Appendix 1C

Comments from Regional and Local Agencies and Responses

This section contains copies of comment letters from regional and local agencies 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 agency name (example: CDWA 1). The comments with the associated responses are arranged alphabetically by agency name, and appear in the chapter in that order.

Copies of the comments are provided in Section 1C.1. Responses to each of the comments follow the comment letters, and are numbered in accordance with the numbers assigned in the letters.

Large attachments included with letters from Central Delta Water Agency; Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District; and South Delta Water Agency are provided in Section 1C.2.

1C.1 Comments and Responses

The agencies listed in Table 1C.1 provided comments on the Draft EIS.

Table 1C.1 Regional and Local Agencies Providing Comments on the Draft Environmental Impact Statement

Acronym	Commenter
CDWA	Central Delta Water Agency
CDWA SDWA 1	Central Delta Water Agency and South Delta Water Agency
CDWA SDWA 2	Central Delta Water Agency and South Delta Water Agency
EBMUD	East Bay Municipal Utility District
EDCWA	El Dorado County Water Agency
EID	El Dorado Irrigation District
EDWPA	El Dorado Water and Power Authority
Folsom – Roseville – SJWD	Cities of Folsom and Roseville, and San Juan Water District
FWA	Friant Water Authority
NCWA – GCID	Northern California Water Association and Glenn-Colusa Irrigation District
OID – SSJID – SEWD	Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District
PCWA	Placer County Water Agency

Acronym	Commenter
SAC	City of Sacramento
SLDMWA – WWD – SJRECWA	San Luis & Delta-Mendota Water Authority, Westlands Water District, and San Joaquin River Exchange Contractors Water Authority
SCVWD	Santa Clara Valley Water District
SDWA	South Delta Water Agency
Stanislaus	Stanislaus County
WWD	Westlands Water District

1C.1.1 Central Delta Water Agency

CENTRAL DELTA WATER AGENCY
235 East Weber Avenue • P.O. Box 1461 • Stockton, CA 95201
Phone (209) 465-5883 • Fax (209) 465-3956

DIRECTORS
George Biagi, Jr.
Rudy Mussi
Edward Zuckerman

COUNSEL
Dante John Nomellini
Dante John Nomellini, Jr.

September 29, 2015

Via email: bcnelson@usbr.gov

Ben Nelson
Natural Resources Specialist
Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

Re: DEIS Coordinated Long-Term Operation of the Central Valley Project and State Water Project

PURPOSE AND NEED OF THE ACTION

CDWA 1

The purpose statement places inappropriate emphasis on enabling "reclamation and DWR to satisfy their contractual obligations to the fullest extent possible." Such an emphasis is inconsistent with the priorities of water rights and mandates of law. The contractual obligations are only part of the obligations of the projects and are junior in priority to many of the other obligations. The Coordinated Operation Agreement provides:

> "It is in the best interest of the United States and the State to agree on the use of water rights as set forth in this agreement rather than litigate such uses as between the two projects and potentially all other water users in the Central Valley of California.
>
> Both the State and the United States are dedicated to utilizing their existing and future water conservation facilities so as to provide the maximum benefits to the people of California and the Nation and believe that through the coordinated and cooperative operation of State and Federal facilities, these benefits can be maintained."

The DEIS purpose statement has created a bias in favor of project contractual obligations over other obligations, including the obligations to honor senior water rights, honor priorities for areas of

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origin, provide salinity control for the Delta, protect the public trust, protect the environment, including endangered species, mitigate adverse impacts and limit exports from the Delta to water which is truly surplus to the present and future needs of the Delta and other areas of origin. CDWA 1 continued

This bias in purpose has resulted in the limitation of consideration of all reasonable alternatives, including those which lawfully limit deliveries to contractors in deference to senior priorities.

The need for the DEIS is to examine the RPA actions as to the significant effect to the human environment. The human environment includes much more than just the interest of the project contractors who receive project water exported from the Delta.

The promises and law constituting the obligations of the CVP and SWP to those other than contractors appear to have been overlooked, misinterpreted, or intentionally marginalized.

THE DEIS FAILS TO INCLUDE ANALYSES OF A REASONABLE RANGE OF ALTERNATIVES WHICH LIMIT AND EVEN PRECLUDE PROJECT DELIVERIES TO THEIR CONTRACTORS DUE TO THE ABSENCE OF SURPLUS WATER.

Deliveries to contractors have a variety of impacts depending on location and other factors. Such impacts include entertainment of fish eggs and larvae at diversions, degradation of water quality, inducement of reverse flows, inducement of bay salinity intrusion, reduction of water levels, creation of predator ambush locations, obstruction to and destruction of spawning grounds and reduction of availability of water necessary to meet the other and more senior obligations of the projects. CDWA 2

NEPA requires that the DEIS meet the requirements of 40 CFR section 1502.14 which provides:

> "§1502.14 Alternatives including the proposed action.
>
> This Section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (§1502.15) and the Environmental Consequences (§1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public. In this section agencies shall:
>
> (a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

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(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.
(c) Include reasonable alternatives not within the jurisdiction of the lead agency.
(d) Include the alternative of no action.
(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.
(f) Include appropriate mitigation measures not already included in the proposed action or alternatives." (Emphasis added.)

CDWA 2 continued

An alternative which requires that the SWP and CVP be operated in accordance with current law is a reasonable alternative which must be rigorously and objectively evaluated.

The ability of the SWP and CVP to deliver the full amount of entitlements in every year never existed and thus, a range of reasonable alternatives must be considered including substantially reduced and at times no exports from the Delta. The upper range is of course limited by law and hydrology.

Export of water from the Delta is counter productive to improving the ecosystem and the DEIS has failed to present the environmental impacts and alternatives in a manner providing a clear basis for choice among options by the decisionmaker and the public as required by 40 CFR section 1502.14. The proposition that removal of natural flows into and through the Bay-Delta Estuary will improve the ecosystem is unique, bold and unsupportable. CDWA 3

HYDROLOGY

The hydrology predating the construction of the CVP and SWP reflected that no surplus water would be available for export from the Sacramento-San Joaquin Watershed during a reoccurrence of the 1929-1934 drought. CDWA 4

Attached hereto as Exhibit A is a copy of the hydrographs from page 116 of the Weber Foundation Studies titled "An Approach To A California Public Works Plan" submitted to the California Legislature on January 28, 1960. The highlights and margin notes are mine.

The 1928/29-1933/34 six year drought period reflected on Exhibit A shows the average yearly runoff is 17.631 million acre feet with local requirements of 25.690 million acre feet. There is a shortage during the drought period within the Delta Watershed of 8.049 million acre feet per year without any exports. It is questionable whether the groundwater basins can be successfully mined to meet the shortage within the watershed let alone the export demands. A comparable review of the hydrograph for the North Coast area reflects that surplus water could have been developed without

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CDWA 4 continued

infringing on local requirements.

The limited hydrology was clearly recognized in the planning for the SWP which was to develop projects on the rivers in the North Coast watersheds sufficient to import to the Delta about 5,000,000 acre feet of water seasonally for transfer to areas of deficiency. (See Exhibit B December 1960 Bulletin 76 page 13). Such areas of deficiency were expected to be both north and south of the Delta pumps. The projects in the North Coast watersheds were never constructed and the projects are woefully short of water.

In addition to the lack of precipitation in the Delta watershed to meet local and export needs are the environmental needs. Water is needed for mitigation of project impacts and the affirmative obligations for salinity control and fish restoration.

The original planning for the SWP and CVP appears to have underestimated the needs to protect fish both as to flow requirements and carryover storage required for temperature control. In 2009 after only two (2) dry years, the SWP and CVP violated the February outflow requirements claiming that meeting the outflow requirements would reduce storage below the point necessary to meet cold water requirements for salmon later in the year. Although the project operators lied and the real reason for the violation was the ongoing pumping of the unregulated flow to help fill San Luis Reservoir, the incident clearly shows the inability of the projects to provide surplus water for export in the 4th, 5th and 6th years of drought.

In May of 2013 the SWP and CVP again claimed a need to preserve cold water in storage for fish. They requested and were allowed by the SWRCB to reduce outflow so as to exceed the western and interior Delta agricultural water quality objectives to save such cold water in storage. They did not suggest and did not reduce export pumping which would have had the same effect as reducing outflow.

Currently the SWRCB has been issuing curtailment notices to post-1914, and some pre-1914 water right holders in the areas of origin and reducing exports due to the lack of water.

Six year droughts can be expected and even longer droughts are possible. The historic occurrence of multi-year droughts was examined in a DWR study of tree rings. Exhibit C is Table 3 from such study. Also attached as Exhibit D is the March 10, 2014 News release, showing the severity of drought back to the 900s for the Sacramento and San Joaquin.

The State Water Project Delivery Reliability Report 2013 shows a long-term (10 year period) average Table A delivery as 2,266,000 acre feet per year; a long-term average (1921-2003) as 2,400,000 acre feet per year; a single dry year (1977) as 453,000 acre feet and a 6-year drought (1987-1992) as 1,055,000 acre feet per year. These figures can be contrasted to the Maximum Possible SWP

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Table A Delivery of 4,172,000 acre feet per year. See Exhibit E excerpts from SWP Delivery Reliability Report 2013. CDWA 4 continued

LAW

CDWA 5

The Delta Reform Act of 2009 includes provisions intended to provide additional protection for the Delta. Such provisions include Water Code §85054 which provides:

> "§85054. Coequal goals
>
> 'Coequal goals' means the two goals of providing a more reliable water supply for California and 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 §85021 which provides:

> "§85021. Reduction of reliance on Delta for future water supply needs
>
> The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts."

The Delta and other areas of origin both upstream and downstream are part of California. The DEIS purposes are clearly directed only at the ability of the SWP and CVP to deliver water to contractors. Restoration and protection of Delta water quality and flows including flushing flows are not mentioned as a part of a more reliable water supply for California. Non-degradation of water quality and the statutory obligations to provide enhancement of water quality and an adequate supply are also absent from the purposes.

Embedded in the BDCP referenced in the DEIS is isolated conveyance which will clearly render water supply less reliable in all areas downstream. The common pool for the interior Delta will be eliminated along with the common interest in protecting the water quality. The isolated CDWA 6

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CDWA 6 continued

conveyance has no outlets and requirements to protect water quality in dry periods are always circumvented. For areas throughout the watershed, including those along the tributaries upstream of the Delta, curtailment of local water use, and water transfers to increase utilization of the highly expensive tunnels combined with the need for fish flows and high water consumption habitat to mitigate for the construction and operation of the tunnels will greatly add to unreliability of deliveries to contractors.

CDWA 7

The DEIS ignores the need to reduce reliance on exports of water from the Delta. The hydrology of the Delta watershed is inadequate to support even the past level of exports. Development within the watersheds of origin and the need to recapture water from SWP and CVP exports will increase. There is evidence that more water will be needed to mitigate for the SWP and CVP damage to fish including meeting the CVPIA anadromous fish restoration requirements of 2 times the average natural production for the years 1967 through 1991. Climate change is also expected to adversely affect water supply. The increasing threat of terrorism, the continuing threat of natural calamities, including earthquakes and the growing need for electricity all gravitate towards less reliance on exports from the Delta and instead concentration on developing local self sufficiency. The deficit due to the failure to develop North Coast watersheds will not be overcome by efforts at self sufficiency, however, increased efforts in urban communities can increase the amount of water available for agriculture and the environment.

CDWA 8

The legislative intent to increase not diminish protection for the Delta and other areas of origin is made especially clear in the adoption of Water Code section 85031(a) which provides:

> "(a) This division does not diminish, impair, or otherwise affect in any manner whatsoever any area of origin, watershed of origin, county of origin, or any other water rights protections, including, but not limited to, rights to water appropriated prior to December 19, 1914, provided under the law. This division does not limit or otherwise affect the application of Article 1.7 (commencing with Section 1215) of Chapter 1 of Part 2 of Division 2, Sections 10505, 10505.5, 11128, 11460, 11461, 11462, and 11463, and Sections 12200 to 12220, inclusive." (Emphasis added.)

Water Code Sections 11460 et seq. and 12200 et seq. are particularly specific in defining the limitation on the export of water from the Delta by the SWP and CVP. Water Code Section 11460 et seq. were added by Statutes 1943, c. 370, p. 1896 around the time of commencement of the CVP. Water Code Section 12200 et seq. was added by Statutes 1959, c. 1766, p. 1766 around the time of commencement of the State Water Project.

The obligation of the projects to provide salinity control and an adequate water supply sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta was made clear.

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A summary of the promises made on behalf of the United States to those in the areas of origin is contained in the 84th Congress, 2D Session House Document No. 416, Part One Authorizing Documents 1956 at Pages 797-799 as follows:

CDWA 8 continued

"My Dear Mr. Engle: In response to your request to Mr. Carr, we have assembled excerpts from various statements by Bureau and Department officials relating to the subject of diversion of water from the Sacramento Valley to the San Joaquin Valley through the operation of the Central Valley Project.

A factual review of available water supplies over a period of more than 40 years of record and the estimates of future water requirements made by State and Federal agencies makes it clear that there is no reason for concern about the problem at this time.

For your convenience, I have summarized policy statements that have been made by Bureau of Reclamation and Department of the Interior officials. These excerpts are in the following paragraphs:

On February 20, 1942, in announcing the capacity for the Delta-Mendota Canal, Commissioner John C. Page said, as a part of his Washington D.C., press release: "The capacity of 4,600 cubic feet per second was approved, with the understanding that the quantity in excess of basic requirements mainly for replacement at Mendota Pool, will not be used to serve new lands in the San Joaquin Valley if the water is necessary for development in the Sacramento Valley below Shasta Dam and in the counties of origin of such waters."

On July 18, 1944, Regional Director Charles E. Carey wrote a letter to Mr. Harry Barnes, chairman of a committee of the Irrigation Districts Association of California. In that letter, speaking on the Bureau's recognition and respect for State laws, he said: "They [Bureau officials] are proud of the historic fact that the reclamation program includes as one of its basic tenets that the irrigation development in the West by the Federal Government under the Federal reclamation laws is carried forward in conformity with State water laws."

On February 17, 1945, a more direct answer was made to the question of diversion of water in a letter by Acting Regional Director R. C. Calland, of the Bureau, to the Joint Committee on Rivers and Flood Control of the California State Legislature. The committee had asked the question, "What is your policy in connection with the amount of water that can be diverted from one watershed to another in proposed diversions?" In stating the Bureau's policy, Mr. Calland quoted section 11460 of the

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CDWA 8 continued

State water code, which is sometimes referred to as the county of origin act, and then he said:

"As viewed by the Bureau, it is the intent of the statute that no water shall be diverted from any watershed which is or will be needed for beneficial uses within that watershed. The Bureau of Reclamation, in its studies for water resources development in the Central Valley, consistently has given full recognition to the policy expressed in this statute by the legislature and the people. The Bureau has attempted to estimate in these studies, and will continue to do so in future studies, what the present and future needs of each watershed will be. The Bureau will not divert from any watershed any water which is needed to satisfy the existing or potential needs within that watershed. For example, no water will be diverted which will be needed for the full development of all of the irrigable lands within the watershed, nor would there be water needed for municipal and industrial purposes or future maintenance of fish and wildlife resources."

On February 12, 1948, Acting Commissioner Wesley R. Nelson sent a letter to Representative Clarence F. Lea, in which he said:

"You asked whether section 10505 of the California Water Code, also sometimes referred to as the county of origin law, would be applicable to the Department of the Interior, Bureau of Reclamation. The answer to this question is: No, except insofar as the Bureau of Reclamation has taken or may take assignments of applications which have been filed for the appropriation of water under the California Statutes of 1927, chapter 286, in which assignments reservations have been made in favor of the county of origin.

The policy of the Department of the Interior, Bureau of Reclamation, is evidenced in its proposed report on a Comprehensive Plan for Water Resources Development–Central Valley Basin, Calif., wherein the Department of the Interior takes the position that "In addition to respecting all existing water rights, the Bureau has complied with California's 'county of origin' legislation, which requires that water shall be reserved for the presently unirrigated lands of the areas in which the water originates, to the end that only surplus water will be exported elsewhere."

On March 1, 1948, Regional Director Richard L. Boke wrote to Mr. A. L. Burkholder, secretary of the Live Oak Subordinate Grange No. 494, Live Oak, Calif., on the same subject, and said:

"I can agree fully with the statement in your letter that it would be grossly unjust to 'take water from the watersheds of one region to supply another region until all present and all possible future needs of the first region have been fully determined and completely and adequately provided for.' That is established Bureau of Reclamation

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CDWA 8 continued

policy and, I believe, it is consistent with the water laws of the State of California under which we must operate."

On May 17, 1948, Assistant Secretary of the Interior William E. Warne wrote a letter to Representative Lea on the same subject, in which he said:
"The excess water made available by Shasta Reservoir would go first to such Sacramento Valley lands as now have no rights to water."

Assistant Secretary Warne goes on to say, in the same letter:
"As you know, the Sacramento Valley water rights are protected by: (1) Reclamation law which recognizes State water law and rights thereunder; (2) the State's counties of origin act, which is recognized by the Bureau in principle; and (3) the fact that Bureau filings on water are subject to State approval. I can assure you that the Bureau will determine the amounts of water required in the Sacramento Valley drainage basin to the best of its ability so that only surplus waters would be exported to the San Joaquin. We are proceeding toward a determination and settlement of Sacramento Valley waters which will fully protect the rights of present users; we are determining the water needs of the Sacramento Valley; and it will be the Bureau's policy to export from that valley only such waters as are in excess of its needs."

On October 12, 1948, Secretary of the Interior Krug substantiated former statements of policy in a speech given at Oroville, Calif. Secretary Krug said, with respect to diversion of water:
"Let me state, clearly and finally, the Interior Department is fully and completely committed to the policy that no water which is needed in the Sacramento Valley will be sent out of it."
He added:
"There is no intent on the part of the Bureau of Reclamation ever to divert from the Sacramento Valley a single acre-foot of water which might be used in the valley now or later."

The California Water Resources Development Bond Act provides in Water Code Section 12931 that the Sacramento-San Joaquin Delta shall be deemed to be within the watershed of the Sacramento River.

Exhibit F is a copy of the 1960 ballot argument in favor of the California Water Resources Development Bond Act which spawned the State Water Project (SWP). Of particular note are the following representations:

"No area will be deprived of water to meet the needs of another nor will any area be

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CDWA 8 continued

asked to pay for water delivered to another."

"Under this Act the water rights of Northern California will remain securely protected."

"A much needed drainage system and water supply will be provided in the San Joaquin Valley."

Water Code §§12200 through 12205 are particularly specific as to the requirements to provide salinity control for the Delta and provide an "adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban and recreational development."

For ease of reference, the following Water Code sections are quoted with emphasis added:

§12200. Legislative findings and declaration

The Legislature hereby finds that the water problems of the Sacramento-San Joaquin Delta are unique within the State; the Sacramento and San Joaquin Rivers join at the Sacramento-San Joaquin Delta to discharge their fresh water flows into Suisun, San Pablo and San Francisco bays and thence into the Pacific Ocean; the merging of fresh water with saline bay waters and drainage waters and the withdrawal of fresh water for beneficial uses creates an acute problem of salinity intrusion into the vast network of channels and sloughs of the Delta; the State Water Resources Development system has as one of its objectives the transfer of waters from water-surplus areas in the Sacramento Valley and the north coastal area to water-deficient areas to the south and west of the Sacramento-San Joaquin Delta via the Delta; water surplus to the needs of the areas in which it originates is gathered in the Delta and thereby provides a common source of fresh water supply for water-deficient areas. It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good. *(Added by Stats. 1959, c. 1766, p. 4247, §1.)*

§12201. Necessity of maintenance of water supply

The Legislature finds that the maintenance of an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta area as set forth in Section 12220, Chapter 2, of this part, and to provide a common source of fresh water for export to areas of water deficiency is necessary to the peace, health, safety and welfare of the people of the State, except

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that delivery of such water shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code. *(Added by Stats. 1959, c. 1766, p 4247, §1.)*

CDWA 8 continued

§12202. Salinity control and adequate water supply; substitute water supply; delivery

Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operation of the Federal Central Valley Project, shall be the provision of salinity control and an adequate water supply for the users of water in the Sacramento-San Joaquin Delta. If it is determined to be in the public interest to provide a substitute water supply to the users in said Delta in lieu of that which would be provided as a result of salinity control no added financial burden shall be placed upon said Delta water users solely by virtue of such substitution. Delivery of said substitute water supply shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code. *(Added by Stats. 1959, c. 1766, p 4247, §1.)*

§12203. Diversion of waters from channels of delta

It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users within said Delta are entitled. *(Added by Stats. 1959, c. 1766, p 4249, §1.)*

§12204. Exportation of water from delta

In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections 12202 and 12203 of this chapter. *(Added by Stats. 1959, c. 1766, p 4249, §1.)*

§12205. Storage of water; integration of operation and management of release of water

It is the policy of the State that the operation and management of releases from storage into the Sacramento-San Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible in order to permit the fulfillment of the objectives of this part. *(Added by Stats. 1959, c. 1766, p 4249, §1.)*"

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§11460 provides:

> "**§ 11460. Prior right to watershed water**
>
> In the construction and operation by the department of any project under the provisions of this part a watershed or area wherein water originates, or an area immediately adjacent thereto which can conveniently be supplied with water therefrom, shall not be deprived by the department directly or indirectly of the prior right to all of the water reasonably required to adequately supply the beneficial needs of the watershed, area, or any of the inhabitants or property owners therein. *(Added by Stats. 1943, c. 370, p. 1896. Amended by Stats. 1957, c. 1932, p. 3410, §296.)*"

The December 1960 DWR Bulletin 76 (Exhibit 14) which includes a contemporaneous interpretation by DWR of Water code Section 12200 through 12205 provides at page 12:

> "In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta <u>are first</u> provided." (Emphasis added.)

Similarly the DWR confirmed its interpretation of law in the contract between the State of California Department of Water Resources and the North Delta Water Agency For the Assurance of a Dependable Water Supply of Suitable Quality dated January 28, 1981, which provides:

> "(d) The construction and operation of the FCVP and SWP at times have changed and will further change the regimen of rivers tributary to the Sacramento-San Joaquin Delta (Delta) and the regimen of the Delta channels from unregulated flow to regulated flow. This regulation at times improves the quality of water in the Delta and at times diminishes the quality from that which would exist in the absence of the FCVP and SWP. The regulation at times also alters the elevation of water in some Delta channels."
>
> "(f) The general welfare, as well as the rights and requirements of the water users in the Delta, require that there be maintained in the Delta an adequate supply of good quality water for agricultural, municipal and industrial uses."
>
> "(g) The law of the State of California requires protection of the areas within which water originates and the watersheds in which water is

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> developed. The Delta is such an area and within such a watershed. Part 4.5 of Division 6 of the California Water Code affords a first priority to provision of salinity control and maintenance of an adequate water supply in the Delta for reasonable and beneficial uses of water and relegates to lesser priority all exports of water from the Delta to other areas for any purpose." (Emphasis added.) (See Exhibit 17.)

In the case of United States vs. State Water Resources Control Board 182 Cal.App.3d 82 (1986) the court, at page 139 provides:

> "In 1959, when the SWP was authorized, the Legislature enacted the Delta Protection Act (§§ 12200-12220.) The Legislature recognized the unique water problems in the Delta, particularly 'salinity intrusion,' which mandates the need for such special legislation 'for the protection, conservation, development, control and use of the waters in the Delta for the public good.' (§ 12200.) The act prohibits project exports from the delta of water necessary to provide water to which the Delta users are 'entitled' and water which is needed for salinity control and an adequate supply for Delta users. (§§ 12202, 12203, 12204.)"

As related to the Peripheral Canal or Tunnels or any other isolated conveyance facility, the requirements of WC 12205 are particularly relevant.

> "It is the policy of the State that the operation and management of releases from storage into the Sacramento- Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible to permit fulfillment of the objectives of this part."

The objectives include salinity control and an adequate water supply. Conveyance facilities which transport stored water to the export pumps with no outlets or releases to provide salinity control and an adequate water supply in the Delta would not comply.

CDWA 9

The export projects must additionally fully mitigate their respective impacts and meet the affirmative obligations to the Delta and other areas of origin including those related to flow. Failure to so do results in a shift of the cost of the project to someone else. The State Water Resources Development Bond Act was intended to preclude such a shift in costs. See also Goodman v. Riverside (1993) 140 Cal.App.3d 900 at 906 for the requirement that the costs of the entire project be paid by the contractors. Water Code Section 11912 requires that the costs necessary for the preservation of fish and wildlife be charged to the contractors. The term "preservation" appears to be broader than mitigation and appears to create an affirmative obligation beyond mitigation.

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CDWA 9 continued

Title 34 of Public Law 102-575 referred to as the Central Valley Project Improvement Act in Section 3406(b)(l) authorizes and directs the Secretary of Interior to enact and implement a program which makes all reasonable efforts to ensure by the year 2002 natural production of anadromous fish (including salmon, steelhead, striped bass, sturgeon and American shad) will be sustainable on a long term basis at levels not less than twice the average levels attained during the period of 1967-1991.

Reliability of water supply for exports from the Delta and other contract deliveries must be junior to the needs and obligations requiring water in the Delta and other areas of origin including fish and wildlife needs. The modeling and analysis should provide a clear confirmation of the types and numbers of years when no water will be available for export and provide estimates of the amounts that might be available in other years. Care should be taken to model carryover storage requirements with due consideration of meeting temperature, flow and statutory requirements to determine the firm yield available for export. Such modeling is necessary to determine the impacts to the human environment.

CDWA 10

Reliability of water supply for Northern California requires that no water be exported that is necessary to meet the needs of and obligations to restore and even enhance fish.

CDWA 11

Both State and Federal laws seek to prevent degradation of water quality. Isolated conveyance will remove the higher quality Sacramento River water from the Delta pool thereby reducing the dilution of the poorer quality water returning to the Delta by way of the San Joaquin River from SWP and CVP operations which deliver water to the west side of the San Joaquin Valley. The delivery of such water to the San Luis Unit was prohibited by the San Luis Act of 1960 unless there was a Valley Drain with an outlet to the ocean. (See Exhibit G). The prohibition was circumvented. Even the promise that "A much needed drainage system and water supply will be provided in the San Joaquin Valley" included in ballot argument in favor of the California Water Resources Development Act (SWP) was not kept. (See Exhibit F). The DEIS Purposes unreasonably seek to provide deliveries to contractors to the fullest extent possible. Exports from the Delta to the west side of the San Joaquin Valley degrade Delta water quality. CDWA 12 The commitment to isolated conveyance aggravates such degradation.

CDWA 13

The provision of salinity control and an adequate supply for the Delta was deemed to be of utmost importance and is a critical feature of a reliable supply for the Delta.

Salinity control for the Sacramento-San Joaquin Delta is a primary purpose for Shasta Dam.

Water Code Section 11207 provides:

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CDWA 13 continued

> "§11207. Primary purposes
>
> Shasta Dam shall be constructed and used primarily for the following purposes:
>
> i. Improvement of navigation on the Sacramento River to Red Bluff.
> ii. Increasing flood protection in the Sacramento River.
> iii. <u>Salinity control in the Sacramento-San Joaquin Delta</u>.
> iv. Storage and stabilization of the water supply of the Sacramento River for irrigation and domestic use. (*Added by Stats. 1943, c 370, p. 1896*) (Emphasis added.)

The Delta Protection Act of 1959 in WC 12200 specifically provides: "It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good."

The degradation of water quality in the Delta adversely impacts agricultural, industrial, urban and recreational (including fish and wildlife) uses in the Delta and surrounding areas as well as areas served with exports from the Delta.

Except as provided by agreement, salinity control and the adequacy of the quality of the water supply for the Delta is determined by water quality objectives set by the SWRCB. Such objectives provide the minimum level deemed necessary to protect beneficial uses. Although the objectives are set for certain uses for certain periods, it is the composite of all objectives which the SWRCB determined would provide the protection for all beneficial uses. Such objectives have at times been violated and it is critical to the rigorous and objective analysis of alternatives to incorporate with and without compliance conditions.

Federal law is specific as to the obligations for the CVP.

PL99-546 (HR3113) specifically provides:

> "(b)(1) Unless the Secretary of the Interior determines that operation of the Central Valley project in conformity with State water quality standards for the San Francisco Bay/Sacramento-San Joaquin Delta and Estuary is not consistent with the congressional directives applicable to the project, the Secretary is authorized and directed to operate the project, in conjunction with the State of California water project, in conformity with such standards. Should the Secretary of the Interior so determine, then the Secretary shall promptly request the

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CDWA 13 continued

> Attorney General to bring an action in the court of proper jurisdiction for the purposes of determining the applicability of such standards to the project.
>
> (2) The Secretary is further directed to operate the Central Valley project, in conjunction with the State water project, so that water supplied at the intake of the Contra Costa Canal is of a quality equal to the water quality standards contained in the Water Right Decision 1485 of the State of California Water Resources Control Board, dated August 16, 1978, except under drought emergency water conditions pursuant to a declaration by the Governor of California. Nothing in the previous sentence shall authorize or require the relocation of the Contra Costa Canal intake."

Section (b)(1) does not allow for the Bureau of Reclamation to operate the CVP without conforming to the State water quality standards for the San Francisco Bay/Sacramento-San Joaquin Delta and Estuary even if the SWRCB is willing to look the other way. A determination by a court of law is required. (See Exhibit H .)

There are specific processes and procedures for changes to Water Quality Control Plans including review by the United States EPA, which are not being considered.

Section (b)(1) is thus applicable and requires USBR and USF&WS compliance unless the Secretary of Interior makes a determination that compliance is inconsistent with congressional directives applicable to the project and then the Attorney General is to be requested to bring a legal action for a court determination of the applicability of the standards. There is no such court determination that would allow the CVP to operate without conforming to the standards.

Section (b)(2) provides an additional constraint with regard to the water quality at the intake to the Contra Costa Canal. Even if the standards were determined by the court to not be applicable to the CVP, then the D-1485 water quality standards would be applicable to the intake of the Contra Costa Canal except under drought emergency water conditions pursuant to a declaration by the Governor of California.

In 2004 Congress passed another law to ensure that Delta water quality standards and objectives would be met. CDWA 14

PL 108-361 (HR 2828) Section 103(d)(2), in pertinent part provides:

"(D) Program to Meet Standards. -

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> (i) In General. - Prior to increasing export limits from the Delta for the purposes of conveying water to south-of-Delta Central Valley Project contractors or increasing deliveries through an intertie, the Secretary shall, not later than 1 year after the date of enactment of this Act, in consultation with the Governor, develop and initiate implementation of a project to meet all existing water quality standards and objectives for which the Central Valley Project has responsibility." (See Exhibit I.)

CDWA 14 continued

PL 108-361 also provided in Section 103(d)(1)(C)(i) that the USBR conduct a water supply and yield study. The results of a determination of firm yield in successive years of drought is essential to analyzing the impact to the human environment. The absence of available water for contractors regardless of RPAs would presumably show no adverse impact. If the USBR has failed to conduct such study as mandated by Congress, then it should be done as a part of the requirements for a proper DEIS.

CDWA 15

The DEIS must also take into account the provisions in PL 108-361 requiring the Secretary to include to the maximum extent feasible in a plan to meet standards a recirculation program to reduce reliance on New Melones Reservoir for water quality and fishery flow objectives, reduction of the water quality impacts of discharges from wildlife refuges that receive water from the federal government and discharge salt and other constituents into the San Joaquin River, the acquisition of water from willing sellers from streams tributary to the San Joaquin and other sources to provide flow, dilute discharges of salt and other constituents and to improve water quality in the San Joaquin below the confluence of the Merced and to reduce reliance on New Melones for meeting water quality and fishery flow objectives. The DEIS should include alternatives which provide for the purchase of water for the above purposes, including waters which is otherwise the subject of transfers for delivery to contractors. Recapture of a portion such waters at the Delta may be possible.

CDWA 16

The DEIS purpose of providing exports from the Delta to serve contractors to the fullest extent possible is directly contrary to the direction of Congress which was to assure that all existing (October 25, 2004) water quality standards and objectives would first be met.

<u>CREATION OF ADDITIONAL TIDAL WETLANDS IN THE DELTA IS NOT A REASONABLE OR PRUDENT ACTION</u>

CDWA 17

Driving the need for ecosystem restoration is the need to address the dramatic decline in fish species and in particular those in danger of extinction. The DEIR puts forth the proposition that habitat in the Delta and factors other than the amount flow into and through the Delta are the cause of the subject fish declines. The impact of SWP and CVP exports on the amount of flow into and through the Delta from diversion to storage and direct diversion is improperly discounted.

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CDWA 17 continued

The correlation between SWP and CVP exports and the decline of the fisheries has been a concern for many years. In August of 1978 the State Water Resources Control Board rendered its Water Right Decision 1485. The Decision was the culmination of 32 days of evidentiary hearing initiated on November 15, 1976 and concluded on October 7, 1977. At that time the striped bass index was considered to be the indicator of ecosystem health for the Delta and Suisun Marsh. Striped bass were in effect the "canary in the coal mine". As the years passed and striped bass populations plummeted, the water exporters claimed striped bass to be invasive species, predators on endangered species and major cause of fish declines wrongfully attributed to the export of water. The canary died and the death was ignored to facilitate greater exports. As Exhibits J-M show, striped bass, steelhead, Delta smelt, fall-run Chinook salmon and winter-run Chinook salmon all co-existed at relatively high populations at lower export levels.

In 1978 the SWRCB concluded in D-1485 at page 13 that:

> "To provide full mitigation of project impacts on all fishery species now would require the virtual shutting down of the project export pumps." (See Exhibit N.)

The SWRCB also concluded in D-1485 at page 14 that:

> "Full protection of Suisun Marsh now could be accomplished only by requiring up to 2 million acre feet of fresh water outflow in dry and critical years in addition to that required to meet other standards." (See Exhibit N.)

Exports from the Delta were not curtailed and the additional 2 million acre feet of outflow was not provided for the marsh.

Exhibits J-M show that significant declines in fish populations commenced when annual exports reached 2 million acre feet. Increased development in the watersheds and the effects of climate change would indicate that additional water yield would have to be developed within the Delta watershed to provide a comparable level of fish protection for the future and maintain the 2 million acre feet of exports. Little or no export water in dry years and more in wet years would likely be necessary in any event.

An examination of the fish population graphs indicates that restoration of the ecosystem for fish is not correlated with Delta wetland habitat conditions in the 1850's or at all. The likely relationship is to water conditions, particularly flow.

The Delta was fully leveed and reclaimed by about 1930.

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"By 1930 all but minor areas of the swampland had been leveed and were in production." (See page 8 of December 1960 Bulletin 76 - Exhibit B.) The USACE completed project levee construction on the San Joaquin River in the early 1960's. There are no significant changes in leveed areas or even riverine habitat which appear to be the cause of the decline of the fisheries. In fact, there have been increases in Delta wetland habitat during the periods of apparent decline. Mildred Island flooded in 1983 and has not been reclaimed. Little Mandeville and Little Frank's Tract flooded in the 1980's and have not been reclaimed. Lower Liberty Island levees were not restored and the area has been in a tidal wetland condition since at least 2002. CDWA 17 continued

The focus on conversion of Delta land to habitat as a substitute for water for fish is misplaced. Adequate analysis has not been done to determine if development of shallow wetland habitat is actually detrimental to salmon and other anadromous fish. In particular, stranding and predation from otters, egrets, herons, cormorants, gulls, white pelicans and the like needs further analysis. The limited study (Exhibit O) showing a picture of larger salmon smolts raised for a time in a wetland versus smaller smolts raised in the channel is cited as the evidence that shallow seasonal wetland in the Delta would be a substitute for flow and justification for increased exports. The study monitored caged smolts in the channel where the fish must constantly swim against the current and compared those smolts to smolts in cages in shallow wetlands where there was little or no current. The experiment did not attempt to evaluate stranding or predation and it is doubtful that the smolts in the channel cages if uncaged would spend as much time swimming against the stronger currents rather than seeking areas of the channel where the velocity is lower. The presentation of results including the fat fish/skinny fish photo neglected to show the sizes of the fish from the cages in the channel upstream of the shallow habitat which reportedly were comparable to those in the wetlands. "During periods of low, clear water, fish growth rates in the river site above the floodplain were comparable to those in the floodplain". (Exhibit O, pg 1.)

Creation of Floodplain Habitat Is Not a Substitute for Flow

The available evidence and studies do not support such a substitution. The floodplain habitat which is suggested as potentially beneficial is that which is inundated by high flows for a limited period; involves a large area of water of a proper depth to help avoid predation; assumes avian predator populations are limited; is properly drained to avoid stranding and avoids increased water temperatures detrimental to salmonids.

The Jeff Opperman Final Report for Fellowship R/SF-4 referenced above containing the picture of the fat fish and skinny fish is often shown as support for the proposition that floodplain habitat can be substituted for flow (Exhibit O.) The study does not put forth that conclusion but suggests "that juvenile Chinook benefit from access to floodplain habitats". (Page 2) It is important to recognize that the test fish were caged and thus predation from birds, fish and other animals was not an issue. Stranding was down-played but admittedly not tested. The test was conducted in and along the Cosumnes River. The skinny fish were in the river swimming against the current and

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CDWA 17 continued

because they were in cages they couldn't move with the current or move to quiet and more productive water. The fat fish obviously saved their energy for growth and apparently benefitted from improved food availability. The possibility exists that fish in the slow moving wetland water may be less able to survive than the thinner and more athletic fish spending more time in the current. The report states "During high flows the river offers poor habitat and fish living in this type of habitat will tend to be displaced downstream." High flows and displacement downstream are likely not detrimental. It is generally accepted that the salmon do well in high flow years. The return of adults (escapement) is usually higher two and one-half years after a high flow year. It is recognized that ocean conditions also play a part and may in some cases reduce escapement nullifying the benefit of high flow. The difference in food availability in the high flow channel versus in the quiet water may not be significant in the test given the consumption of energy and lack of opportunity for the skinny fish to move to more favorable parts of the river. Displacement downstream into the cooler and more productive parts of the estuary is likely not bad for displaced salmon smolts.

Floodplain Habitat Not Accompanied by High Flow Does Not Appear to Result in Increased Chinook Salmon Ocean Survival and May Not Improve Survival of Sacramento River Juvenile Chinook Salmon Migrating to the Ocean

In the study titled "Floodplain Rearing of Juvenile Chinook Salmon: Evidence of enhanced growth and survival" by Sommer, et al. (2001), a copy of which is Exhibit P, tests were conducted in the Yolo Bypass in 1998 and 1999. The study concluded that during such years salmon increased in size substantially faster in the seasonally inundated agricultural floodplain than in the river, suggesting better growth rates. The study, however, provides: "Survival indices for coded-wire-tagged groups were somewhat higher for those released in the floodplain than for those released in the river, but the differences were not statistically significant. Growth, survival, feeding success, and prey availability were higher in 1998 than in 1999, a year in which flow was more moderate indicating that hydrology affects the quality of floodplain rearing habitat". (Exhibit P, pg 1.)

In the discussion the authors provide:

> "Mean length increased faster in the Yolo Bypass during each study year, and CWT fish released in the Yolo Bypass were larger and had higher apparent growth rates than those released in the Sacramento River. It is possible that these observations are due to higher mortality rates of smaller individuals in the Yolo Bypass or of larger individuals in the Sacramento River; however we have no data or reasonable mechanism to support this argument."
>
> "Elevated Yolo Bypass survival rates are also consistent with significantly faster migration rates in 1998, the likely result of which would be reduced exposure time to mortality risks in the delta,

CDWA 17 continued

including predation and water diversions."

In the study "Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain" by Sommer, et al. (2004), a copy of which is Exhibit Q, the authors build upon the above study with further testing in 2000 and present their analysis of ocean survival.

The author's abstract provides:

> "Although juvenile Chinook salmon *Oncorhynchus tshawytscha* are known to use a variety of habitats, their use of seasonal floodplains, a highly variable and potentially risky habitat, has not been studied extensively. <u>Particularly unclear is whether a seasonal floodplain is a net "source" or net "sink" for salmonid production</u>. . . Adult ocean recoveries of tagged hatchery fish indicate that seasonal floodplains support survival at least comparable with that of adjacent perennial river channels. These results indicate that floodplains appear to be a viable rearing habitat for Chinook salmon, making floodplain restoration an important tool for enhancing salmon production. (Emphasis added.)

The data provided for ocean survival is as follows:

> Table 1. – Number of coded wire tags recovered in the ocean and commercial fisheries for Chinook salmon released in the Yolo Bypass and Sacramento River. The total number of tagged fish released in each location for each year is shown in parentheses. The survival ration is calculated as the number of Yolo Bypass recoveries divided by the number of Sacramento River recoveries.

Release Group	1998 (53,000)	1999 (105,000)	2000 (55,000)
Yolo Bypass	75	136	27
Sacramento River	35	138	47
Survival Ration	2.14	0.99	0.57

A more complete analysis is required.

<u>It Is Unclear Whether Shaded River Aquatic Habitat Is Good for Special Status Fish</u>

CDWA 18

It is assumed that shaded river aquatic habitat is desirable for special status fish and that implementation of the USACE ETL or other disturbance would require mitigation. Attention is called to the BDCP Draft Chapter 8 which puts forth the need to control predators by removing structures which affect flow fields and provide shade. The focus appears to be on abandoned docks, pilings and the like, however, shaded river aquatic habitat can provide the same affect on flow and provide shade.

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The impact of shaded river aquatic habitat on special status fish is unclear. CDWA 18 continued

Increase in Tidal Prism

A significant additional threat occurs where floodplain habitat is created in the tidal zone where increases in the tidal prism results in increased flood and ebb tide flows. Such increase in the tidal prism created by the flooding of Lower Liberty Island has been found to have caused juvenile salmon migrating to the ocean to be pushed from their normal Sacramento River migration route back up into the lower region of the Yolo Bypass thereby further exposing such fish to the risk of predation, stranding and detrimental temperatures. (See attached excerpts from "Insights into the Problems, Progress, and Potential Solutions For Sacramento River Basin Native Anadromous Fish Restoration", April 2011 by Dave Vogel). (Exhibit R.) CDWA 19

THE PROPOSED CREATION OF ADDITIONAL TIDAL WETLANDS IN THE DELTA IS NOT A REASONABLE OR PRUDENT ACTION

RPAs 1.6.1 and 1.6.2 direct restoration of floodplain habitat to the lower Sacramento basin including Liberty Island. Although still located within the basin of the lower Sacramento, Liberty Island is in great part no longer "Floodplain" or seasonally flooded but rather is permanently inundated area bordered by wetlands.

The April 2011 report by Dave Vogel titled "Insights into the Problems, Progress, and Potential Solutions for Sacramento River Basin Anadromous Fish Restoration"prepared for the Northern California Water Association and Sacramento Valley Water Users contains the results of studies which include the Liberty Island Ecological Reserve area. (The entire study can be viewed on the Northern California Water Association website by clicking on "Fisheries") (Excerpts are attached as Exhibit R).

At pages 112 and 113 the report provides:

> Subsequent, additional juvenile salmon telemetry studies were conducted by Natural Resource Scientists Inc. on behalf of the USFWS and CALFED in the north Delta (Vogel 2001, Vogel 2004). Triangulating radio-tagged fish locations in real time (Figure 61) clearly demonstrated how juvenile salmon move long distances with the tides and were advected into regions with very large tidal prisms, such as upstream into Cache Slough and into the flooded Prospect and Liberty Islands (Figure 62). During the studies, it was determined that some radio-tagged salmon were eaten by predatory fish in northern Cache Slough, near the levee breaches into flooded islands (discussed below).

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CDWA 19 continued

At page 120 the report provides:

During recent years, there has been an emphasis to reclaim or create shallow, tidal wetlands to assist in re-recreating the form and function of ecosystem processes in the Delta with the intent of benefitting native fish species (Simenstad *et al.* 1999). Amoung a variety of measures to create such wetlands, Delta island levees either have been breached purposefully or have remained unrepaired so the islands became flooded. A recent example is the flooding of Prospect Island which was implemented under the auspices of creating shallow water habitat to benefit native fish species such as anadromous fish (Christophel *et al.* 1999). Initial fish sampling of the habitat created in Prospect Island suggested the expected benefits may not have been realized due to an apparent dominance of non-native fish (Christophel *et al.* 1999). Importantly, a marked reduction of sediment load to the Delta in the past century (Shvidchenko *et al.* 2004) has implications in the long-term viability of natural conversion of deep water habitats on flooded Delta islands into shallow, tidal wetlands. The very low rates of sediment accretion on flooded Delta islands indicate it would take many years to convert the present-day habitats to intertidal elevations which has potentially serious implications for fish restoration (Nobriga and Chotkowski (2000) due to likely favorable conditions for non-salmonid fish species that can prey on juvenile salmon. Studies of the shallow water habitats at flooded Delta islands showed that striped bass and largemouth bass represented 88 percent of the individuals amoung 20 fish species sampled (Nobriga *et al.* 2003).

There have likely been significant adverse, unintended consequences of breaching levees in the Delta. There is a high probability that site-specific conditions at the breaches have resulted in hazards for juvenile anadromous fish through the creation of favorable predator habitats. The breaches have changed the tidal prisms in the Delta and can change the degree in which juvenile fish are advected back and forth with the tides (Figure 61; previously discussed). Additionally, many of the breaches were narrow which have created deep scour holes favoring predatory fish. Sport anglers are often seen fishing at these sites during flood or ebb tides. Breaching the levees at Liberty Island is an example (Figure 72 and 73). Recent acoustic-tagging of striped bass in this vicinity confirmed a high presence of striped bass (Figure 74, D. Vogel, unpub. data.)

The evidence appears to be clear that the increased tidal prism and advection of juvenile salmon into the area of Cache Slough, Prospect Island and Liberty Island resulting from maintaining Lower Liberty Island as proposed will likely cause ongoing significant adverse impacts to juvenile salmon.

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Increased Loss of Fresh Water

Absent from consideration is that surface water bodies and wetland vegetation result in increased consumptive use of fresh water when compared to farming as occurred on Lower Liberty in its pre-flooded conditions. CDWA 20

Attached hereto is Table A-5 from DWR Bulletin 168, October 1978 which shows the annual Et values for various crops and for Riparian Vegetation and Water Surface. The Riparian Vegetation and Water Surface 67.5 inches can be compared to tomatoes 33.8 inches and alfalfa 46.0 inches. The increased fresh water loss is from 33.7 inches when compared to tomatoes and 21.5 when compared to alfalfa.

For the 4,308 acres in Lower Liberty this represents an increased loss of fresh water in the range of 7,719 to 12,098 acre ft. per year which is particularly significant in drier years.

The Division of Water Resources (predecessor to The Department of Water Resources) in the Sacramento - San Joaquin Water Supervisor's report for the year 1931 dated August 1932 and designated Bulletin 23 includes the results of studies of water consumption of tules and cat-tails. Attached hereto as Exhibit S is Table 69 from such report. Consumptive use for open water surface is shown as 4.91 acre feet per acre, tules at 9.63 acre feet per acre, and alfalfa at 3.51 acre feet per acre. To examine the relatively high consumptive use for tules the U.S. Department of Agriculture undertook a continuation of the study of consumptive use for asparagus, tules and cat-tails. Tables 74 and 75 from the report are attached as Exhibit T. The tables show an average of 14.63 acre feet per acre for cat-tails and 13.48 acre feet per acre for tules. Results from cat-tails and tules grown in tanks at Camp 3, King Island for 1931 are shown in Table 77 which is attached as Exhibit U. The results for normal sized tules was 8.0 acre feet per acre.

The impacts on the increased loss of fresh water from the proposed habitat restoration in the Delta are significant and require further analysis.

The Delta already has thousands of acres tidal wetlands like what has occurred on Lower Liberty and there is no justification for more.

Water Quality

Impacts of the proposed floodplain restoration in the Delta on salinity, methyl mercury and other water quality parameters requires a more complete analysis. The increase in tidal prism alone will induce greater salinity intrusion. CDWA 21

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Damage to Adjoining Land and Levees

CDWA 22

The exposure to surrounding area levees and lands from the increased fetch for wind waves and seepage could result in levee breaks and flooding resulting in soil erosion, damage to land, structures and services, injury to and death to people and animals. Such impacts are significant and unmitigated.

CDWA 23

PREDATOR CONTROL PROGRAMS FOR BLACK BASS AND STRIPED BASS ARE IN GENERAL OF UNCERTAIN BENEFIT AND COULD HAVE A SIGNIFICANT DETRIMENTAL IMPACT ON RECREATION AND ON THE SOURCE OF FOOD FOR AN IMPORTANT SEGMENT OF THE POPULATION

The substantial decline in Striped Bass appears to parallel the decline in Delta Smelt and winter run salmon, and does not appear to correlate in any way with declines in fall run salmon even on the San Joaquin Tributaries. (See Exhibit L.) It is apparent that fish eat other fish however it is clear that Striped Bass, Delta Smelt and Salmon co-existed at relatively high populations until the late 1960's when exports from the Delta substantially increased.

Congress has specifically included Striped Bass in the CVPIA required restoration for doubling of the natural production over the 1967 to 1992 levels.

Prior to the start of the SWP in the Bulletin 76 report to the California Legislature in December 1960 the Department of Water Resources stated:

> "The 50,000 acres of water surface and almost 1,000 miles of shore line in the Delta offer a vast and fascinating area with a great diversity of recreational opportunities. Fishing is the favorite pursuit and striped bass is the leading catch. Salmon, shad, black bass, catfish and sturgeon are also important in the sportsman's bag. (emphasis added). (See Exhibit B page 22.)

Today a notable portion of the population fishing in the Delta depends on their catch for food. Black Bass and Striped Bass are a significant part of their catch.

Such predators replace other predators and all take advantage of the physical conditions of the various waterways. Modification of such conditions in particular waterbodies may prove more effective than some method of predator control.

Additionally, improved public access and facilities for fishing at Clifton Court Forebay and other publicly owned terminal locations is a better way to address predation than electroshocking, trapping and other methods which eliminate recreational opportunity and a source of food.

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A far better approach is to restore water conditions to those existing in the 1960's when populations of fish appeared to be at acceptable and sustainable levels. CDWA 23 continued

THE RPAs AND DEIS MISCHARACTERIZE THE DELTA AND REFLECT A BIAS IN FAVOR OF DELIVERIES TO CONTRACTORS

CDWA 24

The RPAs characterize the Delta as being severely degraded over the past 150 years due to anthropgenic actions within its boundaries and in the surrounding watersheds. The Delta was reclaimed pursuant to the encouragement and direction of the laws of the United States and the State of California. Through the Arkansas Act of 1850 (sometimes referred to as the Swampland Act of 1850) the mosquito infested swamps and overflowed land in the Delta and other areas of the United States was conveyed to the States for reclamation and development. In furtherance of such objective the State conveyed the lands into private ownership. Such reclamation has enhanced not degraded the human environment, and the demonstration that reclamation and farming of the Delta islands has resulted in degradation of any kind has not been set forth.

It is crystal clear that reclamation and farming of the Delta has resulted in the salvage of hundreds of thousands of acre feet of water per year by way of reduction in evaporative losses. (See above discussion and exhibits.) Water surface, cat-tails, tules and other wetland vegetation results in evaporative losses far greater than what occurs with the current use which is farming. The relevant period for fishery concerns appears to be the period since the late 1960s. Not the period prior to reclamation.

It should be recognized that most of the constituents of concern in Delta waters come from upstream and a great portion is due to SWP and CVP deliveries of water to contractors and the associated induced development.

SUGGESTED ALTERNATIVE 6

CDWA 25

An additional alternative should be put forth to require the SWP and CVP to develop a plan of operation to meet all legal requirements, including HR 2828, the CVPIA and SWRCB D-1641 without "Temporary Urgency Changes" for a recurrence of at least the droughts experienced in 1929-1934 and 1987-1992 and determine the amounts of surplus water available for delivery to contractors in each of such y ears.

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With such determination a proper comparison can then be made with the addition of the RPAs to determine impacts to the human environment. CDWA 25 continued

Very truly yours

Dante John Nomellini, Sr.
Manager and Co-Counsel

1C.1.1.1 Attachments to Comments from Central Delta Water Agency

Attachments to the Central Delta Water Agency Comment letter are included in Attachment 1C.1 located at the end of Appendix 1C.

1C.1.1.2 Responses to Comments from Central Delta Water Agency

CDWA 1: The purpose of the action, as described in Chapter 2, Purpose and Need, of the EIS, is not biased because it considers the purposes for which the CVP was authorized, and as amended by Central Valley Project Improvement Act (CVPIA), as well as the regulatory limitations on CVP operations, including applicable state and federal laws and water rights.

CDWA 2: The alternatives considered in the EIS deliver water do not deliver full contract amounts to CVP and SWP water service contractors in most years. The CVP and SWP operations assume that water is delivered to water rights holders and to meet regulatory requirements prior to delivery to CVP and SWP water contractors. Water deliveries would average about 56 to 69 percent of full contract amounts under long-term average annual water conditions, and 22 to 30 percent of full contract amounts under critical dry year water conditions as shown in in Tables C-19 and C-20 in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Table 5A.B.1 in Appendix 5A, Section B, CalSim II and DSM2 Modeling Simulations and Assumptions, for full contract amounts).

CDWA 3: The EIS compares conditions under a range of CVP and SWP water deliveries, including Delta exports, and related Delta flow scenarios. The alternatives were developed to continue to meet the CVP and SWP authorized purposes and regulatory requirements related to the CVP and SWP operations, as described in Chapter 2.

CDWA 4: The comments related to the hydrology that occurred between 1922 and 2003 is consistent with the assumptions used in the hydrologic analysis included in the EIS. Additional details related to the recent drought conditions and CVP and SWP operations has been added to the Affected Environment section of Chapter 5, Surface Water Resources and Water Supplies, of the EIS.

CDWA 5: The Delta Reform Act requires actions by state and local agencies that are within the legal definition of a covered action to be consistent with the policies included in the Delta Stewardship Council's 2013 Delta Plan (see Appendix 4A, Federal and State Policies and Regulations). As described in the 2013 Delta Plan, the current regulatory provisions of the Delta Plan, including the consistency review and appeals process, apply to only covered actions by state and local agencies. The Delta Plan also discusses that the Delta Stewardship Council is working with federal agencies to explore opportunities for federal participation in the Delta Plan implementation efforts.

CDWA 6: The Bay-Delta Conservation Plan (BDCP) is identified in the EIS as a potential future projects in the cumulative effects analysis. The BDCP, including the WaterFix alternative, is undergoing separate project development and separate environmental documentation concurrent with this EIS process. The results of that analysis are not known at this time; and therefore, are only included as a cumulative effects program.

CDWA 7: The analysis in the EIS includes a range of hydrologic conditions projected to occur with a projected 2030 level of demand and regulatory requirements (including implementation of the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions (BOs) which are consistent with the CVPIA Section 3406(b)(1) to provide sustainable populations of anadromous fish through natural production in Central Valley rivers and streams at levels not less than twice the average levels attained during the period of 1967-1991), climate change and sea level rise, as described in Appendix 5A, Section A, CalSim II and DSM2 Modeling. It is anticipated, as described in Section 5.4.2 of Chapter 5, Surface Water Resources and Water Supplies, that the projected CVP and SWP water deliveries will be less in 2030 than under existing conditions due to further use of water rights, climate change, and sea level rise. It is also anticipated that some existing users of CVP and SWP water supplies will be able to increase use of alternative water supplies. However, other users will not be able to access alternative water supplies, such as ocean desalination facilities, as described in Chapter 5. These conditions would occur under the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5. Under each of the alternatives considered in this EIS, as discussed in the response to Comment CDWA 2, full contract deliveries to CVP and SWP water contractors is not anticipated in the future.

CDWA 8: Reclamation operates to the federal and state regulatory requirements, include the State Water Resources Control Board Decision 1641 which was deemed to be adequate for the protection of beneficial uses in the Delta. None of the alternatives considered in this EIS include a new conveyance facility.

CDWA 9: As discussed in response to Comment CDWA 2, water deliveries to the CVP and SWP water contractors would average about 56 to 69 percent of full contract amounts under long-term average annual water conditions, and 22 to 30 percent of full contract amounts under critical dry year water conditions as shown in in Tables C-19 and C-20 in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Table 5A.B.1 in Appendix 5A, Section B, CalSim II and DSM2 Modeling Simulations and Assumptions, for full contract amounts). Annual exports under each of the alternatives and Second Basis of Comparison are presented in Table C-18 of Appendix 5A, Section C of the EIS. The model results are presented for monthly exceedances. For example, under Alternative 5, monthly CVP and SWP exports may be as low as 7,000 acre-feet/month during May 10 percent of the time because at this time Old and Middle River criteria would be positive. Similarly, monthly CVP and SWP exports may be as low as 80,000 acre-feet/month during May 10 percent of the time under Alternative 1 which does not include requirements for Old and Middle River flows.

CDWA 10: Reclamation operates in accordance with federal and state regulatory requirements that considers upstream and Delta water quality and flow requirements.

CDWA 11: The models used in the EIS to analyze the alternatives assume compliance with federal and state regulatory water quality requirements, as described in Appendix 5A, Section A, CalSim II and DSM2 Modeling. The purpose and need for the EIS 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. None of the alternatives considered in this EIS include a new conveyance facility.

CDWA 12: As described in Chapter 6, Surface Water Quality, it is assumed that dischargers will be in compliance with the existing and planned Total Maximum Daily Load objectives and that programs such as the Grasslands Bypass Project would be completed by 2030. Therefore, water quality in the San Joaquin River would be similar under all of the alternatives as compared to the No Action Alternative and Second Basis of Comparison.

CDWA 13: The models used in the EIS to analyze the alternatives assume compliance with federal and state regulatory water quality requirements, as described in Appendix 5A, Section A, CalSim II and DSM2 Modeling.

CDWA 14: The study referred to in this comment was published in March 2014 as the *Central Valley Project Integrated Resource Plan*.

CDWA 15: The CVP water cannot purchase water for long-term water supplies due to the Anti-Deficiency Act. In addition, purchasing water for long-term water supplies would be speculative for large amounts of water.

CDWA 16: The purpose and need for the EIS 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.

CDWA 17: The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 include tidal wetlands projects that have been initiated or completed, including Suisun Marsh Habitat Management, Preservation, and Restoration Plan; Yolo Ranch; and Northern Liberty Island Fish Restoration Project, as discussed in Sections 3.3.1.2 and 3.3.1.3.4 of Chapter 3, Description of Alternatives. The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 also includes floodplain habitat to be implemented in the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan, as discussed in Section 3.3.1.2 of Chapter 3.

CDWA 18: Alternative 4 includes provisions to not implement the U.S. Army Corps of Engineers requirements to remove vegetation from levees. This would lead to a larger extent of shaded riverine aquatic habitat as compared to conditions under No Action Alternative; Alternatives 1, 2, 3, and 5; and Second Basis of Comparison which would benefit terrestrial and aquatic resources.

CDWA 19: As described in the response to Comment CDWA 17, the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 include tidal wetlands projects that have been initiated or completed, including Suisun Marsh Habitat Management, Preservation, and Restoration Plan; Yolo Ranch; and Northern Liberty Island Fish Restoration Project which have completed environmental documentation, as discussed in Chapter 3. These areas do not specifically include projects on Lower Liberty Island.

CDWA 20: The areas for additional tidal wetlands considered under the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 do not specifically include projects on Lower Liberty Island.

CDWA 21: The EIS assumes that the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 would include similar tidal wetlands and floodplain habitat because these programs would have occurred with or without implementation of the 2008 USFWS BO and 2009 NMFS BO; and therefore, water quality changes would be similar under all of the alternatives. The environmental documentation for ongoing tidal wetland restoration projects indicate that the projects would not result in substantial changes in Delta water quality primarily because of the locations of multiple, relatively small restored areas located in the Suisun Marsh and Cache Slough areas. With respect to potential changes in mercury due to implementation of tidal wetland and floodplain restoration projects by 2030, it is assumed that the ongoing State Water Resources Control Board and Regional Water Quality Control Boards Total Maximum Daily Load (TMDL) programs will be fully implemented before 2030 and that the restoration plans will be compliant with the mandated TMDL requirements.

CDWA 22: The currently identified tidal wetlands restoration projects considered to be completed under the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 with or without implementation of the 2008 USFWS BO and 2009 NMFS BO would be located within Suisun Marsh and the Cache Slough area. Environmental documentation for several of the larger projects considered potential for impacts due to wind fetch and included design measures to protect adjacent leveed lands and uplands, including the Lower Yolo Restoration Project described in the EIS.

CDWA 23: Alternatives 3 and 4 include increased bag limits for bass as a measure to reduce the populations of these predatory fish. The alternatives do not include electroshocking or trapping. As discussed in the response to Comment CDWA 8, Reclamation operates to the federal and state regulatory requirements, include the State Water Resources Control Board Decision 1641 which was deemed to be adequate for the protection of beneficial uses in the Delta.

CDWA 24: As described in the affected environment section of Chapter 6, Surface Water Quality, constituents of concern in the Delta waters are influenced by sources located both upstream and within the Delta.

CDWA 25: The alternatives considered in the EIS were analyzed in a wide range of hydrologic conditions, including drought conditions in 1927 through 1934 and 1987 through 1992. The CalSim II model assumptions include assumptions for compliance with federal and state regulatory requirements. The model results indicate that CVP and SWP water deliveries under critical dry periods is minimal. For example, water deliveries to CVP and SWP water contractors (not water rights holders, settlement, or exchange contractors) would average about 22 to 30 percent of full contract amounts under critical dry year water conditions as shown in Tables C-19 and C-20 in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Table 5A.B.1 in Appendix 5A, Section B, CalSim II and DSM2 Modeling Simulations and Assumptions, for full contract amounts). The CalSim II model does not represent historical annual responses to extreme conditions by Reclamation, DWR, and other agencies to reduce adverse conditions to a wide range of water users, as described in Section 5.3 of Chapter 5, Surface Water Resources and Water Supplies, in the Final EIS.

1C.1.2 Central Delta Water Agency and South Delta Water Agency

BISON CONNECT

Nelson, Benjamin <bcnelson@usbr.gov>

Request for Extension of Comment Period

1 message

S. Dean Ruiz <dean@hprlaw.net> Fri, Sep 25, 2015 at 12:59 PM
To: "bcnelson@usbr.gov" <bcnelson@usbr.gov>
Cc: "Dante Nomellini, Sr. (ngmplcs@pacbell.net)" <ngmplcs@pacbell.net>, "John Herrick (Jherrlaw@aol.com)" <Jherrlaw@aol.com>, "Dan Nomellini Jr (dantejr@pacbell.net)" <dantejr@pacbell.net>

Dear Mr. Nelson:

CDWA
SDWA 1

I am attorney for both the Central and South Delta Water Agencies. The Agencies request an extension of the comment period for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft EIS. The issues contained within the EIS are highly complicated and involved. This is an extremely busy time in the water field. Many of us are also allocating our limited resources and time reviewing the DEIS/DEIR for the California Water Fix. An extension of the comment period is clearly in the best interest of the public.

I appreciate your consideration of this request.

Sincerely,

S. Dean Ruiz, Esq.

HARRIS, PERISHO & RUIZ

ATTORNEYS AT LAW

Brookside Corporate Center

3439 Brookside Road, Suite 210

Stockton California 95219

Telephone: (209) 957-4254

Facsimile: (209) 957-5338

www.harrisperishoruiz.com

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1C.1.2.1 Responses to Comments from Central Delta Water Agency and South Delta Water Agency

CDWA and SDWA 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.

1C.1.3 East Bay Municipal Utility District

EAST BAY
MUNICIPAL UTILITY DISTRICT

RICHARD G. SYKES
DIRECTOR OF WATER AND NATURAL RESOURCES
(510) 287-1629
rsykes@ebmud.com

<u>VIA EMAIL (bcnelson@usbr.gov) AND U.S. MAIL</u>

September 29, 2015

Mr. Ben Nelson, Natural Resources Specialist
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

SUBJECT: Comments on the Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project & State Water Project

Dear Mr. Nelson:

EBMUD 1

The East Bay Municipal Utility District (EBMUD) appreciates this opportunity to comment on the Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (DEIS). EBMUD supplies water to nearly 1.4 million people in the East Bay. EBMUD's 332-square mile water service area encompasses incorporated and unincorporated areas within Alameda and Contra Costa Counties. EBMUD's Mokelumne River and East Bay watershed sources of supply are sufficient in most years. However, to reliably meet the needs of its customers in dry years, EBMUD uses CVP water under its Long Term Renewal Contract No. 1406-200-5183A-LTR1 (LTRC) with Reclamation in addition to its Mokelumne and East Bay supplies.

EBMUD 2

Table 5D.33 of Appendix D of the DEIS tabulates water demand and supply information for EBMUD under future conditions. Information in this table appears to have been developed based on review of EBMUD's 2010 Urban Water Management Plan and Water Supply Management Program 2040 Plan. However, information is incorrect and the manner in which information is presented in this table does not accurately reflect EBMUD's portfolio approach to meeting current and future water demands or the unique nature of EBMUD's dry-year only LTRC. EBMUD's Mokelumne system is severely limited during droughts. Our CVP supply is central to our drought planning and provides a critical water supply that reduces the potential for severe water rationing and economic losses during droughts, in combination with continued use of stored Mokelumne supplies, aggressive conservation and recycling programs, and other water supplies.

EBMUD requests that Table 5D.33 be corrected as shown in the attached redlined version of the table. Based on EBMUD's understanding of the alternatives, we do not believe our water supply planning would change based on Reclamation's implementation of a preferred alternative.

We appreciate this opportunity to comment on the DEIS. If you have any questions about these comments, please contact me at 510-287-0125.

Sincerely,

Michael T. Tognolini
Manager of Water Supply Improvements

Attachment

375 ELEVENTH STREET . OAKLAND . CA 94607-4240 . FAX (510) 287-0541
P.O. BOX 24055 . OAKLAND . CA 94623-1055

Table 5D.33 East Bay Municipal Utility District

Items	Water Demand and Supplies (acre-feet)	Notes
Water Demand		
Service Area Water Demand	~~256,500~~ 349,440[1]	East Bay Municipal Utility District. 2011. *Urban Water Management Plan 2010 Document*. June.
Water Sales to Others	–	–
Total Demand	~~256,500~~ 349,440	–
Water Supplies for NAA	~~Supplemental supply~~	~~Up to 133,000 acre-feet in a dry year, with a maximum of 165,000 acre-feet over three dry years, CVP Water Service Contract (14-08-200-5183A-LTR1) from the American River.~~
CVP Water Supplies	Dry year supply	Up to 133,000 acre-feet in a dry year, with a maximum of 165,000 acre-feet over three dry years, CVP Water Service Contract (14-08-200-5183A-LTR1) from the American River.
SWP Water Supplies	–	–
Other Imported Water Supplies	~~241,746~~ Up~~-~~ to 240,800[2]	~~Up~~ EBMUD has up to 364,037 acre-feet of water rights on the Mokelumne River, but available amount varies depending on hydrology per East Bay Municipal Utility District. ~~2012. *Water Supply Management Program 2040 Plan*. April. Assume 241,746 acre-feet based on information per East Bay Municipal Utility District.~~ 2011. *Urban Water Management Plan 2010 Document*. June~~; and East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April~~.
Local Surface Water Supplies	16,800	Water rights from local watersheds within the East Bay Municipal Utility District (EBMUD) watershed average 16,800 to 28,000 acre-feet per East Bay Municipal Utility District. ~~2012. *Water Supply Management Program 2040 Plan*. April.~~ 2011. *Urban Water Management Plan 2010*. June.
Groundwater	~~1,120~~ Dry year supply	Up to 1,120 acre-feet in dry years. Bayside Groundwater Project Phase 1 groundwater recharge facility within EBMUD service area per East Bay Municipal Utility District. ~~2012. *Water Supply Management Program 2040 Plan*. April. Assume 241,746 acre-feet based on information per East Bay Municipal Utility District.~~ 2011. *Urban Water Management Plan 2010 Document*. June~~; and East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April~~.

EBMUD
2
continued

EBMUD
2
continued

Items	Water Demand and Supplies (acre-feet)	Notes
Recycled Wastewater	11,200 22,400[3]	11,200 acre-feet additional reclamation per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April. This value is consistent with 20,970 acre-feet in East Bay Municipal Utility District. 22,400 acre-feet from East Bay Municipal Utility District. 2011. *Urban Water Management Plan 2010 Document*. June.
Recycled Stormwater	–	–
Desalination[4]	Dry year supply	Up to 22,400 acre-feet in dry years from regional desalination facility; however, not anticipated until 2040 per East Bay Municipal Utility District. 2011. *Urban Water Management Plan 2010 Document*. June. –
Transfers/Exchanges[4]	Dry year supply	5,040 to 49,952 acre-feet in dry years. Transfers from Northern California water users per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.
Conservation	35,580 69,440[5]	35,850 acre-feet from permanent conservation programs per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April. This is greater than projections of 25,227EBMUD's Water Conservation Master Plan is based on 69,440 acre-feet conservation in 2040, per East Bay Municipal Utility District. 2011. *Urban Water Management Plan 2010 Document*. June. Up to 38,500 acre-feet could be saved from 15 percent rationing during droughts or emergencies as compared to UWMP demand projections for 2030. However,
Bayside Groundwater Project Phase 2[4]	Dry year supply	2,240 to 10,080 acre-feet in dry years. Bayside Groundwater Project Phase 2 per East Bay Municipal Utility District. 2011. *Urban Water Management Plan 2010 Document*. June.
Groundwater Banking outside of EBMUD service area[4]	Dry year supply	Dry year supply of 4,704 acre-feet of groundwater banking in Sacramento Valley and/or 19,500 acre-feet in San Joaquin Valley; not anticipated until 2040 per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.
Enlarge Lower Bear Reservoir[4]	Dry year supply	Up to 4,500 acre-feet in dry years; however, not in plan for 2030 per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.

Expand Los Vaqueros Reservoir[4]	Dry year supply	Exact amount available to be determined and additional study needed per East Bay Municipal Utility District. *Urban Water Management Plan 2010*. June.
Total Future Water Supplies ~~for NAA~~	349,440[6] (non-dry years)	Does not include CVP water supply for dry years ~~or~~, up to 15 percent rationing in dry years, or other dry year supply projects.
~~**Possible Future Water Supplies**~~		
~~Bayside Groundwater Project Phase 2~~	~~10,080~~	~~Bayside Groundwater Project Phase 2 per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April. Requires further study and environmental analyses.~~
~~Groundwater Banking outside of EBMUD service area~~	–	~~Includes 4,704 acre-feet of groundwater banking in Sacramento Valley and/or 19,500 acre-feet in San Joaquin Valley; not anticipated until 2040 per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.~~
~~Transfers~~	~~14,560~~	~~Transfers from Northern California water users per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.~~
~~Regional Desalination Facility~~	–	~~Up to 22,400 acre-feet from regional desalination facility; however, not anticipated until 2040 per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.~~
~~Enlarge Lower Bear Reservoir~~	–	~~Up to 4,500 acre-feet; however, not in plan for 2030 per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.~~ ~~Enlargement of Pardee Reservoir is not included in the recommendations of the East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.~~
~~Expand Los Vaqueros Reservoir~~	~~6,700~~	~~Up to 6,700 acre-feet per East Bay Municipal Utility District. 2012. *Water Supply Management Program 2040 Plan*. April.~~
~~**Subtotal Potential Future Water Supplies**~~	–	~~All future projects not included for M&I No Action Alternative assumptions since some of the future projects are not fully defined or analyzed.~~
~~**Total Potential Future Water Supplies**~~	~~306,446~~	~~**Does not include CVP water supply for dry years or up to 15 percent rationing in dry years.**~~

EBMUD 2 continued

Notes:

1 Represents EBMUD's projected 2040 demand.
2 "Other Imported Water Supplies" include EBMUD's entitlements on the Mokelumne River. Although EBMUD has water rights up to 364,037 acre-feet, the actual amount available in any given year varies depending on hydrology, required releases to senior downstream water rights holders, and releases to meet instream flow requirements.
3 EBMUD's goal is to deliver 22,400 acre-feet of recycled water by the year 2040.
4 EBMUD has identified a range of water supply projects that it will pursue simultaneously to meet future water needs. By considering a broad mix of projects, with inherent scalability and the ability to adjust implementation schedules for a particular component, EBMUD will be able to minimize the risks associated with future uncertainties such as project implementation challenges and climate change. If EBMUD is able to successfully develop one component, this could result in deferral of other additional water supply components over the planning period.
5 EBMUD's goal for conservation is 69,440 acre-feet by the year 2040.
6 During normal years EBMUD anticipates having sufficient supplies to meet demands. Meeting customer demands during dry years will depend on the use of CVP supplies, rationing, and the implementation of additional water supply projects.

EBMUD 2 continued

1C.1.3.1 Responses to Comments from East Bay Municipal Utility District

EBMUD 1: Comment noted.

EBMUD 2: The suggested changes have been included in Table 5D.33 of Appendix 5D, Municipal and Industrial Water Demands and Supplies. Information related to future actions have been categorized within the definitions of the No Action Alternative and the cumulative effects actions.

1C.1.4 El Dorado County Water Agency

El Dorado County Water Agency

Maria Capraun, Georgetown Divide P.U.D.
James R. Jones, South Tahoe P.U.D.
Michael Ranalli, Board of Supervisors
Shiva Frentzen, Board of Supervisors
Brian K. Veerkamp, Board of Supervisors

September 24, 2015

Mr. Ben Nelson,
Natural Resources Specialist
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

Subject: El Dorado County Water Agency (EDCWA) Comments

Dear Mr. Nelson:

EDCWA 1

This letter summarizes EDCWA comments to the Bureau of Reclamation (Reclamation) Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (DEIS). Comments relate entirely to EDCWA's pending long term water service contract with Reclamation for up to 15,000 acre-feet annually (AFA) of Central Valley Project (CVP) municipal and industrial M&I water supply. The contract was mandated by Public Law 101-514, Section 206(b)(1)(B), dated November 5, 1990, and is commonly referred to as the "EDCWA Fazio Contract".

EDCWA 2

Comment 1. The DEIS erroneously refers to the EDCWA Fazio Contract in several locations as a Warren Act Contract. The EDCWA Fazio Contract should be correctly characterized in the Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) as a long-term water service contract. Error locations in the DEIS include, but may not be limited to:

- Executive Summary, Section ES.8.8, Alternative 5.
- Chapter 3, Section 3.4.5.1, Continued Long-Term Operation of the CVP and SWP Facilities.
- Chapter 3, Section 3.4.7.1.1, Water Demands.
- Chapter 5, Section 5.4.3.4 Alternative 3.
- Chapter 5, Section 5.4.3.6 Alternative 5.

EDCWA 3

Comment 2. The EDCWA Fazio Contract is integral and immediate to any future operation of the CVP and should therefore have been included in all alternatives, rather than just Alternatives 3 and 5. The allocation of 15,000 AFA is assumed under the No

Mr. Ben Nelson,
Natural Resources Specialist
El Dorado County Water Agency (EDCWA) Comments
Page 2 – September 24, 2015

EDCWA 3 continued

Action Alternative and should also be assumed under all other alternatives in the DEIS. Accordingly, the EDCWA Fazio Contract and the full 15,000 AFA need to be clearly identified and incorporated into Reclamation's ROD, regardless of which alternative or combination of alternatives Reclamation selects for the following reasons:

1. The ROD should recognize Reclamation's intent to comply with Public Law 101-514 which directs and requires the Secretary of the Interior to execute the contract;

2. The ROD should be consistent with Reclamation's analysis contained in the "Biological Assessment on the Continued Long-term Operations of the Central Valley Project and the State Water Project, dated August 2008" (2008 BA); and

3. The ROD should recognize that, after extraordinary effort by the parties over many years, the contracting process is nearly complete. To date, Reclamation has: (a) negotiated and is in the process of updating a draft final contract with EDCWA; (b) completed and released a Draft EIS for public review; and (c) completed Endangered Species Act Section 7 consultation and received letters of concurrence from the U.S. Fish and Wildlife Service and National Marine Fisheries Service respectively. In addition, the EDCWA Board of Directors (Board) has certified the Final Environmental Impact Report for purposes of California Environmental Quality Act (CEQA) compliance. The Board has directed the Interim General Manager to complete the process and execute the contract on a priority basis as soon as possible during this fiscal year.

Thank you for your consideration. EDCWA is prepared to provide additional information as necessary to further support our comments. Please contact me directly at ken.payne@edcgov.us or (916) 425-0734.

Sincerely,

Kenneth V. Payne, P.E.
Interim General Manager
El Dorado County Water Agency

cc: Mr. Jim Abercrombie, General Manager, El Dorado Irrigation District
Mr. Ron Milligan, Regional Operations Manager, Bureau of Reclamation
Mr. Drew Lessard, Area Manager, Bureau of Reclamation
Mr. Rick Woodley, Regional Resources Manager, Bureau of Reclamation
Craig Muehlberg, Deputy Area Manager, Bay-Delta Office

1C.1.4.1 Responses to Comments from El Dorado County Water Agency

EDCWA 1: Comment noted.

EDCWA 2: The text has been modified in Section ES.8.8 of the Executive Summary; Sections 3.4.5.1 and 3.4.7.1.1 of Chapter 3, Description of Alternatives; and Sections 5.4.3.4 and 5.4.3.6 of Chapter 5, Surface Water Resources and Water Supplies to provide the correct reference to the El Dorado County Water Agency water service contract.

EDCWA 3: Specific implementation plans and approvals for delivery of CVP water under the El Dorado County Water Agency water service contract were not finalized at the time of the publication of the Notice of Intent for this EIS in March 2012. Therefore, these deliveries were not included in the No Action Alternative or all of the alternatives. This water service contract has been included in Alternatives 3 and 5 of the EIS. However, during the review of the numerical modeling analyses used in this EIS, it was discovered that the demands for the El Dorado County Water Agency contract were not included in the CalSim II modeling analysis for Alternatives 3 and 5 as presented in Chapters 5 through 21. A sensitivity analysis using the CalSim II model to compare the results of the analysis with and without these demands is presented in Appendix 5B of this EIS for Alternatives 3 and 5. The results of the sensitivity analysis have been used in conjunction with the results presented in Chapters 5 through 21 to analyze the effects of including the CVP water service contract for El Dorado County Water Agency in Alternatives 3 and 5, as described in Sections 3.4.6 and 3.4.7 of Chapter 3, Description of Alternatives, and Section 5.4.3 of Chapter 5, Surface Water Resources and Water Supplies. Results of the impact analysis for all of the alternatives will be considered by Reclamation during preparation of the Record of Decision.

1C.1.5 El Dorado Irrigation District

Bill George – *President*
Division 3

Greg Prada – *Director*
Division 2

Dale Coco, MD – *Director*
Division 4

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George Osborne – *Vice President*
Division 1

Alan Day – *Director*
Division 5

Jim Abercrombie
General Manager

Thomas D. Cumpston
General Counsel

In reply refer to: M0915-015 and L2015-53

September 29, 2015

Mr. Ben Nelson
Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814–2536

Via Facsimile (916) 414–2439
Via Email bcnelson@usbr.gov

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

Dear Mr. Nelson:

EID 1

Thank you for the opportunity to provide comments to the U.S. Bureau of Reclamation (Reclamation) on the Draft Environmental Impact Statement (DEIS) for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) (Project). The El Dorado Irrigation District (EID) has vital interests in the Project and its environmental review as a holder of one CVP Water Service Contract (WSC) and two Warren Act Contracts (WAC), as a proposed subcontractor for a second WSC at Folsom Reservoir, and as the only water purveyor that does not receive its Folsom Reservoir supplies from federal pumping facilities.

EID currently holds a long-term WSC in the amount of 7,550 acre-feet (AF) annually. In addition to this CVP supply in Folsom Reservoir, EID also holds a long-term WAC in the amount of 4,560 AF annually associated with long-held water rights for which EID has relocated its points of diversion or rediversion to Folsom Reservoir. Further, EID holds a 5-year WAC in the amount 8,500 AF annually, which represents a portion of a 17,000-AF water right EID holds. EID and Reclamation have been working together for the past decade to enter into a long-term WAC for the full quantity of this right. In addition to these supplies, EID is a proposed subcontractor to El Dorado County Water Agency (EDCWA) for a proposed WSC as required by Public Law 101-514, Section 206(b)(1)(B). EDCWA has been pursuing that WSC with

2890 Mosquito Road, Placerville CA, 95667 (530) 622-4513

El Dorado Irrigation District

Reclamation since the early 1990s. These existing and future supplies will be withdrawn from Folsom Reservoir through EID's intake facilities that have been in operation since 1961. EID 1 continued

The following comments address EID's concerns about inconsistencies and errors in how the WSC and WAC are addressed and characterized in the DEIS, and also address Reclamation's requirement to construct a temperature control device or equivalent contribution to a regional solution in association with EID's pursuit of its non-federal supplies in Folsom Reservoir.

Current and Future Demands and Supplies of El Dorado Irrigation District

In Chapter 5 *Water Resources and Water Supplies,* the DEIS states that assumptions related to municipal water demands are based upon review of Urban Water Management Plans (UWMPs) (page 5-67). Future supplies were compared to the No Action Alternative and the Second Basis of Comparison assumptions to determine if the projects were reasonable and certain to occur by 2030. Reclamation indicated that projects that had undergone environmental review or met other certain specified conditions were included in the future water supply assumptions for 2030 in the No Action Alternative and the Second Basis of Comparison. Projects described in the UWMPs that are currently under evaluation were included in the Cumulative Effects analysis for future water supplies. Finally, in the DEIS Reclamation indicated that future water supplies considered for municipalities by 2030 were presented in Appendix 5D *Municipal and Industrial Water Demands and Supplies*. EID 2

Although Chapter 5 of the DEIS describes this decision process for future water supplies, Appendix 5D introduces two additional terms –"Possible Future Water Supplies" and "Potential Future Water Supplies" – but does not appear to define these terms or explain if either or both are included within the roster of projects Reclamation has determined to be reasonable and certain to occur by 2030. Inclusion of the descriptors "possible" and "potential" implies there may be some question as to whether projects in these categories would proceed. In the case of the 17,000 AF WAC and 15,000 AF WSC, these contracts should be categorized as "projected" or "planned" if there is a need to qualify or subcategorize future Reclamation Actions.

EID completed its environmental review of the 17,000-AF WAC by filing a California Environmental Quality Act (CEQA) Notice of Determination on July 13, 1999. El Dorado County Water Agency (EDCWA) completed its CEQA review of the 15,000-AF CVP WSC by filing its NOD on January 20, 2011. Therefore, the CEQA obligations for these contracts were satisfied prior to initiation of environmental review (determined by issuance of the Notice of Intent) for the Project and these contracts have been included in UWMPs for many years. EID 3

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El Dorado Irrigation District

Further, Reclamation consulted with the National Marine Fisheries Service (NMFS) regarding both the WAC and WSC and received Endangered Species Act determination concurrence for full execution of both actions on May 22, 2014 and June 2, 2014, respectively. EID 3 continued

Given this information, these contracts should be included with the Municipal Water Supply Projects that, together with a host of other actions, would occur with or without the Project as described on pages ES-9 and ES-10. However, for unknown reasons, Reclamation has, at least in some portions of the DEIS (pages 3-34, 3-41, 5-126, and 5-181 among potential others),not acknowledged these contracts as such and instead has proposed implementation of both these actions separately from all other Municipal Water Supply Projects with the same or similar status. Further, it appears that completion of the final steps of these contracting efforts, even though they have been ongoing for the past decade or more, are only proposed under Alternatives 3 and 5 of the Project. This treatment is erroneous: Reclamation has included both contracts in future condition Operational Criteria and Plan (OCAP) modeling for over a decade in both the 2004 and 2008 OCAP consultations, issued a DEIS for the EDCWA WSC, executed a five-year WAC for 8,500 AF of the full 17,000 AF, collaborated with EID to prepare NEPA documentation for the 17,000 AF long-term WAC, and publicly negotiated the WSC and WAC. The supplies provided by these contracts represent critical needs for the citizens of El Dorado County and are reasonably certain to occur. Therefore, for the reasons described herein, EID respectfully requests that Reclamation remove the separate characterization of these two contracts from the EIS and properly include these contracts (or clarify that they are already included) with the Municipal Water Supply Projects that would be considered to occur under the No Action Alternative and Second Basis of Comparison and, therefore, implemented under all alternatives.

EID reviewed Appendix 5A and notes that at page 5A-51, EID's 4,560-AF long-term WAC does not appear to be included in the modeling assumptions for the No Action Alternative and Second Basis of Comparison. EID and Reclamation executed this WAC (Contract No. 06-WC-20-3315) on September 9, 2010 and EID has regularly exercised the WAC since 2011. These demands should therefore be included in the modeling analysis. EID notes that in this location of the document, both the 17,000-AF WAC to EID and the 15,000-AF WSC to EDCWA are correctly included in the No Action Alternative and Second Basis of Comparison. EID 4

EID reviewed Appendix 5D and notes that Reclamation correctly characterized EID's 17,000-AF water supply provided by the El Dorado Hydroelectric Project (Project No. 184) as an existing supply (page 5D-15) under the No Action Alternative (NAA). However, this page erroneously EID 5

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states that this supply is diverted at Forebay Reservoir. EID does divert some Project No. 184 water at Forebay Reservoir for consumptive uses pursuant to various pre-1914 water rights, , but the water rights permit for the 17,000-AF supply requires that it be diverted from Folsom Reservoir under a WAC. The five-year, 8500-AF WAC (Contract No. 15-WC-20-4654) currently satisfies that requirement. EID 5 continued

On page 5D-16, Reclamation incorrectly characterizes agricultural ditch supplies diverted from the North Fork Cosumnes River, Clear Creek, and Squaw Hollow Creek as contributors towards EID's municipal and industrial (M&I) water supplies. In fact, these are non-potable water supplies provided to EID's agricultural customers who have no other alternative sources. They cannot be utilized for M&I purposes and are not influenced by M&I supply conditions. The agricultural descriptor should conversely be removed from the EID water demand in Table 5D.12. The Middle Fork Cosumnes River supply described on that page serves potable water supplies to an EID satellite water systems that has no interconnection with EID's main system and cannot be served by M&I supplies from or influenced by Folsom Reservoir conditions. This supply should also be removed from this description of currently available supplies under the NAA.

Further, EID notes that Reclamation has incorrectly characterized the current available supplies of recycled water under the NAA. In its UWMP, EID noted that approximately 3,804 AF of recycled water is currently available annually. Supplies may climb to 7,730 AF annually by 2030 as additional wastewater is generated that can be treated to recycled water standards, but the availability of these supplies is affected by the amount of M&I water available, including the 17,000 AF WAC and EID's portion of the 15,000-AF WSC to EDCWA.

In summary, it appears that not every alternative in the DEIS as written clearly includes the long-proposed EID and EDCWA contracts. Unless this error is corrected, it is possible that Reclamation could select an alternative in the Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) that omits these contracts, which could leave Reclamation without the NEPA coverage to enter into these contracts and thus leave EID unable to access critical supplies that we have been working toward in cooperation with Reclamation for over a decade. EID 6

Heeding Reclamation's recommendations and advice on many occasions over the past several years, EID and EDCWA have patiently waited for the remand process to take its course so the final steps of the contracting process could be completed. We are therefore alarmed to find ourselves responding to a DEIS that fails to clearly and properly characterize our contracts, and

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El Dorado Irrigation District

that potentially excludes them from NEPA coverage, without any prior notice, coordination, or explanation from Reclamation. EID requests that Reclamation utilize the FEIS/ROD process to rectify this error and clarify and correctly characterize these two contracts so they are clearly included under each alternative.

EID 6 continued

Requirement for Temperature Control Device (TCD) on EID Facilities

EID 7

Reclamation and EID have been working together for nearly twenty years to develop mechanisms to manage the cold water pool in Folsom Reservoir, while also providing the M&I water supplies that the Folsom facilities were intended to serve. As part of those efforts, EID secured federal funding through congressional authorizations and appropriations on three separate occasions to offset the costs to construct new, or modify EID's existing intake facilities to improve temperature control. Since securing those authorizations and funding, EID has conducted and shared with Reclamation numerous engineering and modeling evaluations and determined that the significant capital costs of modifying EID's facilities would provide only nominal cold water pool benefits. EID has therefore advocated allocating this funding and other matching sources toward a regional TCD solution that would more effectively contribute toward improving temperature management of the penstock outlet facilities, and has funded technical analyses to identify effective solutions. EID and Reclamation have negotiated contractual provisions acknowledging the option to pursue, and EID's contribution toward, the most cost-effective solution, which is reflected in WAC 15-WC-20-4654 currently being exercised. NMFS has accepted this agreement in its May 22, 2014 Endangered Species Act (ESA) concurrence letter to Reclamation for the full 17,000-AF WAC.

Even though Reclamation and NMFS have both agreed to this approach, the DEIS does not appear to acknowledge this important fact. Page 3-21 describes various structural improvements for temperature management, including a TCD on EID's intake facilities, but this section only describes the facilities in the context of actions that would otherwise occur by 2030 under the No Action Alternative. Page ES-5 indicates that many of the provisions of the 2009 NMFS Biological Opinion (BO) will require subsequent environmental documentation for future facilities to be constructed or modified, which EID understands includes either a TCD on EID's facility or a regional TCD solution. This page continues by indicating that specific actions are not known at this time and therefore the EIS assumes completion of the actions in a manner consistent with the ESA and does not address impacts during construction or start-up phases. Accordingly, it does not appear that the DEIS accurately reflects Reclamation's view that the potential requirement of installing a TCD at EID's intake that would be cost-ineffective and

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make negligible improvements to Folsom Reservoir temperature management, and should therefore be abandoned.

EID 7 continued

Although Page ES-11 indicates that Alternative 2 does not include implementation of the 2009 NMFS BO Reasonable and Prudent Alternative Action II.3 Structural Improvements for Temperature Management on the American River, of which the EID-facility TCD is a part, EID was unable to locate any other reference to this TCD in the document. Therefore, EID respectively requests that in the Final EIS, Reclamation include within the proposed action and alternatives the option to proceed with the regional TCD solution concept as included within WAC 15-WC-20-4654 and authorized by NMFS.

EID respectively requests that Reclamation address these comments to correctly characterize EID's existing and near-term water supplies and the potential for EID to contribute toward a regional TCD solution during preparation of the Final EIS, which EID understands is due by December 1, 2015 according to the U.S. District Court for the Eastern District of California. If there are any questions regarding these comments please contact Dan Corcoran, Environmental Manager, at (530) 642-4082 so that EID can facilitate Reclamation's revisions in the FEIS.

EID 8

Sincerely,

Jim Abercrombie
General Manager

JA:DMC:pj

cc: Tom Cumpston, General Counsel
Brian Poulsen, Senior Deputy General Counsel
Brian Mueller, Director of Engineering
Dan Corcoran, Environmental Manager
Drew Lessard, Central California Area Office Manager, Bureau of Reclamation
Ron Milligan, Central Valley Operations Office Manager, Bureau of Reclamation
Ken Payne, Interim General Manager, El Dorado County Water Agency

1C.1.5.1 Responses to Comments from El Dorado Irrigation District

EID 1: Comment noted.

EID 2: In Appendix 5D, the words “Possible Future Water Supplies” refer to water supplies considered under a cumulative effects analysis. The words “Potential Future Water Supplies” refers to the total of water supplies considered under the No Action Alternative and the cumulative effects analysis.

In the Final EIS, the next-to-last subheading in the tables has been changed to “Subtotal Possible Future Water Supplies.”

EID 3: As described in Appendix 5B, Sensitivity Analysis on Representation of EID’s Warren Act and EDCWA’s Water Service Contracts with Reclamation in Alternatives 3 and 5, of the EIS, these two actions were included in a sensitivity analysis in Alternatives 3 and 5. These actions were not included in the No Action Altenative, Second Basis of Comparison, and Alternatives 1, 2, and 4 because there was a need to conduct an analysis of these contracts on the coordinated long-term operation of the CVP and SWP.

EID 4: The 4,560 acre-feet of Ditch water rights is included in the upstream depletion analysis; and therefore is accounted for in the CalSim II modeling.

EID 5: The changes included in this comment have been incorporated into Appendix 5D in the Final EIS.

EID 6: As described in response to Comment EID 3, Reclamation has included assumptions for the El Dorado Irrigation District Warren Act contract and El Dorado County Water Agency CVP water service contract in Alternatives 3 and 5 to provide an analysis of implementation of these contracts with the coordinated long-term operation of the CVP and SWP. However, during the review of the numerical modeling analyses used in this EIS, it was discovered that the demands for the El Dorado Irrigation District Warren Act contract were not included in the CalSim II modeling analysis for Alternatives 3 and 5 as presented in Chapters 5 through 21. A sensitivity analysis using the CalSim II model to compare the results of the analysis with and without these demands is presented in Appendix 5B of this EIS for Alternatives 3 and 5. The results of the sensitivity analysis have been used in conjunction with the results presented in Chapters 5 through 21 to analyze the effects of including the CVP Warren Act contract for El Dorado Irrigation District in Alternatives 3 and 5, as described in Sections 3.4.6 and 3.4.7 of Chapter 3, Description of Alternatives, and Section 5.4.3 of Chapter 5, Surface Water Resources and Water Supplies.

The Preferred Alternative is described in Section 1.5 of Chapter 1, Introduction, of the Final EIS.

EID 7: The No Action Alternative and Alternative 5 included an assumption that either the Temperature Control Device (TCD), or equivalent actions, would be implemented to conserve the cold water pool in Folsom Lake in accordance with the 2009 NMFS BO. It is recognized that based upon recent studies, the TCD for EIS deliveries may or may not be required for long-term operations to conserve the cold water pool, and that future studies will be completed to finalize decisions related to specific operations and any necessary facilities. Therefore, the fisheries analysis in Chapter 9, Fish and Aquatic Resources, assumes that the cold water pool is conserved without specifying the methodology used by El Dorado Irrigation District under the No Action Alternative and Alternative 5.

The discussion in the Executive Summary and Chapter 3, Description of Alternatives, indicate that Action II.3 of the 2009 NMFS BO is only included in the No Action Alternative and Alternative 5. The text under Section 3.3.3 of Chapter has been expanded to specifically indicate which actions under the biological opinions are not included under the Second Basis of Comparison; and therefore, by definition of the alternatives, not included in Alternatives 1, 3, and 4.

The discussion in Chapter 9, Fish and Aquatic Resources, has been expanded to specifically provide more details in the text of each alternative related to this analysis.

EID 8: Comment noted.

1C.1.6 El Dorado Water and Power Authority

EL DORADO COUNTY BOARD OF SUPERVISORS • EL DORADO COUNTY WATER AGENCY • EL DORADO IRRIGATION DISTRICT

EL DORADO
WATER & POWER
AUTHORITY

4110 Business Drive, *Suite* B
Shingle Springs, California 95682
Tel 530.621.5392, *Fax* 530.672.6721
www.co.el-dorado.ca.us/waterandpower

September 24, 2015

Mr. Ben Nelson,
Natural Resources Specialist
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

Subject: El Dorado Water & Power Authority (EDWPA) Comments

Dear Mr. Nelson:

This letter summarizes EDWPA comments to the Bureau of Reclamation (Reclamation) Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (DEIS). Comments relate to EDWPA's pending filed petitions with the SWRCB for partial assignment of State Filed Applications 5644 and 5645, and accompanying applications allowing for the total withdrawal and use of 40,000 acre-feet per year from the American River watershed, as is commonly referred to as the "EDWPA Water Reliability Project" (formally the Supplemental Water Rights Project). EDWPA 1

Comment. Section *3.5 Assumptions for Cumulative Effects Analysis* of the DEIS correctly includes the El Dorado Water & Power Authority's Water Reliably Project *(Section 3.5.1.6 El Dorado Water and Power Authority Supplemental Water Rights Project)* as a reasonably foreseeable future action included in the cumulative effects analysis. The allocation of 40,000 AFA should be included in the No Action Alternative and assumed under all other alternatives in the DEIS. The EDWPA Water Reliability Project with the full diversion of 40,000 AFA needs to be clearly identified and incorporated into Reclamation's ROD, regardless of which alternative or combination of alternatives Reclamation selects. EDWPA 2

El Dorado Water & Power Authority (EDWPA) Comments
Mr. Ben Nelson,
Natural Resources Specialist
September 24, 2015
Page 2

Thank you for your consideration. EDWPA is prepared to provide additional information as necessary to further support our comments. Please contact me directly at ken.payne@edcgov.us or (916) 425-0734.

Sincerely,

Kenneth V. Payne, P.E.
Interim Executive Director
El Dorado Water & Power Authority

cc: Mr. Jim Abercrombie, General Manager, El Dorado Irrigation District
Mr. Brian Veerkamp, Chair, El Dorado County Board of Supervisors
Mr. Ron Milligan, Regional Operations Manager, Bureau of Reclamation
Mr. Drew Lessard, Area Manager, Bureau of Reclamation
Mr. Rick Woodley, Regional Resources Manager, Bureau of Reclamation
Craig Muehlberg, Deputy Area Manager, Bay-Delta Office

1C.1.6.1 Responses to Comments from El Dorado Water and Power Authority

EDWPA 1: Comment noted.

EDWPA 2: Specific implementation plans and approvals for the El Dorado Water and Power Authority Water Reliability Project were not finalized at the time of the publication of the Notice of Intent for this EIS in March 2012. Therefore, these deliveries were not included in the No Action Alternative or any of the alternatives. This water service contract has been included in cumulative effects analyses of the EIS. Results of the impact analysis, including consideration for cumulative effects, for all of the alternatives will be considered by Reclamation during preparation of the Record of Decision.

1C.1.7 Cities of Folsom and Roseville and San Juan Water District

September 29, 2015

Mr. Ben Nelson
Bureau of Reclamation
801 I Street, Suite 140
Sacramento, CA 95814-2536

BY U.S. MAIL AND E-MAIL TO
bcnelson@usbr.gov

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

Dear Mr. Nelson:

This letter presents comments by our agencies on the Bureau of Reclamation's Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project ("DEIS"). We incorporate the comments in the analysis prepared by Bartkiewicz, Kronick & Shanahan, P. C. (Attachment A) and the technical memorandum prepared by MBK Engineers (Attachment B). Folsom Roseville SJWD 1

As discussed in more detail in the attached comments, the DEIS should be revised and additional analysis should be conducted before Reclamation adopts a Final Environmental Impact Statement ("FEIS") for these actions. Folsom Roseville SJWD 2

We are also concerned that the DEIS shows significant impacts to Folsom Reservoir storage, which our region is dependent upon for our water needs. These impacts include reducing the probability that American River Region municipal and industrial contractors like our agencies will receive full allocations from the CVP from approximately 50 percent to 30 percent of all years, while increasing the probability we will receive only 50 percent allocations from approximately 5 percent to 10 percent of all years. The DEIS also shows reduced Folsom Reservoir carryover storage, which will increase the likelihood of extreme shortage conditions at Folsom Reservoir. Folsom Roseville SJWD 3

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We look forward to your responses to these comments.

Very truly yours,

CITY OF FOLSOM

By: Marcus Yasutake
Environmental and Water Resources Director

CITY OF ROSEVILLE

By: Richard Plecker
Director, Environmental Utilities

SAN JUAN WATER DISTRICT

By: Shauna Lorance
General Manager

Encls.

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ATTACHMENT A

BARTKIEWICZ, KRONICK & SHANAHAN

PAUL M. BARTKIEWICZ
RICHARD P. SHANAHAN
ALAN B. LILLY
RYAN S. BEZERRA
JOSHUA M. HOROWITZ
KATRINA C. GONZALES
ANDREW J. RAMOS

Of Counsel
STEPHEN A. KRONICK

A PROFESSIONAL CORPORATION
1011 TWENTY-SECOND STREET
SACRAMENTO, CALIFORNIA 95816-4907
TEL. (916) 446-4254
FAX (916) 446-4018
E-MAIL bks@bkslawfirm.com

September 29, 2015

Mr. Marcus Yasutake
Environmental and Water Resources Director
City of Folsom
50 Natoma Street
Folsom, CA 95630

Mr. Richard Plecker
Director, Environmental Utilities
City of Roseville
2005 Hilltop Circle
Roseville, CA 95747

Ms. Shauna Lorance
General Manager
San Juan Water District
9935 Auburn-Folsom Road
Granite Bay, CA 9574

Dear Mr. Yasutake, Mr. Plecker, and Ms. Lorance:

This letter presents the analysis prepared by Bartkiewicz, Kronick & Shanahan, P. C. to assist your agencies when commenting on the Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project ("DEIS") prepared by the Bureau of Reclamation ("Reclamation"). Folsom Roseville SJWD 4

As discussed further below, the DEIS requires revisions and additional analyses before Reclamation adopts a Final Environmental Impact Statement for these proposed actions. The DEIS incorrectly defines the No Action Alternative, which renders analysis in the DEIS incorrect and leads Reclamation to not propose required mitigation measures. Folsom Roseville SJWD 5 The hydrologic analysis in the DEIS also does not account for the legal requirements that protect the American River Region and does not adequately analyze impacts to Folsom Reservoir from implementation of the proposed actions. Folsom Roseville SJWD 6

1. The DEIS Incorrectly Defines the No Action Alternative and, As a Result, Does Not Comply with the Ninth Circuit's Direction to Reclamation to Prepare an EIS that Analyzes the Human and Environmental Costs of Implementing the Biological Opinions' Reasonable and Prudent Alternatives Folsom Roseville SJWD 7

Under the National Environmental Policy Act ("NEPA"), each federal agency must prepare a detailed environmental impact statement ("EIS") for any "major Federal action[] significantly affecting the quality of the human environment." (42 U.S.C. § 4332, subd. (2)(c).) The EIS must include "the alternative of no action." (40 C.F.R. § 1502.14(d); *American Rivers v. FERC* (9th Cir. 1999) 187 F.3d 1007, 1020.) The no action alternative represents the "status quo," defined as the continuation of existing policy and management direction without adoption

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of the proposed major Federal action. (*American Rivers*, *supra*, 187 F.3d at pp. 1020-1021.) The EIS also must explore and evaluate the proposed action and all reasonable alternatives, and include appropriate mitigation measures not already included in the proposed action or alternatives. (40 C.F.R. § 1502.14, subds. (a)-(c), (f).)

Folsom Roseville SJWD 7 continued

On November 13, 2009, Judge Oliver Wanger entered a memorandum decision, which determined that Reclamation violated NEPA by failing to conduct an environmental assessment or prepare an EIS before provisionally accepting the United States Fish and Wildlife Service's 2008 delta smelt biological opinion ("2008 USFWS BiOp") and its proposed Reasonable and Prudent Alternative ("RPA"). The Ninth Circuit affirmed Judge Wanger's decision on this issue, concluding that Reclamation's provisional adoption of the RPA in the 2008 USFWS BiOp was a major federal action because adoption of the RPA would effect a change in the "status quo" for operation of the state and federal projects. (*San Luis & Delta-Mendota Water Authority v. Jewell* (2014) 747 F.3d 581, 646.) Regarding the purpose of requiring Reclamation to prepare an EIS, the Ninth Circuit's decision emphasized that the EIS prepared by Reclamation must disclose the effects of adopting the RPAs:

> At this point, we can only speculate about what kind of significant effects will eventually result from implementation of the BiOp because Reclamation has not yet completed its EIS. But it is beyond dispute that Reclamation's implementation of the BiOp has important effects on human interaction with the natural environment. We know that millions of people and vast areas of some of America's most productive farmland will be impacted by Reclamation's actions. Those impacts were not the focus of the BiOp. In sum, we cannot reach an informed decision about the extent to which implementation of the BiOp is an environmental preservation action in the vein of *Douglas County* and *Drakes Bay Oyster* because we do not know how the action will impact the broader natural environment. We find no basis for exempting Reclamation from the EIS requirement. [Citation.] We recognize that the preparation of an EIS will not alter Reclamation's obligations under the ESA. *But the EIS may well inform Reclamation of the overall costs – including the human costs – of furthering the ESA*.

(*San Luis & Delta-Mendota Water Authority*, *supra*, 747 F.3d at 653 (italics added).)

Following these court orders, Reclamation prepared the DEIS. (DEIS, p. 1-9.) The DEIS states that its purpose is to "conduct a NEPA review to determine *whether the RPA actions cause a significant impact on the human environment*." (DEIS, p. 2-2 (italics added).) In the DEIS, however, Reclamation defined the baseline, "No Action Alternative" conditions to include the RPA actions described in the 2008 USFWS BiOp RPA and the 2009 National Marine Fisheries Service ("NMFS") salmonid biological opinion ("2009 NMFS BiOp") in 2030. (DEIS, pp. 3-21 to 3-22.) The DEIS states Reclamation did this because Reclamation provisionally accepted and implemented the RPAs in the 2008 USFWS BiOp and 2009 NMFS BiOp prior to preparation of

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the DEIS. (DEIS, p. 3-22.) The DEIS also includes a Second Basis of Comparison that does not include implementation of the RPAs. (*Ibid.*)

Folsom Roseville SJWD 7 continued

By defining the No Action Alternative to include the major federal action that the courts ordered Reclamation to analyze, Reclamation has not complied with NEPA or these court orders. As required by the Ninth Circuit's decision, the purpose of requiring Reclamation to prepare an EIS was to inform Reclamation of the human and environmental costs of significantly changing the status quo for the state and federal water projects by adopting the RPAs. (*San Luis & Delta-Mendota Water Authority*, *supra*, 747 F.3d at 653.) The DEIS does not meet this requirement because it *assumes* the RPAs are part of the status quo by defining the No Action Alternative to include them. This flaw affects the DEIS's analysis, because it assumes that the status quo includes incurring the significant human and environmental costs of implementing the RPAs, and then the DEIS proceeds to analyze the five alternatives against this assumption. This is the opposite of the analysis required by NEPA and ordered by the Ninth Circuit's decision.

