Chapter 3
Alternatives Description

3.1 Introduction

The State Water Resources Control Board (State Water Board) is considering amendments to the *2006 Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary* (2006 Bay-Delta Plan). The plan amendments would include new February–June Lower San Joaquin River (LSJR) flow objectives for the protection of fish and wildlife beneficial uses and an associated program of implementation. The plan amendments would modify existing southern Delta water quality (SDWQ) objectives for the protection of agricultural beneficial uses and the associated program of implementation for those objectives. Other potential changes to the program of implementation (Appendix K, *Revised Water Quality Control Plan*) that would not result in a change in the environment are not discussed in detail in this substitute environmental document (SED).

This chapter describes: the purposes and goals[1] of the plan amendments, the LSJR alternatives and SDWQ alternatives evaluated in this SED, and the alternatives considered but eliminated from further consideration in this SED.

3.2 Purposes and Goals

The 2006 Bay-Delta Plan designates beneficial uses of water, establishes water quality objectives for the reasonable protection of those beneficial uses, and outlines a program of implementation for achieving the water quality objectives. The program of implementation contains actions that the State Water Board will undertake, including monitoring and special studies, to achieve the objectives. It also provides recommendations for other entities of actions they can take that will contribute to achieving the objectives. The purpose for the plan amendments is twofold.

- To establish flow objectives during the February–June period and a program of implementation for the reasonable protection of fish and wildlife beneficial uses in the LSJR watershed, including the three eastside, salmon-bearing tributaries (the Stanislaus, Tuolumne, and Merced Rivers).
- To establish southern Delta water quality objectives for the reasonable protection of southern Delta agricultural beneficial uses and a program of implementation to achieve the objectives.

As described in Appendix C, *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives*, scientific information indicates that higher flows of a more natural pattern are needed from the three eastside salmon-bearing tributaries to the LSJR during the spring (February–June) to protect fish and wildlife beneficial uses (including San Joaquin

[1] State CEQA Guidelines Section 15124, subdivision (b), requires the lead agency to include a statement of the objectives sought by the proposed project. To avoid confusion with the term "objective" as it is used in reference to flow and water quality objectives, this document will refer to the "objectives" mentioned in Section 15124 instead as "goals."

River [SJR] Basin fall-run Chinook salmon and other important ecosystem processes). Therefore, the goals related to the LSJR flow objectives and associated program of implementation are as follows.

- To provide flow conditions in the LSJR and three eastside tributaries—the Stanislaus, Tuolumne, and Merced Rivers—together with other reasonably controllable measures, sufficient to support and maintain the natural production of viable native fish populations migrating through the Delta, including flows that mimic the natural hydrographic conditions to which native fish species are adapted.
- To consider relevant factors in establishing the objectives, such as factors identified in Water Code Section 13241, those contained in other applicable laws (e.g., the past, present, and probable future beneficial uses of water), and economic factors.
- To provide for adaptive management of flows in order to respond to evolving scientific understanding and changing environmental conditions while minimizing water supply costs.
- To provide for development and implementation of an appropriate monitoring and evaluation program to inform adaptive management of LSJR flows and future changes to the Bay-Delta Plan.
- To provide for and encourage coordination and integration of existing and future regulatory processes related to LSJR flows.

As described in Appendix C, salt stress can damage crops in several different ways, including stunting growth, diminishing seedling success, and causing foliar damage. Salinity conditions in the southern Delta may increase due to salt loading from the SJR as it enters the southern Delta at Vernalis and by local sources and evapoconcentration of salinity within the southern Delta. Salinity conditions are also affected by the capacity of the southern Delta water bodies to assimilate these salinity inputs. This assimilative capacity is potentially affected by hydrodynamic conditions, such as water levels and the direction and magnitude of flow in the various channels of the southern Delta. The goals related to the SDWQ objectives and associated program of implementation are as follows.

- To provide water quality (i.e., salinity) conditions that reasonably protects agricultural beneficial uses of surface waters (i.e., irrigation water supply) in the southern Delta.
- To consider relevant factors in establishing the objectives, such as factors identified in Water Code Section 13241, those contained in other applicable laws, (e.g., the past, present, and probable future beneficial uses of water), and economic factors.
- To balance actions needed to reasonably protect southern Delta agricultural beneficial uses with the needs for water to meet other beneficial uses of water.
- To provide for development and implementation of monitoring and modeling studies needed to better understand the characteristics of salinity conditions in the southern Delta and the dynamics of factors controlling or contributing to those conditions.

3.3 Lower San Joaquin River (LSJR) Alternatives

This SED evaluates four alternatives for LSJR flows during the February–June time frame, including the No Project Alternative (LSJR Alternative 1) and three other LSJR alternatives (LSJR Alternatives 2, 3, and 4). This SED does not include changes to flow objectives outside of the February–June time frame (e.g., the October pulse flow objectives). However, the program of implementation does include monitoring, special studies, and evaluation efforts to inform future changes to flow objectives outside of the February–June time frame. In addition, updates to the coordination process for provision of the October pulse flows are being proposed[2] (see Appendix K, *Revised Water Quality Control Plan*) but will not have any effects on the environment and, therefore, are not discussed in this SED.

LSJR Alternatives 2, 3, and 4 are comprised of a narrative objective and an associated program of implementation. The narrative objective includes four compliance points in the LSJR, including the confluence of the SJR at Vernalis and the confluence of the LSJR with the three eastside tributaries. The narrative objective calls for the following.

> Maintain flow conditions from the San Joaquin River Watershed to the Delta at Vernalis, together with other reasonably controllable measures in the San Joaquin River Watershed, sufficient to support and maintain the natural production of viable native San Joaquin River Watershed fish populations migrating through the Delta. Flow conditions that reasonably contribute toward maintaining viable native migratory San Joaquin River fish populations include, but may not be limited to, flows that mimic the natural hydrographic conditions to which native fish species are adapted, including the relative magnitude, duration, timing, and spatial extent of flows as they would naturally occur. Indicators of viability include abundance, spatial extent or distribution, genetic and life history diversity, migratory pathways, and productivity.

The program of implementation includes specific flow requirements and other measures to implement the narrative objective. Specifically, February–June, the program of implementation would require a specified percent of unimpaired flow from the three eastside tributaries and a baseflow of 1,000 cfs on the SJR at Vernalis. The percent of unimpaired flow would not apply when such flows would cause flooding or other related public safety concerns. These levels would be established through consultation with federal, state, and local agencies and other appropriate interests with expertise in flood management.

The percentages of unimpaired flow under LSJR Alternatives 2, 3, and 4 are described below and range between minimum flows of 20 percent to 60 percent on a 14-day running average. These unimpaired flows were selected as alternatives to capture a range of potential flow alternatives that the State Water Board may implement. The alternative with the lowest flow, LSJR Alternative 2, is 20 percent unimpaired flow and was selected to bracket the low end of flows under current

[2] Under the 2006 Bay-Delta Plan, the October pulse flows are required to be scheduled in consultation with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the Department of Fish and Game (DFG). The 2006 Bay-Delta Plan states that consultation with the CALFED Operations Group, established under the Framework Agreement, will satisfy the consultation requirement (footnote 16, page 3-16). The proposed change to the consultation requirement would delete reference to the CALFED Operations Group. Instead, flows would be coordinated under a new operations group established through changes to the program of implementation.

conditions.[3] LSJR Alternative 3 is 40 percent of unimpaired flow, which represents a mid-point for the analysis. LSJR Alternative 4 has the highest level of flow, with 60 percent of unimpaired flow. The State Water Board's 2010 report, *Development of Flow Criteria for the Sacramento–San Joaquin Delta Ecosystem*, determined that approximately 60 percent of unimpaired flow at Vernalis February–June would be fully protective of fish and wildlife beneficial uses in the three eastside tributaries and LSJR when considering flow alone.

To develop precise requirements for implementation of the provisions described above, LSJR Alternatives 2, 3, and 4 call for establishing an implementation workgroup consisting of persons with expertise in fisheries management, unimpaired flows, and operations on the Stanislaus, Tuolumne, and Merced Rivers to develop recommendations for such measures that would best achieve the February–June flow requirements while minimizing water supply costs. The recommendations would be included in an implementation plan submitted to the Executive Director of the State Water Board for approval within a specified period. The implementation plan would then be considered in State Water Board water right proceedings, Federal Energy Regulatory Commission (FERC) licensing proceedings, or during other implementation actions to achieve the February–June flows.

LSJR Alternatives 2, 3, and 4 would allow for adaptive management of the timing of flows. Specifically, the State Water Board's Executive Director could approve changes to the timing of flows under the alternatives to maximize protection of fish and wildlife beneficial uses based on recommendations from the fisheries agencies (Department of Fish and Game [DFG], National Marine Fisheries Service [NMFS], and U.S. Fish and Wildlife Service [USFWS]) or others provided that the total quantity of water provided over the February–June time period is not less than the required percent of unimpaired flow. For example, a portion of the June flows could be provided in April to increase pulse flows during this period if such an action would maximize protection of fish and wildlife beneficial uses. This adaptive management would be coordinated through a coordinated operations group (COG) comprised of DFG; NMFS; USFWS; representatives of water users on the Merced, Tuolumne, and Stanislaus Rivers; and other appropriate representatives deemed appropriate by the State Water Board Executive Director. In order to inform implementation actions, the State Water Board would work with the COG and interested persons to develop procedures for an adaptive management process to be submitted for approval by the Executive Director within a specified time after final approval of the amendment to the 2006 Bay-Delta Plan.

In order to inform real-time adaptive management and long-term management of flows on the SJR for the protection of fish and wildlife beneficial uses, LSJR Alternatives 2, 3, and 4 include requirements for development of a comprehensive program, the San Joaquin River Monitoring and Evaluation Program (SJRMEP). The SJRMEP would, at a minimum, include monitoring, special studies, and evaluations of flow-related factors on the viability of native fish populations, including abundance, spatial extent (or distribution), diversity (both genetic and life history), and productivity. Specifically, the SJRMEP would evaluate the effect of flow conditions at various times of year, including spring (February–June), fall (including October), summer, and winter months on the abundance, spatial extent, diversity, and productivity of native SJR Basin fish species in order to inform adaptive management and future changes to the LSJR flow objectives and their implementation. In addition, the program of implementation would include recommendations to

[3] Flows in the Stanislaus, Tuolumne, and Merced Rivers and the SJR at Vernalis had median values of 40, 21, 26, and 29 percent of February–June unimpaired flow, respectively, for water years 1986–2009.

other agencies to take additional actions outside of the State Water Board's purview, including nonflow actions, to protect LSJR fish and wildlife beneficial uses.

LSJR Alternatives 1–4 are detailed below. As discussed earlier in this chapter, LSJR Alternatives 2, 3, and 4 have the same narrative objectives and program of implementation with the exception of the required percent of unimpaired flow.

