduce climate impacts. For example, future changes in reservoir flood control reservation to better accommodate a seasonally changing hydrograph may be considered under future programs, but are not considered under the EIS.

5A.B2.2.1 CalSim II Assumptions for Second Basis of Comparison

5A.B2.2.1.1 Hydrology

Inflows/Supplies

Consistent with the No Action Alternative simulation.

Level of Development

Consistent with the No Action Alternative simulation.

Demands, Water Rights, CVP and SWP Contracts

Consistent with the No Action Alternative simulation.

5A.B2.2.1.2 Facilities

Facilities assumptions under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

Fremont Weir

Consistent with the No Action Alternative simulation.

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

Consistent with the No Action Alternative simulation.

SWP Banks Pumping Plant (Banks Pumping Plant) Capacity

Consistent with the No Action Alternative simulation.

CCWD Intakes

Consistent with the No Action Alternative simulation.

5A.B2.2.1.3 Regulatory Standards

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

D-1641 Operations

D-1641 Operations simulated under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

Significant elements of D-1641 include X2 standards, E/I) ratios, Delta water quality standards, real-time Delta Cross Channel operation, and San Joaquin flow standards.

Coordinated Operation Agreement (COA)

Consistent with the No Action Alternative simulation.

CVPIA (b)(2) Assumptions

Consistent with the No Action Alternative simulation.

Continued CALFED Agreements

Consistent with the No Action Alternative simulation.

USFWS BO Actions

The 2008 USFWS BO RPAs are not implemented under the Second Basis of Comparison.

NMFS BO Actions

The 2009 NMFS BO RPAs are not implemented under the Second Basis of Comparison.

Water Transfers

Water transfers assumptions simulated under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

5A.B2.2.1.4 Specific Regulatory Assumptions

Lower American Flow Management

Consistent with the No Action Alternative simulation.

Delta Outflow (Flow and Salinity)

SWRCB D-1641

Consistent with the No Action Alternative simulation.

USFWS BO (December 2008) Action 4

USFWS BO Action 4 is not included under the Second Basis of Comparison.

Combined Old and Middle River Flows

No requirement for minimum combined Old and Middle River flows is included in the Second Basis of Comparison.

South Delta Export-San Joaquin River Inflow Ratio

NMFS BO Action 4.2.1 requires exports to be capped at a certain fraction of San Joaquin River flow at Vernalis during April and May while maintaining a health and safety pumping of 1,500 cfs.

Exports at the South Delta Intakes

The Second Basis of Comparison, similar to the No Action Alternative, includes export restrictions at Jones and Banks Pumping Plant per SWRCB D-1641 requirements.

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

Further limitations on south Delta exports due to NMFS BO Action 4.2.1 are not included under the Second Basis of Comparison.

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

Delta Water Quality

Consistent with the No Action Alternative simulation.

The sea-level rise change assumed at the Year 2030 results in a modified flow-salinity relationship in the Delta. An ANN, which is capable of emulating the DSM2 model results under the 15-cm sea-level rise condition at the Year 2030, is used to simulate the flow-salinity relationship in CalSim II simulation for the Second Basis of Comparison.

San Joaquin River Restoration Program

Consistent with the No Action Alternative simulation.

5A.B2.2.1.5 Operations Criteria

Fremont Weir Operations

Consistent with the No Action Alternative simulation.

Delta Cross Channel Gate Operations

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

The NMFS BO Action 4.1.2 that specifies DCC operations is not included in the Second Basis of Comparison.

Allocation Decisions

The rules and assumptions used for allocation decisions under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

San Luis Operations

The rules and assumptions used for San Luis operations under the Second Basis of Comparison are consistent with the No Action Alternative simulation.

New Melones Operations

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

Fishery

Because the Second Basis of Comparison represents regulatory environment prior to the 2008 USFWS and 2009 NMFS BOs, fishery flows in this simulation refer to flow requirements of the 1997 New Melones Interim Plan of Operations (IPO). These flows include an outmigration pulse flow in April and May. Total annual volume dedicated to fishery flows vary from 0 to 467 TAF depending on the hydrologic conditions defined by the New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) (Tables 5A.B.8 through 5A.B.10).

Table 5A.B.8 Annual Fishery Flow Allocation in New Melones

New Melones Water Supply Forecast (TAF)	Fishery Flows (TAF)
0	0
1,400	98
2,000	125
2,500	345
3,000	467
6,000	467

Table 5A.B.9 Monthly "Base" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Monthly Fishery Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-15	May 16–31	June	July	Aug.	Sept.
98.4	110	200	200	125	125	125	250	250	0	0	0	0
243.3	200	250	250	250	250	250	300	300	200	200	200	200
253.8	250	275	275	275	275	275	300	300	200	200	200	200
310.3	250	300	300	300	300	300	900	900	250	250	250	250
410.2	350	350	350	350	350	350	1,500	1,500	800	300	300	300
466.8	350	400	400	400	400	400	1,500	1,500	1,500	300	300	300

Table 5A.B.10 April 15 through May 15 "Pulse" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Fishery Pulse Flows (CFS) April 15 – May 15
0	0
98	500
125	1,500
345	1,500
467	1,500
467	1,500

Water Quality

Consistent with the No Action Alternative simulation.

Bay-Delta Flows

Consistent with the No Action Alternative simulation.

Water Supply

Consistent with the No Action Alternative simulation.

Water Supply-CVP Eastside Contractors

Consistent with the No Action Alternative simulation.

5A.B2.2.2 DSM2 Assumptions for Second Basis of Comparison

5A.B2.2.2.1 River Flows

Consistent with the No Action Alternative simulation.

5A.B2.2.2.2 Tidal Boundary

Consistent with the No Action Alternative simulation.

5A.B2.2.2.3 Water Quality

Martinez EC

Consistent with the No Action Alternative simulation.

Vernalis EC

Consistent with the No Action Alternative simulation.

5A.B2.2.2.4 Morphological Changes

Consistent with the No Action Alternative simulation.

5A.B2.2.2.5 Facilities

Delta Cross Channel

Delta Cross Channel gate operations are modeled in DSM2. The number of days in a month the DCC gates are open is based on the monthly time series from

CalSim II. DCC gate operations in Second Basis of Comparison are different than those in the No Action Alternative simulation as described previously in this section.

South Delta Temporary Barriers

South Delta Temporary Barriers are included similar to the No Action Alternative. However, the operation of the HORB is different in the Second Basis of Comparison as explained in the following section.

Clifton Court Forebay Gates

Consistent with the No Action Alternative simulation.

5A.B2.2.2.6 Operations Criteria

South Delta Temporary Barriers

Similar to the No Action Alternative simulation with the exception that the USFWS BO Action 5 is not included in the Second Basis of Comparison. Therefore, HORB is installed in spring months (April 1 through May 31) in addition to fall months (September 16 through November 30).

Montezuma Salinity Control Gate

Consistent with the No Action Alternative simulation.

5A.B3 Assumptions for Alternatives Model Simulations

This section describes the CalSim II and DSM2 modeling assumptions for the Alternatives 3 and 5. Alternative 3 is generally consistent with the Second Basis of Comparison, and Alternative 5 is generally consistent with the No Action Alternative. Assumptions that are different from the Second Basis of Comparison for Alternative 3 and from the No Action Alternative for Alternative 5 are described in detail below. Other assumptions that are consistent with the respective basis of comparison, are provided in short form for completeness.

CVP and SWP operational assumptions are identical under the No Action Alternative and Alternative 2; and under the Second Basis of Comparison and Alternatives 1 and 4. Therefore, separate discussions related to assumptions for Alternatives 1, 2, and 4 are not included in this appendix.

5A.B3.1 Alternative 3

Alternative 3 model assumptions generally follow the Second Basis of Comparison simulation with the exception of the Old and Middle River Flows requirement, and a different set of assumptions for the New Melones operation that are based on the Oakdale ID's 2012 proposal [OID et al. 2012]. Alternative 3 includes other assumptions that are not modeled such as predation control, trap and haul fish passage, trap at head of Old River and barge to Chipps Island, and ocean harvest limits for Central Valley Chinook Salmon. Detailed descriptions of

Alternative 3 assumptions are described in the Chapter 3, Description of Alternatives.

Alternative 3 CalSim II and DSM2 assumptions that are different from the Second Basis of comparison are described below.

5A.B3.1.1 CalSim II Assumptions for Alternative 3

5A.B3.1.1.1 Demands, Water Rights, CVP and SWP Contracts

Similar to the Second Basis of Comparison and the No Action Alternative.

5A.B3.1.1.2 Facilities

Fremont Weir

Consistent with the Second Basis of Comparison and the No Action Alternative.

Banks Pumping Plant Capacity

Consistent with the Second Basis of Comparison and the No Action Alternative.

Jones Pumping Plant Capacity

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.B3.1.1.3 Regulatory Standards

Delta Outflow Index (Flow and Salinity)

SWRCB D-1641

Consistent with the Second Basis of Comparison and the No Action Alternative.

USFWS BO Action 4

Consistent with the Second Basis of Comparison.

Combined Old and Middle River Flows

The combined Old and Middle River (OMR) flow criteria are based on concepts addressed in the 2008 USFWS and 2009 NMFS BOs related to adaptive restrictions for temperature, turbidity, salinity, and presence of Delta Smelt. The OMR flow criteria in the Alternative 3 are similar to those of the No Action Alternative, with the exception of the following changes:

- Action 1 that protects the pre-spawning adult Delta Smelt from entrainment is modified to limit exports such that the average daily OMR flow is no more negative than -3,500 cfs for a total duration of 14 days, with a 5-day running average no more negative than 4,375 cfs (within 25 percent of the monthly criteria).
- Action 2 that protects adult Delta Smelt within the Delta from entrainment is modified to limit exports so that the average daily OMR flow is no more negative than -3,500 or -7,500 cfs depending on the previous month's ending X2 location (-3,500 cfs if X2 is east of Roe Island, or -7,500 cfs if X2 is west of Roe Island), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -4,375 cfs if X2 is east of Roe Island, or -9,375 cfs if X2 is west of Roe Island).

- Action 3 that protects larval and juvenile Delta Smelt from entrainment is modified to limit exports so that the average daily OMR flow is no more negative than -1,250, 3,500, or 7,500 cfs, depending on the previous month's ending X2 location (-1,250 cfs if X2 is east of Chipps Island, -7,500 cfs if X2 is west of Roe Island, or -3,500 cfs if X2 is between Chipps and Roe Island, inclusively), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -1,562 cfs if X2 is east of Chipps Island, -9,375 cfs if X2 is west of Roe Island, or -4,375 cfs if X2 is between Chipps and Roe Island).
- Temporal off-ramp for Action 3 is assumed to occur no later than June 15 (changed from June 30).
- An off-ramp based on QWest (westerly flow on the San Joaquin River past Jersey Point calculated as a combination of San Joaquin River at Blind Point, Three Mile Slough and Dutch Slough) is assumed. If Qwest is greater than 12,000 cfs, then the Action 3 is discontinued. Because Action 2 is defined to occur between Actions 1 and 3, the Qwest off ramp also results in discontinuation of Action 2 if it happens before Action 3 is triggered. In monthly CalSim II modeling, the previous month's QWest value is used for determining the off-ramp, therefore if the off-ramp occurs within the previous month, RPA Actions in that previous month are assumed to continue until the end of the month.

South Delta Export-San Joaquin River Inflow Ratio

Consistent with the Second Basis of Comparison.

Exports at the South Delta Intakes

The south Delta exports in Alternative 3 are operated per SWRCB D-1641. Similar to the Second Basis of comparison, the combined export of the CVP Tracy Pumping Plant and SWP Banks Pumping Plant is limited to a percentage of the total Delta inflow, based on the export-inflow ratio specified under D-1641.

Delta Water Quality

Alternative 3 includes SWRCB D-1641 salinity requirements consistent with the Second Basis of Comparison and the No Action Alternative.

San Joaquin River Restoration Program

Consistent with the No Action Alternative simulation.

5A.B3.1.1.4 Operations Criteria

Fremont Weir Operations

Consistent with the Second Basis of Comparison and the No Action Alternative.

Delta Cross Channel Gate Operations

Consistent with the Second Basis of Comparison.

Allocation Decisions

The rules and assumptions used for determining the allocations in the Alternative 3 CalSim II simulation are similar to the No Action Alternative simulation.

San Luis Operations

The rules and assumptions used for San Luis operations under the Alternative 3 are consistent with the No Action Alternative and the Second Basis of Comparison simulations.

New Melones Operations

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

Fishery

In the Alternative 3 simulation, fishery flows are modeled per Oakdale Irrigation District's 2012 proposal (OID et al. 2012). These flows include an outmigration pulse flow from April 1 through May 15. Total annual volume dedicated to fishery flows vary from 174 to 318 TAF depending on the hydrologic conditions defined by the New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) (Tables 5A.B.11 through 5A.B.13).

Table 5A.B.11 Annual Fishery Flow Allocation in New Melones

New Melones Water Supply Forecast (TAF)	Fishery Base Flows (TAF)
0 to 1,800	174
1,801 to 2,500	235
>2,500	318

Table 5A.B.12 Monthly "Base" Flows for Fisheries Purposes Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Monthly Fishery Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
235	252	300	300	150	173	200	200	200	200	200	200	200
318	300	300	300	300	300	300	1,500	850	200	200	200	200

Table 5A.B.13 April 1 through May 31 "Pulse" Flows for Fisheries Purposes Based on the Annual Fishery Volume

New Melones Water Supply Forecast (TAF)	Fishery Pulse Flows (CFS) April 1–May 31
0 to 1,800	750
1,801 to 2,500	1,500
>2,500	1,500

Water Quality

No D-1641 water quality releases are assumed in Alternative 3.

D-1422 dissolved oxygen compliance point is moved to the Orange Blossom Bridge under the Alternative 3. However, for modeling purposes, surrogate flows in CalSim II are assumed to be the same as those to meet the Ripon compliance point (surrogate flows consistent with the Second Basis of Comparison and the No Action Alternative).

Bay-Delta Flows

No D-1641 Bay-Delta flow requirements are assumed under the Alternative 3.

Water Supply

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

Water is provided to Oakdale ID and South San Joaquin ID in accordance with their 1988 Settlement Agreement with Reclamation (up to 600 TAF based on hydrologic conditions), limited by consumptive use. The conservation account of up to 200 TAF storage capacity defined under this agreement is not modeled in CalSim II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) for Stockton East WD and Central San Joaquin WCD (Table 5A.B.14) and are distributed throughout 1 year using monthly patterns.

Table 5A.B.14 CVP Contractor Allocations

New Melones Water Supply Forecast (TAF)	CVP Contractor Allocation (TAF)
<1,400	10
1,400 to 1,800	59
>1,800	155

5A.B3.1.2 DSM2 Assumptions for Alternative 3

5A.B3.1.2.1 Tidal Boundary

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.B3.1.2.2 Water Quality

Martinez EC

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.B3.1.2.3 Morphological Changes

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.B3.1.2.4 Facilities

South Delta Temporary Barriers

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.B3.1.2.5 Operations Criteria

South Delta Temporary Barriers

Consistent with the No Action Alternative, South Delta Temporary Barriers are operated based on San Joaquin flow conditions. Head of Old River Barrier is assumed to be only installed from September 16 to November 30 and is not installed in the spring months, based on the USFWS BO Action 5. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16, and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Montezuma Salinity Control Gate

Consistent with the Second Basis of Comparison and the No Action Alternative.

5A.B3.2 Alternative 5

Alternative 5 model assumptions generally follow the No Action Alternative simulation with the exception of more positive Old and Middle River Flows requirement in April and May, and D 1641 pulse flows at Vernalis. Detailed descriptions of Alternative 5 assumptions are described in Chapter 3, Description of Alternatives.

Alternative 5 CalSim II and DSM2 assumptions that are different from the No Action Alternative are described below.

5A.B3.2.1 CalSim II Assumptions for Alternative 5

5A.B3.2.1.1 Demands, Water Rights, CVP and SWP Contracts

Similar to the Second Basis of Comparison and the No Action Alternative.

5A.B3.2.1.2 Facilities

Fremont Weir

Consistent with the No Action Alternative and the Second Basis of Comparison.

Banks Pumping Plant Capacity

Consistent with the No Action Alternative and the Second Basis of Comparison.

Jones Pumping Plant Capacity

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.B3.2.1.3 Regulatory Standards

Delta Outflow Index (Flow and Salinity)

SWRCB D-1641

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

USFWS BO Action 4

USFWS BO Action 4 requires additional Delta outflow to manage X2 in the fall months following the Wet and Above Normal years. This action is included in Alternative 5. The assumptions for this action under Alternative 5 are consistent with the No Action Alternative.

Combined Old and Middle River Flows

The Alternative 5 OMR flow requirement is similar to the No Action Alternative with the exception of positive OMR flows in April and May in all years.

South Delta Export-San Joaquin River Inflow Ratio

Consistent with the No Action Alternative.

Exports at the South Delta Intakes

Similar to the No Action Alternative, with the exception that the minimum health and safety pumping of 1,500 cfs is not assumed for the months of April and May under Alternative 5.

Delta Water Quality

Consistent with the No Action Alternative and the Second Basis of Comparison.

San Joaquin River Restoration Program

Consistent with the No Action Alternative simulation.

5A.B3.2.1.4 Operations Criteria

Fremont Weir Operations

Consistent with the No Action Alternative and the Second Basis of Comparison.

Delta Cross Channel Gate Operations

Consistent with the No Action Alternative and the Second Basis of Comparison.

Allocation Decisions

The rules and assumptions used for allocation decisions under Alternative 5 are consistent with the No Action Alternative simulation.

San Luis Operations

The rules and assumptions used for San Luis Operations under Alternative 5 are consistent with the No Action Alternative simulation.

New Melones Operations

New Melones operations assumed in Alternative 5 is similar to the No Action Alternative with the exception of D-1641 Vernalis pulse flows.

Fishery

Similar to the No Action Alternative simulation, fishery flows refer to flow requirements of the 2009 NMFS BO Action III.1.3 under Alternative 5.

Water Quality

Consistent with the No Action Alternative.

Bay-Delta Flows

Bay-Delta flow requirements are defined by D-1641 flow requirements at Vernalis (not including pulse flows during the April 15 through May 16 period). These flows are met through releases from New Melones without any annual volumetric limit.