The DEIS attempts to address this issue by including a "Second Basis of Comparison," which "represents a condition in 2030 without implementation of the 2008 USFWS BO and 2009 NMFS BO," and then by also comparing the other alternatives to this basis of comparison. (DEIS, p. 3-3.) However, this analytical approach does not satisfy the Ninth Circuit's decision, because the DEIS does not describe the incremental changes from the Second Basis of Comparison to the alternatives as impacts of the proposed actions, and, as a result, the DEIS does not consider whether mitigation measures are needed to address the impacts of the alternatives when compared to the Second Basis of Comparison. Instead, the inclusion of the RPAs in the No Action Alternative leads the DEIS to improperly conclude that no mitigation is necessary for the adoption of the RPAs. If the DEIS had properly included adoption of the RPAs as an alternative, rather than as part of the No Action Alternative, then the DEIS would have been required to include appropriate mitigation measures to address the effects of the implementing the RPAs. (40 C.F.R. § 1502.14, subd. (f).) Instead, the DEIS assumes implementation of the RPAs and fails to include appropriate mitigation measures to address their effects. (See, e.g., DEIS, pp. 5-237 to 5-261 (failing to include mitigation for effects on surface water of implementing the RPAs).)

2. Numerous Legal Requirements Protect the American River Region's Interests from Being Adversely Impacted by Reclamation's and DWR's Operation of the Projects

Folsom Roseville SJWD 8

Some of the oldest water rights in California concern the American River and are held by agencies in this region, which – unlike other regions of California – is solely dependent on its local water sources. For example, the City of Folsom and San Juan Water District ("SJWD") hold water rights that date to the 1850s. To obtain the water rights needed for the CVP Folsom Unit, and to be authorized to proceed to construct and operate this Unit, Reclamation was required to sign several settlement contracts concerning water supplies deriving from the

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American River. Those settlement contracts include contracts now held by the Cities of Folsom and Sacramento and SJWD.

Folsom Roseville SJWD 8 continued

In addition, when Reclamation applied to the then-State Water Rights Board ("SWRB") for its water-right permits for the CVP's Folsom Unit, numerous agencies in this region had pending applications for American River water rights. These agencies included the City of Roseville and predecessors of SJWD. In its 1958 decision that issued the Folsom Unit's water-right permits to Reclamation, Decision 893, the SWRB imposed on those permits a term – Term 14 – to protect those local applicants:

> Deliveries of water under permits issued pursuant to Application 13370 and 13371 shall be limited to deliveries for beneficial use within Placer, Sacramento and San Joaquin Counties and shall not be made beyond the westerly or southerly boundaries thereof, except on a temporary basis, until the needs of those counties, present or prospective, are fully met provided, however, that agreements in accordance with Federal Reclamation laws between permittee and parties desiring such service within said counties are executed by July 1, 1968.

The 1968 deadline was extended to December 31, 1975 under agreements signed by Reclamation. (Decision 1356, pp. 7-8; Decision Amending And Affirming As Amended, Decision 1356, p. 1 (1970).)

The City of Roseville, SJWD, Placer County Water Agency and the Sacramento Municipal Utility District signed CVP water-service contracts to which Term 14 applies. (Term 14 does not apply to the Reclamation contracts under which the City of Folsom receives water.) Term 14 requires Reclamation to operate the CVP to ensure water-service contract deliveries to these agencies consistent with the intent the SWRB stated in Decision 893:

> Permits are being issued to the United States to appropriate enough American River water to adequately supply the applicants naturally dependent on that source and availability of water to such applicants is reasonably assured by the terms to be contained in the permits to be issued to the United States restricting exportation of water under those permits insofar as exportation interfers [*sic*] with fulfillment of needs within Placer, Sacramento and San Joaquin Counties. Other applicants in more remote areas must if necessary seek water from other sources.

(Decision 893, p. 54.)

Besides these requirements that apply specifically to the CVP's Folsom Unit, California's area-of-origin laws also require Reclamation to operate the CVP to ensure water supplies for this region. For example, Water Code section 11460 – which applies to the CVP through Water Code section 11128 – states (italics added):

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> In the construction *and operation* by the department of any project under the provisions of this part a watershed or area wherein water originates, or an area immediately adjacent thereto which can conveniently be supplied with water therefrom, shall not be deprived by the department directly or indirectly of the prior right to all of the water reasonably required to adequately supply the beneficial needs of the watershed, area, or any of the inhabitants or property owners therein.

Folsom Roseville SJWD 8 continued

Federal law requires Reclamation to respect these state law provisions and water right permit terms in its operation of the CVP. Section 8 of the Reclamation Act of 1902 provides:

> Nothing in [the Reclamation Act] shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or *distribution* of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of [the Reclamation Act], shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof.

(43 U.S.C., § 383 (italics added).)

In *California v. United States*, the United States Supreme Court held that section 8 requires Reclamation to show substantial deference to state laws unless such laws are "directly inconsistent with congressional directives." ((1978) 438 U.S. 645, 678.) Specifically, the Supreme Court concluded Reclamation must comply with conditions imposed by the SWRCB in its operations of New Melones Dam, which is part of the CVP. In reaching this conclusion, the Supreme Court traced the historical relationship between federal government and the states in the reclamation of arid lands, stating that through this relationship "runs the consistent thread of purposeful and continued deference to state water law by Congress." (*Id.* at p. 653.)

Notwithstanding these legal requirements for the CVP's operations, as explained below, the DEIS indicates that Reclamation would not comply with these legal requirements.

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3. The DEIS Shows Reclamation's Operation of the Projects Would Not Comply with the Numerous Legal Requirements that Protect the American River Region's Interests

As discussed in more detail in the technical comments prepared for your agencies by MBK Engineers, the DEIS shows implementation of the RPAs would significantly impact Folsom Reservoir storage. The DEIS's hydrologic modeling states that implementing the RPAs would reduce the probability of American River Region municipal and industrial ("M&I") contractors receiving full allocations from the CVP from approximately 50 percent to 30 percent

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of all years, while the probability of receiving only 50 percent allocations would increase from approximately 5 percent to 10 percent of all years. The DEIS also states that implementation of the RPAs would result in reduced Folsom Reservoir carryover storage. (DEIS, pp. 5-93 to 5-95.)

Folsom Roseville SJWD 9 continued

The DEIS states that Reclamation will place a disproportionate burden on Folsom Reservoir by using it as a "first responder" to meet Delta water quality standards.

> Folsom Reservoir also is operated by Reclamation to release water to meet Delta salinity and flow objectives established to improve fisheries conditions. Weather conditions combined with tidal action and local accretions from runoff and return flows can quickly affect Delta salinity conditions, and require increases in spring Delta inflow to maintain salinity standards, as described in Appendix 3A, No Action Alternative: Central Valley Project and State Water Project Operations. In accordance with Federal and state regulatory requirements, the CVP and SWP are frequently required to release water from upstream reservoirs to maintain Delta water quality. Folsom Lake is located closer to the Delta than Lake Oroville and Shasta Lake; therefore, the water generally is first released from Folsom Lake. Water released from Lake Oroville and Shasta Lake generally reaches the Delta in approximately three and four days, respectively. As water from the other reservoirs arrives in the Delta, Folsom Reservoir releases can be reduced.

(DEIS, pp. 5-32 to 5-33.)

This description of planned CVP and State Water Project ("SWP") operations demonstrates that Reclamation's proposed actions would violate the legal protections that apply to the American River region. This portion of the DEIS states that, for operational convenience, Reclamation plans to impose a disproportionate burden on the region for meeting Delta water quality standards, which are intended to address Delta-export operations, not operations necessary to meet water-supply or environmental requirements in the American River region.

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Because the alternatives discussed in the DEIS are inconsistent with the legal requirements protecting the American River region's water supplies, the DEIS should include at least one alternative that would comply with the settlement contracts held by contractors in this region, the terms in Reclamation's water-right permits for Folsom Dam and Reservoir, and California's area of origin protections.

4. The DEIS Does Not Fully Analyze Impacts Related to Folsom Reservoir Storage

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As discussed in more detail in the technical memorandum prepared by MBK Engineers, the DEIS's hydrological analysis does not accurately analyze how the CVP and SWP would be operated with the combined effects of climate change and multi-year droughts, and, as a result,

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does not properly analyze the impacts of the proposed action on Folsom Reservoir storage and deliveries to American River Region M&I contractors.

The DEIS acknowledges that its analysis and conclusions are probably inaccurate during extremely dry conditions that come with multi-year droughts:

> Under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II utilizes a series of operating rules to reach a solution to allow for the continuation of the simulation. It is recognized that these operating rules are a simplified version of the very complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, *model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are an approximation of extreme operational conditions*. As an example, CalSim II model results show simulated occurrences of extremely low storage conditions at CVP and SWP reservoirs during critical drought periods when storage is at dead pool levels at or below the elevation of the lowest level outlet. Simulated occurrences of reservoir storage conditions at dead pool levels may occur coincidentally with simulated impacts that are determined to be potentially significant. When reservoir storage is at dead pool levels, there may be instances in which flow conditions fall short of minimum flow criteria, salinity conditions may exceed salinity standards, diversion conditions fall short of allocated diversion amounts, and operating agreements are not met.

(DEIS, p. 5-61 (italics added).)

Folsom Roseville SJWD 11 continued

Regarding climate change, the DEIS does not disclose the proposed alternatives' impacts against baseline conditions without projected climate change. Instead, all of the DEIS's alternatives include the projected future impacts of climate change in the 2030 timeframe. (DEIS, p. ES-7.) This makes it impossible for reviewers to segregate impacts that are predicted to result from climate change from the impacts that would occur from implementation of the proposed alternatives. Furthermore, as discussed in MBK's technical memorandum, it is not possible to know whether future climate change will occur exactly as projected in the DEIS's single climate change scenario. Therefore, the DEIS does not adequately inform the public of the proposed alternatives' impacts, because the lack of an analysis of the proposed alternatives' impacts without climate change obscures how the state and federal projects are likely to operate if climate change does not occur exactly as projected in the DEIS.

Folsom Roseville SJWD 12

The DEIS also does not adequately analyze the impacts of, and potential mitigation for, water shortages in the American River region during multi-year droughts. As discussed in the following paragraphs, the DEIS should include further analysis of the potential impacts that water shortages would have on groundwater storage, socioeconomics and public health.

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Regarding the impacts to groundwater levels from the No Action Alternative, the DEIS concludes that, despite reduced water supplies from the CVP and SWP, groundwater levels would be similar in the Sacramento Valley Groundwater Basins. (DEIS, p, 7-121.) However, the DEIS should separately analyze groundwater impacts to the Sacramento Valley's subbasins to account for the impacts of water shortages in particular areas, including the American River region. Groundwater resources historically were overdrawn in northern Sacramento County and have been recovering largely because surface water from Folsom Reservoir and the American River have been made more widely available in this region. Significant reductions in future Folsom Reservoir storage levels, resulting in reduced surface water deliveries to American River Region M&I contractors, would increase groundwater withdrawals and would cause drawdowns in groundwater supplies. These increased withdrawals could further impact groundwater resources, because contamination from previous industrial and military operations is present in Sacramento County aquifers and could migrate as a result of increased demands on those groundwater aquifers. Folsom Roseville SJWD 13 continued

The DEIS also does not adequately analyze the socioeconomic impacts resulting from severe water shortages. The DEIS's analysis of the socioeconomic impacts of regional changes to M&I water supplies assumes that M&I contractors would be able to make up for shortages using alternate stored surface and groundwater supplies, increased groundwater pumping and transfers. (DEIS, p. 19-40.) However, such supplies are limited for agencies like ours, which cannot be served economically with pumped groundwater. For example: (1) the City of Roseville can pump groundwater from the western portion of its service area to a portion of the rest of its service area, but not all of it; (2) San Juan Water District can rely on some of its retail suppliers using groundwater, but groundwater cannot be used throughout the District's service area; and (3) the City of Folsom has little ability to serve groundwater in much of its existing service area. Furthermore, because your agencies divert surface water at Folsom Reservoir, and there are few opportunities for transfers from upstream water users, the DEIS's assumption that your agencies could alleviate significant water shortages through transfers is not supported. Folsom Roseville SJWD 14

The DEIS also does not adequately analyze impacts to public health from the possible lack of M&I water supplies sufficient to meet minimal public health and safety needs during severe water shortages. As the DEIS acknowledges, during the current drought, the cutbacks in CVP and SWP allocations have been the most stringent in history, with CVP M&I water service contractors receiving only 50 percent of the amounts of their historical use. (DEIS, pp. 18-2 to 18-3.) As discussed above, implementation of the RPAs will continue to reduce M&I deliveries. During multi-year droughts, this may lead to the physical unavailability of water from the M&I intake at Folsom Reservoir. (DEIS, p. 5-30.) That intake would become dry if the reservoir's water level were to decline to about 320 feet above mean sea level, which would be when there is about 100,000 acre-feet (AF) of water stored there. Several agencies that use the intake would begin to have serious water-supply problems at reservoir storage volumes well above 100,000 AF. Folsom Roseville SJWD 15

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Despite the DEIS's own statements regarding the potential impacts on your region from implementation of the RPAs during multi-year droughts, the DEIS states that it is too "difficult" to identify local public health and safety issues associated with severe water shortages. (DEIS, p. 18-4.) The DEIS should provide an analysis of potential impacts to public health and safety associated with long-term reductions in CVP M&I deliveries, and especially those impacts associated with extreme shortages during multi-year droughts. This analysis is necessary to comply with the Ninth Circuit's statement that the DEIS must inform Reclamation of the human cost of implementing the RPAs. (*San Luis & Delta-Mendota Water Authority*, *supra*, 747 F.3d at 653 (italics added).)

Folsom Roseville SJWD 15 continued

For the reasons discussed in this letter, the DEIS should be revised and additional analyses should be conducted before Reclamation adopts a Final Environmental Impact Statement. The DEIS incorrectly defines the No Action Alternative, which renders analysis in the DEIS incorrect and leads Reclamation to not propose required mitigation measures. The hydrologic analysis in the DEIS also does not account for the legal requirements that protect the American River Region and does not adequately analyze impacts to Folsom Reservoir that would occur from implementation of the proposed actions.

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Very truly yours,

ALAN B. LILLY

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ATTACHMENT B

MBK ENGINEERS

Water Resources • Flood Control • Water Rights

TECHNICAL MEMORANDUM

DATE: September 29, 2015

TO: Alan B. Lilly

FROM: Lee G. Bergfeld and Walter Bourez

SUBJECT: Technical Comments on Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft Environmental Impact Statement

This technical memorandum is a summary of MBK Engineers' (MBK) findings and opinions on the hydrologic modeling that the U.S. Bureau of Reclamation (Reclamation) performed for the draft environmental document for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (LT Ops DEIS).

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This review focuses on water operations modeling using CalSim II. CalSim II is a computer program jointly developed by the California Department of Water Resources (DWR) and Reclamation. CalSim II presents a comprehensive simulation of State Water Project (SWP) and Central Valley Project (CVP) operations. CalSim II is widely recognized as the most prominent water management model in California, and it is generally accepted as a useful and appropriate tool for assessing the water delivery capability of the SWP and CVP. CalSim II estimates, for various times of the year, how much water will be diverted, how much will serve as instream flows, and how much will remain in reservoirs.

For the LT Ops DEIS, Reclamation applied CalSim II to analyze how CVP and SWP operations changed as a result of implementation of the Reasonable and Prudent Alternatives (RPAs) in the 2008 U.S. Fish and Wildlife Service (USFWS) Biological Opinion (BO) on Delta smelt and the 2009 National Marine Fisheries Service (NMFS) Biological Opinion on Chinook salmon. The coding and assumptions included in the CalSim II model drive the results. Data and assumptions, such as the amount of precipitation runoff at a certain measuring station or the demand for water by specific water users are input into the model. Criteria used to operate the CVP and the SWP (including regulatory requirements such as biological opinions) are included in model assumptions. Because of the volume of water controlled and delivered by the CVP and SWP, these operational criteria significantly influence model results. Additionally, operational logic is coded into CalSim II to simulate how DWR and Reclamation would operate the system under circumstances for which there are no regulatory or otherwise definitive rules, e.g. when to move water from storage in reservoirs upstream of the Delta to reservoirs downstream of the Delta. This attempt to simulate the logic sequence and relative weighting that the CVP and SWP operators use as part of their "expert judgment" is a critical element of CalSim II.

The CalSim II model is the foundational model for analysis of the LT Ops DEIS, including effects and impacts analyses. Results from CalSim II are used to examine how water supply and reservoir operations are modified by the RPAs in both BOs and for each project alternative. CalSim II results are also used by subsequent models to determine physical and biological effects including water quality, water levels, water temperature, Delta flows, and fish response. Any errors or inconsistencies identified in the underlying CalSim II model are therefore present in subsequent analyses of environmental effects. Folsom Roseville SJWD 17 continued

The following sections provide our comments on CalSim II analysis conducted for the LT Ops DEIS (LT Ops DEIS Model).

Climate Change

Analysis presented in the LT Ops DEIS attempts to incorporate the effects of climate change at a future date of approximately 2025 (LT Ops DEIS, page 5A.A-27). The methodology followed in the LT Ops DEIS is the same as used in analysis for the Bay-Delta Conservation Plan DEIS/EIR and the California Water Fix Revised DEIS/EIR. Analysis for the LT Ops DEIS is focused on an Early Long-Term (ELT) condition, as simulated in several different Global Climate Models under a range of future emissions conditions. These different Global Climate Model results, which vary significantly in their depictions of future temperatures and precipitation, are analyzed to determine a central tendency used to represent a potential future condition. The central tendency prediction of changes in temperature and precipitation is downscaled from large spatial grids used in Global Climate Models and input to the Variable Infiltration Capacity (VIC) hydrology model to generate simulated natural stream flows. These climate-influenced simulated stream flows on a watershed scale are then used to determine fractional changes from the historical, observed inflow patterns in CalSim II. Changes are then applied to the monthly historical reservoir inflows in CalSim II to depict a future, climate-changed hydrology. Folsom Roseville SJWD 18

Figure 1 illustrates the assumed average annual and monthly Folsom Reservoir inflows at the ELT condition, by water year type (historical Sacramento Valley Water Year Type), that were used for analysis of all alternatives in the LT Ops DEIS Model.

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Folsom Roseville SJWD 18 continued

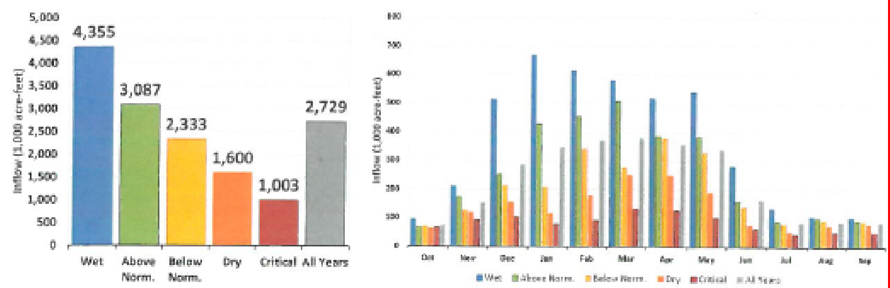

Figure 1: Average Annual and Monthly Inflow to Folsom in All Alternatives of LT Ops DEIS Model

Figure 2 shows the changes in the average annual and monthly Folsom inflows by water year type between the ELT condition used in the LT Ops DEIS Model and historically based inflows from a recent CalSim II study from Reclamation. The historically-based inflows were used for analysis of the CVP Municipal and Industrial (M&I) Water Shortage Policy Environmental Impact Statement released September 2015. Differences in Figure 2 show that while the average annual reduction in Folsom Reservoir inflow is only 9,000 acre-feet under the ELT assumptions, there are much higher reductions in drier year types, and seasonal shifts to higher inflows from November through March, and lower inflows from May through October.

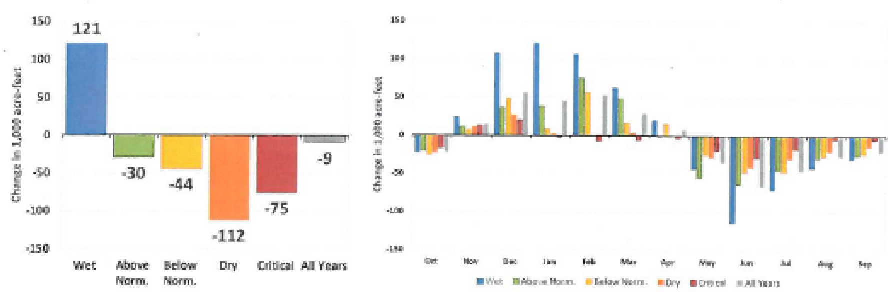

Figure 2: Average Annual and Monthly Change in Inflow to Folsom under ELT Climate Change Conditions included in All Alternatives of LT Ops DEIS Model

There is considerable uncertainty regarding the effects of climate change on future temperatures and precipitation. As described above, the LT Ops DEIS relied on one potential depiction of these effects. Analysis of only one potential future condition does not cover the range of potential future conditions and introduces inconsistent assumptions in the model. An example of these inconsistent assumptions occurs on the upper American River. The LT Ops DEIS assumed changes from historical inflow to Folsom based on potential change in future temperatures and precipitation and analysis with the VIC model to understand changes in natural stream flows. However, the American River watershed upstream from Folsom Reservoir is not

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expected to change in the same manner as a natural stream. There is significant storage capacity in Placer County Water Agency's (PCWA) Middle Fork Project and the Sacramento Municipal Utility District's (SMUD) Upper American River Project. Operations of these reservoirs directly affect Folsom inflow and operating criteria such as flood credit space. To produce acceptable modeling of Folsom Reservoir and the American River, there must be consistency in the hydrology used to model reservoirs upstream from Folsom and the hydrology used to model Folsom Reservoir. Changes in inflow and operations of these upstream projects should be considered to properly incorporate climate change into modeling of Folsom Reservoir. Alternatively, climate change analysis could be conducted as sensitivity analysis, as opposed to being included in all project alternatives. Standard practice for modeling CVP and SWP operations is to simulate the No Action and Project alternatives with historically-based hydrology. In our opinion, this is the preferred approach to avoid inconsistencies in model assumptions and over reliance upon results from one of many potential future climate-changed conditions.

Folsom Roseville SJWD 19 continued

Additionally, in examining possible effects of climate change, it is not appropriate to assume that current project operations will remain static and not respond to climate change. The analysis for the LT Ops DEIS assumes continued operations of the CVP and SWP without adaptations. This approach produces results that are not useful for dealing with the complex problem of climate change because it does not reflect the way in which the CVP and the SWP would actually operate, whether or not the RPAs are implemented. We recommend a sensitivity analysis be conducted to develop a better understanding of the range of possible responses to climate change by the CVP and SWP, and the regulatory structures that dictate certain project operations.

Climate Change Assumptions Result in Unrealistic Operations

Review of model output for the LT Ops DEIS No Action Alternative (NAA) reveals that the model is operated beyond its usable range. The purpose of CalSim II is to simulate how the CVP and SWP systems would be operated to meet regulatory requirements and water delivery objectives based on a certain amount of precipitation and runoff. When the precipitation patterns and resultant runoff were changed for the LT Ops DEIS Model with climate change, the logic regarding how the system is operated to meet the regulatory and water delivery objectives was not changed. The net effect is that during certain periods of the model simulation neither the regulatory criteria nor the delivery objectives are met.

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With the predicted changes in precipitation and temperature implemented in the LT Ops DEIS Model, there is simply not enough water available in the simulation to meet all regulatory objectives and water user demands. Yet the LT Ops DEIS Model continues its normal routine until the modeled system essentially crashes and thus fails to meet its objectives. In this aspect, the LT Ops DEIS Model simply does not simulate reality. For example, if ELT conditions actually occur, the CVP and SWP would likely adapt to protect water supplies and the environment. Examples of adaptations to climate change would likely include: (1) updating operational rules regarding water releases for flood protection; (2) during severe droughts, emergency drought declarations could call for mandatory conservation, changes in some

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Folsom Roseville SJWD 20 continued

regulatory criteria, or even an inability to meet contractual obligations, similar to what has occurred during the current and previous droughts; and (3) if droughts become more frequent, the CVP and SWP would likely revisit the rules by which they allocate water during shortages and operate with lower deliveries during wetter years. The likelihood of an appropriate operational response to climate change is supported by the many modifications to CVP and SWP operations that were made during the winter and spring of 2014 and 2015 to respond to the current drought. Thus, while the LT Ops DEIS Model shows that difficult decisions will have to be made if ELT conditions occur, the LT Ops DEIS Model does not attempt to simulate the results of such decisions.

Under the climate change conditions, reservoir storage (particularly in the CVP system) is simulated to operate aggressively such that reservoirs are drawn down to an extremely low level. Simulated storage levels reach the model-defined dead pool, at which point no water can be released from reservoir storage – for fish, drinking water, or agriculture. CalSim II specifies dead pool in Folsom Reservoir as 90,000 acre-feet and storage reaches this level during approximately six percent of all years (see Figure 3). By comparison, since Folsom Reservoir became operational in 1955, the lowest storage level on record was 147,000 acre-feet at the end of September 1977. However, the LT Ops DEIS Model predicts that, with ELT climate change, reservoir storage will be approximately 90,000 acre-feet, nearly 40% lower than its historical low, during six percent of all years. Some municipalities, like the City of Folsom, the City of Roseville, and San Juan Water District, are almost entirely dependent on Folsom Reservoir releases for drinking water; and Folsom Reservoir's reaching 90,000 acre-feet could cut their municipal deliveries below the levels required to maintain public health and safety for over 500,000 people.

In reality, and to avoid such dire circumstances, the CVP and SWP would likely request that regulatory agencies modify the applicable standards so that the CVP and SWP could conserve storage. Conservation or rationing by water users would probably also occur. Similar steps were taken in spring 2014 and 2015 to reduce water diversions and reservoir releases for fishery needs and Delta requirements. Emergency measures such as these are not simulated in the model, so the LT Ops DEIS Model does not reflect reasonable future operations with climate change.

Modeling climate change, without adaptation measures, leads to results showing insufficient water supplies to meet all regulatory objectives and user demands. This modeling approach significantly limits the utility of the LT Ops DEIS Model results in analyzing the effects of implementing the RPAs, particularly during drought conditions. With future conditions modeled to be so dire, the modeled effects of the RPAs are reduced because it appears that conditions cannot get any worse; i.e., reservoir storage cannot be reduced below minimum levels. However, in reality, the future conditions will not be as depicted in the LT Ops DEIS Model. Operations during the current drought show that drawing reservoirs down to near minimum levels to meet regulatory and contractual requirements is not realistic. Instead, difficult decisions are made in an attempt to balance environmental conditions in reservoirs and rivers, while still meeting water supply needs. These real-world decisions create different environmental conditions than simulated in the LT Ops DEIS Model. Therefore, comparisons of

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results from alternatives simulated in the LT Ops DEIS Model do not capture the environmental effects during these drought periods. We recommend Reclamation, in cooperation with key agencies, develop more realistic operating rules for the hydrologic conditions expected over the next half-century, and incorporate those operating rules into any CalSim II model that includes climate change.

Folsom Roseville SJWD 20 continued

Effects of the Biological Opinions

The LT Ops DEIS states Reclamation was ordered by the Ninth Circuit Court to prepare the EIS to "*determine whether the acceptance and implementation of the RPA actions cause a significant effect on the human environment*" (LT Ops DEIS page ES-6). The LT Ops DEIS No Action Alternative (NAA) includes implementation of the RPA actions in the simulated operations of the CVP and SWP. Effects from the implementation of the RPA actions on the American River Basin are shown by comparison of the NAA with the Second Basis of Comparison (SBC). Reclamation developed the SBC, which does not include RPA actions, in response to scoping comments, and to provide a basis of comparison to determine effects of implementing RPA actions.

MBK previously analyzed the effects of implementing the 2008 USFWS and 2009 NMFS BOs on CVP and SWP operations without climate change. Overall, changes in simulated CVP/SWP operations contained in the LT Ops DEIS are generally consistent with previous studies conducted by MBK. Differences in the effects presented in the LT Ops DEIS, where they exist, are likely due to the inclusion of climate change.

Folsom Roseville SJWD 21

An important assumption for the operation of Folsom Reservoir, as simulated for the LT Ops DEIS, is that both the NAA and the SBC include operations to meet the Lower American River Flow Management Standard (FMS). The FMS was one of the RPA actions in the 2009 NMFS BO; however, it also is included in the SBC. The inclusion of the FMS in both the NAA and SBC is important when comparing results of the two studies because none of the differences between the NAA and the SBC are the result of implementing the FMS. Additionally, the majority of the other RPA actions apply to areas outside of the American River Basin. Therefore, changes in Folsom Reservoir operations and deliveries in the American River Basin are a result of CVP operations to meet RPA actions outside of the basin.

Folsom Roseville SJWD 22

For water users in the American River Basin, potential effects on the human environment are focused on the operation of Folsom Reservoir and water deliveries. Figure 3 illustrates the probability of exceedance for end-of-September (carryover) storage in Folsom Reservoir for the NAA with implementation of the BO RPA actions and the SBC without implementation of the BO RPA actions.

Folsom Roseville SJWD 23

Folsom Roseville SJWD 23 continued

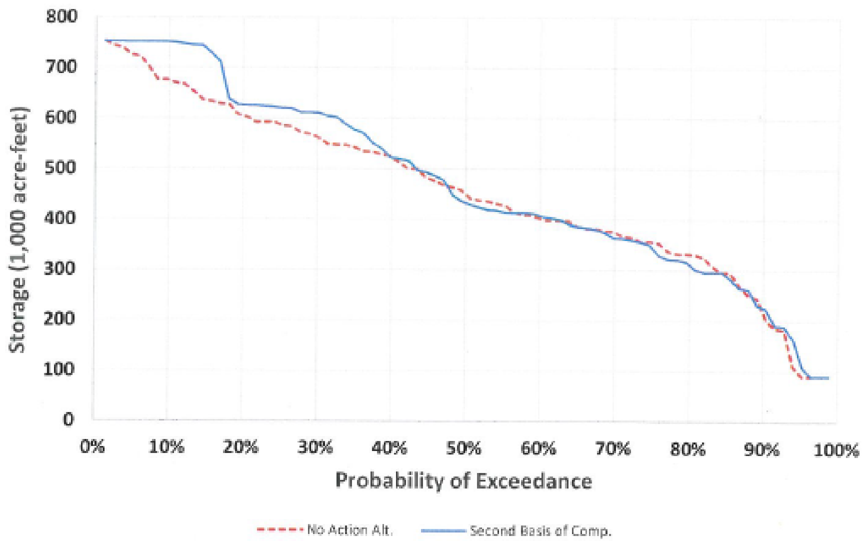

Figure 3: Probability of Exceedance for Folsom Reservoir End-of-September Storage

Results presented in Figure 3 illustrate one of the most significant effects of implementing the BO RPA actions on Folsom Reservoir. Folsom Reservoir carryover storage in wetter year types, i.e. below approximately the 40 percent exceedance level, is reduced as a result of additional releases to meet the fall X2 RPA action in the 2008 USFWS BO. In many years when Folsom Reservoir carryover storage is high, the reservoir will fill and spill in subsequent years. However, there are exceptions. Two examples included in the analysis are the years that preceded the 1976-1977 drought and the 1987-1992 drought. Both 1975 and 1986 are classified as wet water years by the Sacramento Valley Water Year Index and in both years carryover storage in Folsom Reservoir was reduced in the NAA by releases to meet the fall X2 RPA. Overall, the LT Ops DEIS lacks sufficient detail describing the effects of the different alternatives on CVP/SWP operations and the effects of implementing the BOs on the human environment. We recommend that more description of the operational changes and interpretation of the model results be included in the final EIS.

Changes in Folsom Reservoir storage can result in changes in CVP North-of-Delta (NOD) M&I water service contract allocations. Lower allocations result in less water deliveries to American River CVP contractors. Figure 4 illustrates the probability of exceedance for CVP NOD M&I allocations for the NAA and the SBC.

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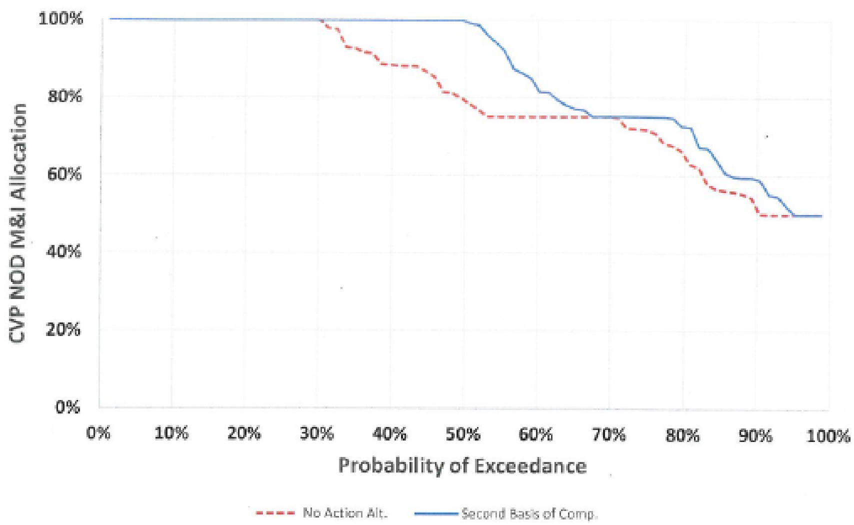

Figure 4: Probability of Exceedance for CVP NOD M&I Water Service Contract Allocations

Allocations illustrated in Figure 4 show a reduction in water available under CVP contracts as a result of implementing RPA actions contained in the BOs. The probability of receiving full allocations is reduced from approximately 50 percent to 30 percent, while the probability of receiving a 50 percent allocation is increased from approximately 5 percent to 10 percent. Changes in allocations are one parameter to understand the effects of implementing the BOs on American River water users. However, as described above, in the six percent of years when model results show that Folsom Reservoir would be drawn down to dead pool in both the NAA and SBC, there is not enough water in the simulation to meet the model allocations.

American River Basin Demands

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Demand assumptions in CalSim II for a future level of development in the American River basin can vary. Table 1 is a summary of the average annual demands, by water purveyor, assumed in all alternatives for the LT Ops DEIS.

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Table 1: Summary of American River Basin Water Purveyor Demands in LT Ops DEIS Model

Water Purveyor	Annual Demand (1,000 acre-feet)
Placer County Water Agency	65.0
PCWA – CVP Contract	35.0
City of Folsom	27.0
City of Folsom – CVP Contract	7.0
Folsom Prison	5.0
San Juan Water District (SJWD)	33.0
SJWD from PCWA	25.0
SJWD – CVP Contract	24.2
City of Roseville – from PCWA	30.0
City of Roseville – CVP Contract	32.0
Sac. Suburban Water District – from PCWA	0.0
El Dorado Irrigation District (EID)	0.0 or 17.0*
EID – CVP Contract	7.55
El Dorado County Water Agency (EDCWA) – CVP Contract	0.0 or 15.0*
So. Cal. Water Company/Arden Cordova Water Service	5.0
California Parks and Recreation	5.0
Sacramento Municipal Utilities District (SMUD)	15.0
SMUD – CVP Contract	30.0
City of Sacramento (Fairbairn and Sacramento River)	311.8
Carmichael Water District	12.0
Sacramento County Water Agency Total (SCWA)	109.7
SCWA – CVP Contract	45.0
East Bay Municipal Utilities District – CVP Contract	Up to 112.0

* These demands for EID and EDCWA are only included in sensitivity analyses performed for Alternatives 3 and 5.

The majority of the demands summarized in Table 1 approximate a buildout level of demand. One exception to this is for Sacramento Suburban Water District (Sac Suburban). There is no demand/diversion simulated for Sac Suburban for any of the alternatives evaluated in the LT Ops DEIS.

American River Basin Water Budget

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Appendix 5B of the LT Ops DEIS describes the sensitivity analysis that was conducted to evaluate the effects of additional diversions from Folsom Reservoir. Alternatives 3 and 5 are described to include a potential future Warren Act Contract between Reclamation and El Dorado Irrigation District (EID) for the use of Folsom Reservoir to convey 17,000 acre-feet annually, and a M&I water service contract with El Dorado County Water Agency (EDCWA) for up to 15,000 acre-feet annually, subject to CVP M&I allocations. These two additional demands for water from Folsom Reservoir were not included in the modeling for Alternative 3 or Alternative 5. However, additional simulations were performed for the LT Ops DEIS for both alternatives that included the additional demands. The LT Ops DEIS states comparisons of these additional simulations that include the EID and EDCWA demands can be made to results for Alternatives 3

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and 5, which do not include these demands, to understand the changes as a result of the additional 32,000 acre-feet of demand.

Folsom Roseville SJWD 25 continued

Review of these sensitivity studies shows an error in simulating the additional diversions in the context of the CVP/SWP system. Model studies correctly simulate the additional diversion of water from Folsom Reservoir, an annual average of approximately 17,000 acre-feet to EID and 12,000 acre-feet to EDCWA, after adjustment for CVP M&I allocations. Model studies also include an assumption that approximately 46 percent of the additional diversion returns to the system. The return flow appears to represent the monthly indoor M&I use of the additional demand being met from the surface water diversion. However, there is no additional depletion from the American River Basin, or Depletion Study Area (DSA) 70. Instead, the additional diversion from Folsom Reservoir results in: (1) increased return flows above the specified 46 percent, (2) reductions in other surface water diversions, and (3) a reduction in groundwater pumping within DSA 70. This change in groundwater pumping within DSA 70 is not a correct response of the model because the additional surface water diverted to EID and EDCWA under these two contracts would not be used to meet demands within DSA 70 that are currently being met from groundwater. Figure 5 illustrates the average annual change in different flow arcs in the CalSim II representation of the American River Basin/DSA 70.

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Folsom Roseville SJWD 25 continued

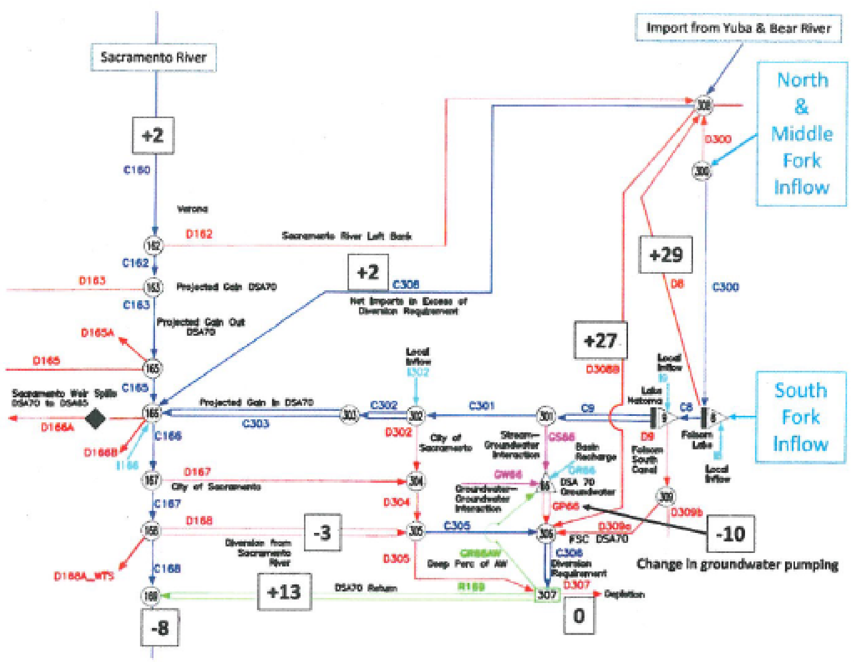

Figure 5: Average Annual Change in DSA 70 Water Budget for Sensitivity Analysis to Additional American River Basin Demands (1,000 acre-feet)

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The result of these errors is to underestimate the potential environmental effects of these additional demands in Alternatives 3 and 5. Figure 5 illustrates that the reduction in Delta inflow is approximately 8,000 acre-feet on an average annual basis as a result of meeting up to 32,000 acre-feet of additional demand. Return flows are approximately 13,000 acre-feet of the 29,000 acre-feet diverted from Folsom Reservoir. Therefore, the remainder of the water should be depleted from the DSA 70 water budget, resulting in an average annual reduction in Delta inflow of approximately 16,000 acre-feet. However, instead of being depleted, the additional diversions from Folsom Reservoir increase return flow to the Sacramento River through arc C308, decrease Sacramento River diversions through arc D168, and reduce groundwater pumping through arc GP66. None of these changes should occur as a result of diverting additional water from Folsom Reservoir for delivery within EID and/or EDCWA. Additionally, there is no additional depletion of water from DSA 70 through arc D307. It is expected that some portion of the additional diversions under the two contracts would be depleted from the system. These model errors affect only the analysis of Alternatives 3 and 5 as presented in the sensitivity studies in Appendix 5B.

Folsom Roseville SJWD 25 continued

Lee Bergfeld, P.E.

LB/jw
1978-3/TECH MEMO COMMENTS ON LT OPS DEIS 2015-09-29

1C.1.7.1 Responses to Comments from City of Folsom, City of Roseville, and San Juan Water District

Folsom Roseville SJWD 1: Comment noted.

Folsom Roseville SJWD 2: Reclamation has modified the Final EIS in response to comments; and will use the Final EIS in the development of the Record of Decision. 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 include additional alternatives, which would require recirculation of an additional Draft EIS for public review and comment, nor does Reclamation believe additional analysis is required to constitute a sufficient EIS. Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts.

Folsom Roseville SJWD 3: This comment is consistent with the information in the EIS.

Folsom Roseville SJWD 4: Comment noted.

Folsom Roseville SJWD 5: Please see response to Comment Folsom Roseville SJWD 2.

Folsom Roseville SJWD 6: The CVP and SWP operations prioritize meeting federal and state regulatory requirements and deliveries to water rights holders, including the City of Sacramento, prior to deliveries of water to CVP and SWP water contractors. The modeling analyses presented in the EIS include these prioritizations for long-term operation of the CVP and SWP without inclusion of changes that could be developed for specific extreme flood or drought events.

Folsom Roseville SJWD 7: As described in Section 3.3, Reclamation had provisionally accepted the provisions of the 2008 USFWS BO and 2009 NMFS BO, and was implementing the BOs at the time of publication of the Notice of Intent in March 2012. Under the definition of the No Action Alternative in the National Environmental Policy Act regulations (43 CFR 46.30), Reclamation's NEPA Handbook (Section 8.6), and Question 3 of the Council of Environmental Quality's Forty Most Asked Questions, the No Action Alternative could represent a future condition with "no change" from current management direction or level of management intensity, or a future "no action" conditions without implementation of the actions being evaluated in the EIS. The No Action Alternative in this EIS is consistent with the definition of "no change" from current management direction or level of management. Therefore, the RPAs were included in the No Action Alternative as Reclamation had been implementing the BOs and RPA actions, except where enjoined, as part of CVP operations for approximately three years at the time the Notice of Intent was issued (2008 USFWS BO implemented for three years and three months, 2009 NMFS BO implemented for two years and nine months).

As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order. However, the Second Basis of Comparison is not consistent with the definition of the No Action Alternative used to develop the No Action Alternative for this EIS. Therefore, mitigation measures have not been considered for changes of alternatives as compared to the Second Basis of Comparison.

The analysis in the EIS includes hydrologic conditions projected to occur in 2030 with existing regulatory requirements, future population growth in areas located north of the Delta, climate change, and sea level rise, as described in Appendix 5A, Section A, CalSim II and DSM2 Modeling. These changes are not caused by changes in CVP and SWP operations, and would occur with or without implementation of the BOs or other actions in the alternatives. Because these changes are included in the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5, the effects of these changes are not considered in the comparative analysis used in this EIS to determine effects of the alternatives.

Folsom Roseville SJWD 8: Comment noted.

Folsom Roseville SJWD 9: The CVP and SWP operations prioritize meeting federal and state regulatory requirements and deliveries to senior water rights holders, including the City of Sacramento. The modeling analyses presented in the EIS include these prioritizations for long-term operation of the CVP and SWP without inclusion of changes that could be developed for specific extreme flood or drought events.

Reclamation is aware of the storage and diversion limitations that exist for the intakes in Folsom Lake during drought periods when Reclamation may be allocating and delivering water in consideration of federal and state regulatory requirements, including water rights. Droughts have occurred throughout California's history, and are constantly shaping and innovating the ways in which Reclamation and DWR balance both federal and state regulations, public health standards and urban and agricultural water demands. 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 implementation of a barge and pump system in Folsom Lake to allow diversions when low water surface elevations would cause capacity issues for existing intakes.

Folsom Roseville SJWD 10: 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 include additional alternatives, which would require recirculation of an additional Draft EIS for public review and comment, nor does Reclamation believe additional analysis is required to constitute a sufficient EIS. Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts.

Folsom Roseville SJWD 11: The alternatives considered in the EIS were analyzed over a wide range of hydrologic conditions, including drought conditions in 1927 through 1934 and 1987 through 1992. The CalSim II model assumptions include assumptions for compliance with federal and state regulatory requirements. The model results indicate that CVP and SWP water deliveries under critical dry periods is minimal. For example, water deliveries to CVP and SWP water contractors (not water rights holders, settlement, or exchange contractors) would average about 22 to 30 percent of full contract amounts under critical dry year water conditions as shown in Tables C-19 and C-20 in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Table 5A.B.1 in Appendix 5A, Section B, CalSim II and DSM2 Modeling Simulations and Assumptions, for full contract amounts). The CalSim II model does not represent historical annual responses to extreme conditions by Reclamation, DWR, and other agencies to manage adverse conditions associated with wide range of water users, as described in Section 5.3 of Chapter 5, Surface Water Resources and Water Supplies, in the Final EIS.

Folsom Roseville SJWD 12: The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 all include hydrologic and water quality conditions with climate change and sea level rise at Year 2030. Because the EIS analysis is based upon a comparison of Alternatives 1 through 5 to the No Action Alternative, and a comparison of the No Action Alternative and Alternatives 1 through 5 to the Second Basis of Comparison, the effects of climate change and sea level rise are not included in the incremental differences between the alternatives. Therefore, the relative incremental differences between the alternatives at Year 2030 are representative of the differences between the alternatives with or without climate change and sea level rise.

Folsom Roseville SJWD 13: Section 7.4 of Chapter 7, Groundwater Resources and Groundwater Quality, has been modified in the Final EIS to provide more clarity related to localized groundwater issues in areas of the Central Valley in the vicinity of communities that use CVP and SWP water and that are not specifically addressed in the CVHM groundwater model. Information presented in Appendix 5A, Section C, CalSim II and DSM2 Model Results, (e.g., projected CVP water deliveries) and Appendix 5D, Municipal and Industrial Water Demands and Supplies, (e.g., urban water management plan projections for 2030) were used in the EIS to analyze effects of the alternatives as compared to the No Action Alternative and Second Basis of Comparison.

Folsom Roseville SJWD 14: The EIS describes that a suite of alternative water supplies could be used by the Year 2030 during drier years and over the long-term. The alternative water supplies include wastewater and stormwater recycling and water conservation, as well as water transfers from water rights holders as is projected for the American River Basin in the urban water management plans for the Year 2030.

Folsom Roseville SJWD 15: As described in the response to Comment Folsom Roseville SJWD 9, Reclamation is aware of the storage and diversion limitations that exist for the intakes in Folsom Lake during drought periods when Reclamation may be allocating and delivering water in consideration of federal and state regulatory requirements, including water rights. Droughts have occurred throughout California's history, and are constantly shaping and innovating the ways in which Reclamation and DWR balance both federal and state regulations, public health standards and urban and agricultural water demands. 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 implementation of a barge and pump system in Folsom Lake to allow diversions when low water surface elevations would cause capacity issues for existing intakes.

Folsom Roseville SJWD 16: Please see response to Comments Folsom Roseville SJWD 2, Folsom Roseville SJWD 7, and Folsom Roseville SJWD 9.

Folsom Roseville SJWD 17: Comment noted. This comment is consistent with information presented in the EIS.

Folsom Roseville SJWD 18: As stated in Section 5A.A.5.4 of Appendix 5A, Section A, CalSim II and DSM2 Modeling, the median climate change scenario was based on more than hundred climate change projections and 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 (e.g., Pierce et al. 2009). The median climate change is considered appropriate for the EIS because of the comparative nature of the NEPA analysis. Due to the use of the same climate change assumptions in the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5, the results of the NEPA comparative analysis are indicative of the changes between the model runs without climate change at the Year 2030. The results of the CalSim II model run cannot be used in a predictive manner. Therefore, it was determined that a sensitivity analysis using the different climate change conditions was not required for this EIS.

Folsom Roseville SJWD 19: As stated in Appendix 5A, Section A, CalSim II and DSM2 Modeling, the hydrologic assumptions in all of the Sacramento Valley watersheds, including the American River watershed, were developed using historical hydrology and applying the climate change projections for each watershed to develop projected conditions in the Year 2030. However, the commenter is correct that the CalSim II model assumptions do not include any transient trends in the vegetation or water management that may affect stream flows that could be considered to be speculative under the NEPA No Action Alternative assumptions (see Section 5A.A.4 in Appendix 5A, Section A, of the EIS).

Folsom Roseville SJWD 20: Evaluation of water supplies over the 82-year simulation period of the CalSim II model includes several series of increased and decreased stressed conditions that range from extreme floods to extreme droughts. As described in Section 5A.A.3.5 of Appendix 5A, Section A, 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. 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 as the CalSim II model makes month-by-month decisions based on values for that month only. These reductions would be lessened in real-time by making decisions in prior months as well as the current month to manage the actual available water supplies within legal and contractual obligations.

All of the CalSim II model runs in this EIS alternatives include consistent climate change conditions without consideration of potential regulatory or operational changes due to climate conditions in the future. Potential climate-related operational changes are currently unknown and it would be speculative to develop such assumptions for a NEPA analysis. Similarly, due to unique nature of each flood or drought period, assuming a prescriptive “operation” would be considered speculative. The EIS acknowledges these uncertain conditions that cannot be quantitatively analyzed at this point; and attempts to qualitatively assess the effects of changes from current affected environment to conditions in 2030 in Section 5.4 of Chapter 5, Surface Water Resources and Water Supplies of the Final EIS.

The impact analysis compares conditions under the Alternatives 1 through 5 to the No Action Alternative; and under the No Action Alternative and Alternatives 1 through 5 to the Second Basis of Comparison. This comparative approach eliminates effects of future uncertainty that cannot be modeled because the uncertainty would occur under all compared alternatives. This comparative approach reduces the effects of climate change from the incremental changes which are used to compare the alternatives, No Action Alternative, and Second Basis of Comparison.

As described in response to Comment Folsom Roseville SJWD 9, Reclamation is aware of the storage and diversion limitations that exist for the intakes in Folsom Lake during drought periods when Reclamation may be allocating and delivering water in consideration of federal and state regulatory requirements, including water rights. Droughts have occurred throughout California’s history, and are constantly shaping and innovating the ways in which Reclamation and DWR balance both federal and state regulations, public health standards and urban and agricultural water demands. 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 implementation of a barge and pump system in Folsom Lake to allow diversions when low water surface elevations would cause capacity issues for existing intakes.

Folsom Roseville SJWD 21: Comment noted.

Folsom Roseville SJWD 22: This comment is consistent with the information presented in the EIS.

Folsom Roseville SJWD 23: Please see response to Comment Folsom Roseville SJWD 20.

Folsom Roseville SJWD 24: As described in Appendix 5D, Municipal and Industrial Water Demands and Supplies, it is assumed that Sacramento Suburban Water District supplies are met through water purchased from Placer County Water Agency water rights water and treated by San Juan Water District, and water purchased from City of Sacramento water rights water.

Folsom Roseville SJWD 25: The comment is correct that the depletion terms in CalSim II model for El Dorado Irrigation District and El Dorado County Water Agency deliveries are not well-represented. A subsequent CalSim II model study was developed using a different configuration that would represent a worst-case scenario in terms of water supply in Folsom Lake. Based on this study, the changes in overall system operations show similar conditions to the analysis presented in Appendix 5B, Sensitivity Analysis on Representation of EID's Warren Act and EDCWA's Water Service Contracts with Reclamation in Alternatives 3 and 5.

1C.1.8 Friant Water Authority

FRIANT WATER AUTHORITY

Eric Borba
Chairman of the Board

Kent H. Stephens
Vice Chairman

Lucille Demetriff
Secretary/Treasurer

Bill Luce
Interim General Manager

Jennifer T. Buckman
General Counsel

Member Agencies
Arvin-Edison W.S.D.
Chowchilla W.D.
City of Fresno
Kaweah Delta W.C.D.
Kern-Tulare W.D.
Lindmore I.D.
Lindsay-Strathmore I.D.
Orange Cove I.D.
Porterville I.D.
Saucelito I.D.
Terra Bella I.D.
Tulare I.D.

Main Office
854 N. Harvard Avenue
Lindsay, CA 93247
559.562.6305
559.562.3496 Fax
Sacramento Office
1107 9th Street, Ste. 640
Sacramento, CA 95814
916.346.5165
916.346.4165 Fax

www.friantwater.org

September 29, 2015

VIA ELECTRONIC MAIL

Mr. Ben Nelson, Natural Resources Specialist
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento CA 95814-2536
bcnelson@usbr.gov

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

Dear Mr. Nelson,

FWA 1

The Friant Water Authority is a joint powers authority consisting of fourteen agencies that comprise 54% of the total Friant Division and Cross Valley Contract water supplies in the Friant Service Area. We have reviewed the draft EIS regarding the Coordinated Long-term Operation of the Central Valley Project (CVP and State Water Project (SWP) and have the following comments for your consideration.

FWA 2

First, we are totally confused by the characterization of the implantation of the 2008 USFWS delta smelt biological opinion and the 2009 NMFS winter run salmon biological opinion as the "No Action" alternative. While we appreciate the inclusion of the Second Basis of Comparison, which represents the true "No Action", it is bizarre on its face to declare that the "No Action" alternative include the actions that are the subject of the environmental review. This appears to be a deliberate attempt to mislead the public as to the true impacts of the biological opinions and to mischaracterize the significant impacts on CVP contractor's water supplies. The Final EIS should correct this "Alice in Wonderland" logic and describe the Second Basis of Comparison as the No Action alternative.

FWA 3

Second, we were disappointed to note that Reclamation did not even include the Friant Division facilities as part of the CVP facilities that are potentially impacted by the subject biological opinions, even though the Friant Water Authority is identified in Chapter 1, page 1-13 as an entity with which Reclamation had or was in the process of signing an MOU. Clearly, the Friant Contractors rely on the operations of the CVP and Delta exports to ensure delivery of water from the San Joaquin River.

FWA 4

Third, Table 5.26. Changes in CVP Water Deliveries under the No Action Alternative as Compared to the Second Basis of Comparison, reflects no changes to deliveries to Exchange Contractors in any year. While we understand the limitations of modeling for comparison of long term operations, Reclamation is well aware that in both 2014 and 2015 there were insufficient exports of CVP water to meet the Substitute Water delivery requirements to the Exchange Contractors, which we are informed and believe to be largely the result of the implementation of the two subject biological opinions and their RPAs. As a result of these reduced exports, all of the San Joaquin River runoff in 2014 and a substantial portion of the San Joaquin River runoff in 2015 was delivered to the Exchange Contractors, which left Friant Long Term Contractors with a zero allocation in both years.

This circumstance resulted in significant impacts to farms and communities in the Friant service area, including, but not limited to the following: Water users within the Friant Division were forced to rely on groundwater alone for their entire 2014 supply. The results were predictably disastrous. Thousands of acres of productive fruit and nut trees had to be abandoned due to lack of any or sufficient water supply. The total economic loss associated with the loss of nearly 30,000 acres of trees, including lost production until crops could be replanted and begin production again, was over $1 billion. Hundreds of domestic wells went dry. 15 communities in California ran out of drinking water supplies in 2014: 14 of those communities -- Alpaugh, Earlimart, Farmersville, Frazier Park, Huron, Lindsay, London, Madera County, Orange Cove, Pixley, Poplar, Porterville, Strathmore, Tipton, and Terra Bella -- are within the Friant Service Area. Some of these communities depend exclusively on Friant Division supplies to sustain them, while others rely on groundwater sources that are normally boosted by the surface water deliveries; last year, those sources were overtaxed and failed. Homes within these areas remain without adequate water for drinking, basic sanitation, and fire suppression. To this day, numerous families who have lost their domestic wells at their homes have to drive to a public park to shower. Some of these families have been without water in their homes for 7 – 9 months. The impact has been disproportionately large on low-income families that cannot afford to move or dig deeper wells. Impacts for 2015 have not been fully determined, but they are likely to be similar, if not greater.

This magnitude of economic damage from the implementation of the biological opinions cannot be ignored simply because the long-term CalSIM II modeling couldn't discern what was known to have happened in 2014 and 2015. The water supply analysis should be corrected to address the very real likelihood of reductions in Delta supplies to the Exchange Contractors caused by the subject biological opinions' Project modifications, which result in Friant Division water supply reductions, and the concomitant impacts of these supply reductions should be discussed in the Final EIS's resource chapters.

Mr. Ben Nelson
September 29, 2015
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If you have any questions regarding these comments, please feel free to contact me at sottemoeller@friantwater.org or (559) 306-9986.

Sincerely,

Stephen H. Ottemoeller
Acting Interim General Manager
Friant Water Authority

1C.1.8.1 Responses to Comments from Friant Water Authority

FWA 1: Comment noted.

FWA 2: As described in Section 3.3, Reclamation had provisionally accepted the provisions of the 2008 USFWS BO and 2009 NMFS BO, and was implementing the BOs at the time of publication of the Notice of Intent in March 2012. Under the definition of the No Action Alternative in the National Environmental Policy Act regulations (43 CFR 46.30), Reclamation's NEPA Handbook (Section 8.6), and Question 3 of the Council of Environmental Quality's Forty Most Asked Questions, the No Action Alternative could represent a future condition with "no change" from current management direction or level of management intensity, or a future "no action" conditions without implementation of the actions being evaluated in the EIS. The No Action Alternative in this EIS is consistent with the definition of "no change" from current management direction or level of management. Therefore, the RPAs were included in the No Action Alternative as Reclamation had been implementing the BOs and RPA actions, except where enjoined, as part of CVP operations for approximately three years at the time the Notice of Intent was issued (2008 USFWS BO implemented for three years and three months, 2009 NMFS BO implemented for two years and nine months).

As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order. However, the Second Basis of Comparison is not consistent with the definition of the No Action Alternative used to develop the No Action Alternative for this EIS. Therefore, mitigation measures have not been considered for changes of alternatives as compared to the Second Basis of Comparison.

FWA 3: Reclamation was directed by the District Court to remedy its failure to conduct a NEPA analysis when it accepted and implemented the 2008 USFWS BO RPA and the 2009 NMFS BO RPA pursuant to the Federal Endangered Species Act of 1973 (ESA) as amended (United States Code [U.S.C.] 1531 ET SEQ.). The BOs did not address the Friant Division of the CVP; therefore, the EIS does not address the Friant Division of the CVP.

FWA 4: 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.

1C.1.9 Northern California Water Association and Glenn-Colusa Irrigation District

September 28, 2015

Via First-Class Mail And Electronic Mail

Mr. Ben Nelson
Bureau of Reclamation
801 I Street, Suite 140
Sacramento, CA 95814-2536
bcnelson@usbr.gov

Re: Northern California Water Association and Glenn-Colusa Irrigation District Comments on Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Dear Mr. Nelson:

The Northern California Water Association (NCWA) and Glenn-Colusa Irrigation District (GCID) provide these comments on the Bureau of Reclamation's Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project ("DEIS"). As discussed below, and as detailed in other comments submitted to Reclamation on this matter, the DEIS should be revised and additional analysis should be conducted before Reclamation adopts a Final Environmental Impact Statement ("FEIS") for the proposed actions. NCWA GCID 1

Deficient Alternatives Analysis

Under the National Environmental Policy Act ("NEPA"), each federal agency must prepare a detailed environmental impact statement ("EIS") for any "major Federal action[] significantly affecting the quality of the human environment." (42 U.S.C. § 4332, subd. (2)(c).) The EIS must include "the alternative of no action." (40 C.F.R. § 1502.14(d); *American Rivers v. FERC* (9th Cir. 1999) 187 F.3d 1007, 1020.) The no action alternative represents the "status quo," defined as the continuation of existing policy and management direction without adoption of the proposed major Federal action. (*American Rivers*, *supra*, 187 F.3d at pp. 1020-1021.) A valid EIS must also evaluate the proposed action and all reasonable alternatives, and include appropriate mitigation measures not already included in the proposed action or alternatives. (40 C.F.R. § 1502.14, subds. (a)-(c), (f).) NCWA GCID 2

Pursuant to the Ninth Circuit's decision in *San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581 (9th Cir. 2014), Reclamation is required to prepare an EIS that discloses the effects of adopting the Reasonable and Prudent Alternatives ("RPA") contained in the United States Fish and Wildlife Service's 2008 delta smelt biological opinion ("2008 USFWS BiOp"). In this regard, the Court stated as follows:

> At this point, we can only speculate about what kind of significant effects will eventually result from implementation of the BiOp because Reclamation has not yet completed its EIS. But it is beyond dispute that Reclamation's implementation of the BiOp has important effects on human interaction with the natural environment. We know that

> millions of people and vast areas of some of America's most productive farmland will be impacted by Reclamation's actions. Those impacts were not the focus of the BiOp. In sum, we cannot reach an informed decision about the extent to which implementation of the BiOp is an environmental preservation action in the vein of *Douglas County* and *Drakes Bay Oyster* because we do not know how the action will impact the broader natural environment. We find no basis for exempting Reclamation from the EIS requirement. [Citation.] We recognize that the preparation of an EIS will not alter Reclamation's obligations under the ESA. *But the EIS may well inform Reclamation of the overall costs – including the human costs – of furthering the ESA.*
>
> *Id.*, 747 F.3d at 653 (italics added).)

NCWA GCID 2 continued

In accordance with the court orders, Reclamation prepared the DEIS. (DEIS, p. 1-9.) The DEIS states that its purpose is to "conduct a NEPA review to determine *whether the RPA actions cause a significant impact on the human environment*." (DEIS, p. 2-2 (italics added).) In the DEIS, however, Reclamation defined the baseline, "No Action Alternative" conditions to include the RPA actions described in the 2008 USFWS BiOp RPA and the 2009 National Marine Fisheries Service ("NMFS") salmonid biological opinion ("2009 NMFS BiOp") in 2030. (DEIS, pp. 3-21 to 3-22.) The DEIS states Reclamation did this because Reclamation provisionally accepted and implemented the RPAs in the 2008 USFWS BiOp and 2009 NMFS BiOp prior to preparation of the DEIS. (DEIS, p. 3-22.) The DEIS also includes a Second Basis of Comparison that does not include implementation of the RPAs. (*Ibid.*)

By defining the No Action Alternative to include the major federal action that the courts ordered Reclamation to analyze, Reclamation has not complied with NEPA or the applicable court directives. The purpose of requiring Reclamation to prepare an EIS was to inform Reclamation of the human and environmental costs of significantly changing the status quo for the state and federal water projects by adopting the RPAs. (*San Luis & Delta-Mendota Water Authority*, *supra*, 747 F.3d at 653.) The DEIS does not meet this requirement because it *assumes* the RPAs are part of the status quo by defining the No Action Alternative to include them. This results in a flawed alternatives analysis because it assumes that the status quo includes incurring the significant human and environmental costs of implementing the RPAs, and then the DEIS proceeds to analyze the five alternatives against this assumption. This contravenes the analysis required by NEPA and ordered by the Ninth Circuit.

The DEIS attempts to address this issue by including a "Second Basis of Comparison," which "represents a condition in 2030 without implementation of the 2008 USFWS BO and 2009 NMFS BO," and then by also comparing the other alternatives to this basis of comparison. (DEIS, p. 3-3.) This analytical approach, however, does not comport with the Ninth Circuit's decision, because the DEIS does not describe the incremental changes from the Second Basis of Comparison to the alternatives as impacts of the proposed actions, and does not consider whether mitigation measures are needed to address the impacts of the alternatives when compared to the Second Basis of Comparison. Instead, the inclusion of the RPAs in the No Action Alternative leads the DEIS to improperly conclude that no mitigation is necessary for the adoption of the RPAs. If the DEIS had properly included adoption of the RPAs as an alternative, rather than as part of the No Action Alternative, then the DEIS would have been required to include appropriate mitigation measures to address the effects of the implementing the RPAs. (40 C.F.R. § 1502.14, subd. (f).) Instead, the DEIS assumes implementation of the RPAs, and fails to include appropriate mitigation measures to address their effects. (See, e.g., DEIS, pp. 5-237 to 5-261 (failing to include mitigation for effects on surface water of implementing the RPAs).)

Deficient Hydrological Analysis

NCWA GCID 3

The DEIS's hydrological analysis does not accurately analyze how the CVP and SWP would be operated with the combined effects of climate change and multi-year droughts, and, as a result, does not properly

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analyze the impacts of the proposed actions. The DEIS acknowledges that its analysis and conclusions are probably inaccurate during extremely dry conditions that come with multi-year droughts: NCWA GCID 3 continued

> Under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II utilizes a series of operating rules to reach a solution to allow for the continuation of the simulation. It is recognized that these operating rules are a simplified version of the very complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, *model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are an approximation of extreme operational conditions*. As an example, CalSim II model results show simulated occurrences of extremely low storage conditions at CVP and SWP reservoirs during critical drought periods when storage is at dead pool levels at or below the elevation of the lowest level outlet. Simulated occurrences of reservoir storage conditions at dead pool levels may occur coincidentally with simulated impacts that are determined to be potentially significant. When reservoir storage is at dead pool levels, there may be instances in which flow conditions fall short of minimum flow criteria, salinity conditions may exceed salinity standards, diversion conditions fall short of allocated diversion amounts, and operating agreements are not met.
>
> (DEIS, p. 5-61 (italics added).)

Regarding climate change, the DEIS does not disclose the proposed alternatives' impacts against baseline conditions without projected climate change. Instead, all of the DEIS's alternatives include the projected future impacts of climate change in the 2030 timeframe. (DEIS, p. ES-7.) This makes it impossible for the reviewing public to segregate impacts that are predicted to result from climate change from the impacts that would occur due to implementation of the proposed alternatives. Furthermore, it is not possible to know whether future climate change will occur exactly as projected in the DEIS's single climate change scenario. In this regard, the DEIS does not adequately inform the public of the proposed alternatives' impacts, because the lack of an analysis of the proposed alternatives' impacts without climate change obscures how the state and federal projects are likely to operate if climate change does not occur exactly as projected in the DEIS. NCWA GCID 4

Conclusion

For the foregoing reasons, the DEIS should be revised and additional analyses should be conducted before Reclamation adopts an FEIS for the proposed actions. NCWA and GCID appreciate Reclamation's consideration of these comments. NCWA GCID 5

Sincerely,

David J. Guy
President
Northern California Water Association

Thaddeus Bettner
General Manager
Glenn-Colusa Irrigation District

cc: Andrew Hitchings

1C.1.9.1 Responses to Comments from Northern California Water Association and Glenn-Colusa Irrigation District

NCWA GCID 1: Comment noted.

NCWA GCID 2: As described in Section 3.3, Reclamation had provisionally accepted the provisions of the 2008 USFWS BO and 2009 NMFS BO, and was implementing the BOs at the time of publication of the Notice of Intent in March 2012. Under the definition of the No Action Alternative in the National Environmental Policy Act regulations (43 CFR 46.30), Reclamation's NEPA Handbook (Section 8.6), and Question 3 of the Council of Environmental Quality's Forty Most Asked Questions, the No Action Alternative could represent a future condition with "no change" from current management direction or level of management intensity, or a future "no action" conditions without implementation of the actions being evaluated in the EIS. The No Action Alternative in this EIS is consistent with the definition of "no change" from current management direction or level of management. Therefore, the RPAs were included in the No Action Alternative as Reclamation had been implementing the BOs and RPA actions, except where enjoined, as part of CVP operations for approximately three years at the time the Notice of Intent was issued (2008 USFWS BO implemented for three years and three months, 2009 NMFS BO implemented for two years and nine months).

As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order. However, the Second Basis of Comparison is not consistent with the definition of the No Action Alternative used to develop the No Action Alternative for this EIS. Therefore, mitigation measures have not been considered for changes of alternatives as compared to the Second Basis of Comparison.

The analysis in the EIS includes hydrologic conditions projected to occur in 2030 with existing regulatory requirements, future population growth in areas located north of the Delta, climate change, and sea level rise, as described in Appendix 5A, Section A, CalSim II and DSM2 Modeling. These changes are not caused by changes in CVP and SWP operations, and would occur with or without implementation of the BOs or other actions in the alternatives. Because these changes are included in the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5, the effects of these changes are not considered in the comparative analysis used in this EIS to determine effects of the alternatives.

NCWA GCID 3: The alternatives considered in the EIS were analyzed over a wide range of hydrologic conditions, including drought conditions in 1927 through 1934 and 1987 through 1992. The CalSim II model assumptions include assumptions for compliance with federal and state regulatory requirements. The model results indicate that CVP and SWP water deliveries under critical dry periods is minimal. For example, water deliveries to CVP and SWP water contractors (not water rights holders, settlement, or exchange contractors) would average about 22 to 30 percent of full contract amounts under critical dry year water conditions as shown in Tables C-19 and C-20 in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Table 5A.B.1 in Appendix 5A, Section B, CalSim II and DSM2 Modeling Simulations and Assumptions, for full contract amounts). The CalSim II model does not represent historical annual responses to extreme conditions by Reclamation, DWR, and other agencies to manage adverse conditions associated with wide range of water users, as described in Section 5.3 of Chapter 5, Surface Water Resources and Water Supplies, in the Final EIS. Additional details have been included in Section 5.3 to describe recent CVP operations that delivered water to the San Joaquin River Exchange Contractors from Millerton Lake.

NCWA GCID 4: The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 all include hydrologic and water quality conditions with climate change and sea level rise at Year 2030. Because the EIS analysis is based upon a comparison of Alternatives 1 through 5 to the No Action Alternative, and a comparison of the No Action Alternative and Alternatives 1 through 5 to the Second Basis of Comparison, the effects of climate change and sea level rise are not included in the incremental differences between the alternatives. Therefore, the relative incremental differences between the alternatives at Year 2030 are representative of the differences between the alternatives with or without climate change and sea level rise.

NCWA GCID 5: Comment noted.

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 include additional alternatives, which would require recirculation of an additional Draft EIS for public review and comment, nor does Reclamation believe additional analysis is required to constitute a sufficient EIS. Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts.

1C.1.10 Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District

September 29, 2015

VIA ELECTRONIC MAIL

Mr. Ben Nelson
Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536
Email: bcnelson@usbr.gov

RE: Comments from Stanislaus River Plaintiffs on Draft EIS for the Coordinated Long-Term Operation of the CVP and SWP

Dear Mr. Nelson:

The Stanislaus River Plaintiffs, comprised of Oakdale Irrigation District (OID), South San Joaquin Irrigation District (SSJID), and Stockton East Water District (SEWD), submit the following comments on the Draft Environmental Impact Statement (DEIS) for the Coordinated Long-Term Operation of the CVP and SWP.

OID SSJID SEWD 1

Chapter 1

The DEIS states that the "CVP provides water stored in New Melones Reservoir for water rights holders in the Stanislaus River watershed and CVP contractors in the northern San Joaquin Valley and to meet existing water right permit conditions to support fish and wildlife and water quality beneficial uses." (**p. 1-10, ln. 35-38**.) This statement is incomplete. The CVP provides water to OID and SSJID pursuant to an Agreement and Stipulation with the Bureau of Reclamation from 1988. The CVP provides project water to SEWD and Central San Joaquin Water Conservation District (CSJWCD) pursuant to contract.

OID SSJID SEWD 2

At **page 1-11**, the DEIS fails to recognize and address Phases 1-3 of the State Water Resources Control Board's (SWB) Water Quality Control Plan (WQCP). The SWB initiated the process in 2009. The Draft WQCP and Substitute Environmental Document were issued in 2012. The Draft 2012 had as a preferred alternative 35% unimpaired flow from February 1 through June 30. None of the alternatives include such a flow regime for the New Melones Project, which

OID SSJID SEWD 3

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is covered by Phase I. The material for Phase I can be found at www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/index.shtml

OID SSJID SEWD 3 continued

At **subchapter 1.7** (Participants in Preparation), the DEIS fails to note that SSJID has signed the Memorandum of Understanding (MOU).

OID SSJID SEWD 4

At **subchapter 1.8** (Related Projects and Activities), the DEIS fails to list the SWB's WQCP for the San Joaquin-Sacramento Rivers and Bay-Delta.

OID SSJID SEWD 5

Chapter 3: Description of Alternatives

As an initial matter, the alternatives are purposely confusing and complicated. It is impossible to determine from the alternatives what is being studied. Given the scope of the study and volumes of water involved, including and then excluding certain actions or projects just gets lost in the noise.

It appears that the intention of the authors was to set up alternatives without distinction.

OID SSJID SEWD 6

Chapter 5: Surface Water Resources and Water Supplies

At **subchapter 5.3.2.2.2**, describing Hydrological Conditions and Major Surface Water Facilities in the San Joaquin Valley, the DEIS uses old and outdated data to describe the Stanislaus River. (**p. 5-36, lns. 10-16**.) The DEIS uses averages and medians over a 90-year period. The average runoff in the Stanislaus River Basin over the past 20 years has dropped. It is expected with climate change that while the amount of precipitation may remain the same, the runoff will be due more to rainfall and less to snowmelt. With changing thermoclines, this will impact water temperatures in reservoirs.

OID SSJID SEWD 7

There is also no discussion of the firm yield of the project. Prior Reclamation studies found the firm yield of the project to be less than 700,000 acre-feet, based on the 1987-1992 drought. The current drought of 2011 – present is more severe, so the firm yield should also be less.

OID SSJID SEWD 8

At **page 5-36, lines 29-30**, please provide a citation for the assertion that "[t]wenty ungauged tributaries contribute intermittent flows to the lower portion of the Stanislaus River." This number appears exceedingly high and misleading.

OID SSJID SEWD 9

The entire description of New Melones Reservoir found on **pages 5-36 (lns. 34-44)** and **5-37 (lns. 1-17)** is incorrect and must be rewritten. The following facts should be stated in this subsection.

OID SSJID SEWD 10

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Reclamation has an Agreement with OID and SSJID on how Reclamation will operate New Melones to meet the Districts' Senior Water Rights first. The Districts' water is not CVP project water. The Districts' water cannot be used to meet NMFS's Reasonable and Prudent Alternative Table 2E flows. Once the senior rights of the Districts' have been met, then Reclamation has water available to meet its obligations. OID SSJID SEWD 10 continued

The paragraphs on meeting D-1641 objectives are vague and ambiguous. The Dissolved Oxygen Objective is contained in CVRWQCB Basin Plan, and made a condition of Reclamation's water right permit by D-1422. The description of "minimum flow requirements . . . at Vernalis" is vague (**pg. 5-37, ln. 9.**) There are three (3) specific requirements: February-June flows, April-May pulse flow, and October minimum flows. OID SSJID SEWD 11

Reclamation has not met the April-May Pulse flow requirement since the end of VAMP. Are the model runs done with the April-May Pulse Flow being solely met by Reclamation from New Melones?

The February-June flow requirements have also not been met. Are the model runs done with the February-June Pulse Flow being solely met by Reclamation from New Melones?

Finally, in the last two (2) years, the October flow requirement has not been met. Are the model runs done with the October minimum flows being solely met by Reclamation from New Melones?

Reclamation's water rights for the entire CVP are currently, solely, responsible for meeting these flows.

At **page 5-37, lines 12-17**, delete Goodwin Reservoir material. It is a re-regulating reservoir holding less than 2,000 acre-feet. This type of information is totally irrelevant to the questions presented under Chapter 5. OID SSJID SEWD 12

At **page 5-52, lines 4-7**, the 2009 OCAP-BO specifies that Reclamation meets the flow schedule, however the Vernalis April-May Pulse Flow has not been met since the end of VAMP. OID SSJID SEWD 13

Regarding the CalSim II Model (**p. 5-60, lines 18-21**), CalSim II is a land use based model. OID and SSJID have been and will continue to use the full amount of their water rights. Pursuant to the 1988 Agreement, the Districts are entitled to 600,000 acre-feet. CalSim II uses projected land-use and arrives at an average annual use of 526,000 acre-feet. The unused portion (74,000 acre-feet) goes into storage in New Melones. This presents an extremely optimistic and distorted picture of reservoir storage in New Melones. The Districts' water use the last 15 years has been fully maximized. OID SSJID SEWD 14

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At **page 5-60, lines 27-29**, the statement that "[w]ater rights deliveries to non-CVP and non-SWP water rights holders are not modified in the CalSim II simulations of the alternatives" is incorrect. They are modified. They are reduced. OID SSJID SEWD 15

Regarding **subsection 5.4.2.1**, climate change and sea level rise can mask impacts. An alternative basis with no climate change or sea level rise should be included for analysis purposes. OID SSJID SEWD 16

Regarding **Table 5.20 (p. 5-84)** showing Changes in New Melones Reservoir Storage under the No Action Alternative as Compared to the Second Basis of Comparison, the numbers being used are averages. Averages do not disclose impacts. Since Reclamation has this information, please provide maximums and minimums as well. OID SSJID SEWD 17

Regarding **Table 5.37 (p. 5-112)**, please provide maximums and minimum figures in addition to the averages. OID SSJID SEWD 18

Regarding **Table 5.54 (p. 5-140)**, please provide maximums and minimum figures in addition to the averages. OID SSJID SEWD 19

Beginning at **page 5-192**, comparing Changes in New Melones Reservoir Storage and Elevation under Alternative 5 as Compared to the No Action Alternative, please address the following. OID SSJID SEWD 20

The SWB and the Delta Watermaster have both notified Reclamation by letter that it is responsible for meeting the D-1641 April-May Pulse Flow. As such, this analysis should be included in the No Action, not as a separate alternative. (No Action as set forth by NEPA.) The analysis provided in this section is helpful, but the modeling done in the No Action should have included this analysis. Then the No Action would have had significant impacts to Reservoir storage in New Melones' flows and water temperatures in the Stanislaus River. See Table 5.88.

<u>Chapter 6: Surface Water Quality</u>

6.3.3.2 Water Temperature

This section of the DEIS provides information regarding water temperatures in the San Joaquin River upstream of the confluence of the Stanislaus River. This information is irrelevant since Alternatives 1 through 5 would not influence conditions in this reach. Air temperatures control water temperatures in the San Joaquin River and South Delta. Releases from New Melones will not impact water temperatures in the San Joaquin River or South Delta downstream of the confluence of the Stanislaus River. OID SSJID SEWD 21

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Table 6.16 presents temperature objectives recommended by the USEPA to be used as guidelines in determining temperature criteria. These guidelines represent optimal conditions determined by laboratory studies of salmonids from the Pacific Northwest. The temperature tolerances of Central Valley salmon stocks are likely distinct from those of other stocks in the Pacific Northwest, and the applicability of laboratory derived tolerance values to stocks that have evolved in (and are adapted to) habitats at the southernmost extent of the species' range is questionable. High growth and survival of natural Chinook stocks in the Central Valley at temperatures considered higher than optimal for most stocks (based on data from northern stocks) indicate high thermal tolerance of these stocks. OID SSJID SEWD 21 continued

6.3.3.2.2 Stanislaus River Water Temperature

As was predicted by extensive modeling previously conducted, water temperature objectives established in NMFS 2009 BO have not been met. See Attachment A. OID SSJID SEWD 22

<u>Chapter 9: Fish and Aquatic Resources</u>

At **9.3.4.16**, the DEIS improperly references a body of water by the name of Goodwin Lake. There is no Goodwin Lake. There is a Goodwin Dam. OID SSJID SEWD 23

9.3.4.17.1 Fall-run Chinook Salmon

The DEIS provides no quantitative descriptions of the temporal and geographic distribution of fall-run Chinook salmon spawning in the Stanislaus River. Based on redd surveys conducted by FISHBIO, peak spawning typically occurs in November with roughly 7% of spawning occurring prior to November 1, and 2% prior to October 15. The few redds created during late-September and early October are typically near the upper end of Goodwin Canyon. More information is provided in Attachment A for reference. OID SSJID SEWD 24

There is no hatchery on the Stanislaus River, yet since the implementation of constant fractional marking, at least 22% of salmon observed at the Stanislaus River weir have been adipose fin-clipped indicating they were of hatchery origin. With approximately 25% of hatchery production marked, it is estimated that nearly all adult salmon escaping to the Stanislaus River are of hatchery origin. This finding is similar to the results of otolith michrochemistry analyses which found that approximately 90% of Central Valley salmon were of hatchery origin (Barnett-Johnson 2007). OID SSJID SEWD 25

9.3.4.17.1 Steelhead

The Stanislaus River is known to have one of the largest populations of *O. mykiss* in the Central Valley. FISHBIO estimated the yearly average abundance to be about 20,220 trout in the river between 2009-2014, and in that time numbers never dipped below 14,000 fish. This abundance is due in part to high quality habitat, particularly in Goodwin Canyon, where water is OID SSJID SEWD 26

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fast moving and boulders create a diversity of hiding places for the fish. Highest densities and abundances of *O. mykiss* are consistently found in Goodwin Canyon. In 2015, abundance declined to only about 5,000 fish. Densities, or numbers of *O. mykiss* per river mile or per habitat unit, have been on the decline since 2013, with 2015 densities the lowest on record. The most dramatic decline has been observed between Goodwin Dam and Knights Ferry. It appears that temperature is the single most important factor driving abundance, and small year-to-year variations in flow have no substantial effect. Due to low storage in New Melones Reservoir, water temperatures have increased substantially in recent years. See Attachment A for more information. OID SSJID SEWD 26 continued

Weir monitoring since 2003 indicates that on average, about 5 untagged adult *O. mykiss* >16" migrate upstream in the Stanislaus River annually. Most spawning is believed to occur upstream of Orange Blossom Bridge, not Oakdale.

9.3.4.17.2 Aquatic Habitat

First, Reclamation does not manage New Melones for cold-water supply or releases. In order to access cold water pools in the reservoir, the low-level outlet must be used. This outlet has only been opened twice in the history of the project. OID SSJID SEWD 27

Contrary to Hallock et al. (1970) indicating adult migration is prevented under low dissolved oxygen (DO), migration has been observed at DO < 5mg/L. Adult upstream migration rate and timing is not dependent on DO concentrations. Low DO concentrations are limited to the Deep Water Ship Channel (DWSC), and are the result of anthropogenic manipulation of channel geometry. The Stanislaus River discharges high-quality Sierra Nevada water which has low planktonic algal content and oxygen demand, and is not a major source of oxygen demand contributing to the low DO problem in the DWSC. DO concentrations in the DWSC can be ameliorated by installation of the Head of Old River Barrier. See Attachments B, C and D for additional information regarding dissolved oxygen. OID SSJID SEWD 28

9.3.4.17.4 Predation

Various studies have identified predation by non-native species as a significant source of mortality of juvenile Chinook salmon in the San Joaquin Basin. Reduced juvenile survival due to predation is a key factor limiting efforts to increase salmon survival and abundance. OID SSJID SEWD 29

Between 1986 and 2006, paired releases of large groups of coded wire tagged smolts were made near the upper extent of spawning and near the mouth of the Stanislaus, Tuolumne, and Merced rivers. Tributary survival was estimated based on the numbers of tagged smolts from the upper group relative to the lower group that were recovered in the San Joaquin River at Mossdale. These mark-recapture studies provided the first direct estimates of poor tributary survival in some years.

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Rotary screw trapping to monitor juvenile outmigration from the Stanislaus River began in 1995, and comparisons of estimated abundance at an upstream site relative to a downstream site near the confluence with the San Joaquin River indicate survival is poor in many years. This data is valuable because it provides estimates of survival for naturally produced juvenile salmon of all lifestages migrating volitionally throughout the varying conditions observed during each migration season.

OID
SSJID
SEWD 29
continued

In 1998 and 1999, a pilot radio telemetry study conducted in the Stanislaus River was the first in the basin to directly confirm predation by electroshocking a large striped bass and retrieving the radio tag (the tagged salmon smolt was digested) from its stomach. This early research was important and established that predation was occurring, that suspected predation was occurring more frequently in substantially altered habitats such as mine pits and deep scour holes, and that non-native predators were present and relatively abundant in the Stanislaus River even under the wetter hydrology observed in the years studied.

The Stanislaus River counting weir, which has been in operation since 2003, was the first of its type used in the Central Valley. Weir monitoring has documented migration characteristics of adult striped bass, and has demonstrated that stripers live in the river year-round and are abundant, especially in dry years.

In 2012, after more than 15 years of juvenile outmigrant survival studies and monitoring indicating that predation is a major problem in the Stanislaus River, the USFWS estimated smolt survival using radio telemetry. The survival estimate of 7% in 2012 was much lower than the 40-60% previously estimated by CWT mark-recapture studies conducted by CDFW.

Differential in catches at upstream and downstream rotary screw traps in the Tuolumne River between 2007 and 2012 also indicate high losses ranging from 76% to 98%. In 2012 rotary screw trap monitoring on the Tuolumne River found 96% mortality of juvenile Chinook outmigrants. As part of relicensing for the Don Pedro Project, a predation study conducted the same year found that based on observed predation rates and estimated predator abundance between the RSTs, it is plausible that most losses of juvenile Chinook salmon in the lower Tuolumne River between the upper and lower traps during 2012 could be attributed to predation by non-native predatory species.

In addition to the evidence in the Stanislaus and Tuolumne rivers, the Vernalis Adaptive Management Plan (VAMP) investigated the relationship between salmon smolt survival through the San Joaquin Delta and flow, exports, and operation of the Head of Old River Barrier between 2000 and 2011. A peer review of this work and the results of similar, earlier studies, concluded that "high and likely highly variable impacts of predation, appear to affect survival rates more than the river flow". Since 2003, survival through the San Joaquin Delta has consistently been < 12%, while flows at Vernalis ranged between 2,000 cfs and 27,000 cfs.

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During spring 2014 a predation study in the lower San Joaquin River near Mossdale was conducted by NOAA Fisheries under contract to DWR. Predators were found to outnumber Chinook salmon by a ratio of roughly 200 predators for every 1 Chinook salmon. Similar to recent studies conducted by NOAA Fisheries on the Sacramento River, live Chinook salmon were tethered to quantify the frequency of predation events. On some nights, 100% of the tethered Chinook salmon were preyed upon within one hour, indicating much heavier predation rates in the San Joaquin River than observed during the studies conducted on the Sacramento River. Similar to previous work in the tributaries, this study provided the first direct estimates of predation in the San Joaquin River confirming that low survival rates could likely be explained by predation by introduced fish species such as largemouth bass and striped bass.

OID SSJID SEWD 29 continued

9.4 Impact Analysis

Table 9.3 showing **Water Temperature Objectives** utilize average monthly water temperatures. Average water temperatures are irrelevant. The NMFS OCAP-BO requires 7-day average of the daily maximums. (7 DADM.) The EIS should use the temperature measurements required by NMFS.

OID SSJID SEWD 30

At **subsection 9.4.2.2.2**, in the section titled "Aquatic Habitat Conditions in the Stanislaus River from Goodwin Dam to San Joaquin River" (**p. 9-131 to 9-133**), the DEIS fails to account for the increase in water temperatures within New Melones Reservoir caused by releases made under Table 2E, which draw down the reservoir quicker and result in lower conditions for longer.

OID SSJID SEWD 31

Please let us know if you have any questions.

Very truly yours,

Tim O'Laughlin
O'LAUGHLIN & PARIS

Karna E. Harrigfeld
HERUM\CRABTREE

TW/llw

1C.1.10.1 Attachments to Comments from Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District

Attachments to the Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District Comment letter are included in Attachment 1C.2 located at the end of Appendix 1C.

1C.1.10.2 Responses to Comments from Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District

OID SSJID SEWD 1: Comment noted.

OID SSJID SEWD 2: The text on page 1-10 in Chapter 1, Introduction, provides a summary of information that is presented in Chapter 5, Surface Water Resources and Water Supplies, and Appendix 3A, No Action Alternative: Central

Valley Project and State Water Project Operations. The text on page 1-10 of the Draft EIS has been modified in the Final EIS to include a reference to additional details in Chapter 5 and Appendix 3A.

OID SSJID SEWD 3: The text in this section of Chapter 1 of the Draft EIS (Section 1.6) has been modified in the Final EIS to include a reference to the ongoing SWRCB update of the Water Quality Control Plan.

As described in Section 1.6 of Chapter 1, Introduction, of the Draft EIS, it is anticipated that substantial changes could occur to CVP and SWP operations as future projects are implemented. It is anticipated that most of these future projects have been identified in Section 3.5 of Chapter 3, Description of Alternatives, including the Bay Delta Water Quality Control Plan Update. Many of these future projects have not been fully defined and are not anticipated to be operational until the late 2020s. If any of these future projects would substantially change CVP operations, Reclamation would evaluate the need to request for initiation of consultation under ESA with the USFWS and NMFS.

The future projects are being developed for different project objectives than the purpose and need in this EIS for the coordinated long-term operation of the CVP and SWP. Because the future operations under future projects have not been finalized at this time; and because projects that would substantially change CVP operations would require future consultations with USFWS and NMFS, it would be pre-decisional to include these projects in the alternatives evaluated in this EIS. Therefore, the alternatives under these future projects are considered in the cumulative effects analysis in this EIS.

OID SSJID SEWD 4: In August 2012, Reclamation sent over 700 invitations to participate as a NEPA cooperating agency in development of this EIS, including an invitation to South San Joaquin Irrigation District (SSJID). The invitation directed interested parties to respond to Reclamation with a written request. Reclamation has no record of a letter from SSJID requesting to be a cooperating agency. However, SSJID has been invited to update meetings and included in preliminary review of written materials that were used in preparation of this EIS.

OID SSJID SEWD 5: The study referenced in this comment is presented in Section 1.8 on page 1-15 of the DEIS as “Bay-Delta Water Quality Control Plan Update.”

OID SSJID SEWD 6: The alternatives are described in detail in Sections 3.4.3 through 3.4.7 in Chapter 3, Description of Alternatives, including operational details. The description of the alternatives is complex because the range of alternatives represents a variety of methods to operate individual CVP and SWP operational actions.

OID SSJID SEWD 7: The text on page 5-36, lines 10 through 16 has been modified to be consistent with reference “SWRCB 2012” which is used in development of the following paragraph.

OID SSJID SEWD 8: The analysis in the EIS is conducted using a monthly analysis with an 82-year historic hydrology modified for projected climate change, as described in Appendix 5A. The analysis includes evaluations of average monthly and annual conditions for the long-term average and averages under five water year types. The analysis does not consider firm yield concepts.

OID SSJID SEWD 9: The sentence referred to in this comment has been deleted from the Final EIS.

OID SSJID SEWD 10: Reclamation operates the CVP to meet water rights and other agreements, including the 1988 stipulation agreement related to the Stanislaus River.

OID SSJID SEWD 11: As stated on pages 5-36 and 5-37, additional CVP and SWP operational details, including discussions of SWRCB D-1641 objectives, are included in Appendix 3A. The Vernalis Adaptive Management Program allowed for additional sources of water, other than New Melones Reservoir, to be used to maintain flow in the San Joaquin River. After completion of this program, Reclamation does not have sufficient supply available in New Melones Reservoir to meet the inflow targets suggested by this comment.

Additional details about the recent droughts have been included in Section 5.3.3 of Chapter 5, Surface Water Resources and Water Supplies, and Section 6.3.3.6 of Chapter 6, Surface Water Quality, in the Final EIS to describe historical responses by CVP and SWP to these drought conditions.

OID SSJID SEWD 12: Information related to Goodwin Reservoir is included because the fisheries analysis evaluates reservoir fish in this water body in Chapter 9, Fish and Aquatic Resources.

OID SSJID SEWD 13: Please refer to the response to Comment OID SSJID SEWD 11.

OID SSJID SEWD 14: As described in Section 5A.2.1.1.4 of Appendix 5A, the water demands for Oakdale Irrigation District and South San Joaquin Irrigation District in the CalSim II model for Year 2030 operations are up to a total of 600,000 acre-feet per year depending upon land use. The model is used to analyze long-term conditions by the Year 2030, and does include an assumed water demand of 526,000 acre-feet for long-term conditions by Year 2030.

OID SSJID SEWD 15: The assumed water demands for water rights holders are not reduced in the CalSim II model assumptions, and water is delivered in accordance with water rights and agreements, as described in Appendix 5A, Section B. However, it is recognized that some alternatives considered in this EIS limit the ability to deliver water to meet the water right demands.

OID SSJID SEWD 16: The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 include climate change and sea level rise conditions. The EIS assumes that there will be no changes in regulatory or operational requirements due to climate change in the future. The EIS analyzes the alternatives in a comparative manner, and does not analyze any of the alternatives in an absolute manner. Therefore, the impact analysis compares conditions under the Alternatives 1 through 5 to the No Action Alternative; and conditions under the No Action Alternative and Alternatives 1 through 5 to the Second Basis of

Comparison. This comparative approach minimizes effects of climate change and sea level rise and indicates the differences in the comparisons of alternatives to the No Action Alternative and Second Basis of Comparison.

OID SSJID SEWD 17: The exceedance curves shown in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Figures C.6.1 through C.6.3) present the results of the CalSim II model runs, including the minimum and maximum results, for the New Melones Reservoir storage. The exceedance values at 10 percent increments are presented in Tables C.6.1 through C.6.6 which also are included in Appendix 5A, Section C.

OID SSJID SEWD 18: As described in Comment OID SSJID SEWD 17, the exceedance curves shown in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Figures C.6.1 through C.6.3) present the results of the CalSim II model runs, including the minimum and maximum results, for the New Melones Reservoir storage. The exceedance values at 10 percent increments are presented in Tables C.6.1 through C.6.6 which also are included in Appendix 5A, Section C.

OID SSJID SEWD 19: As described in Comment OID SSJID SEWD 17, the exceedance curves shown in Appendix 5A, Section C, CalSim II and DSM2 Model Results (see Figures C.6.1 through C.6.3) present the results of the CalSim II model runs, including the minimum and maximum results, for the New Melones Reservoir storage. The exceedance values at 10 percent increments are presented in Tables C.6.1 through C.6.6 which also are included in Appendix 5A, Section C.

OID SSJID SEWD 20: The No Action Alternative represents a continuation of existing policy and management actions at the time of the publication of the Notice of Intent in 2012. The Vernalis Adaptive Management Program allowed for additional sources of water, other than New Melones Reservoir, to be used to maintain flow in the San Joaquin River. After completion of this program, Reclamation does not have sufficient supply available in New Melones Reservoir to meet the inflow targets suggested by this comment.

OID SSJID SEWD 21: This information is presented in the Affected Environment to provide an understanding of potential changes in San Joaquin River water temperatures downstream of the confluence with the Stanislaus River. Changes in water temperatures at the confluence of the Stanislaus River and the San Joaquin River are calculated in the EIS, and are indicative of potential changes in fisheries conditions on the San Joaquin River downstream of the Stanislaus River. It is recognized that ambient air temperature conditions become a more dominant factor than upstream water temperatures as the San Joaquin River enters the Delta.

OID SSJID SEWD 22: As described in the EIS, the model results indicate that there will be periods that the temperature objectives would not be achieved under the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5. The EIS considers the changes in Stanislaus River water temperatures under Alternatives 1 through 5 as compared to the No Action Alternative and

Second Basis of Comparison and under the No Action Alternative as compared to the Second Basis of Comparison (see Figures 6B.17.1 through 6B.17.12 and 6B.18.1 through 6B.18.12).

OID SSJID SEWD 23: In Chapter 9, Fish and Aquatic Resources, references to Goodwin Lake has been replaced by references to the water body formed by Goodwin Dam.

OID SSJID SEWD 24: In response to this comment, a quantitative description of the temporal and geographic distribution of fall-run Chinook Salmon spawning in the Stanislaus River has been added to Section 9.3.4.17.1 of the Draft EIS and somewhat conflicting language has also been removed from this section.

OID SSJID SEWD 25: The text referenced in this comment has been modified in the Final EIS to include a discussion of straying of Chinook Salmon in the Stanislaus River.

OID SSJID SEWD 26: In response to this comment, text has been added to the steelhead Section 9.3.4.17.1 describing the timing and numbers of steelhead observed in the Stanislaus River. The reference to spawning above Oakdale has been replaced with "between Goodwin Dam and Orange Blossom Bridge."

OID SSJID SEWD 27: The paragraph referenced in this comment has been deleted in the Final EIS.

OID SSJID SEWD 28: The text referenced in this comment has been modified in the Final EIS to include the analysis of dissolved oxygen and migration of adult Chinook Salmon with references to Lee and Jones-Lee (2003) and SJTA (2012).

OID SSJID SEWD 29: It is acknowledged that predation is an important factor influencing the survival of juvenile salmonids in the Stanislaus River. The EIS addresses predation as a stressor on listed species and discusses it specifically for each of the water bodies analyzed, including the Stanislaus River. The EIS also discusses predation in terms of predator management (see Draft EIS section starting on page 9-274).

OID SSJID SEWD 30: The 7-day average of the daily maximums (7 DADM) prescribed in the NMFS OCAP BO is a management criterion designed to be measured in real-time.

The Draft EIS uses average monthly temperatures to provide a comparison on ability of operations considered under alternatives to meet temperature objectives for species. As described in Section 5A.A.3.6, temperature modeling is subsequent to CalSim II modeling that simulates operations on a monthly basis. As mentioned in Section 5A.A.3.5, regarding CalSim II model results and model results interpretations dependent on CalSim II, 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.

It is acknowledged that temperature operations in real-time would be dependent on daily variations of meteorological conditions, reservoir operations, fish presence, and other external factors such as prolonged drought. It is unfortunately not possible to capture all of these on a daily basis in a model. Therefore, the Draft EIS uses model results in a comparative manner to provide a trend analysis rather than interpreting these results as absolute effects, which would be speculative. In addition, this comparative approach should capture the same differences regardless of whether monthly average temperatures or 7DADM were used. This level of detail is deemed appropriate for a NEPA analysis.

OID SSJID SEWD 31: Changes in water temperature depend on upstream reservoir storage, monthly flow patterns, and residence times in the downstream reservoirs. Detailed discussion of such changes are provided in the EIS.

1C.1.11 Placer County Water Agency

PCWA
water • energy • stewardship

PLACER COUNTY WATER AGENCY
SINCE 1957

BOARD OF DIRECTORS
Gray Allen, District 1
Primo Santini, District 2
Mike Lee, District 3
Robert Dugan, District 4
Joshua Alpine, District 5
Einar Maisch, General Manager

BUSINESS CENTER
144 Ferguson Road
MAIL
P.O. Box 6570
Auburn, CA 95604
PHONE
(530) 823-4850
(800) 464-0030
WWW.PCWA.NET

September 23, 2015

Mr. Ben Nelson
Natural Resources Specialist
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

SUBJECT: Placer County Water Agency (PCWA) Comments

Dear Mr. Nelson:

The purpose of this letter is to present PCWA's comments to the Bureau of Reclamation (Reclamation) Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (DEIS). Comments pertain exclusively to the Sacramento River Water Reliability Project (SRRP) as described and analyzed in Reclamation's Biological Assessment on the Continued Long-term Operations of the Central Valley Project and the State Water Project, dated August 2008 (2008 BA). PCWA 1

Comments to the DEIS. Considering the extent of supporting studies, analyses and authorities, and the continuing commitment by PCWA and partner agencies to complete the project, the SRRP should be incorporated into Reclamation's Final Environmental Impact Statement (FEIS) and Record of Decision (ROD). Specifically: PCWA 2

1. If there is no relief to the current court-ordered deadline (December 1, 2015) for issuing the ROD, then the SRRP should be included as a related project in the FEIS and ROD as described in DEIS Chapter 1, Section 1.8 and relevant parts.

2. Should the court grant an extension of the current December 1, 2015, deadline, then the SRRP should be included in Reclamation's cumulative effects analysis for the FEIR and ROD as a reasonably foreseeable future project (Reference DEIS Chapter 3, Section 3.5 and relevant parts). PCWA is prepared to provide modeling and other technical support to Reclamation in completing an updated cumulative effects analysis, as requested. PCWA 3

Basis for Comments:

PCWA 3 continued

- The Final Environmental Impact Statement (FEIS) and Planning Report for the American River Water Resources Investigation (ARWRI), completed in 1997 by Reclamation and the Sacramento Metropolitan Water Authority[1], identified an environmentally preferred alternative for future water supply needs that includes additional surface water diversions and regional conjunctive management.

- Based upon an extensive analysis, the Sacramento Water Forum Agreement, dated April 24, 2000 (WFA) defined a wide range of water management actions by regional water agencies and environmental organizations to improve water supply reliability and resource protection within the American River and adjacent watersheds. One principal objective in the WFA involves diversions on the Sacramento River to reduce future diversions from the American River.

- Public Law 106-554 dated December 21, 2000, directed the Reclamation to conduct a feasibility study of a Sacramento River diversion facility consistent with the project identified in WFA. The goal of the study was to develop a water supply plan that was consistent with the WFA objectives of pursuing a Sacramento River diversion to meet water supply needs of the Placer-Sacramento region and promoting ecosystem preservation along the lower American River.

- SRRP effects were analyzed as part of the 2008 BA. The SRRP was subsequently addressed in the National Marine Fisheries Service (NMFS) "Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project", dated June 4, 2009 (NMFS BiOp).

- Reclamation completed an administrative draft Environmental Impact Statement for the study. However, work was suspended in 2012 due mainly to lack of funding by the non-federal cost share partners. Pending development of an alternative funding plan and reformulated approach to the project, and considering the immediacy of the then-applicable court-ordered date for producing a ROD (December 1, 2013), PCWA accepted that Reclamation's National Environmental Policy Act (NEPA) analysis would assume that all 35,000 acre-feet of PCWA's CVP contract supplies are diverted from the American River Pump Station (ARPS) on the North Fork, American River.

- Since that time, and in parallel with Reclamation's extended NEPA process, PCWA has continued to collaborate with other regional agencies to fund, develop and implement a reformulated approach to the SRRP. Project partners

[1] Now the Regional Water Authority (RWA)

Page 2

1

include PCWA, City of Roseville (Roseville), City of Folsom (Folsom), City of Sacramento (Sacramento), Sacramento County Water Agency (SCWA), Rio Linda/Elverta Community Water District (RLECWD), Sacramento Suburban Water District (SSWD), Citrus Heights Water District (CHWD), El Dorado County Water Agency (EDCWA), San Juan Water District (SJWD) and California American Water Company (CalAm). The Sacramento Water Forum is engaged as a partner as well. The project partners are also actively pursuing Reclamation participation and assistance in the SRRP.

PCWA 3 continued

- Participating agencies are committed to project completion. On March 20, 2015, the partners signed a cost-sharing agreement for the Development of a Project Framework Document for a new Sacramento River Water Supply. The respective Boards of Directors for PCWA, RLECWD, SCWA, SJWD, SSWD, CHWD, EDCWA, CalAm, the City Councils of Sacramento, Roseville and Folsom have all executed this agreement in support of the project.

- The current project is consistent structurally and operationally with corresponding project descriptions in the WFA, P.L. 106-554 and the 2008 BA. The initial planning report was completed in August 2015. Detailed planning and environmental analysis is scheduled to be completed by the end of 2018. Implementation (Procurement, Design, and Construction) is tentatively scheduled to begin early 2019 and continue through 2023. The project is consistent with adaption and mitigation strategies identified in the draft Sacramento – San Joaquin Basin Plan, and is expected to be a central component of the Regional Drought Contingency Plan currently being developed by PCWA and RWA under grant from Reclamation's WaterSMART Program.

Thank you for your consideration. Please let me know if PCWA can provide any additional clarification. I can be reached at afecko@pcwa.net or (530) 823-4490.

Sincerely

PLACER COUNTY WATER AGENCY

Andrew Fecko
Director of Resource Development

AF:vf

Page 3

cc: Rich Plecker, City of Roseville
Marcus Yasutake, City of Folsom
Brett Ewart, City of Sacramento
Darrel Eck, Sacramento County Water Agency
Mary Henrici, Rio Linda/Elverta Community Water District
Rob Roscoe, Sacramento Suburban Water District
Bob Churchill, Citrus Heights Water District
Ken Payne, El Dorado County Water Agency
Shauna Lorance, San Juan Water District
Audie Foster, California American Water Company
Craig Muehlberg, Acting Manager, Bay Delta Office, Bureau of Reclamation
Drew Lessard, Area Manager, Central California Area Office, Bureau of Reclamation

G:/vf2015cor.

1C.1.11.1 Responses to Comments from Placer County Water Agency

PCWA 1: Comment noted.

PCWA 2: The Sacramento River Water Reliability Project has been added to the list of related projects in Section 3.5 of Chapter 3, Description of Alternatives, and in the cumulative effects analyses in Chapters 5 through 21 of the EIS. Results of the impact analysis for all of the alternatives will be considered by Reclamation during preparation of the Record of Decision.

PCWA 3: This project is still under development and is appropriate for inclusion in the cumulative effects analysis. The cumulative effects analysis for the EIS is a qualitative analyses due to the preliminary nature of the programs, projects, and policies considered under this analysis. 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 incorporate detailed information about this project. However, information related to this project from existing publically-available references will be used in the analysis of cumulative effects during preparation of the Final EIS.