3.3.1 LSJR Alternative 1: No Project

California Code of Regulations, Title 14, Chapter 3, Section 15126.6(e), parts (1) and (3)(A), require that the potential impacts of not approving a proposed project be evaluated under a no project alternative and compared against baseline conditions to determine impacts. For regulatory plans or policies, the no project alternative must assume the continuation of existing plans or policies into the foreseeable future.

LSJR Alternative 1 (No Project Alternative) conditions include full compliance with all flow and water quality objectives in the 2006 Bay-Delta Plan as implemented through Water Right Decision 1641 (D-1641) and the NMFS biological opinion Stanislaus River reasonable and prudent alternative, including Action 3.1.3 (NMFS BO). SJR flow and SDWQ conditions differ between the No Project Alternative and baseline. Specifically, relative to flow, the Vernalis Adaptive Management Program (VAMP) flows were being implemented under baseline conditions, but VAMP ended in 2011, after the baseline was established. Accordingly, under the No Project Alternative, flow requirements at Vernalis would be those required under D-1641, which are generally higher than those required previously under VAMP. The differences in conditions under baseline and under SDWQ Alternative 1 are described in Section 3.4.1.

Chapter 15, *LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)* and Appendix D, *Evaluation of LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, evaluate the potential impacts of the No Project Alternative. LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative) are evaluated together because flows would be required to achieve full compliance with both the flow and water quality (salinity) objectives identified in the 2006 Bay-Delta Plan.

3.3.2 LSJR Alternative 2: 20% Unimpaired Flow

LSJR Alternative 2 would require minimum 14-day running average unimpaired flows February–June of 20 percent from the Stanislaus, Tuolumne, and Merced Rivers. As described above, the State Water Board Executive Director could approve changes to the timing of these flows during the February–June time frame in order to maximize benefits to fishery resources in the SJR and the three eastside tributaries; however, the total volume of flow February–June could not be less than 20 percent of the unimpaired flow for that time period. All other provisions of LSJR Alternative 2 are as described above, including baseflow requirements of 1,000 cfs at Vernalis.

3.3.3 LSJR Alternative 3: 40% Unimpaired Flow

LSJR Alternative 3 would require minimum 14-day running average unimpaired flows February–June of 40 percent from the Stanislaus, Tuolumne, and Merced Rivers. As described above, the State Water Board Executive Director could approve changes to the timing of these flows during the February–June time frame in order to maximize benefits to fishery resources in the SJR and the three eastside tributaries; however, the total volume of flow February–June could not be less than 40 percent of the unimpaired flow for that time period. All other provisions of LSJR Alternative 3 are as described above, including baseflow requirements of 1,000 cfs at Vernalis.

3.3.4 LSJR Alternative 4: 60% Unimpaired Flow

LSJR Alternative 4 would require minimum 14-day running average unimpaired flows February–June of 60 percent from the Stanislaus, Tuolumne, and Merced Rivers. As described above, the State Water Board Executive Director could approve changes to the timing of these flows during the February–June time frame in order to maximize benefits to fishery resources in the SJR and the three eastside tributaries; however, the total volume of flow February–June could not be less than 60 percent of the unimpaired flow for that time period. All other provisions of LSJR Alternative 4 are as described above, including baseflow requirements of 1,000 cfs at Vernalis.

3.4 Southern Delta Water Quality (SDWQ) Alternatives

This SED evaluates the No Project Alternative (SDWQ Alternative 1) and two other SDWQ alternatives (SDWQ Alternatives 2 and 3). SDWQ Alternatives 2 and 3 are comprised of a numeric objective and an associated program of implementation. SDWQ Alternatives 2 and 3 have different numeric objectives, which are described in detail below. The range of alternatives analyzed in this SED is based on the water quality needs of the most salt-sensitive crops grown in the southern Delta, the predominant soil type, and irrigation practices in the area. Additional information related to these issues is provided in Appendix C, *Technical Report on the Scientific Basis for Alternatives* and Appendix E, *Salt Tolerance of Crops in the Southern Sacramento–San Joaquin Delta*.

The program of implementation for SDWQ Alternatives 2 and 3 would require the U.S. Bureau of Reclamation (USBR) to continue complying with the existing 2006 Bay-Delta Plan 0.7 deciSiemens per meter (dS/m) EC[4] objective at Vernalis for April–August and 1.0 dS/m for September–March as a 30-day average. This would help maintain assimilative capacity downstream of Vernalis into the interior southern Delta during the main growing season and would also help to ensure compliance with existing salinity objectives at the Central Valley Project (CVP) State Water Project (SWP) pumping plants (C-9 and DMC-1 in Table 2 of D-1641). DWR and USBR would also be required to develop a comprehensive operations plan to address the effects of CVP and SWP pumping operations on assimilative capacity in the southern Delta. The program of implementation also

[4] EC is electrical conductivity, which is generally expressed in deciSiemens per meter (dS/m) in this chapter and document. Measuring EC assesses salinity, which is the concentration of dissolved salts (often expressed in parts per thousand or parts per million). Because salinity refers to salt concentration in the water, whereas EC values are the result of one measurement technique to assess salinity, both "EC" and the more general term "salinity" are used in this chapter.

provides for DWR and USBR to continue to install and operate the agricultural barriers they currently install and operate in the southern Delta or to take other reasonable measures to meet the objectives. In addition, the program of implementation calls for DWR and USBR to perform monitoring, modeling, special studies, and reporting activities, in coordination with other monitoring programs (e.g., the Delta Regional Monitoring Program) to ensure that the SDWQ objectives are effectively implemented. The program of implementation also includes recommendations to other agencies that would assist in meeting the SDWQ objectives. The program of implementation expresses the willingness of the State Water Board to consider changes to these salinity objectives and the program of implementation based on the findings from the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) process and/or recommendations from the Central Valley Regional Water Quality Control Board (Central Valley Water Board).

SDWQ Alternatives 1, 2, and 3 are detailed below. As discussed earlier in this chapter, SDWQ Alternatives 2 and 3 have different numeric objectives but the same programs of implementation.

3.4.1 SDWQ Alternative 1: No Project

As discussed above, pursuant to the California Code of Regulations, the environmental analysis must evaluate a no project alternative. The no project alternative must consider what would be reasonably expected to occur in the foreseeable future if the plan amendments are not implemented and be compared against baseline conditions to determine impacts. SDWQ Alternative 1 (No Project Alternative) assumes full compliance with all flow and water quality objectives in the 2006 Bay-Delta Plan as implemented through D-1641 and the NMFS BO on the Stanislaus River (which is included in the baseline [See Chapter 4, *Introduction to the Analysis*, of this SED, Section 4.6, *Baseline*]). Specifically, relative to salinity, SDWQ Alternative 1 would result in no changes to the existing water quality objectives for agricultural beneficial uses for the southern Delta established in the 2006 Bay-Delta Plan and implemented in D-1641 (Table 2). The 2006 Bay-Delta Plan states that the maximum 30-day running average of mean daily EC is 0.7 millimhos per centimeter (mmhos/cm)[5] April 1–August 30 and 1.0 mmhos/cm September 1–March 31 for all water year types. This is applicable to the three interior compliance stations (C-6, C-8, and P-12) and the compliance station at Vernalis (C-10). Under baseline, these salinity levels are not always fully met.

Chapter 15, *LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)* and Appendix D, *Evaluation of LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, evaluate the potential impacts of satisfying the assumptions of the No Project Alternative. As described in Section 3.3.1, *LSJR Alternative 1: No Project*, LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative) are evaluated together in Chapter 15 and Appendix D because flows would be required to achieve full compliance with both the flow and salinity water quality objectives identified in the 2006 Bay-Delta Plan.

3.4.2 SDWQ Alternative 2: 1.0 dS/m Salinity

SDWQ Alternative 2 would establish a numeric salinity objective of 1.0 dS/m as a maximum 30-day running average of mean daily EC for all months in the SJR between Vernalis and Brandt Bridge, Middle River from Old River to Victoria Canal, and Old River/Grant Line Canal from the Head of Old River to West Canal. To maintain assimilative capacity downstream of Vernalis into the interior

[5] In this SED, electrical conductivity is generally expressed in deciSiemens per meter (dS/m). The conversion is 1 mmhos/cm = 1 dS/cm).

southern Delta during the main growing season, the program of implementation would continue to require USBR to comply with the existing 2006 Bay-Delta Plan 0.7 dS/m EC objective at Vernalis during the months of April–August and 1.0 dS/m September–March as a 30-day average.

3.4.3 SDWQ Alternative 3: 1.4 dS/m Salinity

SDWQ Alternative 3 is the same as SDWQ Alternative 2 except the maximum 30-day running average of mean daily EC is 1.4 dS/m for all months. The compliance locations and all other provisions of SDWQ Alternative 3 are the same as for SDWQ Alternative 2.

3.5 Preferred Alternatives

The Preferred LSJR Alternative and Preferred SDWQ Alternative were identified after evaluating analyses contained in this SED. Accordingly, the evaluation of the preferred alternatives is included in Chapter 20, *Preferred LSJR Alternative and SDWQ Alternative*. Proposed amendments to the 2006 Bay-Delta Plan are identified in Appendix K, *Revised Water Quality Control Plan*. The Preferred SDWQ Alternative is analyzed in this SED. The Preferred LSJR Alternative falls within the range of alternatives analyzed in this SED.

3.6 Alternatives Considered but Eliminated from Further Evaluation

Water quality control plans (WQCP) adopted by the State Water Board must contain water quality objectives and programs of implementation designed to achieve these objectives, which include descriptions of the nature of actions necessary to achieve the objectives, time schedules for the actions to be taken, and surveillance and monitoring activities to determine compliance with the objectives (Wat. Code, §§ 13050(j), 13242).

As part of the environmental analysis of proposed WQCPs, the State Water Board is required under CEQA to evaluate a range of reasonable alternatives to a proposed project that would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant impacts (State CEQA Guidelines, § 15126.6(a)). CEQA also requires identification of any alternatives that were considered by the lead agency but were rejected as infeasible during the scoping process with a brief explanation of the reasons underlying the lead agency's determination (State CEQA Guidelines, § 15126.6(c)).

This section summarizes and evaluates alternatives considered but eliminated that were received from the public during the comment periods associated with the February 13, 2009 notice of preparation and the April 1, 2011 revised notice of preparation. This section also includes discussion of flow recommendations received during the process of preparing the August 2010 State Water Board staff report entitled *Development of Flow Criteria for the Sacramento–San Joaquin Delta Ecosystem* (State Water Board 2010). These recommended alternatives are evaluated and compared against the alternatives that were selected for evaluation in this SED.

3.6.1 LSJR Flow Objectives and Program of Implementation

As part of developing the LSJR flow objectives and program of implementation alternatives described in Section 3.3, *Lower San Joaquin River (LSJR) Alternatives*, above, public comments were considered regarding environmental condition metrics, lifecycle modeling, flow schedule-based approaches, and water right-specific elements. Following is a description of the flow recommendations submitted by commenters and a discussion of how they were considered in the development of the LSJR alternatives.