D-1641 requires flows at Vernalis to be maintained during the February through June period and is based on the required location of X2 and the San Joaquin Valley water year hydrologic classification (60-20-20 Index) as summarized in Table 5A.B.15.

Table 5A.B.15 Bay-Delta Vernalis Flow Objectives (average monthly cfs)

60-20-20 Index	Flow Required if X2 is West of Chipps Island	Flow required if X2 is East of Chipps Island
Wet	3,420	2,130
Above Normal	3,420	2,130
Below Normal	2,280	1,420
Dry	2,280	1,420
Critical	1,140	710

In addition to the D-1641 “base” flows, D-1641 pulse flows for the April 15 through May 15 period are also simulated under Alternative 5 (Table 5A.B.16).

Table 5A.B.16 Bay-Delta Vernalis Flow Objectives (average monthly cfs)

60-20-20 Index	Pulse Flow Required if X2 is West of Chipps Island	Pulse Flow required if X2 is East of Chipps Island
Wet	8,620	7,330
Above Normal	7,020	5,730
Below Normal	5,480	4,620
Dry	4,880	4,020
Critical	3,540	3,110

Water Supply

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

Water is provided to Oakdale ID and South San Joaquin ID in accordance with their 1988 Settlement Agreement with Reclamation (up to 600 TAF based on hydrologic conditions), limited by consumptive use. The conservation account of up to 200 TAF storage capacity defined under this agreement is not modeled in CalSim II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using New Melones water supply forecast (the end-of-February New Melones Storage, plus the March through September forecast of inflow to the reservoir) for Stockton East WD and Central San Joaquin WCD (Table 5A.B.17), and are distributed throughout 1 year using monthly patterns.

Table 5A.B.17 CVP Contractor Allocations

New Melones Water Supply Forecast (TAF)	CVP Contractor Allocation (TAF)
<1,400	0
1,400 to 1,800	49
>1,800	155

5A.B3.2.2 DSM2 Assumptions for Alternative 5

5A.B3.2.2.1 Tidal Boundary

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.B3.2.2.2 Water Quality

Martinez EC

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.B3.2.2.3 Morphological Changes

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.B3.2.2.4 Facilities

South Delta Temporary Barriers

Consistent with the No Action Alternative.

5A.B3.2.2.5 Operations Criteria

South Delta Temporary Barriers

Consistent with the No Action Alternative and the Second Basis of Comparison.

Montezuma Salinity Control Gate

Consistent with the No Action Alternative and the Second Basis of Comparison.

5A.B3.3 Summary of Alternatives Assumptions

A summary table of the EIS alternatives' assumptions is provided below for quick reference (Table 5A.B.18).

Table 5A.B.18 EIS Alternatives CalSim II Model Key Modeling Assumptions Summary

		No Action Alternative and Alternative 2	Alternatives 1 and 4 and Second Basis of Comparison	Alternative 3	Alternative 5
USFWS BO RPAs	Action 1 – First Flush	Represented	Not Represented	Modified to be operationally less restrictive (-7,500 cfs limit)	Represented
	Action 2 – Adult Protection OMR	Represented	Not Represented	Modified to be operationally less restrictive (-7,500 cfs limit)	Represented
	Action 3 – Juvenile Protection OMR	Represented	Not Represented	Modified to be operationally less restrictive (-7,500 cfs limit)	Modified to be operationally more restrictive
	Action 4 – Fall X2	Represented	Not Represented	Not Represented	Represented
	Action 5 – Spring HORB	Represented	Not Represented	Represented	Represented
NMFS BO RPAs	I.1.1 – Clear Creek Spring Attraction	Represented	Not Represented	Not Represented	Represented
	I.3.1, I.3.2, I.3.3 – Red Bluff Ops	Represented	Represented	Represented	Represented
	I.7 – Yolo Bypass Modification	Represented using BDCP Modeling Logic	Represented using BDCP Modeling Logic	Represented using BDCP Modeling Logic	Represented using BDCP Modeling Logic
	III.1.3 – Goodwin Flow Schedule	Represented per Appendix 2E Table	Fishery Flows from 1997 IPO	Fishery Flows from OID/SSJID Plan (2012)	Represented per Appendix 2E Table

		No Action Alternative and Alternative 2	Alternatives 1 and 4 and Second Basis of Comparison	Alternative 3	Alternative 5
NMFS BO RPAs	IV.1.2 – DCC Ops	Represented per RPA	Represented per D-1641	Represented per D-1641	Represented per RPA
	IV.2.1 – I/E Ratio	Represented	Not Represented	Not Represented	Represented
	IV.2.3 – OMR	See USFWS Actions 1-3	See USFWS Actions 1-3	See USFWS Actions 1-3	See USFWS Actions 1-3
Spring Delta Outflow		D-1641	D-1641	D-1641	Increased from D-1641 due to OMR Action in April and May
Releases from Goodwin	Fishery Flows	NMFS RPA III.1.3 (Appendix 2E)	Fishery Flows from 1997 Interim Plan of Operations	Fishery Flows from OID/SSJID Proposal (2012)	NMFS RPA III.1.3 (Appendix 2E)
	Vernalis Base Flow	D-1641 – no cap	D-1641 – no cap	N/A	D-1641 – no cap
	Vernalis Pulse Flow	N/A	N/A	N/A	D-1641 – no cap
	Vernalis Salinity	D-1641—no cap	D-1641—no cap	N/A	D-1641 – no cap
	Dissolved Oxygen	D-1641 standard at Ripon	D-1641 standard at Ripon	D-1641 standard at Orange Blossom Bridge (no model changes)	D-1641 standard at Ripon
OID/SSJID Deliveries		1988 Agreement limited by consumptive use, no conservation account	1988 Agreement limited by consumptive use, no conservation account	1988 Agreement limited by consumptive use, no conservation account	1988 Agreement limited by consumptive use, no conservation account
CVP Contractor Allocations		Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF	Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF	Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 59 TAF >1,800 = 155 TAF	Based on New Melones Index: <1,400 = 0 TAF 1,400-1,800 = 49 TAF >1,800 = 155 TAF

5A.B4 Timeframe of Evaluation

The No Action Alternative, the Second Basis of Comparison, and the other alternatives are simulated at Year 2030 conditions. Changes in climate conditions and sea level (15-cm rise) were assumed at Year 2030 and are consistent within all alternatives.

Using this approach, the climate scenario was derived based on sampling of the ensemble of global climate model projections rather than one single realization or a handful of individual realizations. The Q5 scenario that represents the central tendency of the climate projections was selected for the EIS analysis.

Simulation of climate change and sea-level rise effects in CalSim II modeling of the alternatives is accomplished by:

- Incorporating the modified CalSim II inputs reflecting climate change for parameters including, inflows, water year types, runoff forecasts, and Delta water temperature.
- Incorporating modified ANNs to reflect the flow-salinity response under sea level change.

Simulation of the tidal marsh restoration areas and sea-level rise effects in DSM2 modeling of the alternatives is accomplished by:

- Incorporating consistent grid changes identified in corroboration simulation into the DSM2 model for the sea-level rise condition.
- Modifying the downstream stage and EC boundary conditions at Martinez in the DSM2 model using the appropriate regression equation for the 15-cm sea-level rise. The adjusted astronomical tide specified at Martinez in the alternatives is modified using the correlations shown in Table 5A.B.19. The Martinez EC boundary condition resulting from the G-model is modified using the correlations specified in the Table 5A.B.19.

Table 5A.B.19 Correlation to Transform Baseline Martinez Stage and EC for use in Alternatives DSM2 Simulations at Year 2030

	Martinez Stage (feet NGVD 29)		Martinez EC (µS/cm)	
Scenario	Correlation	Lag (min)	Correlation	Lag (min)
Year 2030 (15cm SLR)	Y = 1.0033*X + .47	-1	Y = 0.9954* X + 556.3	0

Notes:

X = Baseline Martinez stage or EC

Y = Alternative Martinez stage or EC

5A.B5 No Action Alternative and Second Basis of Comparison Callout Tables

5A.B5.1 CalSim II Assumptions

This subsection provides a summary of the CalSim II assumptions for the No Action Alternative and the Second Basis of Comparison (Table 5A.B.20).

5A.B5.2 DSM2 Assumptions

This subsection provides a summary of the DSM2 assumptions for the No Action Alternative and the Second Basis of Comparison (Table 5A.B.21).

5A.B6 American River Demands

This section includes the information in the "Bay Delta Conservation Plan EIR/EIS Project—CalSim II Baselines Models—American River Assumptions," dated February 17, 2010.

5A.B6.1 Introduction

The following is a summary of the assumptions that are EIS alternatives. For specific diversion-related assumptions, see the following section.

- American River Flow Management is included, as required by the June 2009 NMFS Biological Opinion Action II.1.
- Water rights and CVP demands are assumed at a full buildout condition with CVP contracts at full contract amounts
- Placer County Water Agency (PCWA) Pump Station is included at full demand
- Freeport Regional Water Project (FRWP) is included at full demand (East Bay Municipal Utility District (EBMUD) CVP contracts and SCWA CVP contract and new appropriative water rights and water acquisitions as modeled in the FRWP EIS/R)
  - Sacramento River Water Reliability Project is not included
  - Sacramento Area Water Forum is not included (dry year "wedge" reductions and mitigation water releases are not included)

5A.B6.2 Summary of Demands

The Table 5A.B.22 below summarizes the water rights, CVP contract amounts, and demand amounts for each diverter in the American River system in the No Action Alternative and the Second Basis of Comparison.

1 **Table 5A.B.20 CalSim II Inputs – Assumptions**

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Planning horizon[a]	Year 2030	Same
Demarcation date[a]	March 2012	Same
Period of simulation	82 years (1922-2003)	Same
HYDROLOGY		
Inflows/Supplies	Historical with modifications for operations upstream of rim reservoirs and with changed climate at Year 2030	Same
Level of development	Projected 2030 level[c]	Same
DEMANDS, WATER RIGHTS, CVP and SWP CONTRACTS		
Sacramento River Region (excluding American River)		
CVP[d]	Land-use based, full buildout of contract amounts	Same
SWP (FRSA)[e]	Land-use based, limited by contract amounts	Same
Non-project	Land-use based, limited by water rights and SWRCB Decisions for Existing Facilities	Same
Antioch Water Works	Pre-1914 water right	Same
Federal refuges[f]	Firm Level 2 water needs	Same
Sacramento River Region—American River[g]		
Water rights	Year 2025, full water rights	Same
CVP	Year 2025, full contracts, including Freeport Regional Water Project	Same
San Joaquin River Region[h]		
Friant Unit	Limited by contract amounts, based on current allocation policy	Same
Lower Basin	Land-use based, based on district level operations and constraints	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Stanislaus River[i]	Land-use based, Revised Operations Plan[t] and NMFS BO (June 2009) Actions III.1.2 and III.1.3[v]	Land-use based, Revised Operations Plan[t]
San Francisco Bay, Central Coast, Tulare Lake and South Coast Regions (CVP and SWP project facilities)		
CVP[d]	Demand based on contract amounts	Same
CCWD[j]	195 TAF/year CVP contract supply and water rights	Same
SWP[e,k]	Demand based on Table A amounts	Same
Article 56	Based on 2001-2008 contractor requests	Same
Article 21	MWD demand up to 200 TAF/month from December to March subject to conveyance capacity, Kern County Water Agency demand up to 180 TAF/month, and other contractor demands up to 34 TAF/month in all months, subject to conveyance capacity	Same
North Bay Aqueduct (NBA)	77 TAF/yr demand under SWP contracts, up to 43.7 cfs of excess flow under Fairfield, Vacaville, and Benicia Settlement Agreement	Same
Federal refuges[f]	Firm Level 2 water needs	Same
FACILITIES		
Systemwide	Existing facilities	Same
Sacramento River Region		
Shasta Lake	Existing, 4,552 TAF capacity	Same
Red Bluff Diversion Dam	Diversion dam operated with gates out all year, NMFS BO (June 2009) Action I.3.1[v]; assume permanent facilities in place	Same
Colusa Basin	Existing conveyance and storage facilities	Same
Upper American River[g,l]	PCWA American River Pump Station	Same
Lower Sacramento River	Freeport Regional Water Project[n]	Same
San Joaquin River Region		
Millerton Lake (Friant Dam)	Existing, 520 TAF capacity	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Lower San Joaquin River	City of Stockton Delta Water Supply Project, 30-mgd capacity	Same
Delta Region		
SWP Banks Pumping Plant (South Delta)	Physical capacity is 10,300 cfs but 6,680 cfs permitted capacity in all months up to 8,500 cfs during Dec. 15 through Mar. 15 depending on Vernalis flow conditions[o]; additional capacity of 500 cfs (up to 7,180 cfs) allowed for July through Sept. for reducing impact of NMFS BO (June 2009) Action IV.2.1 Phase II[v] on SWP[w]	Physical capacity is 10,300 cfs but 6,680 cfs permitted capacity in all months up to 8,500 cfs during Dec. 15 through Mar. 15 depending on Vernalis flow conditions[o]; additional capacity of 500 cfs (up to 7,180 cfs) allowed for July through Sept. for reducing impact of B2 Actions.
CVP C.W. Bill Jones Pumping Plant (Tracy Pumping Plant)	Permit capacity is 4,600 cfs in all months (allowed for by the Delta-Mendota Canal-California Aqueduct Intertie)	Same
Upper Delta-Mendota Canal Capacity	Existing plus 400 cfs Delta-Mendota Canal-California Aqueduct Intertie	Same
CCWD Intakes	Los Vaqueros existing storage capacity, 160 TAF, existing pump locations, AIP included[p]	Same
San Francisco Bay Region		
South Bay Aqueduct (SBA)	SBA rehabilitation, 430 cfs capacity from junction with California Aqueduct to Zone 7 Water Agency diversion point	Same
South Coast Region		
California Aqueduct East Branch	Existing capacity	Same
REGULATORY STANDARDS		
North Coast Region		
Trinity River		
Minimum flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/year)	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Trinity Reservoir end-of-September minimum storage	Trinity EIS Preferred Alternative (600 TAF as able)	Same
Sacramento River Region		
Clear Creek		
Minimum flow below Whiskeytown Dam	Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS, predetermined CVPIA 3406(b)(2) flows[q], and NMFS BO (June 2009) Action I.1.1[v]	Downstream water rights, 1963 Reclamation Proposal to USFWS and NPS, predetermined CVPIA 3406(b)(2) flows[q]
Upper Sacramento River		
Shasta Lake end-of-September minimum storage	NMFS 2004 Winter-run Biological Opinion, (1900 TAF in non-critically dry years), and NMFS BO (June 2009) Action I.2.1[v]	NMFS 2004 Winter-run Biological Opinion, (1900 TAF in non-critically dry years)
Minimum flow below Keswick Dam	SWRCB WR 90-5, predetermined CVPIA 3406(b)(2) flows[q], and NMFS BO (June 2009) Action I.2.2[v]	SWRCB WR 90-5, predetermined CVPIA 3406(b)(2) flows[q]
Feather River		
Minimum flow below Thermalito Diversion Dam	2006 Settlement Agreement (700/800 cfs)	Same
Minimum flow below Thermalito Afterbay outlet	1983 DWR, DFW Agreement (750-1,700 cfs)	Same
Yuba River		
Minimum flow below Daguerre Point Dam	D-1644 Operations (Lower Yuba River Accord)[r]	Same
American River		
Minimum flow below Nimbus Dam	American River Flow Management[s] as required by NMFS BO (June 2009) Action II.1[v]	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Lower Sacramento River		
Minimum flow near Rio Vista	SWRCB D-1641	Same
San Joaquin River Region		
Mokelumne River		
Minimum flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100-325 cfs)	Same
Minimum flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25-300 cfs)	Same
Stanislaus River		
Minimum flow below Goodwin Dam	1987 Reclamation, DFW agreement, and flows required for NMFS BO (June 2009) Action III.1.2 and III.1.3[v]	1987 Reclamation, DFW agreement
Minimum dissolved oxygen	SWRCB D-1422	Same
Merced River		
Minimum flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180-220 cfs, Nov.-Mar.), and Cowell Agreement	Same
Minimum flow at Shaffer Bridge	FERC 2179 (25-100 cfs)	Same
Tuolumne River		
Minimum flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94-301 TAF/yr)	Same
San Joaquin River		
San Joaquin River below Friant Dam/ Mendota Pool	San Joaquin River Restoration-full flows, not constrained by current canal capacity[u]	Same
Maximum salinity near Vernalis	SWRCB D-1641	Same
Minimum flow near Vernalis	SWRCB D-1641, and NMFS BO (June 2009) Action IV.2.1[v]	SWRCB D-1641

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Sacramento River – San Joaquin Delta Region		
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641 and USFWS BO (Dec. 2008) Action 4	SWRCB D-1641
Delta Cross Channel gate operation	SRWCB D-1641 with additional days closed from Oct. 1 – Jan. 31 based on NMFS BO (June 2009) Action IV.1.2[v] (closed during flushing flows from Oct. 1 – Dec. 14 unless adverse water quality conditions)	SRWCB D-1641
South Delta exports (Jones Pumping Plant and Banks Pumping Plant)	SWRCB D-1641, Vernalis flow-based export limits Apr. 1 – May 31 as required by NMFS BO (June 2009) Action IV.2.1[v] (additional 500 cfs allowed for July – Sept. For reducing impact on SWP)[w]	SWRCB D-1641 (additional 500 cfs allowed for July – Sept. For reducing impact of B2 Actions)
Combined Flow in OMR	USFWS BO (Dec. 2008) Actions 1 through 3 and NMFS BO (June 2009) Action IV.2.3[v]	None
OPERATIONS CRITERIA: RIVER-SPECIFIC		
Sacramento River Region		
Upper Sacramento River		
Flow objective for navigation (Wilkins Slough)	NMFS BO (June 2009) Action I.4[v]; 3,500 – 5,000 cfs based on CVP water supply condition	Same
American River		
Folsom Dam flood control	Variable 400/670 flood control diagram (without outlet modifications)	Same
Feather River		
Flow at Mouth of Feather River (above Verona)	Maintain DFW/DWR flow target of 2,800 cfs for Apr. through Sept. dependent on Oroville inflow and FRSA allocation	Same
San Joaquin River Region		
Stanislaus River		
Flow below Goodwin Dam[i]	Revised Operations Plan[t] and NMFS BO (June 2009) Action III.1.2 and III.1.3[v]	Revised Operations Plan[t]