1C.1.12 City of Sacramento

City of SACRAMENTO
Department of Utilities

September 29, 2015

Mr. Ben Nelson
Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

By U. S. Mail and E-Mail to: BCNelson@usbr.gov

Re: Comments on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft EIS

The City of Sacramento (City) and the US Bureau of Reclamation (Reclamation) are party to a settlement and operating contract (Contract No. 14-06-200-6497, hereafter Settlement Contract) wherein the City gave up certain rights in exchange for Reclamation's operation of Folsom Reservoir so as to make water available to the City in accordance with the contractual schedule. The City diverts the water made available under the Settlement Contract largely at its Fairbairn facility on the Lower American River. The City also has senior water rights on both the Sacramento and American Rivers. SAC 1

In practice, Reclamation and the City have a good record of cooperative communication and operations in support of their contractual relationship and the City's water rights. The Draft EIS needs to reflect Reclamation's obligation to operate in compliance with the Settlement Contract and applicable water right priorities and laws. In several respects, it does not appear to do so. SAC 2

The City submits these comments in furtherance of continued operations in cooperation with Reclamation. SAC 3

- The DEIS shows significant impacts to Folsom Reservoir, including decreased storage, decreased reliability, and increased incidence of "dead pool" conditions. Figure C-4-2, entitled Folsom Lake, End of September Storage (Appendix 5, Page 5A-179), suggests that Folsom Lake would reach dead pool conditions under the alternatives approximately three to five percent of the time. Allowing Folsom Lake to reach dead pool conditions is not consistent with Reclamation's obligations under the Settlement Contract.

- The DEIS appears to show CVP operations placing a disproportionate burden on Folsom Reservoir by using it as a "first responder" to meet Delta water quality standards. Folsom Reservoir is not a sufficiently large resource to sustain these demands and reliably meet local obligations including that of the City. SAC 4

- The DEIS's hydrological analysis does not analyze how the CVP and SWP would be operated to provide Settlement Contract deliveries during multi-year droughts, and, as a result, does not properly analyze the impacts of the proposed action on Folsom Reservoir storage and water to be made available for diversion by the City. SAC 5

City of Sacramento Department of Utilities
916-808-1400
1395 35th Avenue
Sacramento, CA 95822

1C.1.12.1 Responses to Comments from City of Sacramento

SAC 1: Comment noted.

SAC 2: Comment noted.

SAC 3: The CVP and SWP operations prioritize meeting federal and state statutory and regulatory requirements and obligations to senior water rights holders, including the City of Sacramento prior to deliveries of water to other CVP and SWP water contractors. The modeling analyses presented in the EIS include these prioritizations for long-term operation of the CVP and SWP without inclusion of changes that could be developed for specific extreme flood or drought events. Water is delivered every year under the water right contract to the City of Sacramento in the 82-year hydrology analyzed with the CalSim II model in the EIS.

Reclamation is aware of the storage and diversion limitations that exist for the intakes in Folsom Lake during drought periods when Reclamation may be allocating and delivering water in consideration of federal and state regulatory requirements, including water rights. Droughts have occurred throughout California's history, and are constantly shaping and innovating the ways in which Reclamation and DWR balance both federal and state regulations, public health standards and urban and agricultural water demands. 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 implementation of a barge and pump system in Folsom Lake to allow diversions when low water surface elevations would cause capacity issues for existing intakes.

SAC 4: As described in Appendix 3A, No Action Alternative: Central Valley Project and State Water Project Operations, in the EIS, 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 water quality criteria. If, in this circumstance, it is decided the reasonable course of action is to increase upstream reservoir releases, then generally water is released from Folsom Reservoir 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 are generally adjusted downward. Water releases from Folsom Lake are determined based upon water rights in the American River watershed and federal and state statutory and regulatory requirements related to the operation of the CVP and SWP.

SAC 5: As described in the response to Comment SAC 3, water is delivered every year under the water right contract to the City of Sacramento in the 82-year hydrology analyzed with the CalSim II model in the EIS. The low Folsom Lake water storage conditions that occur during drought periods under the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 in the EIS occur after water is delivered in the CalSim II model to the City of Sacramento and other water rights holders in the American River watershed.

1C.1.13 San Luis & Delta-Mendota Water Authority, Westlands Water District, and San Joaquin River Exchange Contractors Water Authority

San Luis & Delta-Mendota Water Authority
P.O. Box 2157
Los Banos, CA 93635
Phone: (209) 826-9696
Fax: (209) 826-9698

Westlands Water District
3130 N. Fresno Street
P.O. Box 6056,
Fresno, CA 93703-6056
Phone: (559) 224-1523
Fax: (559) 241-6277

San Joaquin River Exchange Contractors Water Authority

September 29, 2015

VIA U.S. MAIL AND EMAIL

Mr. Brian Nelson
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536
Email: bcnelson@usbr.gov

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

Dear Mr. Nelson:

The San Luis & Delta-Mendota Water Authority, Westlands Water District, and the San Joaquin River Exchange Contractors Water Authority appreciate the opportunity to comment on the Draft Environmental Impact Statement for the Coordinated Long-term Operation of the Central Valley Project and State Water Project ("Draft EIS").[1] In its coming Record of Decision, the United States Bureau of Reclamation ("Reclamation") will be making policy decisions on a matter of vital importance to the future of California, including its protected fish and wildlife species, millions of its people, and millions of acres of its prime farm land.

SLDMWA WWD SJRECWA 1

Reclamation must make a new and thoughtful decision regarding how it will operate the Central Valley Project ("CVP"), in coordination with the Department of Water Resources' operation of the State Water Project ("SWP"), to serve project purposes while meeting its obligations under section 7 of the federal Endangered Species Act ("ESA"). No one can afford a

[1] The member agencies of the San Luis & Delta-Mendota Water Authority and the San Joaquin River Exchange Contractors Water Authority are listed in the attached Exhibit A.

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reflexive, status quo re-adoption of the policy decisions Reclamation made some seven years ago to adopt and implement the existing reasonable and prudent alternatives. The Draft EIS is in response to court orders entered in litigation brought by the Authority, Westlands and other water contractors challenging those decisions. As the courts have found, those decisions were unlawful, because they were made without the benefit of any environmental review under the National Environmental Policy Act ("NEPA"). Further, those decisions relied upon limited and now outdated science, and were not informed by the critical social and environmental impacts realized over the past seven years of implementing the existing reasonable and prudent alternatives. The seven years since have shown devastating adverse impacts from lost water supply due to the ESA restrictions, but no recovery in the protected species. Indeed, despite implementation of the ESA restrictions, the listed species have continued to decline. It is past time for a new approach. SLDMWA WWD SJRECWA 1 continued

The current NEPA review provides Reclamation with an opportunity to make a more informed and better decision than it did seven years ago, an opportunity Reclamation should embrace. NEPA requires no less. As the Council on Environmental Quality's regulations dictate, "[a]n environmental impact statement is more than a disclosure document. It shall be used by federal officials in conjunction with other relevant material to plan actions and make decisions." 40 C.F.R. § 1502.1. Reclamation's environmental impact statement must analyze and inform the public and policy makers of whether and what changes to CVP and SWP operations are necessary to meet the requirements of the ESA, the available alternatives, the trade-offs inherent among the available alternatives, and potential mitigation for resulting impacts. The environmental impact statement should provide the information necessary to a decision that will maximize the ability of the CVP to achieve all its authorized purposes, while still providing the protection due listed species under the ESA. SLDMWA WWD SJRECWA 2

We are disappointed that the Draft EIS ignores this opportunity. Although the Draft EIS states that a purpose of the proposed action is to "continue the operation of the CVP in coordination with operation of the SWP, for its authorized purposes," that purpose is not reflected in the alternatives or analysis. It is a lengthy document that teaches very little, and falls well short of what NEPA requires. Some of the more significant deficiencies of the Draft EIS are: SLDMWA WWD SJRECWA 3

- It does not critically examine the need for, or expected benefits for listed species of, the existing reasonable and prudent alternatives in the biological opinions, nor does it offer a meaningful comparison of the projected effects and benefits of alternatives.

- It does not identify any mitigation for lost CVP and SWP water supply, despite acknowledging that the existing reasonable and prudent alternatives will result in an average annual loss of over one million acre-feet of project water, and despite the devastating impacts on the human environment already caused by resulting water shortages, including overdrafting groundwater basins, land subsidence, and degraded air quality. SLDMWA WWD SJRECWA 4

- It attempts to deny any significant future water supply impacts from implementing the existing reasonable and prudent alternatives by unreasonably SLDMWA WWD SJRECWA 5

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assuming that increased use of groundwater will entirely substitute for lost CVP and SWP water supply. SLDMWA WWD SJRECWA 5 continued

- It does not explain the significant scientific uncertainty underlying the existing biological opinions and similar prescriptions, and hence does not inform the public or decision makers of the true nature and range of the largely policy-based choices to be made regarding future operations. SLDMWA WWD SJRECWA 6

- It neglects to consider an integrated approach to meeting the needs of both the delta smelt and salmonid species, to remedy the sometimes conflicting requirements of the two existing biological opinions. SLDMWA WWD SJRECWA 7

We provide more detailed comments supporting these and additional points in the Exhibits attached to this letter.[2] Significant revisions and additional analyses are required for Reclamation to make a well-informed decision, and to meet NEPA's requirements. SLDMWA WWD SJRECWA 8

All will benefit if Reclamation takes the opportunity before it and performs the NEPA review necessary to adequately inform its coming decisions. Under the current remand schedule in the delta smelt case, Reclamation's Record of Decision is due by December 1, 2015. As we have noted in prior comments, that is not enough time to make needed revisions to the Draft EIS. These parties are open to an extension of the current remand deadline, which of course the court would have to approve. We invite further discussion with Reclamation on this issue. SLDMWA WWD SJRECWA 9

Thank you for your consideration of these comments.

Sincerely,

Daniel G. Nelson
Executive Director
San Luis & Delta-Mendota Water Authority

Thomas Birmingham
General Manager
Westlands Water District

Steve Chedester
Executive Director
San Joaquin River Exchange Contractors Water Authority

SLDMWA WWD SJRECWA 10

[2] The Authority submitted written comments on June 28, 2012 in response to the notice of intent and scoping, on May 3, 2013 in response to the first version of the administrative draft environmental impact statement, and on July 14, 2015 in response to the second version of administrative draft environmental impact statement. We incorporate those prior comments, including all attachments thereto, in these comments as well.

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EXHIBIT A

San Luis & Delta-Mendota Water Authority Member Agencies

The Authority's members are: SLDMWA WWD SJRECWA 11

Banta-Carbona Irrigation District; Broadview Water District; Byron Bethany Irrigation District (CVPSA); Central California Irrigation District; City of Tracy; Columbia Canal Company (a Friend); Del Puerto Water District; Eagle Field Water District; Firebaugh Canal Water District; Fresno Slough Water District; Grassland Water District; Henry Miller Reclamation District #2131; James Irrigation District; Laguna Water District; Mercy Springs Water District; Oro Loma Water District; Pacheco Water District; Pajaro Valley Water Management Agency; Panoche Water District; Patterson Irrigation District; Pleasant Valley Water District; Reclamation District 1606; San Benito County Water District; San Luis Water District; Santa Clara Valley Water District; Tranquillity Irrigation District; Turner Island Water District; West Side Irrigation District; West Stanislaus Irrigation District; Westlands Water District.

San Joaquin River Exchange Contractors Water Authority Member Agencies

The Exchange Contractors' members are:

Central California Irrigation District; San Luis Canal Company; Firebaugh Canal Water District; Columbia Canal Company

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EXHIBIT B

DETAILED COMMENTS REGARDING DRAFT EIS

I. THE DRAFT EIS IS FUNDAMENTALLY FLAWED

A. The Draft EIS Fails To Analyze An Important Aspect Of The Decision Facing Reclamation – What Changes To CVP Operations Are, Or Are Not, Necessary To Comply With ESA Section 7

The review provided in the Draft Environmental Impact Statement for the Coordinated Long-term Operation of the Central Valley Project and State Water Project ("Draft EIS") pursuant to the National Environmental Policy Act ("NEPA") is inconsistent with the district court's rulings in the *Consolidated Smelt Cases* and *Consolidated Salmonid Cases* and with Reclamation's obligations on remand. The court found that Reclamation violated NEPA when it adopted and implemented major changes to Central Valley Project ("CVP") and State Water Project ("SWP") (collectively, the "Projects") operations pursuant to biological opinions ("BiOps"), changes that caused significant adverse effects on the quality of the human environment, without doing any NEPA review. To understand and inform the public and policymakers regarding its coming decision, Reclamation must consider whether and how the continued operations of the CVP and SWP should be modified to ensure compliance with the Endangered Species Act ("ESA"). Reclamation must engage in a fundamental reanalysis of the effect of CVP and SWP operations on the listed species, and the necessity for and efficacy of any measures intended to address such effects. SLDMWA WWD SJRECWA 12

In recent years, changes to CVP and SWP operations that purportedly were "necessary" to comply with the ESA have severely impaired the ability of the CVP and SWP to meet their respective authorized purposes, with disastrous consequences. Reclamation's present NEPA review should therefore be keenly focused on identifying actions it and the Department of Water Resources ("DWR") can take to better serve all authorized purposes while still meeting the requirements of the ESA. In performing this assessment, Reclamation should generate and carefully consider the data and analysis of impacts and alternatives in the NEPA process, including new available scientific data and other changes since 2008. The task on remand is not to simply accept the reasonable and prudent alternatives ("RPAs") of the BiOps, but rather to analyze anew what, if any, modifications to CVP and SWP operations are necessary to avoid jeopardy to the species. Reclamation's analysis must consider what effect the coordinated operations of the CVP and SWP actually have on species survival and recovery, what measures are proposed to reduce or compensate for such effects, what the data show about the likely efficacy of those measures, and what other effects those measures will cause including through reductions of water supply. That analysis should distinguish between actions that are necessary to comply with the mandates of ESA section 7 (i.e., to avoid jeopardizing the species or adversely modifying its critical habitat), and other actions that might provide some additional protection or benefit for listed species, but are not necessary to comply with the ESA.

The Draft EIS suggests that it is intended to be used to inform Reclamation's operation of the CVP. The Draft EIS states: "This EIS may be used by Reclamation or cooperating agencies

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that are participating in the preparation of this EIS to inform future decisions related to operation of the CVP and SWP, and implementation of the RPAs in the 2008 USFWS BO and 2009 NMFS BO." Draft EIS at ES-5. However, the Draft EIS does not critically examine the conclusions of the BiOps, or the RPAs. It accepts them as a given, rather than using the NEPA process to analyze the available data and inform decisions regarding what CVP and SWP operations are actually necessary to meet Reclamation's ESA obligations. In order to serve the purposes of NEPA, the Draft EIS must be revisited and revised, to allow an up-to-date analysis that takes the requisite "hard look" at what, if any, modifications to CVP and SWP operations are necessary to comply with the standards of ESA section 7. *South Fork Band Council of Western Shoshone of Nevada v. U.S. Dep't of Interior*, 588 F.3d 718, 726-27 (9th Cir. 2009). That review should expressly note scientific uncertainties and gaps in data, and indicate the significance of shortcomings in the data for the ultimate decision.

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Reclamation is not bound to, and cannot, simply implement the reasonable and prudent alternatives prescribed by the wildlife agencies in the 2008 and 2009 BiOps. Instead, Reclamation must decide for itself what is or is not required to insure that its actions comply with its obligations under the ESA. 16 U.S.C. § 1536(a)(2); *Wild Fish Conservancy v. Salazar*, 628 F.3d 513, 518-19. In making that determination, Reclamation "may not rely solely on [the BiOps] to establish conclusively its compliance with its substantive obligations under section 7(a)(2)." *Pyramid Lake Paiute Tribe of Indians v. U.S. Dep't of Navy*, 898 F.2d 1410, 1415 (9th Cir. 1990). "[T]he action agency must not blindly adopt the conclusions of the consultant agency." *City of Tacoma, Wash. v. Fed. Energy Regulatory Comm'n*, 460 F.3d 53, 76 (D.C. Cir. 2006). This is because in the end, "the ultimate responsibility for compliance with the ESA falls on the action agency." *Id.*; *see also* 16 U.S.C. § 1536(a)(1)-(2).

Reclamation must now reconsider whether and how the continued operations of the CVP and SWP should be modified to ensure compliance with the ESA. As Reclamation considers the 2008 and 2009 BiOps anew, it should "determine whether and in what manner to proceed with the action in light of its section 7 obligations and the Service[s'] biological opinion[s]." 50 C.F.R. § 402.15(a). Reclamation's fresh review of the 2008 and 2009 BiOps and RPAs must not be arbitrary, capricious, or contrary to law, or Reclamation will violate its independent, substantive duty to comply with the ESA. Such independent liability will attach, for example, where the action agency is in possession of "new information" rendering the BiOp suspect. *Wild Fish Conservancy*, 628 F.3d at 532; *Pyramid Lake*, 898 F.2d at 1415. Such liability may also attach where the BiOp is based on data that contradicts the action agency's own data or where the action agency, through the BiOp, failed to consider all relevant factors. *See Defenders of Wildlife v. U.S. Envt'l Prot. Agency*, 420 F.3d 946, 976 (9th Cir. 2005); *Res. Ltd., Inc. v. Robertson*, 35 F.3d 1300, 1305 (9th Cir. 1993); *Pac. Coast Fed'n of Fishermen's Ass'ns v. Gutierrez*, 606 F. Supp. 2d 1122, 1189, 1191 (E.D. Cal. 2008).

Reclamation must review the scientific data underlying the prescriptions of the BiOps, the scientific data available today, and the experience of the past seven years, in order to determine what is necessary to meet its obligations under ESA section 7. The Draft EIS is inadequate to serve that purpose, and hence must be substantially revised to adequately inform Reclamation's decision.

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B. The Draft EIS Fails To Identify The Proposed Action

The Draft EIS does not clearly identify the "proposed action." The Department of Interior's regulations for implementation of NEPA mandate that an EIS include a "description of the proposed action." 43 C.F.R. § 46.415(a)(2). The regulations define the "proposed action" as "the bureau activity under consideration" and the regulations state that the "proposed action" must be "clearly described in order to proceed with NEPA analysis." 43 C.F.R. § 46.30.

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Apparently, Reclamation has not yet decided upon a proposed action. The Draft EIS does not contain a section entitled "proposed action," nor does the document ever clearly identify the proposed action. The Draft EIS states: "This Draft EIS evaluates potential long-term direct, indirect, and cumulative impacts on the environment that could result from implementation of modifications to the continued long-term operation of the CVP and SWP." Draft EIS at 1-1. Reclamation must decide upon a proposed action for the NEPA process. For example, unless and until Reclamation identifies and describes the "proposed action" it is difficult to imagine how Reclamation can develop a reasonable range of alternatives to the proposed action.

C. The No Action Alternative Is Incorrect

An EIS must "[i]nclude the alternative of no action." 40 C.F.R. § 1502.14(d). In an EIS, the action alternatives are compared to the no action alternative to measure the impacts of each action alternative. *See, e.g., Center for Biological Diversity v. U.S. Dept. of the Interior*, 623 F.3d 633, 642, (9th Cir. 2010) ("A no action alternative in an EIS allows policymakers and the public to compare the environmental consequences of the status quo to the consequences of the proposed action. The no action alternative is meant to 'provide a baseline against which the action alternative[ ]'…is evaluated. *Id.* A no action alternative must be considered in every EIS. *See* 40 C.F.R. § 1502.14(d).").

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According to Reclamation's NEPA Handbook, "'[n]o action' represents a projection of current conditions and reasonably foreseeable actions to the most reasonable future responses or conditions that could occur during the life of the project without any action alternatives being implemented." Reclamation's NEPA Handbook (Feb. 2012) at 8-8. Moreover,

> [t]he no action alternative should not automatically be considered the same as the existing condition of the affected environment because reasonably foreseeable future actions may occur whether or not any of the project action alternatives are chosen. When the no action alternative is different from the existing condition, as projected into the future, the differences should be clearly defined. Differences could result from other water development projects, land use changes, municipal development, or other actions. "No action" is, therefore, often described as "the future without the project."

Id.

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The Draft EIS's No Action Alternative does not allow the decisionmakers or the public to evaluate and compare the environmental consequences of implementing the BiOps and RPAs, because it *includes* the RPAs. The Draft EIS states: SLDMWA WWD SJRECWA 15 continued

> For this EIS, the No Action Alternative is based upon the continued operation of the CVP and SWP in the same manner as occurred at the time of the publication of the Notice of Intent in March 2012. Thus, the No Action Alternative consists of the coordinated long-term operation of the CVP and SWP, including full implementation of the RPAs in the 2008 USFWS BO and 2009 NMFS BO because Reclamation provisionally accepted the BOs in 2008 and 2009, respectively, and is implementing the RPAs. The No Action Alternative also includes changes not related to the long-term operation of the CVP and SWP or implementation of the RPAs in the 2008 USFWS BO and 2009 NMFS BO . . . .

Draft EIS at 3-3. This description of the No Action Alternative is inconsistent with the district court's rulings regarding Reclamation's failure to comply with NEPA, and will result in an EIS that fails to comply with law. *See, e.g., Conservation Council for Hawaii v. NMFS*, --- F. Supp. 3d ----, 2015 WL 1499589 at *25 (D. HI Mar. 31, 2015) (finding no action alternative unlawful because it "assum[ed] the very take activities the Navy was proposing to engage in").

The Draft EIS's No Action Alternative essentially pretends that the litigation and the court rulings that resulted in the remand never happened. The Draft EIS states that "[b]ecause the RPAs were provisionally accepted and the No Action Alternative represents a continuation of existing policy and management direction, the No Action Alternative includes the RPAs." Draft EIS at ES-8. However, that rationale ignores the reality that Reclamation was required, but failed, to conduct NEPA review *before* accepting and implementing the RPAs. The "existing policy and management direction" is unlawful because it was adopted without prior NEPA review.

The district court ruled that Reclamation violated NEPA by significantly modifying CVP operations to meet ESA requirements without first performing NEPA analysis of the impacts of such modifications or alternatives to such modifications. To remedy the error found by the court, Reclamation must place itself back in the position it was in before that error occurred (i.e. before provisionally adopting the BiOps without performing any NEPA analysis). Accordingly, in order to respond to the court's ruling on remand, here the "no action" alternative should be defined to include operations consistent with Reclamation's and DWR's obligations and all legal requirements *except* any ESA-related requirements that involve major changes to operations. Under this definition of "no action," CVP and SWP operations would continue in compliance with other regulatory requirements (e.g. D-1641 as modified by applicable laws, including Wilkins Slough requirements, FERC license requirements, American River in-river flow requirements, etc.). Comparing this no action alternative to the action alternatives developed

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during the NEPA process will provide the most comprehensive and appropriate disclosure of the environmental impacts of the various action alternatives to comply with ESA requirements.[1] SLDMWA WWD SJRECWA 15 continued

Treating the BiOps as any part of the No Action Alternative is a highly inadvisable course of action, because it does not cure the NEPA violation found by the district court. It instead contradicts the district court's ruling, because the NEPA analysis does not measure and disclose the impacts of changes to CVP and SWP operations to comply with the ESA. And it defeats the purpose of the No Action Alternative—to provide a meaningful comparative scenario with which to gauge the impacts of the action alternatives. As the Ninth Circuit observed in a similar context, "[a] no action alternative in an EIS is meaningless if it assumes the existence of the very plan being proposed." *Friends of Yosemite Valley v. Kempthorne*, 520 F.3d 1024, 1038 (9th Cir. 2008). To comply with the judgments in the *Consolidated Smelt Cases* and *Consolidated Salmonid Cases*, the No Action Alternative must be revised. SLDMWA WWD SJRECWA 16

The definition of the No Action Alternative (and indeed all alternatives) is incorrect for a second reason. The Draft EIS provides that it "does not address the CVP facilities associated with Millerton Lake, including the Madera and Friant-Kern canals and their service areas, and the San Joaquin River Restoration Program because these facilities are not considered in the consultations related to the 2008 USFWS BO and 2009 NMFS BO." Draft EIS at 3-16. Appendix 3A repeats that "Friant Division operations are not analyzed in th[e] EIS." Draft EIS at 3A-64. But Friant Division operations should be included and analyzed in the EIS. SLDMWA WWD SJRECWA 17

The Friant Division is a part of the CVP. It is operating now, and presumably it will be operating for the foreseeable future. Its operations will continue to affect the overall operations of the CVP and coordinated operations of the SWP. By failing to include Friant Division operations, the Draft EIS is taking an incomplete look at CVP operations, and may be missing important impacts and available alternatives. That omission violates NEPA. It is no excuse that the ESA consultations concluded in 2008 and 2009 failed to include Friant Division operations. Those ESA consultation failings does not warrant creating a NEPA defect as well.

D. The Second Basis Of Comparison Is Not A Substitute For The Correct No Action Alternative

The Authority, Westlands, and the Exchange Contractors appreciate Reclamation's efforts to provide a "Second Basis of Comparison" for comparing the environmental consequences of the alternatives, as a response to our concerns about the No Action Alternative. However, the true remedy is to correctly define the No Action Alternative in the first place. That would eliminate the need for a "second basis of comparison," and simplify the Draft EIS. SLDMWA WWD SJRECWA 18

[1] The situation here is unlike most other circumstances where NEPA review is performed, because the CVP and SWP were constructed and operating before NEPA and the ESA were even enacted. Thus, the "no action" alternative, which usually serves as the baseline for evaluating the significance of environmental impacts of action alternatives, is more complicated. The existing Projects, including operations, must be captured in the "no action" baseline so they are not included in the new effects of the action alternatives. For this reason, a hypothetical "no action" alternative that fails to account for current and previous operations of the Projects would be an improper baseline for comparative analysis. *See American Rivers v. Federal Energy Regulatory Comm.*, 187 F.3d 1007 (9th Cir. 1999).

The Draft EIS states:

> this EIS includes a "Second Basis of Comparison" that represents a condition in 2030 with coordinated long-term operation of the CVP and SWP without implementation of the 2008 USFWS BO and 2009 NMFS BO RPAs. All of the alternatives are compared to the No Action Alternative and to the Second Basis of Comparison to describe the effects that could occur in 2030 under both bases of comparison.
>
> Because several of the 2009 NMFS BO RPA actions had already been initiated prior to issuance of the 2009 NMFS BO; those actions are included in the Second Basis of Comparison. Reasonably foreseeable actions included in the No Action Alternative that are not related to the 2008 USFWS BO or 2009 NMFS BO are also included in the Second Basis of Comparison.

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Draft EIS at ES-8.

We found the description and use of the Second Basis Of Comparison in the Draft EIS somewhat confusing. It is not a remedy for the defects in the No Action Alternative, because it still includes actions based on the BiOps. As we understand it, it does not provide a basis for comparison to CVP and SWP operations consistent with Reclamation's and DWR's obligations and all legal requirements *except* requirements related to the ESA.

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If Reclamation adopts the Second Basis Of Comparison as its No Action Alternative, it should revise it to eliminate any actions taken in response to the BiOps and RPAs. The Second Basis Of Comparison includes the following "actions included in the 2008 USFWS BO and 2009 NMFS BO":

- 2008 USFWS BO RPA Component 4, Habitat Restoration.
- 2009 NMFS BO RPA Action I.1.3, Clear Creek Spawning Gravel Augmentation.
- 2009 NMFS BO RPA Action I.1.4, Spring Creek Temperature Control Curtain Replacement.
- 2009 NMFS BO RPA Action I.2.6, Restore Battle Creek for Winter-Run, Spring-Run, and Central Valley Steelhead.
- 2009 NMFS BO RPA Action I.3.1, Operate Red Bluff Diversion Dam with Gates Out.
- 2009 NMFS BO RPA Action I.5, Funding for CVPIA Anadromous Fish Screen Program.
- 2009 NMFS BO RPA Action I.6.1, Restoration of Floodplain Habitat; and Action I.6.2, Near-Term Actions at Liberty Island/Lower Cache Slough and Lower Yolo Bypass; Action I.6.3, Lower Putah Creek Enhancements; Action I.6.4, Improvements to Lisbon Weir; and Action I.7, Reduce Migratory Delays and Loss of Salmon, Steelhead, and Sturgeon at Fremont Weir and Other Structures in the Yolo Bypass.

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- 2009 NMFS BO RPA Action II.1, Lower American River Flow Management.

Draft EIS at 3-5 – 3-7. If the intent of the Second Basis Of Comparison is to provide a basis of comparison "that does not include implementation of the RPAs" then the Second Basis Of Comparison should not include actions under programs that are being implemented in response to, and in lieu of, the RPAs. Draft EIS at 3-22. The purpose of the No Action Alternative is to inform the public and policy makers of what conditions would be like without major ESA-related restrictions on CVP and SWP operations. The existing Second Basis Of Comparison improperly assumes that modifications to CVP and SWP operations are necessary to avoid jeopardy and includes certain existing actions that are dependent on the BiOps' jeopardy determination.

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In addition, the Second Basis of Comparison does not serve as a substitute for the correct No Action Alternative because the Draft EIS disregards the Second Basis of Comparison throughout much of its NEPA analysis. Critically, the Draft EIS fails to identify mitigation measures that could mitigate the impacts associated with implementing the RPAs, as we explain next.

E. <u>The Draft EIS Lacks Mitigation Measures For the RPAs</u>

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In addition to analyzing the impacts of all potential, feasible alternatives, the EIS must include a discussion of the "means to mitigate adverse environmental impacts." 40 C.F.R. § 1502.16(h). Accordingly, the EIS must identify all relevant, reasonable mitigation measures that could alleviate a project's environmental effects, even if they entail actions that are outside the lead or cooperating agencies' jurisdiction. *See* "Forty Most Asked Questions Concerning CEQ's NEPA Regulations," No. 19b. Such measures must entail feasible, specific actions that could avoid impacts by eliminating certain actions; minimizing impacts by limiting their degree; rectifying impacts by repairing, rehabilitating or restoring the affected environment; reducing impacts through preservation or maintenance; and/or compensating for a project's impacts by replacing or providing substitute resources. 40 C.F.R. § 1508.20.

The Draft EIS fails to identify or examine mitigation measures that may help mitigate the impacts of implementing the RPAs. Reclamation's refusal to even consider ways to mitigate such impacts appears to be tied to its failure to critically examine the RPAs and analyze how the existing RPAs could be modified to mitigate their impacts, such as impacts to SWP and CVP water supplies and deliveries. *See South Fork Band Council of Western Shoshone of Nevada v. U.S. Dept. of Interior*, 588 F.3d 718, 727 (9th Cir. 2009). The EIS fails to provide this critical component of the analysis required by NEPA.

The Draft EIS acknowledges that NEPA requires analysis of mitigation measures, but the Draft EIS fails to identify any measures to mitigate the impacts of implementing the RPAs. The Draft EIS states: "An EIS must also identify relevant, reasonable mitigation measures that are not already included in the proposed action or alternatives to the proposed action that could be used to avoid, minimize, rectify, reduce, eliminate, or compensate for the project's adverse environmental effects." Draft EIS at ES-14. However, the EIS then states that "Mitigation measures were not included to address adverse impacts under the alternatives as compared to the Second Basis of Comparison because this analysis was included in this EIS for information purposes only." *Id.* at ES-14 – ES-15. In other words, the Draft EIS admits there are adverse

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impacts associated with implementing the RPAs, but fails to make any effort to identify mitigation measures to address those impacts. SLDMWA WWD SJRECWA 21 continued

For example, the Draft EIS confirms that continued implementation of the BiOps' RPAs will cause huge reductions in CVP and SWP water deliveries, yet the Draft EIS makes no effort to identify possible ways to mitigate those impacts. Draft EIS at 5-93 – 5-97 (tables showing reduced water deliveries and text describing reductions). It estimates that on a long-term annual average, the RPAs will reduce CVP water deliveries by 332,000 acre-feet annually, and reduce SWP water deliveries by 773,000 acre-feet annually. *Id.* In particular, implementation of the RPAs is expected to reduce deliveries to CVP South of Delta agricultural water service contractors "by 24 percent over the long-term conditions; 33 percent in dry years; and 37 percent in critical dry years." Draft EIS at 5-95. And deliveries of "Article 21 water to SWP South of Delta water contractors would be reduced by 83 percent over the long-term conditions; 96 percent in dry years; and 92 percent in critical dry years." *Id.* at 5-97. Yet, the Draft EIS fails to identify even a single mitigation measure that could help mitigate these water supply impacts. Failing to identify mitigation for the massive losses of water supply that will indisputably result from implementing the RPAs is inexplicable, and an obvious violation of NEPA.

F. The Draft EIS Fails To Provide A Reasonable Range of Alternatives That Are Responsive To The Purpose And Need For The Action

The alternatives presented and analyzed in the Draft EIS do not represent a reasonable range of alternatives that are responsive to the identified purpose and need for the proposed action. The listed alternatives do not reflect the critical inquiry - how can Reclamation best meet the authorized purposes of the CVP while also ensuring compliance with its obligations under ESA section 7? Further, it fails to consider an alternative that integrates the RPAs from the two BiOps, as a way to avoid or lessen conflicts between prescriptions for the delta smelt and salmonid species. SLDMWA WWD SJRECWA 22

1. The Draft EIS Fails To Apply The Purpose And Need In Its Development Of Alternatives

An EIS must contain a statement of "purpose and need" which briefly specifies "the underlying purpose and need to which the [lead] agency is responding in proposing the alternatives including the proposed action." 40 C.F.R. § 1502.13. The purpose and need statement "is a critical element that sets the overall direction of the process and serves as an important screening criterion for determining which alternatives are reasonable." NEPA Handbook at 8-5. This statement of purpose and need is important because it will inform the range of alternatives ultimately selected for analysis in the EIS and "[a]ll reasonable alternatives examined in detail must meet the defined purpose and need." *Id.* The 'need' for the action may be described as the underlying problem or opportunity to which the agency is responding with the action. The 'purpose' may refer to the goal or objective that the bureau it trying to achieve, and should be stated to the extent possible, in terms of desired outcomes." 43 C.F.R. § 46.420(a)(1). SLDMWA WWD SJRECWA 23

Statement of Purpose

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The Draft EIS describes the "purpose" of the action as follows:

> The purpose of the action considered in this EIS is to continue the operation of the CVP in coordination with operation of the SWP, for its authorized purposes, in a manner that:
>
> • Is similar to historic operational parameters with certain modifications;
>
> • Is consistent with Federal Reclamation law; other Federal laws and regulations; Federal permits and licenses; State of California water rights, permits, and licenses; and
>
> • Enables Reclamation and DWR to satisfy their contractual obligations to the fullest extent possible.

Draft EIS at ES-6.

The Authority, Westlands, and the Exchange Contractors appreciate that the statement of purpose now includes satisfying contractual obligations to the fullest extent possible, and operating the CVP for its authorized purposes. However, implementation of the RPAs has prevented Reclamation from meeting the authorized purposes of the CVP. Reclamation's inability to meet the CVP's authorized purposes under the BiOps should be expressly acknowledged, and should inform the development of alternatives.

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Statement of Need

The Draft EIS describes the "need" for the action as follows:

> Continued operation of the CVP is needed to provide river regulation, navigation; flood control; water supply for irrigation and domestic uses; fish and wildlife mitigation, protection, and restoration; fish and wildlife enhancement; and power generation. The CVP and the SWP facilities are also operated to provide recreation benefits and in accordance with the water rights and water quality requirements adopted by the SWRCB.
>
> The USFWS and NMFS concluded in their 2008 and 2009 BOs, respectively, that the coordinated long-term operation of the CVP and SWP, as described in the 2008 Reclamation Biological Assessment, jeopardized the continued existence of listed species and adversely modified critical habitat. The USFWS and NMFS provided RPAs in their respective BOs as an alternative to the project described in the 2008 BA that would not jeopardize listed species or adversely modify critical habitat.

Draft EIS at ES-6.

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This statement of need does not express the "underlying problem" that Reclamation is responding to. In the context here, providing water supply as fully as possible while still complying with the ESA gives rise to the *need* for the action. The "underlying problem" that Reclamation is responding to is the difficulty the CVP and SWP have had in serving water supply and other project purposes while complying with the ESA. That requires an analysis of what changes to operations, if any, are necessary to comply with the ESA, and based thereon whether the BiOp prescriptions or some alternative would better meet all project purposes while doing so. SLDMWA WWD SJRECWA 24 continued

2. The Range Of Alternatives Does Not Focus On The Key Issues

The alternatives analysis is the "linchpin" of an EIS. *Monroe County Conservation Council, Inc. v. Volpe*, 472 F.2d 693, 697 (2d Cir. 1972). Federal agencies must to the fullest extent possible "[u]se the NEPA process to identify and assess reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment" and to use all practicable means to "avoid or minimize any possible adverse effects of their actions upon the quality of the human environment." 40 C.F.R. § 1500.2(e), (f). Agencies must "rigorously explore and objectively evaluate all reasonable alternatives." 40 C.F.R. § 1502.14. Reasonable alternatives are those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action." 43 C.F.R. § 46.420. Each action alternative should address the purpose of and need for the action . . .." NEPA Handbook at 8-9. SLDMWA WWD SJRECWA 25

The Draft EIS's five alternatives (*see* Draft EIS at 3-31 – 3-42) do not reflect the necessary inquiry into what CVP and SWP modifications, if any, are necessary to satisfy Reclamation's obligations under ESA section 7. Nor do the alternatives reflect an effort to design alternatives that meet the CVP's authorized purposes, and avoid, minimize or mitigate impacts to those purposes that may result from modifications to CVP operations. "Alternative 1" is described as "identical to the Second Basis of Comparison." *Id.* at p. 3-31. "Alternative 2" includes the operational components of the existing BiOps but does not include "RPA actions that would require future studies and environmental documentation to define recommended actions (generally, structural actions)." *Id.* "Alternative 3" includes CVP and SWP operations and ongoing operational management policies of the CVP and SWP that would be similar to the operational assumptions under the Second Basis of Comparison, but with specified changes to water demand assumptions, OMR criteria, and operations of New Melones Reservoir to meet SWRCB D-1641 flow requirements on the San Joaquin River at Vernalis. *Id.* at p. 3-34. "Alternative 3" also includes "Actions Related to Predation Control, Wetlands Restoration, Juvenile Salmonid Trap and Haul Program, and Chinook Salmon Ocean Harvest." *Id.* at p. 3-37. "Alternative 4" includes ongoing operational management policies of the CVP and SWP that would be identical to operations described under the Second Basis of Comparison. *Id.* at p. 3-39. In addition, "Alternative 4" includes "Actions Related to Floodplain Protection, Levee Vegetation, Predation Control, Wetlands Restoration, Juvenile Salmonid Trap and Haul Program, and Chinook Salmon Ocean Harvest." *Id.* "Alternative 5" was "developed considering comments from environmental interest groups during the scoping process." *Id.* at p. 3-41. "Alternative 5" has CVP and SWP operations and ongoing operational management policies of similar to the operational assumptions under the No Action Alternative, with certain specified

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changes to water demand assumptions, OMR criteria, and operations of New Melones Reservoir to meet SWRCB D-1641 flow requirements on the San Joaquin River at Vernalis. *Id.* SLDMWA WWD SJRECWA 25 continued

The Draft EIS fails to explain whether or how each of the selected alternatives avoid the likelihood of jeopardizing listed species or their critical habitat. Nor does the Draft EIS explain how the selected alternatives meet the purpose of enabling Reclamation and DWR to satisfy their contractual obligations to the fullest extent possible and meet the authorized purposes of the CVP and SWP, respectively. Such an analysis is necessary for both the decisionmakers and the public to evaluate and compare the alternative actions and inform the decision regarding what modifications, if any, to CVP and SWP operations, should be implemented. Unless and until Reclamation critically examines what action alternatives can meet the purpose and need, Reclamation cannot develop feasible alternatives. Mixing and tweaking elements of the RPAs of the existing BiOps, without ever fundamentally reconsidering the RPAs, does not suffice to meet Reclamation's NEPA obligations on remand. Reclamation's failure, to date, to take a "hard look" at what alternative actions could be taken that would meet its ESA obligations and also minimize or avoid impacts to the human environment has resulted in an inadequate range of alternatives in the Draft EIS. The alternatives should allow for adequate water deliveries and prevent significant impacts to public health and the human environment, and also explore various methods to sufficiently maintain and protect the listed species and their critical habitats.

3. In Developing Alternatives, Reclamation Should Consider Integration Of Measures For Delta Smelt And Salmonids

The two BiOps were developed independently of each other in 2008 and 2009, and in some cases, have conflicting RPAs. For example, Delta outflow prescribed for the delta smelt can diminish carryover storage in reservoirs beneficial to temperature management for salmonid species. Expert have suggested that the measures in the two BiOps should be integrated to best account for the needs of all species overall. *See* National Research Council 2010, A Scientific Assessment of Alternatives for Reducing Water Management Effects on Threatened and Endangered Fishes in California's Bay Delta.[2] In 2011, federal agencies planned an integrated biological opinion. *See* Interim Federal Action Plan Status Update for the California Bay-Delta: 2011 and Beyond, available at https://www.doi.gov/sites/doi.gov/files/migrated/news/pressreleases/upload/Final-Status-Update-2010-12-15.pdf. That has not yet happened, however. SLDMWA WWD SJRECWA 26

In order to better meet the purpose and need, Reclamation should develop alternatives that reflect a comprehensive and integrated approach to meeting its ESA obligations with respect to both delta smelt and salmonid species, something it and expert scientists have already identified as the appropriate approach. Such an inquiry may reveal that there are ways to maximize overall benefits to protected species while also reducing water supply impacts.

G. <u>The Comparison Of Alternatives Is Inadequate</u>

The Draft EIS's comparison of alternatives runs afoul of NEPA. NEPA requires an EIS to "present the environmental impacts of the proposal and the alternatives in comparative form" SLDMWA WWD SJRECWA 27

[2] References cited are listed below, and will be submitted electronically with these comments.

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in a manner that "sharply defin[es] the issues and provid[es] a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. § 1502.14. Although the Draft EIS includes two comparison tables that purport to identify the differences between the alternatives, the No Action Alternative, and the Second Basis of Comparison, neither the tables nor the resource chapters of the Draft EIS provide a clear basis for choice among the options.

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Because the proposed modifications of CVP and SWP operations are required under the ESA only if they are necessary to avoid jeopardy and destruction or adverse modification of critical habitat (*see* Draft EIS at ES-5), it is essential that for each alternative the EIS analyze and describe the estimated attributable increase or decrease in: (1) the numbers of individuals of each species, (2) the estimated population viability of the listed species, and (3) the amount or quality of their critical habitats under each alternative. This type of quantitative analysis would enable numerical comparisons of the type preferred in Reclamation's NEPA Handbook. *See* NEPA Handbook at 8-13.

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If Reclamation concludes there is no way to reliably compute such differences among the expected outcomes of each of the alternatives, the EIS should reveal and explain that lack of pertinent information. The Draft EIS lacks any of this information and explanation, and hence is not in compliance with the NEPA requirement to "[d]evote substantial treatment to each alternative considered in detail . . . so that reviewers may evaluate their comparative merits." 40 C.F.R. § 1502.14(b); *see also* NEPA Handbook at 8-8.

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While the two comparison tables included in the Draft EIS's Executive Summary chapter provide quantitative information regarding the reduction in surface water resources and water supplies,[3] for example, the information regarding fish and aquatic resources is wholly qualitative, and does not allow for an easy comparison of the relative merits of the various alternatives analyzed, or the trade-offs involved in choosing one alternative over another. The following entries from Table ES.2, Comparison of No Action Alternative and Alternatives 1 through 5 to the Second Basis of Comparison, demonstrate the problem. Regarding the effects of the No Action Alternative, Alternative 3, and Alternative 5 on the delta smelt, as compared to the Second Basis of Comparison, the Draft EIS states:

- No Action Alternative: "Overall, likely would result in better conditions for Delta Smelt, primarily due to lower percentage entrainment for larval and juvenile life stages, and more favorable location of Fall X2 in wetter years, and on average." Draft EIS at ES-60.
- Alternative 3: "Overall, effects would be similar based on reduced entrainment and more favorable location of Fall X2." *Id.* at ES-64.
- Alternative 5: "Overall, likely would result in better conditions for Delta Smelt, primarily due to lower percentage entrainment for larval and juvenile life stages,

[3] For example, Table ES.2 indicates that the No Action Alternative would result in reduced storage in San Luis Reservoir in October through February, April, and May of wet years, up to 57.2%, as compared to the Second Basis of Comparison. Draft EIS at ES-48; *see also* Draft EIS at 22-36 (Table 22.2). In contrast, Alternative 3 would result in reduced storage in San Luis Reservoir in December through February and June of wet years, up to 15.7%, as compared to the Second Basis of Comparison (*id.* at ES-51), and Alternative 5 would result in reduced storage in San Luis Reservoir in October through February and April through August of wet years, up to 9.9% (*id.* at ES-55).

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and more favorable location of Fall X2 in wetter years, and on average." *Id.* at ES-69.

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These statements suggest that the each of the three alternatives would result in similar or "better" conditions for delta smelt, but they do not identify how much "better" for delta smelt each alternative might be. The missing information is necessary to enable decisionmakers to evaluate the alternatives in light of the trade-offs involved in choosing one alternative over another. Table ES.2 indicates that the No Action Alternative results in significantly reduced storage in San Luis Reservoir in wet years as compared to Alternative 5 (Draft EIS at ES-48, ES-55), but the table indicates that both the No Action Alternative and Alternative 5 "likely would result in better conditions for Delta Smelt" (*id.* at ES-60, ES-69). As a modifier in this context, "better" is useless. How much better than the Second Basis of Comparison would the alternatives be for delta smelt? To a significant degree? Are the "better conditions" necessary to avoid jeopardizing the delta smelt or adversely modifying its critical habitats? Is the science too uncertain to be able to say? Is there a difference in the improvement between the No Action Alternative and Alternative 5? What is the water supply cost for these "better" conditions? The answers to these questions must be apparent in any comparison table in the final EIS.

The discussion in each of the various resource chapters of the Draft EIS does not enable a meaningful comparison of the alternatives either. For example, the following statements from Chapter 9 are provided in the discussion of the No Action Alternative and Alternatives 1 through 5 relative to the Second Basis of Comparison, regarding the effects on the Sacramento River Winter-Run Chinook Salmon:

- No Action Alternative: "These model results suggest that effects on winter-run Chinook Salmon would be similar under both scenarios [under the No Action Alternative and the Second Basis of Comparison], with a small likelihood that winter-run Chinook Salmon escapement would be higher under the No Action Alternative. This potential distinction between the two scenarios, however, may be offset by the benefits of implementation of fish passage under the No Action Alternative intended to address the limited availability of suitable habitat for winter-run Chinook Salmon in the Sacramento River reaches downstream of Keswick Dam. This potential beneficial effect and its magnitude would depend on the success of the fish passage program." Draft EIS at 9-164.

- Alternative 3: "These model results suggest that effects on winter-run Chinook Salmon would be similar under both scenarios, with a small likelihood that winter-run Chinook Salmon escapement would be higher under Alternative 3 than under the Second Basis of Comparison. The ocean harvest restrictions under Alternative 3 could provide additional benefit, although the effects of the predator management program are uncertain." *Id.* at 9-325.

- Alternative 5: "The analysis of temperatures indicates somewhat higher temperatures and greater likelihood of exceedance of thresholds under Alternative 5 as compared to the Second Basis of Comparison. This is reflected in the slightly lower survival of winter-run Chinook Salmon eggs predicted by Reclamation's salmon mortality model. Flow changes under Alternative 5 would

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> have small effects on the availability of spawning and rearing habitat for winter-run Chinook Salmon as indicated by the decrease in flow (habitat)-related mortality predicted by SALMOD under Alternative 5. Through Delta survival of juvenile winter-run Chinook Salmon would be the same under both Alternative 5 and Second Basis of Comparison as indicated by the DPM results; and the OBAN results suggest that Delta survival could be higher under Alternative 5. Entrainment may also be reduced under Alternative 5 as indicated by the OMR flow analysis. Median adult escapement to the Sacramento River would be reduced slightly under Alternative 5 as indicated by the IOS model results which incorporate temperature, flow, and mortality effects on each life stage over the entire life cycle of winter-run Chinook Salmon. However, the OBAN model results indicate an increase in escapement over a more limited time period (1971 to 2002). Considering all the above analyses for the winter-run Chinook Salmon population, the changes in overall effects under Alternative 5 compared to Second Basis of Comparison are highly uncertain. However, the upstream fish passage included under Alternative 5 could benefit the winter-run Chinook Salmon population in the Sacramento River as compared to the Second Basis of Comparison if successful." *Id.* at 9-359.

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These descriptions do not indicate the materiality of the projected differences for the populations of affected fish species. Are the differences in projected conditions material? What criteria will be used to determine whether a particular difference is material? Is one alternative better suited than another in terms of avoiding jeopardy and destruction or adverse modification of critical habitat? As with Tables ES.1 and ES.2, the descriptions in the Draft EIS's resource chapters do not enable decisionmakers or the public to understand the differences between Alternatives 1-5, the No Action Alternative, and the Second Basis of Comparison. More information is needed. If the expected relative benefit of a particular operation intended to protect fish populations is minimal, that information would usefully inform Reclamation's ultimate decision on whether to adopt that measure, especially if that measure significantly impairs other project purposes. If the materiality of the differences in conditions is unknown, that absence of information should be expressly noted. A synthesis and presentation of information regarding the materiality of potential changes in operations for fish populations, or the lack of such information, would help inform the public and decision makers of the expected benefits or detriments of alternative operations.

Tables ES.1 and ES.2 and the resource chapters in the Draft EIS should be revised to provide a more meaningful comparison among all the alternatives. Dually providing analytic information in both text and tabular or other graphic formats will best provide full and understandable disclosure to the public and decision-makers of the relative merits of each action alternative and the No Action Alternative, and better inform and support any policy decisions Reclamation makes at the end of the NEPA processes. Without revision, the comparison of alternatives in the Draft EIS will violate NEPA's requirement to "present complete and accurate information to decision makers and the public to allow an informed comparison of the alternatives considered in the EIS." *Nat. Resources Def. Council v. U.S. Forest Serv.*, 421 F.3d 797, 813 (9th Cir. 2005).

H. The "Snapshot" Look At The Year 2030 For The Effects Analyses Is Not Adequately Explained And Masks Aggregate Impacts

The Draft EIS states that it "analyzes future conditions projected for the Year 2030," and a "range of alternatives" for coordinated operations "in the Year 2030." Draft EIS at ES-7, 3-1 and 4-1. The stated justification for looking to that single year is that "the coordinated long-term operation of the CVP and SWP, as described in the alternatives analyzed in this EIS, would continue to at least 2030 before major changes to CVP and SWP operations would be implemented." Draft EIS at ES-7. SLDMWA WWD SJRECWA 30

This does not explain why the analysis excludes consideration of the years from 2015 to 2029. Looking only to a single year fifteen years from today, in 2030, omits consideration of impacts in the interim period. For example, if the existing reasonable and prudent alternatives continue in operation each year until 2030, they will likely result in water supply impacts in each of those years. The nature of the impacts may change over that period, as other operations and conditions change. If Reclamation has concluded that conditions, operations and impacts in 2030 will typify all the intervening years, it has not explained and justified that conclusion. Another problem with limiting analysis to 2030 is it fails to consider fifteen years of impacts in the aggregate. The impacts to farms and communities and resources from one year of lost CVP water supply in 2030 is not the same as the accumulated impact of 15 years of lost CVP water supply. Finally, impacts of actions taken between now and 2030 may continue to be felt after 2030. For example, the Draft EIS projects increased use of groundwater to compensate for lost surface supplies. That will create a deficit in groundwater supplies that will have impacts well past 2030.

I. The Draft EIS Fails To Acknowledge Or Incorporate The Lessons From Operating The Projects Under The BiOps The Past Seven Years

For this NEPA review, Reclamation is not in a situation where it must rely entirely on projections and modeling to forecast what might happen with implementation of the RPAs. Reclamation has the unusual advantage of knowing the actual, observed consequences of implementing the BiOps over the past seven years. That information is highly useful in projecting what would likely occur with implementation of the RPAs between now and 2030. Unfortunately, the Draft EIS fails to take advantage of that experience. Instead its analysis largely ignores and indeed contradicts the realized effects of implementing the BiOps. SLDMWA WWD SJRECWA 31

As detailed below, the Draft EIS relies heavily on modeling and assumptions without "truing up" those models and assumptions with what has actually occurred as a result of operating the CVP and SWP to meet the RPAs since 2008. For example, it assumes that groundwater will fully substitute for lost CVP and SWP supplies. But in fact, that is not what has happened since 2008. Instead, shortages of surface water supply have resulted in extensive fallowing of farm land, demonstrating that groundwater in fact cannot fully replace lost surface water supply. Further, in the years since the RPAs were adopted, the delta smelt and salmonid species have further declined, not recovered. That experience should inform any assessment of the supposed benefit of and necessity for the RPA prescriptions, and the impact of CVP and SWP operations relative to other stressors. Yet, as described above, the Draft EIS fails to critically examine the conclusions in the BiOps and RPAs at all.

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J. **The Draft EIS Fails To Disclose The Limits Of Scientific Knowledge And The Policy-Based Decision Facing Reclamation**

The Draft EIS is deficient because it lacks an analysis and explanation of the substantial scientific uncertainties underlying the conclusions and prescriptions in the BiOps. When Reclamation is "evaluating the reasonably foreseeable significant adverse effects on the human environment in [the EIS] and there is incomplete or unavailable information," it is required to "always make clear that such information is lacking." 40 C.F.R. § 1502.22. The comments submitted by the State Water Contractors extensively document such uncertainties, and the scientific information not addressed in the Draft EIS. As the State Water Contractors note, the Draft EIS neglects to identify relevant data and studies that contradict some of its premises, and it treats mere hypotheses as accepted truths. SLDMWA WWD SJRECWA 32

The available science falls well short of dictating any particular decision or specific requirement, e.g. a particular limit on negative OMR flows for delta smelt, as essential to the continued survival of the species. For example, as a National Research Council report explained about the OMR requirement for delta smelt:

> there is substantial uncertainty regarding the amount of flow that should trigger a reduction in exports. In other words, the specific choice of the negative flow threshold for initiating the RPA is less clearly supported by scientific analyses. The biological benefits and the water requirements of this action are likely to be sensitive to the precise values of trigger and threshold values. There clearly is a relationship between negative OMR flows and mortality of smelt at the pumps, but the data do not permit a confident identification of the threshold values to use in the action, and they do not permit a confident assessment of the benefits to the population of the action. As a result, the implementation of this action needs to be accompanied by careful monitoring, adaptive management, and additional analyses that permit regular review and adjustment of strategies as knowledge improves.[4]

The Draft EIS should be revised to acknowledge and define this and similar gaps in knowledge for decision makers, and the public. Even with the benefit of the most recent data available, Reclamation's coming decisions will be predominantly policy choices made in the context of significant scientific uncertainty.

Part of the value of the NEPA process is its requirement to disclose and discuss the relevance of conflicting, inconsistent data and unavailable or incomplete data. Past regulatory decisions taken without the guiding light of NEPA have been made with an unjustified claim of certainty or necessity without acknowledgment of the significant uncertainty or imprecision that accompanied such actions. This obscures the true weight of the policy decisions set before the agency, and discourages honest and critical evaluation of policy options.

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[4] National Research Council (2012). Sustainable Water and Environmental Management in the California Bay-Delta. Washington DC: National Academies Press, at pp. 210-211.

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In 2004, the National Research Council issued a report addressing the degree of scientific certainty, or lack thereof, regarding measures imposed under the ESA for the protection of listed fishes in the Klamath River basin. National Research Council, *Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery*. Washington, DC: The National Academies Press, 2004. To accomplish their charge, the committee developed "specific conventions for judging the degree of scientific support for a proposal or hypothesis" in the Klamath biological opinions. *Id.* at p. 35. The committee summarized these conventions in the following table:

TABLE 1-2 Categories Used by the Committee for Judging the Degree of Scientific Support for Proposed Actions Pursuant to the Goals of the ESA

Basis of Proposed Action	Scientific Support	Possibly Correct?	Potential to be Incorrect
Intuition, unsupported assertion	None	Yes	High
Professional judgment inconsistent with evidence	None	Unlikely	High
Professional judgment with evidence absent	Weak	Yes	Moderately high
Professional judgment with some supporting evidence	Moderate	Yes	Moderate
Hypothesis tested by one line of evidence	Moderately strong	Yes	Moderately low
Hypothesis tested by more than one line of evidence	Strong	Yes	Low

These or similar criteria should be explicitly applied in the NEPA process here to assess the strength of any scientific justification for the reasonable and prudent alternatives in the existing BiOps, and any other proposed restrictions on CVP and SWP operations that are intended to benefit listed species. Doing so will assist decisionmakers and the public in better understanding the choices to be made among alternatives.

Some have sought to justify restrictions on CVP and SWP operations even in the absence of substantial scientific support, based on the "precautionary principle." As the Klamath report observed, however, "even when a policy decision is made to apply the precautionary principle, the question of whether the decision is consistent with the available scientific information is important. . . . At some point [] erring on the side of protection in decision-making ceases to be precautionary and becomes arbitrary. One indication that policy-based precaution has given way to bias or political forces is a major inconsistency of a presumed precautionary action with the available scientific information." *Id.* at 315. If Reclamation makes a policy decision to apply the precautionary principle here, that choice should be explicit, so that choice and the tradeoffs involved are made clear to the public and any reviewing courts. That policy choice has not been made explicit in past decisions. In the litigation regarding the 2009 Salmonid BiOp, for example, NMFS sought to justify a restriction on OMR flows based on precaution, but as the district court found "nowhere in the BiOp (or any other document in the administrative record cited by the parties) [did] NMFS disclose its intent to use a 'precautionary principle' to design the RPA Actions." *Consolidated Salmonid Cases*, 713 F. Supp. 2d 1116, 1145 (E.D. Cal. 2010).

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The Draft EIS does a poor job of describing the full extent of available scientific data, and disclosing the scientific uncertainty underlying the necessity for and efficacy of the existing reasonable and prudent alternatives. The Draft EIS fails to disclose or acknowledge that there is significant uncertainty regarding the effects of CVP and SWP operations on ESA-listed species, and regarding the potential benefits of modifications to operations, such as those identified in the existing RPAs. Current science does not, and cannot, dictate the precise modifications to CVP and SWP operations, if any, that are necessary to avoid jeopardizing listed species. Rather, there is a range of alternative actions that Reclamation could take that would comply with its legal obligations, including its obligations under under ESA section 7, given the available scientific data. Selecting an action within that range is essentially a policy decision, not a decision ultimately dictated by science.

In sum, the NEPA review here should make clear the differences between what is known based on the best available science, and where the appropriate decision makers must make policy judgments in the face of uncertainty. Reclamation should be explicit in identifying the scientific uncertainty associated with any restrictions on CVP and SWP operations that are proposed as necessary to comply with the ESA, and acknowledge that it is essentially making a policy decision. Reclamation's policy decision should be informed by a multitude of considerations, including avoiding water supply impacts to its CVP contractors.

II. <u>THE ANALYSIS OF IMPACTS RELATING TO WATER RESOURCES AND AQUATIC SPECIES SUFFERS FROM ADDITIONAL DEFECTS</u>

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An EIS's discussion of environmental consequences "forms the scientific and analytical basis" for comparing the environmental impacts of the proposed action and the alternatives. 40 C.F.R. § 1502.16. One of the purposes of NEPA is to ensure that "environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality." 40 C.F.R. § 1500.1(b). An EIS must provide "full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." 40 C.F.R. § 1502.1. NEPA requires that all federal agencies, to the fullest extent possible, "utilize a systematic, interdisciplinary approach which will insure the integrated use of natural and social sciences" and "initiate and utilize ecological information in the planning and development of resource-oriented projects." 42 U.S.C. § 4334(2)(A), (H).

A. <u>The Draft EIS Makes Unreasonable And Unsupported Assumptions Regarding Water Supplies And Associated Environmental Impacts</u>

1. The EIS Unreasonably Assumes That Increased Groundwater Use Will Fully Compensate For Lost Surface Water Supplies

The Draft EIS makes several unreasonable and unsupported assumptions regarding water supplies that skew the environmental effects analyses and cause environmental impacts to be masked or understated. First, the Draft EIS unreasonably assumes that future water demands will be met in dry and critical dry years. The Draft EIS states: SLDMWA WWD SJRECWA 33 continued

> Under the No Action Alternative and Second Basis of Comparison, it is assumed that water demands would be met on a long-term basis and in dry and critical dry years using a combination of conservation, CVP and SWP water supplies, other imported water supplies, groundwater, recycled water, infrastructure improvements, desalination water treatment, and water transfers and exchanges. It is anticipated that individual communities or users could be in a situation that would not allow for affordable water supply options, and that water demands could not be fully met. However, on a regional scale, it is anticipated that water demands would be met.

Draft EIS at 5-67. This assumption is unreasonable and unsupported because it is grounded in several other unreasonable assumptions, particularly regarding the availability of groundwater, as discussed below.

Second, the Draft EIS unreasonably assumes that groundwater will not just continue to be available at current levels, but that groundwater use can be increased from current levels, despite recent landmark legislation that will significantly regulate groundwater use. *See e.g.*, Draft EIS at 19-48 (describing assumed "increase in groundwater pumping of approximately 6 percent" in Sacramento Valley and San Joaquin Valley). The Draft EIS states: "The No Action Alternative and the Second Basis of Comparison assume that groundwater would continue to be used even if groundwater overdraft conditions continue or become worse." Draft EIS at 5-68. The Draft EIS only briefly acknowledges the California law regulating groundwater use, and then proceeds to ignore the implications of the new law on the availability of groundwater to meet future water demands. The Draft EIS states, in relevant part: SLDMWA WWD SJRECWA 34

> It is recognized that in September 2014 the Sustainable Groundwater Management Act (SGMA) was enacted. The SGMA provides for the establishment of a Groundwater Sustainability Agencies (GSAs) to prepare Groundwater Sustainability Plans (GSPs) that will include best management practices for sustainable groundwater management.
>
> . . .
>
> 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 CAGESM results by 2022. Sustainable groundwater operations must be achieved within 20 years following completion of the GSPs. In some areas with adjudicated groundwater basins, sustainable groundwater management could be achieved and/or maintained by 2030. However, to achieve sustainable conditions in many areas,

> measures could require several years to design and construct water supply facilities to replace groundwater, such as seawater desalination. Therefore, it does not appear to be reasonable and foreseeable that sustainable groundwater management would be achieved by 2030; and it is assumed that groundwater pumping will continue to be used to meet water demands not fulfilled with surface water supplies or other alternative water supplies in 2030.

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Draft EIS at 5-68 – 5-69; *see id.* at 7-109 ("this EIS analysis assumes that the new facilities or conservation measures are not implemented by 2030. Therefore, reductions in groundwater use in accordance with the SGMA are not anticipated until after 2030")

The assumption that groundwater use will increase in 2030, despite SGMA, is unreasonable and unsupported. For starters, SGMA requires that groundwater basins in critical overdraft begin being managed under groundwater sustainability plans starting in 2020. Cal. Wat. Code, § 10720.7(a)(1). The Draft EIS's presumption that groundwater availability will not be affected in 2030, after ten years of implementing a sustainability plan for a basin in critical overdraft, is untenable. Likewise, the Draft EIS's presumption that regulating agencies in other basins will do nothing in the first eight years that they are supposed to be moving towards sustainable use of groundwater is baseless. *See* Cal. Wat. Code, § 10720.7(a)(2) (requiring submittal of groundwater sustainability plans for other basins by 2022). The Draft EIS itself admits that "in some basins and subbasins, SGMA actions could be implemented early, and sustainable groundwater management might be fully underway by 2030." Draft EIS at 7-142. Yet, the Draft EIS presumes that SGMA implementation will not affect the volume of groundwater available for use in 2030. The Draft EIS fails to acknowledge that SGMA requires annual reporting regarding water use to DWR and also requires DWR to assess each basin's progress in achieving sustainability, at least every five years after a sustainability plan is submitted. Cal. Wat. Code, § 10733.8. This means that the Draft EIS's assumption that the status quo for groundwater use will be maintained up to and including 2030 is incorrect, because managing agencies will be required to demonstrate progress towards sustainability (e.g. using less groundwater) by 2025 or 2027. Further, the Draft EIS does not recognize that in some cases sustainability may be achieved through reductions in water demands (e.g. fallowing of agricultural lands), and that these reductions do not require new "water supply facilities" to be in place before reductions are mandated. See Draft EIS at 5-68 – 5-69.

The Draft EIS fails to account for the fact that many of the groundwater basins that would be affected by reduced surface water supplies from the CVP and SWP are basins that have been identified as being in critical overdraft. The Draft EIS admits that '[d]ue to the low amounts of average annual precipitation, limited surface water supply and extensive agricultural water use, there are areas of significant overdraft that exist in the San Joaquin Valley Groundwater Basin. Eight subbasins in the San Joaquin Valley Groundwater Basin were identified in a state of critical overdraft: Chowchilla, Eastern San Joaquin, Madera, Kings, Kaweah, Tule, Tulare Lake, and Kern (DWR 1980)." Draft EIS at 7-28. But the Draft EIS fails to explain how it is reasonable to assume that groundwater use will increase in basins that are already in critical overdraft, and which will need to be managed for sustainability starting in 2020. Cal. Wat. Code, § 10720.7(a)(1). How can the Draft EIS assume that in 2030, these basins will be able to sustain increased use of groundwater to make up for lost CVP and SWP surface water supplies?

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In fact, the Draft EIS elsewhere contradicts its own unreasonable assumption regarding SGMA and future groundwater use. In the discussion of cumulative effects on groundwater resources, the Draft EIS concedes that SGMA is expected to result in reduced groundwater use. It states: SLDMWA WWD SJRECWA 34 continued

> Implementation of SGMA, will have a beneficial effect on groundwater resources, as most areas will develop plans to manage groundwater extractions to not exacerbate further groundwater level declines. The implementation of the SGMA in high and medium groundwater basins would reduce the impacts on groundwater levels, storage and groundwater supply by implementing sustainable groundwater management plans and actions at the local level.

Draft EIS at 7-142. The Draft EIS's expectation that implementation of SGMA will alleviate groundwater level declines is premised on SGMA resulting in reduced groundwater use. Yet, the Draft EIS's analysis assumes *increased* groundwater use in 2030.

Third, the Draft EIS assumes groundwater use can increase in the future, despite existing conditions indicating limitations on the availability and utility of groundwater. For example, the EIS acknowledges that "there are several locations [within the Sacramento Groundwater Basin] showing early signs of persistent drawdown, suggesting limitations due to increased groundwater use in dry years. Locations of persistent drawdown include: Glenn County, areas near Chico in Butte County, northern Sacramento County, and portions of Yolo County." Draft EIS at 7-14. The Draft EIS states that the "persistent areas of drawdown [in the Sacramento Groundwater Basin] could be early signs that the limits of sustainable groundwater use have been reached in these areas." Draft EIS at 7-15. Yet, the Draft EIS fails to reconcile its assumption of increased groundwater use in the future, with the existing conditions indicating that certain groundwater basins may not be able to sustain even the current levels of groundwater use. SLDMWA WWD SJRECWA 35

Several recent reports provide evidence that is it unreasonable for the Draft EIS to assume that groundwater can make up the difference between future water demands and shortages in surface water supplies. In recent years the lack of surface water supply has resulted land fallowing, something that would not occur if groundwater could simply be substituted for lost surface supplies. As DWR recently reported, the experience in water years 2014 and 2015, in which CVP south-of-Delta agricultural contractors received zero CVP water supplies, was large-scale land fallowing and lost agricultural employment. As DWR observed: "[a]lthough groundwater and water transfers may make up for some of the lost surface water supplies, cuts of this magnitude [like those of 2014 and 2015] result in abandonment of permanent plantings such as orchards and vineyards, large-scale land fallowing, and job losses in rural communities dependent on agricultural employment." DWR, 2015 Drought Brochure, at 11.[5] DWR estimated that almost 700,000 acres of land were fallowed in 2014, as a result of the water shortages experienced that year. DWR, 2014 Public Update for Drought Response, at 34.[6] The

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[5] Available at http://www.water.ca.gov/waterconditions/docs/DWR_DroughtBroch_070815-web.pdf
[6] Available at http://www.water.ca.gov/waterconditions/docs/DWR_PublicUpdateforDroughtResponse_GroundwaterBasins.pdf

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extent of land fallowing during the recent drought shows that during times of surface water shortages, such as the shortages that would occur under the RPAs, groundwater does not serve as a complete substitute.

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In addition, the existing problems with land subsidence provide evidence that there are significant and irreversible consequences of relying on groundwater to make up for surface water shortages. For example, a NASA report from August of 2015 shows that areas of the Central Valley have suffered extreme land subsidence during the recent drought. During the period of May 2014-January 2015, NASA observed that certain areas of the Central Valley subsided by over 13 inches. NASA, Progress Report, at 1.[7] This land subsidence is, or threatens to, impact major infrastructure, including the California Aqueduct and Mendota Canal, which provide critical conveyance of surface water supplies throughout California. *See id.* (subsidence of approximately 14 inches observed within a half a mile of the California Aqueduct). The NASA report shows how subsidence rates can accelerate with increasing reliance on groundwater. For example, the report states that during the period of July 2013 through March 2015, a subsidence bowl near the California aqueduct "impacted the aqueduct significantly," causing 8 inches of subsidence along a 1.3 mile stretch of the aqueduct. *Id.* at 14-15.

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The Draft EIS's unreasonable assumption regarding future groundwater use is a significant error for several reasons. For one, the EIS assumes that groundwater will effectively make up the difference between future water demands and other water supplies. Draft EIS at 5-68 – 5-69. In addition, the EIS presumes that groundwater will provide over one-third of the total future water supplies. *See id.* at 5-68, Table 5.10 (identifying groundwater as providing 2,644,047 acre-feet of the total 7,798,561 acre-feet future water demand). Most importantly, the unreasonable assumption regarding future groundwater supplies permeates the analyses of environmental effects and causes environmental effects in multiple resource categories to be understated.

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2. The Draft EIS's Unreasonable Assumptions Regarding Water Supplies Skew The Analyses Of Other Resource Categories

(a) Impacts To Agricultural Resources Are Underestimated

The Draft EIS's unreasonable assumptions regarding future use of groundwater skew the analyses of impacts to other resource categories. For example, the analysis of impacts to agricultural resources assumes that groundwater use in 2030 will increase, in response to reductions in the availability of CVP and SWP water supplies. "The analysis does not restrict groundwater withdrawals based upon groundwater overdraft or groundwater quality conditions." Draft EIS at 12-24. While the Draft EIS acknowledges that "the Sustainable Groundwater Management Act requires preparation of Groundwater Sustainability Plans (GSPs) by 2020 or 2022 for most of the groundwater basins in the Central Valley Region," the EIS still assumes that "Central Valley agriculture water users would not reduce groundwater use by 2030, and that groundwater use would change in response to changes CVP and SWP water supplies." *Id.* The presumption that agriculture water users would be able to *increase* groundwater use as needed to support existing cropping levels, despite being subject to stricter regulation of groundwater use is

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[7] Available at http://www.water.ca.gov/groundwater/docs/NASA_REPORT.pdf

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unreasonable, and disguises the potential for land fallowing and other impacts to agricultural production. Due to this unreasonable assumption, the Draft EIS concludes that implementation of the RPAs will not measurably reduce agricultural production. For example, the Draft EIS concludes that "Agricultural production in the Sacramento Valley would be similar (less than 5 percent change) under the No Action Alternative and the Second Basis of Comparison over long-term average conditions and in dry and critical dry years due to increased use of groundwater . . .." Draft EIS at 12-28. The Draft EIS reaches the same flawed conclusion with respect to agricultural production in the San Joaquin Valley. *See id.* at p. 12-30.

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The Draft EIS's conclusions regarding no significant impacts to agricultural production are also contradicted by substantial evidence indicating that lands will be fallowed in response to reductions in surface water supplies from the CVP and SWP. In Westlands Water District, for example, land fallowing has significantly increased during the last two years of zero percent CVP contract allocations to Westlands. See Exhibit C, Westlands Water District Water Supply Graph, attached. In 2014, farmers within Westlands fallowed over 200,000 acres and farmers are expected to fallow a similar amount of acreage in 2015, due to the lack of CVP surface water supplies. The Draft EIS itself acknowledges that "[i]n extreme dry periods, such as 2014 when there were no deliveries of CVP water to San Joaquin Valley water supply agencies with CVP water service contracts, permanent crops were removed because the plants would not survive the stress of no water or saline groundwater (Fresno Bee 2014)." Draft EIS at 12-10. Yet, the Draft EIS does not appear to apply these observed facts to its analysis of how agricultural resources will be impacted by reduced CVP and SWP deliveries in the future. And despite the recognition that farmers have fallowed crops because saline groundwater is not suitable for certain crops, the Draft EIS does not consider groundwater quality as a factor in evaluating the ability to increase groundwater use for agricultural production. *See* Draft EIS at 12-24 ("The analysis does not restrict groundwater withdrawals based upon groundwater overdraft or groundwater quality conditions."). The observed trends in land fallowing in response to reductions in surface water supplies need to be incorporated into the EIS's analysis of expected impacts to agricultural production.

(b) Socioeconomic Impacts Are Underestimated

The Draft EIS's unreasonable assumption about groundwater use, and resulting conclusions regarding effects on agriculture, skew the analysis of socioeconomic impacts. The assessment of socioeconomic impacts to agriculture-dependent communities in the Central Valley region is grounded in the faulty assumption that "the impact to irrigated acreage and agricultural production is relatively small" and that "[m]ost of the change in CVP or SWP irrigation supplies would be offset by changes in groundwater pumping, with only small changes in crop acreage in production." Draft EIS at 19-39. In turn, the Draft EIS's estimates of socioeconomic impacts associated with reduced agricultural production are gross underestimates. For example, the Draft EIS states:

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> The agricultural production value under long-term average conditions would be reduced by less than 1 percent ($1.6 million/year in the Sacramento Valley and $0.5 million/year in the San Joaquin Valley) primarily due to an increase in groundwater pumping of approximately 6 percent. The agricultural production

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> value under dry and critical dry conditions also would be reduced by less than 1 percent ($11.3 million/year in the Sacramento Valley and $20.3 million/year in the San Joaquin Valley) primarily due to an increase in groundwater pumping.

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Draft EIS at 19-48. If reasonable assumptions were made regarding groundwater use and agriculture production, the estimated socioeconomic impacts of implementing the RPAs would be significantly greater.

The Draft EIS significantly underestimates the socioeconomic impacts of reduced CVP and SWP water supplies. For example, the Draft EIS concludes that implementation of the RPAs will only result in the loss of 254 agricultural-related jobs in the San Joaquin Valley in dry or critically dry years. *See* Draft EIS at 19-49, Table 19-61. Yet, existing literature provides evidence that past reductions in CVP and SWP water deliveries have resulted in significantly more lost jobs than the Draft EIS estimates. For example, several economic reports have estimated the number of jobs lost as a result of reductions in CVP and SWP water deliveries in 2009, and one of the most recent reports estimates that 9,100 agricultural-related jobs were lost in the San Joaquin Valley as a result of the 2009 water supply reductions.[8] The report also found that the lost jobs corresponded to land fallowing that occurred in response to reductions in CVP and SWP water deliveries, and estimated that "the 2009 water supply reductions reduced harvested acreage in the San Joaquin Valley by 240,000 acres . . .." *Id.* This report indicates that reductions in CVP and SWP water deliveries would be expected to result in significant losses in agricultural-related jobs, and contradict the Draft EIS's conclusion that similar job losses will not occur in the future in response to reductions in water deliveries. The Draft EIS must look at empirical data and existing literature to inform its conclusions regarding impacts to agriculture and agricultural-related jobs.

The actual impacts to agriculture-dependent communities from reduced CVP and SWP water supplies are not revealed in the Draft EIS, but the importance of agriculture to the Central Valley economy is clear. The Draft EIS fails to identify the percent of the total workforce within the Central Valley region that depend on agriculture for employment, but the Draft EIS does show that over half of the state's farm employment is in the Central Valley region. See Draft EIS at 19-9, Table 19.10. The Draft EIS also acknowledges that "farming is one of the most important basic industries in the Central Valley; and supports many other businesses including farm inputs (e.g., fertilizer, seed, machinery, and fuel) and processing of food and fiber grown on farms. As a result, employment both directly on farm and indirectly dependent on farming is higher than the values" reported in the Draft EIS for "farm employment." *Id.* at p. 19-14. For example, as the Draft EIS acknowledges, a "study of the local economy in four counties of the San Joaquin Valley found that, for every on-farm job, about two and one-half additional jobs are supported because of inputs purchased for farming operations (NEA 1997)." *Id.* at p. 19-14. This means that there are cascading socioeconomic impacts that result from decreased agriculture productivity. The central role of agriculture in Central Valley communities makes it

[8] Auffhammer, M., Foreman, K., and Sunding, D. (2014) Turning Water Into Jobs: The Impact of Surface Water Deliveries on Farm Employment and Fallowing in California's San Joaquin Valley, *Submitted for publication*, at p. 4.

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even more critical that Reclamation include reasonable assumptions regarding water supplies, and regarding the corresponding impacts on agriculture of reduced water supplies. SLDMWA WWD SJRECWA 39 continued

(c) Environmental Justice Impacts Are Underestimated

Due to the Draft EIS's unreasonable assumptions about groundwater use and in turn, agriculture and agriculture-dependent communities, the Draft EIS provides no analysis of the environmental justice impacts that result from reduced CVP and SWP water supplies. Despite the Draft EIS's acknowledgment that communities throughout the Central Valley, and particularly the San Joaquin Valley, are areas with higher concentrations of minority populations and/or populations below the poverty level, the issue of environmental justice is left unexamined in the Draft EIS. The Draft EIS states the reason for this omission is that changes in employment related to irrigated agriculture and M&I water supplies would be similar under the RPAs and compared to the Second Basis of Comparison, and therefore, "these changes are not analyzed in this EIS." Draft EIS at 21-46. However, as explained above, the Draft EIS's assumption that groundwater can provide a substitute for reduced CVP and SWP water supplies due to implementation of the RPAs is unreasonable and contrary to observed conditions in the San Joaquin Valley. Reduced CVP and SWP water supplies have, and will continue to have, a significant impact on the agricultural communities throughout the Central Valley, and will cause environmental justice impacts on communities that are already suffering. SLDMWA WWD SJRECWA 40

The Draft EIS acknowledges that many of the areas that would be impacted by reduced water deliveries from the CVP and SWP, such as the San Joaquin Valley, are areas with higher concentrations of minority populations and/or populations below the poverty level. For example, the Draft EIS recognizes that portions of the San Joaquin Valley are considered "poverty areas": "Merced, Fresno, Tulare, and Kern counties are defined as poverty areas because more than 20 percent of the populations in these counties are below the poverty level." Draft EIS at 21-16. Also, "[t]here are communities within these counties that have higher concentrations of minority populations and/or populations below the poverty level. These communities are mainly farming communities that have been impacted by loss in agricultural employment . . .." *Id.* There is no debate that these communities are disadvantaged communities that are negatively impacted by the lost agricultural employment that results from reductions in surface water supplies.

Conditions during the recent drought exemplify the types of impacts that occur in these disadvantaged communities, due to reductions in water supplies and the resulting land fallowing. As the EIS describes: "increased levels of land fallowing on irrigated cropland in the San Joaquin Valley has resulted in significant economic losses in small farming communities. Higher than typical unemployment rates has resulted in increased food insecurity." Draft EIS at 21-21. The Draft EIS recognizes that agriculture-dependent communities, such as Huron and Mendota, have experienced increased unemployment and increased reliance on social services "at a time when both agricultural cultivated acreage and farm employment in the area declined; and included five consecutive years with reduced water availability . . .." Draft EIS at 21-23. The observed relationship between reduced surface water supplies and reduced agricultural productivity and farm employment shows that the reductions in CVP and SWP water supplies due to implementation of the RPAs will negatively impact these agriculture-dependent communities. The Draft EIS's failure to provide any analysis of the environmental justice impacts to these areas with higher rates of minority populations and/or poverty levels from lost farm employment is an alarming omission. These communities are already disproportionately suffering and the Draft EIS cannot turn a blind eye to the known environmental justice impacts that result from reduced CVP and SWP water supplies. SLDMWA WWD SJRECWA 40 continued

(d) Air Quality And Public Health Impacts Associated With Land Fallowing Are Underestimated

The Draft EIS's unreasonable assumptions regarding future use of groundwater also infect its analysis of air quality impacts. As explained above, recent history shows that groundwater does not adequately make up for water shortages. Shortages in the almost seven years that the Smelt BiOp RPA has been implemented (six of which the Salmon BiOp RPA was also being implemented) have resulted in large-scale land fallowing. Because the Draft EIS does not properly acknowledge the extent of land fallowing that results from implementation of the RPAs, the air quality effects associated with fallowing, including increased levels of airborne dust and particulate matter and increased risk of exposure to Valley Fever, are necessarily underestimated in the Draft EIS. SLDMWA WWD SJRECWA 41

The Draft EIS acknowledges that "[a]ir quality issues may be exacerbated under dry conditions. When water supplies and irrigation levels are decreased in urban, rural, and agricultural areas, there is increased potential for the formation and transport of fugitive dust." Draft EIS, at 16-13. Yet, the Draft EIS states that because "irrigated acreage under Alternatives 1 through 5 would be similar to irrigated acreage under both the No Action Alternative and the Second Basis of Comparison[,] . . . there would be no change in potential for dust generation." Draft EIS at 16-24. This is a mistake. As explained above, there are significant changes in irrigated acreage due to implementation of the RPAs that necessarily result in a change in the potential for dust generation. Reclamation must analyze the concomitant air quality impacts.

Reclamation must also go one step further and ensure that any effects on air quality do not violate the federal Clean Air Act, 42 U.S.C. §7401 *et seq*. The Draft EIS already acknowledges that numerous counties in the Central Valley Region are designated as nonattainment for Ozone, PM 2.5, and PM 10 under state and federal Clean Air Act standards. Draft EIS at 16-8 – 16-9. Because of this, Reclamation is required to comply with various reductions and control measures designed to meet the National Ambient Air Quality Standards. It could violate the Clean Air Act if Reclamation chooses an alternative that worsens Ozone, P.M. 2.5, or PM 10 because doing so could violate measures already in place to rectify air quality problems in existing nonattainment areas. The Final EIS must make these trade-offs clear.

The federal Clean Air Act also prohibits Reclamation from engaging in any activity which does not conform to a Clean Air Act implementation plan. 42 U.S.C. 42 U.S.C. § 7506(c). Accordingly, the Final EIS should analyze the alternatives in a manner that allows the decisionmaker to determine whether or not implementation would be consistent with existing implementation plans. Until the shortcomings in Chapter 16 are corrected, the Draft EIS's analysis of air quality impacts is insufficient.

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3. CVP Water Supply Impacts To CVP Wildlife Refuges And San Joaquin River Exchange Contractors Are Underestimated

The Draft also understates the CVP water supply impacts to wildlife refuges and the San Joaquin River Exchange Contractors ("Exchange Contractors"). First, as Reclamation is aware, section 3406(d) of the 1992 Central Valley Project Improvement Act ("CVPIA") requires Reclamation to deliver CVP water supplies to wildlife refuges. Section 3406(d) of the CVPIA describes two categories of refuge water supplies: "Level 2" and "Level 4." The refuges use water to provide needed habitat during waterfowl migration periods in the fall, winter, and spring. In critically dry hydrologic years, the refuge water supply contracts and section 3406(d) of the CVPIA authorize reductions in Level 2 water deliveries by no more than 25%. Shortages to the refuges are triggered when deliveries to agricultural contractors are reduced, a circumstance made more frequent and extensive due to the loss of supply from implementation of the reasonable and prudent alternatives in the biological opinions.

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Table 5.26 in the Draft EIS purports to identify the changes in CVP water deliveries under the No Action Alternative as compared to the Second Basis of Comparison for CVP refuges. For CVP refuges located south of the Delta, the table identifies *no* difference (0 acre-feet) over the long-term between the No Action Alternative and the Second Basis of Comparison. Draft EIS at 5-94. The chapter does not explain how it is possible that there will be no change in deliveries between the No Action Alternative and the Second Basis of Comparison, despite the admitted water supply loss due to the reasonable and prudent alternatives included in the No Action Alternative. The conclusion that this loss of supply makes no difference to refuge is unsupported and contrary to actual experience.

Between 1992, when the CVPIA was implemented, and 2008, when Reclamation began implementing the RPA in the Smelt BiOp, Reclamation delivered the minimum 75% of Level 2 supply to south-of-Delta wildlife refuges in just three years out of seventeen: 1992, 1993, and 1994. Reclamation, 2015 Summary of Water Supply Allocations. In contrast, since 2008, south-of-Delta wildlife refuges have been shorted to *less* than 75% in two years: in 2014, they received 65%, and in 2015, they anticipate receiving even less. While these shortages have occurred in drought years, Reclamation's ability to export water south of the Delta is adversely affected by limitations on CVP operations, which include implementation of the RPA actions. The Draft EIS must analyze how implementation of the alternatives may further limit exports, including during drought years, and then look at the real impact to south-of-Delta wildlife refuges. Receiving less than 100%, particularly less than 75%, has harmful effect on the refuges, including inability to provide habitat for local breeding wildlife and migratory shorebirds, growing food for migratory birds, and diminishing water quality. Impacts from these shortages are described in the August 21, 2015 declaration of Ricardo Ortega filed in *San Luis & Delta-Mendota Water Authority v. Jewell*, E.D. Cal. Case No. 1:15-cv-01290. Second, the Draft EIS makes the same error in estimating the difference in water supply impacts to the Exchange Contractors as it does for estimating impacts to the wildlife refuges. Table 5.26 identifies *no* difference (0 acre-feet) in annual average deliveries between the No Action Alternative and the Second Basis of Comparison for the Exchange Contractors. Draft EIS at 5-94. Again, Reclamation's Summary of Water Supply Allocations shows that the combination of RPA implementation and drought conditions have resulted in real impacts to the Exchange Contractors' water supply. Since 2008, the Exchange Contractors have been shorted to less than their 75% contractual minimum supply in two years: 2014 and 2015. These shortages have caused the Exchange Contractors' member entities to reduce the allocation to their growers, and growers have in turn had to fallow land and increase groundwater use. The Exchange Contractors, like the south-of-Delta agricultural water service contractors discussed elsewhere in these comments, suffer significant adverse socioeconomic impacts as a result of such shortages. SLDMWA WWD SJRECWA 42 continued

The water supply analysis should be corrected to address the very real likelihood of shortages to refuges and the Exchange Contractors resulting from project modifications, and the concomitant impacts of these shortages should be discussed in the final EIS's resource chapters.

B. The Draft EIS Fails To Adequately Describe And Analyze The Impacts Of Increased Groundwater Use

In addition to unreasonably assuming that increased groundwater use will fully compensate for lost surface supplies, the Draft EIS fails to adequately describe or analyze the impacts of increased groundwater use in response to diminished CVP and SWP supplies. The EIS briefly acknowledges that increased groundwater use will lead to declining groundwater levels, more land subsidence, and reductions in groundwater quality, but it fails to analyze the materiality or consequences of such impacts, let alone potential mitigation. SLDMWA WWD SJRECWA 43

1. The Draft EIS Fails To Provide The Reduction In Availability Of SWP And CVP Water By Groundwater Basin

The foundation for analysis of groundwater level impacts is the change in availability of SWP and CVP water within the area being analyzed (typically a groundwater basin). While the Draft EIS provides information about the aggregate change in availability of SWP and CVP water, Chapter 7 does not quantify (with the exception of the analysis for the Central Valley Region) the change in availability by groundwater basin. Without that quantification, the basis for analysis of groundwater level impacts in the Draft EIS is unclear, which prevents decision makers and interested parties from making a meaningful review of the impacts presented in the Draft EIS.

The Draft EIS does not employ any modeling at all to assess impacts to groundwater outside the Central Valley. Absent a quantified estimate of the change in SWP and CVP water available to groundwater basins, the "impacts analysis" essentially becomes limited to general observations about how a theoretical increase in groundwater production might impact groundwater levels. This appears to be the case in this Draft EIS – for example, page 7-123 discusses impacts of the No Action Alternative relative to the Second Basis of Comparison on groundwater use and elevations for the San Francisco Bay Area, Central Coast, and Southern California Regions as follows:

> Under the No Action Alternative, it is anticipated that CVP and SWP water supplies in the San Francisco Bay Area, Central Coast, and Southern California regions would be reduced as compared to CVP and SWP water supplies under the Second Basis of Comparison, as discussed in Chapter 5, Surface Water Resources and Water Supplies. The reduction in surface water supplies could

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> result in increased groundwater withdrawals, decreased groundwater recharge, and decreased groundwater levels in areas with CVP and SWP water users. It may be legally impossible to extract additional groundwater in adjudicated basins without gaining the permission of watermasters and accounting for groundwater pumping entitlements and various parties under their adjudicated rights.

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The essence of this analysis is that increasing groundwater production results in lower groundwater levels. While there should be general agreement with this principle, it does not provide information that is specific to groundwater basins, and does not define the potential magnitude of the impacts.

The analysis of other topics, like subsidence and groundwater quality, are closely related to groundwater levels, and without quantification of the groundwater level impacts the analysis of these other topics also appears to be limited to general principles rather than quantified impacts. For example, the Draft EIS discussion of land subsidence impacts of the No Action Alternative relative to the Second Basis of Comparison on subsidence and groundwater quality for the San Francisco Bay Area, Central Coast, and Southern California Regions again is expressed in the form of general principles rather than quantified impacts. For example, the Draft EIS discusses the potential land subsidence as follows on page 7-124:

> "Increased use of groundwater and reductions in groundwater levels would result in an increased potential for additional land subsidence under the No Action Alternative as compared to the Second Basis of Comparison in the Santa Clara Valley Groundwater Basin in the San Francisco Bay Area Region, and the Antelope Valley and Lucerne Valley groundwater basins in the Southern California Region"

While there may be general agreement with the principle that reductions in groundwater levels result in an increased potential for land subsidence, information is not provided on the reductions in SWP and CVP water available to these basins that cause these impacts, and the potential subsidence impact is not quantified.

2. The Draft EIS Fails To Present Information On Changes In Groundwater Levels In A Form Useful To Decisionmakers And The Interested Public

A fundamental purpose of NEPA is to ensure that decision makers and interested members of the public have enough information about impacts to make informed decisions about the project being analyzed. The information provided needs to be in a form that is understandable, and which can be effectively used as the basis for a decision about the project. The quantified information provided on groundwater level impacts in the Central Valley Region fails to achieve that purpose because it is unnecessarily difficult to understand and interpret. As discussed below, a reader must evaluate a discussion of "post processing" in a technical

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groundwater modeling appendix in order to understand the groundwater level impacts presented within the Draft EIS. That is not reasonable. SLDMWA WWD SJRECWA 44 continued

A common method to summarize groundwater levels for alternatives is to show: (1) maps of groundwater levels at the end beginning and end of the study period, and the change in groundwater levels; and (2) hydrographs of groundwater levels at selected locations, which show the groundwater level trends. These types of presentations provide useful information that is relatively easy to understand. For example, the maps can provide a basis to understand what areas experience declines in groundwater levels and how large those declines are over the period analyzed. That helps show if a given groundwater basin is in overdraft, what areas might be susceptible to subsidence, and what the flow patterns are. This type of information has presumably already been developed using the model, and should be included in the Draft EIS.

Information about groundwater levels for each alternative can then be supplemented with quantified information that compares different alternatives (for example, maps of differences in groundwater levels at the end of the study period between alternatives, and hydrographs at selected locations showing the differences in groundwater levels over time).

The Draft EIS does not include information on groundwater levels for each alternative, and instead is limited to information that shows differences between alternatives. This does not give decision makers and interested parties a full understanding of groundwater conditions needed to evaluate the impacts of the project. For example, because only differences in groundwater levels are provided, there is no information about whether groundwater levels are rising or falling in any particular alternative, which may impact an assessment of the potential for subsidence.

The maps presenting differences between alternatives are not clearly explained within the Draft EIS. For example, Figure 7.15 (titled "Forecast Groundwater-Level Changes for Alternative 2 and No Action Alternative Compared to Second Basis of Comparison for Average July in a Future Wet Year") is difficult to interpret, leaving decision-makers and the interested public to attempt to interpret these results. Possible interpretations might include:

- Interpretation A - The difference in groundwater levels represents the difference that would occur between two scenarios for a single occurrence of a future wet year. Under this interpretation, the map can be read as showing in some areas might experience from 200 to 500 feet of lowering of groundwater levels in an individual year.
- Interpretation B – The difference in groundwater levels represents an average for all years classified as "wet." Under this interpretation, the map can be read as showing groundwater levels in some areas might be from 200 to 500 feet lower on average in years classified as "wet," but does not tell a reader anything about what happens in an individual year.

Because the Draft EIS does not include information about groundwater levels for each alternative individually, a reader cannot look at the groundwater levels for each alternative to try

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and interpret what these differences might mean, which complicates the interpretation of information like Figure 7.15. SLDMWA WWD SJRECWA 44 continued

The text of the Draft EIS also does not help a reader understand what the results are. For example on page 7-121 groundwater level impacts are described as follows:

> Overall, under the No Action Alternative as compared to the Second Basis of Comparison, July average groundwater levels decrease approximately 2 to 10 feet in most of the central and southern San Joaquin Valley Groundwater Basin in all water year types. July average groundwater levels decline 10 to 50 feet in the Delta-Mendota, Tulare Lake, and Kern County subbasins; and 100 to over 200 feet in the Westside subbasin in all water year types. In critical dry years, groundwater levels decline by up to 200 feet in the Westside subbasin. Groundwater level changes in the Sacramento Valley are forecast to be less than 2 feet. The groundwater level change hydrographs show that in the central and southern San Joaquin Valley, groundwater levels can fluctuate up to 200 feet in some areas due to climatic variations under the No Action Alternative compared to the Second Basis of Comparison.

It is not clear whether the differences in groundwater levels between the two scenarios represent changes in levels that might be experienced in a single year, or if they are differences in groundwater levels which have been averaged over a number of years. This language can be read to be consistent with either Interpretation A or Interpretation B above.

Based on our review, to resolve this question a reader must make a close reading of Section 7A.3.1 ("Post-Processing and Results Analysis") of Appendix 7A to understand what the results presented in the Draft EIS actually mean (and even then, it is complicated by the lack of results for individual alternatives that can be used to help confirm the interpretation). Our best judgment is that the interpretation in the second bullet above (Interpretation B) is the correct one, though we are not 100 percent certain of that interpretation.

The interpretation of the hydrographs presenting differences in groundwater levels over time at specific locations between alternatives (for example, Figure 7.21 which is titled "Forecast Groundwater-Level Change Hydrographs for Alternative 2 and No Action Alternative Compared to Second Basis of Comparison at Example Locations in the San Joaquin Valley") has similar complications to the maps showing groundwater level changes. Based on our review of Section 7A.3.1 of Appendix 7A, our best judgment is that these graphs show the difference in the groundwater levels at a given location between two alternatives, though again we are not 100 percent certain of that interpretation.

3. The Draft EIS Fails To Provide Information Regarding Long-Term Decline In Groundwater Levels Due To Implementation Of The RPAs

The Draft EIS fails to describe the aggregate impacts to groundwater levels due to the expected increase in groundwater pumping from now through 2030, and beyond. The Draft EIS SLDMWA WWD SJRECWA 45

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acknowledges that groundwater levels have experienced significant declines over the last few years, due to increased groundwater pumping in reaction to diminished supplies of surface water. For example, the Draft EIS states that "[r]ecent information indicates that between the spring 2010 and spring 2014, groundwater levels declined at some wells in the Delta-Mendota subbasin by up to 20 feet (DWR 2014c, 2014d). Draft EIS at 7-30 – 7-31. In addition, the Draft EIS acknowledges that "[r]ecent information indicates that between the spring 2013 and spring 2014, groundwater levels have declined at some wells in the Westside subbasin by up to 40 feet within the 1-year period (DWR 2014c, 2014d)." Draft EIS at 7-42. Yet, the Draft EIS does not discuss the implications of similar periods of groundwater draw down that are expected in the future due to implementation of the RPAs.

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The Draft EIS states that the reasonable and prudent alternatives in the biological opinions will result in declines in groundwater levels in the future. The Draft EIS states:

> In areas of the Central Valley Region that use CVP water service contract and SWP entitlement contract water supplies, the CVP and SWP water supplies would be less under the No Action Alternative as compared to the Second Basis of Comparison. The differences would result in increased groundwater use and decreased groundwater levels in the San Joaquin Valley Groundwater Basin under the No Action Alternative as compared to the Second Basis of Comparison.

Draft EIS at 7-121. In particular, "July average groundwater levels decline 10 to 50 feet in the Delta-Mendota, Tulare Lake, and Kern County subbasins; and 100 to over 200 feet in the Westside subbasin in all water year types. In critical dry years, groundwater levels decline by up to 200 feet in the Westside subbasin." Draft EIS at 7-121. Yet, the Draft EIS provides no analysis of the significance of such declines, nor does it analyze whether the affected groundwater basins can withstand the expected levels of decline. The Draft EIS fails to explain the consequences of such significant declines in groundwater levels in any meaningful detail. Critically, the Draft EIS fails to evaluate the aggregate impacts to groundwater levels if the RPAs are implemented from now until 2030. If the RPAs result in consistent declines in groundwater levels because of reductions in surface water supplies, what are the implications for groundwater availability, groundwater quality, and land subsidence? The Draft EIS fails to tell decision makers or the public what are the aggregate impacts to groundwater levels, or the expected consequences of a long-term trend of declining groundwater levels. This is a significant omission that must be remedied in the final EIS.

4. The Draft EIS Omits The Modeling Results And Data Regarding Land Subsidence

While the Draft EIS acknowledges that certain areas are experiencing significant land subsidence as a result of increased groundwater use, the Draft EIS provides only a limited and qualitative analysis of expected land subsidence. In fact, the Draft EIS omits the land subsidence modeling results that show the expected total subsidence resulting from groundwater use, claiming that the results are "overly conservative." The Draft EIS states:

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> CVHM includes a module known as the SUB package that computes the cumulative compaction of each model layer during the model simulation. The cumulative layer compactions at the end of the simulation are summed into a total subsidence. However, this version of the SUB package does not consider the potential reduction in the rate of subsidence that would occur as the magnitude of compaction approaches the physical thickness of the affected fine-grained interbeds. Thus, subsidence forecasts from the predictive versions of CVHM were judged to be overly conservative. Therefore, a qualitative approach was used for the estimation of the potential for increased land subsidence in areas of the Central Valley that have historically experienced inelastic subsidence due to the compaction of fine-grained interbeds.

Draft EIS at 7-112; *see id.* at 7A-17. Reclamation's decision to omit available land subsidence modeling results from the Draft EIS does not serve the informational purposes of NEPA. If Reclamation concluded that the results were overly conservative, it should explain why, but still provide the results to help inform the decision-makers and the public. In addition, Reclamation should identify what information, if any, supports the conclusion that the rates of subsidence would decline by 2030. Reclamation should also identify what information supports its conclusion that the subsidence estimated by the groundwater model is "overly conservative."

The Draft EIS's qualitative analysis of land subsidence impacts is effectively meaningless. Despite acknowledging the observed impacts of land subsidence, the Draft EIS does nothing more than tell the reader that the implementation of the reasonable and prudent alternatives will make land subsidence worse in the future. The Draft EIS confirms that in "areas adjacent to the Delta-Mendota Canal in this subbasin, extensive groundwater withdrawal has caused land subsidence of up to 10 feet in some areas. Land subsidence can cause structural damage to the Delta-Mendota Canal which has caused operational issues for CVP water delivery." Draft EIS at 7-31. Yet, in describing the expected land subsidence associated with implementing the reasonable and prudent alternatives, the Draft EIS only provides a "there will be more" conclusion. The Draft EIS states: "Under the No Action Alternative, potential for land subsidence due to groundwater withdrawals in the Delta-Mendota and Westside subbasins of the San Joaquin Valley Groundwater Basin would increase as compared to the Second Basis of Comparison due to the increased groundwater withdrawals." Draft EIS at 7-122. The Draft EIS also says: "increased groundwater pumping under the long-term average conditions may result in an additional increment of subsidence in those areas within the Central Valley. The additional amount of subsidence and the economic costs associated with it have not been quantified in this EIS. However, total subsidence-related costs have been shown to be substantial, as reported by Borchers et al. (2014) who estimated that the cost of subsidence in San Joaquin Valley between 1955 and 1972 was more than $1.3 billion (in 2013 dollars). These estimates are based on the impacts to major infrastructure in the region including the San Joaquin River, Delta Mendota Canal, Friant-Kern Canal and San Luis Canal in addition to privately owned infrastructure. The incremental subsidence-related costs, expressed on an annual basis, could be an unknown fraction of that cumulative cost." Draft EIS at p. 19-49; see also p. 19-61. Thus, the Draft EIS confirms that increased land subsidence will result from implementation of the reasonable and

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prudent alternatives, and will likely be a problem, but it leaves unanalyzed and unanswered how big a problem. SLDMWA WWD SJRECWA 46 continued

5. **The Draft EIS Fails To Account For Or Analyze Expected Impacts To Groundwater Quality**

Likewise, the Draft EIS provides no meaningful analysis of expected impacts to groundwater quality. The "Groundwater Model Documentation" in Appendix 7A indicates that one of the modeling objectives was to evaluate "[c]hanges to groundwater quality based on a potential inducement of migration of poor quality groundwater because of groundwater flow changes." Draft EIS at 7A-3. However, there is no further discussion of how the model would be used to make this evaluation. SLDMWA WWD SJRECWA 47

Despite extensive acknowledgement of existing groundwater quality issues, and the stated intent to use the groundwater model to evaluate groundwater quality, the Draft EIS merely provides a qualitative analysis of groundwater quality impacts associated with implementing the reasonable and prudent alternatives. For example, the Draft EIS states: "In areas that use CVP and SWP water supplies, groundwater quality under the No Action Alternative could be reduced as compared to the Second Basis of Comparison in the central and southern San Joaquin Valley Groundwater Basin due to increased groundwater withdrawals and resulting potential changes in groundwater flow patterns." Draft EIS at 7-122. The Draft EIS makes no effort to describe the extent or magnitude of impacts to groundwater quality, nor does the Draft EIS consider the implications of degraded groundwater quality in areas that are already experiencing groundwater quality issues. At a minimum, the Draft EIS should provide informative examples of the types of groundwater quality degradation that may occur in particular regions and how the degradation may impact the ability to use that water for municipal or agricultural use. Simply stating that groundwater quality would be "reduced" does not provide the decision makers or the public with sufficient information to evaluate the impacts of implementing the existing reasonable and prudent alternatives, or to allow for meaningful comparison among the alternatives.

C. **<u>The Draft EIS's Analysis Of Effects On Surface Water Resources And Water Supplies Is Inadequate</u>**

1. **The Draft EIS Presents Incomplete Modeling Information Regarding Surface Water Supplies**

Chapter 5 and its accompanying appendices present an incomplete picture of the modeling work that supports Reclamation's conclusions regarding surface water supply. Revision is required. SLDMWA WWD SJRECWA 48

<u>First</u>, a partial set of CalSim II model results are reported in Appendix 5A, but the Draft EIS does not explain why these particular set of outputs or metrics have been selected and does not describe their importance. For example, the significance of flows through Steamboat Slough is not described. There is also no explanation of why results for Millerton Reservoir are presented in the comparative analysis when simulation of the CVP Friant Division is identical across all alternatives.

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Second, the Draft EIS does not adequately explain its assumptions or its modeling of changed circumstances. For example, the reasonable and prudent alternative in the NMFS BiOp requires Reclamation to achieve certain end-of-September and end-of-April storage resulting from the operation of Lake Shasta for a percentage of years. Draft EIS at 3A-31. The Draft EIS states that no specific CalSim II modeling code is implemented to simulate these performance measures (Draft EIS at 5A-9) and there are appears to be no check that these performance measures are being met. Indeed, figures presented in Appendix 5A (Draft EIS at 5A-159 and 5A-161) suggest these criteria are not being met. Reclamation should explain why it is not simulating performance measures, and its rationale for not ensuring that performance measures are being met.

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Reclamation should also revise the Draft EIS to explain its treatment of changing demands. For example, the Draft EIS provides: "By 2030, water demands associated with water rights and CVP and SWP contracts in the Sacramento Valley [are] projected to increase by 443,000 acre-feet per year, especially in the communities in El Dorado, Placer, and Sacramento Counties." Draft EIS at 5-66. The Draft EIS does not explain if or how these increased demands are represented in CalSim II.

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Third, the Draft EIS should provide further explanation of its treatment of modeling anomalies. For example, the Draft EIS states: "in very dry years, the model simulates minimum reservoir volumes (also known as 'dead pool conditions') that appear to prevent Reclamation and DWR from meeting their contractual obligations, including water deliveries." Draft EIS at 5-63. Further discussion of these anomalies in simulated reservoir operations should be included in the final environmental document. In real time operations reservoirs are operated to avoid dead pool conditions and measures taken could include relaxation of some flow criteria or changes to contract allocation procedures, impacting deliveries. Allowing simulated storage to fall to dead pool may result in an over-estimate of CVP delivery capability to CVP contractors south-of-the-Delta in dry years.

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2. The Draft EIS Does Not Set Necessary Thresholds Of Significance

Chapter 5 also fails to allow decisionmakers and the public to understand how the proposed modifications in the various alternatives will have different effects on surface water supply. The Draft EIS does not explain whether the reasonable and prudent alternatives and the proposed operation of the CVP and SWP would significantly affect the quality of the human environment. The Draft EIS Executive Summary includes a list of substantial beneficial and adverse impacts; however thresholds or levels of significance for metrics are not set.

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The Draft EIS states that "CalSim II model output includes minor fluctuations of up to 5 percent due to model assumptions and approaches. Therefore, if the quantitative changes between a specific alternative and the No Action Alternative and/or Second Basis of Comparison are 5 percent or less, the conditions under the specific alternative would be considered to be "similar" to conditions under the No Action Alternative and/or Second Basis of Comparison." Draft EIS at 5-60. While there is uncertainty associated with any model results, the selection of 5 percent as the level to define "similar" conditions is unsupported and is in conflict with other environmental projects and programs that have used CalSim II for impact analysis.