Environmental Condition Metrics

Commenters suggested the State Water Board consider using environmental condition metrics for evaluating the success of the narrative flow objective rather than salmon population metrics. In particular, the following goals could be established and adjusted on an annual basis in the adaptive management framework: increased spring outmigration flows, increased fall attraction flows, adequate temperatures along the mainstem and the tributaries, and sufficient flow to mobilize fine sediment.

The program of implementation includes a draft San Joaquin River Monitoring and Evaluation Program (SJRMEP), which would inform real-time adaptive management and long-term management of flows on the SJR for the protection of fish and wildlife beneficial uses. This program would evaluate the effect of flow conditions at various times of year, including spring (February–June) and fall (October) on the abundance, spatial extent, diversity, and productivity of native SJR watershed fish populations. The SJRMEP would be integrated and coordinated with existing monitoring and special studies programs on the SJR, including monitoring and special studies being conducted pursuant to federal BO requirements and as part of the FERC licensing proceedings for the Merced and Tuolumne Rivers. It is anticipated that environmental condition metrics will be considered during the development of monitoring or special studies programs.

Lifecycle Modeling

Commenters suggested the program of implementation for the revised Bay-Delta Plan include specific life cycle modeling language and a science plan to support lifecycle models.

In 2011, the Delta Science Program's Independent Workshop Panel reviewed existing lifecycle models for salmonids in the Sacramento–San Joaquin Delta (Delta Science Program 2011). The Independent Workshop Panel evaluated several approaches to lifecycle modeling, including mechanistic, statistical, and dynamic programming models. The report indicated that existing lifecycle models would need further development before they could be used to analyze the effects of water operations and NMFS-prescribed RPA actions on salmonids at various life stages and at the population level. The program of implementation for the revised Bay-Delta Plan has the flexibility to allow the development of lifecycle models. In addition, the alternatives and the adaptive management element of the program of implementation allow for the development of additional science that can be utilized by lifecycle models in the future. For instance, additional science regarding abundance, spatial extent or distribution, genetic and life history diversity, migratory pathways, and productivity could be incorporated into improved lifecycle models.

Flow Schedule-Based Programs of Implementation

Several commenters suggested the State Water Board consider implementation programs consisting of flow schedule-based alternatives containing fixed monthly flow objectives.

As detailed in Appendix C, *Technical Report on the Scientific Basis Alternative for San Joaquin River Flow and Southern Delta Salinity Objectives*, retaining the spatial and temporal attributes of the natural flow regime is important in protecting a wide variety of ecosystem processes. The historical practice of developing fixed monthly flow objectives to be met from limited sources has been shown to be less than optimal in protecting fish and wildlife beneficial uses in the SJR Basin. Accordingly, to preserve the attributes of the flow regime to which native SJR Basin fish and wildlife have adapted and that are believed to be generally protective of the current beneficial uses, the flow requirements in the program of implementation are expressed as a percentage of unimpaired flow (e.g., 40 percent of unimpaired flow). However, if specific information indicates that more fixed flows would be more protective of fish and wildlife, the adaptive management provisions of LSJR Alternatives 2, 3, and 4 could allow for such an approach to be implemented, provided that the total quantity of flow is less than or equal to that of the LSJR alternatives. To assess whether this would be possible for the specific flow recommendation that the State Water Board received, an analysis was conducted to compare the flow exceedance curves for LSJR Alternatives 2, 3, and 4 with the different recommended flow schedules. If flow exceedance curves for the recommended flows are less than or equal to the flow exceedance curves for the alternatives, and if it is determined that the recommended flow schedule is more protective than the percent of unimpaired flow pursuant to the alternatives, then adequate water would generally be available to meet the recommended flows. Accordingly, such recommendations are effectively covered by the alternatives analyzed in this SED.

Contra Costa County Department of Conservation and Development

The Contra Costa County Department of Conservation and Development (CCCDCD) submitted scoping comments on the *Southern Delta Agriculture and San Joaquin River Flows Revised Notice of Preparation* (CCCDCD 2011). The CCCDCD scoping comments included recommendations on setting quantitative LSJR flow objectives that would have percentages of unimpaired flow that vary by month yet ensure additional reduced-flow impacts are not created outside of the February–June period. Presented in Table 3-1 are the flow schedule-based recommendations submitted by CCCDCD.

Table 3-1. Contra Costa County Department of Conservation and Development Flow Schedule-Based Recommendations

Minimum Monthly Average Flow as a Percentage of Monthly Unimpaired Flow					
Month	Vernalis	Stanislaus River upstream of the confluence with the SJR	Tuolumne River upstream of the confluence with the SJR	Merced River upstream of the confluence with the SJR	Upper SJR upstream of the confluence with the Merced
Jan[1]	20**%**	20% with an upper cap[2]	20% with an upper cap	20% with an upper cap	20% with an upper cap
Feb	50**%**	30%	30%	30%	30%
Mar	50**%**	30%	30%	30%	30%
Apr	40%	20%	20%	20%	20%
May	30%	20%	20%	20%	20%
Jun	30%	20%	20%	20%	20%
Jul–Dec[1]	20%	20% with an upper cap	20% with an upper cap	20% with an upper cap	20% with an upper cap

[1] Minimum flows are also needed outside the February–June period of greatest concern for fish and wildlife to ensure flow impacts are not redirected to the July–January period.

[2] The upper cap should be based on the 70th percentile of the unimpaired flows for each tributary and month. In other words, the minimum flow requirement of 20% of unimpaired flow would generally apply in critical, dry, and normal years but would be capped at 20% of the 70th-percentile unimpaired flow in wet years. This cap would only apply from July–January (i.e., outside of the period of greatest concern for fish).

Comparison of the exceedance plots for flow at Vernalis in Figure 3-1 indicates that LSJR Alternatives 2, 3 and 4 encompass the CCCDCD flow recommendations for all water year types. The CCCDCD flow recommendations are less than LSJR Alternative 4 in all years. The CCCDCD flow recommendations are generally greater than LSJR Alternative 2 in all years.

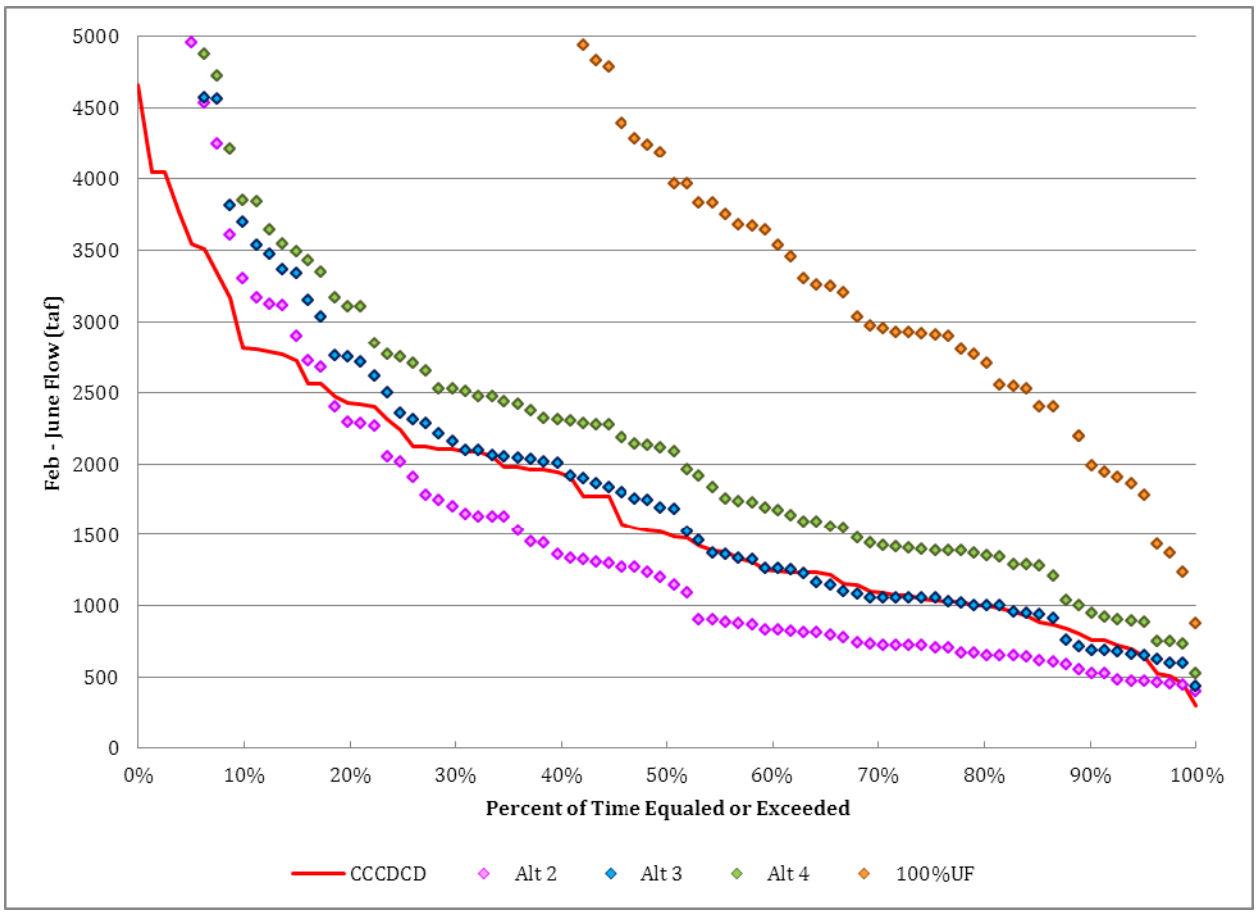

Figure 3-1. Flow Exceedance Plot of Contra Costa County Department of Conservation and Development's (CCCDCD's) Flow Recommendations and State Water Board's LSJR Alternatives (thousand acre-feet [TAF]) (UF = unimpaired flow)

California Department of Fish and Game

DFG provided written testimony and closing comments as part of the State Water Board Proceeding to Develop Flow Criteria for the Delta (DFG 2010a, 2010b). DFG testimony and comments included flow recommendations for the SJR at Vernalis that would double Chipps Island SJR fall-run Chinook salmon smolt production from 78,210 to more than 156,420 (derived from SJR Salmon Model V.1.6 output). Table 3-2 presents the flow schedule-based recommendations from DFG.