	No Action Alternative Assumption	Second Basis of Comparison Assumption
San Joaquin River		
Salinity at Vernalis	Grasslands Bypass Project (full implementation)	Same
OPERATIONS CRITERIA: SYSTEMWIDE		
CVP water allocation		
Settlement/Exchange	100 percent (75 percent in Shasta critical years)	Same
Refuges	100 percent (75 percent in Shasta critical years)	Same
Agriculture Service	100 percent-0 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641, USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	100 percent-0 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641
Municipal & Industrial Service	100 percent-50 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641, USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	100 percent-50 percent based on supply, South-of-Delta allocations are additionally limited due to D-1641
SWP water allocation		
North of Delta (FRSA)	Contract specific	Same
South of Delta (including North Bay Aqueduct)	Based on supply; equal prioritization between Ag and M&I based on Monterey Agreement; allocations are additionally limited due to D-1641 and USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	Based on supply; equal prioritization between Ag and M&I based on Monterey Agreement; allocations are additionally limited due to D-1641
CVP-SWP coordinated operations		
Sharing of responsibility for in-basin-use	1986 Coordinated Operations Agreement (FRWP EBMUD and 2/3 of the North Bay Aqueduct diversions considered as Delta Export; 1/3 of the North Bay Aqueduct diversion as in-basin-use)	Same
Sharing of surplus flows	1986 Coordinated Operations Agreement	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Sharing of total allowable export capacity for project-specific priority pumping	Equal sharing of export capacity under SWRCB D-1641, USFWS BO (Dec. 2008) and NMFS BO (June 2009) export restrictions[v]	Equal sharing of export capacity under SWRCB D-1641
Water transfers	Acquisitions by SWP contractors are wheeled at priority in Banks Pumping Plant over non-SWP users; LYRA included for SWP contractors[w]	Same
Sharing of total allowable export capacity for lesser priority and wheeling-related pumping	Cross Valley Canal wheeling (max of 128 TAF/year), CALFED ROD defined Joint Point of Diversion (JPOD)	Same
San Luis Reservoir	San Luis Reservoir is allowed to operate to a minimum storage of 100 TAF	Same
CVPIA 3406(b)(2)[v,q]		
Policy Decision	Per May 2003 Department Decision:	Same
Allocation	800 TAF, 700 TAF in 40-30-30 dry years, and 600 TAF in 40-30-30 critical years as a function of Ag allocation	Same
Actions	Predetermined upstream fish flow objectives below Whiskeytown and Keswick Dams, non-discretionary NMFS BO (June 2009) actions for the American and Stanislaus Rivers, and NMFS BO (June 2009) and USFWS BO (Dec. 2008) actions leading to export restrictions[v]	Predetermined upstream fish flow objectives below Whiskeytown and Keswick Dams
Accounting	Releases for non-discretionary USFWS BO (Dec. 2008) and NMFS BO (June 2009)[v] actions may or may not always be deemed (b)(2) actions; in general, it is anticipated that, accounting of these actions using (b)(2) metrics, the sum would exceed the (b)(2) allocation in many years; therefore no additional actions are considered and no accounting logic is included in the model[q]	No accounting logic is included in the model

	No Action Alternative Assumption	Second Basis of Comparison Assumption
WATER MANAGEMENT ACTIONS		
Water Transfer Supplies (long-term programs)		
Lower Yuba River Accord[w]	Yuba River acquisitions for reducing impact of NMFS BO export restrictions[v] on SWP	Yuba River acquisitions
Phase 8	None	None
Water Transfers (short-term or temporary programs)		
Sacramento Valley acquisitions conveyed through Banks Pumping Plant[x]	Post-analysis of available capacity	Post-analysis of available capacity

Notes:

a. These assumptions were developed under the direction of the DWR and Reclamation in 2010. Only operational components of 2008 USFWS and 2009 NMFS BOs as of demarcation date of No Action Alternative and the No action Alternative assumptions are included. Restoration of at least 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh required by the 2008 USFWS BO and restoration of at least 17,000 to 20,000 acres of floodplain rearing habitat for juvenile winter-run and spring-run Chinook Salmon and Central Valley Steelhead in the Yolo Bypass and/or suitable areas of the lower Sacramento River required by the NMFS 2009 BO are not included in the No Action Alternative assumptions because environmental documents of projects regarding these actions were not completed as of the publication date of the Notice of Preparation/Notice of Intent (February 13, 2009).

b. The Sacramento Valley hydrology used in the No Action Alternative CalSim II model reflects nominal 2005 land-use assumptions. The nominal 2005 land use was determined by interpolation between the 1995 and projected 2020 land-use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects 2005 land-use assumptions developed by Reclamation. Existing-level projected land-use assumptions are being coordinated with the California Water Plan Update for future models.

c. The Sacramento Valley hydrology used in the No Action Alternative CalSim II model reflects 2020 land-use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by Reclamation. Development of Future-level projected land-use assumptions are being coordinated with the California Water Plan Update for future models.

d. CVP contract amounts have been updated according to existing and amended contracts as appropriate. Assumptions regarding CVP agricultural and M&I service contracts and Settlement Contract amounts are documented in the Delivery Specifications attachments.

e. SWP contract amounts have been updated as appropriate based on recent Table A transfers/agreements. Assumptions regarding SWP agricultural and M&I contract amounts are documented in the Delivery Specifications attachments.

f. Water needs for Federal refuges have been reviewed and updated as appropriate. Assumptions regarding firm Level 2 refuge water needs are documented in the Delivery Specifications attachments. Refuge Level 4 (and incremental Level 4) water is not analyzed.

g. Assumptions regarding American River water rights and CVP contracts are documented in the Delivery Specifications attachments. The Sacramento Area Water Forum agreement, its dry year diversion reductions, Middle Fork Project operations and “mitigation” water is not included.

h. The new CalSim II representation of the San Joaquin River has been included in this model package (CalSim II San Joaquin River Model, Reclamation, 2005). Updates to the San Joaquin River have been included since the preliminary model release in August 2005. The model reflects the difficulties of ongoing groundwater overdraft problems. The 2030 level of development representation of the San Joaquin River Basin does not make any attempt to offer solutions to groundwater overdraft problems. In addition a dynamic groundwater simulation is not yet developed for the San Joaquin River Valley. Groundwater extraction/recharge and stream-groundwater interaction are static assumptions and may not accurately reflect a response to simulated actions. These limitations should be considered in the analysis of results.

i. The CalSim II model representation for the Stanislaus River does not necessarily represent Reclamation’s current or future operational policies. A suitable plan for supporting flows has not been developed for NMFS BO (June 2009) Action 3.1.3.

j. The actual amount diverted is operated in conjunction with supplies from the Los Vaqueros project. The existing Los Vaqueros storage capacity is 160 TAF. Associated water rights for Delta excess flows are included.

k. Under No Action Alternative, it is assumed that SWP Contractors demand for Table A allocations vary from 3.0 to 4.1 million acre-feet (MAF)/year. Under the No Action Alternative, it is assumed that SWP Contractors can take delivery of all Table A allocations and Article 21 supplies. Article 56 provisions are assumed and allow for SWP Contractors to manage storage and delivery conditions such that full Table A allocations can be delivered. Article 21 deliveries are limited in Wet years under the assumption that demand is decreased in these conditions. Article 21 deliveries for the NBA are dependent on excess conditions only, all other Article 21 deliveries also require that San Luis Reservoir be at capacity and that Banks Pumping Plant and the California Aqueduct have available capacity to divert from the Delta for direct delivery.

l. PCWA American River pumping facility upstream of Folsom Lake is included in both the Existing and No Action Alternative No Action Alternative. The diversion is assumed to be 35.5 TAF/Yr.

m. footnote removed

n. footnote removed

o. Current USACE permit for Banks Pumping Plant allows for an average diversion rate of 6,680 cfs in all months. Diversion rate can increase up to 1/3 of the rate of San Joaquin River flow at Vernalis from Dec. 15th to Mar. 15th, up to a maximum diversion of 8,500 cfs, if Vernalis flow exceeds 1,000 cfs.

p. The CCWD AIP is an intake at Victoria Canal that operates as an alternate Delta diversion for Los Vaqueros Reservoir. This assumption is consistent with the future no-project condition defined by the Los Vaqueros Enlargement study team.

q. CVPIA (b)(2) fish actions are not dynamically determined in the CalSim II model, nor is (b)(2) accounting done in the model. Since the USFWS BO and NMFS BO were issued, the Department has exercised its discretion to use (b)(2) in the delta by accounting some or all of the export reductions required under those biological opinions as (b)(2) actions. It is therefore assumed for modeling purposes that (b)(2) availability for other delta actions will be limited to covering the CVP’s VAMP export reductions. Similarly, since the USFWS BO and NMFS BO were issued, the Department has exercised its discretion to use (b)(2) upstream by accounting some or all of the release augmentations (relative to the hypothetical (b)(2) base case) below Whiskeytown, Nimbus, and Goodwin as (b)(2) actions. It is therefore assumed for modeling purposes that (b)(2) availability for other upstream actions will be limited to covering Sacramento releases, in the fall and winter. For modeling purposes, predetermined time series of minimum instream flow requirements are specified. The time series are based on the Aug. 2008 BA Study 7.0 and Study 8.0 simulations which did include dynamically determined (b)(2) actions.

r. D-1644 and the Lower Yuba River Accord is assumed to be implemented for Existing and No Action Alternative No Action Alternative. The Yuba River is not dynamically modeled in CalSim II. Yuba River hydrology and availability of water acquisitions under the Lower Yuba River Accord are based on modeling performed and provided by the Lower Yuba River Accord EIS/EIR study team.

s. Under Existing Conditions, the flow components of the proposed American River Flow Management are as required by the NMFS BO (June 4, 2009).

t. The model operates the Stanislaus River using a 1997 Interim Plan of Operation-like structure, i.e., allocating water for Stockton East Water District and CSJWCD, Vernalis water quality dilution, and Vernalis D-1641 flow requirements based on the New Melones Index. Oakdale Irrigation District and South San Joaquin Irrigation District allocations are based on their 1988 agreement and Ripon DO requirements are represented by a static set of minimum instream flow requirements during June thru Sept. Instream flow requirements for fish below Goodwin are based on NMFS BO Action III.1.2. NMFS BO Action IV.2.1’s flow component is not assumed to be in effect.

u. SJR Restoration Water Year 2010 Interim Flows Project are assumed, but are *not input into the models; operation not regularly defined at this time*

v. In cooperation with Reclamation, National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife, the Department of Water Resources has developed assumptions for implementation of the USFWS BO (Dec. 15, 2008) and NMFS BO (June 4, 2009) in CalSim II.

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

x. Only acquisitions of Lower Yuba River Accord Component 1 water are included.

1 **Table 5A.B.21 DSM2 Assumptions**

	No Action Alternative Assumption	Second Basis of Comparison Assumption
Period of simulation	82 years (1922-2003)[a,b]	Same
REGIONAL SUPPLIES		
Boundary flows	Monthly time series from CalSim II output (alternatives provide different flows and exports)[c]	Same
REGIONAL DEMANDS AND CONTRACTS		
Ag flows (DICU)	2005 Level, DWR Bulletin 160-98[d]	2020 Level, DWR Bulletin 160-98[d]
TIDAL BOUNDARY		
Martinez stage	15-minute adjusted astronomical tide[a]	Same
WATER QUALITY		
Vernalis EC	Monthly time series from CalSim II output[e]	Monthly time series from CalSim II output[e]
Agricultural Return EC	Municipal Water Quality Investigation Program analysis	Same
Martinez EC	Monthly net Delta Outflow from CalSim II output and G-model[f]	Monthly net Delta Outflow from CalSim II output and G-model[f]
MORPHOLOGICAL CHANGES		
Mokelumne River	None	None
San Joaquin River	None	None
Middle River	None	None
Dutch Slough Restoration Project	None	None

	No Action Alternative Assumption	Second Basis of Comparison Assumption
FACILITIES		
Contra Costa Water District Delta Intakes	Rock Slough Pumping Plant, Old River at Highway 4 Intake	Rock Slough Pumping Plant, Old River at Highway 4 Intake and Alternate Improvement Project Intake on Victoria Canal
South Delta barriers	Temporary Barriers Program	Same
Two Gate Program	None	None
Franks Tract Program	None	None
SPECIFIC PROJECTS		
Water Supply Intake Projects		
Freeport Regional Water Project	None	Monthly output from CalSim II
Stockton Delta Water Supply Project	None	Monthly output from CalSim II
Antioch Water Works	Monthly output from CalSim II	Monthly output from CalSim II
Sanitary and Agricultural Discharge Projects		
Veale Tract Drainage Relocation	The Veale Tract Water Quality Improvement Project, funded by CALFED, relocates the agricultural drainage outlet that was relocated from Rock Slough channel to the southern end of Veale Tract, on Indian Slough[k]	Same
OPERATIONS CRITERIA		
Delta Cross Channel	Monthly time series of number of days open from CalSim II output	Monthly time series of number of days open from CalSim II output
Clifton Court Forebay	Priority 3, gate operations synchronized with incoming tide to minimize impacts to low water levels in nearby channels	Same

	No Action Alternative Assumption	Second Basis of Comparison Assumption
South Delta barriers	Temporary Barriers Project operated based on San Joaquin River flow time series from CalSim II output; HORB is assumed only installed[l] Sept. 16 through Nov. 30; agricultural barriers on OMR are assumed to be installed starting from May 16 and on Grant Line Canal from June 1; all three barriers are allowed to be operated until November 30; May 16 to May 31; the tidal gates are assumed to be tied open for the barriers on Old and Middle Rivers[m].	Temporary Barriers Project operated based on San Joaquin River flow time series from CalSim II output; HORB is assumed installed[l] April 1 through May 31 and Sept. 16 through Nov. 30; agricultural barriers on OMR are assumed to be installed starting from May 16 and on Grant Line Canal from June 1; all three barriers are allowed to be operated until November 30; May 16 to May 31; the tidal gates are assumed to be tied open for the barriers on ORM[m]

Notes:

a. A new adjusted astronomical tide for use in DSM2 planning studies has been developed by DWR's Bay Delta Office Modeling Support Branch Delta Modeling Section in cooperation with the Common Assumptions workgroup. This tide is based on a more extensive observed dataset and covers the entire 82-year period of record.

b. The 16-year period of record is the simulation period for which DSM2 has been commonly used for impacts analysis in many previous projects, and includes varied water year types.

c. Although monthly CalSim II output was used as the DSM2-HYDRO input, the Sacramento and San Joaquin rivers were interpolated to daily values in order to smooth the transition from high to low and low to high flows. DSM2 then uses the daily flow values along with a 15-minute adjusted astronomical tide to simulate effect of the spring and neap tides.

d. The Delta Island Consumptive Use (DICU) model is used to calculate diversions and return flows for all Delta islands based on the level of development assumed. The nominal 2005 Delta region hydrology land use was determined by interpolation between the 1995 and projected 2020 land-use assumptions associated with Bulletin 160-98.

e. CalSim II calculates monthly EC for the San Joaquin River, which was then converted to daily EC using the monthly EC and flow for the San Joaquin River. Fixed concentrations of 150, 175, and 125 μmhos/cm were assumed for the Sacramento River, Yolo Bypass, and eastside streams, respectively.

f. Net Delta outflow based on the CalSim II flows was used with an updated G-model to calculate Martinez EC. Under changed climate conditions, Martinez EC is modified to account for the sea-level rise at early (15 cm) and late (45 cm) long-term phases (Year 2060).

g. footnote removed.

h. footnote removed.

i. footnote removed.

j. footnote removed.

k. Information was obtained based on the information from the draft final “Delta Region Drinking Water Quality Management Plan” dated June 2005 prepared under the CALFED Water Quality Program and a presentation by David Briggs at SWRCB public workshop for periodic review. The presentation “Compliance Location at Contra Costa Canal at Pumping Plant #1 – Addressing Local Degradation” notes that the Veale Tract drainage relocation project will be operational in June 2005. The DICU drainage currently simulated at node 204 is moved to node 202 in DSM2.

l. Based on the USFWS BO Action 5, HORB is assumed to be not installed in April or May; therefore HORB is only installed in the fall, as shown.

m. Based on the USFWS BO Action 5 and the project description provided in the page 119.