The Draft EIS defines an appropriate use of modeling results as identifying trends that differentiate alternatives and for quantifying specific levels of impacts. Applying the 5 percent threshold to average monthly or average annual values may result in not reporting significant trends. The 5 percent threshold would seem more appropriate when applied to individual monthly results, not averages. SLDMWA WWD SJRECWA 52 continued

3. The Draft EIS Improperly Treats Climate Change And Sea-Level Rise

The Draft EIS's modeling of climate change and sea level rise also warrants revision. As noted elsewhere in these comments, the Draft EIS analyzes future conditions projected for the year 2030. Assumptions regarding sea-level rise and climate change are included in all of the alternatives, including the No Action Alternative and Second Basis of Comparison. These assumptions are the same across all alternatives. Therefore, the effects of climate change and sea-level rise are assumed to be similar across all alternatives. SLDMWA WWD SJRECWA 53

The Draft EIS deviates from past practice by not also presenting an analysis of the future No Action Alternative *without* the effects of climate change. For example, the 2015 SWP Delivery Capability Report published by DWR presents model results for a "base" scenario and an "early long-term" scenario. The latter includes climate effects associated with a 2025 time horizon and a 15 cm sea-level rise, the former does not.

Model results for the No Action Alternative cannot be compared to current or recent historical CVP and SWP operations because the effects of climate change cannot be isolated from the effects of changing regulatory requirements, land use, and facilities.

The analysis of alternatives with climate change and sea-level rise appears to be consistent with past studies and reports produced by DWR and Reclamation. However, the Draft EIS fails to present or discuss any sensitivity analysis for climate change assumptions. Such an analysis could include climate change scenarios based on GCM results representing warmer and drier conditions rather than the Q5 scenario, which is derived from the central tending consensus of climate projections. Similarly, no sensitivity is presented for sea-level rise. For example, a 12 cm or 18 cm rise, which corresponds to the range of projections from the work conducted by Rahmstorf, could also be considered. There is little discussion of whether the use of more recent IPCC CMIP 5 climate projections would significantly change the analysis. More explanation is required.

4. Additional Errors And Inconsistencies In Chapter 5 And Its Accompanying Appendices

CalSim II model results are summarized in Chapter 5 of the Draft EIS and are presented in more detail in Appendices 5A through 5C. There are some errors and inconsistencies in these reported results. For example, south-of-Delta average annual CVP M&I deliveries under the No Action Alternative are reported as 15 TAF per year (Table C-19-1-2). This value is extremely low and inconsistent with the corresponding exceedance plot (Figure C-19-1-5). The geographical breakdown of M&I deliveries also appears to be incorrect; no CVP M&I deliveries are reported for the Tulare Lake Region (Table C-19-1-1). Some mislabeling of results adds to SLDMWA WWD SJRECWA 54

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the confusion. For example, total CVP deliveries south-of-Delta are stated to include "Settlement" deliveries (Table C-19-1-2). Instead, results are the total of water service contract deliveries and refuge deliveries. Deliveries to the Exchange Contractors are not reported, although Settlement Contractor deliveries are reported under the Sacramento Valley. Reclamation should review the presentation of model results for correctness and consistency. SLDMWA WWD SJRECWA 54 continued

D. The Analysis Of Effects On Aquatic Species In Chapter 9 Is Inadequate

Chapter 9 of the Draft EIS is intended to describe the fish and aquatic resources that occur in the portions of the project area that could be affected as result of implementing the alternatives evaluated in the EIS and to describe the potential impacts to those resources. However, Chapter 9 includes flaws in both its description of the affected environment and its analysis of impacts. SLDMWA WWD SJRECWA 55

1. Chapter 9's Discussion Of Affected Environment Requires Revision

The Draft EIS's discussion of affected environment in Chapter 9 requires revision because it contains a number of unsupported statements and includes a number of statements that are not based on the best and most current science. Such statements must be supported or revised in the Final EIS, at minimum to ensure the final environmental document complies with the requirement in the CEQ regulations that "[a]gencies . . . insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements" and "identify any methodologies used and . . . make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement." 40 C.F.R. § 1502.24.

Without revision, Chapter 9's conclusory statements made without support will run afoul of NEPA's requirements. For example, at page 9-57, lines 38-39, the Draft EIS states that "[spring-run Chinook Salmon] [y]earlings typically enter the Delta as early as November and December and continue outmigration through at least March." The Draft EIS does not explain how yearling spring-run are being identified, whether by length at date criteria or genetics. Reclamation cites NMFS 2009 in support, which in turn cites to Snider and Titus 2000. Snider and Titus 2000 describe using length at date criteria, and nowhere say that yearling spring-run typically enter the Delta in November through mid-March. In fact, under the length at date criteria there is no yearling spring-run sized Chinook in November and December; yearling spring-run ends in mid-October. In order to insure scientific integrity of this statement, it must accurate, and it must be supported. There is a great deal of uncertainty when using length at date criteria to distinguish yearling spring-run from other juveniles that needs to be acknowledged.

The discussion regarding nonnative invasive species at page 9-80 provides another example. There, the Draft EIS states that "[n]ot all nonnative species are considered invasive or harmful. Some introduced species do not greatly affect the ecosystem, or have minimal ability to spread or increase in abundance. Others have commercial or recreational value (e.g., Striped Bass, American Shad, and Largemouth Bass)." *Id.* at 9-80. This statement is unsupported, and is contrary to the general understanding that *all* nonnative species increase competition and therefore are considered invasive or harmful where they prey on or compete with native species. That some may value these species for other reasons does not remove their adverse effect on native species. Finally another example of an unsupported—and therefore problematic—statement in Chapter 9 is at page 9-97, in the discussion of predation. At lines 22-27, the Draft EIS notes NMFS made reference to predation studies regarding predation loss on the Tuolumne and Stanislaus rivers that showed significant loss in run-of-river gravel mining ponds and dredged areas. Yet, the Draft EIS also notes that NMFS's statements were made *without citation*; without adding citation, Reclamation cannot now adopt NMFS's observations wholesale. Doing so would lack "scientific integrity" and would be contrary to 40 C.F.R. § 1502.24. Revision of Chapter 9 is required to ensure that these, and similarly unsupported statements, identify and be consistent with scientific support. SLDMWA WWD SJRECWA 55 continued

Additional portions of the affected environment section of Chapter 9 require revision to add references to the best and most recent science. In several places Chapter 9 cites outdated science in the face of more recent science. For example, at page 9-56, the Draft EIS uses Feyrer et al. 2007 to support the connection between X2 and hypothesized habitat, but does not support a connection between X2 and presence or absence of Delta Smelt. This discussion should be revised to add reference to the more recent Feyrer 2011 study, but that study also does not provide a connection between X2 and the presence or absence of Delta Smelt. And Kimmerer et al. 2013, at page 13, warrants discussion, as it explains that X2, or the volume of the low salinity zone, in the spring and fall are not a driver of Delta Smelt abundance, and notes that "[g]iven the difficulty in determining the controls on the delta smelt population, it is not surprising that such a simple descriptor of habitat is inadequate for this species." Another example of a statement requiring revision to reference updated science is at page 9-92. The Draft EIS notes that "the cause of the mortality in the ship channel has not been studied," and identifies possible causes for mortality. However, certain posited causes, i.e., low dissolved oxygen and water quality have been resolved by aeration and upgrades to the Stockton sewage treatment plant, respectively.

The comments submitted by the State Water Contractors identify additional examples of outdated or mis-cited scientific studies, or misstatements of the available data in Chapter 9. The Authority, Westlands, and the Exchange Contractors join in those comments. SLDMWA WWD SJRECWA 56

2. Chapter 9's Impact Analysis Discussion Is Flawed

The resource chapters' "Impact Analysis" sections are intended to allow the comparison of environmental consequences of the No Action Alternative and Second Basis of Comparison to the environmental consequences of the Action Alternatives. In Chapter 9, however, the Draft EIS fails to present the impacts of the alternatives in a manner that "sharply defin[es] the issues and provid[es] a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. § 1502.14. With respect to impacts on fish and aquatic resources, the key issue is whether the proposed modifications in the various alternatives will avoid jeopardizing listed species—accordingly, Chapter 9 must enable a comparison among the alternatives that addresses jeopardy. To the extent possible, that analysis should be quantitative. SLDMWA WWD SJRECWA 57

In order to undertake a useful comparison among the alternatives, the final EIS must allow its readers to answer a number of questions: How many more fish are expected to survive and reproduce under one scenario as opposed to another? If reverse flows in Old and Middle rivers are limited by other existing non-ESA regulations but not by additional measures under the ESA, what are the expected effects on population abundance? If additional restrictions on such

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flows are imposed under the ESA, what is the expected effect on abundance of listed species? Do other measures that do not involve restrictions on CVP and SWP operations, such as habitat restoration, offer greater promise of improving abundance? The Draft EIS does not answer any of these or similar questions.

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The synthesis and conclusion sections of Chapter 9's impacts analysis are lacking. First, Chapter 9 contains a number of conclusory statements that seem to lack any analytic support at all. For example, in discussing changes in fish entrainment, the Draft EIS states that "[c]hanges in CVP and SWP operations can affect through-Delta survival of migratory (e.g., salmonids) and resident (e.g., Delta and Longfin smelt) fish species through changes in the level of entrainment at CVP and SWP export pumping facilities." Draft EIS at 9-113. This statement is unsupported. There is no evidence that exports are negatively related to through-Delta survival based on CWT and acoustic tag experiments, and there is no support for concluding that entrainment is related to abundance. This conclusory statement is not based on scientific evidence.

Another example comes in the Draft EIS's discussion of the Second Basis of Comparison, the Draft EIS states that "[s]imilar to the No Action Alternative, reasonable and foreseeable non-CVP and –SWP water resources projects to provide additional water supplies would be implemented, in addition to restoration of more than 10,000 acres of intertidal and associated subtidal wetlands in Suisun Marsh and Cache Slough; and up to 20,000 acres of seasonal floodplain restoration in the Yolo Bypass." *Id.* at 9-150. Yet, despite this significant restoration, the Draft EIS concludes "[i]t is not likely that operations of the CVP and SWP under the Second Basis of Comparison would result in improvement of habitat conditions in the Delta or increases in populations for these fish by 2030, and the recent trajectory of loss would likely continue." *Id.* This conclusion specifically, and Chapter 9 generally, both elicit the same question—why? Why, if there will be significant habitat restoration, is the Second Basis of Comparison not expected to result in improvement of habitat conditions in the Delta? The Draft EIS fails to explain that factors other than habitat restoration may be more significant in affecting population loss, or to provide any explanation at all for its conclusion.

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Second, Chapter 9 fails to contain any synthesis or conclusions that address the *significance* of effects from the different alternatives on listed species. Nowhere does the chapter identify whether one alternative as compared to another (or to the No Action Alternative or the Second Basis of Comparison) will have any population level effects. As stated repeatedly in these comments, it is crucial that decisionmakers and the public be able to determine whether an alternative avoids jeopardizing listed species. An assessment of any population level effects is important to that determination. The discussion in the Draft EIS does not enable such assessment. For example, in Chapter 9's comparison of the No Action Alternative to the Second Basis of Comparison for Coho Salmon in the Trinity River Region, it states that long term average monthly water temperatures would be similar to, although slightly higher than temperatures under the No Action Alternative as compared to the Second Basis of Comparison. The discussion notes that the temperature model outputs indicate that the temperature threshold for coho "would be exceeded about 8 percent of the time in October, about 1 percent more frequently than under the Second Basis of Comparison." *Id.* at 9-154. Here the Chapter identifies a quantitative difference, but does not explain what exceeding the threshold means for Coho Salmon—does the entire year-class die if the threshold is exceeded? If that is the case, is it possible that a 1 percent increase in the exceedance of the threshold may have a population level effect? Why or why not? SLDMWA WWD SJRECWA 59 continued

Elsewhere, the Draft EIS notes that "[i]n the estimation of potential entrainment loss and comparison of the results for each of the alternatives, differences in entrainment estimates of greater than 5 percent between alternatives are considered biologically meaningful, with potential effects on Delta Smelt." Draft EIS at 9-114. Again, this statement fails give any explanation as to why or how Reclamation determined that a 5 percent difference in calculated entrainment would be considered biologically meaningful; the statement begs the question—what is the effect of a 5 percent change in calculated entrainment on the Delta Smelt population as a whole? Is there population-level significance?

Chapter 9's comparison of the No Action Alternative to the Second Basis of Comparison with respect to spring-run Chinook Salmon provides another example of the Draft EIS's failure to address the significance of impacts. After discussing model results, the chapter notes that "overall, effects on spring-run Chinook Salmon could be slightly more adverse under the No Action Alternative than under the Second Basis of Comparison, with a small likelihood that spring-run Chinook Salmon production would be lower under the No Action Alternative." *Id.* at 9-171. This statement does not explain what "slightly more adverse" means in the context of a jeopardy analysis. Is there a population level effect under the No Action Alternative versus Second Basis of Comparison? Why or why not? Similar questions exist with respect to the chapter's summary of effects for other species, including steelhead, Green Sturgeon, and others. *See, e.g.*, Draft EIS at 9-190 ("overall, effects on steelhead could be slightly more adverse under the No Action Alternative than under the Second Basis of Comparison"), 9-193 ("Overall, the increased frequency of exceedance of temperature thresholds under the No Action Alternative could increase the potential for adverse effects on Green Sturgeon in the Sacramento and Feather rivers relative to the Second Basis of Comparison."). The failure to explain the significance of impacts precludes decisionmakers from complying with their charge under NEPA. SLDMWA WWD SJRECWA 60

Third, Chapter 9's Impact Analysis fails to appropriately note the relative significance of impacts from CVP and SWP operations compared to impacts from other stressors. Although modifications of CVP and SWP operations to adjust outflow and reduce entrainment have been the primary method of addressing problems with Bay-Delta ecosystem management, there is little evidence that such modifications have been effective for improving or protecting the health of listed species or their habitat.[9] The populations of the Delta Smelt and other listed species have declined in the more than six years since the RPAs from the 2008 and 2009 BiOps began being implemented. *See, e.g.*, Draft EIS at 9-63. Chapter 9 does not analyze one of likely reasons for this fact, e.g. the low relative importance of CVP and SWP operations on the status of the species in the context of multiple stressors. Chapter 9 acknowledges the existence of other stressors for listed species, but does not explain which of these stressors are of equal or greater significance to species' population levels versus CVP and SWP projects, or explain the scale of flow variations resulting from such modifications versus the natural flow variations due to the Bay-Delta tidal system.[10] NMFS's 2014 Recovery Plan for the Evolutionarily Significant Units SLDMWA WWD SJRECWA 61

[9] The Authority, Westlands, and the Exchange Contractors incorporate their September 2012 and July 2014 comments on related topics to provide further support for the points in these comments.
[10] In addition to discussing the relative significance of fluctuations in flow due to CVP and SWP operations versus the tide, the final EIS should expressly acknowledge the limits in the available scientific data related to effects of

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of Sacramento river Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead provides a helpful resource for such comparisons. NMFS 2014 (attached) at A-1 (showing relative significance of entrainment versus harvest, predation, and other stressors). SLDMWA WWD SJRECWA 61 continued

Finally, Chapter 9 is problematic because it seems to purposefully avoid using recent science that would tend to show the reduced relative importance of CVP and SWP operations on listed species. For example, Chapter 9 contains the following discussion regarding X2 and Delta Smelt: SLDMWA WWD SJRECWA 62

> The overlap of the low salinity zone (or X2) with the Suisun Bay/Marsh is believed to lead to more favorable growth and survival conditions for Delta Smelt in fall. (Baxter et al. 2010; Feyrer et al. 2011). To evaluate fall abiotic habitat availability for Delta Smelt under the alternatives, X2 values (in km) simulated in the CALSIM II model for each alternative were averaged over September to December, and compared for differences. There are uncertainties and limitations associated with this approach, e.g., it does not evaluate other factors that influence the quality or quantity of habitat available for Delta Smelt (e.g., turbidity, temperature, food availability), nor does it take into account the relative abundance of Delta Smelt that might benefit from the available habitat in the simulated X2 areas, in any given year. Other scientists have developed and described life cycle models to evaluate Delta Smelt population responses to changes in flow-related variables (e.g., Maunder and Deriso 2011; Rose et al. 2013 a, b; Reed et al. 2014), but these life cycle modeling approaches were not selected for use in the current study. In this study, simulated fall X2 values are used as a tool to compare the alternatives, as one of the factors that would indicate suitable habitat to benefit Delta Smelt.

Draft EIS at 9-115. This approach has acknowledged limitations, and is based on outdated science (e.g. Baxter et al. 2010, Feyrer et al. 2011). Yet, Reclamation announces that it does not use more recent life cycle modeling approaches in the Draft EIS, but does not explain why. Would the more recent studies produce different conclusions? More detail is required.

In sum, the Draft EIS's description of the affected environment of and impacts to fish and aquatic resources from the alternatives is flawed. Significant revision is required in order to enable readers of the final environmental document to understand and evaluate the real impacts of the alternatives on listed aquatic species.

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additional outflow. Given the many stressors and changes in the Bay-Delta ecosystem, there is significant uncertainty about the potential benefits of increased outflow for Delta Smelt, longfin smelt, and several other species including white sturgeon and green sturgeon. (Delta Science Program 2014.) Numerous studies have concluded that more flow is not necessarily the solution in highly altered systems. (Poff et al. 1997; Hart and Finelli 1999; Bunn and Arthington 2002; Poff and Zimmerman 2010.) Efficient or targeted use of flow is more likely to attain specific ecological benefits, particularly when paired with additional actions to address non-flow stressors.

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III. RECLAMATION MUST SIGNIFICANTLY REVISE THE EIS TO MEET ITS NEPA OBLIGATIONS

To date, Reclamation has failed to utilized the NEPA process for its intended purpose – to infuse environmental considerations into its decision and inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts to the human environment. As the Council on Environmental Quality's regulations explain: SLDMWA WWD SJRECWA 63

> The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the federal government. It shall provide full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. . . . Statements shall be concise, clear, and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses. An environmental impact statement is more than a disclosure document. It shall be used by federal officials in conjunction with other relevant material to plan actions and make decisions.

40 C.F.R. § 1502.1. The Draft EIS fails to achieve this primary purpose.

As detailed above, Reclamation must significantly revise the Draft EIS to satisfy its NEPA obligations. The Authority, Westlands, and the Exchange Contractors urge Reclamation to perform the requisite analyses and disclosures to inform decisionmakers and the public before a decision is made regarding possible modifications to CVP and SWP operations. Reclamation's upcoming decision has the potential to have significant environmental consequences throughout California and exacerbate the impacts of the state's on-going drought. In the face of such an important decision, it is critical the Reclamation perform a thorough NEPA analysis, one that critically examines alternatives and mitigation measures that can minimize or avoid impacts to the human environment.

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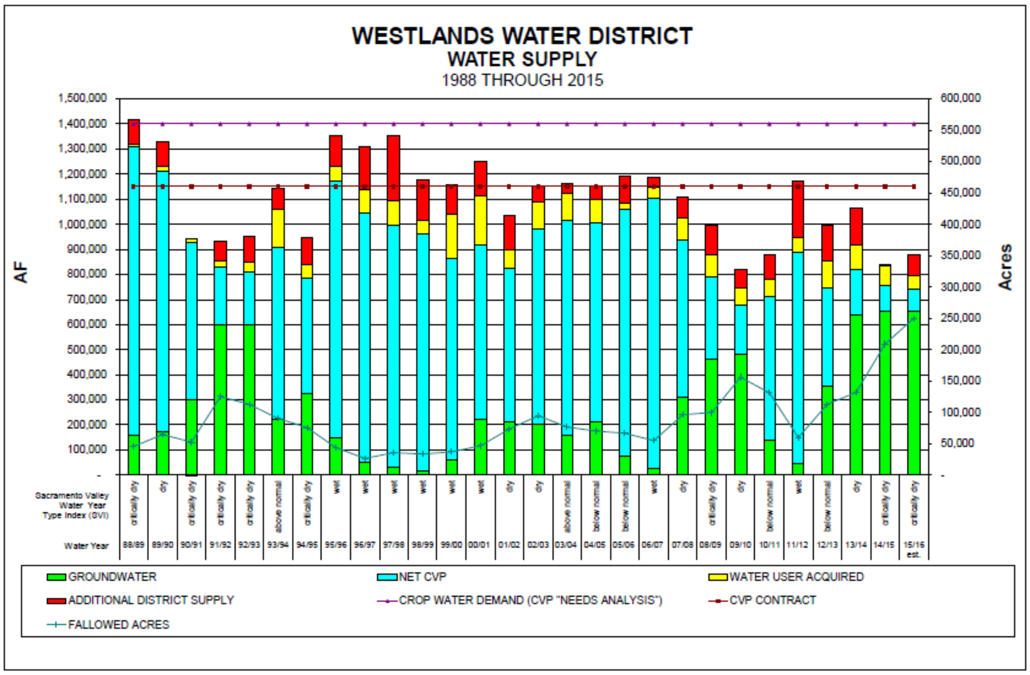
EXHIBIT C

WESTLANDS WATER DISTRICT WATER SUPPLY GRAPH



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Cited References

Auffhammer, M., Foreman, K., and Sunding, D. 2014. Turning Water Into Jobs: The Impact of Surface Deliveries on Farm Employment and Fallowing in California's San Joaquin Valley. Submitted for publication.

Bunn, S.E. and Arthington, A.H. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. *Environmental Management 30: 492-507.*

California Department of Water Resources. 2014. Public Update for Drought Response, http://www.water.ca.gov/waterconditions/docs/DWR_PublicUpdateforDroughtResponse_GroundwaterBasins.pdf.

California Department of Water Resources. 2015. Drought Brochure, http://www.water.ca.gov/waterconditions/docs/DWR_DroughtBroch_070815-web.pdf.

Delta Science Program. 2014. Workshop on Delta Outflows and Related Stressors - Panel Summary Report, http://deltacouncil.ca.gov/sites/default/files/documents/files/Delta-Outflows-Report-Final-2014-05-05.pdf.

Farr, T.G., Jones, C., and Liu, Z. 2015. Progress Report: Subsidence in the Central Valley, California. NASA, Jet Propulsion Laboratory California Institute of Technology, http://water.ca.gov/groundwater/docs/NASA_REPORT.pdf.

Feyrer, F., Newman, K., Nobriga, M., and Sommer, T. 2011. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. *Estuaries and Coasts 34:120-128.*
Hart, D.D. and Finelli, C.M. 1999. Physical-biological coupling in streams: the pervasive effects of flow on benthic organisms. *Annual Review of Ecology and Systematics 30: 363 -395.*

Kimmerer, W.J., MacWilliams, M.L., and Gross, E.S. 2013. Variation of fish habitat and extent of the low-salinity zone with freshwater flow in the San Francisco Estuary. *San Francisco Estuary and Watershed Science 11(4).*

National Marine Fisheries Service. 2014. Recovery Plan for the Evolutionary Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead.

National Research Council. 2004. Endangered and threatened fishes in the Klamath River Basin: causes of decline and strategies for recovery. The National Academies Press.

National Research Council. 2010. A scientific assessment of alternatives for reducing water management effects on threatened and endangered fishes in California's Bay Delta. The National Academies Press.

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Ortega, Ricardo. 2015. Declaration of Ricardo Ortega in Support of Plaintiffs San Luis & Delta-Mendota Water Authority and Westlands Water District's Motion for Preliminary Injunction and Temporary Restraining Order, *San Luis & Delta-Mendota Water Authority v. Jewell*, E.D. Cal. Case No. 1:15-cv-01290.

Poff, N.L., Allan, J.D., Bain, M.B., Karr, J.R., Prestegaard, K.L., Richter, B., Sparks, R., and Stromberg, J. 1997. The natural flow regime: a paradigm for river conservation and restoration. *BioScience 47:769-784.*

Poff, N.L. and Zimmerman, J.K. 2010. Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows. *Freshwater Biology 55: 194–205.*

Salazar, K., and Looke, G. Letter to Sutley, N. 2010. California Bay-Delta Joint Initiative.

United States Department of the Interior, Council on Environmental Quality, United States Department of Agriculture, United States Department of Commerce, United States Environmental Protection Agency, United States Department of the Army. Interim Federal Action Plan Status Update for the California Bay-Delta: 2011 and Beyond, https://www.doi.gov/sites/doi.gov/files/migrated/news/pressreleases/upload/Final-Status-Update-2010-12-15.pdf.

United States Bureau of Reclamation. 2015. Summary of Water Supply Allocations.

San Luis & Delta-Mendota Water Authority

P.O. Box 2157
Los Banos, CA 93635
Phone: (209) 826-9696
Fax: (209) 826-9698

Westlands Water District

3130 N. Fresno Street
P.O. Box 6056,
Fresno, CA 93703-6056
Phone: (559) 224-1523
Fax: (559) 241-6277

July 14, 2015

BY EMAIL: GKRZYS@USBR.GOV

Mr. Greg Krzys
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

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

Dear Mr. Krzys:

The San Luis & Delta-Mendota Water Authority and Westlands Water District (together "Public Water Agencies") appreciate the opportunity to comment on the second Administrative Draft Environmental Impact Statement for the Coordinated Long-term Operation of the Central Valley Project and State Water Project ("Second Admin Draft EIS"). The Second Admin Draft EIS improves upon the last draft, which the Public Water Agencies commented on in 2013.[1] However, the Public Water Agencies have continuing, significant concerns, and suggestions for further improvements that are necessary to ensure compliance with the National Environmental Policy Act ("NEPA"). SLDMWA WWD SJRECWA 64

In its coming Record of Decision, the United States Bureau of Reclamation ("Reclamation") will be making policy decisions on a matter of vital importance to the future of protected species and millions of people and acres of prime farm land. Those must be new and thoughtful decisions, not reflexive re-adoption of the decisions it made some seven years ago to implement the reasonable and prudent alternatives in the existing biological opinions. Those past policy decisions relied upon science that is now outdated, and were not informed by the critical social and environmental impacts realized over the past four years of drought and changes in regulatory approaches. And, those past decisions were illegal, because they were made without the benefit of any environmental review under NEPA.

[1] The Public Water Agencies submitted written comments on June 28, 2012 in response to the notice of intent and scoping, and on May 3, 2013 in response to an earlier version of an administrative draft environmental impact statement. The Public Water Agencies incorporate those prior comments, including all attachments, in these comments. SLDMWA WWD SJRECWA 65

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The supporting analysis and justification for Reclamation's new choices, now informed by NEPA review, must be thorough and transparent. To the fullest extent possible, the information and presentation in the final environmental impact statement should inform the public and policy makers of the necessity for and expected benefit of any changes to CVP and SWP operations to meet the requirements of the federal Endangered Species Act, the available alternatives, and the trade-offs among the available alternatives. As the Council on Environmental Quality's regulations explain: SLDMWA WWD SJRECWA 66

> The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the federal government. It shall provide full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. . . . Statements shall be concise, clear, and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses. An environmental impact statement is more than a disclosure document. It shall be used by federal officials in conjunction with other relevant material to plan actions and make decisions. (40 CFR § 1502.1.)

The Public Water Agencies' comments are intended to help Reclamation prepare an EIS that serves this purpose.

The Public Water Agencies were first provided access to the Second Admin Draft EIS on June 30, 2015. Reclamation has requested comments by July 14, 2015. Given the length of the document, including numerous supporting technical appendices, two weeks is insufficient time to complete a thorough review or provide detailed comments. Therefore, in this letter the Public Water Agencies provide only the following brief, general comments. The Public Water Agencies will provide more detailed comments by the deadline for public comment, which we understand will be September 29, 2015. SLDMWA WWD SJRECWA 67

First, the Public Water Agencies note that the No Action Alternative in the Second Admin Draft EIS includes implementation of the reasonable and prudent alternatives from the biological opinions. This is a serious defect, as we explained in comments on the prior draft. Reclamation's decisions to implement the reasonable and prudent alternatives without doing any NEPA review were illegal. Reclamation cannot cure its violations of NEPA by doing an analysis that assumes its past decisions to adopt the reasonable and prudent alternatives were instead lawful, which it effectively does when it rationalizes that implementing the reasonable and prudent alternatives "represents a continuation of existing policy and management direction" and therefore should be included in the No Action Alternative. (Second Admin Draft EIS at 3-3.) SLDMWA WWD SJRECWA 68

The Second Basis of Comparison in the Second Admin Draft EIS is closer to an appropriate No Action Alternative, because it does not include implementation of the reasonable and prudent alternatives. However, the Second Admin Draft EIS does not use the Second Basis of Comparison as a No Action Alternative, and disregards it in much of its NEPA analysis. The Second Basis of Comparison is "included in [the] EIS for information purposes only." (Second Admin Draft EIS at 4-1, 4-13). The document confirms that continued implementation of the

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reasonable and prudent alternatives will cause huge reductions in CVP and SWP water deliveries compared to operations under the Second Basis of Comparison. (See *id.* at 5-91 – 5-94 [tables showing reduced water deliveries].) It estimates that on a long-term annual average, the reasonable and prudent alternatives will reduce CVP water deliveries by 332,000 acre-feet annually, and reduce SWP water deliveries by 773,000 acre-feet annually. (*Id.*) Yet, the Second Admin Draft EIS fails to identify even a single mitigation measure that could help mitigate these water supply impacts. Instead, it states: "Mitigation measures were not developed for reductions in surface water resources under the alternatives as compared to the Second Basis of Comparison because this analysis was included in this EIS for information purposes only." (*Id.*, at 5-169.) This choice to not identify mitigation for the massive losses of water supply that will indisputably result from implementing the reasonable and prudent alternatives is inexplicable, and an obvious violation of NEPA. The Public Water Agencies again urge Reclamation to reconsider the definition of the No Action Alternative, because staying on the current path will not cure Reclamation's NEPA violation. SLDMWA WWD SJRECWA 68 continued

Second, the Second Admin Draft EIS does not allow for an easy comparison of the relative merits of the various alternatives analyzed, and the trade-offs involved in choosing one alternative over another. In its current form, it separately analyzes and summarizes the environmental consequences of each alternative for each resource category, in chapters 5 through 21. That separate treatment of resource categories may be fine for organizational purposes, but to better inform the public and policy makers the environmental impact statement should also have a section or chapter that synthesizes the overall results. The existing Chapter 3 describes each alternative considered, but it does not analyze or compare the relative environmental consequences and the trade-offs among alternatives. Table 22.1 provides a start on a comparison among alternatives, but is deficient because it does not include the Second Basis of Comparison, does not include any information regarding fish and aquatic resources, and is too brief and general to meaningfully inform decisions. Gathering up the overall consequences of each alternative and analyzing and highlighting the trade-offs involved would benefit both Reclamation and the public in understanding the choices to be made. The Second Admin Draft EIS should be revised to include an analysis and comparison among all the alternatives in a single section or chapter. SLDMWA WWD SJRECWA 69

Third, in at least some cases the Second Admin Draft EIS describes the "environmental consequences" of alternatives as differences in expected conditions without addressing the materiality of those differences. For example, Chapter 9 (regarding Fish and Aquatic Resources) describes differences in various parameters, e.g. water temperatures or flow, that are expected to result from alternative project operations. But Chapter 9 does not assess or describe the materiality of the projected differences for the populations of affected fish species. Are the differences in projected conditions material? What criteria will be used to determine whether a particular difference is material? If the expected relative benefit of a particular operation intended to protect fish populations is minimal, that information would usefully inform Reclamation's ultimate decision on whether to adopt that measure, especially if that measure significantly impairs other project purposes. If the materiality of the differences in conditions is unknown, that absence of information should be expressly noted. A synthesis and presentation of information regarding the materiality of potential changes in operations for fish populations, or the lack of such information, would help inform the public and decision makers of the expected benefits or detriments of alternative operations. SLDMWA WWD SJRECWA 70

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Fourth, the Second Admin Draft EIS is deficient because it lacks an analysis and explanation of the substantial scientific uncertainties underlying the conclusions and prescriptions in the biological opinions. (See 40 CFR § 1502.22.) The available science falls well short of dictating any particular decision or specific requirement, e.g., a particular limit on negative OMR flows for delta smelt, as essential to the continued survival of the species. As a National Research Council report explained about that OMR requirement: "there is substantial uncertainty regarding the amount of flow that should trigger a reduction in exports. In other words, the specific choice of the negative flow threshold for initiating the RPA is less clearly supported by scientific analyses. The biological benefits and the water requirements of this action are likely to be sensitive to the precise values of trigger and threshold values. There clearly is a relationship between negative OMR flows and mortality of smelt at the pumps, but the data do not permit a confident identification of the threshold values to use in the action, and they do not permit a confident assessment of the benefits to the population of the action. As a result, the implementation of this action needs to be accompanied by careful monitoring, adaptive management, and additional analyses that permit regular review and adjustment of strategies as knowledge improves."[2] The Second Admin Draft EIS should be revised to acknowledge and define that gap in knowledge for decision makers, and the public. Even with the benefit of the most recent data available, Reclamation's coming decisions will be predominantly policy choices made in the context of significant scientific uncertainty. SLDMWA WWD SJRECWA 70

Finally, the changes the Public Water Agencies recommend even in this brief comment letter will require substantial revision of the Second Admin Draft EIS, and more detailed comments during the public comment period will likely raise yet additional issues. Under the current remand schedule in the delta smelt case, Reclamation's Record of Decision is due by December 1, 2015. That likely will not allow enough time to make needed revisions. The Public Water Agencies are open to an extension of the current remand deadline, which the court would of course have to approve. We invite further discussion with Reclamation on this issue. In the meantime, however, Reclamation should proceed with the release of the document for public comment. SLDMWA WWD SJRECWA 71

Thank you for your consideration of these comments.

Sincerely,

Daniel G. Nelson
Executive Director
San Luis & Delta-Mendota Water Authority

Thomas Birmingham
General Manager
Westlands Water District

[2] National Research Council (2012). *Sustainable Water and Environmental Management in the California Bay-Delta*. Washington DC: National Academies Press, at pp. 210-211.

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San Luis & Delta-Mendota Water Authority

P.O. Box 2157
Los Banos, CA 93635
Phone: (209) 826-9696
Fax: (209) 826-9698

Westlands Water District

3130 N. Fresno Street
P.O. Box 6056,
Fresno, CA 93703-6056
Phone: (559) 224-1523
Fax: (559) 241-6277

May 3, 2013

BY EMAIL: BCNELSON@USBR.GOV

Mr. Ben Nelson
Bureau of Reclamation, Bay-Delta Office
801 I Street, Suite 140
Sacramento, CA 95814-2536

Re: Administrative Draft Environmental Impact Statement for the Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project and State Water Project

Dear Mr. Nelson:

The San Luis & Delta-Mendota Water Authority and Westlands Water District (together "Public Water Agencies") appreciate the opportunity to comment in response to the United States Bureau of Reclamation's ("Reclamation") request for interested parties to review and comment on the Administrative Draft Environmental Impact Statement for the Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project and State Water Project ("Draft EIS"). SLDMWA WWD SJRECWA 72

The Draft EIS suffers from fundamental and serious deficiencies, and requires substantial revision to provide meaningful environmental analysis for the benefit of the public and policy makers, and comply with the requirements of the National Environmental Policy Act ("NEPA"). At least in part, the deficiencies in the Draft EIS appear to be a result of Reclamation's judgment that it could not conduct a more robust and complete analysis within the time remaining for completion of the remand in the *Consolidated Delta Smelt Cases*, originally set for December 1, 2013. On April 9, 2013, however, the federal district court granted Reclamation an extension of time to complete the remand in that case, as well as in the related *Consolidated Salmon Cases*. The court provided that, so long as Reclamation shows progress with the Collaborative Science and Adaptive Management Process and the Endangered Species Act ("ESA") consultation, the court would allow Reclamation until December 1, 2016 in the *Consolidated Delta Smelt Cases*, and until April 29, 2019 in the *Consolidated Salmon Cases* to complete NEPA review and consultations under section 7 of the ESA. SLDMWA WWD SJRECWA 73

These extensions are welcome news, and provide Reclamation the time and opportunity to make the substantial revisions necessary to bring the Draft EIS into compliance with NEPA. It is vitally important that Reclamation's decision regarding what actions it must take to meet its obligations under the ESA be informed by a sound and complete environmental impact

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statement. Such an environmental impact statement will assist Reclamation in achieving a balance between the actions Reclamation will undertake to comply with the ESA and the manner in which Reclamation will operate the Central Valley Project to meet its various purposes, including delivery of water to the Public Water Agencies. SLDMWA WWD SJRECWA 73 continued

Given the additional time the Court has now granted Reclamation, we urge Reclamation to undertake the following actions: SLDMWA WWD SJRECWA 74

- Prepare a new Biological Assessment for the ESA consultation. A new Biological Assessment is necessary to reflect changes to project operations and new scientific data in the years since the last consultation.

- Exclude from the No Action Alternative under NEPA the major changes to project operations required by the existing biological opinions. Reclamation should do so both because many of those requirements have been invalidated, and because the environmental effects of those measures should be assessed as part of the NEPA analysis. Including the biological opinions in the No Action Alternative masks their impact, and is contrary to the district court's ruling that NEPA analysis must be completed before Reclamation may adopt those measures. SLDMWA WWD SJRECWA 75

- Use NEPA review as an opportunity to better inform Reclamation's judgment about how it can meet its obligations under ESA section 7 with respect to Central Valley Project operations, including whether project operations are likely to jeopardize listed species. Assuming Reclamation concludes that changes to operations are necessary to comply with the ESA, it should explore alternatives that will minimize impacts to water supply. Reclamation should not begin its analysis by presuming that project operations jeopardize listed species, or that the existing reasonable and prudent alternatives are either necessary or efficacious. SLDMWA WWD SJRECWA 76

- Consider and analyze what changes to Central Valley Project operations are necessary, as opposed to sufficient, to ensure that operations are not likely to jeopardize listed species. Reclamation should not be taking actions that reduce water supply unless those actions are necessary to meet the no-jeopardy mandate in ESA section 7.

- In the environmental impact statement, expressly acknowledge the high level of scientific uncertainty underlying the conclusions and requirements of the existing biological opinions, and factor that uncertainty into its analysis of alternatives. To the extent Reclamation proposes actions intended to benefit listed species despite that significant uncertainty, based on a precautionary approach, it should expressly acknowledge it is doing so and identify the trade-offs involved, including lost water supply and socioeconomic impacts. SLDMWA WWD SJRECWA 77

- Conduct quantitative analyses of the potential impacts of each alternative. The entirely qualitative analysis in the Draft EIS is inadequate. SLDMWA WWD SJRECWA 78

- Proceed concurrently with the ESA consultation and NEPA review; each process should inform the other. SLDMWA WWD SJRECWA 79

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Additional and more detailed comments are attached to this letter as Exhibit B. Please note that these comments should not be considered an exhaustive list of all the defects and problems we see in the Draft EIS. Instead, this is our effort, in the limited time allowed, to identify some basic needed changes to the Draft EIS as Reclamation reconsiders its approach in light of the extension of time for completing the remand. SLDMWA WWD SJRECWA 80

Also, the Public Water Agencies previously submitted a comment letter in response to Reclamation's Notice of Intent and Scoping which provides additional explanation of the NEPA analysis Reclamation should be doing on remand. The Draft EIS is inconsistent with many of the suggestions in that letter. As Reclamation re-evaluates its approach to the environmental impact statement, it should reconsider those scoping comments. For your ease of reference, a copy of that letter is attached as Exhibit C.[1] SLDMWA WWD SJRECWA 81

Finally, the Public Water Agencies hope to work in a cooperative manner with Reclamation to ensure that the final environmental impact statement addresses the significant issues that arise from potential modifications of Central Valley Project operations pursuant to the ESA, and that the environmental impact statement includes an appropriate range of alternatives and a robust and complete impact analysis.[2] As the ESA consultation progresses, including particularly preparation of a new biological assessment, Reclamation should be able to concurrently define a proposed action and additional alternatives to be included in its analysis. Reclamation's analysis ultimately must foster a workable, environmentally sound plan for continued operations of the Central Valley Project that protects and restores the socioeconomic vitality of, and minimizes the adverse environmental impacts in, the regions the Central Valley Project serves, while ensuring legally and scientifically supportable, reasonable, and effective protection mechanisms for the listed species. SLDMWA WWD SJRECWA 82

Thank you for your consideration of these comments.

Sincerely,

Daniel G. Nelson
Executive Director
San Luis & Delta-Mendota Water Authority

Thomas Birmingham
General Manager
Westlands Water District

[1] Exhibit C, Public Water Agencies, Comment Letter Regarding Notice of Intent and Scoping under the National Environmental Policy Act on Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project and State Water Project (June 28, 2012).

[2] The Public Water Agencies recognize the close relationship between the NEPA process and the related ESA consultation process. As explained in the Reclamation Stakeholder Engagement Process for Section 7 ESA Consultation and NEPA Compliance on the Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project and State Water Project, issued June 2, 2012 (p. 2), "Reclamation anticipates a free and complete flow of information between the NEPA and Section 7 consultation processes, with each informing the other."

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EXHIBIT A

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San Luis & Delta-Mendota Water Authority Member Agencies

The Authority's members are: Banta-Carbona Irrigation District; Broadview Water District; Byron Bethany Irrigation District (CVPSA); Central California Irrigation District; City of Tracy; Columbia Canal Company (a Friend); Del Puerto Water District; Eagle Field Water District; Firebaugh Canal Water District; Fresno Slough Water District; Grassland Water District; Henry Miller Reclamation District #2131; James Irrigation District; Laguna Water District; Mercy Springs Water District; Oro Loma Water District; Pacheco Water District; Pajaro Valley Water Management Agency; Panoche Water District; Patterson Irrigation District; Pleasant Valley Water District; Reclamation District 1606; San Benito County Water District; San Luis Water District; Santa Clara Valley Water District; Tranquillity Irrigation District; Turner Island Water District; West Side Irrigation District; West Stanislaus Irrigation District; Westlands Water District.

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EXHIBIT B

DETAILED COMMENTS REGARDING DRAFT EIS

I. RECLAMATION NEEDS TO REEVALUATE ITS OBLIGATIONS ON REMAND

The NEPA review provided in the Draft EIS is inconsistent with the district court's rulings in the *Consolidated Smelt Cases* and *Consolidated Salmonid Cases* and with Reclamation's obligations on remand. In recent years, changes to project operations that purportedly were "necessary" to comply with the ESA have severely impaired the water supply function of the two projects, with disastrous consequences. Reclamation's present NEPA review should therefore be keenly focused on identifying actions it and the Department of Water Resources ("DWR") can take to better serve the water supply purposes of the projects while still meeting the requirements of the ESA. SLDMWA WWD SJRECWA 84

Reclamation's analysis must consider what effect the coordinated operations of the CVP and SWP actually have on species survival and recovery, what measures are proposed to reduce or compensate for such effects, what the data show about the likely efficacy of those measures, and what other effects those measures will cause including through reductions of water supply. That analysis should distinguish between actions that are necessary to comply with the mandates of the ESA (i.e., necessary to avoid jeopardy or adverse modification to critical habitat), and other actions that may provide some additional protection or benefit for listed species, but are not necessary to comply with the ESA. SLDMWA WWD SJRECWA 85

A. Reclamation And The Fisheries Agencies Must Engage In A Fundamental Reanalysis In Performing Concurrent Consultation Under The ESA And Environmental Review Under NEPA

The Draft EIS was prepared in response to rulings by the district court in the *Consolidated Delta Smelt Cases* and *Consolidated Salmonid Cases*. The court found that the existing biological opinions ("BiOps") regarding continued operation of the CVP and SWP are unlawful, and that new biological opinions are required. The court further found that Reclamation violated NEPA when it adopted and implemented major changes to project operations pursuant to those unlawful biological opinions, changes that caused significant adverse effects on the quality of the human environment, without doing any NEPA review. SLDMWA WWD SJRECWA 86

The district court ordered a remand schedule that provides for concurrent re-consultation under the ESA and environmental review under NEPA. Under the remand schedule, the FWS and the National Marine Fisheries Service ("NMFS") (collectively, "fisheries agencies") are required to provide Reclamation with new draft biological opinions, which Reclamation can then use in performing its review under NEPA. This remand schedule is intended to allow an exchange of information between Reclamation and the fisheries agencies, to assist in preparing new biological opinions consistent with the requirements of the ESA and in performing NEPA review.

During remand, Reclamation, FWS, and NMFS must engage in a fundamental reanalysis of the effect of CVP and SWP operations on the listed species, and the necessity for and efficacy of any measures intended to address such effects. Reclamation must now reconsider whether

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and how the continued operations of the CVP and SWP should be modified to ensure compliance with the ESA. Before it can finally decide that issue, Reclamation must complete a new consultation under section 7 of the federal ESA regarding each listed species affected by project operations. Such consultation will require Reclamation and the California Department of Water Resources ("DWR") to prepare a new biological assessment describing the proposed CVP and SWP operations. The proposed project operations will be materially different from the operations described in the 2008 biological assessment. The new biological assessment and new biological opinions must also reflect new scientific data that have become available since 2008. SLDMWA WWD SJRECWA 86 continued

The fisheries agencies must provide new biological opinions regarding whether project operations are likely to jeopardize the listed species, to inform Reclamation's decision as action agency regarding whether its proposed operations meet the requirements of ESA section 7. Reclamation should not have any expectation that after reconsultation the next biological opinions will necessarily be similar to the last biological opinions in their conclusions or in any measures they may impose. The Public Water Agencies submit that a scientifically rigorous analysis of the effects of CVP and SWP operations in accordance with ESA section 7 may well conclude that operations are not likely to jeopardize the listed species or adversely modify their critical habitat.

If NMFS or FWS does issue a jeopardy biological opinion, then the biological opinion must provide a Reasonable and Prudent Alternative to the proposed action, recommending modifications to project operations that are necessary to avoid jeopardy to the species. Reclamation must consider those new opinions, and as action agency make a determination of its ESA obligations. In performing these tasks, all the federal agencies should carefully consider the data and analysis of impacts and alternatives produced through the NEPA process, including new available scientific data and other changes since 2008. The task on remand is not to simply analyze the RPAs of the invalidated BiOps, but rather to analyze anew what, if any, modifications to project operations necessary to avoid jeopardy to the species. Reclamation and the fish agencies must determine if any modifications to project operations are necessary to avoid jeopardy to the species and if so, Reclamation and the fish agencies must develop a reasonable range of modifications to project operations that would avoid jeopardy and also meet the goals of continued project operations.

B. <u>The Scope Of Reclamation's NEPA Review Necessarily Depends On The New ESA Consultation And Any Proposed Modifications To Project Operations</u>

In the *Consolidated Delta Smelt Cases* and *Consolidated Salmonid Cases*, the district court concluded that Reclamation failed to satisfy its obligations under NEPA because it failed to analyze the environmental impacts of proposed modifications to project operations before accepting and implementing those modifications. In the *Consolidated Delta Smelt Cases*, the district court ruled that Reclamation's provisional acceptance and implementation of the 2008 Delta Smelt BiOp and its RPA constituted "major federal action" because those actions represented a significant change to the operational status quo of the coordinated operations of the CVP and SWP. (Memorandum Decision re Cross Motions for Summary Judgment on NEPA Issues (Nov. 13, 2009), Doc. 399 at 33, 42.) SLDMWA WWD SJRECWA 87

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The common thread in both decisions is that Reclamation must analyze under NEPA the potential impacts of any proposal or plan to modify the longstanding and ongoing coordinated operations of the CVP and SWP before making any such changes to CVP and SWP operations pursuant to an ESA section 7 consultation. Thus, the ultimate scope of Reclamation's task under NEPA depends upon the initial outcomes of the ESA section 7 consultation among Reclamation, FWS and NMFS. If, after consultation with FWS and NMFS, Reclamation concludes that project operations will not jeopardize the listed species or adversely modify their critical habitat, then no major changes to the regime governing project operations should be required, and hence there would be no significant effects on the existing human environment triggering the need for an EIS. In that circumstance, an environmental assessment would likely suffice to meet NEPA's requirements. SLDMWA WWD SJRECWA 87 continued

The Draft EIS states that Reclamation:

> prepared this EIS as ordered by the United States District Court for the Eastern District of California (District Court). The reason given by the District Court is to evaluate potential modifications to the continued long-term operation of the CVP, in coordination with the operation of the SWP, before Reclamation accepts and implements Reasonable and Prudent Alternatives (RPAs) included in the biological opinions on long-term operation of the CVP and SWP which will be issued by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) pursuant to the Federal Endangered Species Act.

Draft EIS, at p. 1-1. The Draft EIS also states: "[t]he NEPA process analyzes the effects of modifications to the coordinated long-term operation of the CVP and SWP that are likely to avoid jeopardy to listed species and destruction or adverse modification of designated critical habitat." *Id.* at p. 1-9.

These statements misconstrue Reclamation's task on remand and also make presumptions regarding the results of the on-going section 7 consultation process. The FWS and NMFS have not made any new jeopardy determinations regarding the effects of project operations. Therefore, at this time, Reclamation, FWS, and NMFS have not yet completed the necessary analysis to evaluate the effects of project operations on listed species or to determine whether modifications to project operations are necessary to avoid jeopardy to listed species or adverse modifications to their critical habitat. Reclamation's NEPA analysis should not presume at the outset the answer to the question it is supposed to address.

C. <u>**Reclamation Should Consider How It Will Develop A Thorough And Complete Joint EIS Given The Different Remand Schedules**</u>

SLDMWA WWD SJRECWA 88

Reclamation must complete its ESA consultation and NEPA review by the new deadlines ordered by the district court.[1] These deadlines differ between the two cases. The respective deadlines, assuming the agencies show the progress required by the Court, are:

[1] *See Consolidated Smelt Cases*, Docs. 1106, 884; *Consolidated Salmonid Cases*, Docs. 739, 655.

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Action Item	*Consolidated Delta Smelt Cases*	*Consolidated Salmonid Cases*
Draft BiOp	Transmitted Dec. 14, 2011	Oct. 1, 2017
Draft EIS/NEPA	No deadline set by Court	Within 6 months of receiving draft BiOp
Final EIS/NEPA	Within 61 months of Dec. 14, 2011 [Jan. 14, 2017]	Feb. 1, 2019
Final BiOp	Dec. 1, 2016	Feb. 1, 2019
Record of Decision	Within 61 months of Dec. 14, 2011 [Jan. 14, 2017]	April 29, 2019

SLDMWA WWD SJRECWA 88 continued

It appears from the Draft EIS that Reclamation intends to analyze the effects of any changes to CVP and SWP operations for both the delta smelt and salmonid species in a single EIS. The Public Water Agencies acknowledge there may be benefits to performing a joint NEPA review and analysis of the impacts associated with potential project operations to protect both delta smelt and salmonid species. However, the Public Water Agencies are concerned that the differences between the two remand schedules may make it difficult for Reclamation to prepare an adequate joint EIS. Under the remand schedules set by the court in the two cases, the entire remand process related to delta smelt must be completed by January, 2017, while a draft salmonid biological opinion is not due to be completed until October 1, 2017. Hence, unless Reclamation and NMFS complete the remand required by the judgment in the *Consolidated Salmonid Cases* more quickly than the court's schedule would require, a change in schedule would likely be necessary to accommodate a combined analysis integrating all the listed species. Under no circumstances should the January 2017 deadline in the *Consolidated Smelt Cases* be relied upon as an excuse for preparing a qualitative and superficial NEPA review and analysis related to salmonids.

The remand schedules allow Reclamation, FWS, and NMFS more than adequate time to complete the full analyses required under NEPA and the ESA. The court's requirement that the agencies meet dates certain does not excuse an abbreviated, out-dated or incomplete analysis. Integration of NEPA review and ESA consultation will require "close and careful coordination and cooperation between Reclamation" and the fisheries agencies. Reclamation's NEPA Handbook (Feb. 2012) ("NEPA Handbook"), at p. 3-22.

II. THE "PROPOSED ACTION" NEEDS TO BE IDENTIFIED

SLDMWA WWD SJRECWA 89

The Draft EIS does not clearly identify the "proposed action." The Department of Interior's regulations for implementation of NEPA ("Interior's NEPA Regulations") define the "proposed action" as "the bureau activity under consideration" and the regulations state that the "proposed action" must be "clearly described in order to proceed with NEPA analysis." 43 C.F.R. § 46.30. Interior's NEPA Regulations mandate that an EIS include a "description of the proposed action." 43 C.F.R. § 46.415(a)(2).

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Apparently, Reclamation has not yet decided upon a proposed action. The Draft EIS states:

> Concurrent with preparation of this EIS, Reclamation initiated preparation of the consultation package to be submitted to USFWS and NMFS for the remand of the USFWS BO and the NMFS BO. Information presented in this Draft EIS will be used to inform Reclamation during the development of the Proposed Action that will be submitted as part of the consultation package, which will serve as a biological assessment for the purposes of Section 7 consultation.

Draft EIS, at p. 1-10. This statement suggests that the "proposed action" has yet to be defined because it is still in "development." Reclamation must decide upon a proposed action for the NEPA process. For example, unless and until Reclamation identifies and describes the "proposed action" it is difficult to imagine how Reclamation can develop a reasonable range of alternatives to the proposed action.

The Draft EIS describes the development of the "2013 Project Description" but fails to include the "2013 Project Description." Draft EIS, at pp. 3-4 – 3-6. Nor does the Draft EIS otherwise describe or define the "proposed action" that is being analyzed in the Draft EIS. Under the description of "Alternative 2", the Draft EIS states: "[t]he Notice of Intent identified a "preliminary proposed action" that would include the 2013 Project Description actions and the operational components of the RPAs in the USFWS BO and NMFS BO." Draft EIS, at p. 3-22. It is unclear from this statement whether "Alternative 2" is considered the "proposed action." It would be improper to include the RPAs of the invalidated BiOps in the proposed action. Reclamation does not yet know the outcome of re-consultation, and should not presume at this point that *any* reasonable and prudent alternatives are needed to avoid jeopardizing the continued existence of listed species or the adverse modification of designated critical habitat. Furthermore, many of the specific components of the 2008 FWS and 2009 NMFS RPAs were found unlawful, and hence are poor candidates for inclusion in a proposed action.

The Public Water Agencies submit that a scientifically rigorous analysis of the effects of CVP and SWP operations may well conclude that those operations do not jeopardize the listed species or adversely modify their critical habitat. Accordingly, the Public Water Agencies suggest that for NEPA review Reclamation define the proposed action as the continued operation of the projects, including existing, valid regulatory requirements, subject to lawful requirements of the incidental take statements in new biological opinions, without major changes to project operations imposed under the ESA. Ultimately, of course, Reclamation's decision regarding the action necessary to meet its ESA obligations must be informed by the outcome of the pending re-consultations.

III. THE STATEMENTS OF "PURPOSE" AND "NEED" SHOULD BE REVISED

SLDMWA WWD SJRECWA 90

An environmental impact statement must contain a statement of "purpose and need" which briefly specifies "the underlying purpose and need to which the [lead] agency is responding in proposing the alternatives including the proposed action." 40 C.F.R. § 1502.13. The purpose and need statement "is a critical element that sets the overall direction of the process

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and serves as an important screening criterion for determining which alternatives are reasonable." NEPA Handbook at 8-5. This statement of purpose and need is important because it will inform the range of alternatives ultimately selected for analysis in the environmental impact statement and "[a]ll reasonable alternatives examined in detail must meet the defined purpose and need." *Id.*

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The Department of the Interior's NEPA regulations provide that in "some instances it may be appropriate for the bureau to describe its 'purpose' and its 'need' as distinct aspects. The 'need' for the action may be described as the underlying problem or opportunity to which the agency is responding with the action. The 'purpose' may refer to the goal or objective that the bureau it trying to achieve, and should be stated to the extent possible, in terms of desired outcomes." 43 C.F.R. § 46.420(a)(1). The Public Water Agencies appreciate Reclamation's efforts to develop separate "purpose" and "need" statements in the Draft EIS. However, the existing purpose and need statements should be revised, as described below.

Statement of Purpose

The Draft EIS describes the "purpose" of the action as follows:

> to continue the operation of the Central Valley Project (CVP), in coordination with operation of the State Water Project (SWP), to meet the authorized purposes of the CVP and SWP in a manner that is similar to recent historical operations with certain modifications and that: [1] Is consistent with Federal Reclamation law; other Federal laws; Federal permits and licenses; State of California water rights, permits, and licenses; and contractual obligations; and [2] Avoids jeopardizing the continued existence of federally listed species and does not result in the destruction or adverse modification of designated critical habitat in accordance with the requirements of section 7(a) (2) of the Federal Endangered Species Act (ESA) and other applicable statutes.

Draft EIS, at p. 2-1.

Compliance with the ESA should not be included in the purpose of the proposed action. Instead, in the context here, providing water supply as fully as possible while still complying with the ESA gives rise to the *need* for the action. The "underlying problem" that Reclamation is responding to is the difficulty both projects have had in serving water supply and other project purposes while complying with the ESA. Here, the *purpose* of the action, the "goal or objective" expressed in terms of "desired outcomes," should be to continue long-term operation of both the CVP and SWP in a manner that will enable Reclamation and the DWR to satisfy their contractual and other obligations to the fullest extent possible. Importantly, those obligations include optimizing water deliveries to CVP and SWP contractors up to contract amounts, to help meet the needs of 25 people and millions acres of agricultural land.[2]

[2] That obligation is typically found in Articles 11(a) and 12(a) of the CVP water service contracts.

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Statement of Need

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The Draft EIS describes the "need" for the action as follows:

> Continued operation of the CVP is needed to provide river regulation, improvement of navigation; flood control; water supply for irrigation and domestic uses; fish and wildlife mitigation, protection, and restoration; fish and wildlife enhancement; and power generation. The CVP facilities also are operated to provide recreation benefits and in accordance with the water rights and water quality requirements adopted by the State Water Resources Control Board. *However, as was detailed in Chapter 1, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service concluded in their 2008 and 2009 biological opinions, respectively, that recent historical coordinated operation of the CVP and SWP does not comply with the requirements of section 7(a) (2) of ESA. Thus, modifications to the coordinated long-term operation of the CVP and SWP are required.* Modifications to be evaluated should be consistent with the intended purpose of the action, within the scope of the Department of the Interior, Bureau of Reclamation's legal authority and jurisdiction, economically and technologically feasible, and in compliance with the requirements of section 7(a) (2) of ESA.

Draft EIS, at p. 2-1, italics added.

This statement of need presumes that "modifications to the coordinated long-term operation of the CVP and SWP are required," based on the conclusions of the two biological opinions the district court found to be fundamentally defective, and which will be superseded by new biological opinions after completion of re-consultation. This is a serious and fundamental defect in the framework of the Draft EIS that renders it inadequate and unlawful. The Public Water Agencies reject any suggestion that the conclusions of the existing biological opinions regarding effects on listed species are a legitimate starting point for the NEPA process or the new consultations. Those biological opinions and their reasonable and prudent alternatives were remanded because they were not based on the best available science and were otherwise unsupportable and unjustified. Therefore, it is contrary to the court's prior rulings for Reclamation to rely on the conclusions and analyses of the invalidated BiOps for the presumption that modifications to project operations "are required." The impacts of project operations on protected species and whether modifications of project operations are necessary to avoid jeopardy to those species are precisely the issues that must be reevaluated on remand and Reclamation cannot properly rely on the prior conclusions of the invalidated BiOps to frame its NEPA analysis.

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IV. THE DEVELOPMENT AND DESCRIPTION OF POTENTIAL ALTERNATIVES NEEDS TO BE IMPROVED

A. The "No Action Alternative" Must Be Revised

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An environmental impact statement must "[i]nclude the alternative of no action." 40 C.F.R. § 1502.14(d). According to Reclamation's NEPA Handbook, "'[n]o action' represents a projection of current conditions and reasonably foreseeable actions to the most reasonable future responses or conditions that could occur during the life of the project without any action alternatives being implemented." NEPA Handbook at 8-8. Moreover,

> [t]he no action alternative should not automatically be considered the same as the existing condition of the affected environment because reasonably foreseeable future actions may occur whether or not any of the project action alternatives are chosen. When the no action alternative is different from the existing condition, as projected into the future, the differences should be clearly defined. Differences could result from other water development projects, land use changes, municipal development, or other actions. "No action" is, therefore, often described as "the future without the project."

Id.

The Draft EIS states:

> [f]or this EIS, the No Action Alternative is based upon the continued operation of the CVP and SWP in the same manner as occurred at the time of the publication of the Notice of Intent in March 2012. Thus the No Action Alternative consists of the 2013 Project Description as modified by the RPAs in the USFWS BO and NMFS BO because Reclamation provisionally accepted the BOs in 2008 and 2009, respectively, and is implementing the RPAs; and the District Court did not stay or vacate the implementation of the BOs.

Draft EIS, at p. 3-7. This description of the no action alternative is inconsistent with the district court's rulings regarding Reclamation's failure to comply with NEPA, and will result in an EIS that fails to comply with law.

The Draft EIS's no action alternative essentially pretends that the litigation that resulted in the remand never happened. The district court ruled that Reclamation violated NEPA by significantly modifying project operations to meet ESA requirements without first performing NEPA analysis of the impacts of such modifications or alternatives to such modifications. To remedy the error found by the court, Reclamation must place itself back in the position it was in before that error occurred (i.e. before provisionally adopting the BiOps without performing any NEPA analysis). Accordingly, in order to respond to the court's ruling on remand, here the "no

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action" alternative should be defined to include operations consistent with Reclamation's and DWR's obligations and all legal requirements *except* any ESA-related requirements that involve major changes to operations. Under this definition of "no action," project operations would continue in compliance with other regulatory requirements (e.g., D-1641 as modified by applicable laws, including Wilkins Slough requirements, FERC license requirements, American River in-river flow requirements, etc.). Comparing this no action alternative to the action alternatives developed during the NEPA and ESA consultation processes will provide the most comprehensive and appropriate disclosure of the environmental impacts of the various action alternatives to comply with ESA requirements.[3]

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Treating the invalidated BiOps as any part of the "no action alternative" is a highly inadvisable course of action, because that would not cure the NEPA violation found by the district court. It would instead contradict the district court's ruling, because the NEPA analysis then would not measure and disclose the impacts of changes to CVP and SWP operations to comply with the ESA. And it would defeat the purpose of the no action alternative—to provide a meaningful comparative scenario with which to gauge the impacts of the action alternatives. To comply with the judgments in the *Consolidated Smelt Cases* and *Consolidated Salmonid Cases*, the no action alternative must be revised.

B. <u>The "Second Basis Of Comparison" Needs To Be Revised</u>

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The Public Water Agencies appreciate Reclamation's efforts to provide a "Second Basis of Comparison" for comparing the environmental consequences of the alternatives, as a response to our concerns about the no action alternative. However, the true remedy is to correctly define the no action alternative in the first place. That would eliminate the need for a "second basis of comparison."

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We found the description and use of the "Second Basis Of Comparison" in the Draft EIS somewhat confusing. It is not a remedy for the defects in the no action alternative, because it still includes actions based on the invalidated BiOps. As we understand it, t does not provide a basis for comparison to project operations consistent with Reclamation's and DWR's obligations and all legal requirements *except* requirements related to the ESA.

The Draft EIS states:

> [n]umerous scoping comments requested that the No Action Alternative not include the RPAs in the USFWS BO and NMFS BO. The comments indicated that the EIS should include a "basis of comparison" for the alternatives that was similar to conditions prior to implementation of the RPAs in the USFWS BO and

[3] The situation here is unlike most other circumstances where NEPA review is performed, because the CVP and SWP were constructed and operating before NEPA and the ESA were even enacted. Thus, the "no action" alternative, which usually serves as the baseline for evaluating the significance of environmental impacts of action alternatives, is more complicated. The existing projects including operations must be captured in the "no action" baseline so they are not included in the new effects of the action alternatives. For this reason, a hypothetical "no action" alternative that fails to account for current and previous operations of the projects would be an improper baseline for comparative analysis. *See American Rivers v. Federal Energy Regulatory Comm.*, 187 F.3d 1007 (9th Cir. 1999).

SLDMWA WWD SJRECWA 94 continued

> NMFS BO, and consistent with the 2011 Project Description. Scoping comments also indicated that a "No Action Alternative scenario" without implementation of the RPAs in the USFWS BO and NMFS BO could be used to analyze the effects of implementing the RPAs.
>
> Because the RPAs were provisionally accepted and the No Action Alternative, by definition, represents a continuation of existing policy and management actions, the No Action Alternative must include the RPAs. However, in response to scoping comments and to provide a basis for comparison of the effects of implementation of the RPAs (per the District Court's mandate), this EIS includes a "Second Basis of Comparison" that does not include implementation of the RPAs. The Second Basis of Comparison can be used as a basis of comparison for the alternatives that do not include the RPAs. In this way, the action alternatives can be compared against both the No Action Alternative and the Second Basis of Comparison.

Draft EIS, at p. 3-21. For the reasons articulated above, the Public Water Agencies disagree that the no action alternative must include the invalidated RPAs. Instead, that would be inconsistent with the court's NEPA rulings.

If Reclamation adopts the "Second Basis Of Comparison" as its no action alternative, it should revise it to eliminate any actions taken in response to the invalidated BiOps and RPAs. The "Second Basis Of Comparison" includes the following existing "Fisheries and Aquatic Habitat Restoration Actions" that are "similar to actions identified in the RPAs for several ongoing programs:"

- Clear Creek flow management, gravel augmentation, Spring Creek Temperature Control Curtain, Clear Creek thermal stress reduction, and fisheries studies (similar to NMFS BO RPA Action I.1).
- Restore Battle Creek for winter-run and spring-run Chinook salmon and Central Valley steelhead (similar to NMFS BO RPA Action I.2).
- Funding for CVPIA Anadromous Fish Screen Program (similar to NMFS BO RPA Action I.5).
- Lower American River Flow Management, temperature management, temperature control devices in Folsom Lake and Lake Natoma, and minimization of flow fluctuation effects (similar to NMFS BO RPA Action II.1, II.2, II.3, and II.4).
- Measures to reduce the likelihood of entrainment or salvage at the Delta export facilities, modifications of the operation and infrastructure of the CVP and SWP fish collection facilities, and formation of a technical advisory team to address these issues (similar to NMFS BO RPA Action IV.3, IV.4, and IV.5).

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Draft EIS, at pp. 3-21 – 3-22. If the intent of the Second Basis Of Comparison is to provide a basis of comparison "that does not include implementation of the RPAs" then the Second Basis Of Comparison should not include actions under programs that are being implemented in response to, and in lieu of, the invalidated RPAs. Draft EIS, at p. 3-21. The purpose of the no action alternative is to inform the public and policy makers of what conditions would be like without major ESA-related restrictions on project operations. The existing Second Basis Of Comparison improperly assumes that modifications to project operations are necessary to avoid jeopardy and includes certain existing actions that are dependent on the invalidated BiOps' jeopardy determination.

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C. <u>The Draft EIS Inadequately Describes The Criteria Used To Select The Alternatives And Fails To Present A Reasonable Range Of Alternatives</u>

Criteria Used To Develop And Select Alternatives

Reclamation's NEPA Handbook recommends that presentation of alternatives begin with a "[g]eneral discussion of the basis for the selection of alternatives (linkage between underlying purpose and need for action and alternatives)." NEPA Handbook, at p. 8-7. NEPA requires that all federal agencies, to the fullest extent possible, "study, develop and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E). Federal agencies must to the fullest extent possible "[u]se the NEPA process to identify and assess reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment" and to use all practicable means to "avoid or minimize any possible adverse effects of their actions upon the quality of the human environment." 40 C.F.R. § 1500.2(e), (f). Agencies must "rigorously explore and objectively evaluate all reasonable alternatives" and explain why any alternatives were eliminated from detailed consideration. 40 C.F.R. § 1502.14. Reasonable alternatives are those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action." 43 C.F.R. § 46.420.

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"Each action alternative should address the purpose of and need for the action . . .." NEPA Handbook, at p. 8-9. Here, as discussed above, the purpose is to continue long-term operation of both the CVP and SWP in a manner that will serve the authorized purposes of the projects as fully as possible. Those purposes include supplying water to help meet the needs of 25 million people and millions acres of agricultural land. The need for the action arises from the difficulty both projects have had in serving the water supply and other purposes while complying with the ESA. Reclamation is required to rigorously explore a variety of alternatives. The alternatives should allow for adequate water deliveries and prevent significant impacts to public health and the human environment, and also explore various methods to sufficiently maintain and protect the listed species and their critical habitats.

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The Draft EIS states:

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> [t]his EIS evaluates a range of alternatives for the coordinated long-term operation of the Central Valley Project (CVP) and the State Water Project (SWP). The alternatives were developed based upon comments received during the scoping process; review of the "2011 Project Description" submitted by Department of the Interior, Bureau of Reclamation (Reclamation) to the U.S. Fish and Wildlife Service (USFWS), as part of the consultation package and as described below; review of the 2008 USFWS Biological Opinion (USFWS BO) and the 2009 National Marine Fisheries Service (NMFS) Biological Opinion (NMFS BO) Reasonable Prudent Alternatives (RPAs); and comments received from stakeholders and interested parties on the "2011 Project Description."

Draft EIS, at p. 3-1. This statement reveals that Reclamation has relied primarily on comments received from stakeholders and interested parties, along with the invalidated BiOps' RPAs, to develop the alternatives presented in the Draft EIS. Such an approach is inadequate. Reclamation must articulate the criteria used in developing the alternatives and provide a link between the purpose and need of the proposed action and the alternatives selected for detailed review.

The Draft EIS further describes the process employed for identifying a "reasonable range of alternatives" as follows:

> The range of potential alternatives identified during the scoping process and through the review of the 2011 Project Description was compared to the purpose and need of the project and to whether the potential alternative would address one or more significant issues. As described above, due to the nature of the project to continue the coordinated long-term operation of the CVP and SWP, most of the comments addressed changes to portions of the RPAs or the 2011 Project Description and did not propose complete alternatives. Therefore, the range of potential changes was evaluated to define the reasonable range of alternatives to be evaluated in this EIS.

Draft EIS, at p. 3-7. While this statement appears to articulate the criteria employed by Reclamation in developing a "reasonable range" of alternatives, the Draft EIS fails to articulate whether and how the selected alternatives meet the purpose and need of the project. In addition, it is unacceptable for Reclamation to develop alternatives simply based on comments received because the alternatives are supposed to be developed based on a new analysis of project operations, the effects of project operations on listed species, and whether modifications to project operations are necessary. It is Reclamation's responsibility to develop such information and analysis and to develop a reasonable range of alternatives—not the responsibility of stakeholders and interested parties.

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Reasonable Range Of Alternatives

The Draft EIS acknowledges that the "range of alternatives" required to be analyzed under NEPA "includes all reasonable alternatives, which must be rigorously explored and objectively evaluated." Draft EIS, at p. 3-1. The DOI adopted additional regulations which state that "[t]he range of alternatives includes those reasonable alternatives (43 CFR 46.420(b)) that meet the purpose and need of the proposed action, and address one or more significant issues (40 CFR 1501.7(a)(2–3)) related to the proposed action…" 43 C.F.R. 46.415(b). "When there are a very large number of potential alternatives, a reasonable number of alternatives covering the full spectrum of reasonable alternatives can be identified for detailed analyses in the NEPA document (43 CFR 46.420(c))." Draft EIS, at p. 3-6. Reclamation, as the lead agency for NEPA purposes, has "the ultimate responsibility to determine the appropriate range of alternatives." NEPA Handbook, at p. 8-9. "Where substantial controversy may exist concerning the range selected, the criteria used to limit the alternatives should be explicitly defined by Reclamation and logically supported." *Id.* SLDMWA WWD SJRECWA 96

The Draft EIS presents only four alternatives for "detailed" study. Draft EIS, at pp. 3-22 – 3-29.[4] "Alternative 1" is described as "identical to the Second Basis of Comparison." *Id.* at p. 3-22. "Alternative 2" includes the 2013 Project Description, the operational components of the RPAs of the invalidated BiOps, and existing fisheries and aquatic habitat restoration actions that "are similar to actions identified in the RPAs for several ongoing programs." "Alternative 2" does not include:

> actions related to ecosystem restoration (NMFS BO RPA Actions I.6 and USFWS BO RPA Action 6) in the Yolo Bypass, Cache Slough, Delta, or Suisun Marsh except as may occur under ongoing projects not related to the BOs. Alternative 2 does not include actions to reduce migratory delays or losses in Yolo Bypass (NMFS BO RPA Actions I.7), ecosystem restoration in the Stanislaus River watershed (NMFS BO RPA Actions III.2), fish passage at CVP dams (NMFS BO RPA Action V), or genetic management at Nimbus and Trinity River Fish Hatcheries (NMFS BO RPA Action II.6) **(Same as Second Basis of Comparison and Alternative 1)**.

Draft EIS, at pp. 3-22 -3-23. "Alternative 3" includes the 2013 Project Description and an "Expanded Period for Water Transfers through the Delta and Increased Annual Volume of Water." *Id.* at p. 3-23. In addition, "Alternative 3" is described as including "some of the actions included in the RPAs" in the invalidated BiOps "that would not effect Delta exports[,]" such as fisheries and habitat restoration actions. *Id.* at pp. 3-23 – 3-24. "Alternative 3" also includes the following restoration actions that are not addressed in the RPAs of the invalidated BiOps:

- Fish passage from the western Delta to the San Joaquin River using trap and haul techniques.

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[4] For ease of reference, the Draft EIS's presentation of the Action Alternatives is attached hereto as Exhibit C.

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- Establishment of high catch limits for bass and pike minnow.
- Acceleration of the completion of facilities to reduce nutrients discharged from wastewater treatment plants sooner than required under existing SWRCB requirements.

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Draft EIS, at p. 3-24 – 3-25. "Alternative 4" is described as providing changes "to long-term operation of the CVP and SWP that would reduce the frequency of reverse flows in the south Delta, increase Delta outflow, and reduce the amount of San Joaquin River flows diverted at the CVP and SWP south Delta intakes." *Id.* at p. 3-25. The Draft EIS then describes how "Alternative 4" differs from the "No Action Alternative" with respect to CVP and SWP operations. *Id.* "Alternative 4" also includes the fisheries and aquatic restoration actions identified in the RPAs of the invalidated BiOps. *Id.* at p. 3-26.

These four action Alternatives do not represent a "reasonable range" of alternatives. The Draft EIS fails to explain how each of the alternatives meets the purpose and need for the action (i.e. continued project operations that avoid jeopardy and adverse habitat modification) and fails to articulate why these particular Alternatives were selected. Reclamation needs to develop a range of alternatives that meet the purpose and need for the action and that reduce one or more significant impacts as compared to the other alternatives. It is unreasonable for Reclamation to largely rely on the invalidated BiOps' RPAs and the viewpoints of stakeholders as the primary basis for developing the range of alternatives. Cobbling and tweaking the RPAs of the invalidated BiOps will not suffice to meet Reclamation's NEPA obligations on remand.

V. THE "QUALITATIVE" ANALYSIS OF POTENTIAL ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES IS FUNDAMENTALLY INADEQUATE

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An EIS's discussion of environmental consequences "forms the scientific and analytical basis" for comparing the environmental impacts of the proposed action and the alternatives. 40 C.F.R. § 1502.16. One of the purposes of NEPA is to ensure that "environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality." 40 C.F.R. § 1500.1(b). An EIS must provide "full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." 40 C.F.R. § 1502.1. NEPA requires that all federal agencies, to the fullest extent possible, "utilize a systematic, interdisciplinary approach which will insure the integrated use of natural and social sciences" and "initiate and utilize ecological information in the planning and development of resource-oriented projects" 42 U.S.C. § 4334(2)(A), (H).

A. The Qualitative Analysis Is Unjustified And Contrary To NEPA

The "qualitative" analysis provided in the Draft EIS fails to provide the information and analysis necessary to evaluate and compare the environmental consequences of the action alternatives. Reclamation's NEPA Handbook states that the "impacts of each alternative should be quantified and analyzed separately in an organized and logical manner." NEPA Handbook, at p. 8-14. The Draft EIS states: "[t]his EIS qualitatively assesses the potential impacts of changes on . . . resources which could result from implementation of each of the alternatives as compared

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to the No Action Alternative and the Second Basis of Comparison." Draft EIS, at pp. 4-2 – 4-3. Such a qualitative analysis fails to meet Reclamation's obligations under NEPA. SLDMWA WWD SJRECWA 97 continued

The Draft EIS's justification for the "qualitative" analysis is as follows:

> Many of the provisions of the RPAs, as set forth in the 2008 USFWS BO and the 2009 NMFS BO, or as they may be modified in the forthcoming biological opinions as required by the District Court's remand, require further study, monitoring, further consultation, implementation of adaptive management programs, and subsequent environmental documentation for future facilities to be constructed and/or modified, as described in Chapter 3, Description of Alternatives. Because the results of these studies are not presently known, specific actions and specific responses to those actions also are not known at this time. Therefore, this EIS assumes the completion of future actions, including provisions of the RPAs, in a manner that would be consistent with ESA and does not address impacts during construction or start-up phases of these actions. The analysis of environmental consequences in this EIS is conducted in a qualitative manner with consideration of a range of probable long-term effects of the alternatives as compared to the No Action Alternative.

Draft EIS, at p. 1-9. This statement reveals that Reclamation made no effort to quantify the environmental consequences of the action alternatives, despite its obligation and ability to do so.

B. <u>Reclamation Must Obtain The Information Necessary To Analyze The Environmental Consequences Or Disclose Any Incomplete Or Unavailable Information That Cannot Be Obtained</u>

"The EIS analysis is not limited to readily available information. If information exists that is relevant to a potentially significant adverse impact, that information should be included in the analysis." NEPA Handbook, at p. 8-16. Reclamation's Handbook states "Reclamation will obtain the information necessary to fully evaluate all reasonably foreseeable, significant adverse impacts in NEPA documents, unless the information cannot be obtained because the costs are too great or the means of getting it are not available." NEPA Handbook, at p. 3-15. It may be that despite more rigorous analysis there will still be substantial scientific uncertainty regarding the likely environmental consequences of various alternatives. When Reclamation is "evaluating the reasonably foreseeable significant adverse effects on the human environment in [the EIS] and there is incomplete or unavailable information," it is required to "always make clear that such information is lacking." 40 C.F.R. § 1502.22. SLDMWA WWD SJRECWA 98

The NEPA Handbook provides guidance regarding NEPA analysis in the absence of information, as follows:

> When the agency is evaluating reasonably foreseeable adverse impacts, and there is incomplete or unavailable information, the

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> agency shall make clear that such information is lacking. Every effort should be made to collect all information essential to a reasoned choice between alternatives. If the information relevant to a reasoned choice cannot be collected because of exorbitant cost or because no means exists to gather the information (i.e., it does not exist, or there is no way to get it), the agency shall, in the EIS: [1] State that such information is incomplete or not available [2] Indicate the relevance of the incomplete or unavailable information to reasonably foreseeable adverse impacts [3] Include a summary of existing credible scientific evidence relevant to the foreseeable adverse impact [4] Include an evaluation of the reasonably foreseeable adverse impact, based upon theory or research methods generally acceptable to the scientific community[.]

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NEPA Handbook, at p. 8-16.

Thus, at a bare minimum, if the relevant incomplete information "cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known," Reclamation must include a statement in the EIS explaining the nature of such information, its relevance, a summary of existing credible scientific evidence, and Reclamation's evaluation of potential impacts based on approaches or methods generally accepted in the scientific community. 40 C.F.R. § 1502.22(b); NEPA Handbook, at p. 3-15. The Draft EIS does not meet these requirements.

C. Reclamation Has Access To Sufficient Modeling Tools And Scientific Information To Perform A More Detailed Quantitative Analysis Of Environmental Impacts

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Complete and perfect information is not necessary to perform a more detailed quantitative analysis of the environmental consequences of the action alternatives. Reclamation is obligated to try to obtain new information, and use existing information, to evaluate the environmental consequences of the action alternatives. For example, with respect to water supply impacts, Reclamation can utilize the CALSIM II model to assess the water supply impacts associated with any proposed modifications to the CVP and SWP operations. In fact, many of the RPA actions in the invalidated BiOps are already incorporated into the CALSIM II model and the current CALSIM II model could be used to simulate water supply impacts associated with those RPA actions.[5] Reclamation must make every effort to disclose and quantify the water supply impacts associated with any project Alternatives which include modifications to project operations. This may require Reclamation to make certain assumptions regarding operational criteria, water year type, and periodic hydrology to generate information that represents the probable range of water supply impacts for a particular Alternative. However, perfect information should not be the guiding principle in seeking to disclose the likely environmental consequences of a particular action Alternative. More information to inform the public and policymakers of the choices and trade-offs among alternatives, even if it is not perfect

[5] *See* Department of Water Resources, The State Water Project Reliability Report 2009 (Aug. 2010), Appendices A-1, A-2 [describing incorporation of BiOps' RPA actions into CALSIM II model].

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information, should be the goal. A lack of perfect information is not a valid excuse for performing only a qualitative analysis. SLDMWA WWD SJRECWA 99 continued

With respect to impacts to fisheries resources, Reclamation can use existing scientific information to establish parameters for measuring ecological effects and values. The CEQ Regulations require each agency to "[i]dentify environmental effects and values in adequate detail so they can be compared to economic and technical analyses." 40 C.F.R. § 1501.2(b). For example, Reclamation could use existing scientific information to define habitat characteristics and ecological values that support fish populations and then evaluate how the project Alternatives impact those characteristics and values. The expected benefits or impacts of particular project Alternatives should then be described in detail so that they can be compared to other project Alternatives. In addition, to the extent Reclamation wishes to include Alternatives which rely on adaptive management, Interior's NEPA Regulations provide a framework for analyzing the environmental consequences of an adaptive management approach.[6]

While the impacts to water supply resources and fisheries resources are particularly important, Reclamation should reevaluate its analytical approach for assessing environmental impacts to all of the resource categories.

D. **A More Detailed Quantitative Analysis Is Needed To Allow Meaningful Comparison Among Alternatives**

One of the key values of an environmental impact statement is its ability to inform the public and decision-makers of the relative environmental and socioeconomic costs and benefits of each alternative, including the no action alternative. An environmental impact statement does so by including information and analyses that allow and provide a comparative assessment of the environmental impacts or benefits among these alternatives. Accordingly, the Draft EIS must provide a comparison of the benefits and/or impacts of each alternative on all the various resource categories. Because part of the purpose and need entails ESA compliance by operating the projects to avoid jeopardizing the species or adversely modifying their critical habitats, it is critical that the Draft EIS at a minimum provide analyses and descriptions for the no action alternative and the various other alternatives of the estimated increase or decrease in: (1) the numbers of individuals of each species, (2) the estimated population viability of the listed species, and (3) the amount or quality of their critical habitats. This is not an exhaustive list, and Reclamation should determine if other biological metrics would also be useful and appropriate. Because maintaining the projects' water supply reliability is a key aspect of the purpose and need, Reclamation should provide a commensurate level of analysis and detail regarding the degree to which each alternative would impair the ability of the CVP and SWP to serve their water supply functions. The alternatives analysis should allow a comparison that informs what SLDMWA WWD SJRECWA 100

[6] The Interior's NEPA Regulations state: "Bureaus should use adaptive management, as appropriate, particularly in circumstances where long-term impacts may be uncertain and future monitoring will be needed to make adjustments in subsequent implementation decisions. The NEPA analysis conducted in the context of an adaptive management approach should identify the range of management options that may be taken in response to the results of monitoring and should analyze the effects of such options. The environmental effects of any adaptive management strategy must be evaluated in this or subsequent NEPA analysis." 43 C.F.R. § 46.145.

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biological benefits are expected to be gained from proposed measures, and the relative costs of such benefits to other uses of the water resources involved.

In its current form, the Draft EIS fails to provide adequate information or analysis to evaluate and compare the environmental consequences of the project Alternatives.

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EXHIBIT C

PUBLIC WATER AGENCIES' NEPA SCOPING COMMENT LETTER

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COPY

San Luis & Delta-Mendota Water Authority
P.O. Box 2157
Los Banos, CA 93635
Phone: (209) 826-9696
Fax: (209) 826-9698

State Water Contractors, Inc.
1121 L St., Suite 1050
Sacramento, CA 95814
Phone: (916) 447-7357
Fax: (916) 447-2734

Westlands Water District
3130 N. Fresno Street
P.O. Box 6056
Fresno, CA 93703-6056
Phone: (559) 224-1523
Fax: (559) 241-6277

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June 28, 2012

BY U.S. MAIL, FAX TO (916) 414-2439, & EMAIL TO JPINERO@USBR.GOV

Janice Piñero
Endangered Species Compliance Specialist
Bureau of Reclamation, Bay-Delta Office
801 I Street Suite 140
Sacramento, CA 95814-2536

Re: Notice of Intent and Scoping under the National Environmental Policy Act on Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project and State Water Project

Dear Ms. Piñero:

The State Water Contractors ("SWC"), San Luis & Delta-Mendota Water Authority ("SLDMWA"), and Westlands Water District ("Westlands") (collectively, "Public Water Agencies") appreciate the opportunity to comment in response to the Bureau of Reclamation's ("Reclamation") notice of intent to prepare an environmental impact statement ("EIS") and notice of scoping meetings, published in the Federal Register on March 28, 2012 ("NOI"). SLDMWA WWD SJRECWA 102

The NOI comes in response to rulings by the United States District Court in the *Consolidated Delta Smelt Cases* and *Consolidated Salmonid Cases*. The court found that the existing biological opinions regarding continued operation of the Central Valley Project ("CVP") and State Water Project ("SWP") are unlawful, and that new biological opinions are required. The court further found that Reclamation violated the National Environmental Policy Act ("NEPA") when it adopted and implemented major changes to project operations pursuant to those unlawful biological opinions, changes that caused significant adverse effects on the quality of the human environment, without doing any NEPA review.

Reclamation must now reconsider whether and how the continued operations of the CVP and SWP should be modified to ensure compliance with the federal Endangered Species Act ("ESA"). Before it can finally decide that issue, Reclamation must complete a new consultation under section 7 of the federal ESA regarding each listed species affected by project operations. Such consultation will require Reclamation and the California Department of Water Resources ("DWR") to prepare a new biological assessment describing the proposed CVP and SWP operations. The proposed project operations will be materially different from the operations SLDMWA WWD SJRECWA 103

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described in the 2008 biological assessment. Among other changes, the description of operations must include implementation of the San Joaquin River Restoration Program, the Bay Delta Conservation Plan, and new Water Quality Objectives related to San Joaquin River flow. In addition, it should include operations allowing greater opportunities to "transfer" water through the Delta. The new biological assessment and new biological opinions must also reflect new scientific data that has become available since 2008. These data include information related to the adverse impacts caused by nutrients discharged from wastewater treatment plants, the adverse, extra-ordinary impacts of predation, the lack of identifiable adverse impact of pumping by the CVP and SWP, and the lack of identifiable adverse impact associated with changes in the location of X2 during the fall months. The changes in operations and additional scientific data will require new analyses of the effects of project operations. The Public Water Agencies submit that these new analyses should ultimately result in significantly different conclusions regarding the effects of CVP and SWP operations on listed species, and a different decision by Reclamation, than occurred in 2008 and 2009.

As far as we are aware, Reclamation has not yet prepared a biological assessment for the consultation. Reflecting the still incomplete ESA consultation process, the NOI does not define a proposed action for NEPA purposes. The NOI suggests that the proposed action may include unspecified specified "operational components" of the existing biological opinions. The proposed action should not, and presumably will not, include components of the existing opinions found to be unlawful. Since the NOI does not identify a proposed action, it logically could not and indeed does not identify any possible alternatives to such a proposed action.

Reclamation is now at the scoping stage of the NEPA process. Scoping is defined in the Council on Environmental Quality ("CEQ") regulations as "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." 40 C.F.R. § 1501.7. Reclamation has already conducted five public scoping meetings. We appreciate Reclamation's addition of the May 22, 2012 public meeting in Los Banos, which allowed interested parties in that region an opportunity to provide direct input regarding issues that should be addressed in any EIS. Likewise we appreciate Reclamation's action in extending the deadline for written comments in response to the NOI to June 28, 2012.

As part of the scoping process, Reclamation must "[d]etermine the scope (§1508.25) and the significant issues to be analyzed in depth in the environmental impact statement." *Id.* "Scope consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement." 40 C.F.R. § 1508.25. The Public Water Agencies hope to work in a cooperative manner with Reclamation to ensure that the planned EIS addresses the significant issues that arise from potential modifications of project operations pursuant to the ESA, and that the EIS document includes an appropriate range of actions, alternatives and related impacts.[1] The incomplete and preliminary information in the NOI regarding the proposed action

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[1] The Public Water Agencies also recognize the close relationship between the NEPA process and the related ESA consultation process. As explained in the Reclamation Stakeholder Engagement Process ("RSEP") for Section 7 ESA Consultation and NEPA Compliance on the Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project and State Water Project, issued June 2, 2012 (p. 2), "Reclamation anticipates a free and complete flow of information between the NEPA and Section 7 consultation processes, with each informing the other."

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necessarily limits the ability of the Public Water Agencies to provide responsive scoping comments here. As the ESA consultation progresses, including particularly preparation of a new biological assessment, Reclamation should likewise be able to define a proposed action and possible alternatives to be included in its NEPA analysis. The Public Water Agencies request an opportunity to provide additional comments when and as Reclamation does so. Reclamation's NEPA analysis ultimately should help foster a workable, environmentally sound plan for continued operations of the CVP and SWP that will minimize adverse socioeconomic and environmental impacts while ensuring legally and scientifically supportable, reasonable, and effective protection mechanisms for the listed species. SLDMWA WWD SJRECWA 103 continued

I. THE STATE WATER CONTRACTORS, SAN LUIS & DELTA-MENDOTA WATER AUTHORITY, AND WESTLANDS WATER DISTRICT

The SWC organization is a nonprofit mutual benefit corporation that represents and protects the common interests of its 27 member public agencies in the vital water supplies provided by California's SWP. Each of the member agencies of the State Water Contractors holds a contract with DWR to receive water supplies from the SWP. Collectively, the State Water Contractors' members deliver water to more than 25 million residents throughout the state and to more than 750,000 acres of agricultural lands. SWP water is served in the San Francisco Bay Area, the San Joaquin Valley and the Central Coast, and Southern California. The complete list of SWC member agencies is set forth in the attached Exhibit A. SLDMWA WWD SJRECWA 104

SLDMWA is a joint powers authority, established under California's Joint Exercise of Powers Act. Gov. Code, § 6500 et seq. SLDMWA is comprised of 29 member agencies, 27 of which held contractual rights to water from the federal CVP. SLDMWA member agencies have historically received up to 3,100,000 acre-feet annually of CVP water for the irrigation of highly productive farm land, primarily along the San Joaquin Valley's Westside, for municipal and industrial uses, including within California's Silicon Valley, and for publicly and privately managed wetlands situated in the Pacific Flyway. The areas served by SLDMWA's member agencies span portions of seven counties encompassing about 3,300 square miles, an area roughly the size of Rhode Island and Delaware combined. The complete list of the San Luis & Delta-Mendota Water Authority's members is set forth in the attached Exhibit A.

Westlands Water District is a member agency of SLDMWA. Westlands is a California water district formed pursuant to California Water Code sections 34000 *et seq*. Westlands holds vested contractual water rights to receive water from Reclamation, through the San Luis Unit of the CVP, for distribution and consumption within areas of Fresno and Kings Counties. Westlands' total contractual entitlement for CVP water under this contract is 1.15 million acre-feet per year. In addition, Westlands holds 43,500 acre-feet of water entitlement in the form of contract assignments from other districts including Broadview Water District, Centinella Water District, Widren Water District, and Oro Loma Water District. Most of this CVP water supply is used for irrigation. Westlands encompasses approximately 600,000 acres, including some of the most productive agricultural lands in the world.

Each of these entities, their member agencies, their customers, and others within their service areas may experience significant adverse impacts as a result of actions that may follow

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from the ongoing ESA consultations. Accordingly, the Public Water Agencies believe it is vital that they participate actively in the NEPA review process, to ensure that such the environmental and socioeconomic impacts its member agencies and customers could experience from any further water limitations are fully disclosed and analyzed, and that policy makers and the public be fully informed regarding the choices to be made. SLDMWA WWD SJRECWA 104 continued

II. COOPERATING AGENCIES

The NOI states that Reclamation has identified State and local agencies "as potential cooperating agencies," and that it "will invite then to participate as such in the near future." In a letter dated August 19, 2011, Commissioner Mike Connor indicated that the SLDMWA and SWC will be deemed cooperating agencies for this NEPA process, with specific responsibilities to be set forth in a memorandum of understanding. In the same letter, Commissioner Connor indicated that the SLDMWA and SWC would be deemed designated non-Federal representatives in the related section 7 consultation. The SLDMWA and SWC look forward to working with Reclamation in these capacities. Including the SLDMWA and SWC in these roles will further the statutorily mandated policy of Section 2(c)(2) of the ESA, which requires federal agencies to "cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species." 16 U.S.C. § 1531(c)(2). In addition, it may be appropriate for other local public agencies that are members of the SLDMWA or SWC to serve as cooperating agencies, including Westlands, The Metropolitan Water District of Southern California, the Kern County Water Agency, and Santa Clara Valley Water District.[2] Several member agencies will be contacting Reclamation regarding cooperating agency status. SLDMWA WWD SJRECWA 105

According to the CEQ's regulations, cooperating agencies, on request from the lead agency, assume responsibilities for developing information and preparing environmental analyses using the cooperating agency's funds. 40 C.F.R. § 1501.6(b)(3), (b)(5). This role is also recognized in Reclamation's NEPA Handbook (Feb. 2012) at section 8.10.2.

As recommended by Reclamation's NEPA Handbook, a Memorandum of Understanding ("MOU") should be negotiated concerning the roles of the Public Water Agencies and perhaps other agencies as cooperating agencies. We therefore request that a timely meeting be scheduled with you and/or other appropriate Reclamation representatives to clarify the scope of involvement in the environmental review as cooperating agencies.

III. RECLAMATION'S TASK ON REMAND FROM THE DISTRICT COURT

The NOI identifies and briefly describes the outcome of litigation as the reason Reclamation is now undertaking NEPA review. (See discussion under heading "II. Why We Are Taking This Action.") In order to frame the parameters of Reclamation's NEPA review, it is useful to briefly recount the district court's rulings and what they require. SLDMWA WWD SJRECWA 106

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[2] The NOI states that the State and Federal Contractors Water Agency may be invited to participate as a cooperating agency. The SWC does not agree that SFCWA should serve as a cooperating agency.

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A. **The ESA Rulings**

First, with respect to the requirements of the ESA, the district court found that both the U.S. Fish and Wildlife Service ("FWS") and the National Marine Fisheries Service ("NMFS") BiOps were arbitrary, capricious, or contrary to law. These flaws were so fundamental that Reclamation should not have any expectation that after reconsultation the next biological opinions will necessarily be similar to the last biological opinions in their conclusions or in any measures they may impose. By way of example, in the *Consolidated Delta Smelt Cases*, the district court found the following errors: SLDMWA WWD SJRECWA 106 continued

- "The BiOp's reliance on analyses using raw salvage figure to set the upper and lower OMR flow limits of Actions 1, 2, and 3 was arbitrary and capricious and represents a failure to use the best available science. Actions 1, 2, and 3 depend so heavily on these flawed analyses that this failure is not harmless." *Consolidated Delta Smelt Cases*, 760 F. Supp. 2d 855, 968 (E.D. Cal. 2010).
- "Comparison of Calsim II to Dayflow model runs created potentially material bias in the BiOp's evaluation of the impacts of Project operations on the position of X2 and related conclusions regarding population dynamics and habitat. FWS's failure to address or explain this material bias represents a failure to consider and evaluate a relevant factor and violates the ESA and APA." *Id.* at 968.
- "The flawed Calsim II to Dayflow comparison fatally taints the justification provided for Action 4." *Id.* at 968.
- "The BiOp has failed to sufficiently explain why maintaining X2 at 74 km (following wet years) and 81 km (following above normal years), respectively, as opposed to any other specific location, is essential to avoid jeopardy and/or adverse modification." *Id* at 969.
- "[T]he analyses supporting the specific flow prescriptions set forth in the RPA are fatally flawed and predominantly unsupported. The BiOp does not justify or explain its attribution to Project operations adverse impacts caused by other stressors." *Id.* at 969.
- "The BiOp completely fails to analyze economic feasibility, consistency with the purpose of the action, and consistency with the action agency's authority demanded by § 402.02. Further analysis in compliance with § 402.02 is required on remand." *Id.* at 970.

Similarly, in the *Consolidated Salmonid Cases*, the district court found, among other flaws:

- "It was clear error and inconsistent with standard practice in the field of fisheries biology for Federal Defendants to rely upon the raw salvage analyses set forth in Figures 6-65 and 6-66 to reach conclusions about the effect of specific levels of negative OMR flows on the Listed Species. None of the alternative record citations or analyses cited by Defendants, including the PTM Modeling Results, or Figures 6-71, 6-72, or 6-73, provide sufficient alternative bases for NMFS's conclusions regarding the negative OMR flows below which loss of juvenile salmonids 'increases sharply.'" *Consolidated Salmonid Cases*, 791 F. Supp. 2d 802, 955 (E.D. Cal. 2011).
- "Federal Defendants' reliance on Figure 6-71 also suffers from the same unjustified use of raw salvage data. Federal Defendants must clarify on remand whether it is possible to scale the CV steelhead data used in Figures 6-72 and 6-73 to population size and, if not,

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why unscaled analyses are nevertheless useful. Federal Defendants must also further explain and/or refine the statistical methodologies used to develop these figures." *Id.* at 955-956.

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- "The record does not support the BiOp's conclusions about the connection between Project operations on the one hand and pollution and/or food limitations on the other. This is not the best available science." *Id.* at 956.
- "[T]he BiOp does not clearly explain the rationale for imposing a 4:1 ratio in above normal and wet years. Particularly in light of the potential adverse consequences of imposing such a ratio, this is unlawful." *Id.* at 957.
- "Likewise, although there is marginal record support for the imposition of some form of OMR flow restriction, Action IV.2.3 must be remanded for further explanation of the necessity for the specific flow prescriptions imposed, which are derived primarily from PTM simulations, a method that is undisputedly an imperfect, if not incompetent, predictor of salmon behavior." *Id.* at 957.
- "Action IV.3 suffers from a similar defect. Although there is record support for some form of action designed to prevent large numbers of fish from being killed or harmed at the export facilities, lawful explanation is required to justify the specific triggers imposed by Action IV.3." *Id.* at 957.
- "Federal Defendants failed to sufficiently explain whether the RPA can be implemented consistent with the co-equal, non-environmental statutory purposes of the action." *Id.* at 957.
- "[W]hile there is anecdotal evidence for some of the general approaches used in these RPA Actions, the specific prescriptions imposed are not sufficiently justified or explained. NMFS acted arbitrarily and capriciously in concluding that Actions IV.2.1, IV.2.3, and IV.3 are essential to avoid jeopardy and/or adverse modification." *Id.* at 957.

In light of these and other serious flaws in the last biological opinions, Reclamation, FWS, and NMFS must engage in a fundamental reanalysis of the effect of CVP and SWP operations on the listed species, and the necessity for and efficacy of any measures intended to address such effects. For their part, FWS and NMFS must do such reanalysis and issue new biological opinions. For its part, Reclamation must consider those new opinions, and make a determination of its ESA obligations. In performing these tasks, all the federal agencies should carefully consider the data and analysis of impacts and alternatives produced through the NEPA process.

Reclamation must prepare a new biological assessment for the new consultations. A new biological assessment is necessary both because of new scientific data and studies that have become available since 2008, and because of changes in current and planned project operations since 2008. Among other recent information, new science since 2008 includes life-cycle models, analyses of ammonium impacts on the food web, and analyses addressing the need for a "fall X2" measure. An example of changed project operations is implementation of the San Joaquin River Restoration Program, which requires the restoration of flows to the San Joaquin River Basin and the reintroduction of spring-run Chinook salmon into the San Joaquin River. Reclamation has already begun modifying the flows that reach the Delta, and reintroduction of spring-run Chinook salmon to the San Joaquin River is scheduled to begin by December 31, 2012.

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The consultation must also consider other, ongoing regulatory and permitting processes that will influence project operations and the affected environment. The BDCP is expected to provide the basis for endangered species permits for, and a biological opinion regarding, in-Delta operations of the SWP and CVP beginning in about 2025. The draft BDCP is scheduled to be released in late 2012 and finalized in 2013. Elements of the BDCP not involving CVP and SWP operations will improve conditions for listed species even before new facilities become operative in 2025. Also, the State Water Resources Control Board ("State Water Board") is in the process of revising its existing Bay-Delta Plan. This revision may include updated or new objectives (e.g. San Joaquin River flow objectives) that could impact project operations. All that and more must be considered in a new biological assessment, and in the new biological opinions. SLDMWA WWD SJRECWA 106 continued

A final issue related to the new consultations is what period of project operations should be included in the consultation. The FWS and NMFS will issue new biological opinions for BDCP that will address in-Delta CVP and SWP beginning in 2025. Those biological opinions will then supersede the biological opinions that result from the reconsultation pursuant to the remand. Accordingly, the Public Water Agencies suggest that the reconsultation, and the related NEPA review, address project operations until in-Delta CVP and SWP operations are covered through the BDCP permits and BDCP-related biological opinions.

B. **<u>The NEPA Rulings</u>**

The district court did not direct what level of NEPA review Reclamation should undertake on remand. In the *Consolidated Delta Smelt Cases* the district court ruled that Reclamation's provisional acceptance and implementation of the 2008 Delta Smelt BiOp and its RPA constituted "major federal action" because those actions represented a significant change to the operational status quo of the coordinated operations of the CVP and SWP. (Memorandum Decision re Cross Motions for Summary Judgment on NEPA Issues (Nov. 13, 2009), Doc. 399 at 33, 42.) The court explained that the "critical inquiry" with respect to the "major federal action" issue is 'whether the BiOp causes a change to the operational status quo of an existing project." (Doc. 399 at 33.) The court concluded that the "RPA will be implemented by altering flow patterns" and "implementing such management actions constitutes a new and unprecedented change in project operations, which will have restrictive impacts that have the potential to be major and adverse." (Doc. 399 at 36, fn. 13.) The court explained that "Reclamation's decision to implement the RPA is a 'revision [of] its procedures or standards' for operating the Jones pumping plant and other facilities significantly affecting OMR flows" and is therefore "major federal action because it substantially alters the status quo of the Projects' operations." (Doc. 399 at 41-42 [alteration in original].) SLDMWA WWD SJRECWA 107

The district court explained that where the "major federal action" component for triggering NEPA is met, "an agency must prepare an EIS 'where there are substantial questions about whether a project may cause degradation of the human environment.'" (Doc. 399 at 42 [quoting *Native Ecosystems Council v. U.S. Forest Serv.*, 428 F.3d 1233, 1239 (9th Cir. 2005)].) The court found it undisputed that "implementation of the RPA reduced pumping by more than 300,000 AF in the 2008-09 water year" and that such reductions in exports from the Delta may place greater demands upon alternative sources of water, including groundwater. (Doc. 399 at

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43.) The court also found the "potential environmental impact of groundwater overdraft is beyond reasonable dispute." (*Id.*) The court concluded that this, in and of itself, "raises the kind of 'serious questions' about whether a project may cause significant degradation of the human environment, requiring NEPA compliance." (Doc. 399 at 44.) The court therefore held that Reclamation must comply with NEPA and that "NEPA applies to Reclamation's acceptance and implementation of the BiOp and its RPA." (*Id.*)

The district court's summary judgment ruling on the NEPA issue in the *Consolidated Salmonid Cases* relied heavily on the analysis contained in the *Consolidated Delta Smelt Cases* NEPA ruling. *Consol. Salmonid Cases*, 688 F. Supp. 2d 1013 (E.D. Cal. 2010). The district court concluded that "Reclamation's operation of the projects to comply with the 2009 Salmonid BiOp RPAs is major federal action under NEPA." *Id.* at 1024. The court concluded that "implementation of the 2009 Salmonid BiOp is not a continuation of the status quo" and "implementation of the RPA constitutes a non-trivial 'revision of procedures or standards' for the operation of the Projects with draconian consequences." *Id.* at 1031, 1032. The court concluded that at the very least, the OMR Flow Restrictions in the RPA constituted "a significant revision to Reclamation's procedures and standards for operating the CVP." *Id.* at 1033. The court found that "it is hard to imagine more significant adverse effect to the human environment than were effectuated by implementation of the RPAs." *Id.* at 1032. The court found that it was undisputed that "the RPA will materially reduce water exports by 5-7 percent, or approximately 330,000 AF" and concluded that it was beyond dispute "that such reductions have the potential to significantly effect the human environment . . ." *Id.* at 1032. The court therefore concluded that there was no dispute that "'there are substantial questions' about whether coordinated operation of the CVP and SWP under the RPAs 'may cause significant degradation of the human environment'" and that "[n]o more is required to trigger NEPA." *Id.* at 1034.

The common thread in both decisions is that Reclamation must analyze under NEPA the potential impacts of any proposal or plan to modify the longstanding and ongoing coordinated operations of the CVP and SWP before making any such changes to CVP and SWP operations pursuant to an ESA section 7 consultation. Thus, the ultimate scope of Reclamation's task under NEPA depends upon the outcome of the ESA section 7 consultation among Reclamation, FWS and NMFS. If after consultation with FWS and NMFS Reclamation concludes that project operations will not jeopardize the listed species or adversely modify their critical habitat, then no major changes to the regime governing project operations should be required, and hence there would be no significant effects on the existing human environment triggering the need for an EIS. In that circumstance, an environmental assessment would likely suffice to meet NEPA's requirements. The NOI indicates that Reclamation has decided to prepare an EIS. That is a discretionary choice NEPA allows, even if upon further analysis the likely environmental impacts are revealed to be minor. Our point here is only that if there are no major changes to CVP and SWP operations, then an EIS likely would not be required.