Table 3-2. California Department of Fish and Game Flow Schedule-Based Recommendations (cubic feet per second)

Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
C			1500 (Base)	5500 (Pulse) (4/15-5/15) (Total 7000)								
D			2125 (Base)	4875 (Pulse) (4/11-5/20) (Total 7000)								
BN			2258 (Base)	6242 (Pulse) (4/6-5/25) (Total 8500)								
AN			4339 (Base)	5661 (Pulse) (4/1-5/30) (Total 10000)								
W			6315 (Base)	8685 (Pulse) (3/27-6/4) (Total 15000)								

C = critical
D = dry
BN = below normal
AN = above normal
W = wet

Comparison of the exceedance plots for flow at Vernalis in Figure 3-2 indicates that LSJR Alternatives 2, 3 and 4 generally encompass the DFG flow recommendations. The DFG flow recommendations are generally greater than LSJR Alternative 2 in all years.

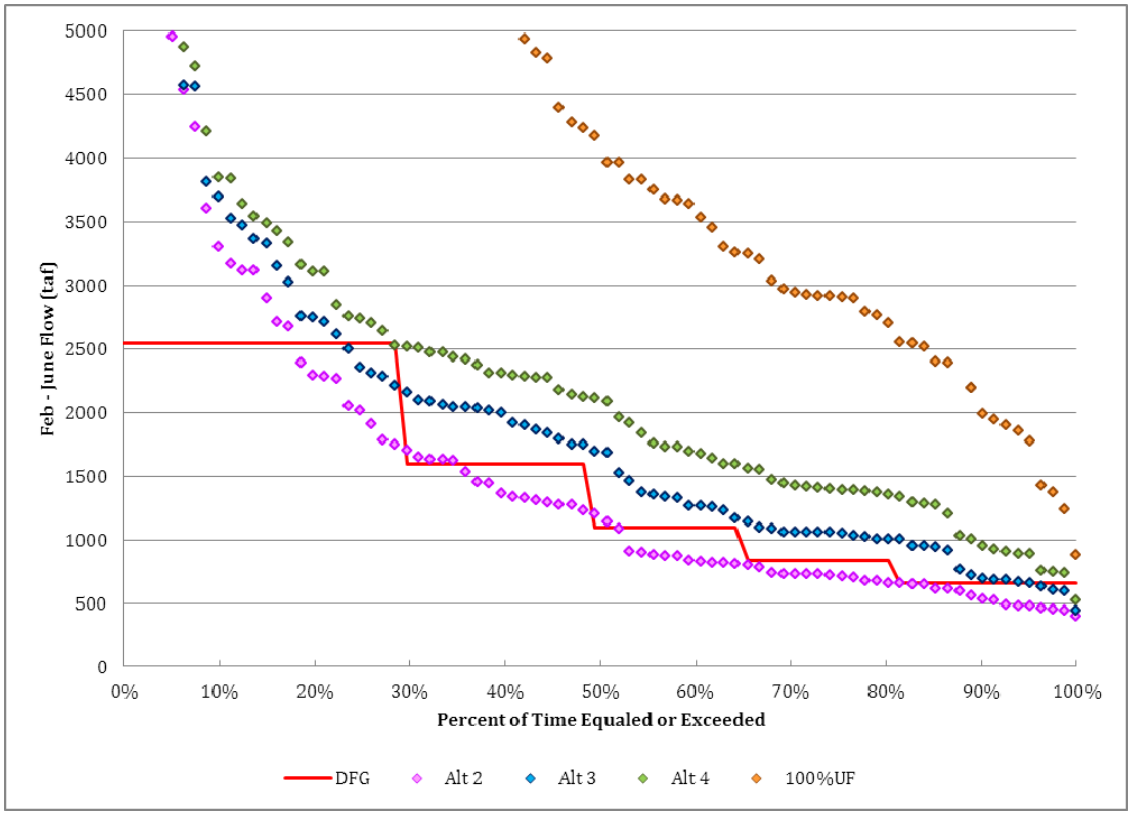

Figure 3-2. Flow Exceedance Plot of California Department of Fish and Game's (DFG's) Flow Recommendations and State Water Board's LSJR Alternatives (thousand acre-feet [TAF]) (UF = unimpaired flow)

California Water Impact Network and California Sportfishing Protection Alliance

California Water Impact Network and California Sportfishing Protection Alliance (C-WIN/CSPA) provided closing comments as part of the State Water Board Proceeding to Develop Flow Criteria for the Delta (C-WIN 2010; CSPA 2010). The C-WIN/CSPA comments included flow recommendations based on pulse flows considered to match and facilitate the early life stages of salmonid larvae, juvenile rearing, and smoltification. Table 3-3 presents the flow schedule-based recommendations by C-WIN/CSPA.

Table 3-3. California Water Impact Network and California Sportfishing Protection Alliance Flow Schedule-Based Recommendations (cubic feet per second)

Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
C		13400	4500	6700 8900	1200					5400		
D		13400 (2 days)	4500	6700 8900	1200					5400		
BN		13400 (16 days), 26800 (2 days)	4500	6700 8900	11200	1200				5400		
AN		13400 (13 days), 26800 (5 days)	4500	6700 8900	11200	1200				5400		
W		13400 (17 days), 26800 (5 days)	13400			14900				5400		

Note: Critically dry is 13,400 for 2 days

C = critical

D = dry

BN = below normal

AN = above normal

W = wet

Comparison of the exceedance plots for flow at Vernalis in Figure 3-3 indicates that LSJR Alternatives 2, 3 and 4 largely encompass the C-WIN/CSPA flow recommendations and entirely encompasses them for above-normal and dry water year types. The C-WIN/CSPA flow recommendations are generally greater than LSJR Alternative 2 in all years.

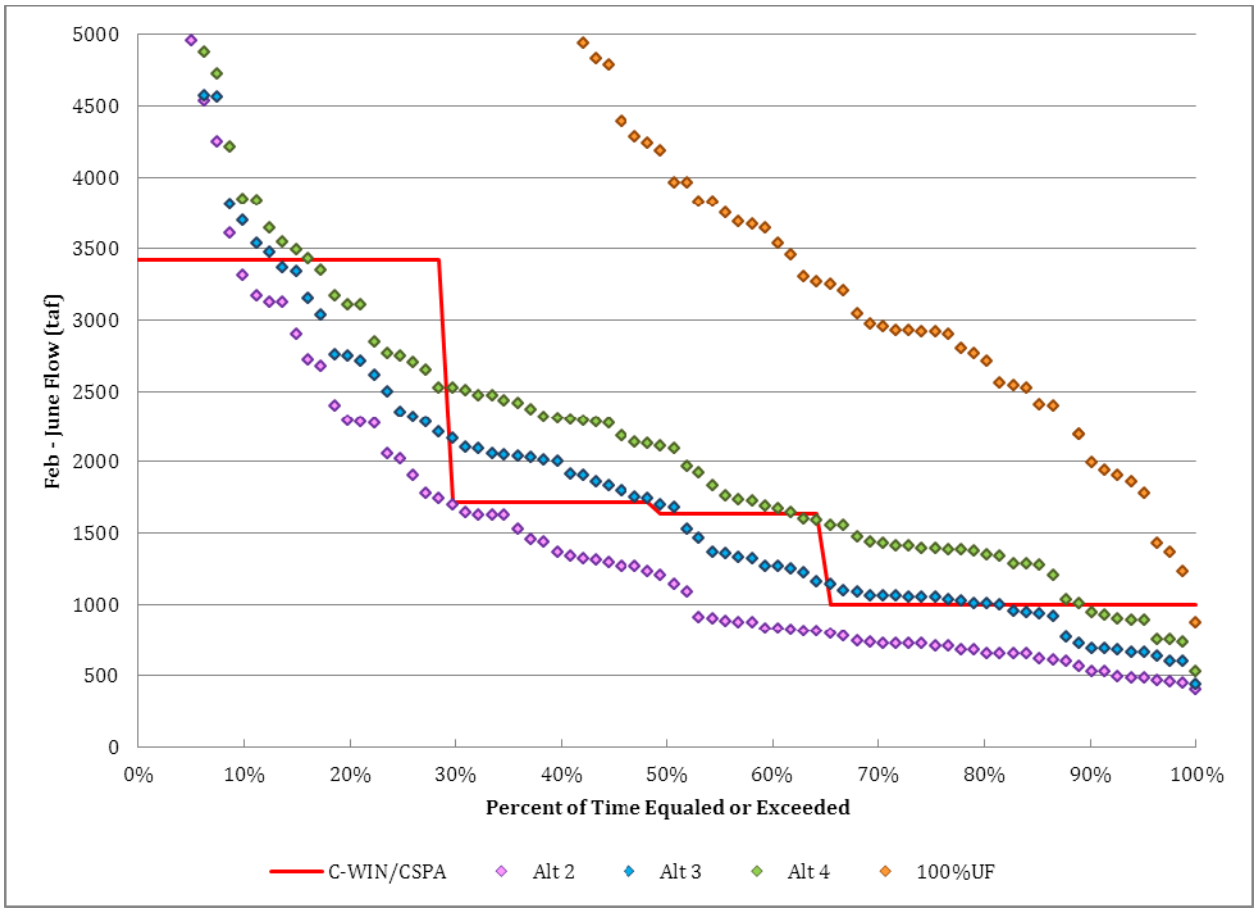

Figure 3-3. Flow Exceedance Plot of California Water Impact Network and California Sportfishing Protection Alliance's (C-WIN/CSPA) Flow Recommendations and State Water Board's LSJR Alternatives (thousand acre-feet [TAF]) (UF = unimpaired flow)

The Bay Institute and Natural Resources Defense Council

The Bay Institute and Natural Resources Defense Council (TBI/NRDC) provided testimony and closing comments as part of the State Water Board Proceeding to Develop Flow Criteria for the Delta (TBI/NRDC 2010a, 2010b, 2010c). The TBI/NRDC testimony and comments included flow recommendations developed by analyzing the relationship between LSJR flows with abundance, productivity, and life history diversity of SJR fall-run Chinook salmon. Table 3-4 presents the TBI/NRDC flow schedule-based recommendations.

Table 3-4. The Bay Institute and Natural Defense Council Flow Schedule-Based Recommendations (cubic feet per second)

Water Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
100% of years (all yrs)		2000		5000					2000			
80% (D yrs)		2000		5000	10000	7000	5000		2000			
60% (BN yrs)		2000		20000	10000	7000	5000		2000			
40% (AN yrs)		2000	5000	20000		7000			2000			
20% (W yrs)		2000	5000	20000		7000			2000			

D = dry
BN = below normal
AN = above normal
W = wet

Comparison of the exceedance curves shown in Figure 3-4 indicates that the State Water Board's flow resulting at Vernalis from the range of LSJR alternatives generally encompasses the TBI/NRDC flow recommendations and entirely encompasses them for above-normal and dry water year types. The TBI/NRDC flow recommendations are generally greater than LSJR Alternative 2 in all years.