Table 5A.B.22 American River Diversions Assumed in the No Action Alternative and Second Basis of Comparison

		No Action Alternative and Second Basis of Comparison (TAF/yr)	No Action Alternative and Second Basis of Comparison (TAF/yr)	No Action Alternative and Second Basis of Comparison (TAF/yr)
	Diversion Location	**CVP M&I[a] Contracts (maximum[a])**	**Water Rights (maximum)**	**Diversion Limit (maximum capacity)**
Placer County Water Agency	Auburn Dam Site	–	65.0	65.0
Total		**0**	**65.0**	**65.0**
Sacramento Suburban Water District[b]	Folsom Reservoir	–	0	0
City of Folsom – includes P.L. 101-514		7	27	34
Folsom Prison		–	5	5
San Juan Water District (Placer County)		–	25	25
San Juan Water District (Sac County) – includes P.L. 101-514	Folsom Reservoir	24.2	33	57.2
El Dorado Irrigation District		7.55	17	24.55
City of Roseville		32	30	62.0
Placer County Water Agency		35	–	35
El Dorado County – P.L.101-514		15	–	15
Total		**120.8**	**137.0**	**257.8**

	Diversion Location	No Action Alternative and Second Basis of Comparison (TAF/yr) CVP M&I[a] Contracts (maximum[a])	No Action Alternative and Second Basis of Comparison (TAF/yr) Water Rights (maximum)	No Action Alternative and Second Basis of Comparison (TAF/yr) Diversion Limit (maximum capacity)
So. Cal WC/Arden Cordova WC	Folsom South Canal	–	5	5
California Parks and Recreation		5	–	5
SMUD		30	15	45
Canal Losses		–	1	1
Total		**35**	**21**	**56**
City of Sacramento[c]	Lower American River	–	225.6	225.6
Carmichael Water District		–	12	12
Total		**0**	**237.6**	**237.6**
Total American River Diversions		**155.8**	**460.6**	**616.4**
Sacramento River Diversions				
City of Sacramento	Lower Sacramento River	–	86.19	86.19
Sacramento County Water Agency		30	–	30
Sacramento County Water Agency—P.L. 101-514		15	–	15
Sacramento County Water Agency—water rights and acquisitions		–	Varies[d], average 32.58	Varies[d], average 32.58

		No Action Alternative and Second Basis of Comparison (TAF/yr)	No Action Alternative and Second Basis of Comparison (TAF/yr)	No Action Alternative and Second Basis of Comparison (TAF/yr)
	Diversion Location	CVP M&I[a] Contracts (maximum[a])	Water Rights (maximum)	Diversion Limit (maximum capacity)
East Bay Municipal Utilities District		133	–	Varies[e], average 8.2
Total Sacramento River Diversions		**178**	**118.8**	**172.0**
Total		**333.8**	**579.4**	**788.4**

Notes:

a. When the CVP Contract quantity exceeds the quantity of the Diversion Limit minus the Water Right (if any), the diversion modeled is the quantity allocated to the CVP Contract (based on the CVP contract quantity shown times the CVP M&I allocation percentage) plus the Water Right (if any), but with the sum limited to the quantity of the Diversion Limit

b. Diversion is only allowed if and when Mar-Nov Folsom Unimpaired Inflow (FUI) exceeds 1,600 TAF

c. When the Hodge single dry year criteria is triggered, Mar-Nov FUI falls below 400 TAF, diversion on the American River is limited to 50 TAF/yr; based on monthly Hodge flow limits assumed for the American, diversion on the Sacramento River may be increased to 223 TAF due to reductions of diversions on American River

d. SCWA targets 68 TAF of surface water supplies annually. The portion unmet by CVP contract water is assumed to come from two sources:

(1) Delta "excess" water- averages 16.5 TAF annually, but varies according to availability. SCWA is assumed to divert excess flow when it is available, and when there is available pumping capacity.

(2) "Other" water- derived from transfers and/or other appropriated water, averaging 14.8 TAF annually but varying according remaining unmet demand.

e. EBMUD CVP diversions are governed by the Amendatory Contract, stipulating:

(1) 133 TAF maximum diversion in any given year

(2) 165 TAF maximum diversion amount over any 3 year period

(3) Diversions allowed only when EBMUD total storage drops below 500 TAF

(4) 155 cfs maximum diversion rate

5A.B7 Delivery Specifications

This section lists the CVP and SWP contract amounts and other water rights assumptions used in the EIS No Action Alternative and No Action Alternative CalSim II simulations (Tables 5A.B.23 through 5A.B.27).

5A.B8 USFWS RPA Implementation

The information included in this section is consistent with what was provided to and agreed upon by the lead agencies in the technical memorandum, "Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies" on February 10, 2010 (updated May 18, 2010).

5A.B8.1 Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies

The USFWS BO was released on December 15, 2008. To develop CalSim II modeling assumptions for the RPA in the BO, DWR led a series of meetings that involved members of fisheries and project agencies. The purpose for establishing this group was to prepare the assumptions and CalSim II implementations to represent the RPAs in Existing and Future Condition CalSim II simulations for future planning studies.

This memorandum summarizes the approach that resulted from these meetings and the modeling assumptions that were laid out by the group. The scope of this memorandum is limited to the December 15, 2008 BO. Unless otherwise indicated, all descriptive information of the RPAs is taken from Appendix B of the BO.

Table 5A.B.28 lists the participants that contributed to the meetings and information summarized in this document.

The RPAs in the USFWS BO are based on physical and biological phenomena that do not lend themselves to simulations using a monthly time step. Much scientific and modeling judgment has been employed to represent the implementation of the RPAs. The group believes the logic put into CalSim II represents the RPAs as best as possible at this time, given the scientific understanding of environmental factors enumerated in the BO and the limited historical data for some of these factors.

Table 5A.B.23 Delta – Future Conditions

CVP/SWP Contractor	Geographic Location	Water Right (TAF/yr)	SWP Table A Amount (TAF)		SWP Article 21 Demand (TAF/mon)	CVP Water Service Contracts (TAF/yr)	
			Ag	M&I		AG	M&I
North Delta							
City of Vallejo	City of Vallejo	–	–	–	–	–	16.0
CCWD*	Contra Costa County	–	–	–	–	–	195.0
Napa County FC&WCD	North Bay Aqueduct	–	–	29.03	1.0	–	–
Solano County WA	North Bay Aqueduct	–	–	47.51	1.0	–	–
Fairfield, Vacaville, and Benicia Agreement	North Bay Aqueduct	31.60	–	–	–	–	–
City of Antioch	City of Antioch	18.0	–	–	–	–	–
Total North Delta		**49.6**	**0.0**	**76.5**	**2.0**	**0.0**	**211.0**
South Delta							
Delta Water Supply Project	City of Stockton	32.4	–	–	–	–	–
Total South Delta		**32.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total		**82.0**	**0.0**	**76.5**	**2.0**	**0.0**	**211.0**

Table 5A.B.24 CVP North-of-the-Delta – Future Conditions

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Anderson Cottonwood ID	Sacramento River Redding Subbasin	–	–	128.0	–	–
Clear Creek C.S.D.		13.8	1.5	–	–	–
Bella Vista WD		22.1	2.4	–	–	–
Shasta C.S.D.		–	1.0	–	–	–
Sac R. Misc. Users		–	–	3.4	–	–
Redding, City of		–	–	21.0	–	–
City of Shasta Lake		2.5	0.3	–	–	–
Mountain Gate C.S.D.			0.4	–	–	–
Shasta County Water Agency		0.5	0.5	–	–	–
Redding, City of/Buckeye		–	6.1	–	–	–
Total		**38.9**	**12.2**	**152.4**		**0.0**
Corning WD	Corning Canal	23.0	–	–	–	–
Proberta WD		3.5	–	–	–	–
Thomes Creek WD		6.4	–	–	–	–
Total		**32.9**	**0.0**	**0.0**	–	**0.0**
Kirkwood WD	Tehama-Colusa Canal	2.1	–	–	–	–
Glide WD		10.5	–	–	–	–
Kanawha WD		45.0	–	–	–	–
Orland-Artois WD		53.0	–	–	–	–

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Colusa, County of		20.0	–	–	–	–
Colusa County WD		62.2	–	–	–	–
Davis WD		4.0	–	–	–	–
Dunnigan WD		19.0	–	–	–	–
La Grande WD		5.0	–	–	–	–
Westside WD		65.0	–	–	–	–
Total		**285.8**	**0.0**	**0.0**	–	**0.0**
Sac. R. Misc. Users	Sacramento River	–	–	1.5	–	–
Glenn Colusa ID	Glenn-Colusa Canal	–	–	441.5	–	–
		–	–	383.5	–	–
Sacramento NWR		–	–	–	–	53.4
Delevan NWR		–	–	–	–	24.0
Colusa NWR		–	–	–	–	28.8
Colusa Drain M.W.C.	Colusa Basin Drain	–	–	7.7	–	–
		–	–	62.3	–	–
Total		**0.0**	**0.0**	**895.0**	–	**106.2**
Princeton-Cordova-Glenn ID	Sacramento River	–	–	67.8	–	–
Provident ID		–	–	54.7	–	–
Maxwell ID		–	–	1.8	–	–
		–	–	16.2	–	–

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Sycamore Family Trust		–	–	31.8	–	–
Roberts Ditch IC		–	–	4.4	–	–
Sac R. Misc. Users[b]		–	–	4.9	–	–
		–	–	9.5	–	–
Total		**0.0**	**0.0**	**191.2**	–	**0.0**
Reclamation District 108	Sacramento River	–	–	12.9	–	–
		–	–	219.1	–	–
River Garden Farms		–	–	29.8	–	–
Meridian Farms WC		–	–	35.0	–	–
Pelger Mutual WC		–	–	8.9	–	–
Reclamation District 1004		–	–	71.4	–	–
Carter MWC		–	–	4.7	–	–
Sutter MWC		–	–	226.0	–	–
Tisdale Irrigation & Drainage Co.		–	–	9.9	–	–
Sac R. Misc. Users		–	–	103.4	–	–
		–	–	0.9	–	–
Feather River WD export		20.0	–	–	–	–
Total		**20.0**	**0.0**	**722.1**	–	**0.0**
Sutter NWR	Sutter bypass water for Sutter NWR	–	–	–	–	25.9
Gray Lodge WMA	Feather River	–	–	–	–	41.4
Butte Sink Duck Clubs		–	–	–	–	15.9
Total		**0.0**	**0.0**	**0.0**		**83.2**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)
		AG	M&I			
Sac. R. Misc. Users	Sacramento River	–	–	56.8	–	–
City of West Sacramento		–	–	23.6	–	–
Davis-Woodland Water Supply Project		DSA 65	–	–	–	–
Total		**0.0**	**0.0**	**80.4**	–	**0.0**
Sac R. Misc. Users	Lower Sacramento River	–	–	4.8	–	–
Natomas Central MWC		–	–	120.2	–	–
Pleasant Grove-Verona MWC		–	–	26.3	–	–
City of Sacramento		–	0.0	–	0.0	–
PCWA (Water Rights)		–	0.0	–	0.0	–
Total		**0.0**	**0.0**	**151.3**	**0.0**	–
Total CVP North-of-Delta		**377.6**	**12.2**	**2,193.8**	**0.0**	**189.4**

Notes:

* Level 4 Refuge water needs are not included.

1 **Table 5A.B.25 CVP South-of-the-Delta – Future Conditions**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Byron-Bethany ID	Upper DMC	20.6		–	–	–	–
Tracy, City of		–	10.0	–	–	–	–
		–	5.0	–	–	–	–
		–	5.0	–	–	–	–
Banta Carbona ID		20.0		–	–	–	–
Total		**40.6**	**20.0**	**0.0**	**0.0**	**0.0**	**0.0**
Del Puerto WD	Upper DMC	12.1	–	–	–	–	–
Davis WD		5.4	–	–	–	–	–
Foothill WD		10.8	–	–	–	–	–
Hospital WD		34.1	–	–	–	–	–
Kern Canon WD		7.7	–	–	–	–	–
Mustang WD		14.7	–	–	–	–	–
Orestimba WD		15.9	–	–	–	–	–
Quinto WD		8.6	–	–	–	–	–
Romero WD		5.2	–	–	–	–	–
Salado WD		9.1	–	–	–	–	–
Sunflower WD		16.6	–	–	–	–	–
West Stanislaus WD		50.0	–	–	–	–	–
Patterson WD		16.5	–	–	6.0	–	–
Total		**206.7**	**0.0**	**0.0**	**6.0**	**0.0**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Upper DMC Loss	Upper DMC	–	–	–	–	–	18.5
Panoche WD	Lower DMC Volta	6.6	–	–	–	–	–
San Luis WD		65.0	–	–	–	–	–
Laguna WD		0.8	–	–	–	–	–
Eagle Field WD		4.6	–	–	–	–	–
Mercy Springs WD		2.8	–	–	–	–	–
Oro Loma WD		4.6	–	–	–	–	–
Total		**84.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Central California ID	Lower DMC Volta	–	–	140.0	–	–	–
Grasslands via CCID	Lower DMC Volta	–	–	–	–	81.8	–
Los Banos WMA		–	–	–	–	11.2	–
Kesterson NWR	Lower DMC Volta	–	–	–	–	10.5	–
Freitas – SJBAP		–	–	–	–	6.3	–
Salt Slough – SJBAP		–	–	–	–	8.6	–
China Island – SJBAP		–	–	–	–	7.0	–
Volta WMA		–	–	–	–	13.0	–
Grassland via Volta Wasteway		–	–	–	–	23.2	–
Total		**0.0**	**0.0**	**140.0**	**0.0**	**161.5**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Fresno Slough WD	San Joaquin River at Mendota Pool	4.0	–	–	0.9	–	–
James ID		35.3	–	–	9.7	–	–
Coelho Family Trust		2.1	–	–	1.3	–	–
Tranquillity ID		13.8	–	–	20.2	–	–
Tranquillity PUD		0.1	–	–	0.1	–	–
Reclamation District 1606		0.2	–	–	0.3	–	–
Central California ID		–	–	392.4	–	–	–
Columbia Canal Co.		–	–	59.0	–	–	–
Firebaugh Canal Co.		–	–	85.0	–	–	–
San Luis Canal Co.		–	–	23.6	–	–	–
M.L. Dudley Company		–	–	–	2.3	–	–
Grasslands WD		–	–	–	–	29.0	–
Mendota WMA		–	–	–	–	27.6	–
Losses		–	–	–	–	–	101.5
Total		**55.5**	**0.0**	**560.0**	**34.8**	**56.6**	**101.5**
San Luis Canal Co.	San Joaquin River at Sack Dam	–	–	140.0	–	–	–
Grasslands WD		–	–	–	–	2.3	–
Los Banos WMA		–	–	–	–	12.4	–
San Luis NWR		–	–	–	–	19.5	–
West Bear Creek NWR		–	–	–	–	7.5	–
East Bear Creek NWR		–	–	–	–	8.9	–
Total		**0.0**	**0.0**	**140.0**	**0.0**	**50.6**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
San Benito County WD (Ag)	San Felipe	35.6	–	–	–	–	–
Santa Clara Valley WD (Ag)		33.1	–	–	–	–	–
Pajaro Valley WD		6.3	–	–	–	–	–
San Benito County WD (M&I)		–	8.3	–	–	–	–
Santa Clara Valley WD (M&I)		–	119.4	–	–	–	–
Total		**74.9**	**127.7**	**0.0**	**0.0**	**0.0**	**0.0**
San Luis WD	CA reach 3	60.1	–	–	–	–	–
CA, State Parks and Rec		2.3	–	–	–	–	–
Affonso/Los Banos Gravel Co.		0.3	–	–	–	–	–
Total		**62.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Panoche WD	CVP Dos Amigos Pumping Plant/ CA reach 4	87.4	–	–	–	–	–
Pacheco WD		10.1	–	–	–	–	–
Total		**97.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Westlands WD (Centinella)	CA reach 4	2.5	–	–	–	–	–
Westlands WD (Broadview WD)		27.0	–	–	–	–	–
Westlands WD (Mercy Springs WD)		4.2	–	–	–	–	–
Westlands WD (Widern WD)		3.0	–	–	–	–	–
Total		**36.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr) AG	CVP Water Service Contracts (TAF/yr) M&I	Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
Westlands WD: CA Joint Reach 4	CA reach 4	219.0	–	–	–	–	–
Westlands WD: CA Joint Reach 5	CA reach 5	570.0	–	–	–	–	–
Westlands WD: CA Joint Reach 6	CA reach 6	219.0	–	–	–	–	–
Westlands WD: CA Joint Reach 7	CA reach 7	142.0	–	–	–	–	–
Total		**1150.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Avenal, City of	CA reach 7	–	3.5	–	3.5	–	–
Coalinga, City of		–	10.0	–	–	–	–
Huron, City of		–	3.0	–	–	–	–
Total		**0.0**	**16.5**	**0.0**	**3.5**	**0.0**	**0.0**
CA Joint Reach 3 – Loss	CVP Dos Amigos PP/CA reach 3	–	–	–	–	–	2.5
CA Joint Reach 4 – Loss	CA reach 4	–	–	–	–	–	10.1
CA Joint Reach 5 – Loss	CA reach 5	–	–	–	–	–	30.1
CA Joint Reach 6 – Loss	CA reach 6	–	–	–	–	–	12.5
CA Joint Reach 7 – Loss	CA reach 7	–	–	–	–	–	8.5
Total		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**63.7**
Cross Valley Canal – CVP	CA reach 14	–	–	–	–	–	–
Fresno, County of		3.0	–	–	–	–	–
Hills Valley ID-Amendatory		3.3	–	–	–	–	–
Kern-Tulare WD		40.0	–	–	–	–	–
Lower Tule River ID		31.1	–	–	–	–	–

CVP Contractor	Geographic Location	CVP Water Service Contracts (TAF/yr)		Settlement/ Exchange Contractor (TAF/yr)	Water Rights/ Non-CVP (TAF/yr)	Level 2 Refuges* (TAF/yr)	Losses (TAF/yr)
		AG	M&I				
Pixley ID		31.1	–	–	–	–	–
Rag Gulch WD		13.3	–	–	–	–	–
Tri-Valley WD		1.1	–	–	–	–	–
Tulare, County of		5.3	–	–	–	–	–
Kern NWR		–	–	–	–	11.0	–
Pixley NWR		–	–	–	–	1.3	–
Total		**128.3**	**0.0**	**0.0**	**0.0**	**12.3**	**0.0**
Total CVP South-of-Delta		**1,937.1**	**164.2**	**840.0**	**44.3**	**281.0**	**183.7**

1 Notes:
2 *Level 4 Refuge water supplies are not included.

1 **Table 5A.B.26 SWP North-of-the-Delta – Future Conditions**

SWP CONTRACTOR	Geographic Location	FRSA Amount (TAF)	Water Right (TAF/yr)	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Other (TAF/yr)
				Ag	M&I		
Feather River							
Palermo	FRSA	–	17.6	–	–	–	–
County of Butte	Feather River	–	–	–	27.5	–	–
Thermalito	FRSA	–	8.0	–	–	–	–
Western Canal	FRSA	150.0	145.0	–	–	–	–
Joint Board	FRSA	550.0	5.0	–	–	–	–
City of Yuba City	Feather River	–	–	–	9.6	–	–
Feather WD	FRSA	17.0	–	–	–	–	–
Garden, Oswald, Joint Board	FRSA	–	–	–	–	–	–
Garden	FRSA	12.9	5.1	–	–	–	–
Oswald	FRSA	2.9	–	–	–	–	–
Joint Board	FRSA	50.0	–	–	–	–	–
Plumas, Tudor	FRSA	–	–	–	–	–	–
Plumas	FRSA	8.0	6.0	–	–	–	–
Tudor	FRSA	5.1	0.2	–	–	–	–
Total Feather River Area		**795.8**	**186.9**	**0.0**	**37.1**	–	–