On the other hand, if the new consultation results in a finding of jeopardizing effect or adverse modification of critical habitat, then Reclamation must consider what reasonable and prudent alternatives ("RPAs") to proposed operations are both necessary and efficacious. If Reclamation concludes that major changes to project operations will be required in order to avoid jeopardizing listed species or adversely modifying their critical habitat, then the scope of

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Reclamation's task to meet NEPA's requirements will increase substantially.[3] The major changes to CVP and SWP operations required by the RPAs in the last biological opinions, for example, resulted in devastating adverse environmental and socioeconomic impacts within the project service areas, including particularly within the west side of the San Joaquin valley. Under the district court's ruling, Reclamation would then be duty bound to consider the impacts from changes in project operations on the quality of the human environment, as well as alternatives that may lessen those impacts while still meeting the requirements of the ESA. That will require an EIS. SLDMWA WWD SJRECWA 107 continued

Although the ultimate scope of the required NEPA review will vary depending upon what changes to project operations, if any, Reclamation decides are needed to meet its obligation under ESA section 7, the NEPA and ESA processes may and should proceed concurrently. *See* 40 C.F.R. § 1502.25(a); 50 C.F.R. § 402.06; NEPA Handbook at 3-21 – 3-23. Based on the NOI, it appears that Reclamation agrees that it may and should begin its NEPA process well before the section 7 consultation is completed. Information developed in the NEPA process should inform and improve the ESA consultations. Likewise, information developed during ESA consultation should be considered for the NEPA process.

C. **Deadlines For Completing Remand**

Reclamation must complete its ESA consultation and NEPA review by deadlines ordered by the district court. These deadlines differ between the two cases. The respective deadlines are: SLDMWA WWD SJRECWA 108

	Consolidated Delta Smelt Cases	*Consolidated Salmonid Cases*
Draft BiOp	Oct. 1, 2011	Oct. 1, 2014
Draft EIS		April 1, 2015
Final EIS	Nov. 1, 2013 (Within 25-months of receiving draft BiOp / RPA)	Feb. 1, 2016
Final BiOp	Dec. 1, 2013	Feb. 1, 2016
Record of Decision		April 29, 2016

These dates were set by the court after consideration of representations by the federal agencies regarding how much time they needed to complete each consultation and related NEPA review.

It appears from the NOI that Reclamation may intend to analyze in a single EIS the effects of any changes to CVP and SWP operations for both the delta smelt and salmonid species. Under the remand schedules set by the court in the two cases, the entire remand process related to delta smelt must be completed by December 1, 2013, while even a draft salmonid biological opinion is not due to be completed until October 1, 2014. Hence, unless Reclamation and NMFS complete the remand required by the judgment in the *Consolidated Salmonid Cases*

[3] We do not address here the obligations of FWS and NMFS under NEPA, as the NOI relates solely to Reclamation's intention to prepare an EIS. The obligations of FWS and NMFS with respect to the existing biological opinions are the subject of ongoing litigation in the Ninth Circuit, and nothing in or absent from this letter should be construed as a waiver of any position regarding the NEPA obligations of those agencies.

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much more quickly than the court's schedule would require, a change in schedule will be necessary to accommodate a combined analysis integrating all the listed species. Depending upon further clarification and discussions with Reclamation, FWS, and NMFS, the Public Water Agencies would consider supporting a change in the remand schedules if reasonably necessary for the purpose of allowing an integrated analysis covering all the listed species. SLDMWA WWD SJRECWA 108 continued

The existing separate remand schedules allow Reclamation, FWS, and NMFS more than adequate time to complete the full analyses required under NEPA and the ESA separately. The court's requirement that the agencies meet dates certain does not excuse an abbreviated, out-dated or incomplete analysis. However, if the federal agencies now believe that either existing schedule would preclude them from doing such full analysis, then the Public Water Agencies are open to discussions with them regarding potential adjustments. Again depending upon further discussions with the federal agencies, the Public Water Agencies would consider supporting an extension of time if and to the extent necessary to do the full analyses required by the ESA and NEPA.

IV. NEPA'S REQUIREMENTS

NEPA has a number of requirements that must be carefully followed in order to be legally compliant with the statute and implementing regulations. We address several of these obligations below, in response to the limited information provided in the NOI. As Reclamation decides upon and reveals more about its intended NEPA review, we will likely have additional comments to provide. SLDMWA WWD SJRECWA 109

A. Purpose And Need

An EIS must contain a statement of "purpose and need" which briefly specifies "the underlying purpose and need to which the [lead] agency is responding in proposing the alternatives including the proposed action." 40 C.F.R. § 1502.13. The purpose and need statement "is a critical element that sets the overall direction of the process and serves as an important screening criterion for determining which alternatives are reasonable." NEPA Handbook at 8-5. This purpose and need are important because they will inform the range of alternatives ultimately selected for analysis in the EIS and "[a]ll reasonable alternatives examined in detail must meet the defined purpose and need." *Id.*

The Department of the Interior's NEPA regulations provide that in "some instances it may be appropriate for the bureau to describe its 'purpose' and its 'need' as distinct aspects. The 'need' for the action may be described as the underlying problem or opportunity to which the agency is responding with the action. The 'purpose' may refer to the goal or objective that the bureau it trying to achieve, and should be stated to the extent possible, in terms of desired outcomes." 43 C.F.R. § 46.420(a)(1).

The NOI states that the "purpose" of the action "is to continue operations of the CVP, in coordination with the SWP, as described in the 2008 Biological Assessment (as modified) to meet its authorized purposes, in a manner that: [1] [i]s consistent with Federal Reclamation law, applicable statutes, previous agreements and permits, and contractual obligations; [2] [a]voids

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jeopardizing the continued existence of federally listed species; and [3] [d]oes not result in destruction or adverse modification of designated critical habitat." 77 Fed. Reg. at 18859. Regarding "need," the NOI mentions only the CVP, stating that continued operation of the CVP is "needed" to "provide flood control, water supply, fish and wildlife restoration and enhancement, and power generation. It also provides navigation, recreation, and water quality benefits." *Id.* The NOI then goes on to observe, however, that coordinated project operations were "found to likely jeopardize the continued existence of listed species and adversely modify critical habitat. *Id.* This is an apparent reference to the conclusions of the two biological opinions the district court found to be fundamentally defective, and which will be superseded by new biological opinions after completion of reconsultation.

The Public Water Agencies believe that in this case, the *purpose* of the action and the *need* for the action are distinct—and, the EIS should reflect that difference. Here, the *purpose* of the action, the "goal or objective" expressed in terms of "desired outcomes," should be to continue long-term operation of both the CVP and SWP in a manner that will enable Reclamation and the DWR to satisfy their contractual and other obligations to the fullest extent possible. Importantly, those obligations include optimizing water deliveries to CVP and SWP contractors up to contract amounts, to help meet the needs of 25 million people and 3 million acres of agricultural land.[4] With population growth, the demands on CVP and SWP supplies will likely increase over time.

Compliance with the ESA should not be included in the purpose of the proposed action. Instead, in the context here, providing water supply as fully as possible while still complying with the ESA gives rise to the *need* for the action. The "underlying problem" that Reclamation is responding to is the difficulty both projects have had in serving water supply and other project purposes while complying with the ESA. In recent years, changes to project operations that purportedly were necessary to comply with the ESA have severely impaired the water supply function of the two projects, with disastrous consequences. Reclamation's present NEPA review should therefore be keenly focused on identifying actions it and DWR can take to better serve the water supply purposes of the projects while still meeting the requirements of the ESA. Reclamation's analysis must consider what effect the coordinated operations of the CVP and SWP actually have on species survival and recovery, what measures are proposed to reduce or compensate for such effects, what the data show about the likely efficacy of those measures, and what other effects those measures will cause including through reductions of water supply. That analysis should distinguish between actions that are necessary to comply with the mandates of the ESA, and other actions that may provide some additional protection or benefit for listed species, but are not necessary to comply with the ESA. The statement of purpose and need should make clear that an action alternative under which operations will comply with the ESA with minimal water supply impacts would be deemed superior to an action alternative under which operations will comply with the ESA but cause substantial water supply impacts. The Public Water Agencies' definition of the purpose and need does so, and will help Reclamation to appropriately focus the proposed action and range of alternatives to be considered in the EIS.

[4] That obligation is typically found in Articles 11(a) and 12(a) of the CVP water service contracts. It is found in Articles 6(b), 6(c) and 16(b) of the standard SWP contract.

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Two statements in the NOI's purpose and need section require additional comment. First, the text states that the purpose of the action is to continue project operations "as described in the 2008 Biological Assessment (as modified)." As stated elsewhere in this letter and in other correspondence with Reclamation, Reclamation must prepare a new biological assessment. We therefore disagree with the NOI to the extent that it implies that no new biological assessment is necessary. Furthermore, DWR and the Public Water Agencies should be permitted to directly and actively participate in the preparation of the biological assessment. Second, as stated elsewhere in this letter and other correspondence, the Public Water Agencies reject any suggestion that the conclusions of the existing biological opinions regarding effects on listed species are a legitimate starting point for the NEPA process or the new consultations. As demonstrated above, those biological opinions and their reasonable and prudent alternatives were remanded because they were not based on the best available science and were otherwise unsupportable and unjustified. SLDMWA WWD SJRECWA 109 continued

B. **Affected Environment**

To fulfill its NEPA duties, Reclamation must also provide a description of the affected environment. Reclamation is required to "succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration." 40 C.F.R. § 1502.15. This discussion should include "a general description of the physical environment of the project area and a map defining the project area, the associated ecosystem(s), and the affected environment." NEPA Handbook at 8-13. This general description "should include not only the physical setting for the project, but it should describe those features—geographic, cultural, recreational, or unique or significant wildlife or vegetation—that distinguish the affected area from other areas." *Id.* The condition of the affected environment includes the presence of a suite of stressors other than project operations that affect listed species. It also includes conditions within the service areas that are dependent upon water deliveries from the CVP and SWP. SLDMWA WWD SJRECWA 110

The NOI does not use the term "affected environment." Under the heading "V. Project Area" the NOI states that "[t]he project area includes the CVP and SWP Service Areas and facilities, as described in this section." 77 Fed. Reg. at 18859. We agree that the directly affected environment includes all of the CVP and SWP service areas, as well as the areas where CVP and SWP facilities are located. The service area and project facilities include much of California. To describe the affected environment, the EIS must go further and include a general description of the physical environment within the service areas. 40 C.F.R. § 1502.15. The affected environment should include the area of and conditions within the Delta, and the Sacramento and San Joaquin river watersheds. The affected environment will encompass areas extending beyond the CVP and SWP service areas as well. For example, reductions in water supplies exported from the Delta may increase demands on Colorado River water as an alternative supply for Southern California. Identifying the direct and indirect effects of restrictions on CVP and SWP operations therefore requires consideration of conditions in a broad geographic region.

Accurately defining the extent and present condition of the affected environment is important to the analysis of environmental consequences. "The general description constitutes a basis from which specific environmental effects can be assessed." NEPA Handbook at 8-13. As

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the NEPA Handbook further explains: "If available, the historic changes and trends affecting a resource or feature, up to and including present conditions, should be described to set the stage for the projection of future changes and trends concerning the resource or feature." *Id.* In particular, there are many historic and existing factors and conditions that affect the survival and recovery of listed species, factors that are unrelated to the operations of the projects (e.g., loss of habitat, upstream water use and diversions by other water users, alterations in land uses, municipal and industrial discharges, exotic species etc.). Those factors and conditions should be carefully described as part of the affected environment so that the effects of future project operations are considered in the appropriate context. While the historic changes in the Delta and throughout the area of analysis have occurred and may be identified to "set the stage," the impacts analysis must not attempt to attribute these past changes and existing impacts to any action alternative. Instead, an accurate and complete description of existing conditions is essential because the effects of the "no action" alternative are measured against the *existing* affected environment (e.g., not the environment that existed before the projects began operations).

C. No Action Alternative

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An EIS[5] must "[i]nclude the alternative of no action." 40 C.F.R. § 1502.14(d). From the NOI, it does not appear that Reclamation has yet defined the no action alternative. "Because the no action alternative is the basis to which all other alternatives are compared, it should be presented first, so the reader can easily compare the other alternatives to it." NEPA Handbook at 8-8. According to Reclamation's NEPA Handbook, "'[n]o action' represents a projection of current conditions and reasonably foreseeable actions to the most reasonable future responses or conditions that could occur during the life of the project without any action alternatives being implemented." (*Id.*) Moreover,

> [t]he no action alternative should not automatically be considered the same as the existing condition of the affected environment because reasonably foreseeable future actions may occur whether or not any of the project action alternatives are chosen. When the no action alternative is different from the existing condition, as projected into the future, the differences should be clearly defined. Differences could result from other water development projects, land use changes, municipal development, or other actions. "No action" is, therefore, often described as "the future without the project."

NEPA Handbook at 8-8.

In an EIS, the action alternatives are compared to the no action alternative to measure the impacts of each action alternative. *See, e.g., Center for Biological Diversity v. U.S. Dept. of the Interior*, 623 F.3d 633, 642, (9th Cir. 2010) ("A no action alternative in an EIS allows

[5] Discussion of the requirements of an EIS accepts Reclamation's apparent assumption that an EIS will be required, although that is not a foregone conclusion. As described above, the scope of the required NEPA review will depend upon what actions Reclamation decides are necessary to meet its obligations under the ESA.

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policymakers and the public to compare the environmental consequences of the status quo to the consequences of the proposed action. The no action alternative is meant to 'provide a baseline against which the action alternative[ ]'…is evaluated. *Id.* A no action alternative must be considered in every EIS. *See* 40 C.F.R. § 1502.14(d)."). The district court ruled that Reclamation violated NEPA by significantly modifying project operations to meet ESA requirements without performing any NEPA analysis of the impacts of such modifications or alternatives to such modifications. Accordingly, in order to respond to this ruling on remand, here the "no action" alternative should be defined to include operations consistent with Reclamation's and DWR's obligations and all legal requirements *except* the requirements of the ESA. Under this definition of "no action," project operations would continue in compliance with other regulatory requirements (e.g., D-1641 as modified by applicable laws, including Wilkins Slough requirements, FERC license requirements, American River in-river flow requirements, etc.). Comparing this no action alternative to the action alternatives developed during the NEPA and ESA consultation process will provide the most comprehensive and appropriate disclosure of the environmental impacts of the various action alternatives to comply with ESA requirements.[6]

When Reclamation defines the no action alternative, it should not include implementation of the RPAs in the 2008 FWS and 2009 NMFS BiOps in the no action alternative. That would contradict the district court's ruling, because the NEPA analysis then would not measure and disclose the impacts of changes to CVP and SWP operations to comply with the ESA. It would defeat the purpose of the no action alternative—to provide a meaningful comparative scenario with which to gauge the impacts of the action alternatives. As the Ninth Circuit observed in a similar context, "[a] no action alternative in an EIS is meaningless if it assumes the existence of the very plan being proposed." *Friends of Yosemite Valley v. Kempthorne*, 520 F.3d 1024, 1038 (9th Cir. 2008).

Appropriately defining the consequences of "no action" will require analysis not done in the previous ESA consultation. The record shows that the conclusions in the existing biological opinions that absent major changes project operations would jeopardize listed species and adversely modify critical habitat were not grounded on rigorous scientific analysis. For example, neither biological opinion employed the standard tool of life cycle modeling to test the significance of the effects of project operations, and other stressors, on the abundance of the listed species. While there is no question that project operations have some effect on individual members of the species through take at the export pumps, the significance of that effect on the overall population was not critically examined. It was instead largely presumed in the existing biological opinions. Further, as the district court found, the biological opinions attributed other adverse effects in the existing environment such as contaminants to project operations based only on speculation and surmise. The absence of sound scientific analysis to support the jeopardizing

[6] The situation here is unlike most other circumstances where NEPA review is performed, because the CVP and SWP were constructed and operating before NEPA and the ESA were even enacted. Thus, the "no action" alternative, which usually serves as the baseline for evaluating the significance of environmental impacts of action alternatives, is more complicated. The existing projects including operations must be captured in the "no action" baseline so they are not included in the new effects of the action alternatives. For this reason, a hypothetical "no action" alternative that fails to account for current and previous operations of the projects would be an improper baseline for comparative analysis. *See American Rivers v. Federal Energy Regulatory Comm.*, 187 F.3d 1007 (9th Cir. 1999).

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conclusions in the existing biological opinions completely undermines the validity of the specific prescriptions they imposed on project operations to remove that supposed jeopardizing effect. Furthermore, as described above, project operations have changed since 2008, and there are other regulatory processes that are underway that may further alter project operations in the coming years, regardless of whether any action is taken to modify project operations pursuant to section 7 of the ESA. SLDMWA WWD SJRECWA 111 continued

In the EIS, Reclamation must compare the environmental consequences of the no action alternative to the environmental consequences of the action alternatives. With respect to consequences for listed species, that comparison should measure and disclose how many more fish are expected to survive and reproduce under one scenario as opposed to another. For example, if reverse flows in Old and Middle rivers are limited by other existing non-ESA regulations but not by additional measures under the ESA, what are the expected effects on population abundance? If additional restrictions on such flows are imposed under the ESA, what is the expected affect on abundance of listed species? Do other measures that do not involve restrictions on project operations, such as habitat restoration, offer greater promise of improving abundance? The results of these analyses may then be considered together with the other environmental consequences associated with various alternatives, including consequences related to differences in water supply. Such a comparison is essential to inform policymakers and the public regarding the choices to be made. SLDMWA WWD SJRECWA 112

It may be that despite more rigorous analysis than has been done before there will still be substantial scientific uncertainty regarding the likely environmental consequences of various alternatives. If so, that uncertainty should be expressly acknowledged. 40 C.F.R. § 1502.22. That, too, is important information for policymakers and the public. The existing biological opinions included specific prescriptions that were initially presented as if they were required by available science, but on closer examination were found to be based only on personal judgments. The -5,000 cfs limitation on Old and Middle river flows in the 2009 Salmonid BiOp is one example. The NEPA process here should make clear the differences between what is known based on the best available science, and where the appropriate decision makers must make policy judgments in the face of uncertainty. SLDMWA WWD SJRECWA 113

D. **<u>Proposed Action</u>**

Under the CEQ regulations, a notice of intent is supposed to briefly describe "the proposed action and possible alternatives." 40 C.F.R. § 1508.22. As discussed above, the NOI does not clearly identify a proposed action, nor any possible alternatives. Indeed, from the NOI it appears Reclamation has not yet decided upon a proposed action, or identified possible alternatives to the proposed action. This apparently reflects the still preliminary and incomplete ESA consultation. The NOI states only that "[t]he proposed action for the purposes of NEPA will consider operational components of the 2008 USFWS and the 2009 NMFS Reasonable and Prudent Alternatives." 77 Fed. Reg. at 18860.[7] But the NOI does not specifically identify which SLDMWA WWD SJRECWA 114

[7] An alternative, possible interpretation of this statement in the NOI is that Reclamation, FWS and NMFS have already decided they will again implement the reasonable and prudent alternatives in the existing biological opinions, and intend to do only perfunctory NEPA analysis and ESA section 7 consultation. That approach would violate NEPA and the ESA, and raise serious issues regarding compliance with the district court's orders The

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of the "operational components" from those biological opinions Reclamation has in mind, except that it will "analyze" "flow management actions" "resulting from" those biological opinions. The NOI does not identify possible alternatives to those components at all. The lack of specific information in the NOI regarding the proposed action and possible alternatives limits the ability of the Public Water Agencies to provide responsive comments here. When and if Reclamation provides specific information on those topics, the Public Water Agencies request that Reclamation provide them an opportunity to provide additional comment. SLDMWA WWD SJRECWA 114 continued

The NEPA Handbook provides that "[t]he proposed action should be defined in terms of the Federal decision to be made. When the proposed action is related to other actions—especially other Federal actions—a careful consideration of the independent value of the proposed action should be made. When the independence of the proposed action is not clear, it may be appropriate to expand the scope to include those other actions." NEPA Handbook at 8-6. Reclamation's decision regarding what it must do to comply with the ESA is closely related to the actions of FWS and NMFS in issuing new biological opinions regarding the effects of project operations on listed species. As a number of the Public Water Agencies have contended in the litigation, FWS and NMFS have a role and NEPA obligations here as well. Reclamation should at least consider defining the relevant Federal action subject to NEPA review to include the actions of FWS and NMFS in issuing the new biological opinions, as well as any role they reserve for themselves in implementing any measures imposed in the new biological opinions.

Components of the flawed existing biological opinions should not be included as part of the proposed action. First, Reclamation does not yet know the outcome of reconsultation, and should not presume at this point that *any* reasonable and prudent alternatives are needed to avoid jeopardizing the continued existence of listed species or the adverse modification of designated critical habitat. Furthermore, many of the specific components of the 2008 FWS and 2009 NMFS RPAs were found unlawful, and hence are poor candidates for inclusion in a proposed action. *See* Section III.D, below (discussing rejected RPA components). It may be appropriate to include some elements of the RPAs in the existing BiOps in potential alternatives for discussion and analysis, but the arbitrary and illegal nature of those measures would provide a sound basis for rejecting them. The NOI states that the "proposed action will not consider" alternatives "that would require future studies." However, NEPA requires new studies where the available information is incomplete, unless the agency can make specific findings of exorbitant cost and infeasibility. 40 C.F.R. § 1502.22.

The Public Water Agencies submit that a scientifically rigorous analysis of the effects of CVP and SWP operations would likely conclude that those operations do not jeopardize the listed species or adversely modify their critical habitat. Accordingly, the Public Water Agencies suggest that for NEPA review Reclamation define the proposed action as the continued operation of the projects, including existing valid regulatory requirements, subject to lawful requirements of the incidental take statements in new biological opinions, without major changes to project operations imposed under the ESA. That proposed action, measured in comparison to the no action alternative, should have only modest environmental impacts. That proposed action would also meet the purpose and need described above. Ultimately, of course, Reclamation's decision

comments in this letter presume that the federal agencies intend to follow the law and the court's orders, and these comments are intended to assist them in doing so.

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regarding the action necessary to meet its ESA obligations must be informed by the outcome of the pending reconsultations. SLDMWA WWD SJRECWA 114 continued

E. **Action Alternatives**

The Public Water Agencies are also concerned about the type and range of alternatives that will be analyzed in the EIS(s). The alternatives analysis is the "linchpin" of an EIS. *Monroe County Conservation Council, Inc. v. Volpe*, 472 F.2d 693, 697 (2d Cir. 1972). In the alternatives analysis, federal agencies must "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. §§ 4332(2)(E); 4332(2)(C)(iii). Agencies must "rigorously explore and objectively evaluate all reasonable alternatives" and explain why any alternatives were eliminated from detailed consideration. 40 C.F.R. § 1502.14. Reasonable alternatives are those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action." 43 C.F.R. § 46.420. SLDMWA WWD SJRECWA 115

According to its own policies, Reclamation must develop and assess appropriate and reasonable alternatives for actions that may significantly affect the environment, integrate the Endangered Species Act into its analyses, and use the best available environmental data, including acquiring additional appropriate and reasonable data to support its decisionmaking. Reclamation Manual Policy No. ENV P03 (1998) *available at* http://www.usbr.gov/recman/env/env-p03.pdf, last visited April 9, 2012. Determining which alternatives are to be considered and analyzed is vitally important in shaping the EIS, and the scope of alternatives is directly related to the underlying purpose and need for which the action is being proposed. 40 C.F.R. § 1502.13. It is the purpose and need for the proposed action that dictates what alternatives should be developed for analysis. *See League of Wilderness Defenders-Blue Mountain Diversity Project v. Bosworth*, 383 F. Supp. 2d 1285 (D. Or. 2005). The Department of Interior's Regulations for Implementation of NEPA explain that "[t]he range of alternatives includes those reasonable alternatives that meet the purpose and need of the proposed action, and address one or more significant issues related to the proposed action." 43 C.F.R. § 46.415.

Here, as discussed above, the purpose is to continue long-term operation of both the CVP and SWP in a manner that will serve the authorized purposes of the projects as fully as possible. Those purposes include supplying water to help meet the needs of 25 million people and 2 million acres of agricultural land. The need for the action arises from the difficulty both projects have had in serving the water supply and other purposes while complying with the ESA. The NOI appears focused on flow-related changes to project operations as the proposed action to be considered in the NEPA process. The Public Water Agencies urge Reclamation to consider measures that may benefit the survival and recovery of listed species that do not involve modifications to project operations. These alternative actions must be explored to ascertain whether any would serve the purpose and need by maintaining or benefitting populations of listed species while at the same time allowing adequate and reliable water supplies to be delivered by the CVP and SWP.

There have been numerous scientific developments since the BiOps and their RPAs were issued and overturned by court order. This new scientific understanding of the various stressors

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and means to alleviate their impacts on listed species must be evaluated as part of the best available environmental data for developing alternatives. Attached hereto as Exhibit B is a list of some of the recent scientific articles issued since the 2009 BiOp was released. These new data relate to NEPA's obligation to examine and fully analyze potential alternative actions, as well as to the ESA's requirement that the best available science be used.

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Reclamation is required to rigorously explore a variety of alternatives. As stated, the alternatives should allow for adequate water deliveries and prevent significant impacts to public health and the human environment, and also explore various methods to sufficiently maintain and protect the listed species and their critical habitats. Thus, alternatives that simply focus on flow regimes or decreasing water exports would be inappropriately narrow. As the district court previously recognized, the RPAs in the remanded BiOps had serious failings, including whether their implementation led to a wasting of water supplies without providing measurable benefit to the species.

If the RPAs in the BiOps are going to be considered as alternatives in the process—an action the Public Water Agencies believe is flawed given the court's prior rejection of the RPAs—the environmental impacts associated with implementing those measures must be fully analyzed. The Public Water Agencies believe the better approach is for the new NEPA process to affirmatively recognize that many portions of the RPAs adopted in the prior BiOps were found to be fatally flawed and to not attempt to ignore the findings of the court by including the RPAs in the environmental analysis regardless of the court's determination. For example, in its decision to remand the FWS BiOp, the district court rejected, among other components of the delta smelt BiOp RPA, its regulation of Old and Middle River ("OMR") flows and setting a range of new OMR flow prescriptions in the RPA based on raw salvage values. Similarly, the court rejected the RPA's regulation of the location of fall X2 in above-average and wet water years due, among other reasons, to the misuse of DAYFLOW data with Calsim modeling output when setting the X2 location prescriptions. The court also rejected the BiOp's conclusions regarding indirect effects. MSJ Decision, *Delta Smelt Consolidated Cases* at pp. 219-25 (Dec. 14, 2010). Further, the court criticized the BiOp's failure to "justify or explain its attribution to Project operations adverse impacts caused by other stressors . . . [requiring] further consideration and explanation." *Id.* at p. 223.

NMFS's imposition of an RPA in the Salmonid BiOp was also fatally flawed, according to the district court. For example, the court rejected the RPA's flawed use of raw salvage for regulating OMR flows; criticized NMFS's "chronic and unsatisfactorily explained failure" to use lifecycle modeling approaches and its "inexplicable" management approach without considering aspects of its lifecycle that are impacted by ocean conditions and ocean harvest; rejected the RPA's imposition of a 4:1 San Joaquin River inflow-export ratio in RPA Action IV.2.1, the specific OMR flow prescriptions in Action IV.2.3, and the triggers imposed by Action IV.3. MSJ Decision, *Consolidated Salmonid Cases* at pp. 270-75 (Sept. 20, 2011). The court specifically noted that questionable and equivocal evidence supporting agency decisions to impose significant adverse consequences on the state's water supply should "not drive the formulation of an RPA." *Id.* at pp. 272-73.

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It follows from the above discussion that serious consideration should be given to discarding the old RPA actions altogether and replacing them with alternative actions that will both benefit listed species and reduce impacts to water exports. When selecting a range of alternatives for the new EIS, Reclamation should strongly consider alternatives that will reduce impacts to water exports, rely upon the best available science, and provide measurable and tangible benefits to the listed species.

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Reclamation is required to consider "potentially reasonable alternatives beyond its own jurisdiction" and to consider "the jurisdictions of other agencies (Federal and otherwise) when determining what reasonable alternatives should be considered." NEPA Handbook at 8-9; 40 C.F.R. § 1502.14(c). Such alternatives may include actions within the jurisdiction of agencies such as the State Water Board and the Regional Water Quality Control Boards, to address water quality habitat stressors created by the discharge of pollutants and contaminants. Alternatives may also include actions within the jurisdiction of the California Department of Fish and Game and the Fish and Game Commission, to address predator stressors created by implementation and enforcement of the bass fishing regulations.

As described in detail below, many other factors should also be considered in formulating alternative actions to be evaluated as part of the NEPA process. At a minimum, the following factors should be evaluated. These factors could potentially constitute elements of alternative actions themselves, or they could be evaluated as mitigation measures that apply no matter what alternative is ultimately selected.

1. Alternatives For The Protection Of All Listed Fish Species In The Delta

General measures should be included as alternatives to decrease the need to rely on curtailing exports by the projects. For example, Reclamation should consider methods for reducing the populations or impacts of alien species/predator species, such as striped bass. (PPIC 2011, *Managing California's Water: From Conflict to Reconciliation*, p. 212.) Alternatives that regulate smaller water diversions, especially unscreened diversions, should also be considered. It would also be appropriate to evaluate alternatives that require and implement an alternative conveyance, and/or reduce toxic chemicals. (PPIC 2011, pp. 222-224.) The 2012 Natural Research Council Report, *Sustainable Water and Environmental Management in the California Bay-Delta*, for example, described potential measures for managing risks to Bay-Delta ecosystems from selenium, methyl-mercury, pesticides/herbicides, emerging chemicals, metals, and legacy organic contaminants and PAHs. (NRC 2012, p. 75.)

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2. Alternatives That Address Specific Concerns Related To The Delta Smelt

a. X2 Location Management Should Not Be Considered Because It Is Not A "Reasonable Alternative"

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As a starting point for the alternatives analysis, the NOI implies that Reclamation will analyze flow management aspects of the 2008 FWS and 2009 NMFS BiOps and RPAs. FWS's effects analysis in the First Draft 2011 Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP, at pp. 285-290 (Dec. 2011), refers extensively to salinity and the low salinity zone ("LSZ") as a primary constituent element ("PCE") of delta smelt habitat.

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However, the best available science shows—and the district court found—that such an approach dramatically overemphasizes the influence of the fall location of X2 on delta smelt survival, reproduction and abundance. *Id.* at pp. 279-83. As Reclamation is well aware, FWS's 2008 BiOp contained a fall action that involved regulating the location of X2 for purported benefits to the delta smelt that was overturned by the Court based upon a lack of supporting evidence. Continued efforts to defend the imposition of Fall X2 in the face of substantial testimony—some of it from the FWS and Reclamation witnesses themselves—indicating that the location of Fall X2 bears little relationship to the abundance of Delta smelt ultimately caused the Court to characterize the FWS's witnesses as "zealots." SLDMWA WWD SJRECWA 117 continued

As further discussed in the document attached hereto as Exhibit C, the LSZ only weakly overlaps the delta smelt's habitat, which is comprised of a multitude of biotic and abiotic characteristics. In light of the analysis in Exhibit C as well as the thorough rejection of the Fall X2 Action by the Court, Reclamation should not commit to an inappropriate overemphasis of the LSZ's influence. Doing so would wrongly attribute impacts to the projects that only have a nominal effect on the species and lead to the selection of alternative measures for NEPA evaluation that waste water resources and have little or no benefit to the species. Moreover, as recognized by the court, the selection of measures that would impose substantial impacts on human health and the environment would be inconsistent with the water supply purpose of the projects.

b. Food Availability For Delta Smelt

Three recent life-cycle modeling studies (Maunder & Deriso 2011, MacNally et al. 2010, and Miller et al. 2012) found that food availability was a significant driver of delta smelt abundance. Consistent with these modeling efforts, the available scientific data from CDFG surveys show evidence that zooplankton food supplies for delta smelt are an important factor affecting the species' population dynamics. By contrast, these studies also show that the location of fall X2 and associated estimates of "abiotic habitat area" are not strong predictors of delta smelt population dynamics.

Food availability could be improved through alternatives that require: wetlands restoration, particularly salt marsh work, controlling ammonia discharges (Dugdale et al 2007) and nutrient inputs (i.e., total N inputs related to ammonium loading) rather than using flows to dilute the pollution; controlling the *Corbula amurensis* clam (NRC 2012, p. 70); controlling aquatic macrophytes; and/or controlling blooms of toxic cyanobacterium *Microcystis aeruginosa* (NRC 2012, p. 67.)

With respect to the *Corbula* clam, the infiltration of the clam into the Suisun Bay region since 1987 has caused major changes in the availability and composition of food sources in the LSZ. It has made Suisun Bay habitat less desirable, while the Cache Slough region—approximately 40 km away to the north and far removed from the LSZ's influence—has maintained important characteristics, such as higher turbidity and food availability, that facilitate spawning and rearing of delta smelt. Recent survey efforts have shown substantial year-round populations of delta smelt in the north Delta.

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c. A Combination Of Turbidity Conditions And Spring Flow Should Be Evaluated, Rather Than Just Focusing On OMR Flow Alone

The best available scientific data also confirm that imposing OMR flow controls alone, without simultaneous consideration of other factors affecting species geographic location and abundance, is insufficient. For the protection of delta smelt, in particular, the correlation of normalized salvage as a function of both turbidity and OMR flow shows that during conditions of low turbidity (i.e., clear water), salvage rates are low even when OMR is highly negative. This may occur because delta smelt avoid open waters and mid-channel areas where they are subject to higher predation and other stressors.

Figure 1, below, shows a bubble plot of normalized salvage as a function of both turbidity and OMR flow performed by Dr. Rick Deriso (2012), where the size of the bubbles is proportional to the amount of observed daily normalized salvage—the bigger the bubble, the larger the percentage of the population salvaged. As seen in the figure, most of the larger normalized salvage events (i.e., larger bubbles) lie in the region that the data suggests would be avoided by using less restrictive OMR limits than are in the remanded delta smelt biological opinion (i.e., the events in the region below and to the right of the OMR trigger would be avoided). Periods when no salvage occurred (i.e., the red dots) generally tend to occur in much greater frequency above and to the left of the trigger line. Thus, the bubble plot shows that salvage is generally more rare above the trigger line, but occurs more frequently and with generally larger salvage events below the trigger line.

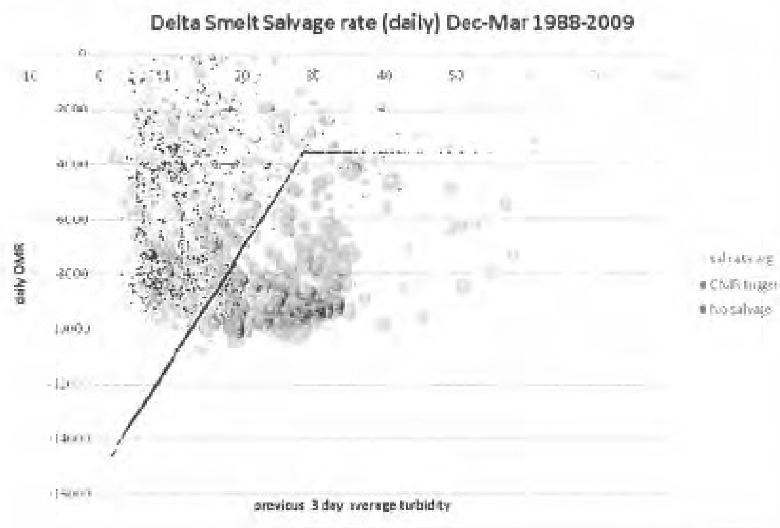

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Figure 1. OMR trigger (Y axis) as a function of prior three-day average turbidity (X-axis), along with observed daily normalized salvage (bubble size). Data is shown only if there are three previous days with turbidity estimates and it is restricted to days with negative daily OMR flow (for a total of 1880 days).

Importantly, OMR flow controls imposed in a vacuum do not provide any particular benefit to the species. The best available scientific data show that OMR flows have application in reducing entrainment, when used in combination with turbidity triggers and normalized salvage. Based upon this information, consideration should be given in the NEPA process to evaluating the environmental effects of an alternative action to protect delta smelt based upon coupling normalized salvage, turbidity and flow regimes. Using this information, alternatives can be developed to provide for the lowest salvage at the lowest possible water cost. Another important question is whether entrainment has population level effects, and if so under what circumstances. Any restrictions on OMR to limit entrainment should be limited to circumstances where doing so is necessary to avoid meaningful population level effects. SLDMWA WWD SJRECWA 117 continued

3. Alternatives That Address Specific Concerns Related To Salmonids

a. Temperature Control

Adequate temperatures need to be maintained for successful spawning, egg incubation, and fry development (between 42.5 and 57.5°F). (Salmonid MSJ Decision p.7, Doc. 633 (Sept. 20, 2011) (*Consol. Salmonid Cases*, 791 F. Supp. 2d 802 (E.D. Cal. 2011)); Salmonid BiOp p. 90, 93.) Temperature is one of the dominant factors affecting Salmonid populations. (Salmonid MSJ Decision p.58., Doc. 633 (2010).) SLDMWA WWD SJRECWA 118

b. Recreational And Commercial Fishing

The potential effects on listed species of recreational and commercial fishing should also be very carefully evaluated. Ocean harvest is one of the dominant factors affecting Salmonid populations. (Salmonid MSJ Decision p.58, Doc. 633 (2010).) As noted by Judge Wanger, "It is inexplicable that these species are being managed in a piecemeal fashion, without considering all aspects of their life cycle in the same analysis, which would facilitate description of the true effect Project operations have on the species in light of other conditions. What population is available to be affected by Project operations is entirely relevant, as all Defendants have sought to attribute the species' decline to Project operations." (Salmonid MSJ Decision p.86, Doc. 633 (2010).)

c. Ocean Conditions

Ocean conditions directly tie into ocean survival of salmonids. The NRC has explained that "patterns in atmospheric temperature, wind, and precipitation drive ocean temperatures, mixing and currents, which in turn control growth and advection of plankton that provide food for salmon." (NRC 2012, p. 95 (citing Batchelder and Kashiwai, 2007).) Thus, an alternative that increases the diversity of wild and hatchery salmon ocean entrance timing would help ameliorate unfavorable ocean conditions. (NRC 2012, p. 107.)

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d. Competition From And Control Of Hatchery Fish

Additionally, an alternative should be included that addresses competition from and control of hatchery fish, because NMFS itself identifies hatchery effects as a major stressor contributing to the decline of Central Valley steelhead. (NRC 2012, p. 92; *see also* NRC 2012, p. 95; PHC 2011, p. 221.) SLDMWA WWD SJRECWA 118 continued

4. Green Sturgeon

Reclamation should also consider alternatives that address the green sturgeon population. Due to known temporal and spatial differences with salmonids, green sturgeon should be evaluated separately. To better understand these differences, more studies may be needed. SLDMWA WWD SJRECWA 119

Based on these factors, the Public Water Agencies suggest that Reclamation explore a broad suite of alternatives actions that will satisfy the agency's ESA obligations while also avoiding unnecessary limitations on the essential water supply operations of the SWP and CVP.

F. **Mitigation Measures**

In addition to analyzing the impacts of all potential, feasible alternatives, the EIS must include a discussion of the "means to mitigate adverse environmental impacts." 40 C.F.R. § 1502.16(h). Accordingly, the EIS must identify all relevant, reasonable mitigation measures that could alleviate a project's environmental effects, even if they entail actions that are outside the lead or cooperating agencies' jurisdiction. *See* "Forty Most Asked Questions Concerning CEQ's NEPA Regulations," No. 19b. Such measures must entail feasible, specific actions that could avoid impacts by eliminating certain actions; minimizing impacts by limiting their degree; rectifying impacts by repairing, rehabilitating or restoring the affected environment; reducing impacts through preservation or maintenance; and/or compensating for a project's impacts by replacing or providing substitute resources. 40 C.F.R. § 1508.20. Any environmental effects that may occur as a result of implementation of these mitigation measures must also be disclosed and analyzed. SLDMWA WWD SJRECWA 120

As with the identification and analysis of alternatives and project components, the development of mitigation measures has the potential to greatly reduce environmental impacts, including those to the listed species and other biota, which could result from some component of the various alternatives. Determining the precise impacts that project operations and the projects' components currently have on the listed species is vitally important; otherwise, mitigation measures (or alternative actions) may be imposed that will have additional environmental impacts but will not actually avoid, minimize, rectify, reduce, or compensate for the project's impacts. In addition, the effectiveness of any mitigation measures in reducing such impacts must be determined, as well as how much those impacts will be reduced by any particular mitigation measure. *See South Fork Band Council of Western Shoshone of Nevada v. U.S. Dept. of Interior*, 588 F.3d 718, 727 (9th Cir. 2009). Some of the actions discussed above in the section on alternatives could potentially also function as mitigation measures. Other types of mitigation measures, including restoration of habitat, could also be explored.

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V. EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS OF ALTERNATIVES

As discussed above, the potential environmental impacts associated with implementing each alternative must be evaluated in the EIS. Impacts occurring not only in the Delta and surrounding areas, but also in the service areas of water agencies that deliver Delta water to tens of millions of Californians and hundreds of thousands of acres of farmland must also be analyzed. As cooperating agencies representing member agencies that have first-hand knowledge of the impacts of reduced Delta water deliveries, the Public Water Agencies can provide some of the specific information that will be needed for this analysis. We include the following information as an overview of the types of impacts to be evaluated, and other critical considerations and information that must be included. Additional, more detailed descriptions of specific environmental impacts that should be evaluated, as well as supporting references, are provided in Exhibit D. SLDMWA WWD SJRECWA 121

A. Impacts To Specific Resource Categories

1. Water Resources, Including Groundwater

Given the value of and constraints on reliable water supplies in California, virtually any reduced deliveries of Delta water supplies to SWC and SLDMWA member agency service areas will have demonstrable, dramatic, and undeniable environmental impacts. Lower export water deliveries translate directly into water losses for urban and agricultural users. Such reduced deliveries compel greater reliance by retail agencies and their customers on groundwater to meet demand not only in dry years, but in other year types when greater exported water deliveries are currently anticipated. In turn, reduced exports and deliveries during more year types and in greater quantities diminish the ability of water managers to replenish and store groundwater when water is available to do so. SLDMWA WWD SJRECWA 122

These circumstances can, and likely will, lead to additional groundwater overdraft (pumping beyond an aquifer's safe yield) throughout the Public Water Agencies' service areas, particularly in agricultural areas. Reduced groundwater levels can also lead to land subsidence that can additionally damage water conveyance facilities and other infrastructure, as has been documented throughout the state. For example, at the recent May 22, 2012 Scoping Meeting held in Los Banos, a speaker from the Central California Irrigation District stated that the District has spent $4.5 million to rehabilitate its conveyance facility, due to land subsidence resulting from groundwater overdraft and is involved in another $2.5 million program with Fresno County to study and replace a bridge damaged by land subsidence.

Reduced ability to replenish ground and surface water reserves also adversely impacts the ability of water purveyors to store water for dry years and emergencies. As just one example, reduced water storage can be expected to render southern and central California increasingly vulnerable to having insufficient supplies to suppress wildfires or sufficient supplies to survive a severe earthquake affecting conveyance facilities or other catastrophic events. Reduced exports of Delta waters also results in increased reliance by retail water users and their customers on other limited and lower quality supplies, such as recycled water, that need to be blended with SWP water to make them available for beneficial use. Finally, any impacts to the ability of the

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CVP and SWP to facilitate water transfers, including transfers of non-project water, should be addressed. For example, Reclamation must evaluate and disclose whether an alternative imposes additional operational constraints that limit (from "no action" conditions) the time or frequency when such transfers could be accomplished. These are just a few of the dozens of potential impacts to water resources that will result from reduced export and delivery of Delta water supplies to the SWP and CVP service areas. SLDMWA WWD SJRECWA 122 continued

2. Land Use, Including Agriculture

Reduced SWP and CVP deliveries will result in significant changes in land use, particularly in agricultural landscapes. As dramatically shown during the 2007-2010 period, reduced export water deliveries can and will increase fallowing of land across the Central Valley and elsewhere. Reduced water supplies can also cause shifts toward planting permanent crops that have diminished ongoing water requirements, but which also require watering year-in and year-out, thus diminishing future flexibility in water budgeting by precluding management options such as annual crop-shifting or fallowing. Reduced supplies and lower quality water can also impact the production of certain crops, as well as the yield of crops that are grown. The unavailability of project water also increases the costs to obtain supplemental water. Lost exports also negatively impact water management plans that are produced by water agencies as source documents for evaluating land use projects. As imported water supplies become less reliable, establishing firm water supplies sufficient to meet land use planning requirements becomes more difficult. SLDMWA WWD SJRECWA 123

3. Socioeconomics

Reduced Delta water supplies also cause socioeconomic impacts. In response to reduced water supplies, farmers fallow fields and this reduced agricultural productivity results in layoffs, reduced hours for agricultural employees, and increased unemployment in agricultural communities. Reduced agricultural productivity also has socioeconomic impacts for agriculture-dependent businesses and industries. In addition, unavailability of stable and sufficient water supplies reduces farmers' ability to obtain financing, which results in employment losses, due to the reduced acreage of crops that can be planted and the corresponding reduction in the amount of farm labor needed for that reduced acreage. Reduced water supplies and the resulting employment losses also cause cascading socioeconomic impacts in affected communities, including increased poverty, hunger, and crime, along with dislocation of families and reduced revenues for local governments and schools. In the urban sector, reduced supplies or increased supply uncertainty can cause water rates to increase as agencies seek to remedy supply shortfalls by implementing measures to reduce demand or augment supplies. Connection fees and other one-time costs for new developments may also increase and further retard economic development. SLDMWA WWD SJRECWA 124

Some of personal and regional socioeconomic impacts of reduced water supplies, particularly to agriculture-dependent communities located on the westside of the San Joaquin Valley, were described by speakers at the May 22, 2012 Scoping Meeting held in Los Banos. At that meeting Congressman Costa described some of the socioeconomic impacts of the reduced water supplies resulting from the BiOps, stating:

SLDMWA WWD SJRECWA 124 continued

> the low average rainfall and court ordered restrictions and, in my opinion, severely misguided regulations that we saw formed in 2008 and 2009, created some of the most severe water shortages in farming communities in my district and throughout the valley in the last 3 years. Starting with a zero water allocation, zero percent in 2009, some of the hardest working people you'll ever meet, many of you in this room, stood in food lines, unable to have work because there was no water and it should have never happened. Thousands of jobs were lost and unemployment reached in communities like Mendota and Firebaugh, over 40%.

Another speaker at the meeting, Fresno County Board of Supervisor Judy Case, described the socioeconomic impacts of the reduced water supplies, stating:

> We're here to talk about what happens when there's no water on the west side. Workers lost their jobs. They not only lost their jobs, they lost jobs that had become permanent with benefits so they had healthcare for their families. Unemployment in Fresno County was higher than the entire United States. We kept unemployment up at 43 percent. And people who have worked really hard to purchase their first home they lost it in foreclosure and they were put in food lines in which food was provided.
>
> As a County, we provide safety nets to help people in a position who can't help themselves and our request for services soared. Some families were forced to leave the area to look for jobs and for work and they left with their children which affected the local schools which lost students and the revenue that came to support those students. For families to survive, they left the house they had just bought and been so hopeful for and they moved in with relatives with two and three and four families living in the same house or apartment.

The statements made by one farmer at the scoping meeting exemplify the real-world impact of reducing water supply deliveries:

> 2009 is a year that is engraved in my mind and it is there because it should never happen again. The impacts were severe on our farm. On my farm alone, I have over 900 acres of land. On those 900 acres were losses that were huge. In farmgate prices, in millions of dollars of losses, in wages, in hundreds of thousands of dollars of food for millions of people around the country. The effects were terrible on our farm, but the effects were more terrible on our farm workers. We saw people without jobs. We saw people who were working then they were unemployed. People that instead of working 60 hours per week were working 40 and 45 hours per

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> week. We tried not to lay people off so we just reduced their hours because our farm was cut down from 2,200 to approximately 1,300 acres.
>
> There were other impacts in my area. We saw many people who lost jobs move away. These are people that are skilled at what they do. Driving tractors, irrigating and harvesting. Many of these people didn't come back. We saw in my area the little brown school out in the country that I went to since I was in first grade closed down for lack of enrollment. So, it hurts us a lot to think about that and we should never forget that.

SLDMWA WWD SJRECWA 124 continued

These statements reflect some of the significant socioeconomic impacts of reducing water supplies to the farms, families and businesses that depend of CVP and SWP water. These impacts are very real and must be honestly explored and evaluated in the NEPA process for any alternatives that would reduce CVP and SWP water supply deliveries.

4. Environmental Justice

Although the impacts from reduced water supplies will have significant impacts on people and farmland throughout the state, the hardest hit areas will be in predominantly poor and minority communities—especially in the Central Valley where employment losses and environmental effects will be the most prevalent. As a result, water export losses have the potential to disproportionately impact disadvantaged communities and persons.

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5. Biological Resources, Including Fish, Wildlife, And Plant Species

Perhaps more than any other resource category, the evaluation of impacts to biological resources will entail a multi-fold analysis. On one hand, reduced Delta exports will impact biological resources dependent upon imported water from the CVP or SWP for their sustenance. Indeed, wetland and riparian areas across the state, including some national and local wildlife refuges, are maintained, in part, by imported water supplies from the CVP and SWP. The fallowing of fields in response to the reduced availability of CVP and SWP water supplies also increases the proliferation of weeds and other invasive species. Invasive species can harbor disease, choke out native species, adversely affect transportation corridors, and clog irrigation canals.

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On the other hand, the EIS will also have to assess the impacts or biological benefits, if any, to the listed species and other biota from the various alternatives evaluated. The Public Water Agencies believe that this portion of the NEPA analyses will provide vital information for the public and decision makers. A major value of NEPA comes in the comparison that may then be made between the effects on the listed species of the no action alternative compared to the other alternatives. Alternatives can also be compared among themselves. In evaluating and comparing these action alternatives, NEPA requires that Reclamation discuss the level of uncertainty and conflicting information in the data used to develop the impacts analyses. Making this information available to the public and decision-makers will allow a fully informed

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decision to be made and provide clear explanation and accountability for that discretionary choice.

6. Water Quality

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Reduced water supplies impact water quality by reducing water agencies' ability to blend lower quality water (e.g., from local groundwater or recycled water) with the higher quality Delta water, which is frequently needed to make the latter water sources beneficially usable. Increased pumping of local groundwater to offset export losses can adversely affect water quality by drawing poor quality or brackish water into higher quality groundwater basins. Increased reliance on groundwater for irrigation can also negatively impact the water quality of surface water streams due to the leachates present in the groundwater that becomes stream runoff.

7. Air Quality

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Reduced Delta water supply deliveries can adversely impact air quality because land fallowing generally results in increased dust and particulate emissions. Additionally, increased air emissions will occur because of the greater amount of energy that is needed for groundwater well pumps to lift water from a lower depth due to the greater reliance on and depletion of groundwater reserves associated with reduced availability of export water supplies.

8. Soils, Geology, And Mineral Resources

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Reduced Delta water supplies impact soils, geology, and mineral resources because increased groundwater use results in soil subsidence due to reduced groundwater replenishment. In turn, greater deposits of salts that negatively affect soil quality occur as a result of relying more heavily upon lower quality groundwater sources. In addition, reduced agricultural planting and increased fallowing leads to greater topsoil lost to erosion.

9. Visual, Scenic, Or Aesthetic Resources

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Aesthetics are impacted by reduced water supplies because resulting socioeconomic impacts from lost agricultural employment will affect urban decay in regions affected by resulting employment losses. Lower reservoirs and water levels in the upper watersheds from restrictions that require reservoir releases, and barren and decaying farmland where planting and maintennce is infeasible due to the unavailability of delta water supplies, will have negative aesthetic impacts. Increased reliance on groundwater can also negatively impact aesthetic resources by causing damage to infrastructure from land subsidence.

10. Global Climate Change, Transportation, And Recreation

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Reduced water supplies from the Delta and increased reservoir releases to meet RPA requirements can also impact climate change due to the greater amount of energy and resulting emissions needed for pumping groundwater from greater depths, reductions in carbon uptake by plants, and changes in the timing and magnitude of project hydropower generation. Transportation can be impacted by greater impediments from blowing dust on fallowed lands,

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tumbleweeds, and bird-on-aircraft strikes. Recreation impacts are also likely to occur due to impacts on reservoir levels and upper watershed flows.

B. **Comparison Among Alternatives**

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One of the key values of an EIS is its ability to inform the public and decision-makers of the relative environmental and socioeconomic costs and benefits of each alternative, including the no action alternative. An EIS does so by including information and analyses that allow and provide a comparative assessment of the environmental impacts or benefits among these alternatives. Accordingly, in the forthcoming EIS Reclamation must provide a comparison of the benefits and/or impacts of each alternative on all the various resource categories. Because part of the purpose and need entails ESA compliance by operating the projects to avoid jeopardizing the species or adversely modifying their critical habitats, it is critical that the EIS at a minimum provide analyses and descriptions for the no action alternative and the various other alternatives of the estimated increase or decrease in: (1) the numbers of individuals of each species, (2) the estimated population viability of the listed species, and (3) the amount or quality of their critical habitats. This is not an exhaustive list, and Reclamation should determine if other biological metrics would also be useful and appropriate. Because maintaining the projects' water supply reliability is a key aspect of the purpose and need, Reclamation should provide a commensurate level of analysis and detail regarding the degree to which each alternative would impair the ability of the CVP and SWP to serve their water supply functions.

In addition to including extensive analyses and discussion, the Public Water Agencies agree with Reclamation's recently released NEPA Handbook, which states:

> A summary table comparing the impacts of all alternatives (including no action) should be attached to the end of the alternatives chapter. Whenever possible, numerical comparisons should be used. Brief narrative comparisons are permissible if numerical comparisons cannot be made. … The graphic display should provide a comparison of the tradeoffs between alternatives and a listing of proportionate effects and merits of each alternative.

NEPA Handbook at 8-13. Dually providing analytic information in both text and tabular or other graphic formats will best provide full and understandable disclosure to the public and decision-makers of the relative merits of each action alternative and the no action alternative, and better inform and support any policy decisions Reclamation makes at the end of the NEPA and ESA consultation processes.

C. **Cumulative Impacts**

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NEPA requires that an EIS also include an analysis and discussion of cumulative environmental impacts, which must discuss the likely long-term impacts from each alternative in conjunction with other reasonably foreseeable actions and future events. As discussed elsewhere in this letter, there are numerous other stressors currently affecting the listed species that are or may be having a cumulative effect on the species. We earlier suggested developing alternatives

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to address these impacts. The Public Water Agencies also encourage Reclamation to explore in the EIS whether any mitigation would address these other causes of cumulative effects, which could maintain or improve the conditions of any of the listed species so as to allow sustained and improved project operations for water supply reliability.

Additionally, there are numerous actions that have recently been completed or are currently being implemented by private, local, state, and federal actors throughout the project area to improve the habitat and status of the listed species whose benefits to the species must be taken into account in all the alternatives. These actions include gravel augmentation to improve salmon spawning conditions, changes in the operations or physical character of diversions (better screens or ladders), and modifications to other structures to improve passage for salmonids and green sturgeon. For example, a new biological opinion on the Yuba River requires the Army Corps of Engineers to implement extensive gravel augmentation and improvements to fish ladders on that tributary for the benefit of salmonids. Similarly, the operations of the Red Bluff Diversion Dam on the Sacramento River have been and will be modified in the future in a manner that will benefit survival, spawning, and passage of salmonids and the green sturgeon as a result of construction of new alternate diversion structures to serve the Tehama-Colusa Canal Authority. There are also other extensive habitat restoration plans ongoing in the Delta and on the San Joaquin River, as well as other Delta tributaries. While a comprehensive listing is not possible here, Reclamation must identify and discuss these ongoing and planned projects and programs and include the estimated improvements to the status of the listed species and their habitats in their evaluation of the impacts of the alternatives, including the no action alternative. At a minimum, the expected beneficial impacts of requirements in other biological opinions issued by FWS and NMFS that address the listed species at issue here must be identified and included in the analysis.

D. <u>Disclosure And Discussion Of Scientific Uncertainty And Data Gaps</u>

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Part of the value of the NEPA process is its requirement to disclose and discuss the relevance of conflicting, inconsistent data and unavailable or incomplete data. Past regulatory decisions taken without the guiding light of NEPA have been made with an unjustified claim of certainty or necessity without acknowledgment of the significant uncertainty or imprecision that accompanied such actions. This obscures the true weight of the policy decisions set before the agency, and discourages honest and critical evaluation of policy options. Accordingly, when Reclamation is "evaluating the reasonably foreseeable significant adverse effects on the human environment in [the EIS] and there is incomplete or unavailable information," it is required to "always make clear that such information is lacking." 40 C.F.R. § 1502.22. If, for example, there is incomplete or unavailable information regarding the effects of the proposed action and the alternatives on salmonids and/or Delta smelt, Reclamation must disclose and discuss this issue. However, "[e]very effort should be made to collect all information essential to a reasoned choice between alternatives." NEPA Handbook at 8-16. At a bare minimum, if the relevant incomplete information "cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known," Reclamation must include a statement in the EIS explaining the nature of such information, its relevance, a summary of existing credible scientific evidence, and Reclamation's evaluation of potential impacts based on approaches or methods generally accepted in the scientific community. 40 C.F.R. § 1502.22(b).

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In 2004, the National Research Council issued a report addressing the degree of scientific certainty, or lack thereof, regarding measures imposed under the ESA for the protection of listed fishes in the Klamath River basin. National Research Council, *Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery.* Washington, DC: The National Academies Press, 2004. To accomplish their charge, the committee developed "specific conventions for judging the degree of scientific support for a proposal or hypothesis" in the Klamath biological opinions. *Id.* at p. 35. The committee summarized these conventions in the following table: SLDMWA WWD SJRECWA 134 continued

TABLE 1-2 Categories Used by the Committee for Judging the Degree of Scientific Support for Proposed Actions Pursuant to the Goals of the ESA

Basis of Proposed Action	Scientific Support	Possibly Correct?	Potential to be Incorrect
Intuition, unsupported assertion	None	Yes	High
Professional judgment inconsistent with evidence	None	Unlikely	High
Professional judgment with evidence absent	Weak	Yes	Moderately high
Professional judgment with some supporting evidence	Moderate	Yes	Moderate
Hypothesis tested by one line of evidence	Moderately strong	Yes	Moderately low
Hypothesis tested by more than one line of evidence	Strong	Yes	Low

These or similar criteria should be explicitly applied in the NEPA process here to assess the strength of any scientific justification for proposals to restrict project operations and intended to benefit listed species. Doing so will assist policymakers and the public in better understanding the choices to be made among alternatives.

Some have sought to justify restrictions on CVP and SWP operations even in the absence of substantial scientific support based on the "precautionary principle." As the Klamath report observed, however, "even when a policy decision is made to apply the precautionary principle, the question of whether the decision is consistent with the available scientific information is important. . . . At some point [] erring on the side of protection in decision-making ceases to be precautionary and becomes arbitrary. One indication that policy-based precaution has given way to bias or political forces is a major inconsistency of a presumed precautionary action with the available scientific information." *Id.* at 315. If the federal agencies make a policy decision to apply the precautionary principle here, that choice should be explicit, so that the choice and the tradeoffs involved are made clear to the public and any reviewing courts. That policy choice has not been made explicit in past decisions. In the litigation regarding the 2009 Salmonid BiOp, for example, NMFS sought to justify a restriction on OMR flows based on precaution, but as the

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district court found "nowhere in the BiOp (or any other document in the administrative record cited by the parties) [did] NMFS disclose its intent to use a 'precautionary principle' to design the RPA Actions." *Consolidated Salmonid Cases*, 713 F. Supp. 2d 1116, 1145 (E.D. Cal. 2010).

In sum, Reclamation should be explicit in identifying the scientific uncertainty associated with any restrictions on project operations that are proposed as necessary to comply with the ESA.

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E. **Information Quality Act**

The Information Quality Act (Public Law 106-554) and orders, regulations, and guidelines issued thereunder impose additional requirements on Reclamation that must be applied to this NEPA process. Reclamation recently issued its peer review policy to implement the mandate in the Office of Management and Budget's Bulletin and Guidelines that important scientific information "shall" be peer reviewed by qualified specialists before being used to inform a government decision ("IQA Policy"). Reclamation's IQA Policy requires peer reviews of all scientific information that is determined to be "influential scientific information" or "highly influential scientific assessments." The IQA Policy applies to NEPA documents:

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> This policy applies to all scientific information produced, used, or disseminated by Reclamation. This includes scientific information that, along with other factors, informs a policy or management decision. For example, this Policy applies to scientific components of an environmental document prepared pursuant to the National Environmental Policy Act that present a scientific evaluation or are otherwise based upon scientific information.

(Reclamation IQA Policy section 5(B)) The forthcoming EIS will likely qualify for peer review under Reclamation's policy either as a "highly influential scientific assessment" or an "influential scientific assessment" based on the level of controversy, potential for societal and resource impacts or implications, the degree to which the scientific information may be novel or precedent setting, and the clear and substantial impact on important public policies and private sector decisions that may be implicated. Accordingly, the Public Water Agencies urge Reclamation to be prepared to implement the IQA peer review policy.

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VI. **CONCLUSION**

The Public Water Agencies thank Reclamation for providing the opportunity to submit comments for consideration in the scoping process. These comments are intended to provide Reclamation with a clear understanding of a few of the primary concerns of the Public Water Agencies and their member agencies as they continue the important work of providing safe, sufficient water to millions of Californians and hundreds of thousands of acres of highly productive farmland. The Public Water Agencies reserve the right to submit additional comments as the NEPA process proceeds. The Public Water Agencies, including individual SWC member agencies, as appropriate, look forward to participating as cooperating agencies, to hearing from you regarding a meeting to develop an MOU, and to working with Reclamation in a cooperative manner in developing the environmental review for the OCAP.

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Sincerely,

Daniel G. Nelson
Executive Director
San Luis & Delta-Mendota Water Authority

Terry L. Erlewine
General Manager
State Water Contractors, Inc.

Thomas Birmingham
General Manager
Westlands Water District

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EXHIBIT A

State Water Contractor Member Agencies

The State Water Contractors' members are: Alameda County Flood Control and Water Conservation District Zone 7; Alameda County Water District; Antelope Valley-East Kern Water Agency; Casitas Municipal Water District; Castaic Lake Water Agency; Central Coastal Water Authority; City of Yuba City; Coachella Valley Water District; County of Kings; Crestline-Lake Arrowhead Water Agency; Desert Water Agency; Dudley Ridge Water District; Empire-West Side Irrigation District; Kern County Water Agency; Littlerock Creek Irrigation District; Metropolitan Water District of Southern California; Mojave Water Agency; Napa County Flood Control and Water Conservation District; Oak Flat Water District; Palmdale Water District; San Bernardino Valley Municipal Water District; San Gabriel Valley Municipal Water District; San Gorgonio Pass Water Agency; San Luis Obispo County Flood Control & Water Conservation District; Santa Clara Valley Water District; Solano County Water Agency; and Tulare Lake Basin Water Storage District.

San Luis & Delta-Mendota Water Authority Member Agencies

The Authority's members are: Banta-Carbona Irrigation District; Broadview Water District; Byron Bethany Irrigation District (CVPSA); Central California Irrigation District; City of Tracy; Columbia Canal Company (a Friend); Del Puerto Water District; Eagle Field Water District; Firebaugh Canal Water District; Fresno Slough Water District; Grassland Water District; Henry Miller Reclamation District #2131; James Irrigation District; Laguna Water District; Mercy Springs Water District; Oro Loma Water District; Pacheco Water District; Pajaro Valley Water Management Agency; Panoche Water District; Patterson Irrigation District; Pleasant Valley Water District; Reclamation District 1606; San Benito County Water District; San Luis Water District; Santa Clara Valley Water District; Tranquillity Irrigation District; Turner Island Water District; West Side Irrigation District; West Stanislaus Irrigation District; Westlands Water District.

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EXHIBIT B
SCIENTIFIC DEVELOPMENTS
2009-CURRENT

- Baerwald, M., Schumer G., Schreier B., May B., 2011. TaqMan assays for the genetic identification of delta smelt (*Hypomesus transpacificus*) and wakasagi smelt (Hypomesus nipponensis), *Molecular Ecology Resources* 5, 784-785.

- Baerwald, M., Schreier B., Schumer G., May B., 2011. Genetic detection of a threatened fish species (delta smelt) in the gut contents of an invasive predator (Mississippi silverside) in the San Francisco Estuary. In Preparation for the *Journal of Fish Biology*.

- Baldwin D.H., Spromberg J.A., Collier T.K., Scholz N.L., 2009. A fish of many scales: extrapolating sublethal pesticide exposures to the productivity of wild salmon populations. *Ecological Applications* 19(8):2004-2015.

- Ballard A., Breuer R., Brewster F., Dahm C, Irvine C., Larsen K., Mueller-Solger A., Vargas A., 2009. Background/summary of ammonia investigations in the Sacramento-San Joaquin Delta and Suisun Bay. Report to Delta Science Program dated 3/2/2009.

- Barnard P, Rikk K., 2010. Anthropogenic influence on recent bathymetric change in west-central San Francisco Bay. *San Francisco Estuary and Watershed Science* 8(3).

- Baxa D.V., Kurobe T., Ger K.A., Lehman P.W., Teh S.J., 2010. Estimating the abundance of toxic *Microcystis* in the San Francisco Estuary using quantitative real-time PCR. *Harmful Algae* 9:342-349.

- Beggel S., Werner I., Connon R.E., Geist J., 2010. Sublethal toxicity of commercial insecticide formulations and their active ingredients to larval fathead minnow (*Pimephales promelas*). *Science of the Total Environment* 408: 3169–3175.

- Beggel, S., Connon, R., Werner, I., Geist, J., 2011. Changes in gene transcription and whole organism responses in larval fathead minnow (*Pimephales promelas*) following short-term exposure to the synthetic pyrethroid bifenthrin. *Aquatic Toxicology* 105, 180-188.

- Brander S.M., Werner I., White J.W., Deanovic L.A., 2009. Toxicity of a dissolved pyrethroid mixture to *Hyalella azteca* at environmentally relevant concentrations. *Environmental Toxicology and Chemistry* 28(7):1493-1499.

- Brooks M.L., Fleishman E, Brown L.R., Lehman P.W., Werner I., Scholz N., Mitchelmore C., Lovvorn J.R., Johnson ML, Schlenk D., Van Drunick S., Drever J.I., Stoms D.M., Parker A.E., Dugdale R., In press. Life histories, salinity zones, and sublethal contributions of contaminants to pelagic fish declines illustrated with a case study of San Francisco Estuary, California, USA. DOI 10.1007/s12237-011-9459-6.

1

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Page E-3

- Brown T., 2009. Phytoplankton community composition: The rise of the flagellates. *IEP Newsletter* 22(3):20-28.

- Cannon, R.E., Deanovic, L.A., Fritsch, E.B., D'Abronzo, L.S., Werner, I., 2011. Sublethal responses to ammonia exposure in the endangered smelt; *Hypomesus transpacificus* (Fam. *Osmeridae*). *Aquatic Toxicology* 105, 369-377.

- Cavallo, B., P. Gaskill and J. Melgo., Investigating the influence of tides, inflows, and exports on sub-daily flows at junctions in the Sacramento-San Joaquin Delta. In Preparation.

- Cavallo, B., Merz J., Setka J., 2012. Effects of predator and flow manipulation on Chinook salmon (*Oncorhynchus tshawytscha*) survival in an imperiled estuary. Environmental Biology of Fishes. In Press.

- Connon R.E. Geist J., Pfeiff J., Loguinov A.V., D'Abronzo L.S., Wintz H., Vulpe C.D., Werner I. 2009. Linking mechanistic and behavioral responses to sublethal esfenvalerate exposure in the endangered delta smelt; *Hypomesus transpacificus*. *BMC Genomics* 10:608.

- Cordell, J.R., Toft J. D., Gray A., Ruggerone G .T., and Cooksey M., 2011. Functions of restored wetlands for juvenile salmon in an industrialized estuary. *Ecological Engineering* 37:343-353.

- Davis J., Sim L., Chambers J., 2010. Multiple stressors and regime shifts in shallow aquatic ecosystems in antipodean landscapes. *Freshwater Biology* 55(Suppl. 1):5-18.

- Deng D.F., Zheng K., Teh F.C., Lehman P.W., Teh SJ., 2010. Toxic threshold of dietary microcystin (-LR) for quart medaka. *Toxicon* 55:787-794.

- Dugdale, R.C., Wilkerson, F.P., Parker, A.E., Marchi, A., Taberski, K., Anthropogenic ammonium impacts spring phytoplankton blooms in the San Francisco Estuary: the cause of blooms in 2000 and 2010. Estuarine and Coastal Shelf Science. Submitted for publication.

- Feyrer F., Sommer T., Slater S.B., 2009. Old school vs. new school: status of threadfin shad (*Dorosoma petenense*) five decades after its introduction to the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 7(1).

- Feyrer F., Hobbs J., Sommer T., 2010. Salinity inhabited by age-0 splittail (*Pogonichthys macrolepidotus*) as determined by direct observation and retrospective analyses with otolith chemistry. *San Francisco Estuary and Watershed Science* 8(2).

1

Janice Piñero
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Page E-4

- Folke C., Carpenter S.R., Walker B., Scheffer M., Chapin T., Rockstrom J., 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* 15(4):20.
- Forbes V.E., Calow P., 2010. Applying weight-of-evidence in retrospective ecological risk assessment when quantitative data are limited. *Human and Ecological Risk Assessment: An International Journal* 8(7):1625-1639.
- Foe C., Ballard, A., Fong, S., 2010. Draft, nutrient concentrations and biological effects in the Sacramento- San Joaquin Delta. Rpt. by Central Valley Regional Water Quality Control Board.
- Ger K.A., Teh S.J., Goldman C.R., 2009. Microcystin-LR toxicity on dominant copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi* of the upper San Francisco estuary. *Science of the Total Environment* 407 (2009) 4852–4857.
- Ger, K.A., Teh, S.J., Baxa, D.V., Lesmeister, S., Goldman, C.R., 2010. The effects of dietary *Microcystis aeruginosa* and microcystin on the copepods of the upper San Francisco Estuary. Freshwater Biology 55, 1548-1559.
- Ger K.A., Arneson P., Goldman CR, Teh S.J., 2010. Species specific differences in the ingestion of Microcystis cells by the calanoid copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi. Journal of Plankton Research* advance access published on 6/18/2010.
- Ger K.A., Panasso R., Lürling M., 2011. Consequences of acclimation to *Microcystis* on the selective feeding behavior of the calanoid copepod *Eudiaptomus gracilis*. *Limnology and Oceanography* 56(6):2103-2114.
- Glibert, P.M., 2010. Long-term changes in nutrient loading and stoichemetry and their relationship with changes in the food web and dominate pelagic fish species in the San Francisco Estuary. *Ca. Review in Fisheries Science* 18 (2), 211-232.
- Glibert P.M., Burkholder J.M., 2011. Harmful algal blooms and eutrophication: "Strategies" for nutrient uptake and growth outside the Redfield comfort zone. *Chinese Journal of Oceanology and Limnology* 29(4):724-738.
- Glibert, P.M., Fullerton, D., Burkholder, J.M., Cornwell, J., Kana, T.M., 2012. Ecological stoichemetry, biogeochemical cycling, invasive species, and aquatic food webs: San Francisco estuary and Comparative Systems. *Reviews in Fisheries Science* 19, 358-417.
- Greene V.E., Sullivan S.J., Thompson J.K., Kimmerer W.J., 2011. Grazing impact of the invasive clam *Corbula amurensis* on the microplankton assemblage of the northern San Francisco Estuary. *Marine Ecology Progress Series* 431:183-193.

1

Janice Piñero
June 28, 2012
Page E-5

- Grimaldo L.F., Stewart A.R., Kimmerer W., 2009. Dietary segregation of pelagic and littoral fish assemblages in a highly modified tidal freshwater estuary. *Marine and Coastal Fisheries* 1:200-217.

- Guo Y.C., Krasner S.W., Fitzsimmons S., Woodside G., Yamachika N., 2010. Source, fate, and transport of endocrine disruptors, pharmaceuticals, and personal care products in drinking water sources in California. National Water Research Institute, May 2010.

- Henery R.E., Sommer T.R., Goldman C.R., 2010. Growth and methylmercury accumulation in juvenile Chinook salmon in the Sacramento River and its floodplain, the Yolo Bypass. *Transactions of the American Fisheries Society* 139:550–563.

- Howe E.R., Simenstad C.A., 2011. Isotopic determination of food web origins in restoring ancient estuarine wetlands of the San Francisco Bay and Delta. *Estuaries and Coasts* 34:597-617.

- Israel J.A., Fisch K.M., Turner T.F., Waples R.S., 2011. Conservation of native fishes of the San Francisco Estuary: Considerations for artificial propagation of Chinook salmon, delta smelt, and green sturgeon. *San Francisco Estuary and Watershed Science* 9(1).

- Johnson M.L., Werner I., Teh S., Loge F., 2010. Evaluation of chemical, toxicological, and histopathologic data to determine their role in the pelagic organism decline. *IEP POD Synthesis Report.*

- Jones RH, Flynn KJ., 2010. Nutritional status and diet composition affect the value of diatoms as copepod prey. *Science* 307:1457-1549.

- Kimmerer W.J., 2011. Modeling delta smelt losses at the south Delta export facilities. *San Francisco Estuary and Watershed Science* 9(1).

- Knowles N., 2010. Potential inundation due to rising sea levels in the San Francisco Bay region. *San Francisco Estuary and Watershed Science* 8(1).

- Kusler J., 2009. Copepods of the San Francisco estuary: Potential effects of environmental toxicants. California Environmental Protection Agency, Department of Pesticide Regulation, Environmental Monitoring Branch, Surface Water Protection Program. Dated 9/3/2009.

- Lavado R., Loyo-Rosales J.E., Floyd E., Kolodziej E.P., Snyder S.A., Sedlak D.L., Schlenk D., In press. Site-specific profiles of estrogenic activity in agricultural areas o f California's inland waters. *Environmental Science and Technology.*

- Lehman, P.W., Teh, S.J., Boyer, G.L, Nobriga, M.L., Bass, E., Hogle, C., 2010. Initial Impacts of *Microcystis aeruginosa* blooms on the aquatic food web in the San Francisco

1

Estuary. *Hydrobiologia* 637: 229-249.

- Limborg M.T., Blankenship S.M., Young S.F., Utter F.M., Seeb L.W., Hanson M.H.H., Seeb J.E., 2011. Signatures of natural selection among lineages and habitats in *Oncorhynchus mykiss*. *Ecology and Evolution* DOI: 10.1002/ece3.59.

- Lindley, S.T., Grimes C.B., Mohr, M.S., Peterson, W., Stein, J., Anderson, J.T., Botsford, L.W., Bottom, D.L., Busack, C.A., Collier, T.K., Ferguson, J., Garza, A.M., Grover, D.G., Hankin, R.G., Kope., R.G., Lawson, P.W., Low., R.B., MacFarlane, K., Moore, M., Palmer-Zwahlen, F.B., Schwing, J., Smith, C., Tracy, R., Webb, B.K., Williams, T.H., 2009. What caused the Sacramento River fall Chinook stock collapse? Pre-publication report to the Pacific Fishery Management Council.

- Lucas L.V., Thompson J.K., Brown L.R., 2009. Why are diverse relationships observed between phytoplankton biomass and transport time? *Limnology and Oceanography* 54(1):381-390.

- MacNally R., Thomson J.R., Kimmerer W.J., Feyrer F., Kewman K.B., Sih A., Bennett W.A., Brown L., Fleischman E., Culberson S.D., Castillo G., 2010. Analysis of pelagic species decline in the upper San Francisco Estuary using multivariate autoregressive modeling (MAR). *Ecological Applications* 20(5):1417-1430.

- Maunder, M.N., Deriso, R., 2011. A state-space multistage life cycle model to evaluate population impacts on the presences of density dependence: illustrated with application to delta smelt (*Hyposmesus transpacificus*). *Can. J. Fish Aquatic Sci*. 68, 1285-1306.

- McClain J, Castillo G., 2010. Nearshore areas used by fry Chinook salmon, Oncorhynchus tshawytscha, in the northwestern Sacramento-San Joaquin Delta, California. *San Francisco Estuary and Watershed Science* 7(2).

- McKee L, Sutula M, Gilbreath A, Beagle J, Gluchowski D, Hunt J., 2011. Numeric nutrient endpoint development for San Francisco Bay estuary: Literature review and data gaps analysis. Southern California Coastal Water Research Project technical report 644.

- Miller, W.J., Manly, B. F. J., Murphy, D.D., Fullerton, D., Ramey, R.R., 2012. An investigation of factors affecting the decline of delta smelt (Hypomesus transpacificus) in the Sacramento- San Joaquin Estuary. *Reviews in Fisheries Science* 20:1. 1-19.

- Murphy DD, Weiland PS. 2010. The best route to best science in implementation of the Endangered Species Act's consultation mandate: The benefits of structured analysis. *Environmental Management* DOI 10.1007/s00267-010-9597-9.

- Murphy DD, Weiland PS, Cummins KW. 2011. A critical assessment of the use of surrogate species in conservation planning in the Sacramento-San Joaquin Delta, California (USA). *Conservation Biology* 25:873-878.

1

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- Newman K.B, Brandeis P.L., 2010. Hierarchical modeling of juvenile Chinook salmon survival as a function of Sacramento-San Joaquin Delta water exports. *North American Journal of Fisheries Management* 30:157-169.
- Nobriga M., 2009. Bioenergetic modeling evidence for a context-dependent role of food limitation in California's Sacramento-San Joaquin Delta. California Department of Fish and Game 95(3):111-121.
- Nobriga M, Herbold B., 2009. The little fish in California's water supply: A literature review and life-history conceptual model for delta smelt (*Hypomesus transpacificus*) for the Delta Regional Ecosystem Restoration and Implementation Plan (DRERIP). Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan.
- Norgaard R., Kallis G., Kiparsky M., 2009. Collectively engaging complex socio-ecological systems: Re-envisioning science, governance, and the California Delta. *Environmental Science and Policy* 12:644-652.
- Ostrach D., Groff J. Weber P., Ginn T., Loge F., 2009. The role of contaminants, within the context of multiple stressors, in the collapse of the striped bass population in the San Francisco estuary and its watershed. Year 2 final report for DWR agreement no. 4600004664.
- Parker, A.E., *et al.*, 2012. Elevated ammonium concentrations from wastewater discharge depress primary productivity in the Sacramento River and the Northern San Francisco Estuary. *Mar. Pollut. Bull.* doi: 10.1016/J.marpolbul.2011.12.016
- Parker, A.E., Marchi, A., Drexel-Davidson, J., Dugdale, R.C., Wilkerson, F.P., 2010. "Effect of ammonium and wastewater effluent on riverine phytoplankton in the Sacramento River, CA." Final Report to the State Water Resources Control Board. 73P.
- Peterson H.A., Vayssieres M., 2010. Benthic assemblage variability in the upper San Francisco estuary: A 27-year retrospective. *San Francisco Estuary and Watershed Science* 8(1).
- Pitt K.A., Welsh D.T., Condon R.H., 2009. Influence of jellyfish blooms on carbon, nitrogen and phosphorus cycling and plankton production. *Hydrobiologia* 616:133-149.
- Pyper, B., S. Cramer, R. Ericksen, R. Sitts., 2012. Implications of mark-selective fishing for ocean harvests and escapements of Sacramento River fall Chinook populations. Marine and Coastal Fisheries. In Press.
- Rigby M.C., Deng X., Grieg T.M., Teh S.J., Hung S.S.O., 2010. Effect threshold for selenium toxicity in juvenile splittail *Pogonichthys macrolepidotus A. Bulletin of Environmental Contaminants and Toxicology* 84:76-79.

1

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- Scheiff T, Zedonis P., 2010. The influence of Lewiston Dam releases on water temperatures of the Trinity and Klamath Rivers, CA, April to October, 2009. Arcata Fisheries Data Series Report Number DS 2010-17.
- Shoup D.E., Wahl D.H., 2009. The effects of turbidity on prey selection by piscivorous largemouth bass. *Transactions of the American Fisheries Society* 138:1018-1027.
- Sommer T, Reece K, Mejia F., 2009. Delta smelt life-history contingents: A possible upstream rearing strategy? *Interagency Ecological Program Newsletter* 22(1):11-13.
- Sommer TR, Reece K, Feyrer F, Baxter R, Baerwald M., 2010. Splittail persistence in the Petaluma River. *IEP Newsletter* 21:9-79.
- Sommer T., Mejia F.H., Nobriga M.L., Feyrer F., Grimaldo L., 2011. The spawning migration of delta smelt in the upper San Francisco Estuary. *San Francisco Estuary and Watershed Science* 9(2).
- Sommer T., Mejia F., Hieb K., Baxter R., Loboschevsky E., Loge F., 2011. Long-term shifts in the lateral distribution of age-0 striped bass in the San Francisco estuary. *Transactions of the American Fisheries Society* 140:1451-1459.
- Spromberg J.A., Scholz N.L., 2011. Estimating the future decline of wild Coho salmon populations resulting from early spawner die-offs in urbanizing watersheds of the Pacific Northwest, USA. *Integrated Environmental Assessment and Management* DOI: 10.1002/ieam.219.
- Stahle D.W., Griffin R.D., Cleaveland M.K., Edmondson J.R., Fye F.K., Burnette D.J., Abatzoglou J.T., Redmond K.T., Meko D.M., Dettinger M.D., Cayan D.R., Therrel M.D., 2011. A tree-ring reconstruction of the salinity gradient in the northern estuary of San Francisco Bay. *San Francisco Estuary and Watershed Science* 9(1).
- Teh, S., Flores, I., Kawaguchi, M., Lesmeister, S., Teh C., 2011. Final report, full life-cycle bioassay approach to assess chronic exposure of *Pseudodiaptomus* to ammonia/ammonium. Submitted to Central Valley Regional Water Quality Control Board, UCD Agreement No. 06-447-300, Subtask No. 14.
- Teh, S. J., S. Lesmeister, I. Flores, M. Kawaguchi, and C.Teh., 2009. Acute Toxicity of Ammonia, Copper, and Pesticides to *Eurytemora affinis*, of the San Francisco Estuary. Final report submitted to Inge Werner, UC-Davis.
- Thomson J.R., Kimmerer W.J., Brown L.R., Newman K.B., MacNally R., Bennett W.A., Feyrer F., Fleishman E., 2010. Bayesian change point analysis of abundance trends for pelagic fishes in the upper San Francisco Estuary. *Ecological Applications* 20(5):1431-1448.

1

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- Thompson B., Weisberg S.B., Melwani A., Lowe S., Ranasinghe J.A., Cadien D.B., Dauer D.M., Diaz R.J., Fields W., Kellogg M., Montagne D.E., Ode PR, Reish D.J., Slattery P.N., In press. Low levels of agreement among experts using best professional judgment to assess benthic condition in the San Francisco Estuary and Delta. *Ecological Indicators*.

- Tierney K.B., Baldwin D.H., Hara T.J., Ross P.S., Scholz N.L., Kennedy C.J., 2010. Olfactory toxicity in fishes. *Aquatic Toxicology* 96:2-26.

- Wagner R.W., Stacey M., Brown L.R., Dettinger M., 2011. Statistical models of temperature in the Sacramento-San Joaquin Delta under climate-change scenarios and ecological implications. *Estuaries and Coasts* 34:544-556.

- Werner I., Deanovic L.A., Markiewicz D., Khamphanh M., Reece C.K., Stillway M., Reece C., 2010. Monitoring acute and chronic water column toxicity in the northern Sacramento-San Joaquin estuary using the euryhaline amphipod, *Hyalella azteca*, 2006-2007. *Environmental Toxicology and Chemistry* 29(10):2190-2199.

- Weston, D. P., Lydy M.J., 2010. Urban and Agricultural Sources of Pyrethroid Insecticides to the Sacramento- San Joaquin Delta of California. Environmental Science and Technology, DOI: 10.1021/es9035573.

- Winder M,, Jassby A.D., 2010. Shifts in zooplankton community structure: Implications for food web processes in the upper San Francisco estuary. *Estuaries and Coasts*. DOI: 10.1007/s12237-010-9342-x

- Vogel D., 2011. Evaluation of acoustic-tagged juvenile Chinook salmon and predatory fish movements in the Sacramento-San Joaquin Delta during the 2010 Vernalis Adaptive Management Program. Natural Resource Scientists, Inc. October 2011.

- Yarrow M., Marin V.H., Finlayson M., Tironi A., Delgado L.E., Fischer F., 2009. The ecology of *Egeria densa* Planchon (Liliopsida: Alismatales): A wetland ecosystem engineer? *Revista Chilena de Historia Natural* 82:299-313.

- Zeug, S., Bergman P., Cavallo B., Jones K., 2012. Application of a life cycle simulation model to evaluate impacts of water management and conservation actions on an endangered population of Chinook salmon. Environmental Modeling and Assessment. In Press.

1

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EXHIBIT C

RATIONALE FOR EXCLUDING ALTERNATIVES FROM THE EIS THAT IMPOSE PROJECT OPERATIONAL RESTRICTIONS FOR MANAGING THE LOCATION OF X2 IN THE FALL

a. Recent Life-Cycle Models Uniformly Conclude That X2 Location Is Not A Significant Factor Affecting Subsequent Delta Smelt Abundance

In the last three years, peer-reviewed delta smelt life-cycle modeling studies have been undertaken by Maunder & Deriso (2011), MacNally et al. (2010), Thomson et al. (2010), and Miller et al. (2012). These published works have assessed the importance of a suite of factors on Delta fish species, with particular focus on delta smelt. None of the studies found evidence of a relationship between the location of X2 and subsequent delta smelt abundance. FWS, First Draft 2011 Formal ESA Consultation on Proposed Coordination of CVP and SWP p. 268 (Dec. 2011).

In addition, the National Research Council reviewed the studies the 2008 Delta Smelt OCAP biological opinion relied upon as support for regulating the position of fall X2 and concluded that the BiOp's reliance on Feyrer et al. (2007) was improper, due to the study's unacknowledged uncertainty arising from improperly linking several statistical models, as well as the lack of rigor in the analysis (National Research Council 2010). A federal district court also examined several of the studies relied upon in the BiOp, including Feyrer et al. (2007, 2011), and reached the conclusion that the best available science did not demonstrate a relationship between fall X2 location and subsequent delta smelt abundance (X2 Decision 2011). The court also noted that the Feyrer analyses were limited to an examination of abiotic habitat factors which ignored species' food supplies and other biotic factors. X2 Decision at 34-36, 132 (2011) (*In re Consol. Delta Smelt Cases*, 812 F. Supp. 2d 1133 (Aug. 31, 2011)). Moreover, the Feyrer studies themselves acknowledged that their analysis was limited and not appropriate for use as a regulatory mechanism (Feyrer et al. 2007).

b. Historical Survey Data Show That Delta Smelt Distribution Only Weakly Overlaps The LSZ, And Thus the LSZ Should Not Be Used As A Habitat Surrogate

Historic survey data show that regulating SWP and CVP operations to manage the location of fall X2 is unnecessary to expand the geographic area utilized by pelagic fish species, such as delta smelt. Contrary to assumptions relied upon, for example, in the 2008 Delta Smelt OCAP biological opinion, applicable survey and other data show that the distribution of delta smelt in the fall occurs over a wide range of environmental and salinity conditions ranging approximately 40 km from Suisun Bay to the Cache Slough region in nearly all years. The LSZ is often referred to as stretching from 0.5 to 6 psu; however, survey data show that delta smelt can be found at salinities substantially greater than 10 psu downstream from the LSZ, and are frequently found in substantial numbers in freshwater portions of the Delta upstream from the LSZ such as the Cache Slough Complex.

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Thorough analysis of data collected in California Department of Fish and Game ("CDFG") Fall Midwater Trawl ("FMWT"), 20 mm, and Summer Townet ("STN") surveys has failed to identify *any* correlation between the location of X2 in the fall and delta smelt distribution, reproduction, or food availability (Hanson 2011). Reclamation's own biologist, Matt Nobriga, testified during a hearing before the federal district court that: "I think that in terms of the historical data, that the three models probably indicate there's – that you're not going to find a correlation out of the historical data." *Consolidated Delta Smelt* Cases, 812 F. Supp. 2d 1133, 1160 (E.D. Cal. 2011). Thus, the analysis of survey data is consistent with the conclusions reached in the delta smelt life-cycle modeling efforts: there is no relationship between fall X2 location and delta smelt abundance.

More recent analyses of the historical survey data also show that the geographic distribution of delta smelt is much broader than previously acknowledged—covering more than 51,800 hectares and areas beyond the LSZ. Merz et al. (2011) extensively reviewed the relevant survey data and concluded that year-round populations of delta smelt are likely present in the lower Sacramento River to Suisun Marsh region, as well as in the Cache Slough, and Sacramento Deepwater Ship Channel region of the northern Delta. Merz et al. (2011) also noted observations of delta smelt at the most upstream sampling station locations, thus indicating that the current surveys may not capture the full extent of smelt distribution upstream of the LSZ. In terms of highest delta smelt densities, the study found that spawning seems to occur in vast regions of the Delta (i.e., Suisun Marsh, Cache Slough, the lower Sacramento River, and Napa River); rearing occurs mainly in Grizzly Bay and the lower Sacramento River; and adults (i.e., the migration phase) tend to occur further east, near the confluence of the Sacramento and San Joaquin Rivers and into the lower Sacramento River region. The existence of a year-round demographic unit of delta smelt in the Cache Slough region also demonstrates that it is likely not a semi-anadromous species as previously believed (Baxter et al. 2010).

The FMWT did not begin surveying in the Cache Slough and Sacramento River Deep Water Ship Channel region until 2009, and the STN survey was not expanded to these areas until 2011. Thus, previous studies ignored a substantial region occupied by the delta smelt population. Indeed, a federal district court, relying on admissions made by the primary author of the studies, found that Feyrer et al. (2007, 2011) studies did not consider the region of Cache Slough in their analyses. 812 F. Supp. 2d at 1155-56; 1201-1202. However, some of the highest densities of larva and juveniles have been sampled in this region in recent years, suggesting that the range of delta smelt spawning and rearing includes areas a significant distance from Suisun Bay. The current scientific consensus is that delta smelt are not restricted solely to the LSZ and that management efforts need to incorporate measures not singly focused on X2 location in the fall.

It is also beyond scientific dispute that habitat is a species-specific concept, and the habitat of a species includes the geographic areas it occupies, all the resources it uses, and the conditional states of those resources. X2 is a poor surrogate of habitat for delta smelt, not only because much of the population resides in areas outside the LSZ, but also because many parts of the LSZ have not been occupied by delta smelt during most of the past decade despite those areas' regularly having salinities within the LSZ range. Thus, it is apparent that delta smelt habitat is not defined by salinity because the LSZ in autumn only weakly overlaps the

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distribution of delta smelt. Because extensive areas of the LSZ do not support delta smelt, much of the LSZ should not be considered habitat for delta smelt.

In addition, the delta smelt located in the upstream, freshwater environment of Cache Slough—which in recent years have comprised as much as one-third of the total number of individuals observed in surveys—are largely unaffected by winter and spring objectives related to X2 and outflow. Rather than migrating upstream to spawn and downstream to rear, the delta smelt appear to simply spread out into available habitat.

c. Conclusion Re Fall X2

Productivity in the LSZ has been drastically limited by springtime suppression of phytoplankton blooms from ammonium loading and feeding by the *Corbula amurensis* clam, which has resulted in a reduced carrying capacity in the Suisun Bay region (Glibert 2010, Kimmerer 2009, Kimmerer 2006). However, the delta smelt occupies a much larger area than just the LSZ (Baxter et al. 2010, Hanson 2011). These and other factors show that regulatory efforts should be directed toward life-cycle modeling related to the relevant fish species to help better determine what factors (e.g., ammonium loading and food supply) are contributing to reductions in delta smelt abundance and how those factors can be addressed to improve the health and numbers of the species. Reclamation cannot promote an action based on a one-size-fits-all variable when there are many more complex interacting variables in the Delta ecosystem that must be addressed for the species' recovery.

The Public Water Agencies are legitimately concerned with FWS's and Reclamation's prior presumptions that the LSZ (and thus any impact from the SWP and CVP on the downstream extent of the LSZ) determines species abundance. Efforts to bolster this flawed hypothesis should be abandoned, the location of fall X2 should not be a primary focus of any regulatory regime, and efforts should rather focus on the proven drivers of species abundance that would improve habitat for delta fishes.

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EXHIBIT D

ENVIRONMENTAL IMPACTS

SLDMWA WWD SJRECWA 137

As explained above, the Public Water Agencies submit that a scientifically rigorous analysis of the effects of CVP and SWP operations in accordance with ESA section 7 will conclude that operations are not likely to jeopardize the listed species or adversely modify their critical habitat. Accordingly, no major changes to CVP and SWP operations should be required to comply with the ESA, and there should be no loss of water supplies and associated impacts. The proposed action should not include major changes to CVP and SWP operations. However, to the extent that Reclamation considers alternative actions involving changes to CVP and SWP operations, and those changes to operations would reduce water supplies, then Reclamation must analyze and disclose the associated impacts. The following discussion is intended to assist Reclamation in identifying potential impacts related to loss of CVP and SWP water supplies resulting from such alternatives.

1. <u>**Water Resources, Including Groundwater**</u>

SLDMWA WWD SJRECWA 138

Reduced deliveries of Delta water supplies into the service areas of the Public Water Agencies member agencies have demonstrable, dramatic, and undeniable impacts on groundwater pumping, risk of groundwater overdraft, local surface water supplies, provision of emergency services, the ability to suppress wildfires, and a host of other impacts. Operational changes to the projects necessary to meet OMR and other flow requirements can lead to increased reservoir releases in the spring, decreased reservoir releases in the summer, decreased reservoir carryover storage, and decreased Delta export pumping.

a. Loss Of Surface Water Supplies For End Users

By way of background, it is undeniable that reduced Delta exports result in reduced supplies in the SWP and CVP service areas. It was undisputed in the delta smelt and salmonid district court cases that "every acre-foot of pumping foregone during critical time periods is an acre-foot that does not reach the San Luis Reservoir where it can be stored for future delivery to users during times of peak demand in the water year."[1] It is also "beyond dispute" that water supply reductions from the BiOps have the potential to significantly affect the human environment.[2]

"The quantity of water lost through pumping reductions translates directly into water losses for urban and agricultural users."[3] "In the SWP service area, one acre-foot of water serves about five to seven people for one year."[4] "Water loss for agricultural users results in reduction

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[1] *Consolidated Salmonid Cases*, 713 F. Supp. 2d 1116, 1148 (E.D. Cal. 2010).
[2] *Consolidated Salmonid Cases*, 688 F. Supp. 2d 1013, 1034 (E.D. Cal. 2010).
[3] 713 F. Supp. 2d at 1151.
[4] 713 F. Supp. 2d at 1151; PI Transcript 186:25-187:1-3 (April 6, 2010).

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in the number of acres that may be sustained with actual water supply."[5] In the SWP service area, it takes approximately 3 acre-feet of water per acre to sustain a crop for a growing season.[6]

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b. Operational Constraints, Non-Project Factors, And Water Demand May Exacerbate Water Supply Impacts From Pumping Restrictions

The level of San Joaquin River flow at Vernalis affects OMR flows, which in turn affects the magnitude of the impact of the OMR flow restrictions.[7] Export facility capacities (either their physical capacity or their operational capacity) can restrict exports under wetter conditions, as occurred in the case of the SWP's pumping facilities on several occasions in January of 2011 due to equipment availability and personnel issues. Project demands can affect the level of exports. Irrigation demands, in particular, are low during the months of December through February, and begin to increase in March and during the later spring months. Storage capacity can restrict or expand exports, particularly during the winter months when demands for direct delivery of project water are lower. Exports at the SWP's Banks Pumping Plant can also be increased when the federal share of San Luis Reservoir fills and pumping capacity at the CVP's Tracy Pumping Plant is available to be used to enhance the pumping capacity otherwise available at the Banks Plant alone. Practical operational considerations can also restrict exports because the project operators will generally operate to meet a lower spring OMR flow level than that specified in the RPAs in order to ensure that they do not exceed the specified level. State Water Resources Control Board Water Right Decision 1641 also restricts exports based on several parameters including the export-to-total Delta inflow ratio, thus providing protections to listed species and their habitats.

c. Groundwater Overdraft, Subsidence, Resulting Dangers

Reductions in Delta exports have a direct impact on groundwater levels across the Public Water Agencies' service areas, particularly in agricultural regions.[8] Reduced Delta water means that Public Water Agencies will not be able to replenish and store groundwater, or will be able to do so at a reduced rate, and will also need to rely more heavily upon groundwater reserves to meet demand.[9]

Shortage of surface water supplies, and the corresponding reliance on groundwater supplies, also leads to groundwater overdraft, which occurs when pumping exceeds the safe yield of an aquifer.[10] When water is removed from the spaces between the particles in the sediment,

[5] 713 F. Supp. 2d at 1151.
[6] 713 F. Supp. 2d at 1151; PI Transcript 87:22-25 (April 6, 2010).
[7] *See* Erlewine Decl. (Doc 816) at 3, Delta Smelt Consol. Cases (Feb. 2011).
[8] *Consolidated Delta Smelt Cases*, 812 F. Supp. 2d 1133, 1182-87 (E.D. Cal. 2011); Leahigh 2nd Supplemental Declaration re X2 Injunction (Doc. 1006) ¶7, *Consol. Delta Smelt Cases* (Aug. 10, 2011); Erlewine X2 Declaration (Doc. 915) pp. 8-9, *Consol. Delta Smelt Cases* (June 16, 2011).
[9] *Id.*
[10] 713 F. Supp. 2d at 1153; Erlewine X2 Declaration (Doc. 915) pp. 9-11, *Consol. Delta Smelt Cases* (June 16, 2011).

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the soils compact, which reduces the volume for water storage.[11] Long-term impacts resulting from overdraft include land subsidence and damage to water conveyance facilities.[12]

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Land subsidence is the sinking of the Earth's surface due to subsurface movement of earth materials. The major cause of subsidence in the southwestern United States is the overdrafting of aquifers. The negative effects of land subsidence include the permanent loss of groundwater storage space and changes in elevation and the slope of streams, canals, and drains.[13] Additionally, in some areas where groundwater levels have declined, surface streams lose flow to adjacent groundwater systems.[14] These losses entail significant impacts to hydrology, as well as the biological systems that depend on those groundwater or surface flows. In additon, land subsidence can lead to cracks and fissures at the land surface, which may damage bridges, roads, railroads, storm drains, sanitary sewers, canals, levees, and private and public buildings. Furthermore, land subsidence leads to the failure of well casings,[15] which will require additional well drilling and attendant environmental impacts to air quality.

While urban areas are especially vulnerable to the damaging effects of subsidence, the largest occurrence of land subsidence in the world induced by human activity occurred in California's Central Valley. Prior to the commencement of CVP and SWP surface water imports to the San Joaquin Valley, parts of northwestern Fresno County experienced land subsidence of up to 30 feet as a result of groundwater overdraft in the area.[16] Large portions of the Kern County groundwater basin also experienced subsidence due to overdraft of the aquifer and the lowering of its hydraulic head. In the San Joaquin River and Tulare Lake regions, for example, an area of 5,200 square miles registered at least 1 foot of subsidence.[17] Land subsidence related to groundwater overdraft exceeded 12 feet in portions of Tulare County and 9 feet in the Arvin-Maricopa area.[18]

Since SWP and CVP operations commenced, imported water from the projects has largely eliminated widespread and large-scale subsidence. However, further loss of project water for export threatens to entirely reverse this trend. To the extent the new BiOps involve additional export restrictions, even more groundwater pumping will be required to meet demand, with attendant environmental impacts.[19]

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[11] Declaration of Russ Freeman (Doc. 170) at 5, *Consol. Salmonid Cases* (Jan. 27, 2010).
[12] 713 F.Supp. 2d at 1153; 812 F. Supp. 2d at 1187; Erlewine X2 Declaration (Doc. 915) pp. 9-11, *Consol. Delta Smelt Cases* (June 16, 2011); Declaration of Russ Freeman (Doc. 170) at 5-6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[13] Beck letter, *supra*, at p. 3; Leake, *supra*, at pp. 1-2.
[14] Central Valley Project Improvement Act ["CVPIA"] Programmatic EIS ["PEIS"] (1997) at p. II-5.
[15] Leake, *supra*, at pp. 1-2.
[16] CVPIA PEIS, *supra*, at p. II-28.
[17] *Id.* at pp. II-10, II-28.
[18] *Id.* at pp. II-42, II-43.
[19] Beck letter, *supra*, at p. 2.

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d. Increased Demand Upon Alternative Water Supplies Such As Local Surface Water, Local Groundwater, And Colorado River Water

Reduced SWP water supplies will result in increased reliance on Colorado River supplies, which are conveyed through Metropolitan Water District's Colorado River Aqueduct.[20] However, Colorado River supplies have been limited to a basic apportionment of 550,000 acre-feet per year, and they are generally high in salinity (averaging 700 mg/L of total dissolved solids (compared to SWP concentrations that range from 200-300 mg/L)).[21] Thus, blending of SWP water is needed to make use of Colorado River supplies. SLDMWA WWD SJRECWA 138

e. Responding To Emergencies, Including Earthquakes, Wildfires

Lost surface and groundwater reserves due to reductions and shortages in project supplies additionally impact the ability to store water for dry years and emergencies. This reduced water storage makes areas across central and southern California increasingly vulnerable to emergencies such as wildfires, because less water is available to suppress and control wildfires and to respond to other emergencies.[22]

If a severe earthquake occurred that disrupts or damages SWP infrastructure, inadequate surface and groundwater reserves would also put human health and safety at risk.[23] Furthermore, earthquake damage to levees inside the Delta could significantly disrupt Delta exports and cause the loss of millions of acre-feet of water, further constraining water supplies if adequate reserves are not replenished and maintained with adequate SWP and CVP supplies.[24]

2. <u>Land Use, Including Agriculture</u>

Reduced project deliveries, and the resulting unavailability of adequate water supplies, will result in significant changes in land use. Related impacts include the removal of prime agricultural land from production, fallowing of land, loss of topsoil, shifts toward planting permanent crops, reduced production and yield of crops due to reduce water quality, increased costs to obtain supplemental water, and negative impacts to water management plans that act as source documents for evaluating land use projects. SLDMWA WWD SJRECWA 139

a. Fallowing Land And Taking Prime Agricultural Land Out Of Production

The federal district court in the *Consolidated Salmonid Cases* found that evidence was established that water losses caused by the NMFS BiOp's RPA would result in a variety of adverse impacts to the human environment, including "irretrievable resource losses" from the

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[20] MWD (Nov. 2008).
[21] MWD (Nov. 2008).
[22] *See* MWD (Nov. 2008); DWR, California's Drought, Water Conditions & Strategies to Reduce Impacts pp.16-17 (March 2009); Governor's Proclamation, State of Emergency-Water Shortage p.3 (Feb. 27, 2009).
[23] *See* MWD (Nov. 2008).
[24] DWR Delta Risk Management Strategy (Feb. 2009) available at http://www.water.ca.gov/floodmgmt/dsmo/sab/drmsp/docs/drms_execsum_ph1_final_low.pdf.

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loss of "permanent crops, fallowed lands, destruction of family and entity farming businesses [and] social disruption and dislocation…."[25]

Agricultural operations in Fresno County, Tulare County, Kern County, San Diego County, and other areas of the State rely on Delta water, and this supply of water has already been impaired by the prior BiOps, with concomitant environmental effects. Farmers have been forced to fallow hundreds and thousands of acres of prime agricultural land as a result of reduced water supplies and uncertainty regarding future water supply.[26] As previously noted, in the SWP service area, it takes approximately 3 acre-feet of water per acre to sustain a crop for a growing season.[27] In the CVP service area, it has been estimated that approximately 400 acres of land may remain out of production for every 1000 acre-feet of water lost.[28] Thus for any reductions in the water supply there will be commensurate reductions in the acreage of crops that can be sustained. Conversely, farmers anticipate that increased water allocations would mitigate anticipated damage to crops in proportion to the amount of water received.[29]

b. Losing Top Soil Due To Erosion

The fallowing of land also leads to greater soil erosion from wind and water, which comprises an additional irretrievable resource loss.[30] Such actions may result in substantial soil erosion and loss of topsoil.[31]

c. Shift To Permanent Crops

Reductions in water supplies have resulted in changed farming practices, such that more permanent crops are grown.[32] However, permanent crops carry an additional risk, because farmers cannot cut back further on the water supply without destroying the crops.[33]

d. Salt Intolerance Limits Some Crops From Being Produced And Reduces Yields

In response to reduced surface water deliveries, farmers must increase their reliance on groundwater, which in many locations is an inferior water source due to its higher salinity.[34] Unfortunately, not all fields and crops can be irrigated with groundwater, and the increased soil salinity from irrigating with saline groundwater impacts the ability to grow certain salinity

[25] 713 F. Supp. 2d at 1153; Declaration of Russ Freeman (Doc. 170) at 3, *Consol. Salmonid Cases* (Jan. 27, 2010).
[26] 713 F. Supp. 2d at 1152; Declaration of Russ Freeman (Doc. 170) at 3-4, *Consol. Salmonid Cases* (Jan. 27, 2010).
[27] 713 F. Supp. 2d at 1152.
[28] 713 F. Supp. 2d at 1152.
[29] 713 F. Supp. 2d at 1151.
[30] *Consolidated Salmonid Cases*, 688 F. Supp. 2d 1013, 1033-34 (E.D. Cal. 2010).
[31] Beck letter, *supra*, at p. 3.
[32] 713 F. Supp. 2d at 1151.
[33] 713 F. Supp. at 1151-52.
[34] 713 F. Supp. 2d at 1153; Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).