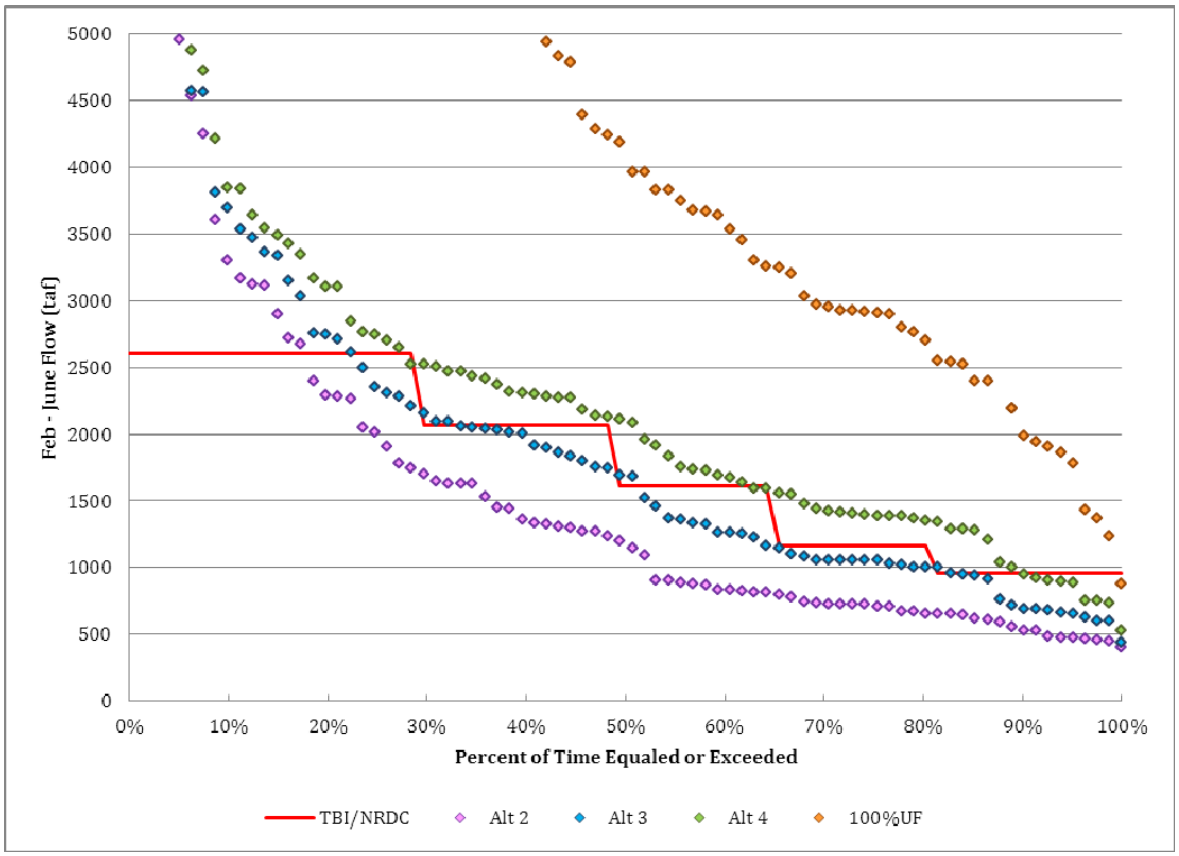

Figure 3-4. Flow Exceedance Plot of The Bay Institute and Natural Defense Council's (TBI/NRDC) Flow Recommendations and State Water Board's LSJR Alternatives (thousand acre-feet [TAF]) (UF = unimpaired flow)

American Rivers and Natural Heritage Institute

The American Rivers and Natural Heritage Institute (AR/NHI) provided testimony and closing comments as part of the State Water Board Proceeding to Develop Flow Criteria for the Delta (AR/NHI 2010a, 2010b). Included in the testimony and closing comments were recommendations for LSJR flows that would benefit salmon rearing habitat and smolt outmigration (i.e., increased flow velocities and turbidity), with focus on temperature (i.e., maintaining temperature at or below 65°F). These flow recommendations are to be in addition to those stipulated in D-1641. Table 3-5 presents the flow schedule-based recommendations provided in the AR/NHI testimony and closing comments.

Table 3-5. American Rivers and Natural Heritage Institute Flow Schedule-Based Recommendations

Water Year	Jan	Feb	Mar		Apr		May	Jun		Jul	Aug	Sept	Oct	Nov	Dec
100% of years (all yrs)			3000	4000	5000			2000							
80% (D yrs)			3000	4000	5000	10000	7000	5000	2000						
60% (BN yrs)			3000	5000	20000	10000	7000	5000	2000						
40% (AN yrs)			3000	5000	20000		7000		2000						
20% (W yrs)			3000	5000	20000			7000	2000						
All			Flows of approx. 10000 cfs should occur at Vernalis for >5 days. There should be at least 2 such events in dry years, and more in wetter years.												

D = dry
BN = below normal
AN = above normal
W = wet

Comparison of the exceedance plots for flow at Vernalis in Figure 3-5 indicates that LSJR Alternatives 2, 3 and 4 generally encompass the AR/NHI flow recommendations and entirely encompass them for above-normal and dry water year types. The AR/NHI flow recommendations are generally greater than LSJR Alternative 2 in all years.

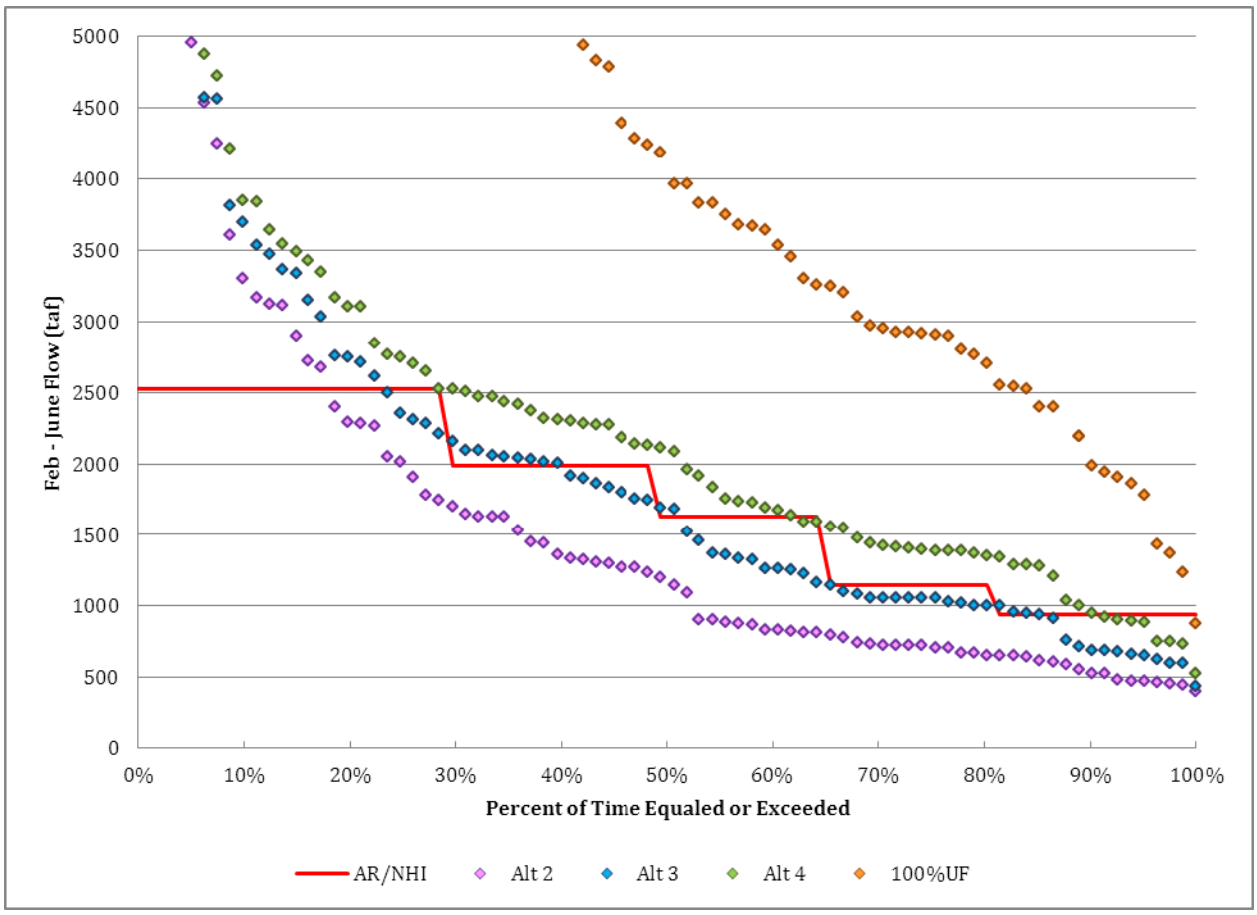

Figure 3-5. Flow Exceedance Plot of American Rivers and Natural Heritage Institute's (AR/NHI) Flow Recommendations and State Water Board's LSJR Alternatives (Thousand acre-feet [TAF]) (UF = unimpaired flow)

U.S. Department of the Interior

Pursuant to the Central Valley Project Improvement Act (CVPIA), the U.S. Department of the Interior (DOI) is required to develop and implement measures to at least double the natural production of anadromous fish in Central Valley streams; the program to achieve this is known as the Anadromous Fish Restoration Program (AFRP). DOI submitted a written summary and witness testimony on behalf of both USFWS and USBR as part of the State Water Board Proceeding to Develop Flow Criteria for the Delta (DOI 2010). Within DOI's written summary and witness testimony, the State Water Board is recommended to evaluate the flow recommendations contained within the CVPIA's 2005 AFRP Report (USFWS 2005) for salmon population doubling and increasing salmon population by 53 percent. Table 3-6 presents USFWS/USBR flow recommendations, as stated in the CVPIA's 2005 AFRP Report, for salmon population doubling and increasing salmon population by 53 percent.

Table 3-6. Central Valley Project Improvement Act's 2005 Anadromous Fish Restoration Program Report Flow Schedule-Based Recommendations (cubic feet per second)

	Water Year Type	Flow			
		Feb	Mar	Apr	May
Doubling Salmon Population	C	1744	2832	4912	5665
	D	1784	3146	5883	7787
	BN	1809	3481	6721	9912
	AN	2581	5162	8151	13732
	W	4433	8866	10487	17369
53% Increase in Salmon Population	C	1250	1665	2888	3331
	D	1350	1850	3459	4579
	BN	1450	1933	3733	5505
	AN	1638	2703	4266	7194
	W	2333	4667	5520	9142

C = critical
D = dry
BN = below normal
AN = above normal
W = wet

Comparison of the exceedance plots for flow at Vernalis in Figure 3-6 indicates that LSJR Alternatives 2, 3 and 4 encompass the USFWS/USBR salmon population doubling flow recommendations for above-normal, below-normal, and dry water year types. The USFWS/USBR salmon population doubling flow recommendations are generally greater than LSJR Alternative 2 in all years.