SWP CONTRACTOR	Geographic Location	FRSA Amount (TAF)	Water Right (TAF/yr)	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Other (TAF/yr)
				Ag	M&I		
Other							
Yuba County Water Agency	Yuba River	–	–	–	–	–	Variable
		–	–	–	–	–	333.6
Camp Far West ID	Yuba River	–	–	–	–	–	12.6
Bear River Exports	American R/DSA70	–	–	–	–	–	Variable
		–	–	–	–	–	95.2
Feather River Exports to American River (left bank to DSA70)	American R/DSA70	–	11.0	–	–	–	–

1 **Table 5A.B.27 SWP South-of-the-Delta –Future Conditions**

SWP Contractor	Geographic Location	Table A Amount (TAF) Ag	Table A Amount (TAF) M&I	Article 21 Demand (TAF/mon)	Losses (TAF/yr)
Alameda Co. FC&WCD, Zone 7	SBA reaches 1-4	–	47.60	1.00	–
	SBA reaches 5-6	–	33.02	None	–
	Total	–	**80.62**	**1.00**	–
Alameda County WD	SBA reaches 7-8	–	42.00	1.00	–
Santa Clara Valley WD	SBA reach 9	–	100.00	4.00	–
Oak Flat WD	CA reach 2A	5.70	–	None	–
County of Kings	CA reach 8C	9.31	–	None	–
Dudley Ridge WD	CA reach 8D	50.34	–	1.00	–
Empire West Side ID	CA reach 8C	2.00	–	1.00	–
Kern County Water Agency	CA reaches 3, 9-13B	608.86	134.60	None	–
	CA reaches 14A-C	99.20	–	180.00	–
	CA reaches 15A-16A	59.40	–	None	–
	CA reach 31A	80.67	–	None	–
	Total	**848.13**	**134.60**	**180.00**	–
Tulare Lake Basin WSD	CA reaches 8C-8D	88.92	–	15.00	–
San Luis Obispo Co. FC&WCD	CA reaches 33A-35	–	25.00	None	–
Santa Barbara Co. FC&WCD	CA reach 35	–	45.49	None	–
Antelope Valley-East Kern WA	CA reaches 19-20B, 22A-B	–	141.40	1.00	–
Castaic Lake WA	CA reach 31A	12.70	–	1.00	–
	CA reach 30	–	82.50	None	–
	Total	**12.70**	**82.50**	**1.00**	–
Coachella Valley WD	CA reach 26A	–	138.35	2.00	–

SWP Contractor	Geographic Location	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Losses (TAF/yr)
		Ag	M&I		
Crestline-Lake Arrowhead WA	CA reach 24	–	5.80	None	–
Desert WA	CA reach 26A	–	55.75	5.00	–
Littlerock Creek ID	CA reach 21	–	2.30	None	–
Mojave WA	CA reaches 19, 22B-23	–	82.80	None	–
Metropolitan WDSC	CA reach 26A	–	148.67	90.70	–
	CA reach 30	–	756.69	74.80	–
	CA reaches 28G-H	–	102.71	27.60	–
	CA reach 28J	–	903.43	6.90	–
	Total	–	**1911.50**	**200.00**	–
Palmdale WD	CA reaches 20A-B	–	21.30	None	–
San Bernardino Valley MWD	CA reach 26A	–	102.60	None	–
San Gabriel Valley MWD	CA reach 26A	–	28.80	None	–
San Gorgonio Pass WA	CA reach 26A	–	17.30	None	–
Ventura County FCD	CA reach 29H	–	3.15	None	–
	CA reach 30	–	16.85	None	–
	Total	–	**20.00**	–	–

SWP Contractor	Geographic Location	Table A Amount (TAF)		Article 21 Demand (TAF/mon)	Losses (TAF/yr)
		Ag	M&I		
SWP Losses	CA reaches 1-2	–	–	–	7.70
	SBA reaches 1-9	–	–	–	0.60
	CA reach 3	–	–	–	10.80
	CA reach 4	–	–	–	2.60
	CA reach 5	–	–	–	3.90
	CA reach 6	–	–	–	1.20
	CA reach 7	–	–	–	1.60
	CA reaches 8C-13B	–	–	–	11.90
	Wheeler Ridge Pumping Plant and CA reaches 14A-C	–	–	–	3.60
	Chrisman Pumping Plant and CA reaches 15A-18A	–	–	–	1.80
	Pearblossom Pumping Plant and CA reaches 17-21	–	–	–	5.10
	Mojave Pumping Plant and CA reaches 22A-23	–	–	–	4.00
	REC and CA reaches 24-28J	–	–	–	1.40
	CA reaches 29A-29F	–	–	–	1.90
	Castaic PWP and CA reach 29H	–	–	–	3.10
	REC and CA reach 30	–	–	–	2.40
	Total	–	–	–	**63.60**
Total		**1,017.10**	**3,038.11**	**412.00**	**63.60**

Table 5A.B.28 Meeting Participants

Aaron Miller/DWR Steve Ford/DWR Randi Field/Reclamation Gene Lee/Reclamation Lenny Grimaldo/Reclamation	Derek Hilts/USFWS Steve Detwiler/USFWS Matt Nobriga/CDFW Jim White/CDFW Craig Anderson/NMFS
Parviz Nader-Tehrani/DWR Erik Reyes/DWR Sean Sou/DWR	Robert Leaf/CH2M HILL Derya Sumer/CH2M HILL

The simulated OMR flow conditions and CVP and SWP Delta export operations, resulting from these assumptions, are believed to be a reasonable representation of conditions expected to prevail under the RPAs over large spans of years (refer to CalSim II modeling results for more details on simulated operations). Actual OMR flow conditions and Delta export operations will differ from simulated operations for numerous reasons, including having near real-time knowledge and/or estimates of turbidity, temperature, and fish spatial distribution that are unavailable for use in CalSim II over a long period of record. Because these factors and others are believed to be critical for smelt entrainment risk management, the USFWS adopted an adaptive process in defining the RPAs. Given the relatively generalized representation of the RPAs, assumed for CalSim II modeling, much caution is required when interpreting outputs from the model.

5A.B8.1.1 Action 1: Adult Delta Smelt Migration and Entrainment (RPA Component 1, Action 1 – First Flush)

5A.B8.1.1.1 Action 1 Summary:

Objective: A fixed duration action to protect pre-spawning adult Delta Smelt from entrainment during the first flush, and to provide advantageous hydrodynamic conditions early in the migration period.

Action: Limit exports so that the average daily combined OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than -2,500 cfs (within 25 percent).

Timing:

Part A: December 1 to December 20 – The Smelt Working Group (SWG) may recommend a start date to the USFWS based upon an examination of turbidity data from Prisoner's Point, Holland Cut, Victoria Canal and salvage data from CVP and SWP (see below), and other parameters important to the protection of Delta Smelt including (but not limited to) preceding conditions of X2, the Fall Midwater Trawl Survey (FMWT), and river flows. The USFWS will make the final determination.

Part B: After December 20 – The action will begin if the 3-day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 nephelometric turbidity units (NTU). However the SWG can recommend a delayed start or interruption based on other conditions such as Delta inflow that may affect vulnerability to entrainment.

Triggers (Part B):

Turbidity: Three-day average of 12 NTU or greater at all three turbidity stations (Prisoner's Point, Holland Cut, and Victoria Canal)

OR

Salvage: Three days of Delta Smelt salvage after December 20 at either facility or cumulative daily salvage count that is above a risk threshold based upon the daily salvage index approach reflected in a daily salvage index value greater than or equal to 0.5 (daily Delta Smelt salvage greater than one-half of the prior year FMWT index value).

The window for triggering Action 1 concludes when either off-ramp condition described below is met. These off-ramp conditions may occur without Action 1 ever being triggered. If this occurs, then Action 3 is triggered, unless the USFWS concludes on the basis of the totality of available information that Action 2 should be implemented instead.

Off-ramps:

Temperature: Water temperature reaches 12 degrees Celsius (°C) based on a three station daily mean at the temperature stations Mossdale, Antioch, and Rio Vista

OR

Biological: Onset of spawning (presence of spent females in the Spring Kodiak Trawl Survey [SKT] or at Banks or Jones).

5A.B8.1.1.2 Action 1 Assumptions for CalSim II Modeling Purposes:

An approach was selected based on hydrologic and assumed turbidity conditions. Under this general assumption, Part A of the action was never assumed because, on the basis of historical salvage data, it was considered unlikely or rarely to occur. Part B of the action was assumed to occur if triggered by turbidity conditions. This approach was believed to tend to a more conservative interpretation of the frequency, timing, and extent of this action. The assumptions used for modeling are as follows:

Action: Limit exports so that the average daily OMR flow is no more negative than -2,000 cfs for a total duration of 14 days, with a 5-day running average no more negative than 2,500 cfs (within 25 percent of the monthly criteria).

Timing: If turbidity-trigger conditions first occur in December, then the action starts on December 21; if turbidity-trigger conditions first occur in January, then the action starts on January 1; if turbidity-trigger conditions first occur in February, then the action starts on February 1; and if turbidity-trigger conditions first occur in March, then the action starts on March 1. It is assumed that once the action is triggered, it continues for 14 days.

Triggers: Only an assumed turbidity trigger that is based on hydrologic outputs was considered. A surrogate salvage trigger or indicator was not included because there was no way to model it.

Turbidity: If the monthly average unimpaired Sacramento River Index (four-river index: sum of Sacramento, Yuba, Feather, and American Rivers) exceeds 20,000 cfs, then it is assumed that an event, in which the 3-day average turbidity at Hood exceeds 12 NTU, has occurred within the month. It is assumed that an event at Sacramento River is a reasonable indicator of this condition occurring, within the month, at all three turbidity stations: Prisoner's Point, Holland Cut, and Victoria Canal.

A chart showing the relationship between turbidity at Hood (number of days with turbidity is greater than 12 NTU) and Sacramento River Index (sum of monthly flow at four stations on the Sacramento, Feather, Yuba and American Rivers, from 2003 to 2006) is shown on Figure 5A.B.1. For months when average Sacramento River Index is between 20,000 cfs and 25,000 cfs, a transition is observed in number of days with Hood turbidity greater than 12 NTU. For months when average Sacramento River Index is above 25,000 cfs, Hood turbidity was always greater than 12 NTU for as many as 5 days or more within the month in which the flow occurred. For a conservative approach, 20,000 cfs is used as the threshold value.

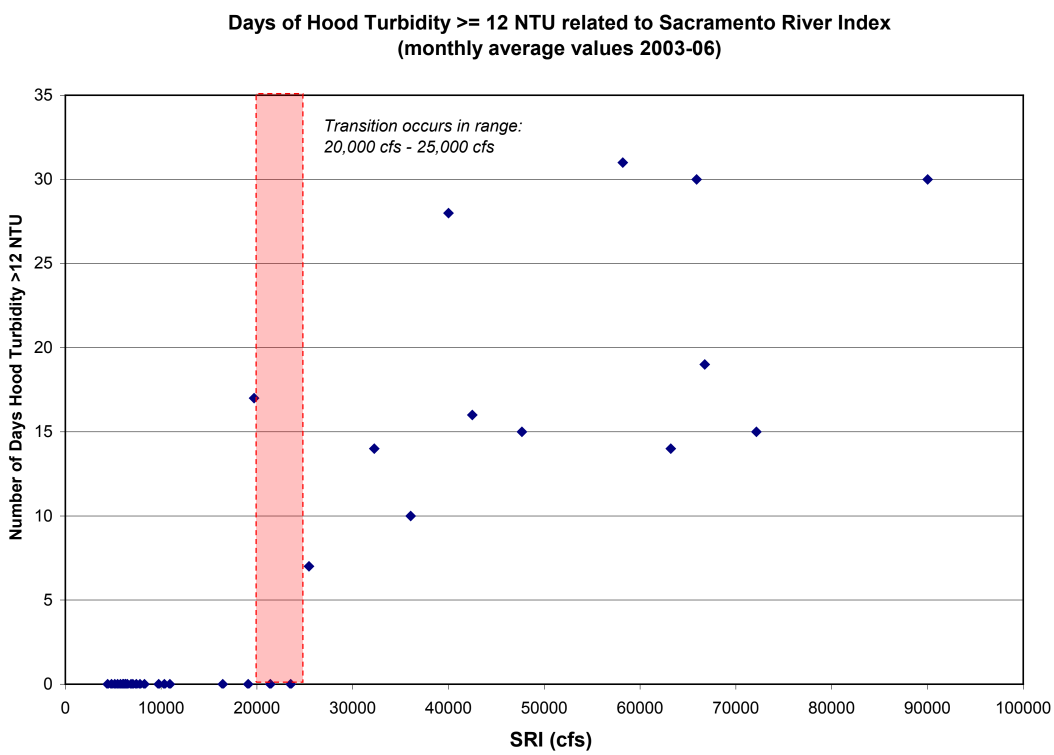

Figure 5A.B.1 Relationship between Turbidity at Hood and Sacramento River Index

Salvage: It is assumed that salvage would occur when first flush occurs.

Off-ramps: Only temperature-based off-ramping is considered. A surrogate biological off-ramp indicator was not included.

<u>Temperature:</u> Because the water temperature data at the three temperature stations (Antioch, Mossdale, and Rio Vista) are only available for years after 1984, another parameter was sought for use as an alternative indicator. It is observed that monthly average air temperature at Sacramento Executive Airport generally trends with the three-station average water temperature (see Figure 5A.B.2). Using this alternative indicator, monthly average air temperature is assumed to occur in the middle of the month, and values are interpolated on a daily basis to obtain daily average water temperature. Using the correlation between air and water temperature, estimated daily water temperatures are estimated from the 82-year monthly average air temperature. Dates when the three-station average temperature reaches 12°C are recorded and used as input in CalSim II. A 1:1 correlation was used for simplicity instead of using the trend line equation illustrated on Figure 5A.B.2.

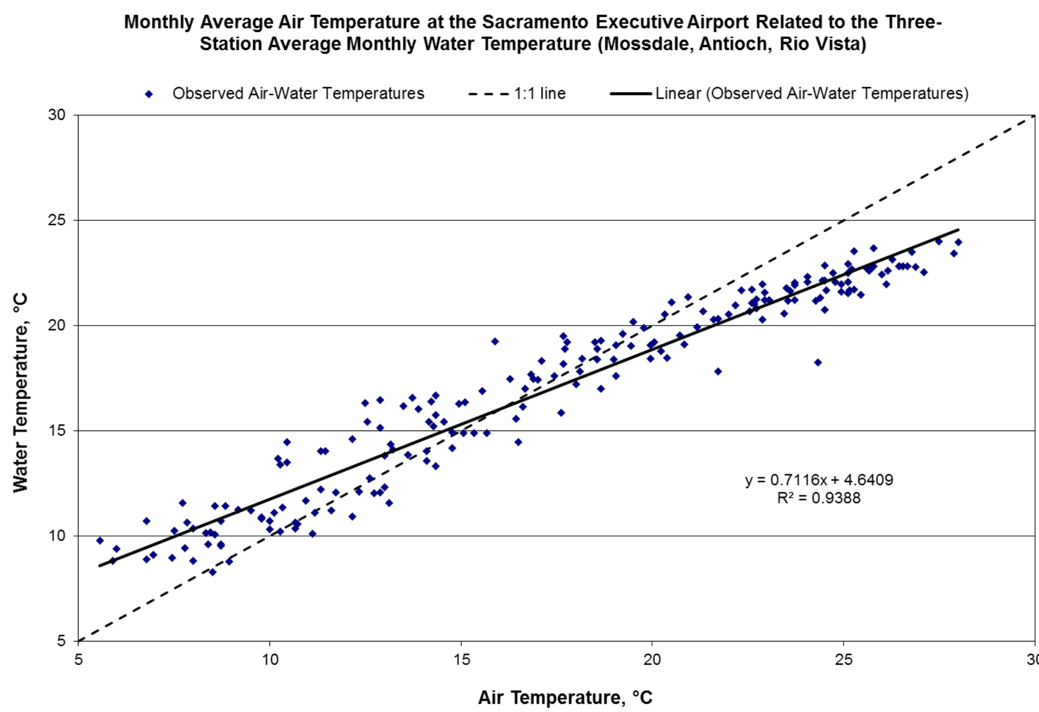

Figure 5A.B.2 Relationship between Monthly Average Air Temperature at the Sacramento Executive Airport and the Three-station Average Monthly Water Temperature

Other Modeling Considerations: For monthly analysis for the month of December (in which Action 1 does not begin until December 21), a background OMR flow must be assumed for the purpose of calculating a day-weighted average for implementing a partial-month action condition. When necessary, the background OMR flow for December was assumed to be -8,000 cfs.

For the additional condition to meet a 5-day running average no more negative than 2,500 cfs (within 25 percent), Paul Hutton's equation is used. Hutton concluded that with stringent OMR standards (1,250 to 2,500 cfs), the 5-day average would control more frequently than the 14-day average, but it is less likely to control at higher flows. Therefore, the CalSim II implementation includes both a 14-day (approximately monthly average) and a 5-day average flow criteria based on Hutton's methodology.

Rationale: The following is an overall summary of the rationale for the preceding interpretation of RPA Action 1.

December 1 to December 20 for initiating Action 1 is not considered because seasonal peaks of Delta Smelt salvage are rare prior to December 20. Adult Delta Smelt spawning migrations often begin following large precipitation events that happen after mid-December.

Salvage of adult Delta Smelt often corresponds with increases in turbidity and exports. On the basis of the above discussion and Figure 5A.B.2, Sacramento River Index greater than 25,000 cfs is assumed to be an indicator of turbidity trigger being reached at all three turbidity stations: Prisoner's Point, Holland Cut, and Victoria Canal. Most sediment enters the Delta from the Sacramento River during flow pulses; therefore, a flow indicator based on only Sacramento River flow is used.

The 12°C threshold for the off-ramp criterion is a conservative estimate of when Delta Smelt larvae begin successfully hatching. Once hatched, the larvae move into the water column where they are potentially vulnerable to entrainment.