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intolerant crops in those areas.[35] Because some crops are particularly sensitive to salinity concentrations, the use of high-salinity water may reduce the yields of these crops.[36] SLDMWA WWD SJRECWA 139 continued

e. **Increased Cost And Infeasibility Of Supplemental Water**

Farmers would be required to make up for any shortfall in imported water deliveries by purchasing supplemental water at drastically increased costs, if such supplemental water is even available.[37]

f. **Impacts To Water Management Planning Related To Land Use**

California law requires all urban water suppliers to prepare urban water management plans every five years to ensure adequate water supplies and for use as a source document for analyzing water supply issues for specific projects under SB 610, SB 221, and the California Environmental Quality Act. The plans must identify and discuss factors affecting current and projected water supplies and demand, and they must identify steps being taken to ensure availability and reliability of supplies. ESA regulatory restrictions that reduce water deliveries for the protection of fish species are one of the main constraints facing water suppliers for providing adequate supplies.[38] Therefore, development projects and land use planning decisions that depend on these plans will also be constrained by any future imported water supply reductions caused by the new BiOps.

3. <u>**Socioeconomics**</u>

Reduced Delta water supplies also cause socioeconomic impacts. In response to reduced water supplies, farmers fallow fields and this reduced agricultural productivity results in layoffs, reduced hours for agricultural employees, and increased unemployment in agricultural communities. Reduced agricultural productivity also has socioeconomic impacts for agriculuture-dependent business and industries. In addition, the unavailability of stable and sufficient water supplies reduces farmers' ability to obtain financing and result in employment losses, due to the reduced acreage of crops that can be planted and the corresponding reduction in the amount of farm labor needed to manage that reduced acreage. Reduced project export water supplies and the resulting employment losses also cause cascading socioeconomic impacts in affected communities, including increased poverty, hunger, and crime, along with dislocation of families and reduced revenues for local governments and schools. SLDMWA WWD SJRECWA 140

[35] *See* 713 F. Supp. 2d at 1153; Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[36] MWD (Nov. 2008); Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[37] 713 F. Supp. 2d at 1151.
[38] Southern California Water Committee, Urban Water Management Plans Fact Sheet, available at http://www.socalwater.org/images/SCWC.UWMP_Fact_Sheet.9.21.11.pdf.

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a. **Lack Of Ability To Obtain Financing**

Water supply uncertainties interfere with farmers' abilities to secure financing for continuing their farming operations.[39] Reduced water availability from the projects frequently results in depletion of supplemental water supplies from local groundwater, which removes the additional water supplies that would be needed for obtaining financing for farming operations.[40] Additionally water constraints would lead to increased payments for supplemental water, which would further affect farmers' cash flows.[41] These financial constraints affect hiring decisions, strain liquidity, and create difficulties for farmers in meeting their payroll obligations.[42]

SLDMWA WWD SJRECWA 140 continued

b. **Employment Losses And Resulting Community Impacts**

Water supply losses can also be linked to unemployment and related sociological impacts, including poverty, hunger, and crime.[43] Regardless of the season, socioeconomic impacts are likely to result from reduced water supplies.[44] For example, the 2009 delivery reduction that resulted from implementing FWS's 2008 BiOp's RPA resulted in a loss of 9,091 jobs in the San Joaquin Valley, relative to the year 2005, most likely as a result of reduced agricultural acreage under production.[45] Even during wet years, reduced water supplies caused by imposing onerous RPAs can impact employment.[46]

Increased project water allocations prevent layoffs to farm employees.[47] It was undisputed in the federal district court "that farm employees and their families have faced devastating losses due to reductions in the available water supply" and that severe impacts have occurred in the farm economy due to a combination of drought and diversion limitations from the BiOps.[48] The decrease in productive agricultural acres resulted in reduced employee hours, salaries, and positions, which had devastating effects on farm employees and their families.[49] The removal of 250,000 acres from production translated into the loss of approximately 4,200 permanent agricultural worker positions, with even more jobs lost in adjunct businesses, such as packing, processing, and other related services.[50] In spring 2010, it was estimated that wage losses in the agriculture industry would be as much as $1.6 billion during that year.[51]

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[39] 812 F. Supp. 2d at 1187; Stiefvater Declaration re X2 Injunction (Doc. 918) *Consol. Delta Smelt Cases* (June 16, 2011); Mettler Declaration re X2 Injunction (Doc. 919) *Consol. Delta Smelt Cases* (June 16, 2011); 713 F. Supp. 2d at 1152.
[40] 812 F. Supp. 2d at 1187-88.
[41] 812 F. Supp. 2d at 1187-88.
[42] 812 F. Supp. 2d at 1187-88.
[43] 812 F. Supp. 2d at 1188; Sunding Declaration re X2 (Docs. 916 & 986) *Consol. Delta Smelt Cases* (June 16, 2011 & July 15, 2011).
[44] 812 F. Supp. 2d at 1187-88; Sunding Declaration re X2 (Docs. 916) at 1, *Consol. Delta Smelt Cases* (June 16, 2011).
[45] 812 F. Supp. 2d at 1188.
[46] 812 F. Supp. 2d at 1188.
[47] 713 F. Supp. 2d at 1151; Declaration of Chris Hurd (Doc 171) at 3, *Consol. Salmonid Cases* (Jan. 27, 2010).
[48] 713 F. Supp. 2d at 1152; Declaration of Daniel G. Nelson (Doc 172) at 4, *Consol. Salmonid Cases* (Jan. 27, 2010).
[49] 713 F. Supp. 2d at 1152; Declaration of Chris Hurd (Doc 171) at 2, *Consol. Salmonid Cases* (Jan. 27, 2010).
[50] 713 F. Supp. 2d at 1152; Declaration of Russ Freeman (Doc 170) at 7, *Consol. Salmonid Cases* (Jan. 27, 2010).
[51] 713 F. Supp. 2d at 1152; Declaration of Chris Hurd (Doc 171) at 3, *Consol. Salmonid Cases* (Jan. 27, 2010).

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Unemployment resulting from water delivery reductions has led to hunger in the impacted San Joaquin Valley communities. For example, one food bank serving Fresno, Madera, and Kings Counties estimated in 2010 that 435,000 people in the area did not have a reliable source of food, that hunger in these communities would continue to increase, and that at least 42,000 people served by the food bank in October 2009 were employed in the farm industry before losing their jobs.[52]

SLDMWA WWD SJRECWA 140 continued

4. **Environmental Justice**

Although the impacts from reduced water supplies will have significant impacts on people and farmland throughout the state, the hardest hit areas will be in predominantly poor and minority communities—especially in the Central Valley where employment losses and environmental effects will be the most prevalent. These characteristics of the counties in the San Joaquin Valley are illustrated in the tables below, using data from the U.S. Census Bureau.[53]

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County	Race/Ethnicity, percent of persons, 2010							
	White	Black	American Indian, Alaska Native	Asian	Native Hawaiian, Other Pacific Islander	Reporting 2+ Races	Hispanic or Latino Origin	White Persons Not Hispanic
Fresno	55.4	5.3	1.7	9.6	0.2	4.5	50.3	32.7
Kern	59.5	5.8	1.5	4.2	0.1	4.5	49.2	38.6
Kings	54.3	7.2	1.7	3.7	0.2	4.9	50.9	35.2
Madera	62.6	3.7	2.7	1.9	0.1	4.2	53.7	38.0
Merced	58.0	3.9	1.4	7.4	0.2	4.7	54.9	31.9
San Joaquin	51.0	7.6	1.1	14.4	0.5	6.4	38.9	35.9
Stanislaus	65.6	2.9	1.1	5.1	0.7	5.4	41.9	46.7
Tulare	60.1	1.6	1.6	3.4	0.1	4.2	60.6	32.6
California	57.6	6.2	1.0	13.0	0.4	4.9	37.6	40.1

County	Income, 2006 - 2010		
	Per Capita Money Income in Past 12 Months (2010 dollars)	Median Household Income	Persons below Poverty Level
Fresno	$20,329	$46,430	22.50%
Kern	$20,100	$47,089	20.60%
Kings	$17,875	$48,684	19.30%
Madera	$18,724	$46,039	19.30%
Merced	$18,041	$43,844	21.80%
San Joaquin	$22,851	$54,341	16.0%
Stanislaus	$22,064	$51,094	16.40%
Tulare	$17,966	$43,851	22.90%
California	$29,188	$60,883	13.70%

[52] 713 F. Supp. 2d at 1153; Declaration of Dana Wilkie (Doc 173) *Consol. Salmonid Cases* (Jan. 27, 2010).
[53] Information gathered from the U.S. Census Bureau, at: http://quickfacts.census.gov/qfd/states/06/06107.html.

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This is even more apparent at the level of local communities within these counties. According to U.S. Census Bureau data, in Huron 96.6% of the population is of Hispanic or Latino origin, and 54.5% of the population is below poverty level. In Mendota, 96.6% of the population is of Hispanic or Latino origin, and 44.6% of the population is below poverty level. In Firebaugh, 91.2% of the population is of Hispanic or Latino origin, and 33.5% of the population is below poverty level. In 2009, each of these communities suffered severe dislocation as a result of water shortages brought about in significant part by ESA related restrictions on water supplies. SLDMWA WWD SJRECWA 141 continued

5. **Biological Resources, Including Fish, Wildlife, And Plant Species**

Reduced delta water supplies will have impacts on biological resources, including the reduced ability to supply areas dependent on water supplies from the projects, including wetlands that are maintained, in part, by those supplies. An indirect impact of resulting reduced agricultural production will be the proliferation of weeds and other invasive species, which adversely affect other biological resources. SLDMWA WWD SJRECWA 142

The EIS will also have to determine and show whether there is any biological benefit to the listed species associated with the alternatives being evaluated. These issues need to be fully addressed in the EIS.

a. Lack Of Water For Wetlands And Species Outside The Delta

Although a biological opinion's purpose is to aid the recovery of listed species, if the expected new BiOps result in reduced project exports, there will also be a significant impact on other protected species, which impacts should be analyzed.

For example, the northwestern portion of Kern County is home to 14,000 acres of flooded water habitat, including the Kern National Wildlife Refuge, where migratory birds, including protected and listed species, nest and feed during the fall and winter. An additional 11,000 acres of recharge ponds are located in the Kern River fan area, which provides seasonal habitat during recharge cycles. These complexes depend on the fall and winter delivery of imported surface water to provide for migratory bird habitat. If the federal action significantly decreases water exports, no Delta water will be available to fill these ponds. Because local surface water supplies to fill the ponds are only available in locally wet years, curtailment of imported water deliveries for the purported benefit of salmonid and delta smelt species would result in the destruction of this habitat for other protected species.[54]

Another example of protected and listed species that could be harmed is found within the boundaries of the Santa Clara Valley Water District—which receives water from both the SWP and CVP. Of the 163 miles of local streams used by Santa Clara for instream groundwater recharge, 129 miles are considered to be habitat for threatened or endangered species, including 32 species of plants, 50 species of wildlife, six amphibians, and three aquatic species listed as special status species under State or federal law. Local reservoirs, streams, and artificial recharge ponds provide habitat for 11 native species and 19 nonnative species of fish. Populations of protected steelhead trout are known to exist in Coyote Creek, Guadalupe River,

[54] Beck letter, *supra*, at p. 3.

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Stevens Creek, and San Francisquito Creek and their tributaries. Santa Clara's average in-stream flow releases for groundwater recharge are normally about 104,000 acre-feet. Project export restrictions could reduce these flow releases, which in turn could significantly impact these species.[55] SLDMWA WWD SJRECWA 142 continued

Furthermore, in the San Joaquin Valley, there are protected oak woodlands that serve as habitat for many other sensitive species. These woodlands and the species they support rely on groundwater and would be injured by further drops in groundwater levels due to increased pumping in response to a curtailment of imported water deliveries.[56] Similar impacts would be felt on other protected species throughout the SWP and CVP service areas. These potential impacts to other listed species must be analyzed in the EIS.

b. Proliferation Of Weeds

Non-cultivated fallow fields can be excellent habitat for non-native weed species such as tumbleweeds (Russian thistle), which break from the soil and are transported with the wind. Proliferation of these weeds in turn "clog irrigation systems, are hazardous to automobile traffic, spread wildfires and harbor insect pests that transmit viruses to many vegetable crops."[57]

c. Beneficial Effects On The Listed Delta Species

The EIS must analyze both adverse and beneficial effects.[58] Therefore, a discussion must also be included to show the beneficial effects of the action, if any, on the listed species. These statements must be objective, balanced, and substantiated with evidence.

6. <u>Water Quality</u>

Reduced imported water supplies impact water quality by reducing water agencies' abilities to blend lower quality water with the higher quality Delta water. For example, local water agencies' beneficial use of recycled water frequently requires blending. Increased reliance on groundwater supplies also affects water quality by drawing in unusable saline, poor quality water from areas adjacent to usable sources. Use of groundwater also impacts the water quality of surface water streams due to the leachates that are present in the groundwater that becomes runoff into local streams. SLDMWA WWD SJRECWA 143

a. Need For High Quality Delta Water For Blending

Because of varying levels of quality in the water sources available, some water agencies must manage the salinity of the water they provide in order to maximize water use and meet the

[55] *See* Declaration of Joan Maher in Reply to Proposal on Interim Remedy, *NRDC v. Kempthorne*, No. 1:05-cv-1207-OWW-LJO ¶ 17 (Aug. 10, 2007).
[56] Beck letter, *supra*, at p. 3.
[57] Lincoln Smith, Biological Control of Russian Thistle (Tumbleweed) (2008) http://www.cwss.org/proceedingsfiles/2008/90_2008.pdf.
[58] Ron Bass, The NEPA Book p 110 (2001); 40 C.F.R. § 1508.8 ("Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.")

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demands for drinking water of the citizens they serve. Water from the Delta, which is of high quality, is necessary to allow for the utilization of other water supplies. For example, Delta water is frequently mixed with lower quality water from other sources before it is provided to Southern California residents for drinking and agricultural uses. The saline geology in the Colorado River Basin causes water from that source to generally be high in total dissolved solids, averaging about 700 mg/L. By contrast, SWP supplies tend to have low TDS concentrations in the range of 200-300 mg/L.[59] Because Colorado River water is highly saline, State Contractor member agencies that use Colorado River water, including Metropolitan, must blend that water with higher quality SWP water in order for the Colorado River water to be usable for drinking water uses or for water banking.[60]

SLDMWA WWD SJRECWA 143 continued

Metropolitan's blending practices provide an example of the necessity of high quality SWP water deliveries. Metropolitan has adopted a policy to achieve blends of these source waters that do not exceed TDS concentrations of 500 mg/L. Metropolitan adopted this standard because salinities higher than this level would increase service costs, decrease the amount of water available, and reduce operating flexibility. For example, high salinity water has a residential impact resulting from the increased degradation of water heaters and other plumbing fixtures. Further, direct treatment of saline water without blending is costly and typically results in losses of up to 15 percent of the water processed. In addition, water with a high salinity content results in more saline wastewater, which lowers its usefulness and increases the costs of treating and utilizing recycled water.[61] If low salinity water is not available, membrane treatment must be used, which result in losses of up 15 percent of the water processed and increased costs.[62]

Unless higher salinity water is treated or blended, it will affect agricultural use and degrade the quality of soils in their service areas. In addition, degradation of the water available for groundwater recharge could limit the use of local groundwater basins for storage due to the inability to meet basin plan water quality objectives established by the RWQCBs. Thus, when SWP supply water is inadequate to blend with more saline Colorado River water supplies, imported Colorado River water cannot be used to recharge groundwater basins without concern for compromising the water quality objectives of the groundwater basins.[63] This would exacerbate the impacts to groundwater caused by any water curtailments required by the action.[64]

b. Inability To Use Recycled Water

Groundwater basins within the service areas of some of the SWC's member agencies are recharged with recycled water, thereby reducing the demand for imported water. However, each cycle of urban use of recycled water typically adds 250 to 400 milligrams per liter ("mg/L") of total dissolved solids ("TDS"). When wastewater flows already have high salinity concentrations, the use of recycled water becomes more limited or will require much more

[59] Metropolitan, *Impacts of Loss of SWP Supplies*, *supra*, at p. 1.
[60] Andrev, John T., *Water Quality, California, 2004: California Water Plan Update 2005*, at pp. 21-22.
[61] Metropolitan, *Impacts of Loss of SWP Supplies*, *supra*, at p. 1; CVPIA PEIS, *supra*, at p. II-16, attached hereto and made a part hereof.
[62] Metropolitan, *Impacts of Loss of SWP Supplies*, *supra*, at p. 1.
[63] Metropolitan, *Impacts of Loss of SWP Supplies*, *supra*, at p. 3.
[64] Metropolitan, *Impacts of Loss of SWP Supplies*, *supra*, at p. 1.

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expensive treatment. Consequently, more and more high quality blend water is required to render this recycled water usable for groundwater recharge and other activities. Some Regional Water Quality Control Boards of the State of California ("RWQCBs") have adopted water quality control plans for groundwater basins within their jurisdictions that include watr quality objectives for maximum amounts of TDS. When inadequate amounts of high-quality SWP or CVP blend water are available to meet the water quality requirements of RWQCB orders for recycled water recharge, recycled water cannot be used for recharge and member agencies must consequently defer, or abandon, water recharge efforts. Loss of high quality water to blend with recycled water for recharge thus contributes to additional groundwater recharge losses and the growing overdraft of groundwater basins in Southern California and the San Joaquin Valley.[65] SLDMWA WWD SJRECWA 143 continued

Recycled water is also frequently used for landscape and agricultural irrigation, as well as industrial applications. However, such reuse becomes problematic at TDS concentrations of more than 1,000 mg/L. Some crops are also particularly sensitive to high TDS concentrations, and the use of high salinity recycled water may reduce the yields of these crops. In addition, concern for water quality in groundwater basins may lead to restrictions on the use of recycled water for irrigation on lands overlying those basins. In the past, reduced SWP supplies have been responsible for increased total dissolved solids concentrations in Metropolitan's blends, which has resulted in documented impacts to Metropolitan's ability to utilize recycled water and provide replenishment service to groundwater basins.[66] Further reductions in delivered SWP and CVP supplies would result in even greater impacts of this type in Metropolitan's and other service areas.[67]

c. Increased Infiltration Of Poor Quality Water In The San Joaquin Valley

In the San Joaquin Valley, there are large areas of saline, poor quality groundwater adjacent to usable, higher quality groundwater.[68] When replenishment of groundwater is reduced, higher quality groundwater levels are drawn down and cause the poor-quality groundwater to be intermixed with good-quality groundwater, thus leading to significant groundwater quality impacts.[69]

d. Runoff Affects Streams

There could also be potential impacts to local streams and wildlife caused by the heavier reliance upon water groundwater for irrigation.[70] Selenium levels are often high in runoff from farms due to concentrations found in the groundwater.[71]

[65] Metropolitan, *Impacts of Loss of SWP Supplies, supra*, at p. 3.
[66] Metropolitan, *Impacts of Loss of SWP Supplies, supra*, at p. 4.
[67] Metropolitan, *Impacts of Loss of SWP Supplies, supra*, at p. 3.
[68] 812 F. Supp. 2d at 1187.
[69] 812 F. Supp. 2d at 1187.
[70] 688 F. Supp. 2d at 1033-34.
[71] *See, e.g.*, Reclamation, Grassland Bypass Project, http://www.usbr.gov/mp/grassland/.

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7. Air Quality

SLDMWA WWD SJRECWA 144

Reduced delta water supplies impact air quality in areas that can no longer sustain the same acreage of agricultural crops because of the increased dust and particulate emissions resulting from land fallowing. There will also be emission impacts related to the greater amount of energy that is needed for groundwater well pumps to lift water from a lower depth due to the greater reliance on groundwater reserves.

a. Dust From Fallowing

Water losses caused by reduced project exports can result in air quality reduction because fallowing land increases the levels of airborne dust and particulate matter.[72] Non-irrigated fields in this semi-arid region can often produce dust during frequent wind events that occur throughout the region compounding the already significant number of respiratory ailments associated with the San Joaquin Valley such as asthma. Increased airborne dust also increases the risk of exposure to a fungus that lives in the San Joaquin Valley soils, which causes the infection commonly referred to as "Valley Fever." Valley Fever typically causes an infection in the lungs but in some cases, the infection spreads throughout the body and can cause death.

The San Joaquin valley is designated as nonattainment for PM 2.5 and PM 10 under state standards, and for PM 2.5 under federal standards.[73] Those conditions are worsened by dust emissions resulting from water shortages. For example, additional fallowing and under-irrigation of agricultural lands that could result in Kern County Water Agency, one of the SWC member agencies, due to further restrictions on Delta exports could add hundreds of tons per year of wind-borne particulates in the air in the San Joaquin air basin.[74] The same emission effect occurs from reductions in CVP water supplies to members of the SLDMWA that serve agricultural uses.

As one study explained: "Wind-blown fugitive dust is a widespread problem in the arid west resulting from land disturbance or abandonment and increasingly limited water supplies. Soil-derived particles obstruct visibility, cause property damage and contribute to violations of health-based air quality standards for fine particles (PM-10). These dry lands are often difficult to revegetate, yet they may require immediate stabilization. … As the forces exerted by the wind overcome the forces that bind soil particles to the surface, soil loss occurs. Dislodged soil particles may roll across the surface (creep), or they may bounce (saltation), dislodging further particles with each impact. This process leads to a cascade effect resulting in massive emissions of dust. Fugitive dust affects crops and native vegetation by abrading and burying plants and by blocking sunlight."[75]

In addition to addressing such impacts under NEPA, Reclamation and the other federal agencies involved here must comply with the federal Clean Air Act, 42 U.S.C. § 7401 et seq.

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[72] 713 F.Supp. 2d at 1152; Declaration of Russ Freeman (Doc 170) at 7-8, *Consol. Salmonid Cases* (Jan. 27, 2010).
[73] San Joaquin Valley Unified Air Pollution Control District, http://www.valleyair.org/aqinfo/attainment.htm.
[74] Beck letter, *supra*, at p. 3.
[75] *California Agriculture* 52(4):14-18. DOI: 10.3733/ca.v052n04p14. July-August 1998.

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Among other requirements, no federal agency is permitted to engage in an activity that does not conform to an implementation plan. 42 U.S.C. § 7506. SLDMWA WWD SJRECWA 144 continued

b. **Emissions From Pumping Lift Increases**

Increased reliance on groundwater reserves for water supplies also results in increased energy use due to increased pumping lift needed to access deeper groundwater.[76]

8. **Soils, Geology, And Mineral Resources**

SLDMWA WWD SJRECWA 145

Reduced Delta water supplies could impact soils, geology, and mineral resources, by causing, for example: 1) groundwater overdraft and the resulting subsidence of the soil; 2) the fallowing of lands and the resulting loss of topsoil; and 3) increased reliance on lower quality saline groundwater sources and the resulting increase in soil salinity.

a. **Subsidence**

As previously noted, surface water shortages and corresponding increases in groundwater usage lead to groundwater overdraft, which occurs when pumping exceeds the safe yield of an aquifer.[77] When water is removed from the spaces between sediments, the soil compact and lose their voume.[78] Long-term impacts resulting from overdraft include land subsidence and damage to infrastructure, including water conveyance facilities.[79]

b. **Loss Of Topsoil**

As discussed above, fallowing land increases the levels of airborne dust and particulate matter, which thus results in greater erosion and loss of topsoil resources from prime agricultural land.[80]

c. **Increased Reliance On Groundwater Degrades The Quality Of The Soil**

As previously noted, increased reliance on groundwater reduces the quality of water applied to the soil because groundwater is often more saline than surface water supplies and the application of groundwater, in turn, increases soil salinity.[81] This increased salinity in the soil degrades the quality of the soil for use in agriculture because it impacts the ability to grow certain salinity intolerant crops in those areas and affects the yield of many other crops.[82]

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[76] 812 F. Supp. 2d at 1187; Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[77] 713 F. Supp. 2d at 1153.
[78] Declartion of Russ Freeman (Doc 170) at 5, *Consol. Salmonid Cases* (Jan. 27, 2010).
[79] 713 F. Supp. 2d at 1153; 812 F. Supp. 2d at 1187.
[80] 713 F. Supp. 2d at 1152.
[81] 713 F. Supp. 2d at 1153; Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[82] *See* 713 F. Supp. 2d at 1153; MWD (Nov. 2008); Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).

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9. **Visual, Scenic, Or Aesthetic Resources**

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Aesthetics will be impacted from reduced water supplies due to urban decay from socioeconomic impacts, barren and decaying farmland, damage to infrastructure from subsidence, and lower reservoirs and water levels in the upper watersheds.

a. **Urban Decay Due To Economic Problems**

As previously noted, socioeconomic impacts would result from reduced water supplies. A by-product of resulting poverty would be urban decay in many centers where displaced workers live.

b. **Fallowed Land, Dead Crops, Destruction Of Permanent Orchard Crops**

As also noted, reduced water supplies result in fallowed land and destruction of permanent orchard crops.[83] In these areas, an otherwise healthy and vibrant landscape, will be replaced with barren and desolate ground, potentially covered with dying or decaying plants.

c. **Damage From Subsidence**

Overdraft of groundwater reserves can result in land subsidence, which can also result in unsightly damage to infrastructure, including water conveyance facilities.[84]

d. **Lowering Of Reservoirs, Lack Of Flows In Upper Watersheds**

Restrictions that call for additional, episodic releases from reservoirs in the upper watershed,[85] have potential to substantially alter upper watershed aesthetics by lowering reservoir levels and reducing releases and flows that otherwise would have occurred throughout the year.

10. **Global Climate Change, Transportation, And Recreation**

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Reduced water supplies can impact climate change, due to greater energy being needed and reduce carbon uptake by plants. Transportation can be impacted by greater impediments from blowing dust, tumbleweeds, and bird-on-aircraft strikes. Recreation impacts are also likely due to impacts to reservoir and upper watershed flows.

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[83] 713 F. Supp. 2d at 1151-52.
[84] 713 F. Supp. 2d at 1153; 812 F. Supp. 2d at 1187; Erlewine X2 Declaration (Doc. 915) pp. 9-11, *Consol. Delta Smelt Cases* (June 16, 2011); Declaration of Russ Freeman (Doc. 170) at 5-6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[85] *See, e.g.*, 812 F. Supp. 2d at 1187.

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a. Climate Change

Increased reliance on groundwater reserves for water supply will result in increased energy usage due to increased pumping lifts needed to access deeper groundwater.[86]

SLDMWA WWD SJRECWA 147 continued

Land fallowing that results from failing to obtain sufficient water allocations to plant crops will also reduce the amount of carbon sequestration that would have otherwise occurred by planting crops, and would have thereby removed carbon dioxide and other greenhouse gases from the atmosphere.[87]

In addition, use of hydroelectric power in California avoids over 29 million metric tons of carbon pollution each year—equal to the output of over 5.5 million passenger cars.[88] Because of the operational changes to project reservoir releases, reservoir carryover, and Delta export pumping needed for meeting flow requirements, there is potential for drastic changes in the timing and magnitude of project hydropower generation. This impacts the availability and cost of clean electricity, and it also requires energy managers to rely on unclean sources of electricity.

b. Transportation

Increased wind-blown and aerosolized dust and particulate matter from land fallowing, as previously discussed above, in turn impairs major transportation routes throughout the Central Valley.[89]

Fallowing can also increase the incidence of bird-on-aircraft strikes, which impacts air transportation for both domestic and national security purposes.[90]

Fallowed fields are an excellent habitat for tumbleweeds (Russian thistle), which break from the soil and are transported with the wind.[91] Proliferation of these species can hamper highways and canals, among other deleterious effects.[92]

c. Recreation

Lower reservoir levels affect recreation. Restrictions that call for additional, episodic releases from reservoirs in the upper watershed[93] have the potential to substantially alter usability of the upper watershed for recreational purposes by reducing releases and flows that otherwise

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[86] 812 F. Supp. 2d at 1183; Declaration of Russ Freeman (Doc. 170) at 6, *Consol. Salmonid Cases* (Jan. 27, 2010).
[87] *See* 812 F. Supp. 2d at 1187.
[88] Risks Ahead: Flows and the Delta: The Consequences of Using a One-Dimensional Approach to Address a Complex Problem, p.6 (March 2012), Hydrologic Modeling Results and Estimated Potential Hydropower Effects Due to the Implementation of the Sacramento Water Resources Control Board Delta Flow Criteria, December 2011, http://www.sfcwa.org/category/programs/delta_governance_water_management/.
[89] 713 F. Supp. 2d at 1152; Declaration of Russ Freeman (Doc. 170) at 7-8, *Consol. Salmonid Cases* (Jan. 27, 2010).
[90] 713 F. Supp. 2d at 1152.
[91] Lincoln Smith, Biological Control of Russian Thistle (Tumbleweed) (2008) http://www.cwss.org/proceedingsfiles/2008/90_2008.pdf.
[92] Lincoln Smith, Biological Control of Russian Thistle (Tumbleweed) (2008) http://www.cwss.org/proceedingsfiles/2008/90_2008.pdf.
[93] *See, e.g.*, 812 F. Supp. 2d at 1183.

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would have occurred throughout the year, and lowering reservoir levels throughout the projects' service areas.[94] Reduced water levels in these areas disrupt recreation and impact entire recreation-based industries that rely on visitors in upper watershed regions such as Shasta, Folsom, and Oroville Reservoirs.[95]

SLDMWA WWD SJRECWA 147 continued

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[94] Risks Ahead: Flows and the Delta: The Consequences of Using a One-Dimensional Approach to Address a Complex Problem, p.7 (March 2012); Hydrologic Modeling Results and Estimated Potential Hydropower Effects Due to the Implementation of the Sacramento Water Resources Control Board Delta Flow Criteria, December 2011, http://www.sfcwa.org/category/programs/delta_governance_water_management/.

[95] Risks Ahead: Flows and the Delta: The Consequences of Using a One-Dimensional Approach to Address a Complex Problem, p.7 (March 2012); Hydrologic Modeling Results and Estimated Potential Hydropower Effects Due to the Implementation of the Sacramento Water Resources Control Board Delta Flow Criteria, December 2011, http://www.sfcwa.org/category/programs/delta_governance_water_management/.

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1C.1.13.1 Responses to Comments from San Luis & Delta-Mendota Water Authority, Westlands Water District, and San Joaquin River Exchange Contractors Water Authority

SLDMWA WWD SJRECWA 1: Comment noted.

SLDMWA WWD SJRECWA 2: The EIS presents a range of alternatives for the future coordinated long-term operation of the CVP and SWP that provide a variety of methods to avoid jeopardy to the continued existence of the species, or avoid destruction or adverse effects to their critical habitat.

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 include additional alternatives, which would require recirculation of an additional Draft EIS for public review and comment, nor does Reclamation believe additional analysis is required to constitute a sufficient EIS. Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts.

SLDMWA WWD SJRECWA 3: Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts. The EIS provides a comparison of projected adverse effects and benefits of Alternatives 1 through 5 and the No Action Alternative. The EIS also provides a comparison of conditions of the No Action Alternative and Alternatives 1 through 5 and the Second Basis of Comparison. The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 4: As described in Section 3.3, Reclamation had provisionally accepted the provisions of the 2008 USFWS BO and 2009 NMFS BO, and was implementing the BOs at the time of publication of the Notice of Intent in March 2012. Under the definition of the No Action Alternative in the National Environmental Policy Act regulations (43 CFR 46.30), Reclamation's NEPA Handbook (Section 8.6), and Question 3 of the Council of Environmental Quality's Forty Most Asked Questions, the No Action Alternative could represent a future condition with "no change" from current management direction or level of management intensity, or a future "no action" conditions without implementation of the actions being evaluated in the EIS. The No Action Alternative in this EIS is consistent with the definition of "no change" from current management direction or level of management. Therefore, the RPAs were included in the No Action Alternative as Reclamation had been implementing the BOs and RPA actions, except where enjoined, as part of CVP operations for approximately three years at the time the Notice of Intent was issued (2008 USFWS BO implemented for three years and three months, 2009 NMFS BO implemented for two years and nine months).

As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order. However, the Second Basis of Comparison is not consistent with the definition of the No Action Alternative used to develop the No Action Alternative for this EIS. Therefore, mitigation measures have not been considered for changes of alternatives as compared to the Second Basis of Comparison.

The No Action Alternative represents operations consistent with implementation of the 2008 and 2009 Biological Opinions. This No Action Alternative represents the current management direction and level of management intensity consistent with the explanation of the No Action Alternative included in Council of Environmental Quality's Forty Most Asked Questions (Question 3). NEPA does not require agencies to mitigate impacts, nor does it require agencies to identify mitigation associated with the No Action Alternative.

Reclamation has a legal obligation to comply with the ESA. Section 7 requires Reclamation to insure that actions it authorizes, funds or carries out do not jeopardize the continued existence of any listed species and do not destroy or adversely modify designated critical habitat. This legal obligation was confirmed in the Central Valley Project Improvement Act. Most of Reclamation's contracts with CVP water users limit Reclamation's liability for shortages associated with meeting legal obligations of the CVP. Additionally, Section 9 of the ESA prohibits unauthorized take of listed species. DWR has chosen to ensure its compliance with the ESA through coordinated operation of the SWP with the CVP to implement the 2008 USFWS BO and 2009 NMFS BO.

Reclamation recognizes that some CVP water users either have initiated or are initiating programs to increase water supplies with separate environmental documentation (see Appendix 5D, Municipal and Industrial Water Demands and Supplies). Other CVP water users may implement future projects to increase water supplies, such as construction and operation of a desalination plants and water recycling programs. None of these future actions are currently authorized and are not being proposed by Reclamation as a part of this decision. Adoption of any of these types of these future actions, if authorized and funded by Reclamation, would require additional analysis under NEPA.

SLDMWA WWD SJRECWA 5: The SWAP model, a regional agricultural production and economic optimization model that simulates the decisions of farmers across 93 percent of agricultural land in California, was used to determine changes in agricultural land use and employment based upon changes in CVP and SWP water deliveries and cost-effective water supplies. This model is described in Appendix 12A, Statewide Agricultural Production Model (SWAP) Documentation. The SWAP model simulates changes in Year 2030 based upon economic optimization factors related to crop selection, water supplies, and other factors to maximize profits with consideration of resource constraints, technical production relationships, and market conditions. The model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained. The EIS evaluates changes in 2030 under the alternatives discussed Chapter 5 through 21 of the EIS.

It should be noted that Figures 7.15 through 7.60 in Chapter 7, Groundwater Resources and Groundwater Quality, have been modified in the Final EIS to correct an error that increased the changes in groundwater elevation by a factor of 3.25. This miscalculation was due to an error in a model post-processor that generates the figures related to changing the values from CVHM Model output from meters to feet. Therefore, the results in these figures and the related text in Chapter 7 are less than reported in the Draft EIS. The figures and the text have been revised in the Final EIS. No changes are required to the CVHM model. The revised results in the figures and the text in Chapter 7 are consistent with the findings of the SWAP model.

SLDMWA WWD SJRECWA 6: Please see response to Comment SLDMWA WWD SJRECWA 32.

SLDMWA WWD SJRECWA 7: The No Action Alternative and Alternative 5 consider actions from both the 2008 USFWS BO and the 2009 NMFS BO in an integrated manner. This EIS was prepared in response to a court order requiring NEPA analysis on the environmental impacts of accepting and implementing the RPA actions. The opportunity to integrate future biological opinions that would meet the needs of both Delta Smelt and salmonids species lies with the agencies responsible for developing those opinions; namely USFWS and NMFS. If implementation of future biological opinions require it, Reclamation will conduct a NEPA review of those future actions.

The No Action Alternative represents operations consistent with implementation of the 2008 and 2009 Biological Opinions. This No Action Alternative represents the current management direction and level of management intensity consistent with the explanation of the No Action Alternative included in Council of Environmental Quality's Forty Most Asked Questions (Question 3). NEPA does not require agencies to mitigate impacts, nor does it require agencies to identify mitigation associated with the No Action Alternative.

SLDMWA WWD SJRECWA 8: Please see responses to Comments SLDMWA WWD SJRECWA 12 to SLDMWA WWD SJRECWA 63.

SLDMWA WWD SJRECWA 9: 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. Reclamation has modified the Final EIS in response to comments from SLDMWA WWD SJRECWA and other commenters; and will use the Final EIS in the development of the Record of Decision.

SLDMWA WWD SJRECWA 10: Please see responses to Comments SLDMWA WWD SJRECWA 64 to SLDMWA WWD SJRECWA 147.

SLDMWA WWD SJRECWA 11: Comment noted.

SLDMWA WWD SJRECWA 12: As discussed in response to Comment SLDMWA WWD SJRECWA 3, the EIS provides a comparison of projected adverse effects and benefits of Alternatives 1 through 5 and the No Action Alternative. The EIS also provides a comparison of conditions under the No Action Alternative and Alternatives 1 through 5 with the Second Basis of Comparison. As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order.

The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat. Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts.

SLDMWA WWD SJRECWA 13: The analysis in the EIS compares conditions under Alternatives 1 through 5 with the No Action Alternative to identify beneficial and adverse impacts for a broad range of physical, environmental, and human resources. The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 14: The initial Proposed Action was defined in the Notice of Intent, and is represented in Alternative 2 in the EIS. The Preferred Alternative is described in Section 1.5 of Chapter 1, Introduction, of the Final EIS. The Environmentally Preferred Alternative will be identified and disclosed in the Record of Decision, as required by the CEQ regulations.

SLDMWA WWD SJRECWA 15: As described in Section 3.3, Reclamation had provisionally accepted the provisions of the 2008 USFWS BO and 2009 NMFS BO, and was implementing the BOs at the time of publication of the Notice of Intent in March 2012. Under the definition of the No Action Alternative in the National Environmental Policy Act regulations (43 CFR 46.30), Reclamation's NEPA Handbook (Section 8.6), and Question 3 of the Council of Environmental Quality's Forty Most Asked Questions, the No Action Alternative could represent a future condition with "no change" from current management direction or level of management intensity, or a future "no action" conditions without implementation of the actions being evaluated in the EIS. The No Action Alternative in this EIS is consistent with the definition of "no change" from current management direction or level of management. Therefore, the RPAs were included in the No Action Alternative as Reclamation had been implementing the BOs and RPA actions, except where enjoined, as part of CVP operations for approximately three years at the time the Notice of Intent was issued (2008 USFWS BO implemented for three years and three months, 2009 NMFS BO implemented for two years and nine months).

As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order. However, the Second Basis of Comparison is not consistent with the definition of the No Action Alternative used to develop the No Action Alternative for this EIS. Therefore, mitigation measures have not been considered for changes of alternatives as compared to the Second Basis of Comparison.

SLDMWA WWD SJRECWA 16: As described in Section 3.3.1.2 of Chapter 3, Description of Alternatives, several actions included in the 2008 USFWS BO and 2009 NMFS BO address items that were underway prior to publication of the BOs, as summarized below.

- 2008 USFWS BO RPA Component 4, Habitat Restoration.
  - In 1987, Reclamation, DWR, CDFW, and the Suisun Resource Conservation District (SRCD) signed the Suisun Marsh Preservation Agreement (SMPA), which contains provisions for Reclamation and DWR to mitigate the adverse effects on Suisun Marsh channel water salinity from the CVP and SWP operations and other upstream diversions. The SMPA required Reclamation and DWR to prepare a timeline for implementing the Plan of Protection for the Suisun Marsh and delineate monitoring and mitigation requirements. In 2001, Reclamation, DWR, USFWS, NMFS, CDFW, SRCD, and CALFED directed the formation of a charter group to develop a plan for Suisun Marsh that would balance the needs of CALFED, the SMPA, and other plans by protecting and enhancing existing land uses, existing waterfowl and wildlife values including those associated with the Pacific Flyway, endangered species, and CVP and SWP water project supply quality. In 2014, Reclamation, CDFW, and USFWS adopted and initiated implementation of the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (Suisun Marsh Management Plan). The USFWS and NMFS have issued biological opinions for the Suisun Marsh Management Plan.
  - The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 assumes that the Suisun Marsh Management Plan will provide up to 7,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh with or without implementation of the 2008 USFWS BO. This would represent up to 87 percent (7,000 of 8,000 acres of this habitat type referenced in the 2008 USFWS BO under the No Action Alternative and Alternative 5.

- 2009 NMFS BO RPA Action I.1.3, Clear Creek Spawning Gravel Augmentation.
  - This effort was initiated in 1996 under the CVPIA Section 3406(b)(12). The Clear Creek fisheries habitat restoration program is being implemented by USFWS and Reclamation in accordance with CVPIA (Reclamation 2011a). By the year 2020 the overall goal is to provide 347,288 square feet of usable spawning habitat from Whiskeytown Dam downstream to the former McCormick-Saeltzer Dam, which is the amount that existed before construction of Whiskeytown Dam. Between 1996 and 2009, a total of approximately 130,925 tons of spawning gravel was added to the creek. The interim annual spawning gravel addition target is 25,000 tons per year, but due to a lack of funding, only an average of 9,358 tons has been placed annually since 1996 (Reclamation 2013a).
  - The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 assume that the CVPIA program will continue through 2030.
- 2009 NMFS BO RPA Action I.1.4, Spring Creek Temperature Control Curtain Replacement.
  - In accordance with SWRCB Order 91-0, temperature control actions were initiated in the 1990s, including construction of the Spring Creek Temperature Control Curtain in 1993. The curtain was damaged and replaced as part of maintenance activities for the CVP facilities in 2011.
  - This action was completed prior to publication of the Notice of Intent for this EIS; therefore, this action is included in No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.
- 2009 NMFS BO RPA Action I.2.6, Restore Battle Creek for Winter-Run, Spring-Run, and Central Valley Steelhead.
  - The Battle Creek Salmon and Steelhead Restoration Project was initiated in the 1999 in accordance with the CVPIA Anadromous Fish Restoration Program. An Agreement in Principle was signed by Reclamation, NMFS, USFWS, CDFW, and Pacific Gas & Electric Company to pursue a restoration project for Battle Creek. A formal Memorandum of Understanding was signed in 1999 to provide funding for the program.
  - The program is consistent with provisions in the California State Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (California Senate Bill 2261, 1990), CALFED Bay-Delta Ecosystem Restoration Program Plan, Upper Sacramento River Fisheries and Riparian Habitat Management Plan (developed in accordance with California Senate Bill 1086, 1989), 1990 CDFW Central Valley Salmon and Steelhead Restoration and Enhancement Plan, 1990 CDFW Steelhead Restoration Plan and Management Plan for California, 1993 CDFW Restoring Central Valley Streams: A Plan for Action, NOAA 1997 Proposed Recovery Plan

for Sacramento River Winter-Run Chinook Salmon, and 1996 CDFW Actions to Restore Central Valley Spring-Run Chinook Salmon.

  - The Final EIS and the Record of Decision for the Battle Creek Salmon and Steelhead Restoration Project were completed in July 2005 and January 2009, respectively.
  - Construction was completed on the first phase in 2010. Construction will be completed prior to 2030 to reestablish approximately 42 miles of salmon and steelhead habitat on Battle Creek and an additional 6 miles of habitat on tributaries. The project includes removal of five dams, installation of new fish screens and fish ladders, provisions for increased instream flows in Battle Creek, improved access roads and trails, and decommissioned power plant canals that conveyed water between tributaries.
  - The Record of Decision and the funding agreements were completed prior to publication of the 2009 NMFS BO. Construction was initiated prior to publication of the Notice of Intent for this EIS, and is anticipated to be complete before 2030. Therefore, this action is included in No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

- 2009 NMFS BO RPA Action I.3.1, Operate Red Bluff Diversion Dam with Gates Out.
  - The Final EIS and Record of Decision were completed in May 2008 for the Tehama-Colusa Canal Authority for the Tehama-Colusa Canal Fish Passage Improvement Project which included construction of the new intake at the Red Bluff Diversion Dam site and removal of the dam gates from the Sacramento River water. This action was initiated following the issuance of the 1993 NMFS BO that reduced the time that water could be diverted from the Sacramento River using the Diversion Dam gates.
  - Construction was initiated in March 2010 and funded by the 2009 American Recovery and Reinvestment Act. The new Red Bluff Pumping Plant began operation in 2012, and the gates no longer block the flow of water in the Sacramento River.
  - These existing facilities are included in No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.
- 2009 NMFS BO RPA Action I.5, Funding for CVPIA Anadromous Fish Screen Program.
  - This effort was initiated over 20 years ago under the CVPIA Section 3406(b)(21).
  - The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 assume continued implementation of the program until the CVPIA program objectives are met which may or may not occur prior to 2030.

- 2009 NMFS BO RPA Action I.6.1, Restoration of Floodplain Habitat; and Action I.6.2, Near-Term Actions at Liberty Island/Lower Cache Slough and Lower Yolo Bypass; Action I.6.3, Lower Putah Creek Enhancements; Action I.6.4, Improvements to Lisbon Weir; and Action I.7, Reduce Migratory Delays and Loss of Salmon, Steelhead, and Sturgeon at Fremont Weir and Other Structures in the Yolo Bypass.
  - These actions are addressed in the ongoing Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan (Implementation Plan) that has been initiated by Reclamation and DWR.
  - The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 assume completion of this Implementation Plan by 2030 with or without implementation of the 2009 NMFS BO.
  - In response to this comment, a sensitivity analysis was included in the Final EIS (Appendix 5E), that presents the results of CalSim II model runs with and without implementation of the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan.
- 2009 NMFS BO RPA Action II.1, Lower American River Flow Management.
  - In 2006, Reclamation began operating in accordance with the American River Flow Management Standard (FMS), as described in Appendix 3A, No Action Alternative: Central Valley Project and State Water Project Operations. The FMS operations were initiated to enhance the protections provided by SWRCB D-893 in accordance with an agreement between Reclamation, USFWS, NMFS, and CDFW.
  - The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 assume continued operations under the FMS in 2030.

SLDMWA WWD SJRECWA 17: Reclamation was directed by the District Court to remedy its failure to conduct a NEPA analysis when it accepted and implemented the 2008 USFWS BO RPA and the 2009 NMFS BO RPA pursuant to the Federal Endangered Species Act of 1973 (ESA) as amended (United States Code [U.S.C.] 1531 ET SEQ.). The BOs did not address the Friant Division of the CVP; therefore, the EIS does not address the Friant Division of the CVP.

SLDMWA WWD SJRECWA 18: Please see response to Comment SLDMWA WWD SJRECWA 4.

SLDMWA WWD SJRECWA 19: Please see response to Comment SLDMWA WWD SJRECWA 16.

SLDMWA WWD SJRECWA 20: As described in Section 3.3, Reclamation had provisionally accepted the provisions of the 2008 USFWS BO and 2009 NMFS BO, and was implementing the BOs at the time of publication of the Notice of Intent in March 2012. Under the definition of the No Action Alternative in the National Environmental Policy Act regulations (43 CFR 46.30), Reclamation's NEPA Handbook (Section 8.6), and Question 3 of the Council of Environmental Quality's Forty Most Asked Questions, the No Action Alternative could represent a future condition with "no change" from current management direction or level of management intensity, or a future "no action" conditions without implementation of the actions being evaluated in the EIS. The No Action Alternative in this EIS is consistent with the definition of "no change" from current management direction or level of management. Therefore, the RPAs were included in the No Action Alternative as Reclamation had been implementing the BOs and RPA actions, except where enjoined, as part of CVP operations for approximately three years at the time the Notice of Intent was issued (2008 USFWS BO implemented for three years and three months, 2009 NMFS BO implemented for two years and nine months).

As described in Section 3.3, Reclamation included the Second Basis of Comparison to identify changes that would occur due to actions that would not have been implemented without Reclamation's provisional acceptance of the BOs, as required by the District Court order. However, the Second Basis of Comparison is not consistent with the definition of the No Action Alternative used to develop the No Action Alternative for this EIS. Therefore, mitigation measures have not been considered for changes of alternatives as compared to the Second Basis of Comparison.

The No Action Alternative represents operations consistent with implementation of the 2008 and 2009 Biological Opinions. This No Action Alternative represents the current management direction and level of management intensity consistent with the explanation of the No Action Alternative included in Council of Environmental Quality's Forty Most Asked Questions (Question 3). NEPA does not require agencies to mitigate impacts, nor does it require agencies to identify mitigation associated with the No Action Alternative.

Reclamation has a legal obligation to comply with Section 7 of the ESA. Section 7 requires Reclamation to insure that actions it authorizes, funds or carries out do not jeopardize the continued existence of any listed species and do not destroy or adversely modify designated critical habitat. This legal obligation was confirmed in the Central Valley Project Improvement Act. Most of Reclamation's contracts with CVP water users limit Reclamation's liability for shortages associated with meeting legal obligations of the CVP. Additionally, ESA prohibits unauthorized take of listed species. DWR has chosen to ensure its compliance with the ESA through coordinated operation of the SWP with the CVP and to implement the 2008 USFWS BO and 2009 NMFS BO.

Reclamation recognizes that some CVP water users either have initiated or are initiating programs to increase water supplies with separate environmental documentation (see Appendix 5D, Municipal and Industrial Water Demands and Supplies). Other CVP water users may implement future projects to increase water supplies, such as construction and operation of a desalination plants and water recycling programs. None of these future actions are currently authorized and are not being proposed by Reclamation as a part of this decision. Adoption of any of these types of these future actions, if authorized and funded by Reclamation, would require additional analysis under NEPA.

SLDMWA WWD SJRECWA 21: Please see response to Comment SLDMWA WWD SJRECWA 20.

SLDMWA WWD SJRECWA 22: The range of alternatives (Alternatives 1 through 5) was identified through consideration of concepts identified in the scoping process, through comments received during preparation of the EIS, and considerations by Reclamation. The concepts were evaluated with respect to screening criteria defined in the purpose of the action (see Chapter 2, Purpose and Need), a determination if the concept addressed one or more significant issues, and if the concept was included in one or more alternatives (see Table 3.1 in Chapter 3, Description of Alternatives). Two of the alternatives, No Action Alternative and Alternative 5, consider actions from both of the 2008 USFWS BO and 2009 NMFS BO in an integrated manner. This EIS was prepared in response to a court order requiring NEPA analysis on the environmental impacts of accepting and implementing the RPA actions. The opportunity to integrate future biological opinions that would meet the needs of both Delta Smelt and salmonids species lies with the agencies responsible for developing those opinions, namely USFWS and NMFS. If implementation of future biological opinions require it, Reclamation will conduct a NEPA require of those future actions

SLDMWA WWD SJRECWA 23: Reclamation was directed by the District Court to remedy its failure to conduct a NEPA analysis when it accepted and implemented the 2008 USFWS BO RPA and the 2009 NMFS BO RPA pursuant to the Federal Endangered Species Act of 1973 (ESA) as amended (United States Code [U.S.C.] 1531 et. seq.). In order to satisfy the Court's directive, Reclamation has analyzed operation of the CVP, in coordination with the operation of the SWP, consistent with the BOs, as well as alternatives which represent potential modifications to the continued long-term operation of the CVP in coordination with the SWP.

The No Action Alternative represents operations consistent with implementation of the 2008 and 2009 Biological Opinions. This No Action Alternative represents the current management direction and level of management intensity consistent with the explanation of the No Action Alternative included in Council of Environmental Quality's Forty Most Asked Questions (Question 3). NEPA does not require agencies to mitigate impacts, nor does it require agencies to identify mitigation associated with the No Action Alternative.

The purpose of the action, as described in Chapter 2, Purpose and Need, of the EIS, considers the purposes for which the CVP was authorized, and as amended by CVPIA, with 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.

Reclamation has a legal obligation to comply with Section 7 of the ESA. Section 7 requires Reclamation to insure that actions it authorizes, funds or carries out do not jeopardize the continued existence of any listed species and do not destroy or adversely modify designated critical habitat. This legal obligation was confirmed in the Central Valley Project Improvement Act. Most of Reclamation's contracts with CVP water users limit Reclamation's liability for shortages associated with meeting legal obligations of the CVP. Additionally, ESA prohibits unauthorized take of listed species. DWR has chosen to ensure its compliance with the ESA through coordinated operation of the SWP with the CVP and to implement the 2008 USFWS BO and 2009 NMFS BO.

Reclamation recognizes that some CVP water users either have initiated or are initiating programs to increase water supplies with separate environmental documentation (see Appendix 5D, Municipal and Industrial Water Demands and Supplies). Other CVP water users may implement future projects to increase water supplies, such as construction and operation of a desalination plants and water recycling programs. None of these future actions are currently authorized and are not being proposed by Reclamation as a part of this decision. Adoption of any of these types of these future actions, if authorized and funded by Reclamation, would require additional analysis under NEPA.

SLDMWA WWD SJRECWA 24: The need statement in Chapter 2 acknowledges that potential modifications to the coordinated operation of the CVP and SWP analyzed in the EIS process should be consistent with the intended purpose of the action, be within the scope of Reclamation's legal authority and jurisdiction, be economically and technologically feasible, and avoid the likelihood of jeopardizing listed species or resulting in the destruction or adverse modification of critical habitat in compliance with the requirements of Section 7(a)(2) of the Endangered Species Act.

SLDMWA WWD SJRECWA 25: The EIS analysis compares conditions under a range of alternatives (Alternatives 1 through 5) with the No Action Alternative to identify beneficial and adverse impacts for a broad range of physical, environmental, and human resources. A reasonable range of alternatives includes technically and economically feasible alternatives to address the purpose and need for the action (40 CFR 1502.14). However, the range of alternatives can be limited if the alternatives analyzed address the full spectrum of alternatives (Question 1b of CEQ Forty Most Asked Questions). The range of alternative concepts were evaluated with respect to screening criteria defined in the purpose of the action (see Chapter 2, Purpose and Need), a determination if the concept addressed one or more significant issues, and if the concept was included in one or more alternatives (Table 3.1 in Chapter 3, Description of Alternatives). The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 26: The No Action Alternative and Alternative 5 consider actions from both of the 2008 USFWS BO and 2009 NMFS BO in an integrated manner. With respect to the potential conflict described in this comment, the EIS impact assessment of the No Action Alternative and Alternative 5 do indicate that reservoir releases to meet fall Delta outflow in wet and above normal years would reduce carryover storage and potentially reduce the ability to meet temperature objectives downstream of the reservoirs. However, the No Action Alternative and Alternative 5 also include fish passage around CVP dams to provide upstream habitat with lower water temperatures.

SLDMWA WWD SJRECWA 27: The comparative tables in Chapter 3, Description of Alternatives, and Executive Summary have been modified in the Final EIS.

SLDMWA WWD SJRECWA 28: Given the complexity of the water system and associated aquatic ecosystem, tools are not available to reliably quantify the numbers of individuals of species, the viability of species populations, and the amount and quality of critical habitat. The analysis in the Draft EIS relied on modeling tools and qualitative analyses to provide an indication of these attributes for comparison among alternatives rather than attempting absolute quantification. However, numerical indications of potential changes in species abundance and habitat availability are presented throughout the impact analysis in the Draft EIS. For example, the two life cycle models used to evaluate effects on winter-run Chinook Salmon provide output in terms of expected escapement. Similarly, SALMOD and the Egg Mortality Model provide outputs that indicate potential changes in salmon abundance. Habitat quality was addressed in terms of water temperature and Weighted Useable Area (WUA) for salmonids and the fall abiotic index was used to quantify potential differences in Delta Smelt habitat.

The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 29: The tables referenced in the comment represent a summary of the impact conclusions for each of the species evaluated. These conclusion statements, as pointed out in the comment, often indicate little distinction in the performance of an alternative relative to another. This is generally because the results of the quantitative analyses are sufficiently similar that a clear difference between the alternatives cannot be made or the uncertainty associated with the outcomes precludes a clear distinction among alternatives. The impact conclusions for each species in Chapter 9 and the summarized conclusions provided in table ES.1 and ES.2 have been revised to more definitely state the conclusions and provide decision makers and the public a clearer indication the magnitude of the differences. Also, please see response to Comment SLDMWA WWD SJRECWA 27.

SLDMWA WWD SJRECWA 30: The EIS analyzed the alternatives at 2030 to consider full implementation of the 2008 USFWS BO and 2009 NMFS BO at 2030; and full implementation of the provisions in each of the alternatives, such as completion of predation control plans in Alternatives 3 and 4 or fish passage programs in Alternative 5 and the No Action Alternative.

If the analyses were conducted at the present time, the existing conditions also would include implementation of the operational provisions of the 2008 USFWS

BO RPA and the 2009 NMFS BO RPA which had been provisionally accepted by Reclamation prior to the publication of the Notice of Intent in 2012.

SLDMWA WWD SJRECWA 31: More details have been included in Section 5.3.3 of Chapter 5, Surface Water Resources and Water Supplies, and Section 6.3.3.6 of Chapter 6, Surface Water Quality, in the Final EIS to describe historical responses by CVP and SWP to recent drought conditions and associated SWRCB requirements, including reductions in recent deliveries of CVP and SWP water. It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term. The EIS analysis is considering the long-term changes by 2030, including agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained.

The EIS includes the comparison of the No Action Alternative to the Second Basis of Comparison to indicate changes related to implementation of the 2008 USFWS BO and 2009 NMFS BO.

It is understood that in any one year with drought conditions, water users may make short-term choices that could involve more crop idling than increased use of groundwater. However, the analysis of groundwater use in Chapter 7, Groundwater Resources and Groundwater Quality, represent long-term operation assumptions that would occur by 2030. The agricultural analysis presented in Chapter 12, Agricultural Resources, indicated that economically, groundwater would continue to be used as compared to crop idling or land fallowing on a long-term basis by 2030.

SLDMWA WWD SJRECWA 32: In response to this and similar comments, additional discussion has been provided in the Final EIS to better capture recent scientific information and to further acknowledge the scientific uncertainty associated with the information used to both formulate the analyses and qualify the conclusions. This additional text is intended to supplement the discussions of uncertainty already presented in Chapter 9 of the Draft EIS and Appendices 9C through 9O. These additions can be found in the discussion of analysis methods and in the impact conclusions where appropriate.

SLDMWA WWD SJRECWA 33: Historically, many water users have been conjunctively use groundwater and surface water by increasing groundwater use when CVP and SWP water supplies are reduced. The urban water management plans present these types of programs for the 2030 conditions. As discussed in the response to Comment SLDMWA WWD SJRECWA 5, the SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained.

It should be noted that Figures 7.15 through 7.60 in Chapter 7, Groundwater Resources and Groundwater Quality, have been modified in the Final EIS to correct an error that increased the changes in groundwater elevation by a factor of 3.25. This miscalculation was due to an error in a model post-processor that generates the figures related to changing the values from CVHM Model output from meters to feet. Therefore, the results in these figures and the related text in Chapter 7 are less than reported in the Draft EIS. The figures and the text have been revised in the Final EIS. No changes are required to the CVHM model. The revised results in the figures and the text in Chapter 7 are consistent with the findings of the SWAP model.

SLDMWA WWD SJRECWA 34: Groundwater Sustainability Agencies will respond differently in the development and implementation of each Groundwater Sustainability Plan (GSP). Different regions of California will have different levels of progress depending upon ongoing programs and facilities. Depending upon the GSP, full implementation of groundwater sustainable actions may not be possible until facilities are constructed to provide replacement water supplies for current groundwater use. Construction of those facilities, following review of the GSP by DWR, could require several years for environmental review, design, permitting, and construction. Therefore, it would be speculative to assume that the GSP objectives can be fully met prior to 2030 when the GSPs have not been completed; and the implementation actions may require a timeframe longer than 2030. It is acknowledged that following full implementation of the GSPs, continued long-term overdrafting of the groundwater would not be allowed.

SLDMWA WWD SJRECWA 35: Historically, many water users have been conjunctively using groundwater and surface water by increasing groundwater use when CVP and SWP water is reduced. The urban water management plans present these types of programs for the 2030 conditions. As discussed in the response to Comment SLDMWA WWD SJRECWA 5, the SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained.

It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term. The EIS analysis is considering the long-term changes by 2030, including agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained.

It should be noted that Figures 7.15 through 7.60 in Chapter 7, Groundwater Resources and Groundwater Quality, have been modified in the Final EIS to correct an error that increased the changes in groundwater elevation by a factor of 3.25 due to an error in a model post-processor that generates the figures related to changing the values from CVHM Model output from meters to feet. Therefore, the results in these figures and the related text in Chapter 7 are less than reported in the Draft EIS. The figures and the text have been revised in the Final EIS. No changes are required to the CVHM model. The revised results in the figures and the text in Chapter 7 are consistent with the findings of the SWAP model.

SLDMWA WWD SJRECWA 36: The comment is consistent with the analysis related to subsidence in Section 7.4 of Chapter 7, Groundwater Resources and Groundwater Quality, of the EIS.

SLDMWA WWD SJRECWA 37: Please refer to responses to Comments SLDMWA WWD SJRECWA 5 and SLDMWA WWD SJRECWA 33.

SLDMWA WWD SJRECWA 38: Please refer to responses to Comments SLDMWA WWD SJRECWA 5, SLDMWA WWD 31, and SLDMWA WWD SJRECWA 35.

SLDMWA WWD SJRECWA 39: As described in responses to Comments SLDMWA WWD SJRECWA 5 and SLDMWA WWD SJRECWA 33, the SWAP analysis indicates that long-term regional agricultural land use, production, and employment would be similar in the alternatives and the Second Basis of Comparison. Therefore, socioeconomic conditions in the agricultural communities would be similar in 2030 within the range of alternatives.

It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term. This led to job losses. The EIS analysis is considering the long-term changes by 2030, including changes in agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained.

SLDMWA WWD SJRECWA 40: As described in responses to Comments SLDMWA WWD SJRECWA 5 and SLDMWA WWD SJRECWA 33, the SWAP analysis indicates that long-term regional agricultural land use, production, and employment would be similar in the alternatives and the Second Basis of Comparison. Therefore, environmental justice conditions in the agricultural communities would be similar in 2030 within the range of alternatives.

It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term. This led to job losses. The EIS analysis is considering the long-term changes by 2030, including changes in agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained.

SLDMWA WWD SJRECWA 41: As described in responses to Comments SLDMWA WWD SJRECWA 5 and SLDMWA WWD SJRECWA 35, the SWAP analysis indicates that long-term regional agricultural land use, production, and employment would be similar in the alternatives and the Second Basis of Comparison. Therefore, air quality conditions in the agricultural communities would be similar.

SLDMWA WWD SJRECWA 42: The CVP and SWP operations prioritize meeting federal and state regulatory requirements and deliveries to senior water rights holders and refuge Level 2 water supplies. The modeling analyses presented in the EIS include these prioritizations for long-term operation of the CVP and SWP using an 82-year hydrology analyzed with the CalSim II model, including delivery of Level 2 refuge water supplies in accordance with the CVPIA. This analytical approach results in low water storage elevations in CVP and SWP reservoirs and low deliveries to CVP agricultural water service contractors located to the south of the Delta in critical dry periods. The modeled operations do not include changes in SWRCB requirements intended to reduce the effects of extreme flood or drought events, such as the recent changes in CVP and SWP drought operations.

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, and Section 6.3.3.6 of Chapter 6, Surface Water Quality, in the Final EIS to describe historical responses by CVP and SWP to these drought conditions, including reductions in recent deliveries of CVP water to the refuges and water service contractors.

SLDMWA WWD SJRECWA 43: The EIS analysis of groundwater effects in the San Francisco Bay Area, Central Coast, and Southern California regions is difficult for two reasons. The CalSim II model water deliveries to these regions are provided at a large regional scale, and it is not possible to determine the deliveries by groundwater basin. In addition, there are no available consistent regional groundwater models that could be used for the CVP and SWP service areas in the San Francisco Bay Area, Central Coast, and Southern California regions. Therefore, a qualitative analysis was conducted in the EIS for changes in groundwater conditions and quality and related subsidence.

Additional description of the qualitative methodology used in these areas has been added to Section 7.4 of Chapter 7, Groundwater Resources and Groundwater Quality. CVP and SWP water delivery information that is currently provided in Appendix 5A, Section C, CalSim II and DSM2 Model Results, has also been added to Chapter 7.

SLDMWA WWD SJRECWA 44: The alternatives and the Second Basis of Comparison are all compared with the same future climate and growth projections at 2030. The environmental analysis does not compare the future conditions under the alternatives and Second Basis of Comparison to existing conditions.

The commenter's "Interpretation B" is correct. The explanation of the methodology is included Appendix 7A, Groundwater Model Documentation.

SLDMWA WWD SJRECWA 45: Additional information has been included in Section 7.4.2 of Chapter 7, Groundwater Resources and Groundwater Quality, to qualitatively discuss groundwater changes between existing conditions and 2030 conditions. As described in the response to Comment SLDMWA WWD SJRECWA 44, the EIS analysis involves comparison of the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 at Year 2030.

SLDMWA WWD SJRECWA 46: The text on page 7-112 of the Draft EIS has been modified in the Final EIS to provide more clarity of the use of qualitative analyses for potential changes in subsidence.

SLDMWA WWD SJRECWA 47: There are no acceptable regional groundwater models available; therefore, the analysis was qualitative. Additional text in the Final EIS has been added to the impact analysis that provides additional groundwater quality information.

SLDMWA WWD SJRECWA 48: The CalSim II post-processor tool was developed in the initial phase of the EIS preparation. Results for flows in Steamboat Slough were included to determine if there was any changes in the North Delta conditions under the alternatives. Millerton Lake results were included to indicate that there were no changes in the operations of the CVP Friant Division for the coordinated long-term operation of the CVP and SWP.

SLDMWA WWD SJRECWA 49: More details have been included in Section 9.4.3 of Chapter 9, Fish and Aquatic Resources, in the Final EIS to qualitatively responses to RPA actions not included in the CalSim II model in the No Action Alternative and Alternatives 2 and 5.

SLDMWA WWD SJRECWA 50: The additional water demand in the Sacramento Valley has been identified in approved general plans and is included in the adopted urban water management plans of these communities. The increased demand are projected to be met through existing water rights in El Dorado, Nevada, Placer, and Sacramento counties and full use of CVP water contracts in Sacramento County. The water rights are senior to water rights held by the CVP and SWP and would need to be fulfilled in the future. Therefore, the additional water demands are included in the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

SLDMWA WWD SJRECWA 51: The CVP and SWP operations prioritize meeting federal and state regulatory requirements and deliveries to senior water rights holders. The modeling analyses presented in the EIS include these prioritizations for long-term operation of the CVP and SWP without inclusion of changes that could be developed for specific extreme flood or drought events.

Water is delivered every year under the water rights in the 82-year hydrology analyzed with the CalSim II model in the EIS.

As described in Section 5.4.1.1.1 of Chapter 5, Surface Water Resources and Water Supplies, under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II utilizes a series of operating rules to reach a solution to allow for the continuation of the simulation. It is recognized that these operating rules are a simplified version of the very complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are an approximation of extreme operational conditions. As an example, CalSim II model results show simulated occurrences of extremely low storage conditions at CVP and SWP reservoirs during critical drought periods when storage is at dead pool levels at or below the elevation of the lowest level outlet. Simulated occurrences of reservoir storage conditions at dead pool levels may occur coincidentally with simulated impacts that are determined to be potentially significant. When reservoir storage is at dead pool levels, there may be instances in which flow conditions fall short of minimum flow criteria, salinity conditions may exceed salinity standards, diversion conditions fall short of allocated diversion amounts, and operating agreements are not met.

Reclamation is aware of the storage and diversion limitations that exist for the reservoirs, including the intakes in Folsom Lake, during drought periods when Reclamation may be allocating and delivering water in consideration of federal and state regulatory requirements, including water rights. Droughts have occurred throughout California's history, and are constantly shaping and innovating the ways in which Reclamation and DWR balance both federal and state regulations, public health standards and urban and agricultural water demands. 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.

SLDMWA WWD SJRECWA 52: The EIS includes the comparison of Alternatives 1 through 5 to the No Action Alternative enabling decision makers to compare the magnitude of environmental effects of the alternatives as compared to the No Action Alternative benchmark (in accordance with Question 3 of the CEQ Forty Most Asked Questions). The EIS analysis does not include a determination of significance thresholds or comparison of the results of impact assessment to the significance thresholds.

The EIS impact analysis starts with use of the monthly CalSim II model to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative analysis are considered to be not substantially different, or "similar." This approach is similar to that used in the Shasta Lake Resources Investigation EIS published by Reclamation in 2015.

SLDMWA WWD SJRECWA 53: The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 include consistent climate change and sea level rise conditions. The EIS assumes that there will be no changes in regulatory or operational requirements due to climate change in the future. The EIS analyzes the alternatives in a comparative manner, and does not analyze any of the alternatives individually. Therefore, the impact analysis compares conditions under the Alternatives 1 through 5 to the No Action Alternative; and conditions under the No Action Alternative and Alternatives 1 through 5 to the Second Basis of Comparison. This comparative approach eliminates effects of climate change and sea level rise and indicates the differences in the comparisons of alternatives to the No Action Alternative and Second Basis of Comparison.

The alternatives and the Second Basis of Comparison are all compared with the same future climate and growth projections at 2030. The EIS analyzed the alternatives at 2030 because the current BOs were analyzed for conditions until 2030. Also, by 2030, there would be full implementation of the provisions in each of the alternatives, such as completion of predation control plans in Alternatives 3 and 4 or fish passage programs in Alternative 5 and the No Action Alternative. If the environmental analysis was conducted under CEQA by a California-based public agency, the analysis would include a comparison of future conditions to existing conditions.

Additional text in Section 5A.A.5.3.1 has been included to discuss that selection of the climate change scenario (Q1 to Q5) does not affect the results of the comparison of alternatives to the No Action Alternative or Second Basis of Comparison. The climate change assumptions are major factors in the determination of reservoir storage and available water for CVP and SWP deliveries in the alternatives. However, the effects of climate change occur under both sets of operational scenarios in the comparative analysis. Therefore, the incremental differences between the alternatives, the No Action Alternative, and the Second Basis of Comparison are similar no matter which climate change scenario is selected, although the absolute results are different. The NEPA analysis is based upon the incremental difference, and not necessarily upon the absolute values of the model results. In addition, due to the uncertainties in the use of planning models (e.g., CalSim II, CVHM, SWAP, CWEST), the results should always be used in a comparative manner and not for prediction of absolute values.

SLDMWA WWD SJRECWA 54: The CalSim II model results presented in Appendix 5A, Section C, CalSim II and DSM2 Model Results, Figures 19.1.1 through 19.1.9 are correct. Tables 19.1.1 through 19.6.2 have been corrected and footnotes have been added to explain how water deliveries to San Francisco Bay Area CVP water users are allocated to the areas North of Delta and South of Delta in the second portions of each table.

SLDMWA WWD SJRECWA 55: In response to this and similar comments made by others, text has been added to the Affected Environment section of the Final EIS to appropriately provide attribution where needed and to expand the discussion and reference to information in the recent scientific literature. For example, the text on page 9-57 of the Draft EIS has been modified to clarify the timing of spring-run emigration in the Delta and appropriately cite the sources of information, including Snider and Titus (1998, 2000b, c, d), Vincik et al. (2006), and Roberts (2007). These same changes have been applied to the discussion of spring-run Chinook Salmon in other parts of the document and in Appendix 9B for consistency.

The text on invasive species on page 9-80 of the Draft EIS has been modified to better define invasive species. The term "invasive species" is now defined (in a footnote) as "species that establish and reproduce rapidly outside of their native range and may threaten the diversity or abundance of native species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat." This is consistent with the commenter's description of the harm that invasive species can have on the environment.

The text on predation on page 9-97 of the Draft EIS has been modified to remove the uncited NMFS reference and add more recent information on predation in the Tuolumne River with the appropriate citations. In addition, text was inserted to better clarify the current understanding of the relation (and uncertainty) between X2 and Delta Smelt habitat and water quality in the Stockton Deepwater Ship Channel. Additional text has been added on page 9-56 from the most recent POD report (Baxter et al. 2010) regarding the potential drivers of the POD and clarifying the relationship (and uncertainty in the relationship) between X2 and habitat for these species.

SLDMWA WWD SJRECWA 56: Please see responses in Section 1.D.1.14, State Water Contractors, for responses to comments from the State Water Contractors.

SLDMWA WWD SJRECWA 57: As discussed in response to Comments SLDMWA WWD SJRECWA 13, the analysis in the EIS compares conditions under Alternatives 1 through 5 with the No Action Alternative to identify beneficial and adverse impacts for a broad range of physical, environmental, and human resources. The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat. Also, please see the response to SLDMWA WWD SJRECWA 28, which explains the basis of the analysis and text additions in the Final EIS to more sharply define the differences among alternatives.

SLDMWA WWD SJRECWA 58: Section 9.4.1.3.3 does state that "[c]hanges in CVP and SWP operations can affect through-Delta survival of migratory (e.g., salmonids) and resident (e.g., Delta and Longfin smelt) fish species through changes in the level of entrainment at CVP and SWP export pumping facilities" as indicated in the comment, but this statement is not conclusory and does not need a citation. It is well known that changes in operations can affect entrainment in the facilities, and therefore survival. Nowhere in this section does the DEIS assert that "exports are negatively related to through-Delta survival" or conclude that "that entrainment is related to abundance."

The conclusion on page 9-150 that ""[i]t is not likely that operations of the CVP and SWP under the Second Basis of Comparison would result in improvement of habitat conditions in the Delta or increases in populations for these fish by 2030, and the recent trajectory of loss would likely continue" refers specifically to "operations" not habitat restoration. The basis for this conclusion is presented in the preceding paragraphs on that page. For example, lines 18-22 state "[u]nder the Second Basis of Comparison in 2030, many years will have passed without seasonal limitations on OMR reverse (negative) flow rates, with the anticipated result that fish entrainment would occur at levels comparable to recent historical conditions. Future pumping operations would continue to expose fish to the salvage facilities and entrainment losses into the future."

SLDMWA WWD SJRECWA 59: The EIS includes the comparison of Alternatives 1 through 5 to the No Action Alternative enabling decision makers to compare the magnitude of environmental effects of the alternatives as compared to the No Action Alternative benchmark (in accordance with Question 3 of the CEQ Forty Most Asked Questions). The EIS analysis does not include a determination of significance thresholds or comparison of the results of impact assessment to the significance thresholds.

Given the complexity of the water system and associated aquatic ecosystem, tools are not available to reliably quantify the numbers of individuals of species, the viability of species populations, and the amount and quality of critical habitat. The analysis in the Draft EIS relied on modeling tools and qualitative analyses to provide indication of these attributes for comparison among alternatives rather than attempting absolute quantification. However, numerical indications of potential changes in species abundance and habitat availability are presented throughout the impact analysis in the Draft EIS. For example, the two life cycle models used to evaluate effects on winter-run Chinook Salmon provide output in terms of expected escapement. Similarly, SALMOD and the Egg Mortality Model provide outputs that indicate potential changes in salmon abundance. Habitat quality was addressed in terms of water temperature and WUA for salmonids and the fall abiotic index was used to quantify potential differences in Delta Smelt habitat. This information contributes to the subsequent effects analysis under Section 7 of the ESA, but as discussed in response to Comment SLDMWA WWD SJRECWA 25, the NEPA analysis does not address species viability or determine if the alternatives would be likely to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 60: The analysis of spring-run Chinook Salmon referenced in the comment was based on the results of a combination of quantitative and qualitative assessments (see Section 9.4.1.8), and was intended to provide indication of the relative differences between the No Action Alternative and the Second Basis of Comparison. In this example, the descriptive term "slightly more adverse" was used to indicate the relative magnitude of the difference. This term was not intended to imply significance (as in CEQA) or the likelihood of jeopardy, which would commonly be found in an ESA analysis, not NEPA. This and other descriptive terms were used in the Draft EIS for presenting the results of the analyses for other species.

The EIS includes the comparison of Alternatives 1 through 5 to the No Action Alternative enabling decision makers to compare the magnitude of environmental effects of the alternatives as compared to the No Action Alternative benchmark (in accordance with Question 3 of the CEQ Forty Most Asked Questions). The EIS analysis does not include a determination of significance thresholds or comparison of the results of impact assessment to the significance thresholds.

SLDMWA WWD SJRECWA 61: While Chapter 9 acknowledges the existence of other stressors for listed species, it also acknowledges that it is impossible to scale the effects of these stressors relative to CVP/SWP operations or determine with any certainty the population level effects of any action. Regarding the scale of flow variations resulting from such operational modifications versus natural flow variations due to the Bay-Delta tidal system, the Bay-Delta system is hardly natural and the flow variations due to the tidal system would be present under any of the alternatives.

The NMFS (2014) attachment showing the relative significance of entrainment versus harvest, predation, and other stressors is based entirely on subjective weightings based on the importance of each life stage, stressor category, and individual stressors. NMFS makes no distinction between stressors in each of the overall stressor category other than sorting by "Normalized Weight" of individual stressors. It should be noted that the "Jones and Banks Pumping Plants" individual stressor is still rated as "VH" (Very High) as an overall stressor and is the highest rated stressor in the "Entrainment" stressor category.

The literature sources provided in footnote 10 do not conclude "that more flow is not necessarily the solution in highly altered systems" as indicated in the comment. Hart and Finelli (1999) indicate that flow is the primary environmental factor determining the character of aquatic ecosystems, a notion shared by the other authors. Most of these authors argue for a more natural flow regime in altered systems or preservation of the natural flow regime if it exists. Poff et al. (1997) recognized that full flow restoration is not always possible and argue for capitalizing on the natural between-year variability in flow and mimicking certain geomorphic processes may provide some ecological benefits. This supports the assertion in the comment that efficient or targeted use of flow is more likely to attain specific ecological benefits, particularly when paired with additional actions to address non-flow stressors. However, the targeted use of flow is not included in the range of alternatives evaluated and is beyond the scope of this NEPA analysis. In addition, the effectiveness of this approach is uncertain. Bunn and Arthington (2002) point out that there is limited ability to predict and quantify biotic responses to flow regulation or separate impacts of altered flow regimes from other factors and interactions. Poff and Zimmerman (2010) conducted a substantial literature review and found that the literature "support[s] the inference that flow alteration is associated with ecological change and that the risk of ecological change increases with increasing magnitude of flow alteration."

SLDMWA WWD SJRECWA 62: The life cycle models of Maunder and Deriso (2011) were referenced on page 9-115 and in Appendix 9B of the Draft EIS. The Maunder and Deriso model uses survey data from the 20mm trawl, summer tow net, and FMWT time series to explore the possibility of density dependence between life stages and possible environmental covariates by fitting the model to the existing data. It was not used because it was not designed (or used) for forecasting future Delta smelt population abundance. The life cycle model developed by Rose et al. (2013a, b) could not be used in this analysis because it uses a wide array of daily data, many of the assumptions and parameter values were based on judgment, and the model was "designed for exploring hypotheses about some of the factors affecting Delta Smelt population dynamics but is not designed for forecasting future Delta Smelt population abundances." In addition, Reed et al. (2014) noted that "To date, these models have not been fully vetted and evaluated sufficiently to be used for direct management applications."

SLDMWA WWD SJRECWA 63: Reclamation has modified the Final EIS in response to comments from SLDMWA WWD SJRECWA and other commenters; and will use the Final EIS in the development of the Record of Decision.

SLDMWA WWD SJRECWA 64: Comment noted.

SLDMWA WWD SJRECWA 65: Please see responses to Comments SLDMWA WWD SJRECWA 72 to SLDMWA WWD SJRECWA 147.

SLDMWA WWD SJRECWA 66: Comment noted.

SLDMWA WWD SJRECWA 67: At the time the request for extension of the review period for the Administrative Draft EIS by Cooperating Agencies 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 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.

SLDMWA WWD SJRECWA 68: Please see response to Comment SLDMWA WWD SJRECWA 4.

SLDMWA WWD SJRECWA 69: A table has been added to Chapter 3, Description of Alternatives, to simply compare the long-term effects of implementing Alternatives 1 through 5 to the No Action Alternative. The comparison is presented in accordance with NEPA requirements (40 CFR 1502.16); and, therefore, does not include the comparison of alternatives to the Second Basis of Comparison.

SLDMWA WWD SJRECWA 70: The impacts and impact conclusions in Chapter 9 have been revised to more definitely state the conclusions and provide decision makers and the public a clearer indication of the magnitude and materiality of the differences where a distinction among alternatives exists. In addition, text has been inserted into the Final EIS to better reflect uncertainty and information in the recent scientific literature, including the discussion of OMR. Also, please see response to Comment SLDMWA WWD SJRECWA 32.

SLDMWA WWD SJRECWA 71: Reclamation has modified the Final EIS in response to comments from SLDMWA WWD SJRECWA and other commenters; and will use the Final EIS in the development of the Record of Decision.

SLDMWA WWD SJRECWA 72: Comment noted.

SLDMWA WWD SJRECWA 73: The Administrative Draft EIS reviewed by Cooperating Agencies in April 2013 was substantially modified prior to publication of the Draft EIS in July 2015.

SLDMWA WWD SJ RECWA 74: The Ninth Circuit upheld the validity of both BOs and FWS and NMFS are no longer under court order to complete new BOs on the effects of CVP and SWP operations on listed species. The remand order to Reclamation does not trigger any obligation for a new Biological Assessment unless Reclamation decides to operate the CVP differently from the operations described in the BOs.

Because Reclamation identified the No Action Alternative as the Preferred Alternative and the No Action Alternative is consistent with the operation described in the BOs, Reclamation does not need to prepare a Biological Assessment at this time. If Reclamation chooses to alter the operation from that described in the BOs at some future time and the effects of the operations are not covered in the analysis of the BOs, a Biological Assessment would be prepared to initiate the Section 7 consultation process.

SLDMWA WWD SJRECWA 75: Please see response to Comment SLDMWA WWD SJRECWA 4.

SLDMWA WWD SJRECWA 76: Please see response to Comment SLDMWA WWD SJRECWA 3.

SLDMWA WWD SJRECWA 77: Please see response to Comments SLDMWA WWD SJRECWA 32 and SLDMWA WWD SJRECWA 62.

SLDMWA WWD SJRECWA 78: The EIS analysis includes quantitative analyses.

SLDMWA WWD SJRECWA 79: Please see response to Comment SLDMWA WWD SJRECWA 74.

SLDMWA WWD SJRECWA 80: The responses to the comments in Exhibit B are presented in this appendix as response to Comments SLDMWA WWD SJRECWA 84 to SLDMWA WWD SJRECWA 101.

SLDMWA WWD SJRECWA 81: Please see responses to Comments SLDMWA WWD SJRECWA 102 to SLDMWA WWD SJRECWA 147.

SLDMWA WWD SJRECWA 82: Comment noted.

SLDMWA WWD SJRECWA 83: Comment noted.

SLDMWA WWD SJRECWA 84: Please see response to Comment SLDMWA WWD SJRECWA 3.

SLDMWA WWD SJRECWA 85: Please see response to Comment SLDMWA WWD SJRECWA 25.

SLDMWA WWD SJRECWA 86: Please see response to Comment SLDMWA WWD SJRECWA 74.

SLDMWA WWD SJRECWA 87: As described in the response to Comment SLDMWA WWD SJRECWA 74, the BOs were upheld. The Ninth Circuit upheld the validity of both BOs and FWS and NMFS are no longer under court order to complete new BOs on the effects of CVP and SWP operations on listed species. The remand order to Reclamation does not trigger any obligation for new BOs from FWS and NMFS unless Reclamation decides to operate the CVP differently from the operations described in the BOs. As described in the response to Comment SLDMWA WWD SJRECWA 3, the EIS provides a comparison of projected adverse effects and benefits of Alternatives 1 through 5 and the No Action Alternative. The EIS also provides a comparison of conditions of the No Action Alternative and Alternatives 1 through 5 and the Second Basis of Comparison. The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 88: As described in the comment, the EIS analyzes the effects of coordinated long-term operation of the CVP and SWP on both Delta Smelt, salmonid species, and sturgeon species.

SLDMWA WWD SJRECWA 89: Please see response to Comment SLDMWA WWD SJRECWA 14 and SLDMWA WWD SJRECWA 74

SLDMWA WWD SJRECWA 90: The purpose of the action was modified in the EIS following preparation of the 2013 Administrative Draft EIS for Cooperating Agency review to include consistency with Federal Reclamation law; other Federal laws and regulations; Federal permits and licenses; and State of California water rights, permits, and licenses. Reclamation has a legal obligation to comply with these law, permits, and licenses, including with Section 7 of the ESA.

SLDMWA WWD SJRECWA 91: As described in the response to Comment SLDMWA WWD SJRECWA 74, the BOs were upheld by the Court. Please see response to Comment SLDMWA WWD SJRECWA 24 related to the Need statement in Chapter 2, Purpose and Need, of the EIS.

SLDMWA WWD SJRECWA 92: Please see response to Comments SLDMWA WWD SJRECWA 4.

SLDMWA WWD SJRECWA 93: Please see response to Comment SLDMWA WWD SJRECWA 4.

SLDMWA WWD SJRECWA 94: Please see response to Comment SLDMWA WWD SJRECWA 16.

SLDMWA WWD SJRECWA 95: The discussion of development and application of the screening criteria, and subsequent identification of alternatives has been expanded in the EIS as compared to the discussion included in the 2013 Administrative Draft EIS for Cooperating Agency review.

SLDMWA WWD SJRECWA 96: The EIS analysis compares conditions under a range of alternatives (Alternatives 1 through 5) with the No Action Alternative to identify beneficial and adverse impacts for a broad range of physical, environmental, and human resources. A reasonable range of alternatives includes technically and economically feasible alternatives to address the purpose and need for the action (40 CFR 1502.14). However, the range of alternatives can be limited if the alternatives analyzed address the full spectrum of alternatives (Question 1b of CEQ Forty Most Asked Questions). The range of alternative concepts was evaluated with respect to screening criteria defined in the purpose of the action (see Chapter 2, Purpose and Need), a determination if the concept addressed one or more significant issues, and if the concept was included in one or more alternatives (Table 3.1 in Chapter 3, Description of Alternatives). The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 97: The EIS analysis includes quantitative analyses.

SLDMWA WWD SJRECWA 98: In response to this and similar comments, text was added to the Final EIS to better clarify uncertainty, particularly as it relates to recent information in the scientific literature. These modifications to the text were made in the Affected Environment sections where relationships between physical attributes of the system and species responses are discussed as well as in the impact conclusions where it was necessary to qualify a conclusion based on the level of uncertainty or to describe expert disagreement.

SLDMWA WWD SJRECWA 99: The EIS analysis includes quantitative analyses using a wide range of analytical tools, including those listed in this comment.

SLDMWA WWD SJRECWA 100: This comment addressed the 2013 Administrative Draft EIS prepared for Cooperating Agency review. That version of the EIS did not include quantitative analyses. The Draft EIS and Final EIS include quantitative analyses where appropriate models are available; and the numeric results are considered in conjunction with the remaining qualitative analyses in the comparison of alternatives. Also, please see response to Comment SLDMWA WWD SJRECWA 59.

SLDMWA WWD SJRECWA 101: Please see response to Comments SLDMWA WWD SJRECWA 102 and SLDMWA WWD SJRECWA 147.

SLDMWA WWD SJRECWA 102: Comment noted.

SLDMWA WWD SJRECWA 103: The Ninth Circuit upheld the validity of both BOs and FWS and NMFS are no longer under court order to complete new BOs on the effects of CVP and SWP operations on listed species. The remand order to Reclamation does not trigger any obligation for a new Biological Assessment unless Reclamation decides to operate the CVP differently from the operations described in the BOs.

Because Reclamation identified the No Action Alternative as the Preferred Alternative and the No Action Alternative is consistent with the operation described in the BOs, Reclamation does not need to prepare a Biological Assessment at this time. If Reclamation chooses to alter the operation from that described in the BOs at some future time and the effects of the operations are not covered in the analysis of the BOs, a Biological Assessment would be prepared to initiate the Section 7 consultation process.

SLDMWA WWD SJRECWA 104: Comment noted.

SLDMWA WWD SJRECWA 105: As described in Section 23.4 of Chapter 23, Consultation and Coordination, of the EIS, a Memorandum of Understanding was developed and signed by the Cooperating Agencies listed in the EIS.

SLDMWA WWD SJRECWA 106: The Ninth Circuit upheld the validity of both BOs and FWS and NMFS are no longer under court order to complete new BOs on the effects of CVP and SWP operations on listed species. The remand order to Reclamation does not trigger any obligation for a new Biological Assessment unless Reclamation decides to operate the CVP differently from the operations described in the BOs and the effects of the operations are not covered in the analysis of the BOs.

Because Reclamation identified the No Action Alternative as the Preferred Alternative and the No Action Alternative is consistent with the operation described in the BOs, Reclamation does not need to prepare a Biological Assessment at this time. If Reclamation chooses to alter the operation from that described in the BOs at some future time and the effects of the operations are not covered in the analysis of the BOs, a Biological Assessment would be prepared to initiate the Section 7 consultation process.

SLDMWA WWD SJRECWA 107: NEPA suggests an EIS be prepared for broad and major federal actions, the alternatives could have significant adverse effects, and/or there is a high degree of controversy (40 CFR 1501.4, 1502.4, 1508.18; and Question 37b of CEQ Forty Most Asked Questions). Based upon these considerations, the range of alternatives suggested during the scoping process, as described in Chapter 3, Description of Alternatives, and the need to quantitatively evaluate a wide range of potential changes to the environment due to implementation of the alternatives, Reclamation determined that the appropriate NEPA document should be an EIS.

The Ninth Circuit upheld the validity of both BOs and FWS and NMFS are no longer under court order to complete new BOs on the effects of CVP and SWP operations on listed species. The remand order to Reclamation does not trigger any obligation for new BOs from FWS and NMFS unless Reclamation decides to operate the CVP differently from the operations described in the BOs. The EIS provides a comparison of projected adverse effects and benefits of Alternatives 1 through 5 and the No Action Alternative. The EIS also provides a comparison of conditions of the No Action Alternative and Alternatives 1 through 5 and the Second Basis of Comparison. The NEPA analysis does not determine if the alternatives would change the findings of the biological opinions in the determination of the likelihood of the alternatives to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 108: Comment noted.

SLDMWA WWD SJRECWA 109: The purpose of the action and the need for the action were modified in the EIS following preparation of the Notice of Intent to include consistency with Federal Reclamation law; other Federal laws and regulations; Federal permits and licenses; and State of California water rights, permits, and licenses. Reclamation has a legal obligation to comply with these law, permits, and licenses, including with Section 7 of the ESA.

SLDMWA WWD SJRECWA 110: The Affected Environment sections of the EIS include detailed descriptions of conditions that have occurred since the adoption of SWRCB D-1641, approximately 15 years ago, for each of the environmental resources addressed in Chapters 5 through 21 of the EIS. The study area for each of the resources generally encompasses the CVP and SWP service area and areas along the water bodies downstream of the CVP and SWP reservoirs. In specific instances, additional areas are analyzed, such as consideration of Colorado River water supplies used by SWP water users in southern California.

In the Final EIS, additional details have been included in Section 5.3.3 of Chapter 5, Surface Water Resources and Water Supplies, and Section 6.3.3.6 of Chapter 6, Surface Water Quality, of the Draft EIS to describe historical responses by CVP and SWP to these drought conditions, including reductions in recent deliveries of CVP water and use of water from Millerton Lake to the San Joaquin River Exchange Contractors.

SLDMWA WWD SJRECWA 111: Please see response to Comment SLDMWA WWD SJRECWA 4.

SLDMWA WWD SJRECWA 112: Given the complexity of the water system and associated aquatic ecosystem, tools are not available to reliably quantify the numbers of individuals of species, the viability of species populations, and the amount and quality of critical habitat. The analysis in the Draft EIS relied on modeling tools and qualitative analyses to provide indication of these attributes for comparison among alternatives rather than attempting absolute quantification. However, numerical indications of potential changes in species abundance and habitat availability are presented throughout the impact analysis in the Draft EIS. For example, the two life cycle models used to evaluate effects on winter-run Chinook Salmon provide output in terms of expected escapement. Similarly, SALMOD and the Egg Mortality Model provide outputs that indicate potential changes in salmon abundance. Habitat quality was addressed in terms of water temperature and WUA for salmonids and the fall abiotic index was used to quantify potential differences in Delta Smelt habitat. This information contributes to the subsequent effects analysis under Section 7 of the ESA, but as discussed in response to Comment SLDMWA WWD SJRECWA 25, the NEPA analysis does not address species viability or determine if the alternatives would be likely to cause jeopardy to the continued existence of the species, or destroy or adversely affect their critical habitat.

SLDMWA WWD SJRECWA 113: In Chapters 5 through 21, and their related appendices, the limitations of quantitative and qualitative analyses have been described. The issue of new science and uncertainty is particularly prevalent in the evaluation of aquatic resources in Chapter 9, Fish and Aquatic Resources. In Chapter 9, the impact discussions and impact conclusions have been revised to more definitely state the conclusions and provide decision makers and the public a clearer indication of the magnitude and materiality of the differences where a distinction among alternatives exists. In addition, text has been included the Final EIS to better reflect uncertainty and information in the recent scientific literature.

SLDMWA WWD SJRECWA 114: The initial Proposed Action was defined in the Notice of Intent, and is represented in Alternative 2 in the EIS. The Preferred Alternative is described in Section 1.5 of Chapter 1, Introduction, of the Final EIS. The justification for the selection of the Preferred Alternative will be presented in the Record of Decision. The Environmentally Preferred Alternative will be identified and disclosed in the Record of Decision, as required by the CEQ regulations.

SLDMWA WWD SJRECWA 115: The EIS does present a range of alternatives for the future coordinated long-term operation of the CVP and SWP that does provide a variety of methods to attempt to avoid jeopardy to the continued existence of the species, or destruction or adversely effects to their critical habitat. As described in response to Comment SLDMWA WWD SJRECWA 25, the screening criteria used to develop the range of alternatives in the EIS was based upon the purpose of the action (see Chapter 2, Purpose and Need), a determination if the concept addressed one or more significant issues, and if the concept was included in one or more alternatives (see Table 3.1 in Chapter 3, Description of Alternatives). The range of alternatives does include the No Action Alternative and Alternative 5 which are consistent with the 2008 USFWS

BO and 2009 NMFS BO. As noted in response 74 and 87, these BOs were upheld by the Ninth Circuit in 2014.

SLDMWA WWD SJRECWA 116: The range of alternatives include concepts that do not specifically affect CVP and SWP Delta exports, such as predation, trap and haul concepts, and changes to allowable Delta and ocean harvest (see Alternatives 3 and 4).

SLDMWA WWD SJRECWA 117: Reclamation is currently operating to the 2009 NMFS BO RPA regarding Fall X2 and believes that its inclusion in the analysis of alternatives is appropriate and reasonable. The Final EIS includes discussion of recent scientific information and the level of uncertainty regarding the relation between X2 and Delta Smelt habitat. In response to scoping comments, the Affected Environment section of the Final EIS also includes discussion of factors influencing food availability for Delta Smelt and turbidity as it relates to OMR flows. Reclamation considers the range of alternatives to be sufficient for this EIS.

Reclamation recognizes that the available scientific information increases each year as the volume of observed data increases. This information is included in Chapters 5 through 21, as appropriate. Therefore, in addition to the alternatives considered in the EIS, Reclamation is committed to continue working toward improvements to the USFWS and NMFS RPA actions through either the adaptive management process, Collaborative Science and Adaptive Management Program (CSAMP) with the Collaborative Adaptive Management Team (CAMT), or other similar ongoing or future efforts.

SLDMWA WWD SJRECWA 118: The range of alternatives included alternatives that considered limitations on commercial fishing harvest (Alternatives 3 and 4). The range of alternatives did include methods to maintain cold water temperatures and changes to hatchery management plans, including release timing of salmon (No Action Alternative, Alternative 2, and Alternative 5 related to the 2009 NMFS BO RPA actions).

SLDMWA WWD SJRECWA 119: The alternatives evaluated in the EIS include actions intended to directly or indirectly address Green Sturgeon. The effects of the alternatives related to green sturgeon were evaluated in Chapter 9, Fish and Aquatic Resources, in the EIS. Reclamation considers the range of alternatives to be sufficient for this EIS.

SLDMWA WWD SJRECWA 120: Mitigation measures are included in Chapters 5 through 21 of the EIS to reduce adverse impacts of Alternatives 1 through 5 as compared to the No Action Alternative.

SLDMWA WWD SJRECWA 121: The responses to comments in Exhibit D are presented in the responses to Comments SLDMWA WWD SJRECWA 137 and SLDMWA WWD SJRECWA 147.

SLDMWA WWD SJRECWA 122: As described in Chapter 5, Surface Water Resources and Water Supplies, and Chapter 7, Groundwater Resources and

Groundwater Quality, changes in CVP and SWP water deliveries have resulted in changes in groundwater elevations.

It should be noted that Figures 7.15 through 7.60 in Chapter 7, Groundwater Resources and Groundwater Quality, have been modified in the Final EIS to correct an error that increased the changes in groundwater elevation by a factor of 3.25. This miscalculation was due to an error in a model post-processor that generates the figures related to changing the values from CVHM Model output from meters to feet. Therefore, the results in these figures and the related text in Chapter 7 are less than reported in the Draft EIS. The figures and the text have been revised in the Final EIS. No changes are required to the CVHM model. The revised results in the figures and the text in Chapter 7 are consistent with the findings of the SWAP model.

SLDMWA WWD SJRECWA 123: As described in the response to Comment SLDMWA WWD SJRECWA 5, the SWAP model, a regional agricultural production and economic optimization model that simulates the decisions of farmers across 93 percent of agricultural land in California, was used to determine changes in agricultural land use and employment based upon changes in CVP and SWP water deliveries and cost-effective water supplies, as described in Appendix 12A, Statewide Agricultural Production Model (SWAP) Documentation, of the EIS. The SWAP model simulates changes in Year 2030 based upon economic optimization factors related to crop selection, water supplies, and other factors to maximize profits with consideration of resource constraints, technical production relationships, and market conditions. The model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production would not change in response to changes in CVP and SWP water deliveries under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison.

Changes in CVP and SWP water deliveries are within the overall range of projected water supplies in related urban water management plans, as described in Appendix 5D, Municipal and Industrial Water Demands and Supplies. It is anticipated that the communities would change their reliance on alternative water supplies, such as groundwater and recycled water, as described in the urban water management plans.

SLDMWA WWD SJRECWA 124: As described in Chapter 19, Socioeconomics, anticipated changes in socioeconomics conditions would occur with respect to recreation opportunities at San Luis Reservoir, freshwater and ocean fishing, and municipal and industrial water costs. The SWAP model output indicated that long-term agricultural land use, production, and employment would not change under any of the alternatives because groundwater use would change in response to changes in CVP and SWP water deliveries under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison.

It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term, and there were losses of jobs. The EIS analysis is considering the long-term changes by 2030, including agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained and agricultural-related jobs would be similar.

SLDMWA WWD SJRECWA 125: As described in Chapter 21, Environmental Justice, anticipated changes in environmental justice conditions would occur with respect to air quality in the San Joaquin Valley due to changes in use of groundwater pumps that are driven by diesel engines, and Delta mercury concentrations.

SLDMWA WWD SJRECWA 126: Chapter 9, Fish and Aquatic Resources, and Chapter 10, Terrestrial Biological Resources, include description of changes in biological resources and habitats related to changes in coordinated long-term operation of CVP and SWP in the alternatives, including changes in wetlands, riparian, and reservoir areas. This analysis includes evaluation of both the effects on species occupying CVP and SWP waterways as well as biological resources dependent on habitats supported by CVP and SWP water deliveries.

In response to Scoping comments, the Final EIS describes the level of uncertainty associated with species and various aspects of the ecosystem, and identifies areas of controversy, where relevant. In addition, the impact conclusions attempt to be definitive to the extent the analysis allows, and provide decision makers and the public a clear indication of the magnitude of the differences. However, because of the similarities in many of the alternatives and the level of uncertainty, a clear distinction is not always possible.

SLDMWA WWD SJRECWA 127: Chapter 6, Surface Water Quality, includes changes in water quality in the reservoirs, streams downstream of the reservoirs, and Delta. Additional details regarding water quality in the CVP and SWP service areas, including use of Delta water supplies to dilute the salinity of other water supplies, have been included in the Final EIS.

SLDMWA WWD SJRECWA 128: Chapter 16, Air Quality and Greenhouse Gas Emissions, includes changes in air quality in the San Joaquin Valley due to changes in use of groundwater pumps that are driven by diesel engines.

SLDMWA WWD SJRECWA 129: Chapter 11, Soils and Geology, discusses the potential for changes in soils and geology under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison. Changes in subsidence potential are discussed in Chapter 7, Groundwater Resources and Groundwater Quality.

SLDMWA WWD SJRECWA 130: Chapter 14, Visual Resources, discusses the potential for changes in visual resources at the reservoirs and at the agricultural lands under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison.

SLDMWA WWD SJRECWA 131: Chapter 15, Recreation Resources, discusses the potential for changes in recreation resources under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison.

The alternatives do not include specific construction activities and agricultural production does not changes between the alternatives; therefore, transportation conditions would not change and was not analyzed in the EIS.

The effects of climate change are included in all analyses for implementation of the alternatives as compared to the No Action Alternative and the Second Basis of Comparison at the Year 2030. The discussion of the effects of the alternatives on climate change potential has been expanded in Chapter 16 of the Final EIS.

SLDMWA WWD SJRECWA 132: Please see response to Comment SLDMWA WWD SJRECWA 112.

SLDMWA WWD SJRECWA 133:

Cumulative projects and programs considered in the EIS are identified in Section 1.6 of Chapter 1, Introduction, of the Draft EIS; and further described in Section 3.5 of Chapter 3, Description of Alternatives. The cumulative effects analyses presented in Chapters 5 through 21 consider if substantial adverse effects would occur with implementation of the alternatives and the cumulative effects programs and policies as compared to the No Action Alternative with implementation of the cumulative effects programs and policies.

The No Action Alternative represents operations consistent with implementation of the 2008 and 2009 Biological Opinions. This No Action Alternative represents the current management direction and level of management intensity consistent with the explanation of the No Action Alternative included in Council of Environmental Quality's Forty Most Asked Questions (Question 3). NEPA does not require agencies to mitigate impacts, nor does it require agencies to identify mitigation associated with the No Action Alternative.

Reclamation has a legal obligation to comply with Section 7 of the ESA. Section 7 requires Reclamation to insure that actions it authorizes, funds or carries out do not jeopardize the continued existence of any listed species and do not destroy or adversely modify designated critical habitat. This legal obligation was confirmed in the Central Valley Project Improvement Act. Most of Reclamation's contracts with CVP water users limit Reclamation's liability for shortages associated with meeting legal obligations of the CVP. Additionally, ESA prohibits unauthorized take of listed species. DWR has chosen to ensure its compliance with the ESA through coordinated operation of the SWP with the CVP and to implement the 2008 USFWS BO and 2009 NMFS BO.

Reclamation recognizes that some CVP water users either have initiated or are initiating programs to increase water supplies with separate environmental documentation (see Appendix 5D, Municipal and Industrial Water Demands and Supplies). Other CVP water users may implement future projects to increase water supplies, such as construction and operation of a desalination plants and water recycling programs. None of these future actions are currently authorized and are not being proposed by Reclamation as a part of this decision. Adoption of any of these types of these future actions, if authorized and funded by Reclamation, would require additional analysis under NEPA.

SLDMWA WWD SJRECWA 134: Please see response to Comment SLDMWA WWD SJRECWA 32.

SLDMWA WWD SJRECWA 135: The requirements of the Information Quality Act were used in the selection of analytical tools and other methodologies used in the Impact Analysis sections of Chapters 5 through 21. The methodologies were described in each chapter.

SLDMWA WWD SJRECWA 136: Comment noted.

SLDMWA WWD SJRECWA 137: Comment noted. The items addressed in this comment were considered in the preparation of the impact analyses in Chapters 5 through 21 of the EIS.

SLDMWA WWD SJRECWA 138: As described in response to Comment SLDMWA WWD SJRECWA 122, water resources analyses presented in Chapters 5 and 7 includes evaluation of changes in CVP and SWP water deliveries to agricultural and municipal and industrial customers, CVP and SWP reservoir storage, groundwater withdrawals, groundwater elevations, and potential for subsidence due to groundwater withdrawal patterns.

As described in response to Comment SLDMWA WWD SJRECWA 127, water quality conditions presented in Chapter 6 includes changes in water quality in the reservoirs, streams downstream of the reservoirs, and Delta. Additional details regarding water quality in the CVP and SWP service areas, including use of Delta water supplies to dilute the salinity of other water supplies, have been included in the Final EIS.

Potential changes related to public health risk, including available water for fighting wildland fires were evaluated in Chapter 18, Public Health.

SLDMWA WWD SJRECWA 139: As described in response to Comment SLDMWA WWD SJRECWA 123, agricultural land use and municipal land use was evaluated in Chapters 12 and 13. The analyses indicated that affordable alternative water supplies would be available in the Year 2030 to use when CVP and SWP water deliveries were reduced. Therefore, agricultural land uses would not change and related soil erosion would not increase, as described in Chapter 11. The urban water management projections for the Year 2030 were used to identify potential future projects, including numerous ongoing projects that had completed planning documents as of this time.

SLDMWA WWD SJRECWA 140: As described in response to Comment SLDMWA WWD SJRECWA 124, socioeconomic changes described in Chapter 19 were associated with changes in recreation opportunities at San Luis Reservoir, freshwater and ocean fishing, and municipal and industrial water costs. Based upon the SWAP and CWEST models, changes in employment would be less than 1 percent of the population in the regions due to the availability of alternative water supplies by the Year 2030.

It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term and job losses occurred. The EIS analysis is considering the long-term changes by 2030, including agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained and agricultural-related jobs would be similar.