Comparison of the exceedance plots for flow at Vernalis in Figure 3-6 indicates that LSJR Alternatives 2, 3 and 4 generally encompass the USFWS/USBR flows. With the exception of critical years, the alternatives entirely encompass both sets of flows. The USFWS/USBR salmon population 53 percent increase flow recommendations are generally lower than LSJR Alternative 2 in most years.

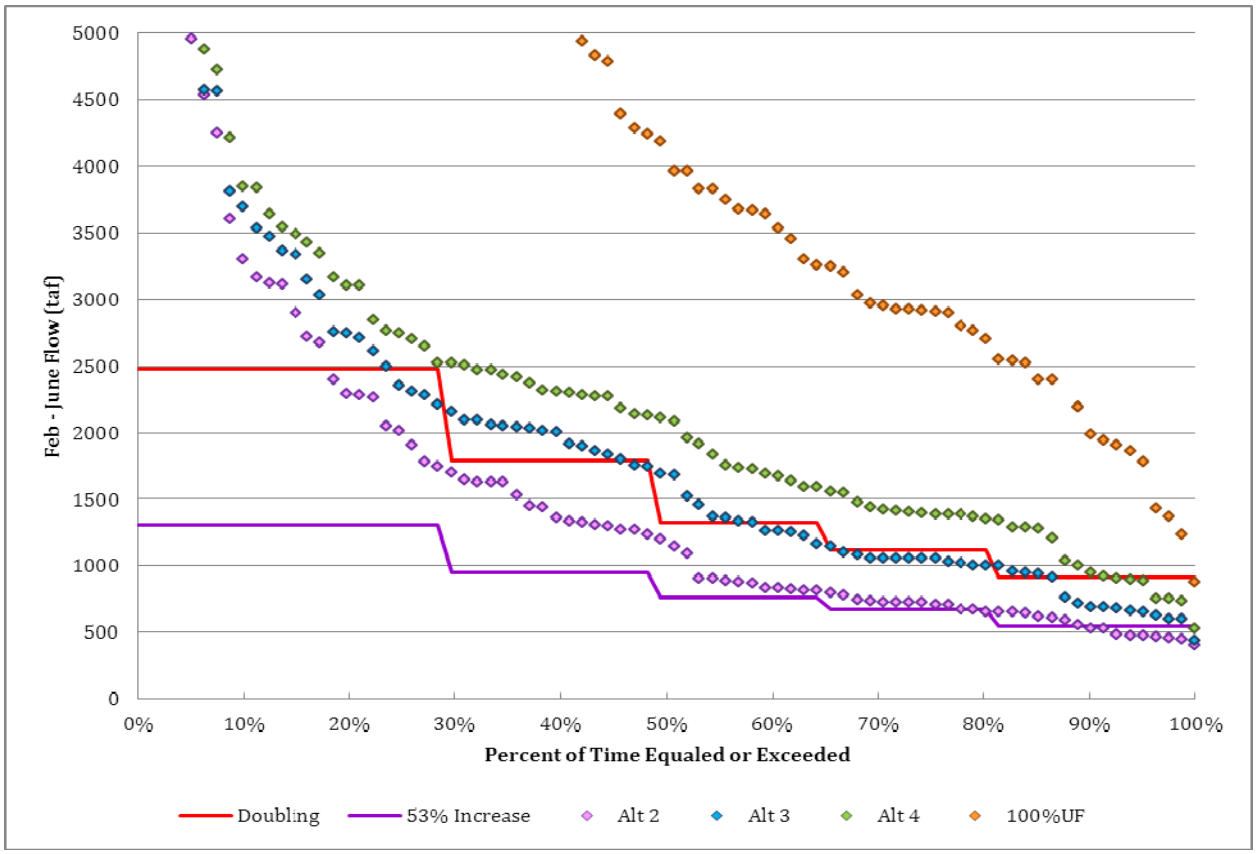

Figure 3-6. Flow Exceedance Plot of Central Valley Project Improvement Act's 2005 Anadromous Fish Restoration Program's Flow Recommendations and State Water Board's LSJR Alternatives (UF = unimpaired flow)

Delta Solution Group

During the development of flow criteria for the Sacramento–San Joaquin Delta, the State Water Board invited a group of experts to participate in and provide scientific information relevant to the Delta Flow Criteria Informational Proceeding. This led to the formation of the Delta Environmental Flows Group. A subset of this group was the U.C. Davis Delta Solutions Group (DSG), who prepared three papers to inform the Delta Flow Criteria Informational Proceeding. Of the three papers, Fleenor et al. (2010) explored several approaches for establishing freshwater flow prescriptions. Detailed in the Fleenor et al. (2010) paper are functional flow prescriptions to support and promote habitat conditions for desirable estuarine fishes. In Table 3-7 are the LSJR flow schedule-based recommendations presented in the Fleenor et al. (2010) paper by the DSG.

Table 3-7. Delta Solution Group LSJR Flow Schedule-Based Recommendations (cubic feet per second)

Water Year	Flow											
Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
C	2000	2000	2000	5000	2000	2000	2000	2000	2000	2000	2000	2000
D	2000	2000	2000	7000[1]	2000[2]	2000	2000	2000	2000	2000	2000	2000
BN	2000	2000	2000	10000	2000	200	2000	2000	2000	2000	2000	2000
AN	2000	2000	2000	15000	15000[3]	2000[4]	2000	2000	2000	2000	2000	2000
W	2000	2000	2000	20000	20000	20000	2000	2000	2000	2000	2000	2000

C = critical

D = dry

BN = below normal

AN = above normal

W = wet

[1] 7000 cubic feet per second (cfs) from April 1st through May 15th. 2 2000 cfs from May 16th through December 31st.

[3] 15000 cfs from May 1st through June 15th.

[4] 2000 cfs from June 16th through December 31st.

Comparison of the exceedance plots for flow at Vernalis in Figure 3-7 indicates that LSJR Alternatives 2, 3 and 4 generally encompass the DSG flow recommendations with the exception of wetter years when flows are often uncontrolled and may incidentally meet the proposed levels. The DSG flow recommendations are generally greater than LSJR Alternative 2 in all years.

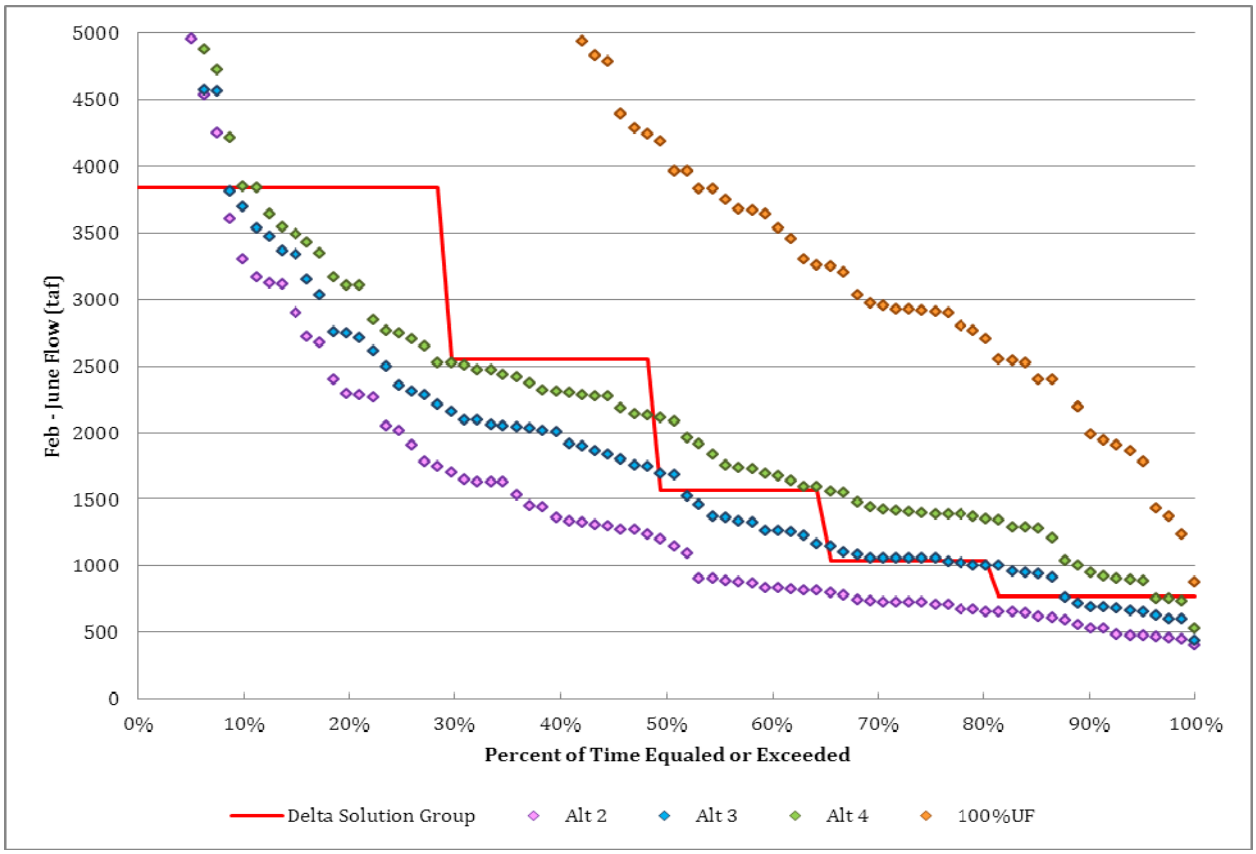

Figure 3-7. Flow Exceedance Plot of Delta Solution Group's Flow Recommendations and State Water Board's LSJR Alternatives (UF = unimpaired flow)

The LSJR alternatives considerably bracket the flow schedule-based recommendations submitted by commenters. There are, however, periods of time when the flow recommendations are outside of this bracket, and the alternatives provide more or less flow than the recommendations. Table 3-8 presents the number of years out of 82 that the February–June flow schedule-based recommendations exceed LSJR Alternative 4 flows.

Table 3-8. Number of Years February– June Flow Schedule-Based Recommendations Exceed LSJR Alternative 4 at Vernalis by Water Year Type

Water Year Type	Total Number of Years (1922–2003) per Water Year Type	Recommendation							
							USFWS/USBR		
		CCCDCD	DFG	C-WIN/ CSPA	TBI/ NRDC	AR/ NHI	Doubling	53% Incr.	DSG
W	24	0	4	10	4	4	4	0	15
AN	16	0	0	0	0	0	0	0	13
BN	13	0	0	2	2	2	0	0	1
D	13	0	0	0	0	0	0	0	0
C	16	0	1	9	9	8	7	1	4
Total	82	0	5	21	15	14	11	1	33

USFWS = U.S. Fish and Wildlife Service
USBR = U.S. Bureau of Reclamation
CCCDCD = Contra Costa County Department of Conservation and Development
DFG = Department of Fish and Game
C-WIN/CSPA = California Water Impact Network and California Sportfishing Protection Alliance
TBI/NRDC = The Bay Institute and Natural Resources Defense Council
AR/NHI = The American Rivers and Natural Heritage Institute
DSG = Delta Solutions Group
W = wet
AN = above normal
BN = below normal
D = dry
C = critical

With the exception of the C-WIN/CSPA and DSG, LSJR Alternative 4 provides more flow than the recommendations for 80–100 percent of the 24 wet water years evaluated. Conversely, for critically dry water years, LSJR Alternative 4 provides less flow than the recommendations for 0–50 percent of the 16 years evaluated. For above-normal, below-normal, and dry water year types, LSJR Alternative 4 results in more flow than the recommendations, with the exception of DSG for above-normal water years.