Results: Using these assumptions, in a typical CalSim II 82-year simulation (1922 through 2003 hydrologic conditions), Action 1 will occur 29 times in the December 21 to January 3 period, 14 times in the January 1 to January 14 period, 13 times in the February 1 to February 14 period, and 17 times in the March 1 to March 14 period. In three of these 17 occurrences (1934, 1991, and 2001), Action 3 is triggered before Action 1 and therefore Action 1 is bypassed. Action 1 is not triggered in nine of the 82 years (1924, 1929, 1931, 1955, 1964, 1976, 1977, 1985, and 1994), typically critically dry years. Refer to CalSim II modeling results for more details on simulated operations of OMR, Delta exports, and other parameters of interest.

5A.B8.1.2 Action 2: Adult Delta Smelt Migration and Entrainment (RPA Component 1, Action 2)

5A.B8.1.2.1 Action 2 Summary:

Objective: An action implemented using an adaptive process to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions.

Action: The range of net daily OMR flows will be no more negative than -1,250 to -5,000 cfs. Depending on extant conditions (and the general guidelines below), specific OMR flows within this range are recommended by the SWG from the onset of Action 2 through its termination (see Adaptive Process description in the BO). The SWG would provide weekly recommendations based upon review of the sampling data, from real-time salvage data at the CVP and SWP, and utilizing most up-to-date technological expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS will make the final determination.

Timing: Beginning immediately after Action 1. Before this date (in time for operators to implement the flow requirement) the SWG will recommend specific requirement OMR flows based on salvage and on physical and biological data on an ongoing basis. If Action 1 is not implemented, the SWG may recommend a start date for the implementation of Action 2 to protect adult Delta Smelt.

Suspension of Action:

Flow: OMR flow requirements do not apply whenever a 3-day flow average is greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and 10,000 cfs in San Joaquin River at Vernalis. Once such flows have abated, the OMR flow requirements of the Action are again in place.

Off-ramps:

Temperature: Water temperature reaches 12°C based on a three-station daily average at the temperature stations: Rio Vista, Antioch, and Mossdale.

OR

Biological: Onset of spawning (presence of a spent female in SKT or at either facility).

5A.B8.1.2.2 Action 2 Assumptions for CalSim II Modeling Purposes:

An approach was selected based on the occurrence of Action 1 and X2 salinity conditions. This approach selects from between two OMR flow tiers depending on the previous month's X2 position, and is never more constraining than an OMR criterion of -3,500 cfs. The assumptions used for modeling are as follows:

Action: Limit exports so that the average daily OMR flow is no more negative than -3,500 or -5,000 cfs depending on the previous month's ending X2 location (-3,500 cfs if X2 is east of Roe Island, or -5,000 cfs if X2 is west of Roe Island), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -4,375 cfs if X2 is east of Roe Island, or -6,250 cfs if X2 is west of Roe Island).

Timing: Begins immediately after Action 1 and continues until initiation of Action 3.

In a typical CalSim II 82-year simulation, Action 1 was not triggered in nine of the 82 years. In these conditions it is assumed that OMR flow should be maintained no more negative than -5,000 cfs.

Suspension of Action: A flow peaking analysis, developed by Paul Hutton (2009), is used to determine the likelihood of a 3-day flow average greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and a 3-day flow average greater than or equal to 10,000 cfs in San Joaquin River at Vernalis occurring within the month. It is assumed that when the likelihood of these conditions occurring exceeds 50 percent, Action 2 is suspended for the full month, and OMR flow requirements do not apply. The likelihood of these conditions occurring is evaluated each month, and Action 2 is suspended for 1 month at a time whenever both of these conditions occur.

The equations for likelihood (frequency of occurrence) are as follows:

- Frequency of Rio Vista 3-day flow average > 90,000 cfs:
  - 0 percent when Freeport monthly flow < 50,000 cfs, OR
  - (0.00289 × Freeport monthly flow – 146) percent when 50,000 cfs ≤ Freeport plus Yolo Bypass monthly flow ≤ 85,000 cfs, OR
  - 100 percent when Freeport monthly flow >85,000 cfs
- Frequency of Vernalis 3-day flow average > 10,000 cfs:
  - 0 percent when Vernalis monthly flow < 6,000 cfs, OR
  - (0.00901 × Vernalis monthly flow – 49) percent when 6,000 cfs ≤ Vernalis monthly flow ≤ 16,000 cfs, OR
  - 100 percent when Vernalis monthly flow >16,000 cfs

The frequency of the Rio Vista 3-day flow average > 90,000 cfs equals 50 percent when Freeport plus Yolo Bypass monthly flow is 67,820 cfs and the frequency of Vernalis 3-day flow average > 10,000 cfs equals 50 percent Vernalis monthly flow is 10,988 cfs. Therefore these two flow values are used as thresholds in the model.

Off-ramps: Only temperature-based off-ramping is considered. A surrogate biological off-ramp indicator was not included.

<u>Temperature:</u> Because the water temperature data at the three temperature stations (Antioch, Mossdale, and Rio Vista) are only available for years after 1984, another parameter was sought for use as an alternative indicator. It is observed that monthly average air temperature at Sacramento Executive Airport generally trends with the three-station average water temperature (Figure 5A.B.2). Using this alternative indicator, monthly average air temperature is assumed to occur in the middle of the month, and values are interpolated on a daily basis to obtain daily average water temperature. Using the correlation between air and water temperature, daily water temperatures are estimated from the 82-year monthly average air temperature. Dates when the three-station average temperature reaches 12°C are recorded and used as input in CalSim II. A 1:1 correlation was used for simplicity instead of using the trend line equation illustrated on Figure 5A.B.2.

Rationale: The following is an overall summary of the rationale for the preceding interpretation of RPA Action 2.

Action 2 requirements are based on X2 location that is dependent on the Delta outflow. If outflows are very high, fewer Delta Smelt will spawn east of Sherman Lake; therefore, the need for OMR restrictions is lessened.

In the case of Action 1 not being triggered, CDFW suggested OMR > -5,000 cfs, following the actual implementation of the BO in winter 2009 because some adult Delta Smelt might move into the Central Delta without a turbidity event.

Action 2 is suspended when the likelihood of a 3-day flow average greater than or equal to 90,000 cfs in Sacramento River at Rio Vista and a 3-day flow average greater than or equal to 10,000 cfs in San Joaquin River at Vernalis occurring concurrently within the month exceeds 50 percent, because at extreme high flows the majority of adult Delta Smelt will be distributed downstream of the Delta and entrainment concerns will be very low.

The 12°C threshold for the off-ramp criterion is a conservative estimate of when Delta Smelt larvae begin successfully hatching. Once hatched, the larvae move into the water column where they are potentially vulnerable to entrainment.

Results: Using these assumptions, in a typical CalSim II 82-year simulation (1922 through 2003 hydrologic conditions), Action 1, and therefore Action 2, does not occur in 12 of the 82 years (1924, 1929, 1931, 1934, 1955, 1964, 1976, 1977, 1985, 1991, 1994, and 2001), typically critically dry years. The criteria for suspension of OMR minimum flow requirements, described above, results in potential suspension of Action 2 (if Action 2 is active) six times in January, 11 times in February, six times in March (however, Action 2 was not active three of these six times), and two times in April. The result is that Action 2 is in effect 37 times in January (with OMR at -3,500 cfs 29 times, and at -5,000 cfs 8 times), 43 times in February (with OMR at -3,500 cfs 25 times, and at -5,000 cfs 18 times), 31 times in March (with OMR at -3,500 cfs 14 times, and at -5,000 cfs 17 times), and 80 times in April (with OMR at -3,500 cfs 46 times, and at -5,000 cfs 34 times). The frequency each month is a cumulative result of the action being triggered in the current or prior months. Refer to CalSim II modeling results for more details on simulated operations of OMR, Delta exports, and other parameters of interest.

5A.B8.1.3 Action 3: Entrainment Protection of Larval and Juvenile Delta Smelt (RPA Component 2)

5A.B8.1.3.1 Action 3 Summary:

Objective: Minimize the number of larval Delta Smelt entrained at the facilities by managing the hydrodynamics in the Central Delta flow levels pumping rates spanning a time sufficient for protection of larval Delta Smelt, e.g., by using a VAMP-like action. Because protective OMR flow requirements vary over time (especially between years), the action is adaptive and flexible within appropriate constraints.

Action: Net daily OMR flow will be no more negative than -1,250 to -5,000 cfs based on a 14-day running average with a simultaneous 5-day running average within 25 percent of the applicable requirement for OMR. Depending on extant conditions (and the general guidelines below), specific OMR flows within this range are recommended by the SWG from the onset of Action 3 through its termination (see Adaptive Process in Introduction). The SWG would provide these recommendations based upon weekly review of sampling data, from real-time salvage data at the CVP and SWP, and expertise and knowledge relating population status and predicted distribution to monitored physical variables of flow and turbidity. The USFWS will make the final determination.

Timing: Initiate the action after reaching the triggers below, which are indicative of spawning activity and the probable presence of larval Delta Smelt in the South and Central Delta. Based upon daily salvage data, the SWG may recommend an earlier start to Action 3. The USFWS will make the final determination.

Triggers:

Temperature: When temperature reaches 12°C based on a three-station average at the temperature stations: Mossdale, Antioch, and Rio Vista.

OR

Biological: Onset of spawning (presence of spent females in SKT or at either facility).

Off-ramps:

Temporal: June 30;

OR

Temperature: Water temperature reaches a daily average of 25°C for three consecutive days at Clifton Court Forebay.

5A.B8.1.4 Action 3 Assumptions for CalSim II Modeling Purposes:

An approach was selected based on assumed temperature and X2 salinity conditions. This approach selects from among three OMR flow tiers depending on the previous month's X2 position and ranges from an OMR criteria of -1,250 to -5,000 cfs. Because of the potential low export conditions that could occur at an OMR criterion of -1,250 cfs, a criterion for minimum exports for health and safety is also assumed. The assumptions used for modeling are as follows:

Action: Limit exports so that the average daily OMR flow is no more negative than -1,250, -3,500, or -5,000 cfs, depending on the previous month's ending X2 location (-1,250 cfs if X2 is east of Chipps Island, -5,000 cfs if X2 is west of Roe Island, or -3,500 cfs if X2 is between Chipps and Roe Island, inclusively), with a 5-day running average within 25 percent of the monthly criteria (no more negative than -1,562 cfs if X2 is east of Chipps Island, -6,250 cfs if X2 is west of Roe Island, or -4,375 cfs if X2 is between Chipps and Roe Island). The more constraining of this OMR requirement or the VAMP requirement will be selected during the VAMP period (April 15 to May 15). Additionally, in the case of the month of June, the OMR criterion from May is maintained through June (it is assumed that June OMR should not be more constraining than May).

Timing: Begins immediately upon temperature trigger conditions and continues until off-ramp conditions are met.

Triggers: Only temperature trigger conditions are considered. A surrogate biological trigger was included.

<u>Temperature:</u> Because the water temperature data at the three temperature stations (Antioch, Mossdale, and Rio Vista) are only available for years after 1984, another parameter was sought to be used as an alternative indicator. It is observed that monthly average air temperature at Sacramento Executive Airport generally trends with the three-station average water temperature (Figure 5A.B.2). Using this alternative indicator, monthly average air temperature is assumed to occur in the middle of the month, and values are interpolated on a daily basis to obtain daily average water temperature. Using the correlation between air and water temperature, estimated daily water temperatures are estimated from the 82-year monthly average air temperature. Dates when the three-station average temperature reaches 12°C are recorded and used as input in CalSim II. A 1:1 correlation was used for simplicity instead of using the trend line equation illustrated on Figure 5A.B.2.

<u>Biological:</u> Onset of spawning is assumed to occur no later than May 30.

Clarification Note: This text previously read "Onset of spawning is assumed to occur no later than April 30", where the CalSim II lookup table has May 30 as the date. Based on RPA team discussions in August 2009, it was agreed upon that onset of spawning could not be modeled in CalSim II. This trigger was actually coded as a placeholder in case in the future this trigger was to be used; the date was selected purposefully in a way that it wouldn't affect modeling results. Temperature trigger for Action 3 does occur before end of April. Therefore it does not matter whether the document is corrected to read May 30 or the model lookup table is changed to April 30.

Off-ramps:

<u>Temporal</u>: It is assumed that the ending date of the action would be no later than June 30.

OR

<u>Temperature:</u> Only 17 years of data are available for Clifton Court water temperature. A similar approach as used in the temperature trigger was considered. However, because 3 consecutive days of water temperature greater than or equal to 25°C is required, a correlation between air temperature and water temperature did not work well for this off-ramp criterion. Out of the 17 recorded years, in 1 year the criterion was triggered in May (May 31), and in 3 years it was triggered in June (June 3, 21, and 27). In all other years it was observed in July or later. With only four data points before July, it was not possible to generate a rule based on statistics. Therefore, temporal off-ramp criterion (June 30) is used for all years.

Health and Safety: In CalSim II, a minimum monthly Delta export criterion of 300 cfs for SWP and 600 cfs (or 800 cfs depending on Shasta storage) for CVP is assumed. This assumption is suitable for dry-year conditions when allocations are low and storage releases are limited; however, minimum monthly exports need to be made for protection of public health and safety (health and safety deliveries upstream of San Luis Reservoir).

In consideration of the severe export restrictions associated with the OMR criteria established in the RPAs, an additional set of health and safety criterion is assumed. These export restrictions could lead to a situation in which supplies are available and allocated; however, exports are curtailed forcing San Luis to have an accelerated drawdown rate. For dam safety at San Luis Reservoir, 2 feet per day is the maximum acceptable drawdown rate. Drawdown occurs faster in summer months and peaks in June when the agricultural demands increase. To avoid rapid drawdown in San Luis Reservoir, a relaxation of OMR is allowed so that exports can be maintained at 1,500 cfs in all months if needed.

This modeling approach may not fit the real-life circumstances. In summer months, especially in June, the assumed 1,500 cfs for health and safety may not be sufficient to keep San Luis drawdown below a safe 2 feet per day; under such circumstances the projects would be required to increase pumping in order to maintain dam safety.

Rationale: The following is an overall summary of the rationale for the preceding interpretation of RPA Action 3.

The geographic distribution of larval and juvenile Delta Smelt is tightly linked to X2 (or Delta outflow). Therefore, the percentage of the population likely to be found east of Sherman Lake is also influenced by the location of X2. The X2-based OMR criteria were intended to model an expected management response to the general increase in Delta Smelt's risk of entrainment as a function of increasing X2.

The 12°C threshold for the trigger criterion is a conservative estimate of when Delta Smelt larvae begin successfully hatching. Once hatched, the larvae move into the water column where they are potentially vulnerable to entrainment.

The annual salvage season for Delta Smelt typically ends as South Delta water temperatures warm to lethal levels during summer. This usually occurs in late June or early July. The laboratory-derived upper lethal temperature for Delta Smelt is 25.4°C.

Results: Action 3 occurs 30 times in February (with OMR at -1,250 cfs 9 times, at -3,500 cfs 11 times, and at -5,000 cfs 10 times), 76 times in March (with OMR at -1,250 cfs 15 times, at -3,500 cfs 27 times, and at -5,000 cfs 34 times), all times (82) in April (with OMR at -1,250 cfs 17 times, at -3,500 cfs 29 times, and at -5,000 cfs 35 times), all times (82) in May (with OMR at -1,250 cfs 19 times, at -3,500 cfs 37 times, and at -5,000 cfs 26 times), and 70 times in June (with OMR at -1,250 cfs 7 times, at -3,500 cfs 37 times, and at -5,000 cfs 26 times). Refer to CalSim II modeling results for more details on simulated operations of OMR, Delta exports and other parameters of interest. (Note: The above information is based on the August 2009 version of the model and documents the development process; more recent versions of the model may have different results.)

5A.B8.1.5 Action 4: Estuarine Habitat During Fall (RPA Component 3)

5A.B8.1.5.1 Action 4 Summary:

Objective: Improve fall habitat for Delta Smelt by managing of X2 through increasing Delta outflow during fall when the preceding water year was wetter than normal. This will help return ecological conditions of the estuary to that which occurred in the late 1990s when smelt populations were much larger. Flows provided by this action are expected to provide direct and indirect benefits to Delta Smelt. Both the direct and indirect benefits to Delta Smelt are considered equally important to minimize adverse effects.

Action: Subject to adaptive management as described below, provide sufficient Delta outflow to maintain average X2 for September and October no greater (more eastward) than 74 kilometers in the fall following Wet years and 81 kilometers in the fall following Above Normal years. The monthly average X2 position is to be maintained at or seaward of these location for each individual month and not averaged over the 2-month period. In November, the inflow to CVP and SWP reservoirs in the Sacramento Basin will be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up to the fall X2 target. The action will be evaluated and may be modified or terminated as determined by the USFWS.

Timing: September 1 to November 30.

Triggers: Wet and Above Normal water-year type classification from the 1995 Water Quality Control Plan that is used to implement D-1641.

5A.B8.1.5.2 Action 4 Assumptions for CalSim II Modeling Purposes:

Model is modified to increase Delta outflow to meet monthly average X2 requirements for September and October and subsequent November reservoir release actions in Wet and Above Normal years. No off-ramps are considered for reservoir release capacity constraints. Delta exports may or may not be reduced as part of reservoir operations to meet this action. The action is summarized in Table 5A.B.29.

Table 5A.B.29 Summary of Action 4 implementation in CalSim II

Fall Months following Wet or Above Normal Years	Action Implementation
September	Meet monthly average X2 requirement (74 km in Wet years, 81 km in Above Normal years)
October	Meet monthly average X2 requirement (74 km in Wet years, 81 km in Above Normal years)
November	Add reservoir releases up to natural inflow as needed to continue to meet monthly average X2 requirement (74 km in Wet years, 81 km in Above Normal years)

Rationale: Action 4 requirements are based on determining X2 location. Adjustment and retraining of the ANN was also completed to address numerical sensitivity concerns.

Results: There are 38 September and 37 October months that the action is triggered over the 82-year simulation period.

5A.B8.1.6 Action 5: Temporary Spring Head of Old River Barrier and the Temporary Barrier Project (RPA Component 2)

5A.B8.1.6.1 Action 5 Summary:

Objective: To minimize entrainment of larval and juvenile Delta Smelt at Banks and Jones or from being transported into the South and Central Delta, where they could later become entrained.