SLDMWA WWD SJRECWA 141: As described in response to Comment SLDMWA WWD SJRECWA 125, anticipated changes in environmental justice conditions, as described in Chapter 21, would occur with respect to air quality in the San Joaquin Valley due to changes in use of groundwater pumps that are driven by diesel engines, and Delta mercury concentrations.

It is recognized that in the short-term, responses to reduced CVP and SWP water deliveries could be different than over the long-term. For example, during the recent drought some areas relied upon crop idling because expansion of groundwater wellfields was not easily implemented in the short-term and job losses occurred. The EIS analysis is considering the long-term changes by 2030, including agricultural water supplies based upon long-term economic modeling (see results of SWAP model runs in Chapter 12, Agricultural Resources). The SWAP model indicated that even with the cost of groundwater pumping from greater depths, the overall agricultural production could be maintained and agricultural-related jobs would be similar.

SLDMWA WWD SJRECWA 142: As described in response to Comment SLDMWA WWD SJRECWA 126, anticipated changes in biological resources (as described in Chapters 9 and 10) would occur biological resources and habitats related to changes in coordinated long-term operation of CVP and SWP in the alternatives, including changes in wetlands, riparian, and reservoir areas.

SLDMWA WWD SJRECWA 143: As described in response to Comment SLDMWA WWD SJRECWA 127, anticipated changes in surface water quality (as described in Chapter 6) would occur in the reservoirs, streams downstream of the reservoirs, and Delta. Additional details regarding water quality in the CVP and SWP service areas, including use of Delta water supplies to dilute the salinity of other water supplies and use for groundwater recharge and water recycling, have been included in the Final EIS. Chapter 6 also describes changes in selenium concentrations in the Delta due to runoff from agricultural and wetlands areas.

SLDMWA WWD SJRECWA 144: As described in response to Comment SLDMWA WWD SJRECWA 128, anticipated changes in air quality (as described in Chapter 16) would occur in the San Joaquin Valley due to changes in use of groundwater pumps that are driven by diesel engines. No changes in dust generation from agricultural fields are anticipated because agricultural production would be similar under all of the alternatives, the No Action Alternative, and the Second Basis of Comparison.

SLDMWA WWD SJRECWA 145: As described in response to Comment SLDMWA WWD SJRECWA 129, changes in soils and geology (as described in Chapter 11) are not anticipated to occur agricultural and municipal land uses would be similar under all of the alternatives, the No Action Alternative, and the Second Basis of Comparison. Changes in subsidence potential are discussed in Chapter 7, Groundwater Resources and Groundwater Quality.

SLDMWA WWD SJRECWA 146: As described in response to Comment SLDMWA WWD SJRECWA 130, changes in visual resources (as described in Chapter 14) were analyzed at the reservoirs and at the agricultural lands under the alternatives as compared to the No Action Alternative and the Second Basis of Comparison.

SLDMWA WWD SJRECWA 147: As described in response to Comment SLDMWA WWD SJRECWA 131, changes in recreation resources (as described in Chapter 15) were evaluated at CVP and SWP reservoirs and the streams downstream of the reservoirs, and for Delta sport fishing.

The alternatives do not include specific construction activities and agricultural production does not changes between the alternatives; therefore, transportation conditions would not change and was not analyzed in the EIS.

The effects of climate change are included in all analyses for implementation of the alternatives as compared to the No Action Alternative and the Second Basis of Comparison at the Year 2030. The discussion of the effects of the alternatives on climate change potential has been expanded in Chapter 16 of the Final EIS.

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1.C.2.1 Attachments to Comments of Central Delta Water Agency

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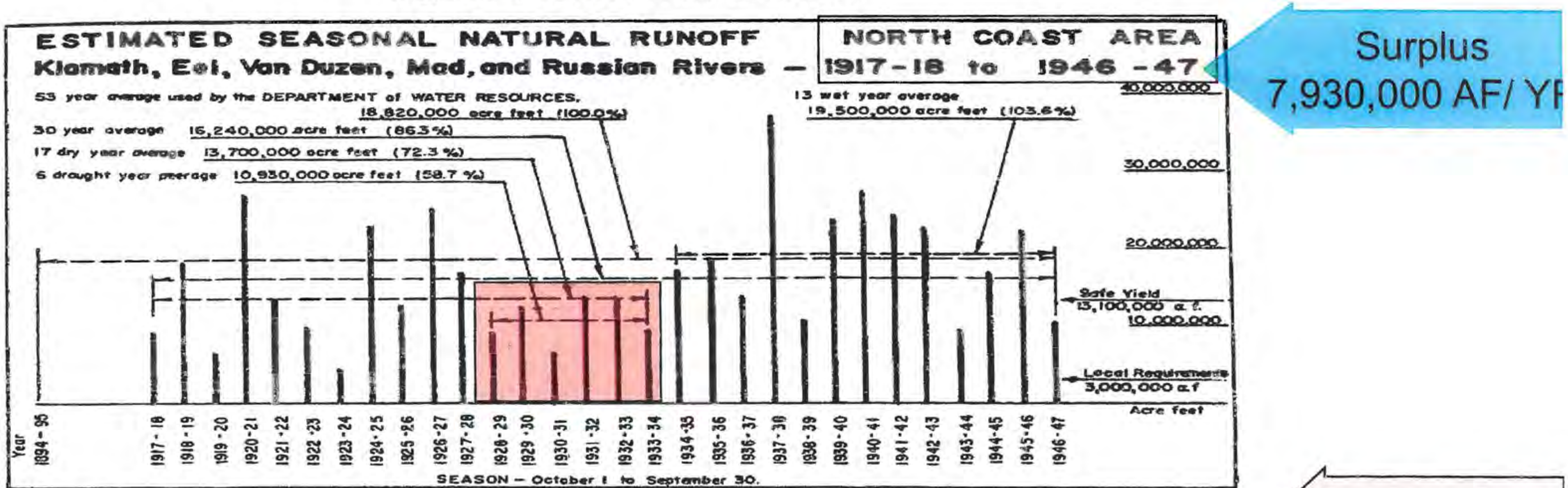
WEBER FOUNDATION STUDIES



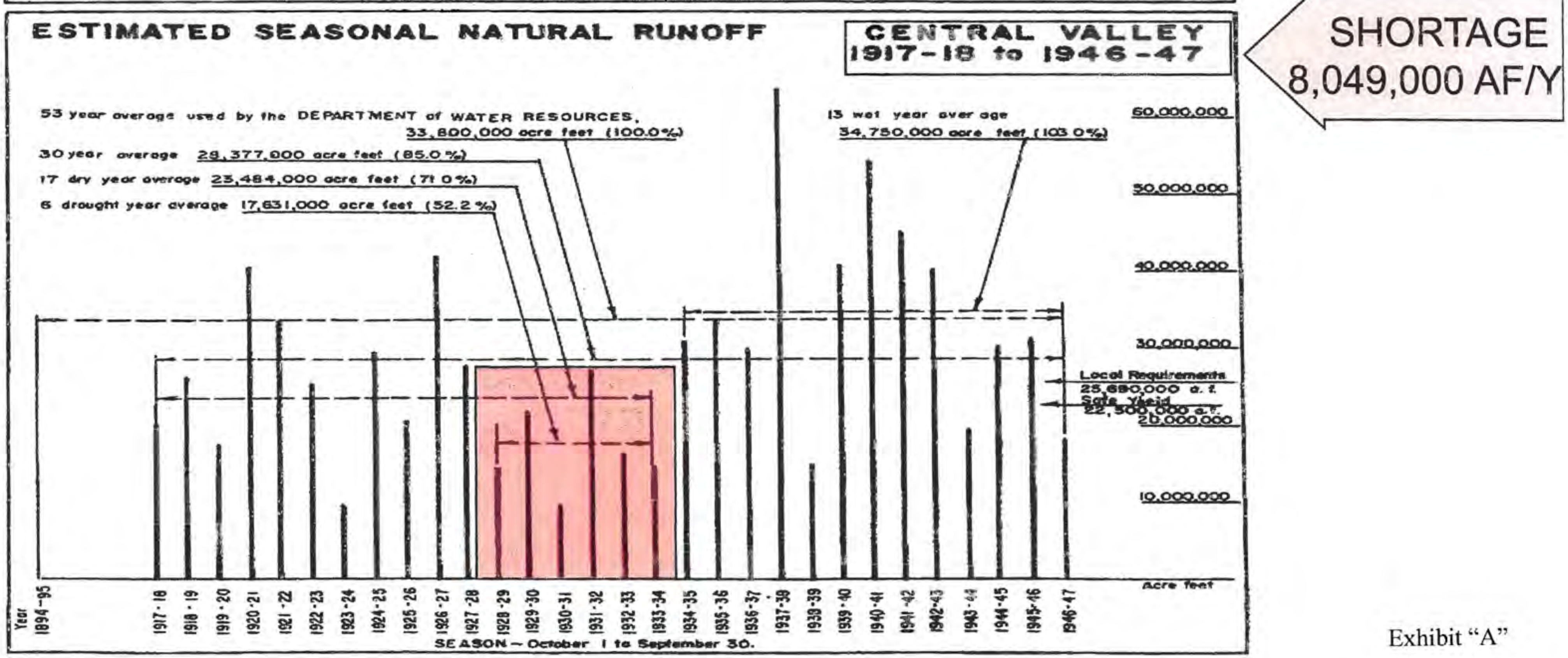


Exhibit "A"

John A. Wilson

Preliminary Edition

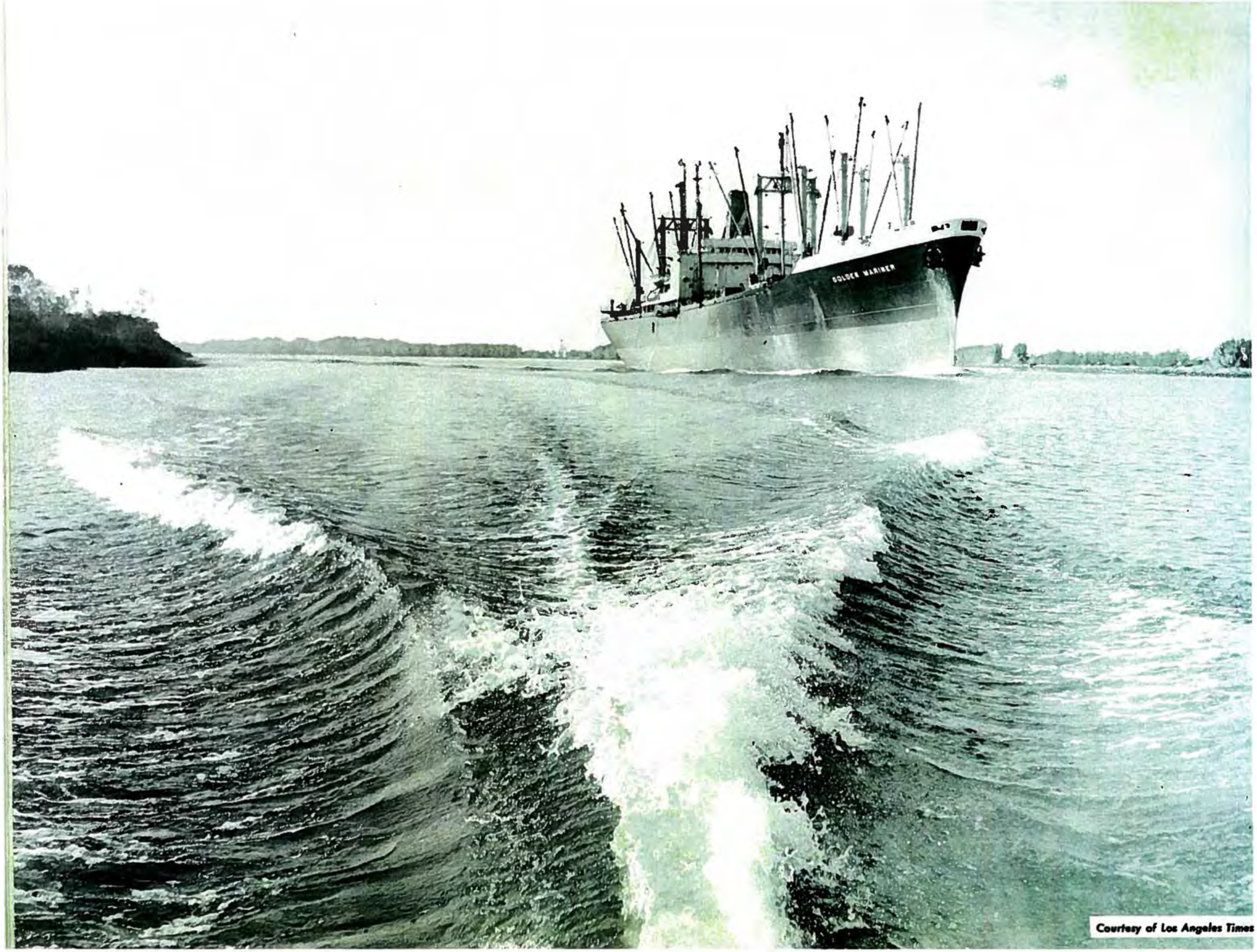
Bulletin No. 76
DELTA WATER FACILITIES

Exhibit "B"

EDMUND G. BROWN
Governor
State of California

December, 1960

HARVEY O. BANKS
Director
Department of Water Resources



Courtesy of Los Angeles Times

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

STATEMENT OF CLARIFICATION

This preliminary edition presents a comparison of alternative solutions to the Delta problems. This bulletin shows that the Single Purpose Delta Water Project is the essential minimum project for successful operation of the State Water Facilities. This bulletin also presents, for local consideration, optional modifications of the Single Purpose Delta Water Project which would provide additional local benefits.

The evaluation of project accomplishments, benefit-cost ratios, and costs of project services, are intended only to indicate the relative merits of these solutions and should not be considered in terms of absolute values. Benefits related to recreation are evaluated for comparative purposes. Detailed recreation studies, presently in progress, will indicate specific recreation benefits.

Subsequent to local review and public hearings on this preliminary edition, a final edition will be prepared setting forth an adopted plan. The adopted plan will include, in addition to the essential minimum facilities, those justifiable optional modifications requested by local entities.

Bulletin No. 76

REPORT TO THE
CALIFORNIA STATE LEGISLATURE

ON THE

DELTA WATER FACILITIES

John A. [illegible]

AS AN INTEGRAL FEATURE OF

THE STATE WATER RESOURCES DEVELOPMENT SYSTEM

EDMUND G. BROWN
Governor

HARVEY O. BANKS
Director

December, 1960

Letters . . . .

HARVEY O. BANKS
Director

EDMUND G. BROWN
Governor

ADDRESS REPLY TO
P. O. BOX [illegible] SACRAMENTO [illegible]
[illegible] N STREET [illegible]

STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

December 30, 1960

Honorable Edmund G. Brown, Governor
Members of the Legislature of the
State of California

Gentlemen:

I have the honor to transmit herewith a preliminary edition of Bulletin No. 76, "Delta Water Facilities". This bulletin summarizes the results of investigations conducted pursuant to the Abshire-Kelly Salinity Control Barrier Acts of 1955 and 1957, Chapter 1434, Statutes of 1955, and Chapter 2092, Statutes of 1957, as amended by Chapters 1765 and 2038, Statutes of 1959.

Bulletin No. 76 presents findings and conclusions regarding the feasibility of alternative plans for the Delta feature of the State Water Facilities included in the Burns-Porter Act approved by the electorate on November 8, 1960. The Delta water facilities would (1) provide adequate water supplies throughout the Delta, (2) transport water across the Delta without undue loss or deterioration in quality, (3) provide flood and seepage control to Delta islands, (4) provide improved vehicular transportation access, and (5) minimize effects on existing recreation development and enhance recreation growth. All of the alternative plans would accomplish the first two objectives, and two alternative plans would also accomplish the other objectives.

Further planning for Delta water facilities should include consideration of joint financing and construction by federal, state and local interests. Facilities for flood and seepage control, vehicular transportation and recreation would not have to be constructed unless local governmental agencies desire these works and are willing to share in certain costs thereof. There would be some conflicts of interest in operation of these facilities which must be resolved prior to a decision by local interests regarding the extent of local participation. To this end, it is recommended that a period of a few months be allowed for local review and resolution of differences, after which public hearings should be held by the California Water Commission and the department. Following the public hearings, a final edition of Bulletin No. 76, incorporating any necessary modifications, should be published.

Very truly yours,

HARVEY O. BANKS
Director

BOARD OF CONSULTING ENGINEERS

November 16, 1960

Mr. Harvey O. Banks, Director
Department of Water Resources
Sacramento, California

Dear Mr. Banks:

This Board of Consulting Engineers which was active in 1958 was reconvened in April, 1960 and has met from time to time with your staff. Thus we have followed the preparation of this report and have commented to you following each meeting.

The Delta Water Facilities constitute needed works vital to the transfer of northern water into and across the Delta to provide water for use in the Delta and for export to water deficient areas along the Coast, in the San Joaquin Valley and to Southern California, to be financed under the California Water Resources Development Bond Act. The Board is of the opinion that the gross future water requirements for municipal and industrial purposes in the Delta have been very liberally estimated.

The Board is of the opinion that the engineering studies, designs and estimates are adequate for the purpose of this planning report and we support the conclusions and recommendations embodied therein.

We believe that the Chipps Island Barrier Project should not be authorized or constructed owing to its high cost of nearly $200 million which substantially exceeds project benefits.

The Delta Water Project, including such economically desirable flood control, seepage control, transportation and recreational features as may be agreed upon by local Delta beneficiaries willing to share in costs, would meet all water requirements with maximum net project benefits, and should be constructed under the Bond Act.

Respectfully submitted,

H. A. Einstein

O. J. Porter

Ray K. Linsley

Samuel B. Morris, Chairman

Preface

This bulletin summarizes the engineering and economic conclusions and recommendations concerning the feasibility of providing salinity control, water supply, flood and seepage control, transportation facilities, and recreation development for the Sacramento-San Joaquin Delta, and conserving and making the most beneficial use of a major portion of the water resources of the State. Alternative plans for accomplishing some or all of these objectives are presented and compared to indicate their relative merits and to guide the selection of facilities to be constructed.

Findings presented herein are the result of intensive studies conducted during a five-year period. Previous studies and cooperative investigations by various public and private agencies and individuals were utilized in development of the plans. The cooperation of these individuals and agencies is gratefully acknowledged.

Study procedures and analyses are summarized in six supporting office reports, which are available to interested agencies and individuals. The subjects and titles of these reports are:

- Salinity Incursion and Water Resources
- Delta Water Requirements
- Channel Hydraulics and Flood Channel Design
- Recreation
- Plans, Designs, and Cost Estimates
- Economic Aspects

TABLE OF CONTENTS

Salinity Control Studies

1879-1880, WM. HAM. HALL

Salinity incursion into the Delta, which was recorded in 1841 and 1871, was recognized by the early settlers as a potential problem to water supplies, and a salt water barrier was proposed in the 1860's. State Engineer Wm. Ham. Hall subsequently studied a barrier in conjunction with flood control and concluded that, while a physical barrier could be constructed, the costs would exceed the benefits.

1924-1928, WALKER YOUNG INVESTIGATION

A series of subnormal water supply years began in 1917 and various proposals for barriers were advanced during the early 1920's. In cooperation with the State of California and the Sacramento Valley Development Association, the U. S. Bureau of Reclamation, under the direction of Walker Young, extensively investigated four alternative barrier sites and concluded that it was ". . . physically feasible to construct a Salt Water Barrier at any one of the sites investigated . . ." It was recognized that without a barrier, ". . . salinity conditions will become more acute unless mountain storage is provided to be released during periods of low river discharge . . ." Economic analyses of barriers were not made by Mr. Young.

1929-1931, BULLETINS NOS. 27 AND 28

Following investigation of the physical feasibility of barriers, the State Division of Water Resources studied the phenomena of salinity incursion and the economics of barriers. In Bulletin No. 27, "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay," it was concluded that ". . . invasion of salinity . . . as far as the lower end of the . . . Delta is a natural phenomenon which, in varying degree, has occurred each year as far back as historical records reveal." It was also concluded that the Delta could be protected from saline invasion and be assured of ample and dependable water supplies if mountain storage were utilized to provide a controlled rate of outflow from the Delta.

In Bulletin No. 28, "Economic Aspects of a Salt Water Barrier," it was concluded that it was not economically justifiable to construct a barrier. With conditions of upstream water use at that time, it was concluded that the most economical solution to salinity incursion and provision of adequate water supplies in the Delta could be achieved by constructing upstream storage and controlling rates of outflow during periods of insufficient natural outflow.

1953, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

Shasta Reservoir on the Sacramento River was constructed and began operation in 1944 for salinity control and other purposes. Expanding water requirements in the Central Valley and San Francisco Bay area stimulated reconsideration of barrier plans for water conservation and related purposes. Seven alternative plans for barriers in the Bay and Delta system were investigated by a Board of Consultants and the State Division of Water Resources for the California Water Project Authority. The Board of Consultants concluded that barriers in the San Francisco Bay system would not be functionally feasible due to the uncertainty of the quality of water in a barrier pool. It was recommended by the Division of Water Resources that "Further consideration be given only to . . . barriers . . . at or upstream from the Chipps Island site" at the outlet of the Delta.

1955, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

Additional legislation specified study of a system of works in the Delta, referred to as the Junction Point Barrier Plan, and the Chipps Island Barrier Plan. The principal purposes of these studies were to develop complete plans for water supply in the San Francisco Bay area and to provide salinity control and urgently needed flood protection in the Delta.

CHAPTER 1434

An act to provide for a study of the junction point barrier and appurtenant facilities, the Abshire-Kelly Salinity Control Barrier Act of 1955, relating to barriers for salinity and flood control purposes, declaring the urgency thereof, to take effect immediately.

[Approved by Governor June 27, 1955. Filed with Secretary of State June 28, 1955.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby appropriated to the Water Project Authority the sum of one hundred thousand dollars ($100,000), payable from the Flood Control Fund of 1946, to initiate the further investigation and study of the Junction Point Barrier and Chipps Island Barrier and appurtenant facilities, as such barriers and facilities are described in the report of the Water Project Authority to the Legislature entitled "Feasibility of Construction by the State of Barriers in the San Francisco Bay System," dated March, 1955, for the purposes of developing complete plans of the means of accomplishing delivery of fresh water to the San Francisco Bay area, including the Counties of Solano, Sonoma, Napa, Marin, Contra Costa, Alameda, Santa Clara, San Benito, and San Mateo, and the City and County of San Francisco, providing urgently needed flood protection to agricultural lands in the Sacramento-San Joaquin Delta, conducting subsurface exploration work in the delta and designing facilities appurtenant to the cross-delta aqueduct, obtaining more complete information on the hydrology of the delta, and studying integration of the proposed project in the California Water Plan.

SEC. 2. The Water Project Authority may contract with such other public agencies, federal, state, or local, as it deems necessary for the rendition and affording of such services, facilities, studies, and reports to the Water Project Authority as will best assist it to carry out this act. The Water Project Authority may also employ, by contract or otherwise, such private consulting engineering and other technical services as it deems necessary for the rendition and affording of such services, facilities, studies, and reports as will best assist it to carry out this act.

SEC. 3. It is the intent of the Legislature that in conducting the study and investigation the Water Project Authority shall confer and exchange information with and shall seek the participation of the United States Navy, the United States Bureau of Reclamation, the United States Corps of Engineers and the local port districts to the extent possible.

SEC. 4. The Water Project Authority shall report to the Legislature the result of its study and investigation not later than March 30, 1957.

SEC. 5. This act shall be known and may be cited as the Abshire-Kelly Salinity Control Barrier Act of 1955.

SEC. 6. This act is an urgency measure necessary for the immediate preservation of the public peace, health or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting such necessity are:

The areas adjacent to the San Francisco Bay urgently need an adequate supply of fresh water for domestic and industrial uses. It is essential to the public health, safety and welfare that a study of salinity control barriers as a means of securing such a supply of fresh water, be undertaken without delay.

A four-year investigation was contemplated, and an interim report, Bulletin No. 60, "Salinity Control Barrier Investigation", was published in March 1957, by the Department of Water Resources. This report outlined a water plan for the San Francisco Bay area, and recommended that the North Bay Aqueduct be authorized for construction. The North Bay Aqueduct was authorized by the Legislature in 1957. The report also compared the Biemond Plan, a system of works in the Delta, with the Chipps Island Barrier Plan, and recommended that further study be limited to the Biemond Plan.

1957, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

The Legislature concurred in limiting further study to the Biemond Plan and stressed the need for improving the quality of water in the Delta and making the most beneficial use of the water resources of the State. A report on the further studies was scheduled for release by March 30, 1959.

CHAPTER 2092

An act relating to barriers for salinity and flood control purposes.

[Approved by Governor July 8, 1957. Filed with Secretary of State July 10, 1957.]

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources may limit its studies of salinity control barriers to the Biemond Plan as described in Bulletin No. 60 of the Department of Water Resources entitled "Salinity Control Barrier Investigation," dated March, 1957, subject to such modifications thereof as the department may adopt, said studies being for the purposes of developing complete plans of the means of accomplishing delivery of fresh water to the Counties of Solano, Sonoma, Napa and Marin, providing urgently needed flood protection to agricultural lands in the Sacramento-San Joaquin Delta, accomplishing salinity control, improving the quality of water exported from the delta to the San Francisco Bay area, San Joaquin Valley, and southern portions of California, making the most beneficial use of the water resources of the State, and studying integration of the proposed project in The California Water Plan.

SEC. 2. The department may contract with such other public agencies, federal, state or local, as it deems necessary for the rendition and affording of such services, facilities, studies, and reports to the department as will best assist it to carry out this act.

SEC. 3. It is the intent of the Legislature that in conducting the study and investigation the department shall confer and exchange information with and shall seek the participation of the United States Navy, the United States Bureau of Reclamation, the United States Corps of Engineers, and the local port districts to the extent possible.

SEC. 4. The department shall submit a report to the Legislature stating the result of its study and investigation not later than March 30, 1959.

SEC. 5. This act shall be known and may be cited as the "Abshire-Kelly Salinity Control Barrier Act of 1957."

1959, ADDITIONAL LEGISLATION

The potential expansion of water requirements of the urban and industrial complex in the western Delta area, and greater upstream water use with resultant depletion of inflow to and outflow from the Delta, indicated need for more concentrated study of the water requirements and supplies of the Delta. Legislation was enacted in 1959 to undertake studies of the type and extent of future water requirements of lands which can be served from present channels in the western Delta, effects of upstream water uses on Delta supplies, plans for water service and costs thereof, and economic and financial feasibility of the plans. Additional legislation authorized studies of the most economical and efficient procedures of constructing levees for flood control.

CHAPTER 1765

An act providing for the investigation of water supplies and flood control levees for the Sacramento-San Joaquin Delta and making an appropriation therefor.

[Approved by Governor July 10, 1959. Filed with Secretary of State July 13, 1959.]

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources shall investigate the water supplies for the Sacramento-San Joaquin Delta. The investigation shall include, among other things: (1) the type and extent of the future water requirements of lands which can be served from present channels in the western Delta; (2) the extent and nature of effects of upstream water developments on water supply available to such lands; (3) the development of plans for water service to such lands and estimates of costs thereof; and (4) economic and financial analyses of such plans. In carrying out the investigation, the department shall seek the co-operation and assistance of the counties and other local agencies and entities in the Sacramento-San Joaquin Delta and of the United States; may enter into contracts with such entities to assist it in carrying out the purposes of such investigation, and shall consult with and keep appropriate legislative committees informed of the progress of this work.

SEC. 2. There is appropriated from the California Water Fund to the Department of Water Resources the sum of two hundred thousand dollars ($200,000) to be expended for the purposes of this act.

SEC. 3. Section 4.5 is added to the Abshire-Kelly Salinity Control Barrier Act of 1957 (Chapter 2092, Statutes of 1957), to read:

Sec. 4.5. As a part of the studies being performed hereunder and to obtain such information as may be required to implement the plan included in the report referred to in Section 4, the department may conduct studies and investigations to determine the most economical and efficient type and methods and procedures of construction to provide an adequate levee system in the Delta.

SEC. 4. There is hereby appropriated to the Department of Water Resources from the California Water Fund the sum of two hundred thirty thousand dollars ($230,000), of which one hundred eighty thousand dollars ($180,000), may be expended for the studies and investigations authorized by Section 3 hereof, and fifty thousand dollars ($50,000) may be expended for such remedial work as may be necessary in connection with levee tests being performed as a part of the studies and investigations authorized by Section 3 hereof.

Intensive studies were made of the future economic growth of lands which can be served from channels in the western Delta. Particular attention was given to the future municipal and industrial water needs in the area and the future water supplies available in the Delta. Due to the expanded scope of the studies, the report was delayed.

CHAPTER 2038

An act to amend Section 4 of Chapter 2092, Statutes of 1957, relating to barriers for salinity and flood control purposes.

[Approved by Governor July 17, 1959. Filed with Secretary of State July 20, 1959.]

The people of the State of California do enact as follows:

SECTION 1. Section 4 of Chapter 2092, Statutes of 1957, is amended to read:

Sec. 4. The department shall submit a report to the Legislature stating the result of its study and investigation not later than January 2, 1961.

The unique character of the water supply problems of the Delta was recognized by the State Legislature when it amended the California Water Code in 1959 to include general policy regarding the Delta. This legislation calls for provision of salinity control and adequate water supplies in the Delta and states that water to which the users within the Delta are entitled should not be exported. The policy in this act is basic to the planning and operation of all works in the Delta or diversions therefrom.

CHAPTER 1766

An act to add Part 4.5 (commencing at Section 12200) to Division 6 of the Water Code, relating to delivery of surplus water into, and extractions thereof for exportation from, the Sacramento-San Joaquin Delta.

[Approved by Governor July 10, 1959. Filed with Secretary of State July 13, 1959.]

The people of the State of California do enact as follows:

SECTION 1. Part 4.5 (commencing at Section 12200) is added to Division 6 of the Water Code, to read:

PART 4.5. SACRAMENTO-SAN JOAQUIN DELTA

CHAPTER 1. GENERAL POLICY

12200. The Legislature hereby finds that the water problems of the Sacramento-San Joaquin Delta are unique within the State; the Sacramento and San Joaquin Rivers join at the Sacramento-San Joaquin Delta to discharge their fresh water flows into Suisun, San Pablo and San Francisco Bays and thence into the Pacific Ocean; the merging of fresh water with saline bay waters and drainage waters and the withdrawal of fresh water for beneficial uses creates an acute problem of salinity intrusion into the vast network of channels and sloughs of the Delta; the State Water Resources Development System has as one of its objectives the transfer of waters from water-surplus areas in the Sacramento Valley and the north coastal area to water-deficient areas to the south and west of the Sacramento-San Joaquin Delta via the Delta; water surplus to the needs of the areas in which it originates is gathered in the Delta and thereby provides a common source of fresh water supply for water-deficient areas. It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good.

12201. The Legislature finds that the maintenance of an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta area as set forth in Section 12220, Chapter 2, of this part, and to provide a common source of fresh water for export to areas of water deficiency is necessary to the peace, health, saftey and welfare of the people of the State, except that delivery of such water shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

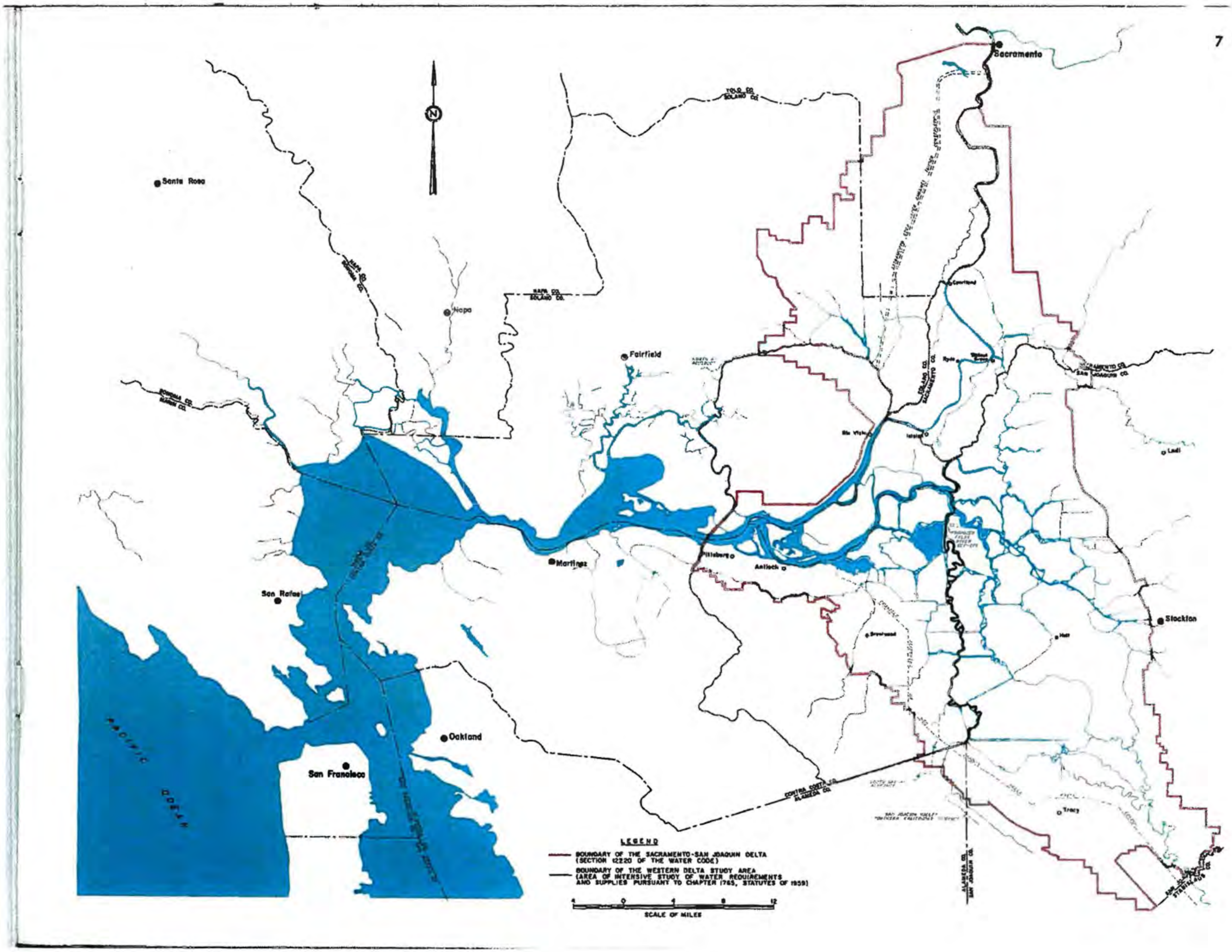
12202. Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operation of the Federal Central Valley Project, shall be the provision of salinity control and an adequate water supply for the users of water in the Sacramento-San Joaquin Delta. If it is determined to be in the public interest to provide a substitute water supply to the users in said Delta in lieu of that which would be provided as a result of salinity control no added financial burden shall be placed upon said Delta water users solely by virtue of such substitution. Delivery of said substitute water supply shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

12203. It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users within said Delta are entitled.

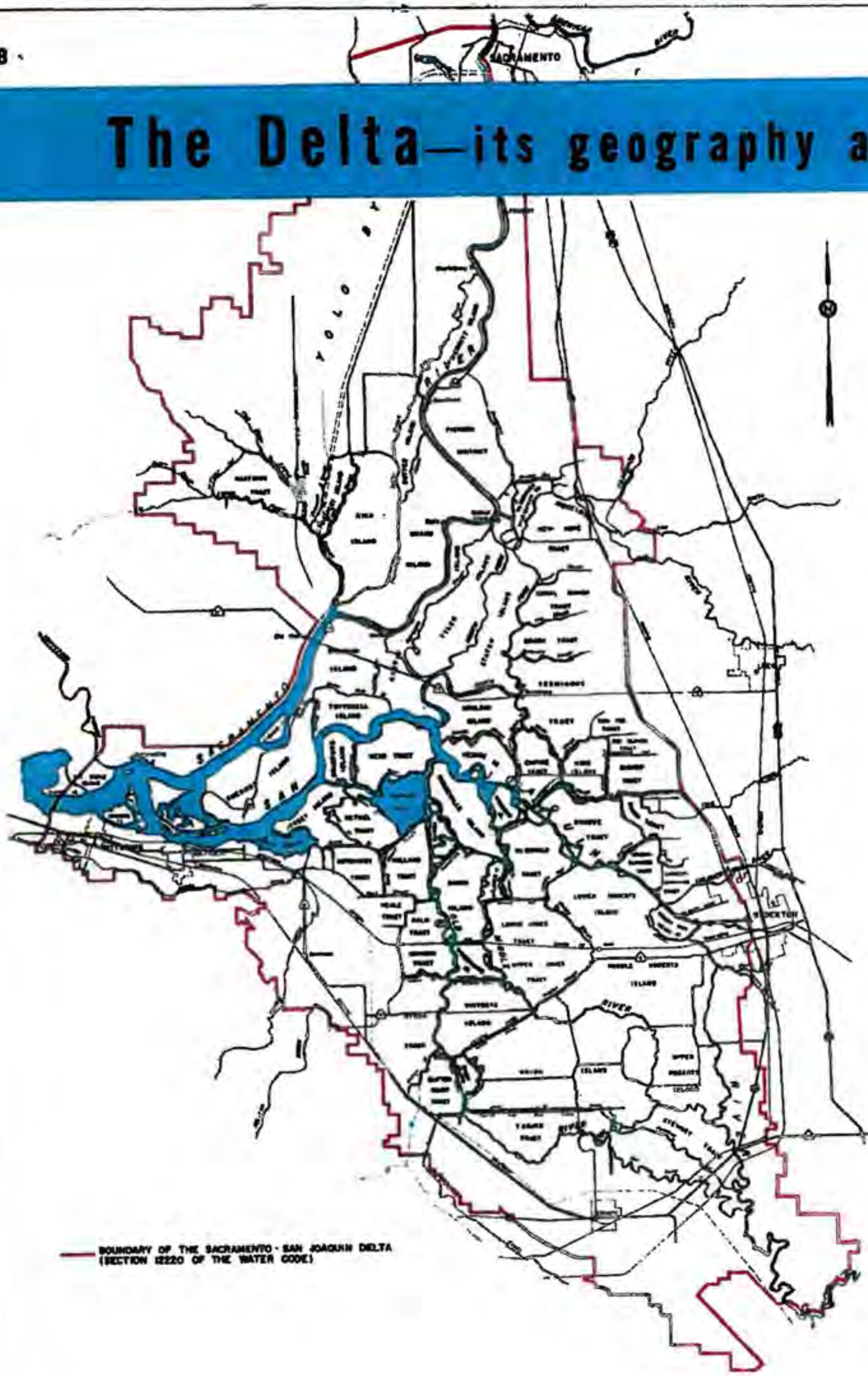
12204. In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections 12202 and 12203 of this chapter.

12205. It is the policy of the State that the operation and management of releases from storage into the Sacramento-San Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible in order to permit the fulfillment of the objectives of this part.

This legislation also described the area of the Delta to which the general policy applies. The boundary of the Delta, as described in Section 12220 of the Water Code, is indicated on the facing map. The area considered in the intensive studies of water requirements and supplies is described as the Western Delta Study Area.


Sacramento
Santa Rosa
Napa
Fairfield
Rio Vista
Isleton
Courtland
Ryde
Lodi
Pittsburg
Antioch
Martinez
San Rafael
Brentwood
Holt
Stockton
Oakland
San Francisco
Tracy
PACIFIC OCEAN
YOLO CO.
SOLANO CO.
NAPA CO.
SONOMA CO.
SOLANO CO.
SACRAMENTO CO.
SAN JOAQUIN CO.
CONTRA COSTA CO.
ALAMEDA CO.
LEGEND
BOUNDARY OF THE SACRAMENTO-SAN JOAQUIN DELTA (SECTION 12220 OF THE WATER CODE)
BOUNDARY OF THE WESTERN DELTA STUDY AREA (AREA OF INTENSIVE STUDY OF WATER REQUIREMENTS AND SUPPLIES PURSUANT TO CHAPTER 1765, STATUTES OF 1959)
4 0 4 8 12
SCALE OF MILES

The Delta—its geography and economy

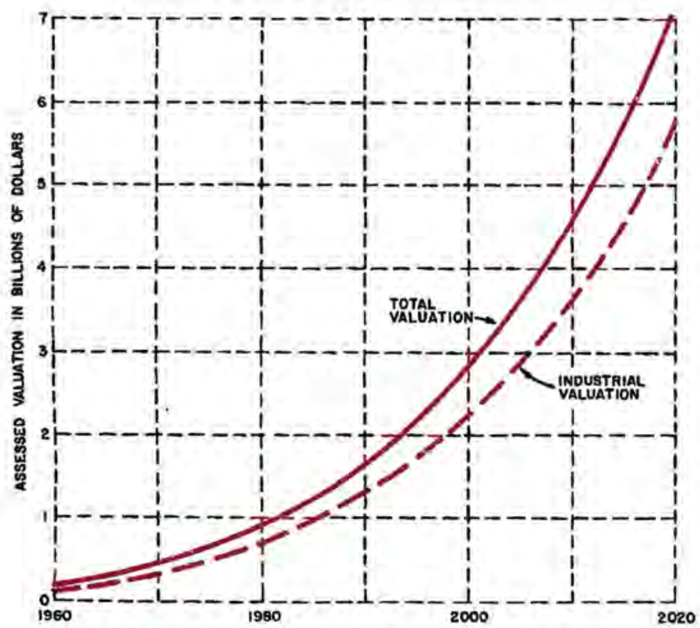


The Delta, located at the confluence of the Sacramento and San Joaquin Rivers system, is a unique feature of the California landscape. The Delta encompasses some 738,000 acres, interlaced with 700 miles of meandering waterways covering 50,000 acres. About 415,000 acres of land, referred to as Delta Lowlands, lie between elevations of 5 feet above and 20 feet below sea level. This area is composed of peat, organic sediments, and alluvium, and is protected from flood water and high tides by man-made levees. The extensive waterways afford opportunity for shipping and provide a wonderland for boating and water sports. These same waterways must safely discharge flood waters of the Central Valley.

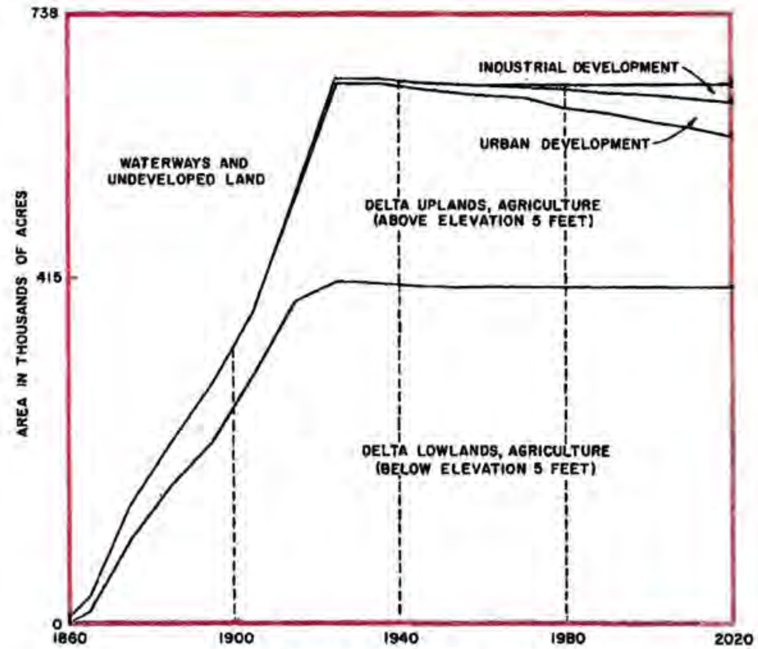
The fortunate combination of fertile soils, convenient water supplies, and shallow-draft shipping to central California markets led to development of an intensified agricultural economy in the Delta. Initial reclamation of the marshlands began slowly in the 1850's, but rapidly expanded after state assistance was provided by a swampland act in 1861. By 1930, all but minor areas of the swamplands had been leveed and were in production.

The Delta has historically been noted for its asparagus, potatoes, celery, and varied truck crops. Recently, greater emphasis has been placed on field corn, milo, grain, and hay, although the Delta still produces most of the nation's canned asparagus. The Delta's agricultural economy for many years was dependent upon repulsion of ocean salinity by fresh water outflow, which fluctuated widely, but during the past sixteen years has been protected largely by releases from upstream reservoirs of the Federal Central Valley Project during summer months.

Several towns and cities are located in the upland areas and an industrial complex is expanding in the western part of the Delta. Early industrial development centered around food and kindred products, steel production, fibreboard, lumber, and shipbuilding activity. Large water-using industries, such as steel, paper products, and chemicals, have developed in the western area where water, rail, and highway transportation, coupled with water supplies, has stimulated growth. The manufacturing employment in this area was about 10,000 people in 1960.



PROJECTED ASSESSED VALUATIONS WITHIN THE WESTERN DELTA STUDY AREA



TRENDS IN LAND USE

A deep-draft ship channel serving commercial and military installations terminates at Stockton, and another is being constructed to Sacramento. Water-borne shipments in the Delta amounted to about 6,000,000 tons annually in recent years.

The Delta encompasses one of California's most important high quality natural gas fields. Since 1941 the field has produced about 300,000,000 cubic feet of methane gas for use in the San Francisco Bay area.

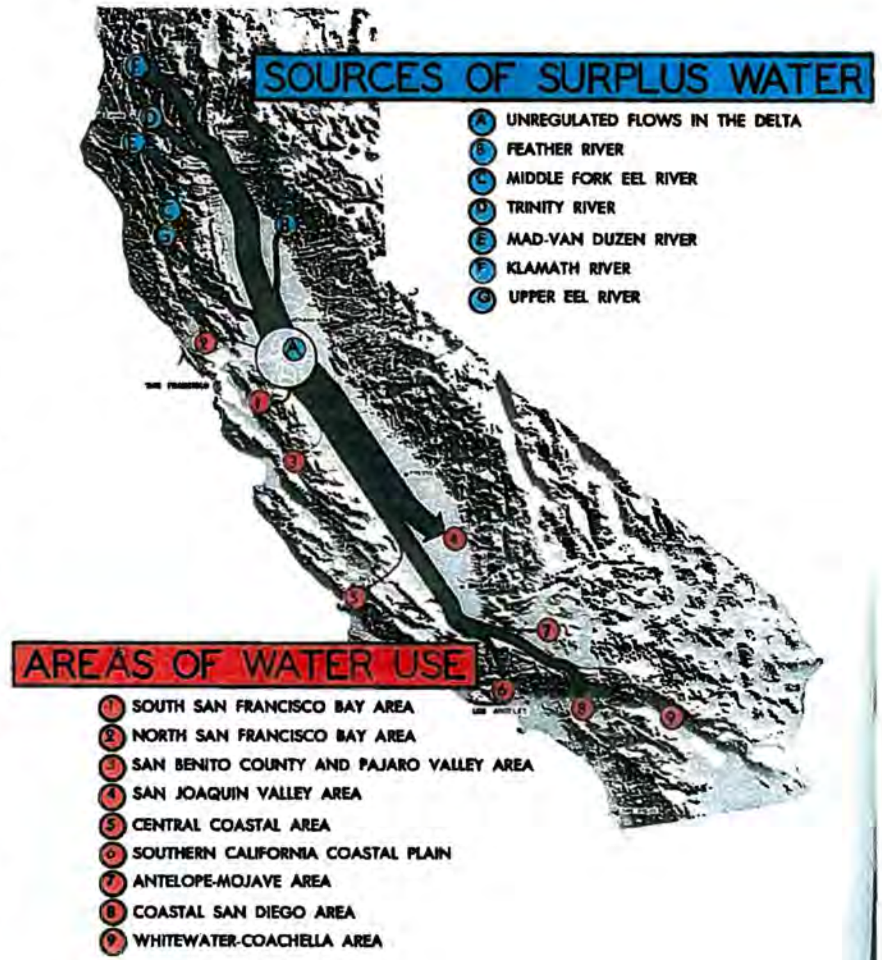
With the growing significance of recreation, the Delta has blossomed into a major recreation area at the doorsteps of metropolitan development in the San Francisco Bay area, Sacramento, and Stockton. In 1960, nearly 2,800,000 recreation-days were enjoyed in this boating wonderland.

The Delta — its role in California's water development

In 1959, the State Legislature enacted the California Water Resources Development Bond Act to finance construction of the State Water Resources Development System. The bond act was approved by the California electorate in November 1960. The State Water Facilities, the initial features of this system, will complement continuing local and federal water development programs and include the very necessary works in the Delta.

One of the principal objectives of the State Water Resources Development System is to conserve water in areas of surplus in the north and to transport water to areas of deficiency to the south and west. The Delta is important in achieving this objective, since it receives all of the surplus flows of Central Valley rivers draining to the ocean during winter and spring months and is the last location where water not needed in the Delta or upstream therefrom can conveniently be controlled and diverted to beneficial use. Surplus water from the northern portion of the Central Valley and north coastal rivers will be conveyed by the natural river system to the Delta, where it must be transferred through Delta channels to export pumping plants without undue loss or deterioration in quality. Aqueducts will convey the water from the Delta to off-stream storage and use in areas of deficiency to the south and west.

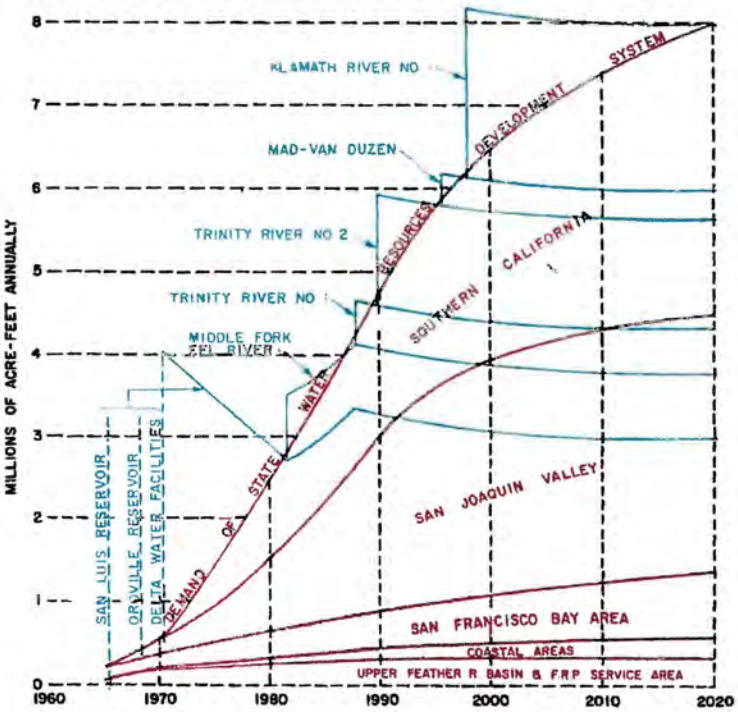
In addition to being an important link in the interbasin transfer of water, the Delta is a significant segment of California's economy, and its agricultural, municipal, and industrial water supply problems, and flood control and related problems, must be remedied. A multipurpose system of Delta water facilities, which will comprise one portion of the State Water Resources Development System, is the most economical means of transferring water and solving Delta problems.



Tracy Pumping Plant

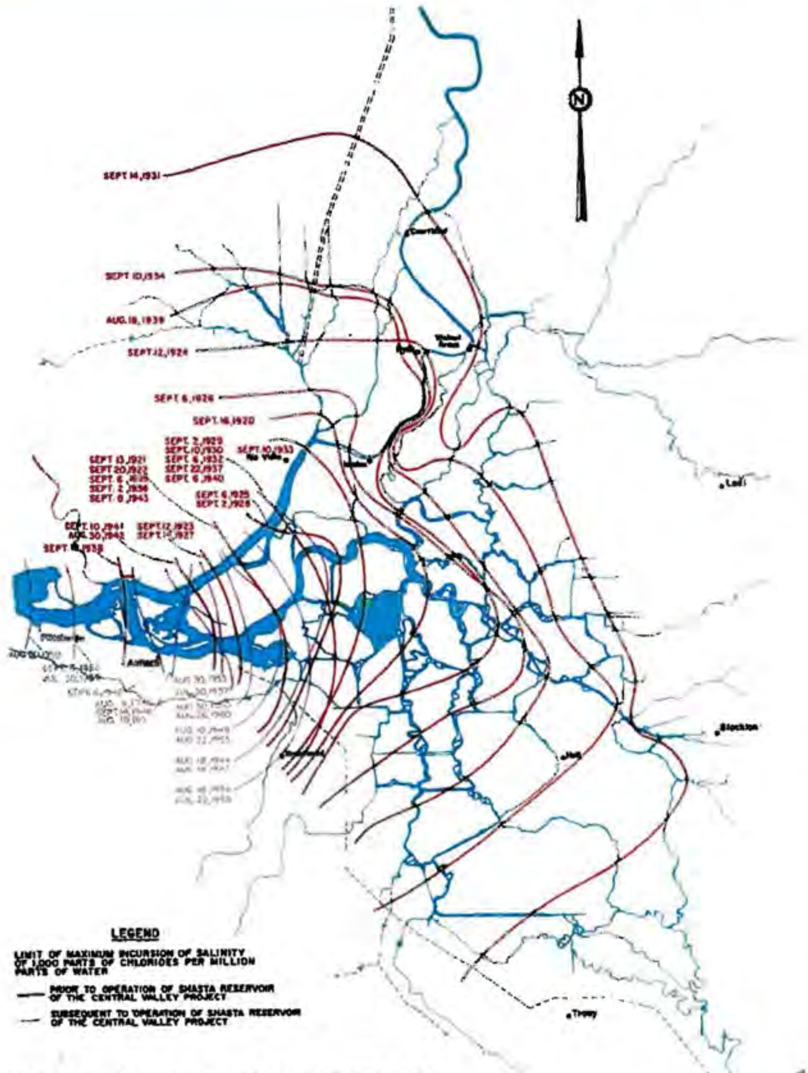
The coordinated use of surplus water in and tributary to the Delta and of regulated or imported supplements to this supply, as required, is referred to as the Delta Pooling Concept. Under this concept of operation the State will ensure a continued supply of water adequate in quantity and quality to meet the needs of export water users. Advantage will be taken of surplus water available in the Delta, and as the demand for water increases and the available surplus supply is reduced by further upstream uses, the State will assume the responsibility of guaranteeing a firm supply of water, which will be accomplished by construction of additional storage facilities and import works. At the same time, the water needs of the Delta will be fully met.

Full demands on the State Water Resources Development system can be met until about 1981 from surplus water in and tributary to the Delta with regulation by the proposed Oroville and San Luis Reservoirs. However, upstream depletions will reduce the available surplus supplies and water will have to be imported from north coastal sources after that year. It is anticipated that coordinated operation of the State Water Resources Development System and the Federal Central Valley Project will afford a limited increase in usable surplus Delta supplies beginning in 1981. As indicated in the chart, upstream depletions will continue to decrease the available surplus supplies.



WATER SOURCES AND USES

Delta Problems — salinity incursion and water supplies

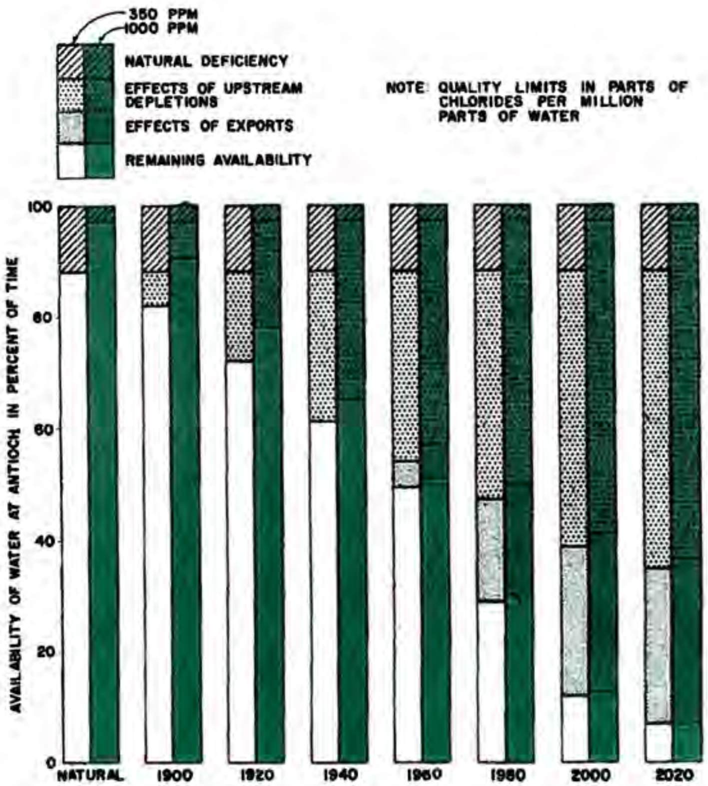


HISTORICAL SALINITY INCURSION
1920-1960

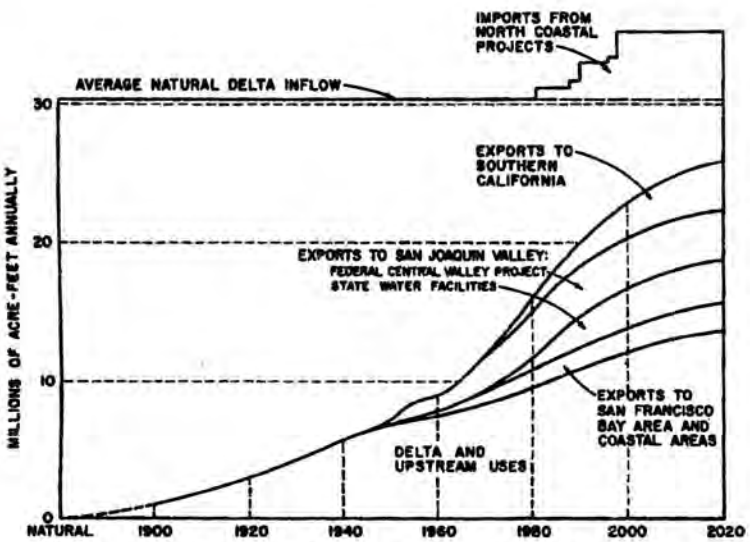
Salinity incursion into the Delta results from the flooding and ebbing of ocean tides through the San Francisco Bay and Delta system during periods when the fresh water outflow from the Delta is insufficient to repel the saline water. The natural fresh water outflow from the Central Valley was historically inadequate to repel salinity during summer months of some years. The first known record of salinity encroachment into the Delta was reported by Cmdr. Ringgold, U. S. Navy, in August 1841, whose party found the water at the site of the present city of Antioch very brackish and unfit for drinking. Since that time, and particularly after the turn of the century, with expanding upstream water use salinity incursion has become an increasingly greater problem in Delta water supplies. The maximum recorded extent of salinity incursion happened in 1931, when ocean salts reached Stockton. Since 1944 extensive incursion has been repulsed much of the time by fresh water releases from Central Valley Project storage in Shasta and Folsom Reservoirs. Without such releases, saline water would have spread through about 90 percent of the Delta channels in 1955 and 1959. Although upstream uses might not have reached present levels in the absence of the Central Valley Project, salinity problems would still have been very serious during most years.

Further increase in water use in areas tributary to the Delta will worsen the salinity incursion problem and complicate the already complex water rights situation. To maintain and expand the economy of the Delta, it will be necessary to provide an adequate supply of good quality water and protect the lands from the effects of salinity incursion. In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta are first provided.

The natural availability of good quality water in the Delta is directly related to the amount of surplus water which flows to the ocean. The graph to the right indicates the historic and projected availability of water in the San Joaquin River at Antioch containing less than 350 and 1,000 parts chlorides per million parts water, under long-term average runoff and *without* specific releases for salinity control. It may be noted that even under natural conditions, before any significant upstream water developments, there was a deficiency of water supplies within the specified quality limits. It is anticipated that, without salinity control releases, upstream depletions by the year 2020 will have reduced the availability of water containing less than 1,000 ppm chlorides by about 60 percent, and that exports will have caused an additional 30 percent reduction.



DELTA WATER QUALITY WITHOUT SALINITY CONTROL



USE OF DELTA WATER SUPPLIES

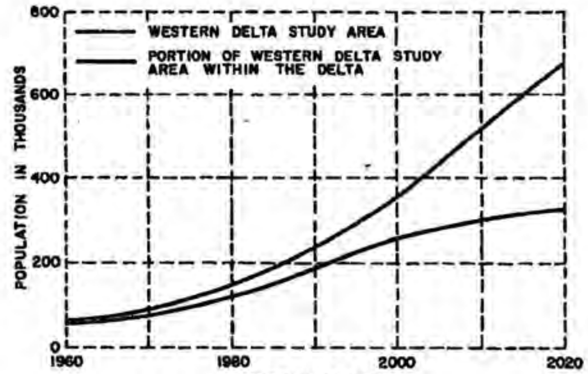
The magnitude of the past and anticipated future uses of water in areas tributary to the Delta, except the Tulare Lake Basin, is indicated in the diagram to the left. It may be noted that, while the present upstream use accounts for reduction of natural inflow to the Delta by almost 25 percent, upstream development during the next 60 years will deplete the inflow by an additional 20 percent. By that date about 22 percent of the natural water supply reaching the Delta will be exported to areas of deficiency by local, state, and federal projects. In addition, economical development of water supplies will necessitate importation of about 5,000,000 acre-feet of water seasonally to the Delta from north coastal streams for transfer to areas of deficiency.

Delta Problems—municipal water

Municipalities in the surrounding upland areas of the Delta, except in the western portion, obtain their water supplies from surface or underground sources which are, or will be with further development, adequate to meet their needs. In the western Delta, the principal municipalities rely on supplies from the Contra Costa Canal which are diverted from Delta channels. The main problem relates to quality of the water. At the present time, the mineral quality of the supplies deteriorates during some summer and fall months below standards established by the U. S. Public Health Service. This results from incursion of ocean salts, combined with industrial wastes and poor quality return water from the Central Valley. Assurance of good quality supplies in adequate quantities to meet present requirements and anticipated future growth is one of the most pressing problems in the Delta.

Estimates of future municipal water requirements in the western Delta area were based on projected population and per capita use. Population projections were founded on national, state, and regional forecasts for moderately high economical conditions. Although these conditions result in forecasts which may exceed an anticipated "most probable" projection by about ten percent, it is believed that this approach will assure adequate consideration of Delta water requirements in plans for diversion of surplus water from the Delta.

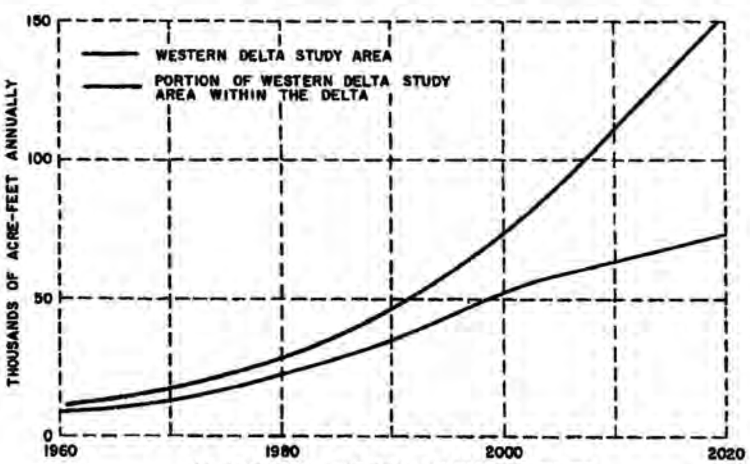
Projected estimates of per capita water uses reflect anticipated increases due to greater emphasis on water-using appliances in homes, additional lawns and landscaping, and the general trend toward higher standards of living. An average municipal water use of about 140 gallons per capita per day at this time reflects the climatic and economic conditions of the area. It is anticipated that the average use in low density residential areas will increase to about 200 gallons per capita per day by 2020. The estimated total annual municipal water requirement in the western Delta area indicates about a fifteenfold increase by 2020.



POPULATION
WESTERN DELTA STUDY AREA

ESTIMATED MUNICIPAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA
(In thousands of acre-feet annually)

Area	1960	1980	2000	2020
Western Delta Study Area				
Contra Costa Co.	9.6	26.8	62.7	116.4
Solano Co.	0.7	1.4	10.0	35.4
Portion of Western Delta Study Area Within the Delta				
Contra Costa Co.	8.6	22.6	52.0	71.4
Solano Co.	0.0	0.0	0.4	2.5



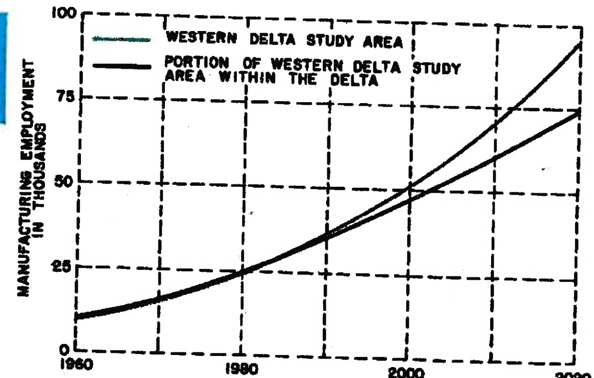
MUNICIPAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA

Delta Problems—industrial water

The problems of industrial water supply are similar to municipal supply problems in that they are concentrated in the western Delta area and center around quality aspects. Deterioration of water supplies by salinity incursion in 1959 caused curtailment of production in several plants and a production halt in one major industry. As additional upstream development and beneficial use of water takes place, the duration and degree of salinity incursion each year will become more extended. It will become increasingly necessary to provide adequate industrial water supplies in the western Delta area for maintenance and expansion of the present economy.

Estimates of future industrial growth were based on correlation of state and regional manufacturing employment with national projections. Projections to 1980 were based on detailed analyses of the several components of the industrial complex, while projections beyond that date reflect total manufacturing employment. A sevenfold increase in manufacturing employment in the western Delta area is anticipated by 2020. Increasing productivity per employee, due to automation and technical advancements, coupled with projected employment, indicates a thirtyfold increase in production by that date.

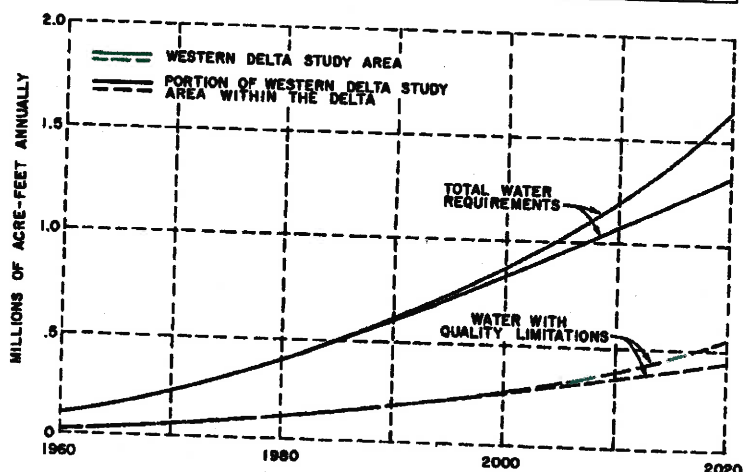
Estimates of future water supplies to enable the production increases were based on six manufacturing categories, and reflect a continuation of the trend of decreasing water use per unit of production. A fifteenfold increase in total industrial water requirements is indicated by 2020. The total requirement includes two types of industrial water. One type is for processing and recirculated cooling with quality limitations, and the second type is for general cooling where good quality water is not required because materials of construction in cooling equipment can satisfactorily withstand a wide range of quality conditions.



MANUFACTURING EMPLOYMENT
WESTERN DELTA STUDY AREA

ESTIMATED INDUSTRIAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA
(In thousands of acre-feet annually)

Area	1960	1980	2000	2020
Western Delta Study Area				
Total water requirements, Contra Costa Co.	106	396	790	1,270
Total water requirements, Solano Co.	1	7	67	387
Water with quality limitations, Contra Costa Co.	30	120	251	423
Water with quality limitations, Solano Co.	–	2	21	129
Portion of Western Delta Study Area Within the Delta				
Total water requirements, Contra Costa Co.	106	396	790	1,270
Total water requirements, Solano Co.	–	–	9	56
Water with quality limitations, Contra Costa Co.	30	120	251	423
Water with quality limitations, Solano Co.	–	–	3	19



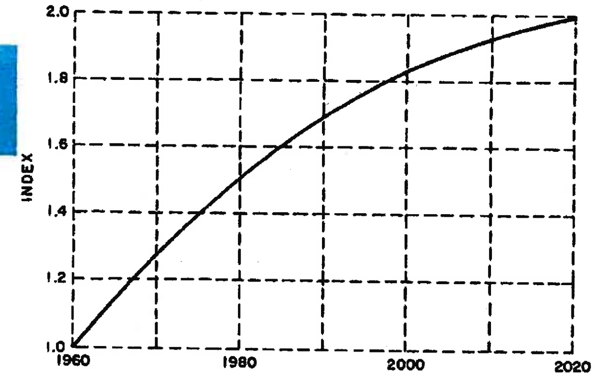
INDUSTRIAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA

Delta Problems—agricultural water

For many years farmers in the Delta have been confronted with salinity incursion in Delta channels. Since 1944 they have enjoyed partial salinity protection and supplemental water due to releases from Shasta and Folsom Reservoirs. As additional water is utilized in areas tributary to the Delta, there will be further reductions in unregulated late spring runoff to the Delta, which will result in diminishing supplies in the western Delta and greater Delta-wide reliance on regulated fresh water outflow. About 40,000 acres in the western Delta are faced with water supplies of poor quality even if future export projects are not constructed. In the southern portion of the Delta the present water supplies during summer months consist mainly of very poor quality drainage water in the San Joaquin River. Operation of the proposed San Joaquin Valley waste conduit may reduce the amount of return drainage water available in the San Joaquin River. If this occurs, substitute water supplies would have to be provided.

Although most of the suitable land in the Delta is now irrigated, limited additional development in the uplands is anticipated, and more intense use by double-cropping will be made of Delta lowlands. Estimates of expanding water requirements reflect correlations with statewide projections of the economic demand for farm produce. It is anticipated that about 10,000 acres of "new" land will be irrigated in the upland areas, but about 40,000 acres will be converted to urban uses by 2020.

Future water requirements were based on projected crop patterns and unit water requirements of the various crops. Some additional water may be required for leaching of lands surrounded by brackish water. Separate allowance for this purpose was provided in operation studies of plans which result in brackish water in western Delta channels.

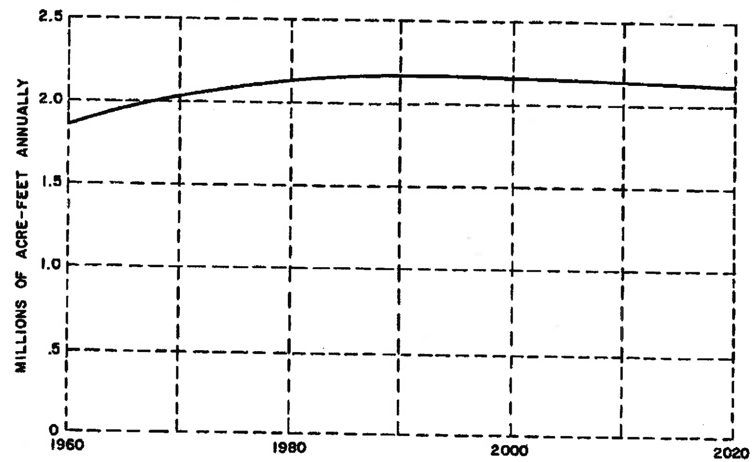


INDEX OF AGRICULTURAL PRODUCTIVITY

ESTIMATED AGRICULTURAL WATER REQUIREMENTS WITHIN THE DELTA [1]
(In thousands of acre-feet annually)

Area	1960	1980	2000	2020
Alameda County	13	15	15	15
Contra Costa County	236	272	275	270
Sacramento County	294	339	342	336
San Joaquin County	838	967	977	958
Solano County	238	264	267	261
Yolo County	244	282	285	279
TOTAL	1,863	2,139	2,161	2,119

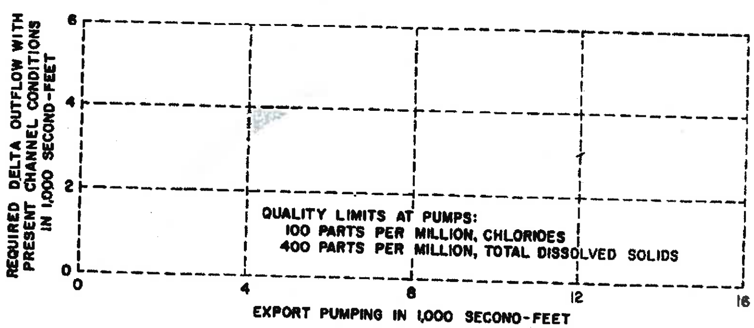
[1] Including effective precipitation.



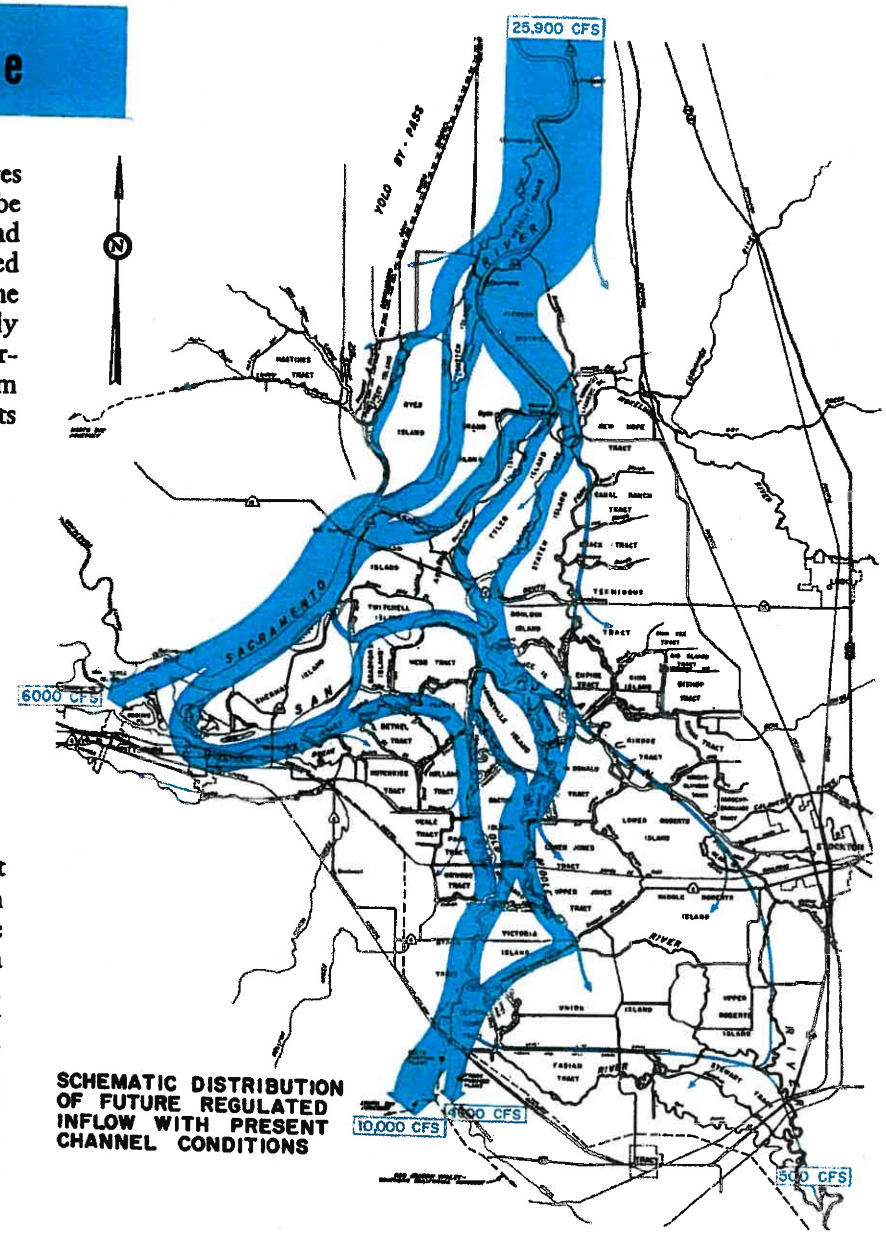
AGRICULTURAL WATER REQUIREMENTS

Delta Problems—water salvage

During winter months of most years, flood flows exceed Delta uses and flush ocean salts from the channel system. Surplus water can be diverted from the Delta under these conditions. During summer and early fall months, the inflow to the Delta is generally limited to regulated flow in the Sacramento River. This supply must meet all uses in the Delta and export therefrom, and prevent salinity incursion from unduly degrading the quality of water in the Delta. Due to the hydraulic characteristics of the complex channel system, the amount of outflow from the Delta necessary for quality control at the export pumping plants increases as the rates of export increase.

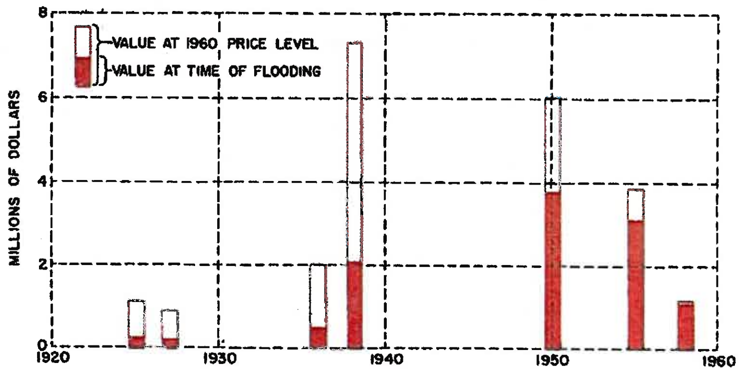


Water in the Sacramento River follows two basic routes to the export pumping plants. It flows from the vicinity of Walnut Grove through several generally parallel channels in a southerly direction across the central portion of the Delta, and also through channels in the western portion around Sherman Island and then upstream into the central area. The quantities transferred by the first route are *not sufficient* to supply the pumps and enroute Delta users during summer months, and water transferred around Sherman Island by the second route is mixed with and carries ocean salts into the Delta. Therefore, greater quantities of water will be necessary to reduce the salinity concentrations in the western Delta, unless a physical barrier is constructed or water is diverted directly southward across the Delta.

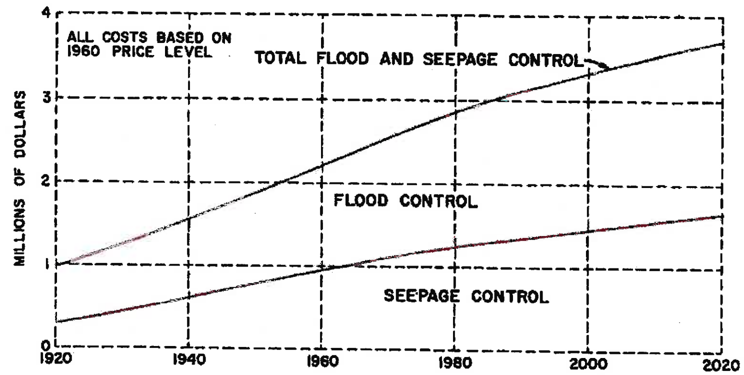


SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW WITH PRESENT CHANNEL CONDITIONS

Delta Problems—flood and seepage control



HISTORICAL FLOOD DAMAGE IN THE DELTA

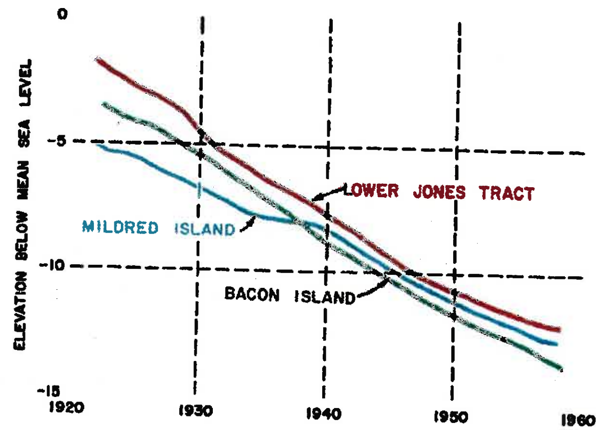


ANNUAL COSTS - FLOOD AND SEEPAGE CONTROL

While the peat soils of the Delta are excellent for growing crops, they cause several difficult levee maintenance and farming problems. Levees along the channels have been constructed on the peat and periodically must be raised and widened as the organic foundation soils are consolidated. During the early stages of land reclamation, islands were frequently flooded by overtopping of the levees. However, under present conditions floods due to overtopping are infrequent in the central portion of the Delta, but numerous islands have been flooded when sections of the levees have suddenly failed. This apparent trend toward decreasing levee stability results from subsidence of the land surface and resultant greater forces on the levees. Despite increasing maintenance work on many existing levees, no significant improvement in protection is achieved.

The land surface in areas of peat soils is subsiding at an average rate of about three inches per year. This is generally attributed to oxidation of the peat fibers, wind erosion, compaction by farm equipment, and loss of water in the upper few feet. As a result of land subsidence, future levees in many areas will be 30 to 35 feet high. Work must be initiated soon to gradually increase the stability of the levees for these future conditions. In this connection, it must be recognized that flood protection for the Delta must include works in the Delta. Flood stages in the Delta result from inflow and high tides, frequently amplified by heavy winds on the ocean and Bay system. Although upstream flood control reservoirs will afford some relief, more stable levees are needed to safely resist the high tide and flood stages.

As the peat soils are lost by oxidation and erosion, the seepage problems are compounded. Differences in elevation between water levels in the channels and in the islands will increase, and the resistance by the peat to upward movement of water from

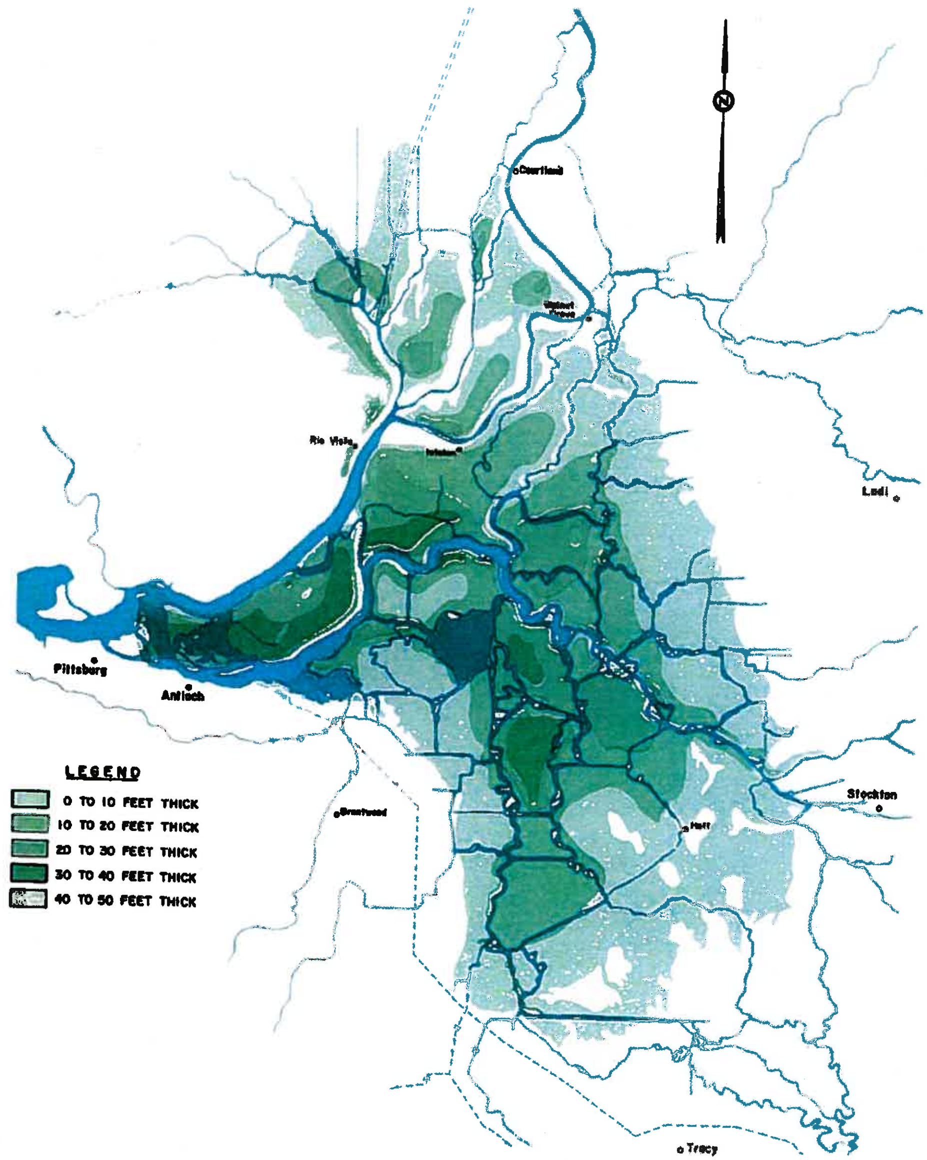


LAND SUBSIDENCE

underlying sand aquifers will be reduced. Unless suitable methods of arresting the loss of peat are developed, farming in the Delta will cause continued subsidence. Experience has shown that this subsidence will continue to within about two to three feet above the bottom of the peat. Significant tracts of Delta land will become impractical to farm unless seepage is controlled and the danger of inundation is reduced.

The largest natural gas field in areal extent in the State of California is located in the Delta. The geological structure of this field is strikingly similar to the structure of the oil fields of Wilmington, California, but the gas pressures are dissimilar. Because of the similarity of geologic conditions, studies are being conducted to determine if deep-seated subsidence might occur as the gas is extracted. Estimates based on preliminary data indicate a maximum subsidence of two feet in the Rio Vista area, if all the gas is extracted from the field.

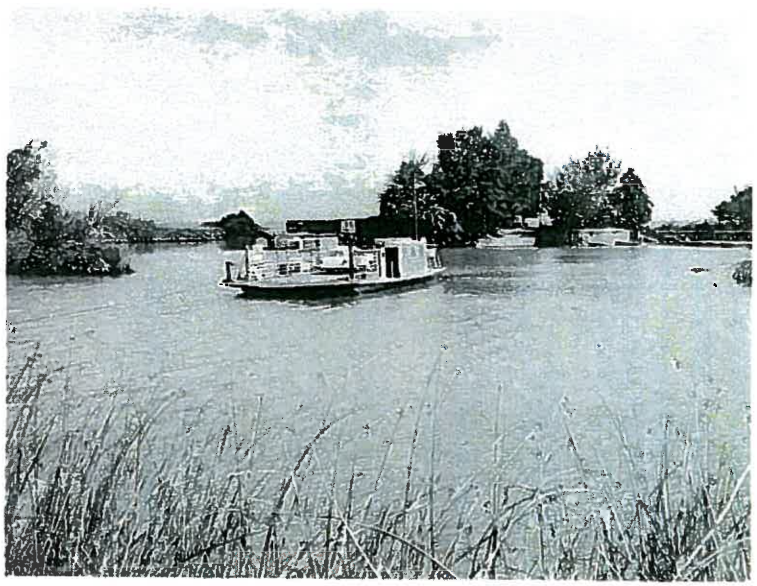
AREAS OF PEAT AND RELATED ORGANIC SEDIMENTS

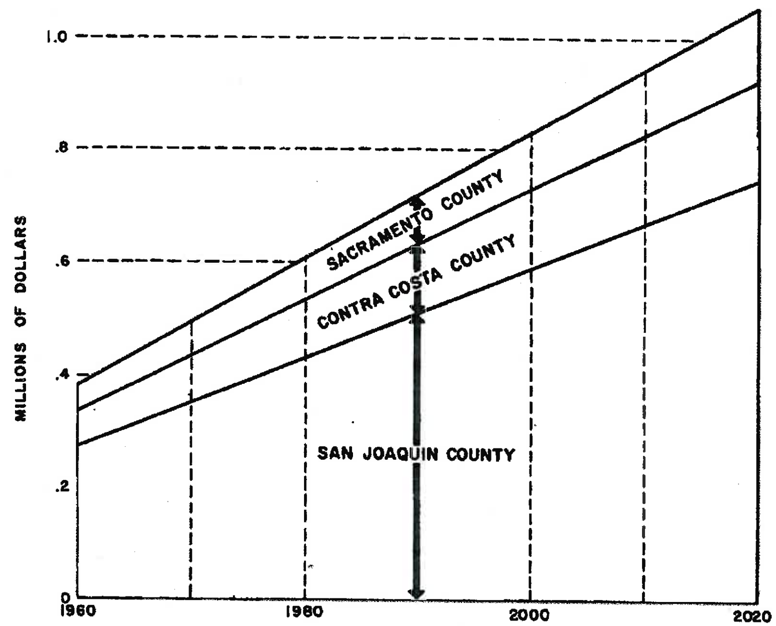


Delta Problems—vehicular transportation

The wooden barges and stern paddle wheelers long ago disappeared from the Delta scene, to be replaced by fast trucks, ocean-going freighters, and tugs towing steel barges. However, despite tremendous technological advances in transportation, the Delta, with its poor foundation soils and miles of open waterways, has hindered the development of a satisfactory highway system.

Vehicular transportation, even today, is confined mainly to the crowns of the levees which encircle the farmlands, and inter-island traffic is dependent to a large extent on ferries. Periodic levee reconstruction to compensate for consolidation and land subsidence results in delays and detours for the traveling public and farm-to-market commerce. In winter months much of the area is inaccessible because of muddy roads. There are 950 miles of paved roads in the area, but because of the unstable peat foundation, the costs of maintenance and operation are disproportionately high. For example, in San Joaquin County only 12 percent of the county's 1,780 miles of roads is in the Delta, but almost 30 percent of the county's annual costs of $1,000,000 for highway facilities is expended in the Delta. Future costs will increase due to greater use of the road system.

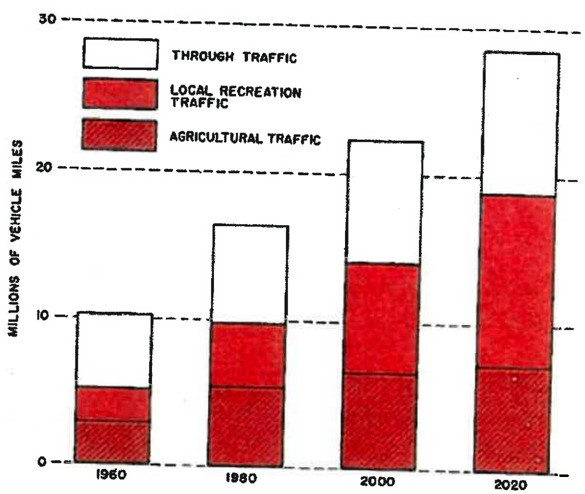




ANNUAL COST OF MAINTAINING
COUNTY ROADS WITHIN THE DELTA

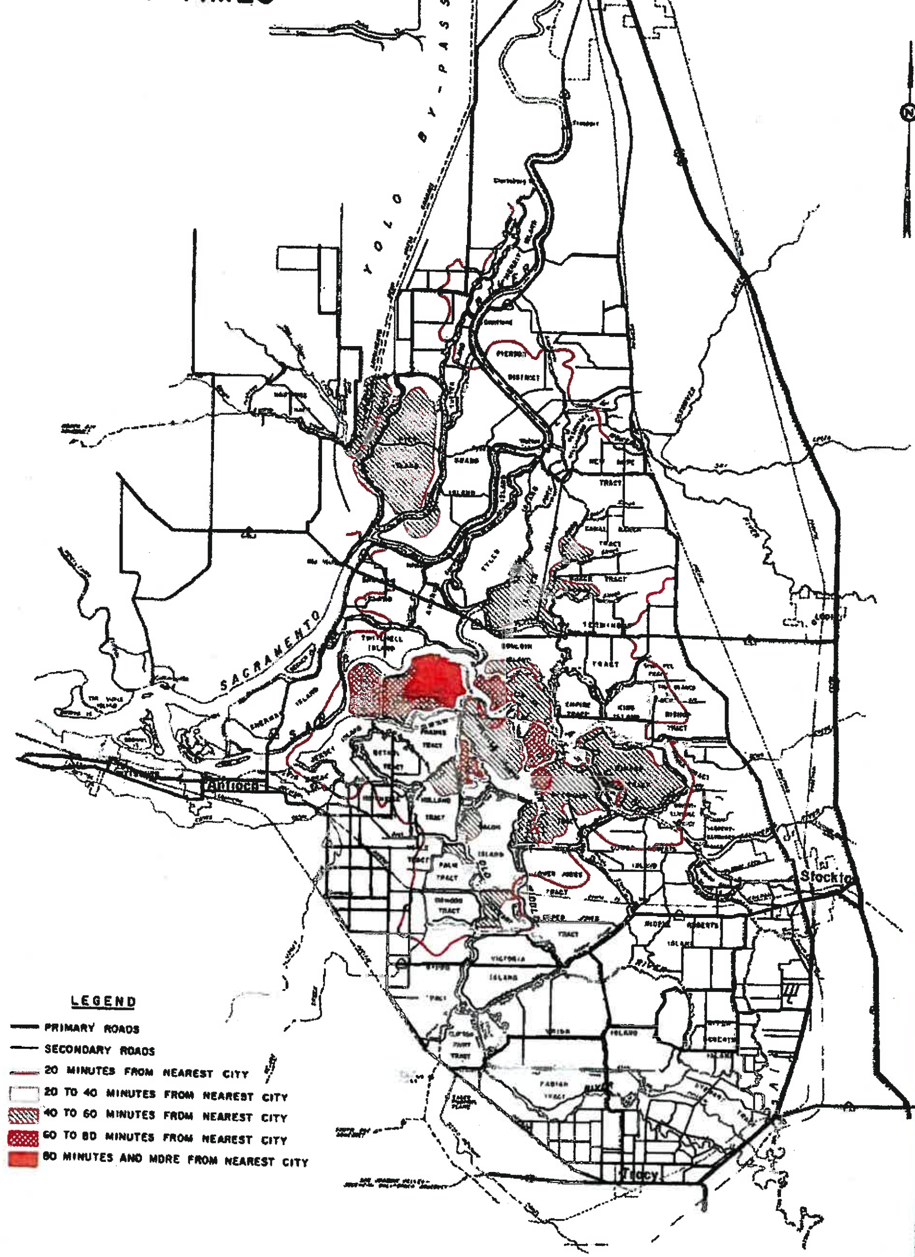
While it is true that today's Delta roads are greatly improved over those of the past, there still remains a serious lack of access to many remote locations of the Delta. Improvements are also needed in roads linked with the state and county highway networks. Travel times to principal cities of Stockton, Tracy, Sacramento, and Antioch are depicted on the map.

An expanded and improved system of roads would unquestionably make the Delta more attractive to the recreation industry. The new roadways also would benefit many local landowners who are presently at an economic disadvantage in shipment of their crops to markets. Increasing production in the Delta, due to anticipated double-cropping and improvements in farming practices, will increase the amount of agricultural road traffic.

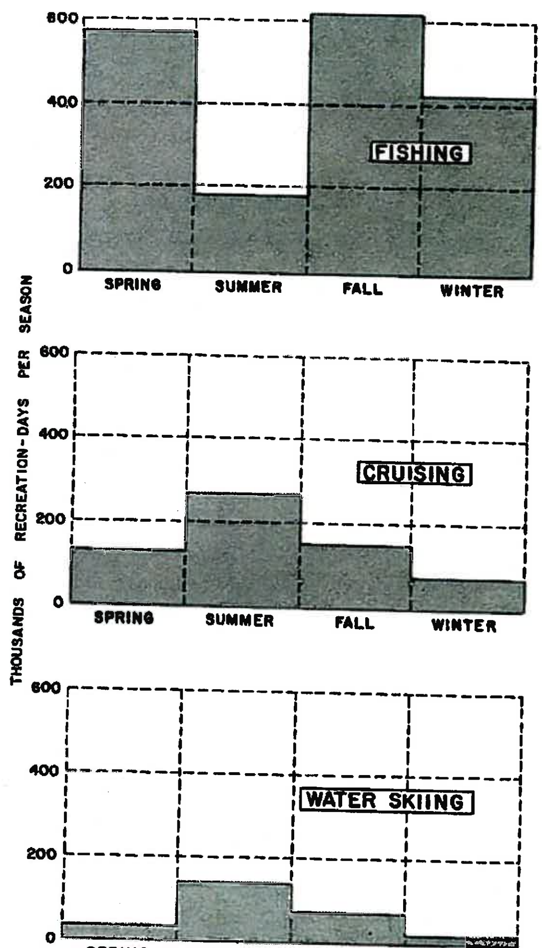


TRENDS IN TRAFFIC

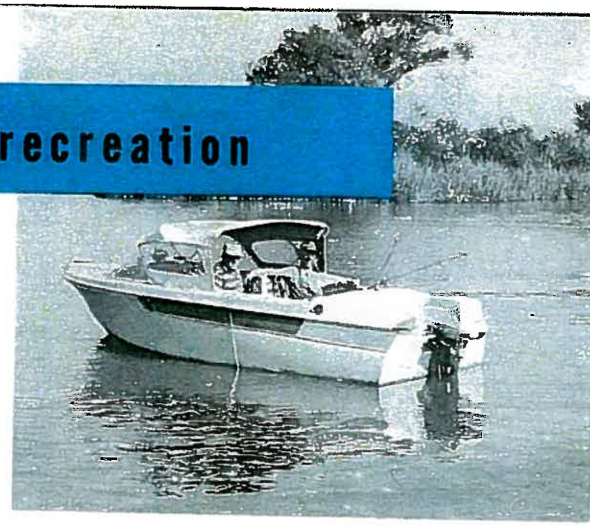
DELTA ROADS and TRAVEL TIMES



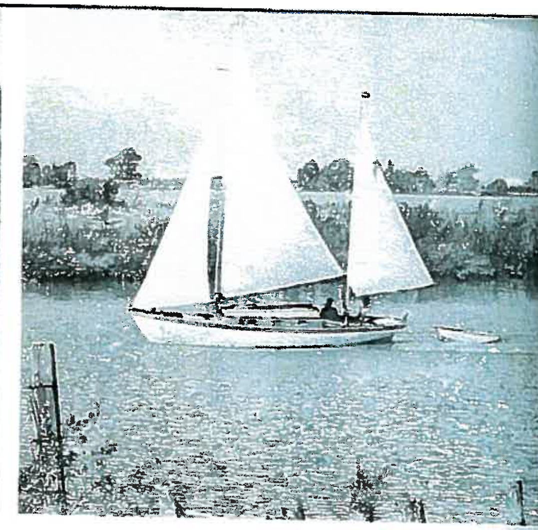
Delta Problems—recreation



RECREATION PATTERNS IN 1960



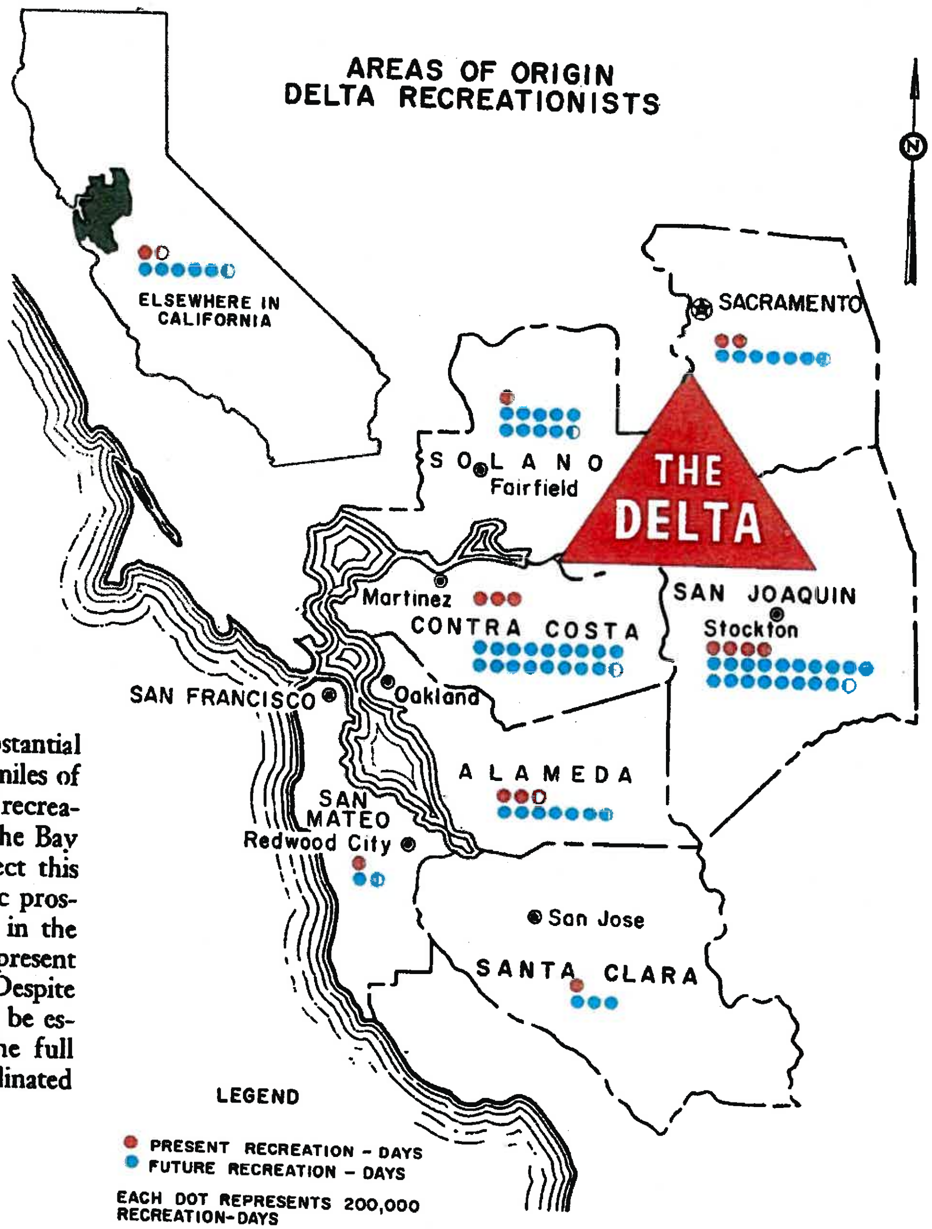
Courtesy of Los Angeles Times



Courtesy of Los Angeles Times

The 50,000 acres of water surface and almost 1,000 miles of shore line in the Delta offer a vast and fascinating area with a great diversity of recreational opportunities. Fishing is the favorite pursuit and striped bass is the leading catch. Salmon, shad, black bass, catfish, and sturgeon are also important in the sportsman's bag. The maze of Delta channels is appealing to boatmen for cruising, and the many miles of calm water are ideal for water skiing and high-speed boating. While many of the channels are not extensively used, due mainly to difficulty of access and lack of service facilities, other areas have become congested and competition is developing between fishermen, boatmen, and skiers. Safety of the recreationists is becoming a significant problem and local law enforcement agencies are increasing their patrols. Levee erosion problems due to speeding boats also have developed in some localities. Picnicking and swimming are becoming more attractive as facilities are developed, and duck and pheasant hunting is very popular. There are now 123 private and public resorts which cater primarily to fishermen and boatmen in the Delta. In addition, many of these resorts are also developing facilities for picnicking and camping.

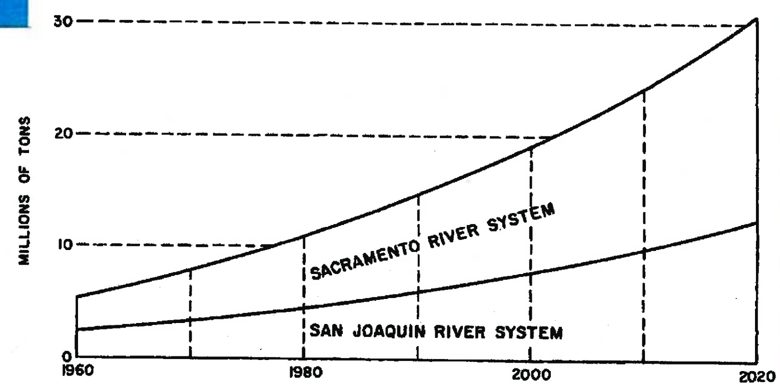
Courtesy of Hubert Miller



Although the Delta at the present time is a scene of substantial recreation use, there is ample room for expansion. Many miles of shore line and large areas of water are still available for recreational development. As the rapid population growth of the Bay area continues, recreation activity in the Delta will reflect this increase. Based on a future of continued general economic prosperity and population growth, the amount of recreation in the Delta will increase from 2,800,000 recreation-days at the present time to as many as 14,000,000 recreation-days by 2020. Despite the size of the Delta, proper local zoning and control will be essential for public safety and continued enjoyment. If the full recreation potential of the region is to be realized, coordinated planning by state and local agencies will be required.

Delta Problems—navigation

The Delta channels are extensively utilized by vessels ranging in size from rowboats to deep-draft commercial freighters and warships. The significance of navigation in the Delta has risen and fallen in the past, but in the last few decades it has been steadily increasing. The Corps of Engineers maintains many miles of channels in authorized navigation projects, the principal one in recent years being the Stockton Deep Water Channel. Construction is now underway on the Sacramento Deep Water Channel. Petroleum products carried by tugs and barges account for the majority of commercial shipping, but large amounts of farm produce are shipped by barges and deep-draft freighters.