For the time periods when the aforementioned flow recommendations are within the LSJR alternatives' brackets, the LSJR alternatives exceed the recommendations. The result is a balance in which the time the alternatives are not satisfying the recommendations is offset by the time the alternatives exceed the recommendations. The LSJR alternatives may not satisfy each of the flow recommendations all the time, but the flow schedule-based recommendations are satisfied the majority of the time. Further, adaptive management of flows could increase the amount of time that the flow recommendations are achieved if information indicates that achieving these schedules is more protective of fish and wildlife.

Other Suggested Program of Implementation Elements

Additional program of implementation suggestions for the LSJR flow objectives involve water rights. These suggestions are described below.

Commenters suggested that this SED should evaluate a "No Action Implementation Alternative," with a program of implementation under which the 2006 Bay-Delta Plan narrative objective for LSJR flows would not be amended, D-1641 would remain in place, and USBR would be responsible for meeting D-1641. The No Project Alternative evaluated in this SED consists of these elements.

Commenters also suggested a "Water Priority Compliance Alternative" based on the water right priority system could be included in the program of implementation. Under this alternative, water rights that are used inbasin would have priority over water rights that support the transport of water outside the watershed or area immediately adjacent to the watershed. For this alternative, the Watershed Protection Statute (Wat. Code, § 11460 et seq.) would require USBR's exports out of the watershed to cease before any inbasin water use is curtailed. Commenters suggested specific water right actions should be described in the program of implementation for the updated Bay-Delta Plan. Specific water right actions can only be implemented through water right orders or decisions, which would be separate actions of the State Water Board. The program of implementation in this SED addresses this concern by stating the State Water Board "will require implementation of the narrative objective through water right actions, Federal Energy Regulatory Commission hydropower licensing processes, other water quality actions, or actions by other agencies."

An "Upstream Inclusion Alternative" was a commenter suggestion that was to include flow contributions and implementation measures from throughout the entire historical SJR watershed, including flow contributions upstream of the Merced River. The purpose of the plan amendments is to establish flow objectives and a program of implementation for the LSJR, including the three eastside tributaries. Currently, the San Joaquin River does not support salmon runs upstream of the Merced River confluence (Upper SJR). However, pursuant to the San Joaquin River Restoration Program (SJRRP), spring-run Chinook salmon are planned to be reintroduced to the Upper SJR no later than December 31, 2012. Flows needed to support this reintroduction are being determined and provided through the SJRRP. During the next review of the Bay-Delta Plan, the State Water Board will consider information made available through the SJRRP process, and any other pertinent sources of information, in evaluating the need for any additional flows from the Upper SJR Basin to contribute to the narrative LSJR flow objective.

A "South Delta and Lower San Joaquin Alternative" was a commenter suggestion that would restrict water diverters in the southern Delta and LSJR from diverting water that was released upstream to meet the narrative objective. The alternative would include a mechanism to assure flows released pursuant to the narrative objective are not rediverted downstream for purposes other than meeting the narrative objective. The program of implementation in Appendix K, *Revised Water Quality Control Plan*, addresses this alternative with the following language.

> To assure that flows required to meet the LSJR narrative flow objective are not rediverted for other purposes, the State Water Board may take water right and other actions to assure that the flows are used for their intended purpose. In addition, the State Water Board may take actions to assure that the provision of flows to meet the narrative San Joaquin River flow objective does not result in redirected impacts to groundwater resources."

A commenter suggested that a "FERC-Free Alternative" be considered that would not rely on the information or the regulatory power of FERC proceedings. The program of implementation for the

alternatives would not depend on the FERC process to implement the objective. Instead, this would be one option the State Water Board could take. The State Water Board could also implement the flows through the water right process and require studies through that process. This SED includes a programmatic evaluation of LSJR alternatives implementation that is not dependent on whether the objective is implemented through the water rights or FERC process. Project-specific evaluation of alternatives relative to implementation will be evaluated through future proceedings to implement the LSJR flows. Further, any actions taken by the State Water Board will be in conformance with existing laws and regulations.

3.6.2 SDWQ Objectives and Program of Implementation

The State Water Board is considering modifications to existing SDWQ salinity objectives to address elevated salinity levels for the protection of agricultural beneficial uses in the southern Delta. The range of alternatives examined in this SED considers the information and overall conclusions provided in Appendix E, *Crop Salt Tolerance in the Southern Sacramento–San Joaquin River Delta*, and from several public comment letters.

As described in Appendix E, the average levels of existing salinity in the southern Delta were suitable for all agricultural crops, and EC values over 1.4 dS/m would begin to affect crop yields. Based on steady-state soil water salinity analysis and published crop salt tolerance information, Appendix E concludes that salinity levels in the range of 0.9 dS/m–1.1 dS/m in irrigation water appear to be reasonably protective of the most salt-sensitive crops grown in the southern Delta. This conclusion assumes information specific to the southern Delta, including crop type, climate, irrigation practices, leaching, and soil type.

Several comment letters suggested the State Water Board analyze salinity objectives within the range of the State Water Board's SDWQ alternatives. There were a few commenters who suggested the State Water Board analyze salinity objectives below 0.7 dS/m, which is outside the range of the SDWQ alternatives. Other commenters suggested that the State Water Board could further analyze southern Delta salinity issues and water circulation to identify specific actions that could be implemented to improve southern Delta salinity. Based on the information contained in Appendix E, the State Water Board believes there is adequate science at this time to refine the numeric salinity objectives for the southern Delta. The commenters' scientific basis for the recommended salinity objectives may be found in each individual referenced comment letter.

This SED analyzes the environmental impacts of a range of salinity objectives, expressed as a maximum 30-day running average of mean daily EC in dS/m. The State Water Board's SDWQ alternatives are presented in Table 3-9, and a more detailed description of these alternatives was presented earlier in this chapter (Section 3.4, *Southern Delta Water Quality [SDWQ] Alternatives)*.

Table 3-9. State Water Board's Southern Delta Water Quality (SDWQ) Alternatives

Southern Delta Water Quality Alternatives	Electrical Conductivity Values Analyzed in this SED
SDWQ Alternative 1, No Project Alternative	0.7 dS/m April–August 1.0 dS/m September–March
SDWQ Alternative 2	1.0 dS/m all year
SDWQ Alternative 3	1.4 dS/m all year
dS/m = deciSiemens per meter	

Following is a description of the salinity objective recommendations submitted by commenters and a discussion of how they were considered in the development of the SDWQ alternatives.

South Delta Water Agency

In its letter dated May 15, 2009, the South Delta Water Agency (SDWA) submitted comments on the proposed SDWQ alternatives (SDWA 2009). The SDWA comments include recommendations for the State Water Board to analyze salinity objectives under normal conditions at Vernalis (C-10) and three interior compliance locations (P-12, C-8, and C-6). The normal condition SDWA recommendations (Recommendations 1–3) are listed below.

(1) 0.65 dS/m April–August and 1.0 dS/m September–March.

(2) 0.65 dS/m April–October and 1.0 dS/m November–March.

(3) 0.70 dS/m April–October and 1.0 dS/m November–March.

In addition to analysis at normal conditions, SDWA recommended the State Water Board analyze salinity objectives under dry conditions at Vernalis (C-10) and three interior compliance locations (P-12, C-8, and C-6). The dry condition SDWA recommendations (Recommendations 4–6) are listed below.

(4) 0.65 dS/m March–August and 1.0 dS/m September–February.

(5) 0.65 dS/m March–October and 1.0 dS/m November–February.

(6) 0.70 dS/m March–October and 1.0 dS/m November–February.

Both SDWQ Alternative 1 and SDWA Recommendations 1–6 are seasonal because it is generally thought that crops are more sensitive to salinity in earlier life stages. However, there is no definitive research quantifying this effect or the effect of varying salinity through the remainder of the growing season. As such, an objective applied across the entire year was deemed appropriate. Having objectives that apply in all months of the year also affords protection for crops grown outside the regular growing season and for pre-irrigation or leaching purposes at the beginning and end of the growing season. Therefore, SDWQ Alternatives 2 and 3 do not vary by season and apply in all months of the year.

The SDWA high salinity objectives match SDWQ Alternatives 1 and 2. However, the low salinity objectives in the SDWA Recommendations 1, 2, 4, and 5 are less than that of any of the SDWQ alternatives. The low salinity objectives in SDWA Recommendations 3 and 6 match the salinity objectives of SDWQ Alternative 1. It was determined in Appendix E, *Crop Salt Tolerance in the Southern Sacramento–San Joaquin River Delta*, that existing water quality in the southern Delta was adequate for all agricultural crops; therefore, it is not necessary to consider alternatives which provide more protection than is needed for the reasonable protection of the potentially affected beneficial uses. Therefore, no SED alternative evaluates objectives less than the current objectives (i.e., those in the 2006 Bay-Delta Plan).

Contra Costa County Department of Conservation and Development

The CCCDCD submitted scoping comments on the *Southern Delta Agriculture and San Joaquin River Flows Revised Notice of Preparation* (CCCDCD 2011). The CCCDCD scoping comments included recommendations for the State Water Board to analyze two additional salinity objectives.

(1) 0.6 dS/m April–August (as 30-day running average of mean daily) and 0.85 dS/m September–March (as 30-day running average of mean daily) at Vernalis (C-10). 0.7 dS/m April–August (as 30-day running average of mean daily) and 1. 0 dS/m September–March (as 30-day running average of mean daily) at interior compliance locations (P-12, C-8, and C-6).

(2) 0.6 dS/m April–August (as 30-day running average of mean daily) and 0.85 dS/m September–March (as 30-day running average of mean daily) at Vernalis (C-10) and interior compliance locations (P-12, C-8, and C-6).

Similar to the State Water Board's SDWQ Alternative 1, CCCDCD's recommendations are seasonal water quality objectives. SDWQ Alternatives 2 and 3, however, eliminate seasonal water quality objectives.