Action: Do not install the spring HORB if Delta Smelt entrainment is a concern. If installation of the HORB is not allowed, the agricultural barriers would be installed as described in the project description. If installation of the HORB is allowed, the Temporary Barrier Project (TBP) flap gates would be tied in the open position until May 15.

Timing: The timing of the action would vary depending on the conditions. The normal installation of the spring temporary HORB and the TBP is in April.

Triggers: For Delta Smelt, installation of the HORB will only occur when particle tracking modeling results show that entrainment levels of Delta Smelt will not increase beyond 1 percent at Station 815 as a result of installing the HORB.

Off-ramps: If Action 3 ends or May 15, whichever comes first.

5A.B8.1.6.2 Action 5 Assumptions for CalSim II and DSM2 Modeling Purposes:

The South Delta Improvement Program Stage 1 is not included in the Existing and Future Condition assumptions being used for CalSim II and DSM2 baselines. The TBP is assumed instead. The TBP specifies that HORB be installed and operated during April 1 through May 31 and September 16 through November 30. In response to the USFWS BO, Action 5, the HORB is assumed to not be installed during April 1 through May 31.

5A.B9 NMFS RPA Implementation

The information included in this section is consistent with what was provided to and agreed by the lead agencies in the, "Representation of U.S. Fish and Wildlife Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies", on February 10, 2010 (updated May 18, 2010).

5A.B9.1 Representation of National Marine Fisheries Service Biological Opinion Reasonable and Prudent Alternative Actions for CalSim II Planning Studies

The NMFS BO was released on June 4, 2009. To develop CalSim II modeling assumptions to represent the operations related RPA actions required by this BO, DWR led a series of meetings that involved members of fisheries and project agencies. The purpose for establishing this group was to prepare the assumptions and CalSim II implementations to represent the RPAs in both Existing- and Future-Condition CalSim II simulations for future planning studies.

This memorandum summarizes the approach that resulted from these meetings and the modeling assumptions that were laid out by the group. The scope of this memorandum is limited to the June 4, 2009 BO. All descriptive information of the RPAs is taken from the BO.

Table 5A.B.30 lists the participants that contributed to the meetings and information summarized in this document.

Table 5A.B.30 Meeting Participants

Aaron Miller/DWR Randi Field/Reclamation Lenny Grimaldo/Reclamation Henry Wong/Reclamation	Derek Hilts/USFWS Roger Guinee/ USFWS Matt Nobriga/CDFW Bruce Oppenheim/ NMFS
Parviz Nader-Tehrani/ DWR Erik Reyes/ DWR Sean Sou/ DWR Paul A. Marshall/ DWR Ming-Yen Tu/ DWR Xiaochun Wang/ DWR	Robert Leaf/CH2M HILL Derya Sumer/CH2M HILL

The RPA actions in NMFS's BO are based on physical and biological processes that do not lend themselves to simulations using a monthly time step. Much scientific and modeling judgment has been employed to represent the implementation of the RPAs. The group believes the logic put into CalSim II represents the RPAs as best as possible at this time, given the scientific understanding of environmental factors enumerated in the BO and the limited historical data for some of these factors.

Given the relatively generalized representation of the RPAs assumed for CalSim II modeling, much caution is required when interpreting outputs from the model.

5A.B9.1.1 Action Suite 1.1 Clear Creek

Suite Objective: The RPA actions described below were developed based on a careful review of past flow studies, current operations, and future climate change scenarios. These actions are necessary to address adverse project effects on flow and water temperature that reduce the viability of spring-run and Central Valley Steelhead in Clear Creek.

5A.B9.1.1.1 Action 1.1.1 Spring Attraction Flows

Objective: Encourage spring-run movement to upstream Clear Creek habitat for spawning.

Action: Reclamation shall annually conduct at least two pulse flows in Clear Creek in May and June of at least 600 cfs for at least 3 days for each pulse, to attract adult spring-run holding in the Sacramento River main stem.

Action 1.1.1 Assumptions for CalSim II Modeling Purposes

Action: Model is modified to meet 600 cfs for 3 days twice in May. In the CalSim II analysis, flows sufficient to increase flow up to 600 cfs for a total of 6 days are added to the flows that would have otherwise occurred in Clear Creek.

Rationale: CalSim II is a monthly model. The monthly flow in Clear Creek is an underestimate of the actual flows that would occur subject to daily operational constraints at Whiskeytown Reservoir. The additional flow to meet 600 cfs for a total of 6 days was added to the monthly average flow model.

5A.B9.1.1.2 Action 1.1.5 Thermal Stress Reduction

Objective: To reduce thermal stress to over-summering steelhead and spring-run during holding, spawning, and embryo incubation.

Action: Reclamation shall manage Whiskeytown releases to meet a daily water temperature of: (1) 60°F at the Igo gauge from June 1 through September 15 and (2) 56°F at the Igo gauge from September 15 to October 31.

5A.B9.1.1.3 Action 1.1.5 Assumptions for CalSim II Modeling Purposes

Action: It is assumed that temperature operations can perform reasonably well with flows included in model.

Rationale: A temperature model of Whiskeytown Reservoir has been developed by Reclamation. Further analysis using this or other temperature model is required to verify the statement that temperature operations can perform reasonably well with flows included in model.

5A.B9.1.2 Action Suite 1.2 Shasta Operations

Objectives: To address the avoidable and unavoidable adverse effects of Shasta operations on winter-run and spring-run:

- Ensure a sufficient cold water pool to provide suitable temperatures for winter-run spawning between Balls Ferry and Bend Bridge in most years, without sacrificing the potential for cold water management in a subsequent year. Additional actions to those in the 2004 CVP and SWP operations opinion are needed, due to increased vulnerability of the population to temperature effects attributable to changes in Trinity River ROD operations, projected climate change hydrology, and increased water demands in the Sacramento River system.
- Ensure suitable spring-run temperature regimes, especially in September and October. Suitable spring-run temperatures will also partially minimize

temperature effects to naturally spawning, non-listed Sacramento River fall-run, an important prey base for endangered Southern Residents.

- Establish a second population of winter-run in Battle Creek as soon as possible, to partially compensate for unavoidable project-related effects on the one remaining population.
- Restore passage at Shasta Reservoir with experimental reintroductions of winter-run to the upper Sacramento and/or McCloud rivers, to partially compensate for unavoidable project related effects on the remaining population.

5A.B9.1.2.1 Action 1.2.1 Performance Measures

Objective: To establish and operate to a set of performance measures for temperature compliance points and End-of-September (EOS) carryover storage, enabling Reclamation and NMFS to assess the effectiveness of this suite of actions over time. Performance measures will help to ensure that the beneficial variability of the system from changes in hydrology will be measured and maintained.

Action: To ensure a sufficient cold water pool to provide suitable temperatures, long-term performance measures for temperature compliance points and EOS carryover storage at Shasta Reservoir shall be attained. Performance measures for EOS carryover storage at Shasta Reservoir are as follows:

- 87 percent of years: Minimum EOS storage of 2.2 MAF
- 82 percent of years: Minimum EOS storage of 2.2 MAF and end-of-April storage of 3.8 MAF in following year (to maintain potential to meet Balls Ferry compliance point)
- 40 percent of years: Minimum EOS storage 3.2 MAF (to maintain potential to meet Jelly's Ferry compliance point in following year)

Performance measures (measured as a 10-year running average) for temperature compliance points during summer season are:

- Meet Clear Creek Compliance point 95 percent of time
- Meet Balls Ferry Compliance point 85 percent of time
- Meet Jelly's Ferry Compliance point 40 percent of time
- Meet Bend Bridge Compliance point 15 percent of time

5A.B9.1.2.2 Action 1.2.1 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. System performance will be assessed and evaluated through post-processing of various model results.

Rationale: Given that the performance criteria are based on the CalSim II modeling data used in preparation of the Biological Assessment, the system performance after application of the RPAs should be similar as a percentage of years that the end-of-April storage and temperature compliance requirements are met over the simulation period. Post-processing of modeling results will be compared to various new operating scenarios as needed to evaluate performance criteria and appropriateness of the rules developed.

5A.B9.1.2.3 Action 1.2.2 November through February Keswick Release Schedule (Fall Actions)

Objective: Minimize impacts to listed species and naturally spawning non-listed fall-run from high water temperatures by implementing standard procedures for release of cold water from Shasta Reservoir.

Action: Depending on EOS carryover storage and hydrology, Reclamation shall develop and implement a Keswick release schedule, and reduce deliveries and exports as needed to achieve performance measures.

Action 1.2.2 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. Keswick flows based on operation of 3406(b)(2) releases in OCAP Study 7.1 (for Existing) and Study 8 (for Future) are used in CalSim II. These flows will be reviewed for appropriateness under this action**.** A post-process based evaluation similar to what has been explained in Action 1.2.1 will be conducted.

Rationale: Performance measures are set as percentage of years that the end-of-September and temperature compliance requirements are met over the simulation period. Post-processing of modeling results will be compared to various new operating scenarios as needed to evaluate performance criteria and appropriateness of the rules developed.

5A.B9.1.2.4 Action 1.2.3 February Forecast; March – May 14 Keswick Release Schedule (Spring Actions)

Objective: To conserve water in Shasta Reservoir in the spring in order to provide sufficient water to reduce adverse effects of high water temperature in the summer months for winter-run, without sacrificing carryover storage in the fall.

Action:

- Reclamation shall make its February forecast of deliverable water based on an estimate of precipitation and runoff within the Sacramento River basin at least as conservative as the 90 percent probability of exceedance. Subsequent updates of water delivery commitments must be based on monthly forecasts at least as conservative as the 90 percent probability of exceedance.
- Reclamation shall make releases to maintain a temperature compliance point not in excess of 56°F between Balls Ferry and Bend Bridge from April 15 through May 15.

Action 1.2.3 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. It is assumed that temperature operations can perform reasonably well with flows included in model.

Rationale: Temperature models of Shasta Lake and the Sacramento River have been developed by Reclamation. This modeling reflects current facilities for temperature controlled releases. Further analysis using this or another temperature model can further verify that temperature operations can perform reasonably well with flows included in model and temperatures are met reliably at each of the compliance points. In the future, it may be that adjusted flow schedules may need to be developed based on development of temperature model runs in conjunction with CalSim II modeled operations.

5A.B9.1.2.5 Action 1.2.4 May 15 through October Keswick Release Schedule (Summer Action)

Objective: To manage the cold water storage within Shasta Reservoir and make cold water releases from Shasta Reservoir to provide suitable habitat temperatures for winter-run, spring-run, Central Valley Steelhead, and Southern Distinct Population Segment (DPS) of Green Sturgeon in the Sacramento River between Keswick Dam and Bend Bridge, while retaining sufficient carryover storage to manage for next year's cohorts. To the extent feasible, manage for suitable temperatures for naturally spawning fall-run.

Action: Reclamation shall manage operations to achieve daily average water temperatures in the Sacramento River between Keswick Dam and Bend Bridge as follows:

- Not in excess of 56°F at compliance locations between Balls Ferry and Bend Bridge from May 15 through September 30 for protection of winter-run, and not in excess of 56°F at the same compliance locations between Balls Ferry and Bend Bridge from October 1 through October 31 for protection of mainstem spring run, whenever possible.
- Reclamation shall operate to a final Temperature Management Plan starting May 15 and ending October 31.

Action 1.2.4 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. It is assumed that temperature operations can perform reasonably well with flows included in model. During the detailed effects analysis, temperature modeling and post-processing will be used to verify temperatures are met at the compliance points. In the long-term approach, for a complete interpretation of the action, development of temperature model runs are needed to develop flow schedules if needed for implementation into CalSim II.

Rationale: Temperature models of Shasta Lake and the Sacramento River have been developed by Reclamation. This modeling reflects current facilities for temperature controlled releases. Further analysis using this or another temperature model is required to verify the statement that temperature operations can perform reasonably well with flows included in model and temperatures are met reliably at each of the compliance points. Alternative flow schedules may need to be developed based on development of temperature model runs in conjunction with CalSim II modeled operations.

5A.B9.1.3 Action Suite 1.3 Red Bluff Diversion Dam (RBDD) Operations

Objectives: Reduce mortality and delay of adult and juvenile migration of winter-run, spring-run, Central Valley Steelhead, and Southern DPS of Green Sturgeon caused by the presence of the diversion dam and the configuration of the operable gates. Reduce adverse modification of the passage element of critical habitat for these species. Provide unimpeded upstream and downstream fish passage in the long-term by raising the gates year-round, and minimize adverse effects of continuing dam operations, while pumps are constructed to replace the loss of the diversion structure.

5A.B9.1.3.1 Action 1.3.1 Operations after May 14, 2012: Operate RBDD with Gates Out

Action: No later than May 15, 2012, Reclamation shall operate RBDD with gates out all year to allow unimpeded passage for listed anadromous fish.

Action 1.3.1 Assumptions for CalSim II Modeling Purposes

Action: Adequate permanent facilities for diversion are assumed; therefore, no constraint on diversion schedules is included in the Future condition modeling.

5A.B9.1.3.2 Action 1.3.2 Interim Operations

Action: Until May 14, 2012, Reclamation shall operate RBDD according to the following schedule:

- September 1—June 14: Gates open. No emergency closures of gates are allowed.
- June 15—August 31: Gates may be closed at Reclamation's discretion, if necessary to deliver water to TCCA.

Action 1.3.2 Assumptions for CalSim II Modeling Purposes

Action: Adequate interim/temporary facilities for diversion are assumed; therefore, no constraint on diversion schedules is included in the No Action Alternative modeling.

5A.B9.1.4 Action 1.4 Wilkins Slough Operations

Objective: Enhance the ability to manage temperatures for anadromous fish below Shasta Dam by operating Wilkins Slough in the manner that best conserves the dam's cold water pool for summer releases.

Action: The Sacramento River Temperature Task Group (SRTTG) shall make recommendations for Wilkins Slough minimum flows for anadromous fish in critically dry years, in lieu of the current 5,000 cfs navigation criterion to NMFS by December 1, 2009. In critically dry years, the SRTTG will make a recommendation.

5A.B9.1.4.1 Action 1.4 Assumptions for CalSim II Modeling Purposes

Action: Current rules for relaxation of NCP in CalSim II (based on BA models) will be used. In CalSim II, NCP flows are relaxed depending on allocations for agricultural contractors. Table 5A.B.31 is used to determine the relaxation.

Table 5A.B.31 NCP Flow Schedule with Relaxation

CVP AG Allocation (percent)	NCP Flow (cfs)
< 10	3,250
10–25	3,500
25–40	4,000
40–65	4,500
> 65	5,000

Rationale: The allocation-flow criteria have been used in the CalSim II model for many years. The low allocation year relaxations were added to improve operations of Shasta Lake subject to 1.9 MAF carryover target storage. These criteria may be reevaluated subject to the requirements of Action 1.2.1.

5A.B9.1.5 Action 2.1 Lower American River Flow Management

Objective: To provide minimum flows for all steelhead life stages.

Action: Implement the flow schedule specified in the Water Forum's Flow Management Standard (FMS), which is summarized in Appendix 2-D of the NMFS BO.

5A.B9.1.5.1 Action 2.1 Assumptions for CalSim II Modeling Purposes

Action: The AFRMP Minimum Release Requirements (MRR) range from 800 to 2,000 cfs based on a sequence of seasonal indices and adjustments. The minimum Nimbus Dam release requirement is determined by applying the appropriate water availability index (Index Flow). Three water availability indices (i.e., Four Reservoir Index (FRI), Sacramento River Index (SRI), and the Impaired Folsom Inflow Index (IFII)) are applied during different times of the year, which provides adaptive flexibility in response to changing hydrological and operational conditions.

During some months, Prescriptive Adjustments may be applied to the Index Flow, resulting in the MRR. If there is no Prescriptive Adjustment, the MRR is equal to the Index Flow.

Discretionary Adjustments for water conservation or fish protection may be applied during the period extending from June through October. If Discretionary Adjustments are applied, then the resultant flows are referred to as the Adjusted Minimum Release Requirement (Adjusted MRR).

The MRR and Adjusted MRR may be suspended in the event of extremely dry conditions, represented by "conference years" or "off-ramp criteria". Conference years are defined when the projected March through November unimpaired inflow into Folsom Reservoir is less than 400,000 acre-feet. Off-ramp criteria are triggered if forecasted Folsom Reservoir storage at any time during the next 12 months is less than 200,000 acre-feet.

Rationale: Minimum instream flow schedule specified in the Water Forum's FMS is implemented in the model.

5A.B9.1.6 Action 2.2 Lower American River Temperature Management

Objective: Maintain suitable temperatures to support over-summer rearing of juvenile steelhead in the lower American River.

Action: Reclamation shall develop a temperature management plan that contains: (1) forecasts of hydrology and storage; (2) a modeling run or runs, using these forecasts, demonstrating that the temperature compliance point can be attained (see Coldwater Management Pool Model approach in Appendix 2-D); (3) a plan of operation based on this modeling run that demonstrates that all other non-discretionary requirements are met; and (4) allocations for discretionary deliveries that conform to the plan of operation.

5A.B9.1.6.1 Action 2.2 Assumptions for CalSim II Modeling Purposes

Action: The flows in the model reflect the FMS implemented under Action 2.1. It is assumed that temperature operations can perform reasonably well with flows included in model.

Rationale: Temperature models of Folsom Lake and the American River were developed in the 1990s. Model development for long-range planning purposes may be required. Further analysis using a verified long-range planning level temperature model is required to verify the statement that temperature operations can perform reasonably well with flows included in the model and when temperatures are met reliably

5A.B9.1.7 Action Suite 3.1 Stanislaus River/Eastside Division Actions

Overall Objectives: (1) Provide sufficient definition of operational criteria for Eastside Division to ensure viability of the steelhead population on the Stanislaus River, including freshwater migration routes to and from the Delta; and (2) halt or reverse adverse modification of steelhead critical habitat.

5A.B9.1.7.1 Action 3.1.2 Provide Cold Water Releases to Maintain Suitable Steelhead Temperatures

Action: Reclamation shall manage the cold water supply within New Melones Reservoir and make cold water releases from New Melones Reservoir to provide suitable temperatures for CV steelhead rearing, spawning, egg incubation smoltification, and adult migration in the Stanislaus River downstream of Goodwin Dam.

Action 3.1.2 Assumptions for CalSim II Modeling Purposes

Action: No specific CalSim II modeling code is implemented to simulate the performance measures identified. It is assumed that temperature operations can perform reasonably well with flow operations resulting from the minimum flow requirements described in Action 3.1.3.

Rationale: Temperature models of New Melones Lake and the Stanislaus River have been developed by Reclamation. Further analysis using this or another temperature model can further verify that temperature operations perform reasonably well with flows included in model and temperatures are met reliably. Development of temperature model runs is needed to refine the flow schedules assumed.

5A.B9.1.7.2 Action 3.1.3 Operate the East Side Division Dams to Meet the Minimum Flows, as Measured at Goodwin Dam

Objective: To maintain minimum base flows to optimize Central Valley Steelhead habitat for all life history stages and to incorporate habitat maintaining geomorphic flows in a flow pattern that will provide migratory cues to smolts and facilitate out-migrant smolt movement on declining limb of pulse.

Action: Reclamation shall operate releases from the East Side Division reservoirs to achieve a minimum flow schedule as prescribed in NMFS BO Appendix 2-E. When operating at higher flows than specified, Reclamation shall implement ramping rates for flow changes that will avoid stranding and other adverse effects on Central Valley Steelhead.

Action 3.1.3 Assumptions for CalSim II Modeling Purposes

Action: Minimum flows based on Appendix 2-E flows (presented in Figure 5A.B.3) are assumed consistent to what was modeled by NMFS (May 14 and 15, 2009 CalSim II models provided by NMFS; relevant logic merged into baselines models).

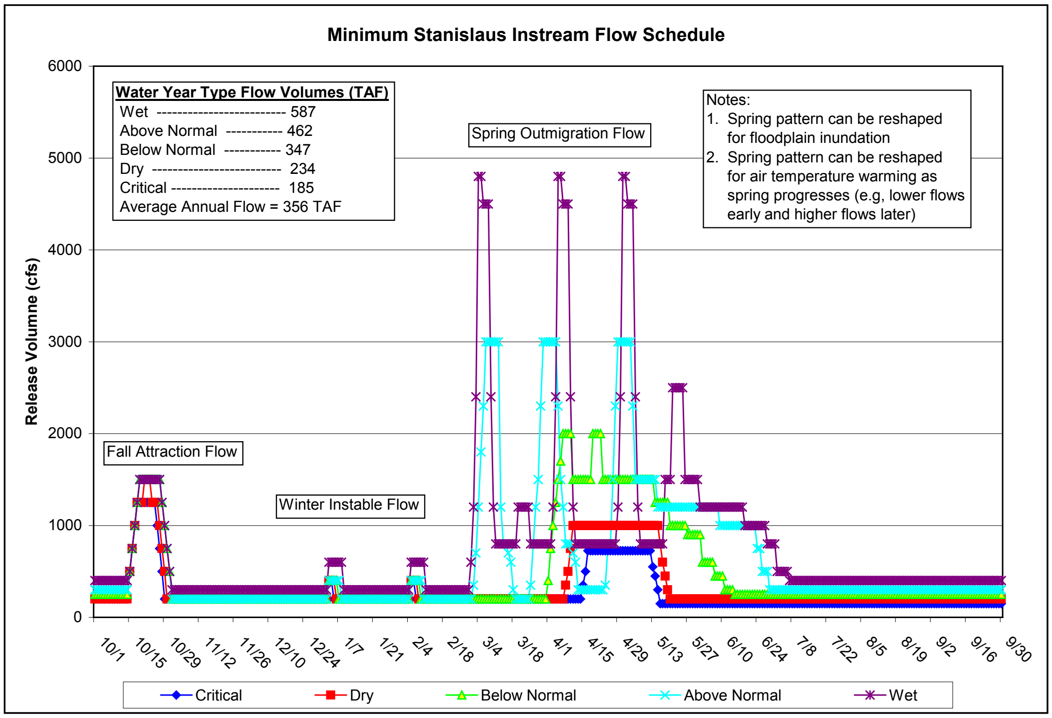

Figure 5A.B.3 Minimum Stanislaus instream flow schedule as prescribed in Appendix 2-E of the NMFS BO (06/04/09)

Annual allocation in New Melones is modeled to ensure availability of required instream flows (Table 5A.B.32) based on a water supply forecast that is comprised of end-of-February New Melones Storage (in TAF) plus forecasted inflow to New Melones from March 1 to September 30 (in TAF). The forecasted inflow is calculated using perfect foresight in the model. An allocated volume of water is released according to water year type following the monthly flow schedule illustrated in Figure 5A.B.3.

Table 5A.B.32 New Melones Allocations to Meet Minimum Instream Flow Requirements

New Melones index (TAF)	Annual Allocation Required for Instream Flows (TAF)
< 1000	0 to 98.9
1,000 to 1,399	98.9
1,400 to 1,724	185.3
1,725 to 2,177	234.1
2,178 to 2,386	346.7
2,387 to 2,761	461.7
2,762 to 6,000	586.9

Rationale: This approach was reviewed by National Oceanic and Atmospheric Administration (NOAA) fisheries and verified that the year typing and New Melones allocation scheme are consistent with the modeling prepared for the BO.

5A.B9.1.8 Action Suite 4.1 Delta Cross Channel Gate Operation, and Engineering Studies of Methods to Reduce Loss of Salmonids in Georgiana Slough and Interior Delta

5A.B9.1.8.1 Action 4.1.2 DCC Gate Operation

Objective: Modify DCC gate operation to reduce direct and indirect mortality of emigrating juvenile salmonids and Green Sturgeon in November, December, and January.

Action: During the period between November 1 and June 15, DCC gate operations will be modified from the proposed action to reduce loss of emigrating salmonids and Green Sturgeon. From December 1 to January 31, the gates will remain closed, except as operations are allowed using the implementation procedures/modified Salmon Decision Tree.

Timing: November 1 through June 15.

Triggers: Action triggers and description of action as defined in NMFS BO are presented in Table 5A.B.33.

Table 5A.B.33 NMFS BO DCC Gate Operation Triggers and Actions

Date	Action Triggers	Action Responses
October 1 – November 30	Water quality criteria per D-1641 are met and either the Knights Landing Catch Index (KLCI) or the Sacramento Catch Index (SCI) are greater than 3 fish per day, but less than or equal to 5 fish per day.	Within 24 hours of trigger, DCC gates are closed. Gates will remain closed for 3 days.
	Water quality criteria per D-1641 are met and either the KLCI or SCI is greater than 5 fish per day.	Within 24 hours, close the DCC gates and keep closed until the catch index is less than 3 fish per day at both the Knights Landing and Sacramento monitoring sites.
	The KLCI or SCI triggers are met, but water quality criteria are not met per D-1641 criteria.	DOSS reviews monitoring data and makes recommendation to NMFS and WOMT per procedures in Action IV.5.

Date	Action Triggers	Action Responses
December 1 – December 14	Water quality criteria are met per D-1641.	DCC gates are closed. If Chinook Salmon migration experiments are conducted during this time period (e.g., Delta Action 8 or similar studies), the DCC gates may be opened according to the experimental design, with NMFS' prior approval of the study.
	Water quality criteria are not met, but both the KLCI and SCI are less than 3 fish per day.	DCC gates may be opened until the water quality criteria are met. Once water quality criteria are met, the DCC gates will be closed within 24 hours of compliance.
	Water quality criteria are not met, but either the KLCI or SCI is greater than 3 fish per day.	DOSS reviews monitoring data and makes recommendation to NMFS and WOMT per procedures in Action IV.5
December 15 – January 31	December 15 – January 31	DCC Gates Closed.
	NMFS-approved experiments are being conducted.	Agency sponsoring the experiment may request gate opening for up to 5 days; NMFS will determine whether opening is consistent with ESA obligations.
	One-time event between December 15 and January 5, when necessary, to maintain Delta water quality in response to the astronomical high tide, coupled with low inflow conditions.	Upon concurrence of NMFS, DCC Gates may be opened 1 hour after sunrise to 1 hour before sunset, for up to 3 days, then return to full closure. Reclamation and DWR will also reduce Delta exports down to a health and safety level during the period of this action.
February 1 – May 15	D-1641 mandatory gate closure.	Gates closed, per WQCP criteria.
May 16 – June 15	D-1641 gate operations criteria	DCC gates may be closed for up to 14 days during this period, per 2006 WQCP, if NMFS determines it is necessary.

Action 4.1.2 Assumptions for CalSim II Modeling Purposes

Action: The DCC gate operations for October 1 through January 31 were layered on top of the D-1641 gate operations already included in the CalSim II model. The general assumptions regarding the NMFS DCC operations are summarized in Table 5A.B.34.

Timing: October 1 through January 31.

Table 5A.B.34 DCC Gate Operation Triggers and Actions as Modeled in CalSim II

Date	Modeled Action Triggers	Modeled Action Responses
October 1 – December 14	Sacramento River daily flow at Wilkins Slough exceeding 7,500 cfs; flow assumed to flush salmon into the Delta	Each month, the DCC gates are closed for the number of days estimated to exceed the threshold value.
	Water quality conditions at Rock Slough subject to D-1641 standards	Each month, the DCC gates are not closed if it results in violation of the D-1641 standard for Rock Slough; if DCC gates are not closed due to water quality conditions, exports during the days in question are restricted to 2,000 cfs.
December 15 – January 31	December 15-January 31	DCC Gates Closed.

Flow Trigger: It is assumed that from October 1 to December 14, the DCC will be closed if Sacramento River daily flow at Wilkins Slough exceeds 7,500 cfs. Using historical data (1945 through 2003, USGS gauge 11390500 “Sacramento River below Wilkins Slough near Grimes, CA”), a linear relationship is obtained between average monthly flow at Wilkins Slough and the number of days in month where the flow exceeds 7,500 cfs. This relation is then used to estimate the number of days of DCC closure for the October 1 to December 14 time period (Figure 5A.B.4).

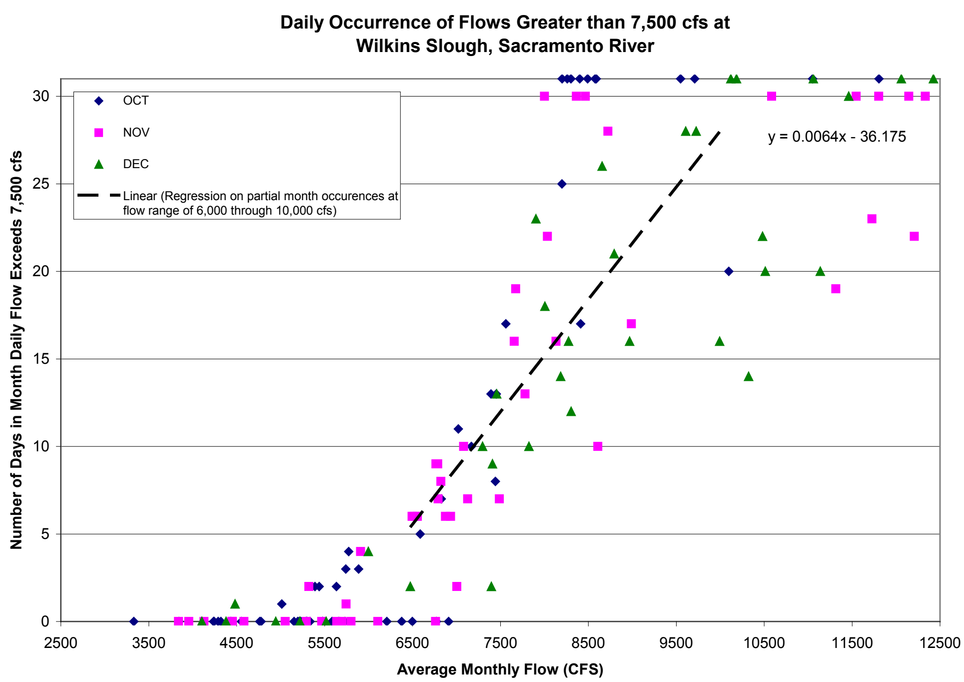

Figure 5A.B.4 Relationship between monthly averages of Sacramento River flows and number of days that daily flow exceeds 7,500 cfs in a month at Wilkins Slough

It is assumed that from December 15 through January 31 that the DCC gates are closed under all flow conditions.

Water Quality: It is assumed that during the October 1 – December 14 time period, the DCC gates may remain open if water quality is a concern. Using the CalSim II-ANN flow-salinity model for Rock Slough, the current month's chloride level at Rock Slough is estimated assuming DCC closure per NMFS BO. The estimated chloride level is compared against the Rock Slough chloride standard (monthly average). If estimated chloride level exceeds the standard, the gate closure is modeled per D-1641 schedule (for the entire month).

It is assumed that during the December 15 through January 31 time period the DCC gates are closed under all water quality conditions.

Export Restriction: During the October 1 to December 14 time period, if the flow trigger condition is such that additional days of DCC gates closed is called for, however water quality conditions are a concern and the DCC gates remain open, then Delta exports are limited to 2,000 cfs for each day in question. A monthly Delta export restriction is calculated based on the trigger and water quality conditions described above.

Rationale: The proposed representation in CalSim II should adequately represent the limited water quality concerns are that Sacramento River flows are low during the extreme high tides of December.

5A.B9.1.9 Action Suite 4.2 Delta Flow Management

5A.B9.1.9.1 Action 4.2.1 San Joaquin River Inflow to Export Ratio

Objectives: To reduce the vulnerability of emigrating Central Valley Steelhead within the lower San Joaquin River to entrainment into the channels of the South Delta and at the pumps due to the diversion of water by the export facilities in the South Delta, by increasing the inflow to export ratio. To enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the main stem of the San Joaquin River for emigrating fish, including greater net downstream flows.

Action: For CVP and SWP operations under this action, "The Phase II: Operations beginning is 2012" is assumed. From April 1 through May 31, (1) Reclamation shall continue to implement the Goodwin flow schedule for the Stanislaus River prescribed in Action 3.1.3 and Appendix 2-E of the NMFS BO); and (2) Combined CVP and SWP exports shall be restricted to the ratio depicted in table 5A.B.35 below based on the applicable San Joaquin River Index, but will be no less than 1,500 cfs (consistent with the health and safety provision governing this action.)

Action 4.2.1 Assumptions for CalSim II Modeling Purposes

Action: Flows at Vernalis during April and May will be based on the Stanislaus River flow prescribed in Action 3.1.3 and the flow contributions from the rest of the San Joaquin River basin consistent with the representation of VAMP contained in the BA modeling. In many years this flow may be less than the minimum Vernalis flow identified in the NMFS BO.

Exports are restricted as illustrated in Table 5A.B.35.

Table 5A.B.35 Maximum Combined CVP and SWP Export during April and May

San Joaquin River Index	Combined CVP and SWP Export Ratio
Critically dry	1:1
Dry	2:1
Below normal	3:1
Above normal	4:1
Wet	4:1

Rationale: Although the described model representation does not produce the full Vernalis flow objective outlined in the NMFS BO, it does include the elements that are within the control of the CVP and SWP, and that are reasonably certain to occur for the purpose of the EIS/EIR modeling.

In the long-term, a future SWRCB flow standard at Vernalis may potentially incorporate the full flow objective identified in the BO; and the Merced and Tuolumne flows would be based on the outcome of the current SWRCB and Federal Energy Regulatory Commission (FERC) processes that are underway.

5A.B9.1.10 Action 4.2.3 Old and Middle River Flow Management

Objective: Reduce the vulnerability of emigrating juvenile winter-run, yearling spring-run, and Central Valley Steelhead within the lower Sacramento and San Joaquin rivers to entrainment into the channels of the South Delta and at the pumps due to the diversion of water by the export facilities in the South Delta. Enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the mainstem of the San Joaquin River for emigrating fish, including greater net downstream flows.

Action: From January 1 through June 15, reduce exports, as necessary, to limit negative flows to -2,500 to -5,000 cfs in Old and Middle Rivers, depending on the presence of salmonids. The reverse flow will be managed within this range to reduce flows toward the pumps during periods of increased salmonid presence. Refer to NMFS BO document for the negative flow objective decision tree.

5A.B9.1.11 Action 4.2.3 Assumptions for CalSim II Modeling Purposes

Action: Old and Middle River flows required in this BO are assumed to be covered by OMR flow requirements developed for actions 1 through 3 of the USFWS BO Most Likely Scenario.

Rationale: Based on a review of available data, it appears that implementation of actions 1 through 3 of the USFWS RPA, and action 4.2.1 of the NOAA RPA will adequately cover this action within the CalSim II simulation. If necessary, additional post-processing of results could be conducted to verify this assumption.

Although the described model representation does not produce the full Vernalis flow objective outlined in the NMFS BO, it does include the elements that are within the control of the CVP and SWP, and that are reasonably certain to occur for the purpose of the EIS/EIR modeling.

In the long-term, a future SWRCB flow standard at Vernalis may potentially incorporate the full flow objective identified in the BO; and the Merced and Tuolumne flows would be based on the outcome of the current SWRCB and FERC processes that are underway.

5A.B9.1.12 Action 4.2.3 Old and Middle River Flow Management

Objective: Reduce the vulnerability of emigrating juvenile winter-run, yearling spring-run, and Central Valley Steelhead within the lower Sacramento and San Joaquin rivers to entrainment into the channels of the South Delta and at the pumps due to the diversion of water by the export facilities in the South Delta. Enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the mainstem of the San Joaquin River for emigrating fish, including greater net downstream flows.

Action: From January 1 through June 15, reduce exports, as necessary, to limit negative flows to -2,500 to -5,000 cfs in Old and Middle Rivers, depending on the presence of salmonids. The reverse flow will be managed within this range to reduce flows toward the pumps during periods of increased salmonid presence. Refer to NMFS BO document for the negative flow objective decision tree.

5A.B9.1.12.1 Action 4.2.3 Assumptions for CalSim II Modeling Purposes

Action: Old and Middle River flows required in this BO are assumed to be covered by OMR flow requirements developed for actions 1 through 3 of the USFWS BO Most Likely Scenario.

Rationale: Based on a review of available data, it appears that implementation of actions 1 through 3 of the USFWS RPA, and action 4.2.1 of the NOAA RPA will adequately cover this action within the CalSim II simulation. If necessary, additional post-processing of results could be conducted to verify this assumption.

5A.B10 References

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