As mentioned earlier, while it is generally thought that crops are more sensitive to salinity at earlier life stages, there is no definitive research quantifying this effect or the effect of varying salinity through the remainder of the growing season. Therefore, an objective applied across the entire year was deemed appropriate. Having objectives that apply in all months of the year also affords protection for crops grown outside the regular growing season and for pre-irrigation or leaching purposes at the beginning and end of the growing season. Therefore, SDWQ Alternatives 2 and 3 do not vary by season and apply in all months of the year.

The CCCDCD recommendations are also equal to or less than existing objective levels, but it was determined in Appendix E, *Crop Salt Tolerance in the Southern Sacramento–San Joaquin River Delta*, that existing water quality in the southern Delta was adequate for all agricultural crops. Therefore, it is not necessary to consider alternatives that provide more protection than is needed for the potentially affected beneficial uses, and no SED alternative evaluates objectives less than the current objectives in the 2006 Bay-Delta Plan.

San Joaquin River Group Authority

O'Laughlin and Paris LLP reviewed the *Peer Review Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* and prepared comments on behalf of the San Joaquin River Group Authority (SJRGA) (O'Laughlin and Paris LLP 2012). The SJRGA comments included recommendations for the State Water Board to analyze five additional salinity objectives, which are as follows.

(1) 0.7 dS/m March 15th–October 31st at interior compliance locations (P-12, C-8, and C-6). Remove the Vernalis (C-10) compliance location.

(2) 0.7 dS/m March 15th–October 31st at Vernalis (C-10) and interior compliance locations (P-12, C-8, and C-6).

(3) 1.0 dS/m March 15th–October 31st at Vernalis (C-10). Remove interior compliance locations (P-12, C-8, and C-6).

(4) For Recommendations 1–3, modify the salinity objective for April 1st–June 31st to be 1.0 dS/cm maximum with a 10-year running average of 0.7 dS/cm at Vernalis (C-10) and interior compliance locations (P-12, C-8, and C-6).

(5) For Recommendations 1–3, modify the salinity objective at Vernalis (C-10) for November 1st–March 14th to be 1.4 dS/cm maximum with a 10-year running average of 1.2 dS/m. For the same time period, eliminate all salinity objectives at the interior compliance locations (P-12, C-8, and C-6), or set a 1.4 dS/m maximum.

Similar to the State Water Board's SDWQ Alternative 1, the recommendations provided by SJRGA are seasonal water quality objectives. However, unlike the SDWQ alternatives and the other recommendations received, the SJRGA recommendations are only effective for a portion of the year dependent on the recommendation (e.g., SJRGA Recommendations 1, 2, and 3 are only effective March 15th–October 31st). While it is generally thought that crops are more sensitive to salinity at earlier life stages, there is no definitive research quantifying this effect or the effect of varying salinity through the remainder of the growing season. Therefore, an objective applied across the entire year was deemed appropriate. Having objectives that apply in all months of the year also affords protection for crops grown outside the regular growing season, and for pre-irrigation or leaching purposes at the beginning and end of the growing season. Therefore, SDWQ Alternatives 2 and 3 do not vary by season and apply in all months of the year.

SJRGA Recommendations 1, 2, and 3, contain salinity objectives that match the SDWQ Alternative 1 objectives. SDWQ Alternatives 1 and 2 encompass the salinity objectives of SJRGA Recommendation 4. SDWQ Alternative 3 encompasses the salinity objectives of SJRGA Recommendation 5.

In addition to salinity objectives, SJRGA included specific recommendations pertaining to compliance locations and running averages that were not included in the salinity recommendations received. In SJRGA Recommendation 1, SJRGA recommends the removal of the Vernalis compliance location. Conversely, in SJRGA Recommendations 3 and 5, SJRGA recommends the removal of the interior compliance locations. The State Water Board's staff has determined that Vernalis and the interior compliance locations may not be eliminated because of their beneficial uses. In addition to the elimination of compliance locations, SJRGA Recommendations 4 and 5 included a maximum 10-year running average of 0.7 dS/m and 1.2 dS/m, respectively, which is not included in any State Water Board alternative. The SJRGA recommendations do not provide a technical basis, nor is there one known, for the need to have a 10-year running average.

In summary, the SRJGA recommendations do not provide protection for beneficial uses year-round, while the SDWQ alternatives do. The SDWQ alternatives provide greater protection of agricultural beneficial uses by requiring equal to or greater salinity objectives than the SJRGA recommendations. Finally, the maximum 10-year running average requirement included in SJRGA Recommendations 4 and 5 is not supported in the literature and, therefore, the State Water Board does not intend to include this condition in the SDWQ alternatives at this time.

City of Tracy

In a letter dated May 15, 2009, the City of Tracy recommended that sodium adsorption ratios should be used as the appropriate objective to protect irrigated agriculture instead of EC. The City of Tracy also recommended that experts should be polled as to the constituent(s) of EC that are of concern for irrigated agriculture, and the 2006 Bay-Delta Plan should be modified to remove EC objectives and include objectives only for those problematic constituents of EC (Downey Brand 2009).

Crop stress associated with salinity is caused by the increase in osmotic pressure across the root membranes, which makes it more difficult for plants to uptake water for evapotranspiration. This increase in osmotic pressure is due to the colligative properties of the soil water in the root zone and is not dependent on the type of solute particles, only their concentration. EC has been the standard way of quantifying this property in soil water as used in nearly all of the supporting literature and appears to be an appropriate measure of the relevant soil water properties. Alternatives based on sodium adsorption ratio, or surveys of experts on other problematic constituents, do not address factors affecting crop stress (i.e., increased osmotic pressure), and are inappropriate for an objective that protects that effect.

U.S. Department of the Interior/U.S. Bureau of Reclamation

In its letter dated May 15, 2009, DOI/USBR suggested that the following recommendations be considered in the development and evaluation of the SED alternatives (USBR 2009).

- Add an alternative that includes no salinity objectives at Vernalis, or downstream of Vernalis, during the nonirrigation season months.
- Use the modeling process to help identify carryover storage levels in all of the major SJR Basin reservoirs to meet the needs of all beneficial uses (possibly including dilution flows) in the short and long term.
- Include consideration of the Central Valley Water Board's total maximum daily load implementation program, which is based on the Vernalis salinity standard.
- Examine the system through a loading approach as well as a dilution flow approach. A loading approach could also examine the opportunities that other flow requirements provide for exporting salt loads from the basin and the potential for redirected impacts when salinity loads are sequestered in groundwater basins.
- Evaluate how changes to southern Delta salinity objectives may affect water control systems, which in turn could affect the control of coldwater resources and/or the value of fish habitat using a water temperature model for the SJR Basin.

The first recommendation is not an acceptable alternative for evaluation in the SED as it does not provide for protection of beneficial uses in the months of September through March. The other recommendations described above could not be evaluated as alternatives in the SED, as they are recommendations about issues to consider in the cumulative impacts analysis or to consider during implementation of the SDWQ objectives.

Stockton East Water District

In its comments received on May 15, 2009, the Stockton East Water District (SEWD) made the following specific recommendations (SEWD 2009).

- A monthly average salinity objective greater than 1.0 dS/m should be modeled to develop appropriate salinity limitations for evaluation.
- A monthly average EC at Vernalis of 1.5 mmhos/cm in all months and a monthly average EC at Brandt Bridge of 1.5 mmhos/cm and 1.8 mmhos/cm in all months should be modeled.

- Include the water year type in establishing the objectives. Modeling should be conducted to determine the effects that water year types have on the salinity objective. It may be appropriate to have differing salinity objectives based on water year type.

SDWQ Alternative 3 considers a salinity objective of 1.4 dS/m for all months of the year. This provides an appropriate upper salinity limit for the SED evaluation. Because 1.4 dS/m was the level above which yield impacts became significant for salt sensitive crops, consideration of higher alternatives were not appropriate as the associated beneficial uses would not be adequately protected (Appendix E, *Crop Salt Tolerance in the Southern Sacramento–San Joaquin River Delta*). Also, crop salt tolerance is not a function of water year type; therefore, alternatives and modeling based on water year type are not necessary.

Central Delta Water Agency

In its letter dated May 14, 2009, the Central Delta Water Agency (CDWA) provided four general recommendations regarding the SDWQ alternatives (CDWA 2009).

The first recommendation was that the sufficiency of the existing objectives to protect agricultural beneficial uses should be verified, and the existing objectives should be modeled and compared with all other alternatives. The existing objectives should be among the modeled alternatives to see how meeting the existing objectives compares with the other alternatives. This recommendation was incorporated into SDWQ Alternative 1.

The second recommendation was that an objective lower than the current 0.7/1.0 dS/m EC objective (e.g., 0.6/0.9 dS/m EC), should be modeled in the context of the current regime. Also, the existing objectives should be modeled with 0.7/1.0 dS/m EC substituted with 0.7 dS/m EC year-round. Appendix E, *Crop Salt Tolerance in the Southern Sacramento–San Joaquin River Delta*, describes that existing water quality in the southern Delta was adequate for all agricultural crops, and it is not necessary to consider alternatives which provide more protection than is needed for the potentially affected beneficial uses. Therefore, no alternatives will evaluate objectives lower than the current objectives.

The third recommendation was to include improvements to the southern Delta barrier program to better improve circulation, eliminate stagnant zones, etc., as well as recirculation of water exported from the Delta. The program of implementation includes requirements for the CVP and SWP projects to develop a coordinated operations plan to address their impact on assimilative capacity in the southern Delta. This coordination operations plan process can address the issues of improved circulation, elimination of stagnant zones, recirculation, etc.

Finally, CDWA recommended that other alternatives should be designed to ensure that the full water supply needs of the New Melones Reservoir area of origin contractors are met. Such considerations, however, are related to water rights and are not necessarily relevant to establishing a level of salinity that is protective of beneficial uses. Also, this SED does not specifically address the question of where water would be provided to meet objectives. That will be addressed during subsequent water rights proceedings.

County of San Joaquin and the San Joaquin County Flood Control and Water Conservation District

In their letter dated May 15, 2009, the County of San Joaquin and the San Joaquin County Flood Control and Water Conservation District made two general comments (Neumiller & Beardslee 2009).

First, the two entities recommended that at least one of the model alternatives needs to include salinity monitoring objectives at locations within the southern Delta and that it is necessary to have Vernalis monitoring and compliance requirements. They recommended that both the interior Delta monitoring locations and the Vernalis monitoring location must remain. This issue is addressed in this SED's program of implementation as part of establishing the monitoring and reporting protocol.

Second, it was recommended that an annual average could lead to "terrible" irrigation season flows being made up for with significantly better winter flows. The salinity objectives recommendation included meeting a minimum monthly compliance requirement and meeting the salinity objective at even more frequent intervals. It is agreed that an annual average objective could allow for unacceptably high concentrations during the growing season. But no information has been provided suggesting that an averaging period of less than a month is necessary. Soil water salinity levels are affected more by average conditions over the growing season than by short-term changes. Furthermore, the historical variability of daily salinity measurements does not suggest there would be a problem.

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