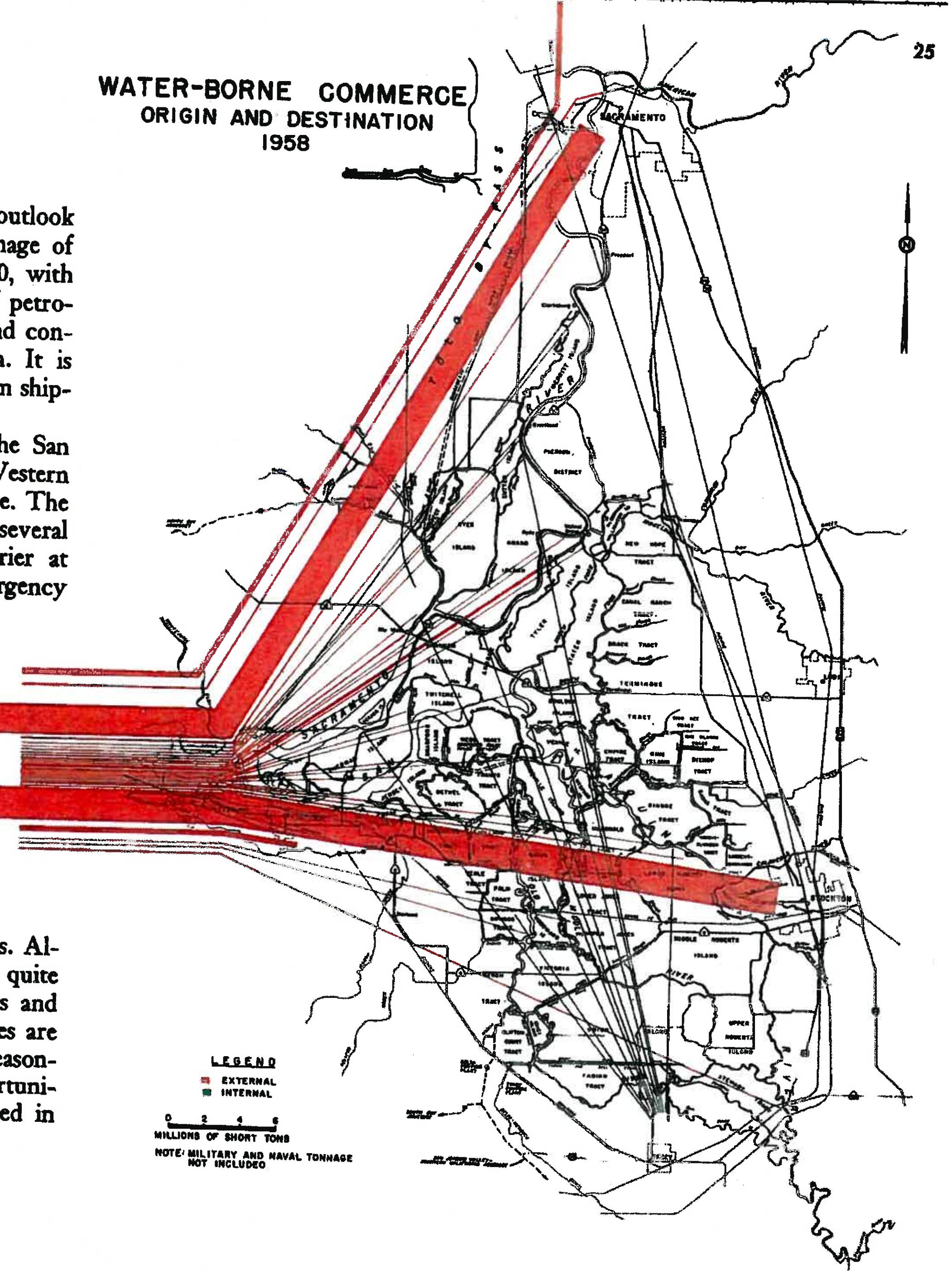


WATER-BORNE COMMERCE

Courtesy of Robert Yelland

Projections of future commerce indicate an optimistic outlook for shipping in the Delta. It is anticipated that the tonnage of commercial shipping will increase about fivefold by 2020, with petroleum being the principal commodity. Projections of petroleum shipments were related to population projections and continuation of the trend toward more vehicles per capita. It is anticipated that the present relationship between petroleum shipments by water and by other means will continue.

In 1955 in conjunction with studies of barriers in the San Francisco Bay system, an opinion was requested of the Western Area Joint Panel on effects of barriers on national defense. The panel, which was composed of representatives of the several branches of the military service, concluded that a barrier at Chipps Island would be permissible, if it contained an emergency access for navigation.



The Delta channels are widely used for recreation boats. Although some areas are relatively unused, other areas become quite congested. Conflicting interests arise between water skiers and cruising parties and the fishermen. In some locations levees are subjected to severe erosion by boat-generated waves. All reasonable measures must be undertaken to preserve boating opportunities, and facilities to enhance recreation can be constructed in certain locations.

Planning and Design Concepts

Planning for solutions to the complex Delta problems necessitates full recognition of the interrelated effects on all phases of the Delta's economy. The best solution should reflect the greatest overall benefits and least detriments, realizing that both objectives cannot be completely achieved when basic interests differ. Economies of construction and operation generally may be effected by multi-use of facilities. Therefore, consideration must be given to multipurpose development.

DELTA WATER SUPPLY

Water users in the Delta enjoy a naturally convenient source of supply in the numerous channels from which water is diverted by siphon or low-lift pumps. The supply problem in portions of the Delta stems from the poor quality of water, due to salinity incursion from the Bay and degradation by agricultural and industrial wastes. Adequate water supplies could be provided either by regulated releases of stored fresh water to repel salinity incursion and flush other wastes, or by constructing a physical barrier against salinity incursion and conveying unusable wastes beyond the barrier. A third alternative would involve a reduction of present salinity control in the western Delta channels and provision of substitute fresh water supplies to users who could not then divert from the channels containing brackish water. All three alternatives were evaluated, with particular attention to minimizing modifications to existing water supply systems.

The California Water Code specifies that one of the functions of the State Water Resources Development System is to provide salinity control and an adequate water supply in the Delta. If it is in the public interest to provide substitute supplies in lieu of salinity control, no added financial burden shall be placed on the local water users as a result of such substitution. The code also declares that water to which the Delta is entitled shall not be diverted. It is clearly established that supplying water for the Delta must be a primary and integral function of the State Water Facilities.

WATER SALVAGE

Unless physical works are constructed in the Delta, increasingly greater quantities of outflow will be required for quality control as more and more water is transferred across the Delta. However, most of the required outflow could be salvaged by constructing a physical barrier against salinity incursion, or by transferring the water more directly across the Delta to prevent commingling with brackish water near the outlet of the Delta.

The quality of water available for export, as well as for use in the Delta, must be suitable for various purposes. Standards for mineral quality, adopted by the Department of Water Resources and incorporated in water service contracts, permit not more than 400 parts of total dissolved solids and 100 parts of chlorides per million parts of water.

FLOOD AND SEEPAGE CONTROL

Flood stages in the Delta result from a combination of high tides, amplified by heavy winds on the ocean and Bay system, and inflow to the Delta. Historic inundations have generally resulted from levee failures, rather than overtopping. As the land behind the levees continues to subside, the stability of the levees decreases.

Physical and economic factors dictate an extended construction period for improvement of levees on organic soils. To reduce the extent and cost of levee improvements, it is prudent to limit flood waters to principal improved flood channels. Additional flood control reservoirs on rivers entering the Delta are contemplated for construction in the near future. Therefore, it is economical to design Delta flood channels for rates of flow anticipated after construction of upstream storage. Design of improved flood channels was predicated on additional regulation of the Cosumnes, Mokelumne, Calaveras, Stanislaus, and Tuolumne Rivers. Although the "design" floods reaching the Delta after completion of these works may generally be expected to occur on an average of once every fifty years, the degree of frequency is not particularly meaningful in the tidal channels of the Delta, since protection is largely dependent on levee stability. It should be recognized that complete flood protection generally cannot be assured by construction of control works. Continued emphasis should be placed on flood plain zoning in the Delta for low value improvement uses as generally associated with farming.

Construction of principal flood channels and creation of interior channels would afford an opportunity to regulate water stages in the interior channels. Since the rate of seepage inflow to the islands is directly related to the level of water in the surrounding channels, seepage could be reduced by lowering the water levels.

However, project operation might cause increased seepage problems in certain locations. Where these problems are evidenced by future operation, remedial measures would be necessary. Allowances for cost of such works were included in planning for areas of anticipated damage.

VEHICULAR TRANSPORTATION

Improvements in the road network of the Delta to enhance recreational opportunities and reduce costs of farm-to-market travel, could conveniently and economically be incorporated in master levee construction for flood and seepage control. Construction of the master levees would involve a wide berm on the landward side of existing levees in most locations. This berm would provide a suitable base for a road. Parking areas off the roadway could also be constructed at many locations. Channel closures in the master levee system would eliminate the need for ferries in certain locations.

Where existing roads would be rendered unusable by construction and operation of the Delta water facilities, equivalent service would be provided. Road improvements which would enhance the existing system, such as better road surfacing or extensions to connect with nearby routes, could be incorporated, if local agencies desire these improvements and participate in the costs.

RECREATION

The Delta is extensively used for recreation at this time, yet its potential use is several times greater. Planning for any facilities in the Delta should seek to minimize adverse effects on recreation, consistent with sound economics, and to enhance the attractiveness and advantages of the Delta for further recreational development. It is recognized that flood and seepage control measures, or other works which restrict free movement of boats, tend to limit recreation activity. While such effects could be reduced by providing small craft locks and portage facilities, some inconvenience would remain. Where such conflicts occur, local choice will be necessary between flood and seepage control works or open channels for recreation. Additional recreation facilities and joint use of certain lands for recreation and other purposes should be planned to enhance the potential recreational development. Local desires, as evidenced by questionnaires and discussions with county recreation agencies, guided planning for recreation facilities.

NAVIGATION

Principal ship channels in the Delta serve deep-draft commercial and military shipping. Shallow-draft tug and barge traffic utilizes the ship channels and many other channels in the Delta. The effects of alternative plans on commercial navigation can be readily evaluated, and the nature and extent of compensating measures or benefits can be determined. Unfortunately, it is not possible to evaluate in comparable terms the effects of war-damaged facilities on national defense. However, comparisons of alternative plans must include recognition of national defense aspects.

FISH

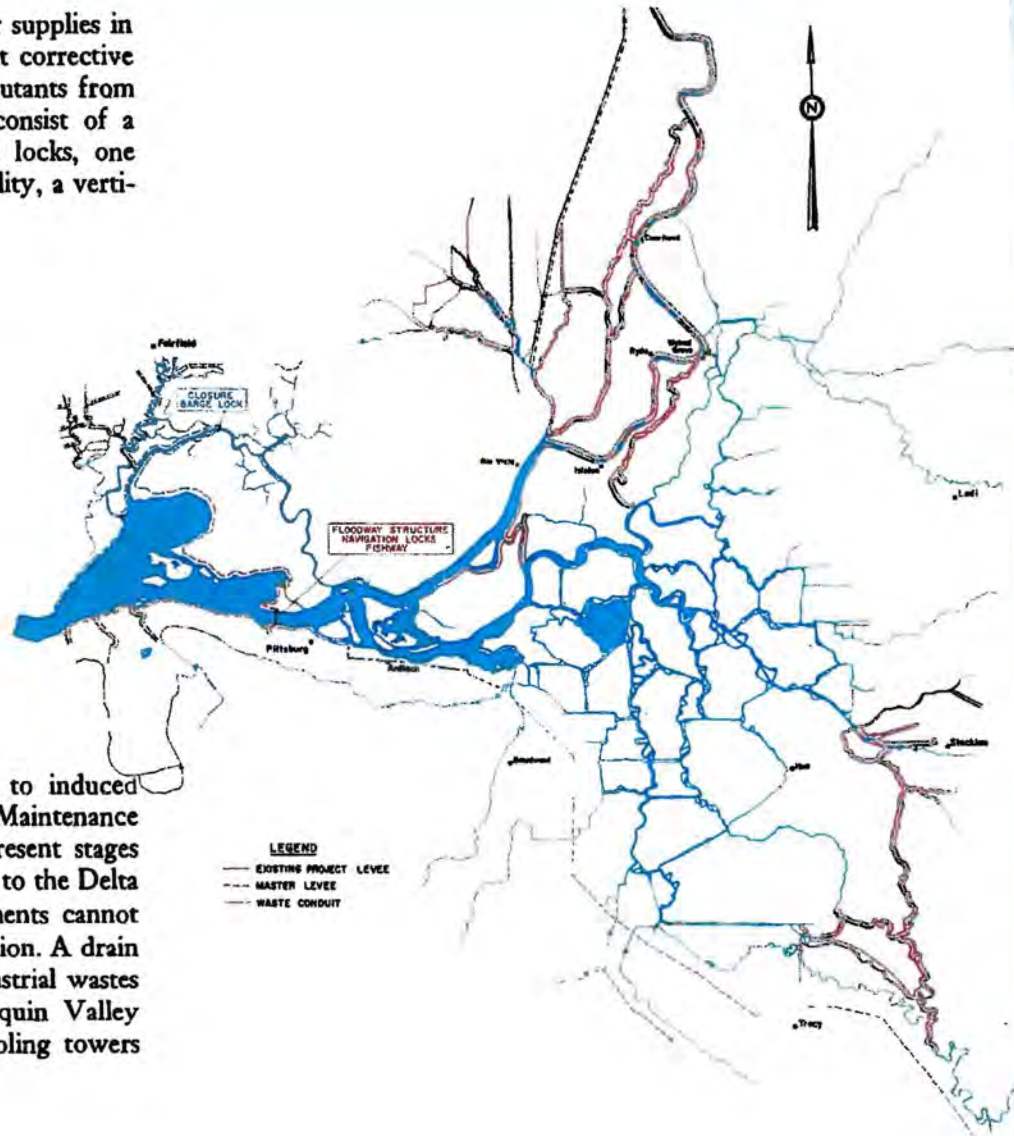
The Delta is a dominant factor in the habitat of several anadromous species of fish and the residence of several additional sport fish. All reasonable measures must be taken to minimize the adverse effects of planned facilities on the fisheries in the Delta and, when possible, to provide for their enhancement.

Courtesy of Los Angeles Times

Chipps Island Barrier Project—physical works

A barrier at Chipps Island would insure the water supplies in the Delta against salinity incursion from the Bay, but corrective features would be necessary to dispose of other pollutants from sources upstream. The principal structure would consist of a gated floodway section, two deep-draft navigation locks, one barge lock, one small craft lock, a tug assistance facility, a vertical baffle fishway, emergency navigation access, and appurtenant operating facilities. The floodway section would have a net area of openings equivalent to the existing channel in order to preclude interference with flood flows. The conventional navigation locks would allow a limited amount of denser saline water to enter the upstream pool, but this water would be removed from a sump by a salt-scavenging system of pipes and pumps. A barge lock would be located on Montezuma Slough near the new Grizzly Island bridge, about ten miles north of Chipps Island.

A barrier at the Chipps Island site would require a master levee system along principal channels in Suisun Bay to contain the high tidal stages, which would be higher than the present high stages. Additional dredging of navigation channels also would be necessary, due to induced lower low tidal stages downstream from the barrier. Maintenance of water levels in Delta channels at lower than present stages during summer months would require improvements to the Delta levees, but the nature and extent of the improvements cannot be accurately evaluated without the project in operation. A drain would be constructed to convey municipal and industrial wastes and agricultural drainage water from the San Joaquin Valley into tidal water downstream from the barrier. Cooling towers

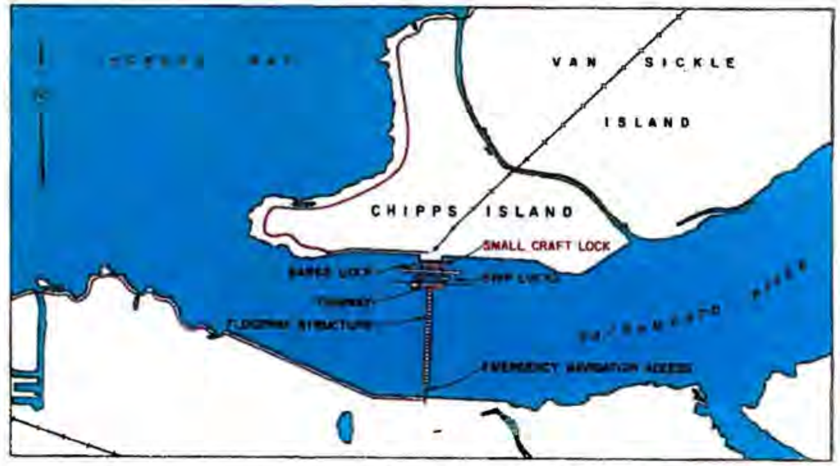


would be required for the two principal power plants which would discharge warm water into the barrier pool.

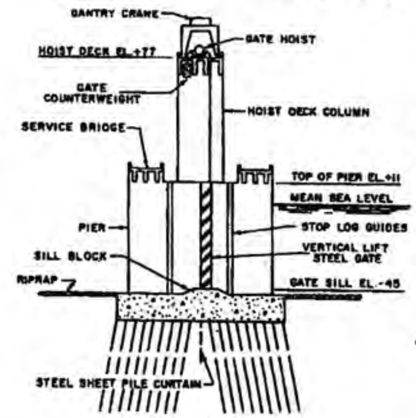
The type and design of the facilities described in this report incorporate results of preliminary designs and quantity estimates of the Corps of Engineers in current work on barriers in the San Francisco Bay system. Estimates of the capital cost of the facilities were based on construction costs prevailing in 1960, plus 15 percent for contingencies and 15 percent for engineering and overhead. The anticipated schedule of construction of the facilities is indicated in the tabulation of estimated capital costs.

SUMMARY OF ESTIMATED CAPITAL COSTS
CHIPPS ISLAND BARRIER PROJECT

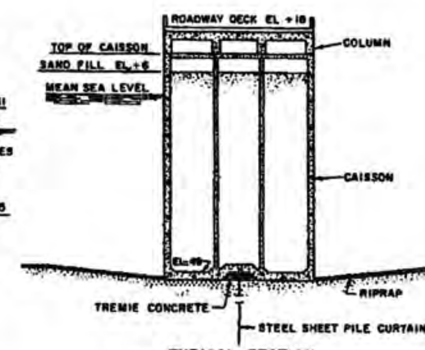
Feature and date of construction	Capital cost
On Site Features	
Floodway structure (1964-70)	$44,119,000
Locks (1964-70)	74,278,000
Salt-scavenging system (1968-70)	3,768,000
Emergency navigation access (1964-66)	6,092,000
South abutment and access facilities (1964-65)	723,000
Fishway (1969)	79,000
Buildings and miscellaneous (1966)	2,062,000
Montezuma Slough closure and barge lock (1968-70)	3,492,000
Subtotal, On Site Features	$134,613,000
Off Site Features	
Waste disposal facilities (1967-70)	$26,914,000
Extension San Joaquin Valley drain (1967-70)	17,356,000
Suisun Bay levee system (1964-73)	21,608,000
Shoreline facilities and dredging (1968-70)	1,481,000
Subtotal, Off Site Features	$67,359,000
TOTAL CAPITAL COST, CHIPPS ISLAND BARRIER PROJECT	$201,972,000



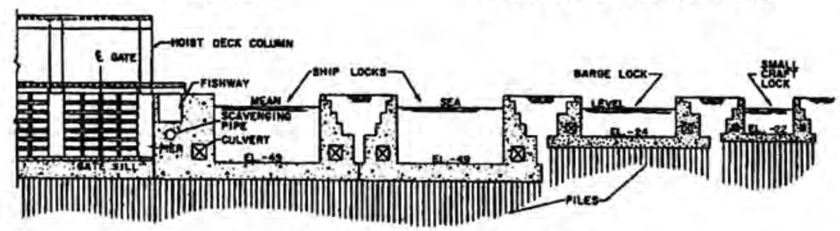
CHIPPS ISLAND BARRIER SITE



TYPICAL SECTION
FLOODWAY STRUCTURE



TYPICAL SECTION
EMERGENCY NAVIGATION ACCESS



TYPICAL SECTION OF FISHWAY AND LOCKS

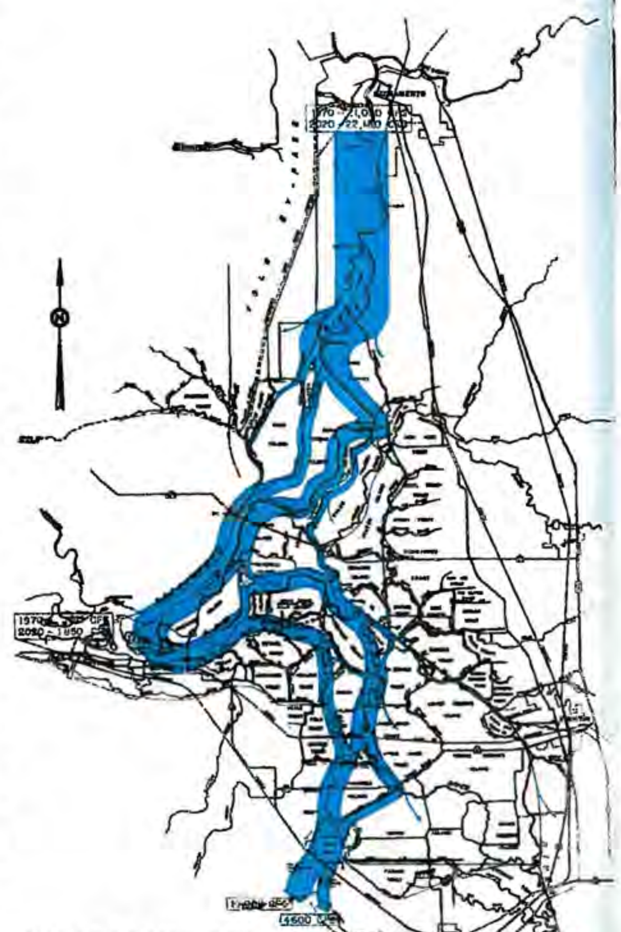
Chipps Island Barrier Project — operation

A barrier at Chipps Island would provide a definite separation between saline water in the Bay system and fresh water in the Delta channels, thereby preventing salinity incursion and assuring adequate water supplies in the Delta. However, there would be attendant operating problems, and the barrier and appurtenances would not provide flood control and related benefits to the Delta.

With the floodway gates closed, the inflow to the Delta to supply local uses and export pumping plants would be distributed in the channels as shown in the schematic diagram. Large quantities of water would be directed through channels in the western Delta to remove heat wastes and maintain satisfactory water quality conditions. Storage in the channels could be utilized to achieve a limited amount of regulation. However, navigation requirements would prevent controlling the water level lower than one foot below mean sea level, without additional dredging. Seepage and levee stability problems would limit the maximum level for sustained storage to about two feet above mean sea level. Economic analyses of various operating ranges indicate that a three-foot range in water levels for conservation of flood water would be most economical.

Electric analog model studies reveal that the barrier would increase the tidal amplitudes downstream from the structure. An unusually large amplitude of 6.3 feet at Chipps Island under present conditions would be increased to about 12 feet by a barrier. Changes indicated on the electric analog model were generally confirmed by preliminary tests by the U. S. Corps of Engineers on a hydraulic model which indicated slightly smaller increases in tidal amplitudes and a slight decrease in the mean tide level. The lower low water would seriously affect navigation depths, and the higher high water would seriously affect levees along the downstream bays and municipal, industrial, and military installations along the shore lines. Remedial measures would be necessary.

Disposal of cooling water from power plants and other industries would cause an increase in temperature in the nearly quiescent barrier pool. This increase in temperature would reduce the efficiency of cooling equipment and adversely affect fish, and could cause significantly increased corrosion in equipment exposed to the warmer water. The monetary magnitude of these effects would be dependent upon the amount of heat energy dissipated in the pool by existing and future industries, and many other factors which cannot be fully evaluated at this time. Satisfactory conditions could probably be achieved by passing cool-



SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

ing water from the principal power plants over cooling towers.

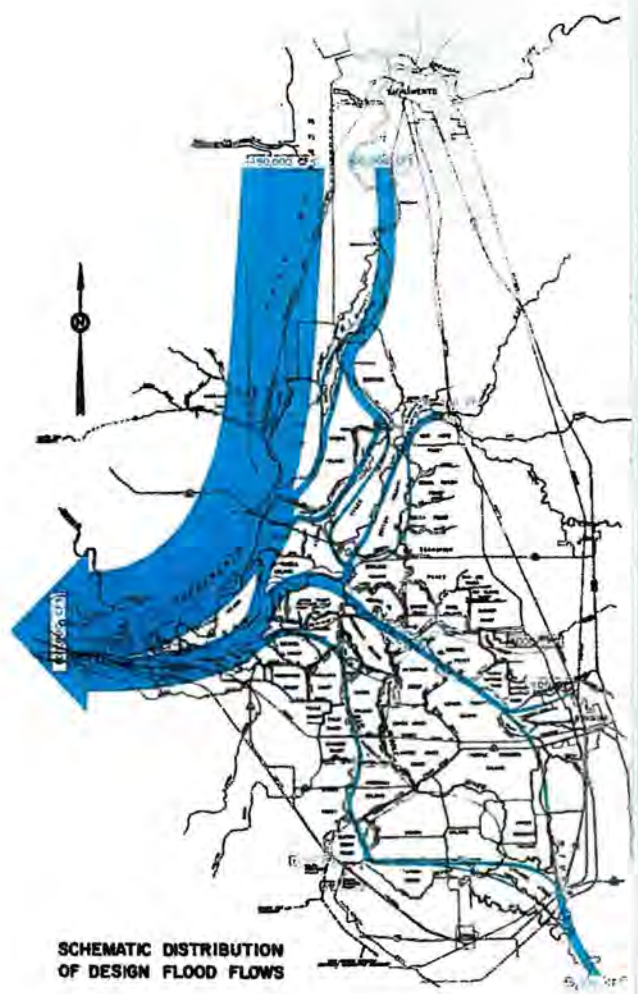
To maintain satisfactory water quality conditions in the barrier pool, it would be necessary to convey industrial and municipal wastes to tidal water. Drainage water from the San Joaquin Valley would also have to be discharged into tidal water.

Saline water entering the pool through the locks would be allowed to settle in a sump from which it would be pumped by a salt-scavenging system. Operation of locks would cause delays of about 35 minutes per transit for deep-draft vessels and 20 minutes for tugs and smaller vessels. Assistance would have to be provided to maneuver deep-draft ships through the locks. A tug and operating crew for this purpose would be necessary at all times.

National defense aspects dictate that an emergency navigation access be incorporated in the barrier. This access would consist of concrete bins filled with sand in a section of the barrier. In an emergency, the sand would be pumped out and the bins towed out of the channel.

Anadromous fish would be passed through a vertical baffle fishway, comprising a series of baffles with vertical slots extending to the bottom to provide passages for water and fish. The baffles would dissipate the energy of the water and create a series of bays with a slightly lower water level in each adjacent downstream bay. The bays would provide resting areas for the fish after passing through short distances of high velocity water in the slots. During high tides downstream from the barrier, the fishway would be closed by a gate to prevent saline water from entering the pool.

During flood conditions the gates in the barrier floodway would be opened. Flood stages in the Delta would be essentially the same as under present conditions for comparable flood flows. Since master levees in the Delta are not incorporated in this plan, high flood water would occur in all the channels. Although the flood stages would not be changed, levee stability problems would increase. Tidal fluctuations presently keep the levees saturated a few feet above the mean tide elevation, but under barrier conditions the peat levees would dry out and crack when water levels would be drawn down to about one foot below sea level. Should a sudden flood occur the open barrier gates would permit tidal fluctuations throughout the Delta and sections of some dried-out levees might become unstable and fail as the water levels rapidly rise and fall. Remedial work would be required as problems develop. Allowances for cost of this as yet undefined work are not included in the cost estimate.



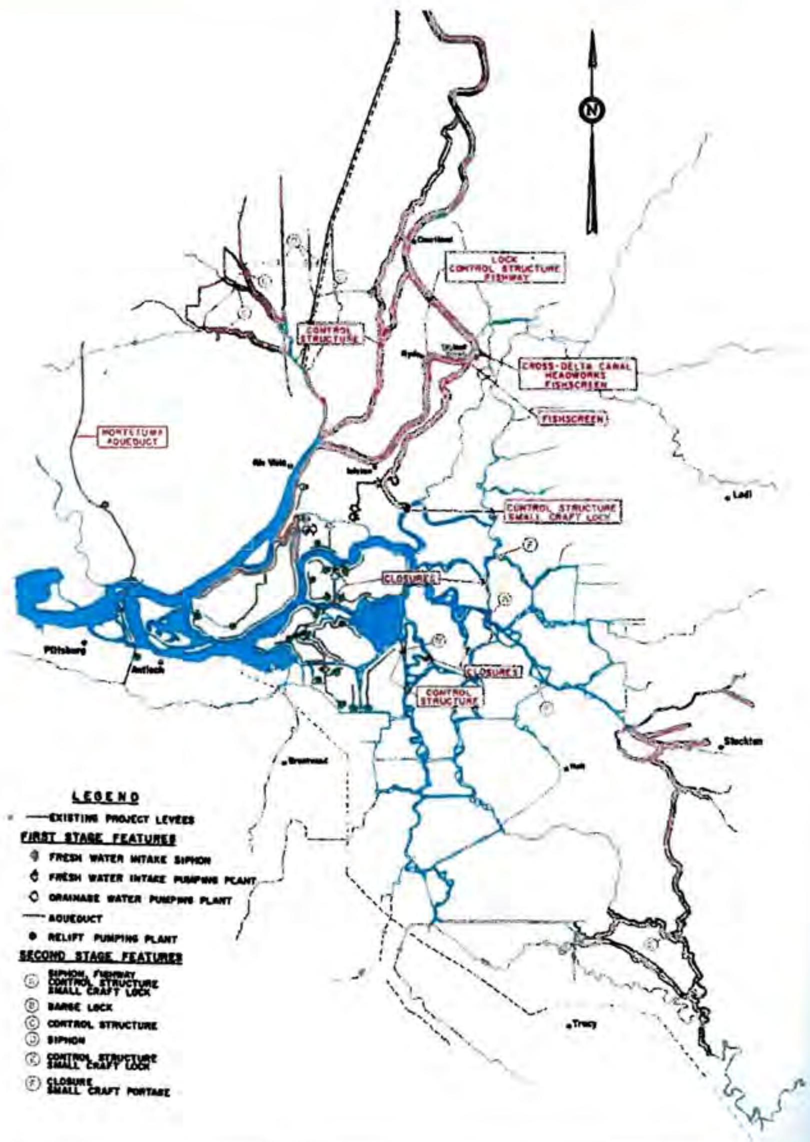
SCHEMATIC DISTRIBUTION OF DESIGN FLOOD FLOWS

Single Purpose Delta Water Project—physical works

This system of works would accomplish essentially the same results as a barrier at Chipps Island, that is, adequate water supplies for the Delta and for export therefrom, but would not necessitate costly remedial works. Good quality water supplies for the Delta and export pumps would be separated from saline water by control structures operated with a relatively small rate of fresh water outflow. Water would be supplied in the western Delta area through new supply facilities, and in the rest of the Delta existing irrigation and drainage works would continue in operation. There are no flood control features in this plan.

Control structures with gated openings for discharging flood flows would be located on channels of the Sacramento, Mokelumne, and San Joaquin Rivers. A barge lock and fishway would be incorporated in the Sacramento River control structure. Earth fill channel closures would be constructed at four locations. In 1980-82, additional gates would be constructed at the existing headworks of the Delta Cross Channel of the Central Valley Project. Small craft locks and portage facilities would be incorporated in certain control structures and channel closures. Vertical louver fish screens would be constructed at the head of Georgiana Slough and at the Delta Cross Channel near Walnut Grove, and rotary drum fish screens would be constructed at other diversions.

Water supply facilities would serve areas in the western Delta. The Montezuma Aqueduct would be constructed in about 1968-71 and in subsequent stages to serve water to potential industrial land and some agriculture in central southern Solano County, and to supplement supplies in Contra Costa County. Works would also be included to remedy detrimental effects of project operation, such as seepage alleviation along the Sacramento River channels and modifications to existing irrigation and drainage works made necessary by the project.



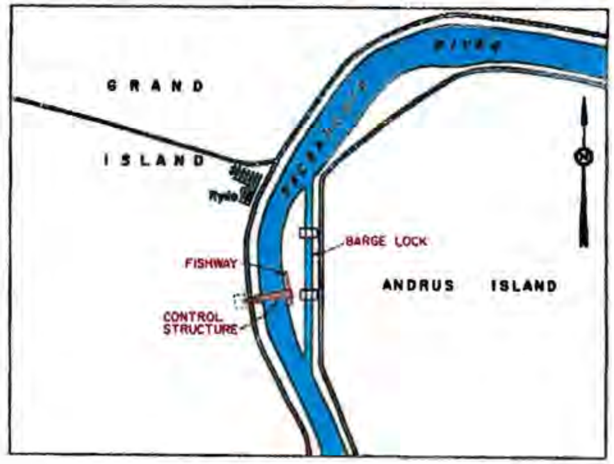
About 1,900 acres of land in the Delta, mostly small unreclaimed islands, would be used for disposal of excess dredged material. Many of these areas would be available and desirable for development as recreation areas.

Additional water could be salvaged by completely separating good quality cross-Delta flows from tidal water, and thereby reducing the amount of fresh water outflow needed for salinity repulsion. These second stage features would include a siphon under the San Joaquin River, additional channel closures, control structures and appurtenances, and water supply facilities. These works may be indefinitely deferred, depending on their need.

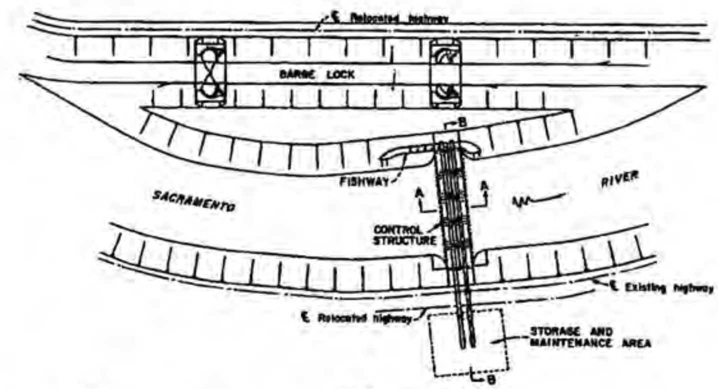
Estimates of the capital costs reflect 1960 construction costs, plus 15 percent for contingencies and 15 percent for engineering and overhead. The anticipated construction schedule is indicated in the following tabulation:

SUMMARY OF ESTIMATED CAPITAL COSTS
SINGLE PURPOSE DELTA WATER PROJECT

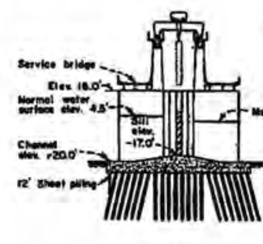
Feature and date of construction	Capital cost
Steamboat Slough control structure (1968-70)	$2,943,000
Miner Slough closure (1970)	108,000
Ryde control structure, barge lock, and fishway (1968-71)	5,653,000
Holland Cut control structure (1973-75)	2,761,000
Mokelumne River control structure and small craft lock (1973-75)	1,951,000
Cross-Delta Canal headworks (1980-82)	1,223,000
Fish screens: Cross-Delta Canal and Georgiana Slough (1968-70)	3,500,000
Closures: Potato Slough, Old River, and Middle River (1974-76)	404,000
Fishermans Cut closures (2) (1964)	133,000
Agricultural water facilities (1963-65)	4,300,000
Municipal and industrial water facilities (1968-71, 1980, 1995, 2010)	13,952,000
Channel dredging (1974-78)	7,154,000
Bank protection (1976-78)	1,880,000
Seepage alleviation facilities (1971)	593,000
TOTAL CAPITAL COST, FIRST STAGE FEATURES	$46,555,000
TOTAL CAPITAL COST, SECOND STAGE FEATURES	$23,765,000



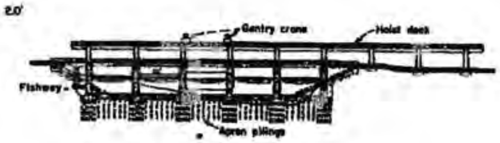
RYDE STRUCTURE SITE



PLAN
CONTROL STRUCTURE, FISHWAY AND LOCK



SECTION A-A
CONTROL STRUCTURE



SECTION B-B
CONTROL STRUCTURE AND FISHWAY

Single Purpose Delta Water Project—operation

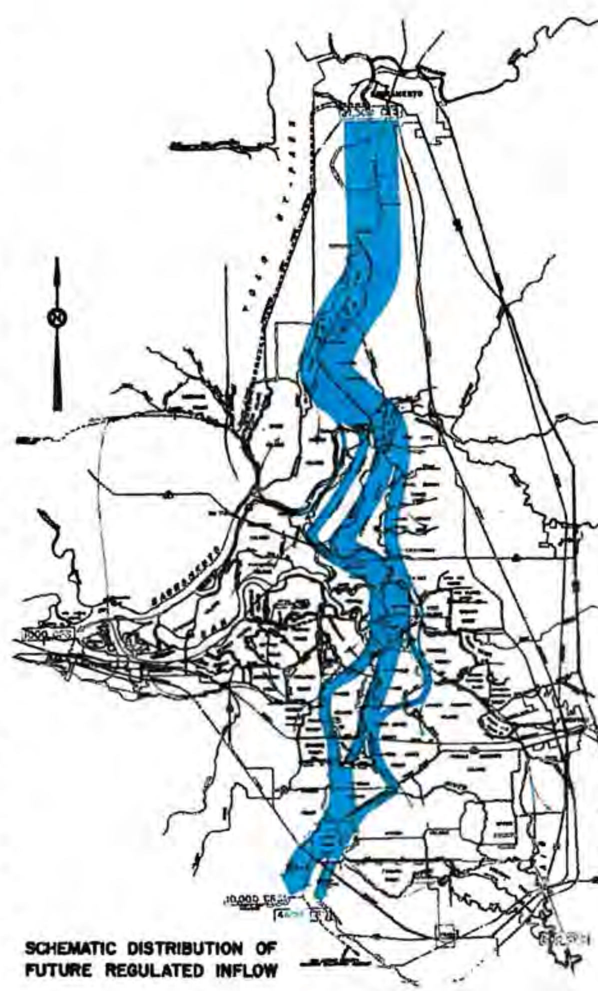
A Single Purpose Delta Water Project would salvage water otherwise wasted to Suisun Bay for salinity control, and would provide water supplies for the Delta and for export and use in areas of deficiency. The project would allow salinity to encroach somewhat farther into the Delta than under present operations; however, the area affected by this controlled incursion would be supplied water by new facilities. Certain aspects of operation described in the following paragraphs would also apply to other variations of the Delta Water Project.

Control structures on the Sacramento River system would divert water southward toward the center of the Delta. Control structures and closures on channels east of Franks Tract would cause the water to flow toward the export pumping plants in channels in the center of the Delta. With this type of operation, it would be necessary to prevent brackish saline water from mixing with fresh water in the center of the Delta. This control could be accomplished by providing fresh water outflow in the Sacramento and San Joaquin Rivers.

The salinity control line, with control to a mean concentration of 1,000 parts of chlorides per million parts of water (1,000 ppm), would be maintained in the San Joaquin River near the mouth of False River, about 7 miles upstream from Antioch and in the Sacramento River at Decker Island, about 1½ miles below Threemile Slough. Salinity control at these locations could be accomplished by maintaining an outflow from the Delta of 1,000 second-feet, of which about 60 percent would be released through the San Joaquin River and the remainder through the Sacramento River.

Good quality water from the cross-Delta flows would be available in existing channels throughout 90 percent of the Delta lowlands. Water would be provided to all agricultural lands downstream of the line of *maximum* salinity encroachment of 500 ppm of chlorides. The mean concentration of chlorides would be about 250 ppm at locations on this line. Research studies by the University of California indicate that seepage of any brackish water from the channels into the Delta islands can be controlled below the plant root zone by application of good quality water on the surface. The supplies diverted from the cross-Delta flows would normally contain between 20 and 80 ppm of chlorides.

Water would also be provided to municipalities and for certain industrial uses in the western Delta area. Most of the required industrial cooling water could be supplied from the adjacent channels. The Contra



SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

Costa Canal could serve the projected industrial requirements in its service area until about 1970, and significant industrial development in southeastern Solano County is not anticipated before 1980. The Montezuma Aqueduct would be constructed to convey supplemental water from the proposed North Bay Aqueduct and would be linked to the Contra Costa Canal near Pittsburg in 1980. The capacity of the Contra Costa Canal would then be utilized primarily between the Delta and the connection with the Montezuma Aqueduct. The estimated quality of the water would be very good, with a chloride content generally ranging between 15 and 80 ppm, total dissolved solids ranging between 125 and 300 ppm, and with total hardness of between 40 and 160 ppm.

Existing irrigation water supply facilities throughout most of the Delta would not be affected by operation of the export pumps, but the average water level in the southern portion of the Delta would be lowered slightly. Irrigation facilities affected thereby would be modified under the project.

Small increases in tidal amplitudes of about 1.5 feet would occur at the Sacramento River and Steamboat Slough control structure sites, but the mean water level would not significantly change. The effects would be very minor at Rio Vista.

The average water level upstream from the control structures would be gradually raised to a maximum of about 2.5 feet under full project operation in about 30 years. The increase would occur during summer months, and any resultant increased seepage from the channels would be fully consumed by crops on adjoining lands without damage.

During flood periods, the control structures would be opened and flood stages throughout the Delta would be similar to those under present conditions. Flood stages on the Sacramento River would be slightly higher for longer periods due to closing of Miner Slough. This effect would tend to increase seepage conditions during a critical crop planting time, and might necessitate installation of seepage alleviation works. Such works would also alleviate existing seepage problems.

The future value of water and quality considerations might justify construction of the second stage features to permit further reduction in the fresh water outflow from the Delta. The outflow could be reduced to the amount of unavoidable losses, or about 750 second-feet. The value of the additionally salvaged water would probably not justify construction of these works before 1990.

SCHEMATIC DISTRIBUTION OF DESIGN FLOOD FLOWS

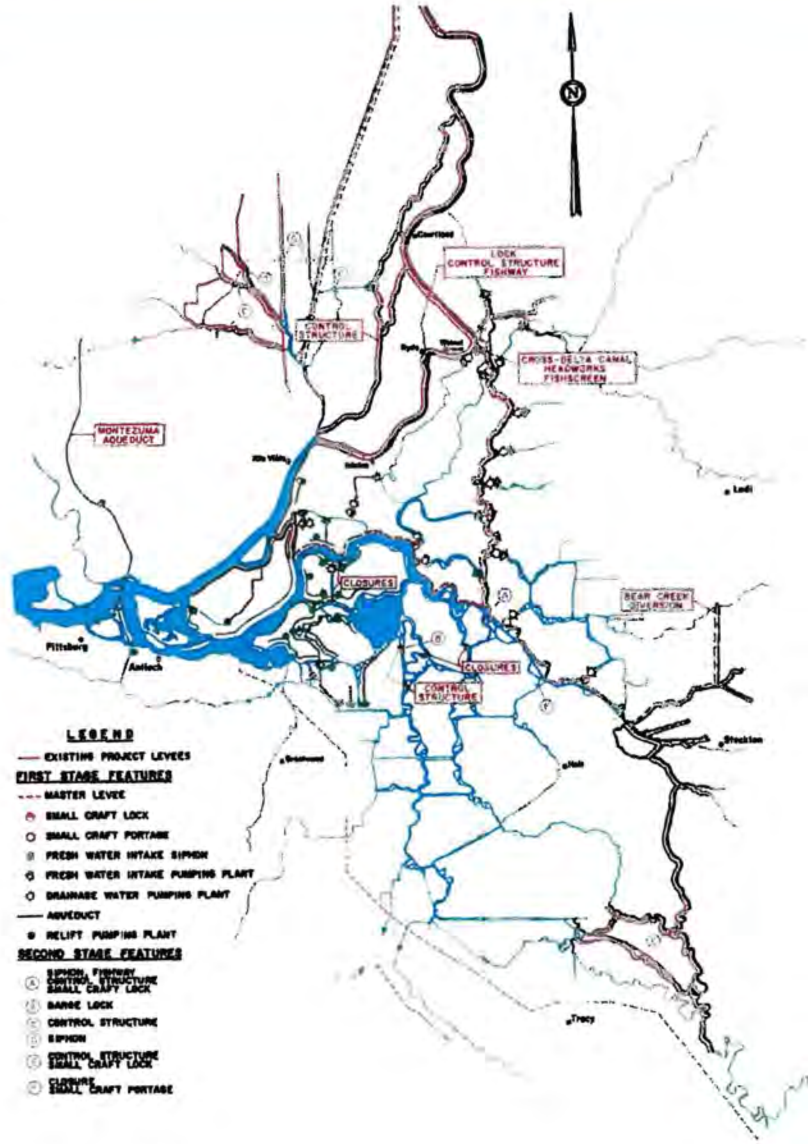
Typical Alternative Delta Water Project — physical works

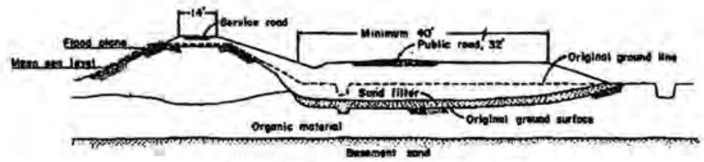
Several additional features can be added to the basic Single Purpose Delta Water Project to provide varying degrees of local benefits, in addition to adequate water supplies. These additional features would be for flood and seepage control, transportation, and recreation. While the economics of construction and operation factors would dictate grouping certain islands within encircling master levee systems, flood protection for any one or more of several groups of islands could be undertaken.

The Typical Alternative Delta Water Project, one of several alternative plans, would include flood protection for the islands in the north central portion of the Delta around Isleton, and for the northeastern islands in the vicinity of Lodi. Fourteen channel closures would be required in addition to those incorporated in the Single Purpose Delta Water Project. Minor modifications and additions would be made in the irrigation water supply and drainage facilities. Rotary drum fish screens would be incorporated where required in all water supply works, and a vertical louver screen would be constructed at the headworks of the Cross-Delta Canal at Walnut Grove. Bear Creek would be diverted into the Calaveras River.

The master levee system would include existing levees of the Sacramento River Flood Control Project. Other existing levees would be improved by constructing a berm on the landward side, and by raising the levee crown where necessary to increase the freeboard. Public roads would be relocated from levee crowns to the berms. A service and maintenance road would be placed on the crown of the levees.

Small craft locks would be constructed at certain channel closures. At locations where rapid transits of boats under 25 feet long would be necessary, a tank elevator boat portage would be installed.



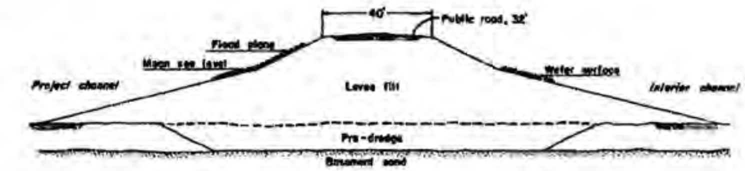


TYPICAL SECTION OF MASTER LEVEE

About 1,900 acres of Delta land would be filled with excess dredged material, and most of this land would be available for recreational development. The additional gates on the Cross-Delta Canal headworks and the extensions of the adjacent highway and railroad bridges would be constructed with about 16 feet of clearance above the present average water level to improve small craft access between the Sacramento River and channels of the Mokelumne River system.

The second stage features of this project would be similar to those contemplated for the Single Purpose Delta Water Project.

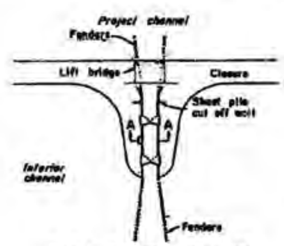
Estimates of capital cost were based on 1960 construction costs plus 15 percent for contingencies and 15 percent for engineering and overhead.



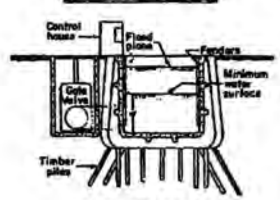
TYPICAL SECTION OF CHANNEL CLOSURE

SUMMARY OF ESTIMATED CAPITAL COSTS
TYPICAL ALTERNATIVE DELTA WATER PROJECT

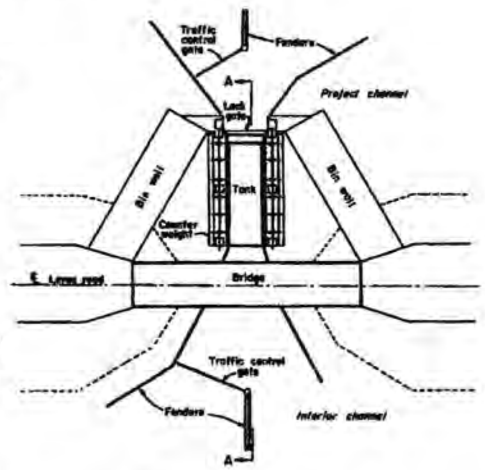
Feature and date of construction	Capital cost
Steamboat Slough control structure (1968-70)	$2,943,000
Miner Slough closure (1970)	108,000
Ryde control structure, barge lock, and fishway (1967-70)	5,653,000
Holland Cut control structure (1973-75)	2,761,000
Cross-Delta Canal headworks (1975-77)	1,998,000
Cross-Delta Canal fish screen (1968-70)	3,500,000
Old River and Middle River closures (1975)	258,000
Fishermans Cut closures (2) (1964)	133,000
Agricultural water facilities (1963-65)	4,282,000
Municipal and industrial water facilities (1968-71, 1980, 1995, 2010)	13,952,000
Channel dredging (1974-78)	7,224,000
Master levee system (small craft locks and portages, irrigation and drainage works)	
Isleton island-group (1964-80)	12,610,000
Lodi island-group (1964-81)	11,439,000
Bear Creek diversion (1967-70)	670,000
TOTAL CAPITAL COST, FIRST STAGE FEATURES	$67,531,000
TOTAL CAPITAL COST, SECOND STAGE FEATURES	$23,635,000



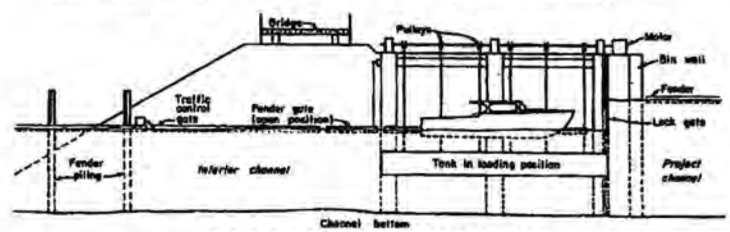
SMALL CRAFT LOCK SITE



SECTION A-A SMALL CRAFT LOCK



PLAN OF SMALL CRAFT PORTAGE



SECTION A-A OF SMALL CRAFT PORTAGE

Typical Alternative Delta Water Project — operation

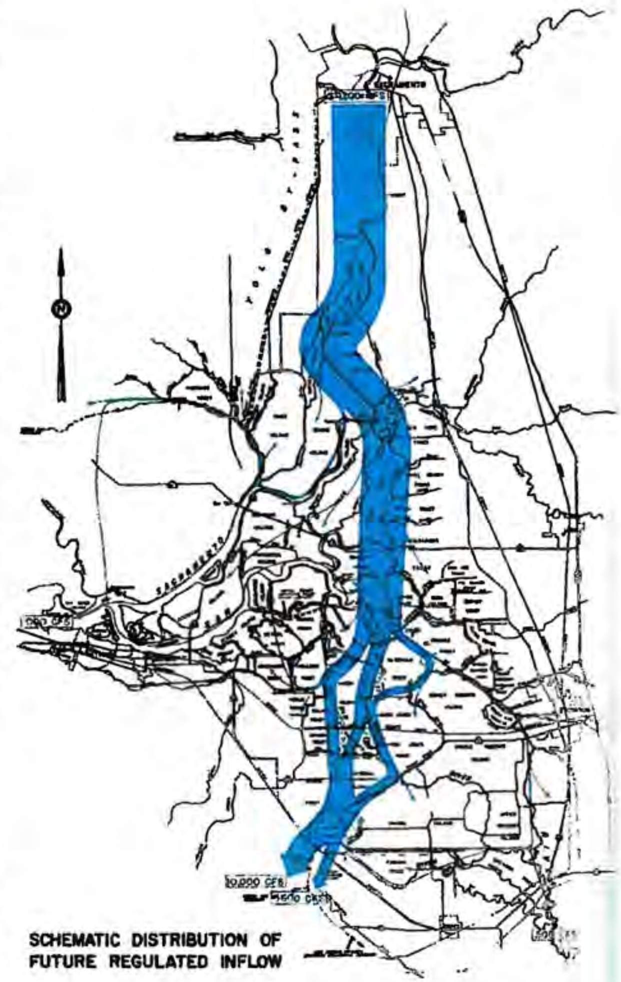
Operation of the Typical Alternative Delta Water Project would be basically the same as with the Single Purpose Delta Water Project. Good quality water would be transferred directly across the Delta and degradation in water quality from salinity incursion would be prevented by limited releases of fresh water with the same degree of control as under the Single Purpose Delta Water Project. Water supplies for the Delta would be distributed from the cross-Delta flows.

Irrigation water for the Isleton island-group and the Lodi island-group would be diverted through siphons from the Cross-Delta Canal into interior channels. Existing diversion works out of the Cross-Delta Canal, which would be rebuilt during construction of the master levees, and diversion works out of the interior channels would continue in operation. Drainage pumping plants at channel closures would have capacity to remove all water pumped from the islands into the interior channels. Under all alternative plans for the Delta Water Project, the irrigation and drainage works would be managed by local districts. Adjustments in costs of operation and maintenance would be made with the districts to reflect costs allocated to interests other than the local districts. Water supply facilities serving several districts or agencies would be operated by the State or by an appropriate master district or agency.

Flood flows would be contained in principal project channels in those portions of the Delta protected by the master levee system, and levees along interior channels would no longer be subject to high flood stages. Levees on interior channels would not need to be as high as for present conditions, and could be allowed to settle. Experience has shown that Delta levees reach a state of equilibrium if they are allowed to settle a limited amount. Thus much of the periodic reconstruction of the interior levees would no longer be necessary. Bank erosion problems due to flood flows also would be eliminated on interior levees.

Storm runoff from upland areas surrounding the Delta would be pumped into flood channels, except in the case of Bear Creek which would be diverted into flood channels.

Water levels in the interior channels could be lowered to achieve reductions in the amount of seepage into the islands. In



SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

practically all channels the level could be five feet lower than the present average level, or about three feet below sea level, without causing maneuvering problems for small craft. Any resultant shallow depths in specific locations could be increased by dredging.

Small craft locks and portage facilities would be operated without cost to the boating public as the costs would be allocated to beneficiaries of the master levee system. The locks would be operated in a standard manner with pumps for filling and draining. The boat portages would be tank elevators with a gate at one end. The tank would be lowered below the hull of the boat, and the boat would then move between guides over the tank. The counter-weighted tank would then be raised to the higher water level and the gate opened to permit the boat to move out under its own power. The time for operation after positioning of the boat over the tank would be less than one minute. The boat would be in the water at all times and there would be no contact with the bottom of the hull.

The operation and maintenance of public roads located on the berm of the master levees would be less costly than for existing roads, which must be periodically reconstructed due to levee settlement and levee rebuilding. Maintenance of the public roads would be by local agencies. Closures in the master levee system of this plan would eliminate the need for continued operation of four ferries.

Reduction of the water surface area under tidal influence would cause limited increases in tidal amplitudes in the Delta, but no significant changes in the average water levels. Such changes on the Sacramento River and Steamboat Slough would be similar to those under the Single Purpose Delta Water Project, and amplitude changes in the San Joaquin River in the heart of the Delta would be less than one foot. However, dredging would be necessary in some navigable channels.

Small islands in bends and side channels, which would be reclaimed and raised by filling, would be available for recreational development after the areas are no longer needed for disposal areas. It is contemplated that arrangements would be made with local governmental agencies for recreational development of the lands, either by direct means or by leasing to concessionaires.

SCHEMATIC DISTRIBUTION OF DESIGN FLOOD FLOWS

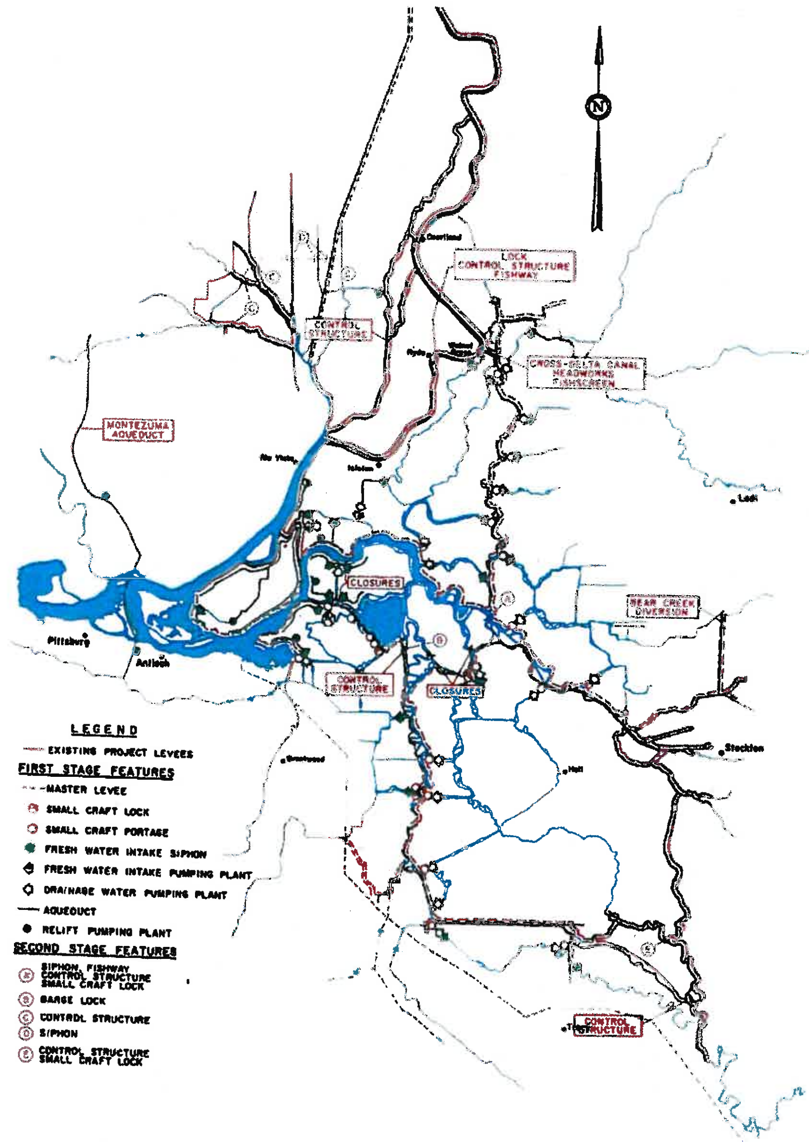
Comprehensive Delta Water Project—physical works

The Comprehensive Delta Water Project would salvage water otherwise needed for salinity control and provide water for the Delta. In addition, the project would provide flood and seepage control, transportation, and recreation benefits for most of the Delta. New master levees would encompass five principal groups of islands and Sherman Island. Works for water supply and drainage in the Delta would include those of the Typical Alternative Delta Water Project, with some modifications, plus other works to serve the newly formed island-groups. Additional small craft facilities would also be constructed.

Flood waters of the San Joaquin River would be divided between the main channel and an improved chain of distributary channels to the west, the two branches coming together in the western Delta. Improved channels of the Lower San Joaquin River Tributaries Flood Control Project would be incorporated.

The master levee along Piper Slough east of Bethel Island would be constructed on old levees on Franks Tract to minimize interference with existing developments on the Bethel Island levee.

The additional interior channels created by the project in northeastern Contra Costa County would contain good quality water, and would serve as a fresh water distribution system for the adjacent islands. Intensive small craft traffic in the vicinity of Bethel Island would necessitate the construction of four small craft portage facilities in adjacent channels and one small craft lock at Sand Mound Slough.

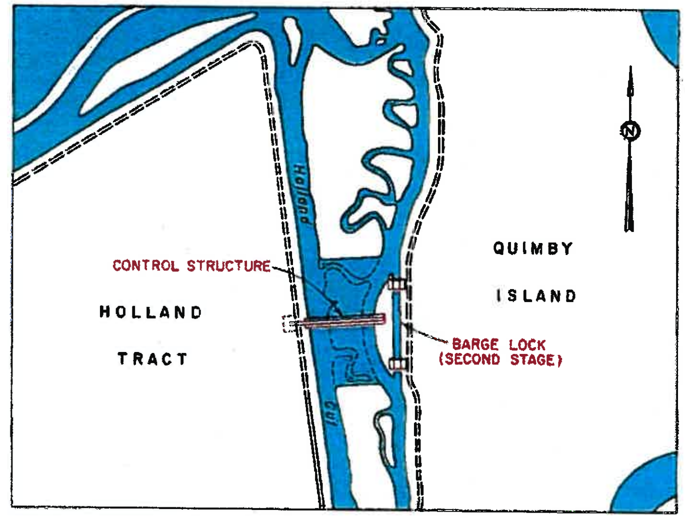


The second stage features of the Comprehensive Delta Water Project would be similar to those in other variations of the Delta Water Project.

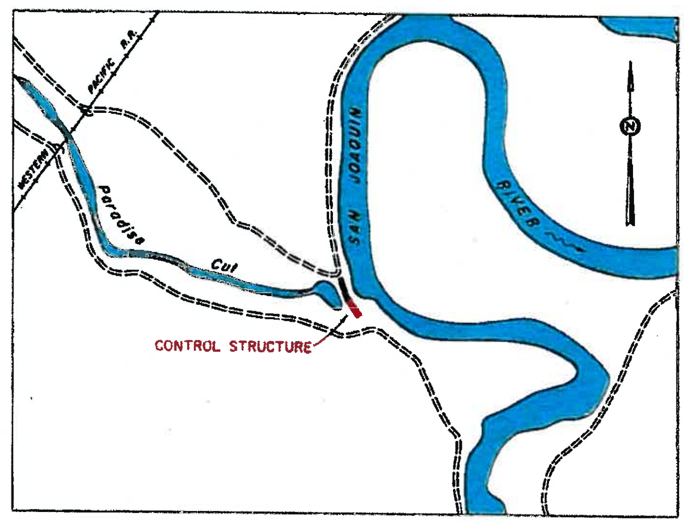
Estimates of the capital costs reflect 1960 construction costs, plus 15 percent for contingencies and 15 percent for engineering and overhead.

SUMMARY OF ESTIMATED CAPITAL COSTS
COMPREHENSIVE DELTA WATER PROJECT

Feature and date of construction	Capital cost
Steamboat Slough control structure (1968-70)	$2,943,000
Miner Slough closure (1970)	108,000
Ryde control structure, barge lock and fishway (1967-70)	5,653,000
Holland Cut control structure (1973-75)	2,761,000
Cross-Delta Canal headworks (1975-77)	1,998,000
Cross-Delta Canal fish screen (1968-70)	3,500,000
Old River and Middle River closures (1975)	258,000
Fishermans Cut closures (2) (1964)	133,000
Agricultural water facilities (1963-65)	2,520,000
Municipal and industrial water facilities (1968-71, 1980, 1995, 2010)	13,952,000
Channel dredging (1968-78)	8,950,000
Master levee system (small craft locks and portages, irrigation and drainage works)	
Isleton island-group (1964-80)	12,610,000
Lodi island-group (1964-81)	11,439,000
Holt island-group (1964-80)	13,810,000
Tracy island-group (1968-74)	4,722,000
Brentwood island-group (1964-79)	9,802,000
Sherman Island (1964-79)	2,030,000
Paradise Cut control structure (1969-71)	121,000
Bear Creek diversion (1967-70)	670,000
Kellogg Creek diversion (1971)	79,000
TOTAL CAPITAL COST, FIRST STAGE FEATURES	$98,059,000
TOTAL CAPITAL COST, SECOND STAGE FEATURES	$21,560,000



HOLLAND CUT STRUCTURE SITE



PARADISE CUT STRUCTURE SITE

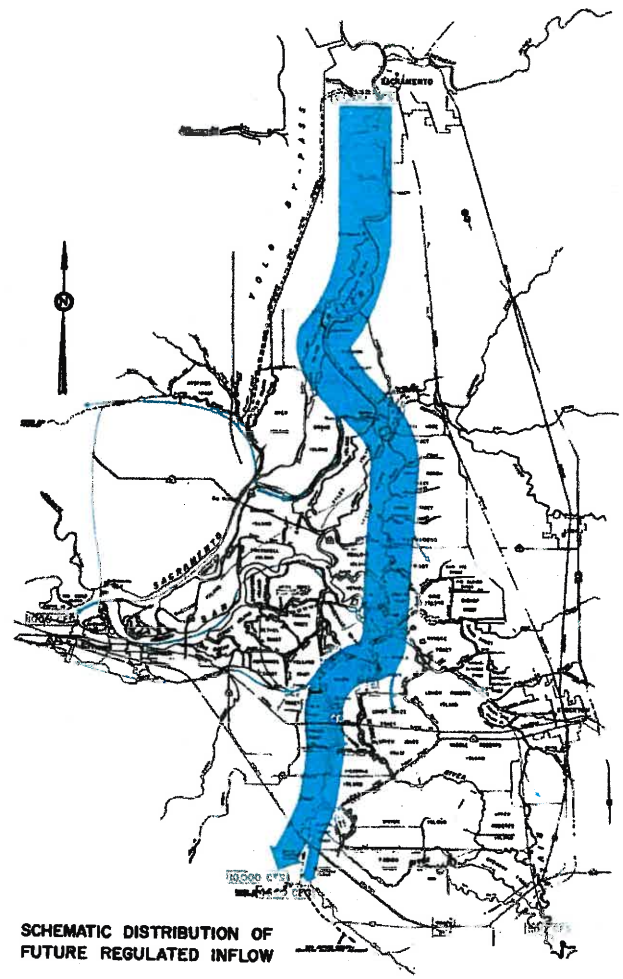
Comprehensive Delta Water Project—operation

Integrated operation of the multipurpose facilities of the Comprehensive Delta Water Project would enhance all principal phases of the Delta's economy, salvage water otherwise needed for salinity control, and provide very good quality water throughout the Delta. Although the project would have some adverse effects on certain segments of the Delta's economy, such as recreation and navigation, the multipurpose works would afford opportunity for enhancement of these same segments in other ways.

Operation of the water supply and transfer facilities during summer months would be similar to that described for the Single Purpose and Typical Alternative plans. Where representative districts or agencies are organized, the facilities could be locally operated and maintained, and appropriate adjustments in costs thereof could be made to achieve equitable distribution of costs to all beneficiaries.

Creation of interior and project channels in the southern portion of the Delta would separate irrigation water supplies from drainage water originating on lands east of the San Joaquin River. Good quality water from cross-Delta flows would be available throughout most of the southern Delta. Lands adjacent to the San Joaquin River upstream from Stockton would continue to divert from the river, but the quality of the water in this area could be improved by upstream flow in the San Joaquin River past Stockton induced by the pumping plants. A small net upstream flow occurs during summer months under present conditions. The quality of water in Paradise Cut could also be improved with circulation induced by pumping from the upper end into the San Joaquin River. Diversions from the river in this vicinity might be affected by operation of a San Joaquin Valley waste conduit. If current studies indicate that substitute supplies would then be necessary, or if further improvement of the quality of the supplies is desired even in the absence of adverse effects of a waste conduit, such supplies could be readily diverted from Delta channels without affecting works described herein.

Lands in the Holt island-group in the south central portion of the Delta range in elevation from several feet below sea level to a few feet above sea level. Irrigation water for the higher islands is pumped from the channels, while siphons are utilized for the lower islands. To achieve seepage control benefits for the lower islands, water



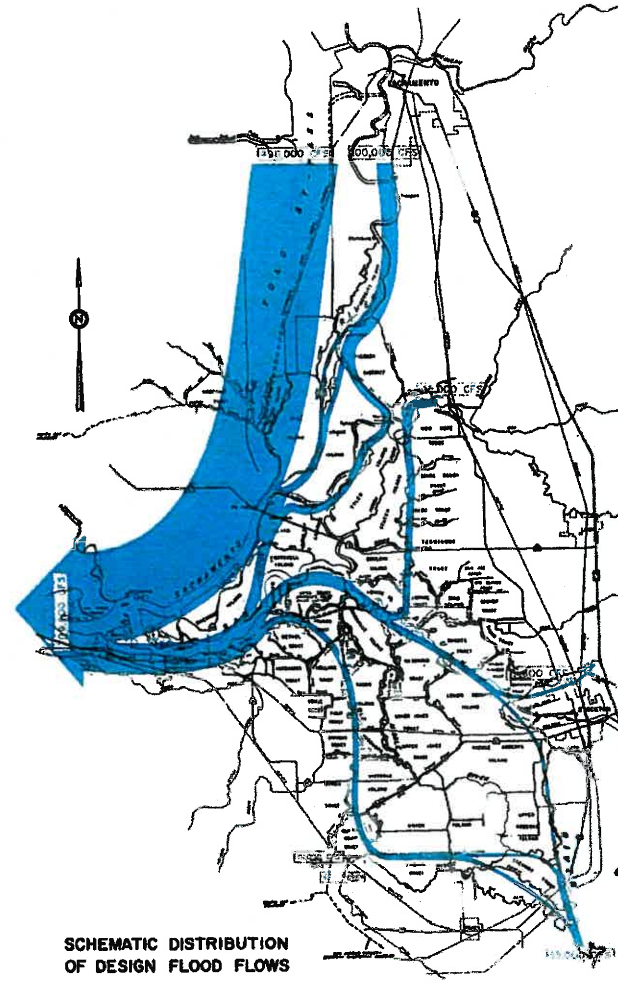
SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

levels in the channels could be lowered. This could be accomplished locally without detriment to the higher lands by constructing low dams with pumping plants in the channels and maintaining different water levels in the interior channel system.

Large volumes of small craft and fishing boats move between marinas and resorts in the Bethel Island area and Franks Tract or more distant points in the Delta and San Francisco Bay system. Peak small boat traffic would be served by three small craft portages on Piper Slough, and by one small craft lock on Sand Mound Slough. Lock or portage service for small craft would be provided at various other locations in the Delta when dictated by construction of channel closures. It should be recognized that subsequent developments and changes in patterns of use may necessitate revisions in the planned local service. While the lock and portages would cause some inconvenience to recreationists, creation of interior channels not subject to flood and tidal stages would benefit shore line installations. An expected great increase in boating in the future would intensify problems of patrolling and safety enforcement. Opportunities would be available to local public agencies to designate certain waterways for specific uses, and problems of regulation would be reduced under controlled access.

Master levees of the project in the southern half of the Delta would cause increased tidal amplitudes in the project channels. The maximum increase in the San Joaquin River system would be about one foot at Stockton. There would be no significant change in the mean water level. Some dredging in navigation channels would be necessary.

Tug and barge shipments into the southern Delta would be limited to the Cross-Delta Canal. Most of the present traffic involves beet shipments to a sugar refinery near Tracy, and the Holland Cut channel east of Franks Tract is generally used. The Cross-Delta Canal would be open to the San Joaquin River, and a barge lock at the Holland Cut control structure would not be economically justified. Although a slightly greater travel distance from northern and western Delta points would be involved under the project, the channel to the vicinity of the sugar refinery would be dredged. This would permit use of larger barges, which are presently precluded by shallow channel depths.



SCHEMATIC DISTRIBUTION OF DESIGN FLOOD FLOWS

Project Accomplishments—Delta water supply

Over 90 percent of the Delta lowlands now has adequate water supplies during summer months due in part to operation of the Central Valley Project. However, ten percent of the Delta in the western portion, including lands occupied by large water-using industries and municipalities, does not have adequate good quality water supplies at all times. Moreover, additional regulation and use of water in areas tributary to the Delta, exclusive of Delta exports, will lengthen the average period each year when salinity incursion from the Bay causes increased operating costs, plant shutdowns, and decreased farm production. The concentrations of dissolved minerals in water from the Contra Costa Canal now approach upper limits of acceptable quality during several months of most years, and significant sums of money are expended by industries for demineralization and water softening.

Under any of the foregoing projects, water of very good quality would continue to be supplied to about 90 percent of the Delta lowlands through existing facilities. It is estimated that the mineral quality of the supplies would generally range between about 15 to 80 parts of chlorides and between 100 and 350 parts of total dissolved solids per million parts water. The quality of water in the southern portion of the Delta would be improved.

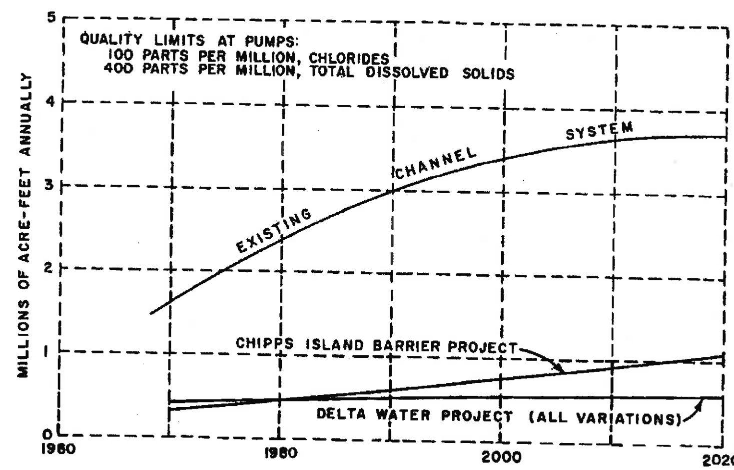
The quality of water in the Pittsburg-Antioch area with the Chipps Island Barrier Project in operation would be uncertain. Although downstream disposal of local municipal and industrial wastes and drainage from the San Joaquin Valley would eliminate the majority of the mineral pollutants, the effects of cooling water and mineral and organic wastes of the Delta might result in water supplies of questionable quality, particularly during critical dry periods. Elimination of the tidal effects in this area by construction of the barrier would also reduce the supply of dissolved oxygen in the water, which is now partly replenished from Suisun Bay.

All of the alternative plans for the Delta Water Project would involve dual water supplies with different water quality characteristics. While the concentrations of minerals in water in certain western channels would increase due to greater ocean salinity incursion, the quality of water from the Contra Costa Canal and from proposed water supply facilities would be excellent. It is estimated that substitute industrial water supplies would generally contain between 15 and 80 parts of chlorides per million parts of water. Similarly, the total dissolved solids would generally range between 125 and 300 parts per million. Irrigation water supplies would be of similar quality. The Contra Costa Canal would annually supply about 195,000 acre-feet of water, including some substitute water in northeastern Contra Costa County. All additionally required supplemental and substitute water would be supplied from the Montezuma Aqueduct. This annual quantity would amount to about 120,000 acre-feet in 1990 and 330,000 acre-feet in 2020. Brackish water supplies in the western Delta channels would vary in quality with location. The mean quality would be about 3,000 parts of chlorides per million parts water at Antioch during summer months. Water containing this much salinity is not necessarily damaging to cooling equipment involving alloy metals. A composite of several factors, most of which would not be modified by alternative plans for the Delta Water Project, controls the rate of corrosion of cooling equipment.

Project Accomplishments—water salvage

Unless physical works are constructed in the Delta to prevent salinity incursion from the Bay system, or to channelize fresh water directly across the Delta channels, it will be necessary to release increasingly greater amounts of fresh water from upstream storage to maintain satisfactory quality conditions. Greater rates of fresh water outflow will be necessary as the rate of export pumping from the Delta increases, and greater quantities of stored water will have to be released as the amount of surplus water for outflow is reduced by upstream depletions and export from the Delta. If Delta works are not constructed, the yield of other features of the State Water Facilities would be reduced and subsequent features for importation of water from north coastal sources would be needed at an earlier date. Any such modifications in the program would increase the cost of water in the Delta.

With any of the plans for the Delta water facilities, the amount of outflow from the Delta otherwise necessary for salinity control would be greatly reduced. It would still be necessary to dispose of municipal and industrial wastes from the western Delta, and drainage from the San Joaquin Valley, into channels downstream from points of usable good quality water. All of the plans are comparable in this respect, except that these wastes would aid in repulsion of ocean salinity incursion with any of the alternatives of the Delta Water Project. Fresh water required for operation of locks and the fishway would be lost with a barrier at Chipps Island, but would be available for use downstream of the control structures with any of the alternatives of the Delta Water Project. A small amount of conservation yield could be obtained from limited storage in Delta channels with a barrier at Chipps Island, but alternatives of the Delta Water Project would not provide conservation storage.



UPSTREAM STORAGE RELEASES FOR PROJECT OPERATION

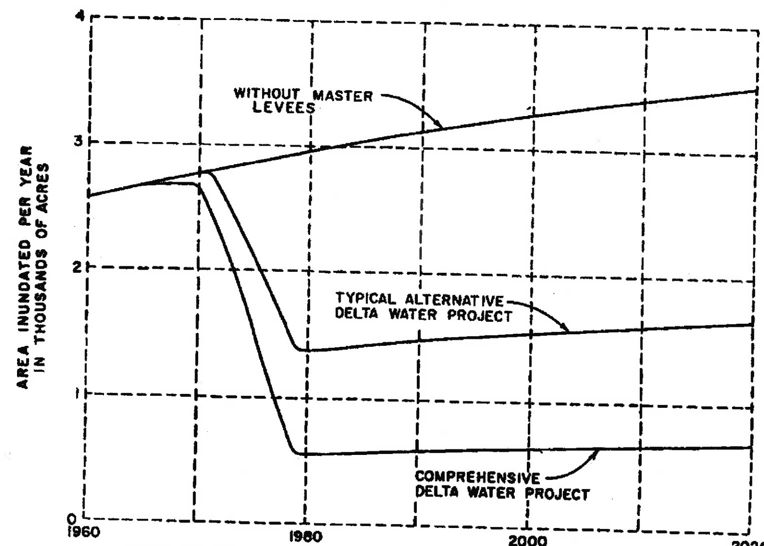
The amount of water otherwise necessary for salinity control which could be salvaged by Delta water facilities would vary with time, as indicated by the above graph. The amount of salvaged water would be the difference between demands on upstream storage for outflow without any works in the Delta, and demands with such works in operation. The estimated average annual salvage during the next 60 years would be 1,900,000 acre-feet with the Chipps Island Barrier Project, and 2,050,000 acre-feet with any of the alternative plans for the Delta Water Project.

Project Accomplishments—flood and seepage control

Only the Typical Alternative Delta Water Project and the Comprehensive Delta Water Project would provide flood and seepage control benefits to the Delta. However, all plans would include remedial works made necessary by adverse effects of flood or tidal water stages changed by project operation. These would be particularly necessary with the Chipps Island Barrier Project.

Project flood control benefits would result from reduction in the frequency of flooding, and from reductions in costs of maintaining Delta levees. It is emphasized that complete flood protection could not be assured, as the inflow to the Delta could exceed the designed capacity of the channels. Furthermore, although the stability of the master levees would be significantly greater than the stability of existing levees, the character of organic foundation soils is such that unforeseen stability problems might develop in some areas. For these reasons, emphasis should be given to zoning Delta lands lying below flood levels for uses involving low-value improvements such as farming, and precluding residential development. While complete flood protection for the Delta lands could not be assured under project conditions, there would be a marked improvement in protection over existing conditions which will worsen as land elevations in the Delta continue to subside.

About 103,000 acres would be benefited by master levees included in the Typical Alternative Delta Water Project, and about 143 miles of levees along interior channels would no longer require costly maintenance for high flood stages. The estimated average annual benefit of reduced flooding and operation and maintenance costs would be about $4.65 per acre. Master levees of the Comprehensive Delta Water Project would benefit about 252,000 acres and would reduce expensive maintenance on 295 miles of interior channel levees. The estimate of average annual flood control benefits is about $3.60 per acre.



PROJECTED AVERAGE ANNUAL AREA OF FLOODING

Seepage control benefits would be made available by lowering water levels in interior channels created by the Typical Alternative Delta Water Project or by the Comprehensive Delta Water Project. In addition, lower water levels would prolong the economic life of certain islands. These benefits and the extent of increased economic life would depend upon lowering average water levels in the interior channels. A general lowering of five feet could be made without adversely affecting depths for small craft, except in isolated locations, or the majority of water supply siphons. Based upon a five-foot lowering of water levels, seepage control benefits, averaging an estimated $0.50 per acre for 103,000 acres, would be available with the Typical Alternative Delta Water Project. The Comprehensive Delta Water Project would afford seepage benefits to 252,000 acres, and the estimated average annual benefit would be $0.45 per acre.

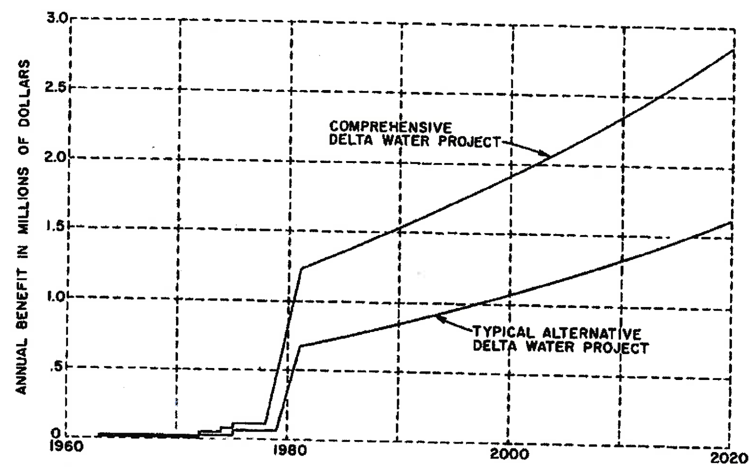
Project Accomplishments—vehicular transportation

The two basic problems of the existing road system in the Delta are (1) inadequate channel crossings and circuitous routes, with resultant excessive travel times, and (2) disproportionately high costs of maintenance. Projects involving master levees for flood control in the Delta would afford means for reducing both of these problems. However, the Chipps Island Barrier Project would provide no benefits to vehicular transportation, and the Single Purpose Delta Water Project would provide only incidental benefits of this kind.

The master levee system of the Typical Alternative Delta Water Project would include twenty-two channel closures upon which roads could be placed, and operation of four existing ferries could be terminated. The Comprehensive Delta Water Project would include thirty-nine channel closures providing new access and would eliminate the need for six ferries.

Roads on the landward berms of the master levees would be more stable and less difficult to maintain than existing roads on levee crowns. Driving on present levee roads is hazardous, as evidenced by frequent drownings when vehicles run off levees into adjacent channels. Passing clearance is often limited by parked vehicles. In addition to improved safety with roads on the levee berms, there would be ample width for parking off the roadways.

To realize the anticipated and needed development of recreation in the Delta, it will be necessary to greatly improve vehicular access. Realization of about 7,000,000 recreation-days each year by 1990, and almost 14,000,000 by 2020 will, in large degree, be dependent upon the improved vehicular access that could be provided by multipurpose use of the master flood control levees.



BENEFITS OF VEHICULAR TRANSPORTATION IMPROVEMENTS

The project benefits from enhancement of the road system would be a combination of savings in maintenance costs and savings in costs to Delta traffic associated with farming and to the recreationists. Savings to Delta interests reflect reduced costs of general travel and produce shipments through decreased travel times and distances. Savings to the recreationists were based upon projected recreation use and decreased travel times and distances.

Project Accomplishments—recreation

While some detriments to recreation are inherent in construction of any facilities in the Delta, substantial benefits would also be achieved. As has been stated, improvements in the road network would make more of the Delta accessible to recreationists. Land areas reclaimed by spoiling material from dredging of channels onto small islands would afford space for development of recreation service facilities and picnic areas. Project works at the head of the Cross-Delta Canal would be constructed to provide clearance for the majority of pleasure craft, thereby connecting the Sacramento and Mokelumne River systems. Elimination of flood and tidal effects from interior channels would make it possible to control water levels in those channels, reducing costs of maintaining waterfront recreation facilities. Furthermore, costs of new facilities would be less than for present conditions. The safety of the boating public is becoming a significant problem, and the incompatibility of high-speed boating, cruising, and skiing with fishing and swimming creates related safety problems. Local authorities will find it desirable and even necessary to designate certain Delta channels for specified types of recreation use. The interior project channels would lend themselves to this type of zoning and also to simplified enforcement.

Planning and construction of recreational developments in the Delta should involve local governmental agencies. Most project channel closures would not be constructed for eight or more years, and changing recreation patterns should be considered in future selection of remedial and enhancement facilities. Needs for small craft locks and boat portages should be re-evaluated at the time closures are constructed.

The most important form of recreation in the Delta is fishing. In terms of recreation-days, fishing is three times as important as the next most popular sport—cruising. A project which would cause a major reduction in fish populations might also cause very adverse effects on the recreation. In this connection the Chipps Island Barrier Project would result in losses of striped bass several times as great as those anticipated with any of the alternative plans for the Delta Water Project.

It is recognized that cruising, sailing, and water skiing are rapidly gaining in popularity in the Delta, and that construction of master flood control levees and channel closures would interfere with unrestricted boating access to certain channels. However, access would be provided through small craft locks or portage facilities at many of the channel closures, thus reducing the detriment primarily to short delays. Studies in other areas indicate that lockage delays are not too important to the majority of pleasure boatmen.

The following tabulation summarizes physical features of the several alternative projects which would affect recreational activity and growth in the Delta.

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Control structures	1	4	3	4
Channel closures	1	10	23	41
New master levees (miles)	0	0	90	185
Fishways	1	1	1	1
Principal fish screens	0	2	1	1
Barge locks	1	1	1	1
Small craft locks	0	0	2	5
Small craft portage facilities	0	0	5	17
Open navigable area (acres)	49,500	49,400	45,800	42,600
Navigable interior area (acres)	0	100	3,700	6,900
Open navigable channels (miles)	700	695	590	450
Navigable interior channels (miles)	0	5	110	250
Project roads (miles)				
Paved	0	0	33	70
Graveled	0	1	47	109
State and county levee roads (miles)	295	295	279	265
New inter-island accesses (closures)	0	6	22	39
New public waterfront land (acres)				
From master levees	0	0	1,900	3,600
From dredge spoils	0	1,900	1,900	2,300
Normal overhead clearance through Delta Cross Channel (feet)	6	16	16	16

Project Accomplishments—fish and wildlife

Any Delta water facilities would affect the habitat of fish in the Delta, but would have little effect, if any, on Delta wildlife. While it is known that the Delta plays an important role in the life cycle of migratory fish, and also supports resident sport fish, insufficient biological information is available with which to clearly define the potential effects of Delta water facilities. Nevertheless, relative comparisons of the alternative projects can be made.

Studies of effects of the Delta water facilities and export pumping plants were made by the California Department of Fish and Game in co-operation with the Department of Water Resources. Cooperative experiments with a full-scale vertical baffle fishway indicate that all migratory species would use this type of fishway. The conclusions of the Department of Fish and Game regarding the alternative projects are as follows:

"Chipps Island Barrier

"This project would be the most damaging of the four studied. It would probably cause a disastrous reduction of almost all species of fish found in the Delta. These losses would be brought about by the rapid salinity and temperature change across the barrier, loss of current in the fresh-water pool for migration direction, striped bass spawning eliminated due to lack of current behind the barrier, loss of important food items, and a threefold increase in pumping of water at Tracy. The amount of Sacramento River water being drawn around the tip of Sherman Island to the pumping plant would be greatly increased. Downstream migrants of the Sacramento River would be diverted to the pumps in large numbers. These fish would have to be screened at the pumps and returned to the river channel below the influence of this current. This condition would be a serious detriment to all fish using the Delta.

"Single Purpose Delta Water Project

"This project would be the least detrimental of the four projects studied. The reversal of flow around Sherman Island would be eliminated. Major fish screens would be installed at the Cross-Delta Canal headworks and at the head of Georgiana Slough. Therefore, downstream migrants in the Sacramento River would be guided down the western side of the Delta out of the influence of the pumps. In general, fish and eggs in the western portion of the Delta would no longer be affected by the pumps. The replacement of the hundreds of existing small irrigation siphons in the western Delta by screened irrigation supply systems would further reduce losses of small fish. In these respects conditions for fish in the Delta would be improved.

"Fish habitat would not be reduced in the Delta. The one channel that would be isolated under this project would be insignificant. An important effect of the project would be the increased reversal of flow in the San Joaquin River above the Cross-Delta Canal crossing. This reversal of flow would occur during an average of seven months of the year under full project operation. We were unable to evaluate the effect of the reversal. However, it could result in serious losses to salmon that now spawn in San Joaquin River tributaries south of the Mokelumne River. Most seriously affected would be upstream migrating salmon. The amount of water pumped from the Delta would be increased threefold. This increased withdrawal of water would divert proportionately more fish than is presently being diverted.

"Typical Alternative Delta Water Project

"This project would be the second least detrimental. Losses would be expected to be greater than the Single Purpose Project because of the reduction of 8 percent of the fish habitat through channel closures, and partial channelization of the Cross-Delta Canal. The channelization would cause a detriment by channeling the fish toward the pumps by a more direct route. Water diversions into isolated channels would be screened and loss of fish would be reduced. However, loss of eggs and fry would be unavoidable. Other project conditions would be the same as the Single Purpose Project.

"Comprehensive Delta Water Project

"This project would be the third least detrimental. It would cause greater loss than the Typical Alternative Project because of the reduction of 14 percent of the fish habitat, and the complete channelization of the Cross-Delta Canal. This would channel the fish directly to the pumps. Other project conditions would be the same as in the Single Purpose Project.

"From the foregoing, if one of the above-named projects is to be built in the Delta, the Department of Fish and Game would favor the Single Purpose Delta Water Project. However, all projects will cause serious fisheries problems and an intensive study would be required to solve these problems."

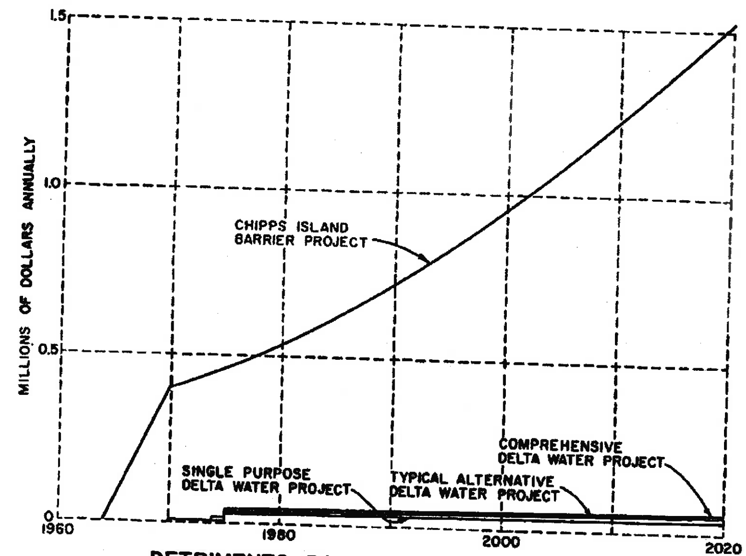
Formulation of project plans reflects comments and recommendations of the Department of Fish and Game. Fish screens would be installed at the heads of channels diverting water southward from the Sacramento River. Such screens would reduce the present rates of fish losses at the Tracy Pumping Plant and in numerous other diversions in the Delta. Project pumping plants would also be screened. Hundreds of diversion siphons and pumping plants in the Delta are not screened at this time. However, project diversions into interior channels would be screened, and the fish populations enhanced thereby.

Project Accomplishments—navigation

Commercial and military navigation in the Delta would be adversely affected in varying degrees by any Delta water facilities, but some potential benefits would also be realized through increases in channel depths and widths.

The Chipps Island Barrier Project would cause the greatest detrimental effect to navigation, since all traffic between the San Francisco Bay system and Delta points would have to pass through locks. At present, an average of about 570 deep-draft commercial vessels, and 10,300 tug and barge tows and small vessels pass Chipps Island each year. It is estimated the annual transits would increase to 2,800 and 40,000, respectively, by 2020. The volume of future military traffic cannot be realistically estimated, nor is it possible to place a reasonable value on its lost time. The increased tidal amplitude downstream from a barrier at Chipps Island would necessitate additional dredging in some areas to provide the required minimum navigation depth. This increased depth might cause additional maintenance dredging which frequently results from deepening navigation channels.

Completion of the Sacramento Deep Water Channel will divert most of the tug and barge traffic away from the Sacramento River between the vicinities of Rio Vista and Sacramento. The traffic which would pass the site of the Sacramento River control structure would generally be limited to that originating from or destined to points of call downstream from the vicinity of Freeport. It is anticipated that the volume of this traffic would increase from 600 transits per year after completion of the Sacramento Deep Water Channel to about 900 transits per year by 2020.



DETRIMENTS TO COMMERCIAL NAVIGATION

Construction of control structures and closures on channels south of the San Joaquin River in the heart of the Delta would increase time and distance for tug and barge travel to a sugar refinery near Tracy. However, channel improvements would permit use of larger barges, if shipping concerns should elect to do so. As this advantage would be subject to many factors in an operator's business which cannot be readily predicted, benefits were not claimed for possible use of larger barges.

Construction of a master levee system would necessitate relocation of some sugar beet loading docks in the Delta. However, improved roads would tend to compensate for increased hauls to relocated docks.

Economic Aspects—benefits, detriments, and costs

Only direct, tangible benefits and detriments to the initial recipient were evaluated for comparison with direct costs. However, it must be recognized that direct, intangible benefits and detriments would also result from project operation. The ratios of benefits to costs provide a guide to project selection, but consideration should also be given to the net benefits in making the final project selection. Although variations in benefit-cost ratios can result from different basic economic premises, the relative comparison of alternative projects would not change.

Certain significant benefits and detriments were not evaluated. All alternative plans would improve the quality of water exported to the San Joaquin Valley and reduce the drainage problems there. Only direct benefits of flood protection to agriculture were evaluated, but this protection would also benefit principal highways and urban developments. The estimated recreation benefits from land made available for development were considered to be equivalent to the value of the land. Intangible benefits would also accrue to recreation, and intangible detriments would result from reduced convenience of access into some channels. Only detriments to commercial fishing are shown, but intangible detriments to sport fishing would also accrue.

All estimates of benefits, detriments, and costs, including amortization, operation, and maintenance, reflect annual equivalent values for the period 1960-2020. An interest rate of four percent per annum was used in the analysis.

Attention is invited to the net benefits of the Comprehensive Delta Water Project which are less than the net benefits of the Typical Alternative Delta Water Project. This condition results from inclusion of economically unjustified flood control for large areas south of the San Joaquin River wherein the direct benefits would be less than the costs. However, flood control for some of the critical areas south of the San Joaquin River warrants further study.

ESTIMATED ANNUAL BENEFITS, DETRIMENTS, AND COSTS
(In thousands of dollars)

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Benefits				
Water salvage (for export)	8,337	8,963	8,963	8,963
Improved water quality—municipal, industrial, and irrigation	880	880	880	880
Supplemental municipal and industrial water supply	503	1,343	1,343	1,343
Flood and seepage control	----	....	530	1,022
Vehicular transportation	----	....	410	734
Recreation	----	19	37	58
Total Benefits	9,720	11,205	12,163	13,000
Detriments				
Commercial navigation	617	18	24	27
Commercial fisheries	844	203	254	287
Total Detriments	1,461	221	278	314
BENEFITS MINUS DETRIMENTS	8,259	10,984	11,885	12,686
Costs				
Capital amortization	6,825	1,358	1,965	2,846
Annual operation and maintenance	2,077	691	884	1,136
Total Costs	8,902	2,049	2,849	3,982
NET BENEFITS	−643	8,935	9,036	8,704
BENEFIT—COST RATIO	0.93:1	5.36:1	4.17:1	3.19:1

Economic Aspects—allocation of costs

The capital and operational costs of each of the alternative projects were allocated among the project functions by the Separable Costs-Remaining Benefits method. In this method, all costs assignable to single functions are identified, and the remaining multipurpose costs are distributed among the functions in proportion to the benefits provided by the project, or in proportion to the lowest cost alternative means of providing equivalent benefits. The lowest value of either the benefits or alternative means is used as a limit.

The basic allocations were made in terms of present worth values (1960) of all costs and benefits. This procedure properly accounts for the time-value of money (interest) and the wide variation in dates of expenditure of money and realization of benefits. Allocations of the capital and operational costs in terms of actual expenditures, rather than present worth, are indicated in the accompanying tabulations to permit convenient comparisons with total amounts of these costs.

Attention is invited to the allocated costs of the Chipps Island Barrier Project. The costs which would be allocated to water salvage and western Delta water supply were limited by the lowest cost alternative means of providing equivalent benefits, which would be the Single Purpose Delta Water Project. The values

ALLOCATION OF ESTIMATED CAPITAL COSTS
(In thousands)

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Water salvage (for export)	$38,384	$38,444	$38,662	$41,655
Western Delta water supply [1]	8,098	8,111	8,156	8,788
Flood and seepage control	none	none	11,900	25,159
Vehicular transportation	none	none	8,132	18,083
Recreation land	none	none	681	1,429
Unassigned local costs	155,490	none	none	2,945
TOTALS	$201,972	$46,555	$67,531	$98,059

[1] For improvement in quality and supplemental water supplies. Allocated costs include portions properly attributable to upstream water users for future effects on the western Delta area due to increased water use in areas tributary to the Delta. Definite values attributable to upstream water users would be dependent upon resolution, negotiated or otherwise, of water rights problems.

shown for the Chipps Island Barrier Project are slightly less than those for the lowest cost alternative, since the funds for the former would be expended at an earlier date. The allocations to both projects in present worth values would be the same. As the costs which may be properly allocated to water salvage and western Delta water supply are less than the total cost, a portion of the costs of the Chipps Island Barrier Project are shown as unassigned local costs. If these costs are not repaid from sources other than water users, the Chipps Island Barrier Project would be financially infeasible.

Attention is also invited to the allocated costs of the Comprehensive Delta Water Project which indicate certain unassigned local costs. In this case the costs of flood and seepage control in areas south of the San Joaquin River exceed the direct benefits of flood and seepage control in these areas. Therefore, the allocation to flood and seepage control for these areas was limited to the benefits. These flood and seepage control features of the Comprehensive Delta Water Project are not economically justified.

After the costs were allocated to principal project functions, it was necessary to make suballocations among particular groups of beneficiaries. These suballocations, which are indicated on the following pages, were also made by the Separable Costs-Remaining Benefits method and were the basis for computing the average annual costs to beneficiaries throughout a 60-year period. In the adjoining tabulations the amounts allocated to vehicular transportation include some costs which would be suballocated to recreation access to reflect the benefits to the public for improved access to recreation areas of the Delta. It is estimated that about $7,075,000 of the capital costs and $92,000 of the annual operational costs for vehicular transportation under the Typical Alternative Delta Water Project would be suballocated to recreation access. Under the Comprehensive Delta Water Project these respective amounts would be $15,123,000 and $176,000. These foregoing amounts would be in addition to the basic allocation to recreation land, which reflects the value of lands made available for recreational development.

ALLOCATION OF ESTIMATED AVERAGE ANNUAL OPERATIONAL COSTS
(In thousands)

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Water salvage (for export)	$395	$571	$506	$483
Western Delta water supply [1]	83	120	107	102
Flood and seepage control	none	none	156	292
Vehicular transportation	none	none	106	210
Recreation land	none	none	9	16
Unassigned local costs	1,599	none	none	34
TOTALS	$2,077	$691	$884	$1,137

[1] For improvement in quality and supplemental water supplies. Allocated costs include portions properly attributable to upstream water users for future effects on the western Delta area due to increased water use in areas tributary to the Delta. Definite values attributable to upstream water users would be dependent upon resolution, negotiated or otherwise, of water rights problems.

Economic Aspects—costs of project services

It was assumed that all project costs not specifically declared nonreimbursable would be repaid by all beneficiaries of project functions. In accordance with the contracting principles established for water service under the State Water Resources Development System, the conservation features of the Delta water facilities will be financially integrated with other conservation features of the system. The cost of supplemental water required by Delta water users will include the Delta Water Charge and an allocated transportation charge.

Estimates of present and future costs of water supply in the western Delta area were predicated on continuation of current federal salinity control policy, which limits the minimum regulated outflow from the Delta to 1,500 second-feet, considered necessary to afford satisfactory quality control at the Central Valley Project pumping plants. Estimates of increased future costs without the State Water Facilities reflect continued upstream depletion of surplus water in the Delta, and represent average costs during the next 60 years. Estimates of costs shown for project conditions also reflect average costs during the next 60 years. It is emphasized that the estimates are comparative average annual *costs* during a 60-year period and do not reflect estimates of year by year *prices* which may be established.

The amounts allocated for repayment were limited by the lowest cost alternative means of accomplishing equivalent benefits. It may be noted that the costs of water supply in the western Delta area would be the same for the Chipps Island Barrier Project, Single Purpose Delta Water Project, and Comprehensive Delta Water Project. The Single Purpose Delta Water Project would be the lowest cost alternative means of providing water supplies and it limits the amount which may be allocated under the other two projects.

The costs of the Typical Alternative Delta Water Project allocated to water salvage would amount to an average of $0.64

COMPARATIVE SUMMARY OF ESTIMATED AVERAGE ANNUAL COSTS OF WATER SUPPLY IN WESTERN DELTA AREA WITH AND WITHOUT STATE WATER FACILITIES DURING 1960-2020 [1]

Item	Future cost without State Water Facilities	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Contra Costa Canal service, $/acre-foot [2]	14.52 [3]	11.66	11.66	11.64	11.66
Substitute municipal and industrial water supply, $/acre-foot	[4]	[4]	3.45	3.33	3.45
Supplemental water supply [5]					
Contra Costa County, $/acre-foot	15.20	9.06	9.06	8.92	9.06
Solano County, $/acre-foot	17.00	8.82	8.82	8.68	8.82
Agricultural water supply, $/acre [6]	7.91 [7]	1.50	1.50	1.45	1.50

[1] Average of estimated costs during a 60-year period. Values do not necessarily reflect *prices* for project services.
[2] For all municipal and industrial water served from the Contra Costa Canal. All costs include $11 per acre-foot for water from the canal. Allocated costs reflect benefits from improved quality.
[3] Includes estimated excess water treatment due to salinity degradation.
[4] Estimated future cost of high quality water from Delta channels will vary between $2.00 and $5.00 per acre-foot, depending upon plant locations and operations.
[5] All supplemental project water available through operation of the Montezuma Aqueduct.
[6] Costs reflect average for about 34,000 acres in the western Delta lowlands.
[7] Cost expressed as loss per acre due to salinity incursion.

per acre-foot for all water exported from the Delta by the State Water Facilities. Similar costs with the other projects would be about $0.66 per acre-foot.

It is anticipated that a federal contribution would be provided for flood and seepage control. This contribution, tentatively estimated at $10,123,000 for the Typical Alternative Delta Water Project and $16,020,000 for the Comprehensive Delta Water Project, would probably reflect current federal policy for allocation of costs of levee improvements, and would be based on reduced flood damages and net savings from reduced levee maintenance costs. Local costs of maintaining existing levees incorporated in the master levee system probably would not be directly met by local districts. Maintenance would be included in the total project costs, and a portion of these costs would be allocated to local beneficiaries.

The total project costs allocated to vehicular transportation were suballocated to the benefited counties and to the general public. The allocation to the general public reflects enhancement of recreation, and was considered nonreimbursable.

COMPARATIVE SUMMARY OF ESTIMATED ANNUAL COSTS OF FLOOD AND SEEPAGE CONTROL WITH AND WITHOUT DELTA WATER FACILITIES DURING 1960-2020[1]

(Per acre)

Item	Island-group					
	Isleton	Lodi	Holt	Tracy	Brentwood	Sherman
Present control cost	$8.00	$8.00	$7.50	$6.50	$7.50	$9.00
Future control cost without a project	10.85	10.29	9.16	7.50	8.83	13.10
Annual damage savings with a project	2.80	1.65	0.35	0.20	1.32	3.12
Typical Alternative Delta Water Project						
Allocated project cost	2.04	2.17				
Interior levees and pumping cost	7.96	7.34				
Total control cost	$10.00	$9.51				
Net savings	3.65	2.43				
Comprehensive Delta Water Project						
Allocated project cost	2.15	2.29	2.09	2.29	2.38	2.53
Interior levees and pumping cost	7.96	7.34	6.66	4.97	6.04	10.57
Total control cost	$10.11	$9.63	$8.75	$7.26	$8.42	$13.10
Net savings	3.54	2.31	0.76	0.44	1.73	3.12

[1] Average of estimated costs during a 60-year period. Values do not necessarily reflect prices for project services.

COMPARATIVE SUMMARY OF ESTIMATED ANNUAL COSTS AND SAVINGS WITH VEHICULAR TRANSPORTATION IMPROVEMENTS DURING 1960-2020[1]

Item	Contra Costa County	San Joaquin County	Sacramento County
Typical Alternative Delta Water Project			
Allocated project cost	$—	$41,400	$4,500
Operational savings to present road system	—	38,500	1,100
Savings to road users	—	265,700	105,200
Net savings	—	268,800	101,800
Comprehensive Delta Water Project			
Allocated project cost	13,300	95,700	11,200
Operational savings to present road system	2,900	59,300	5,000
Savings to road users	82,000	465,600	119,700
Net savings	71,600	429,200	113,500

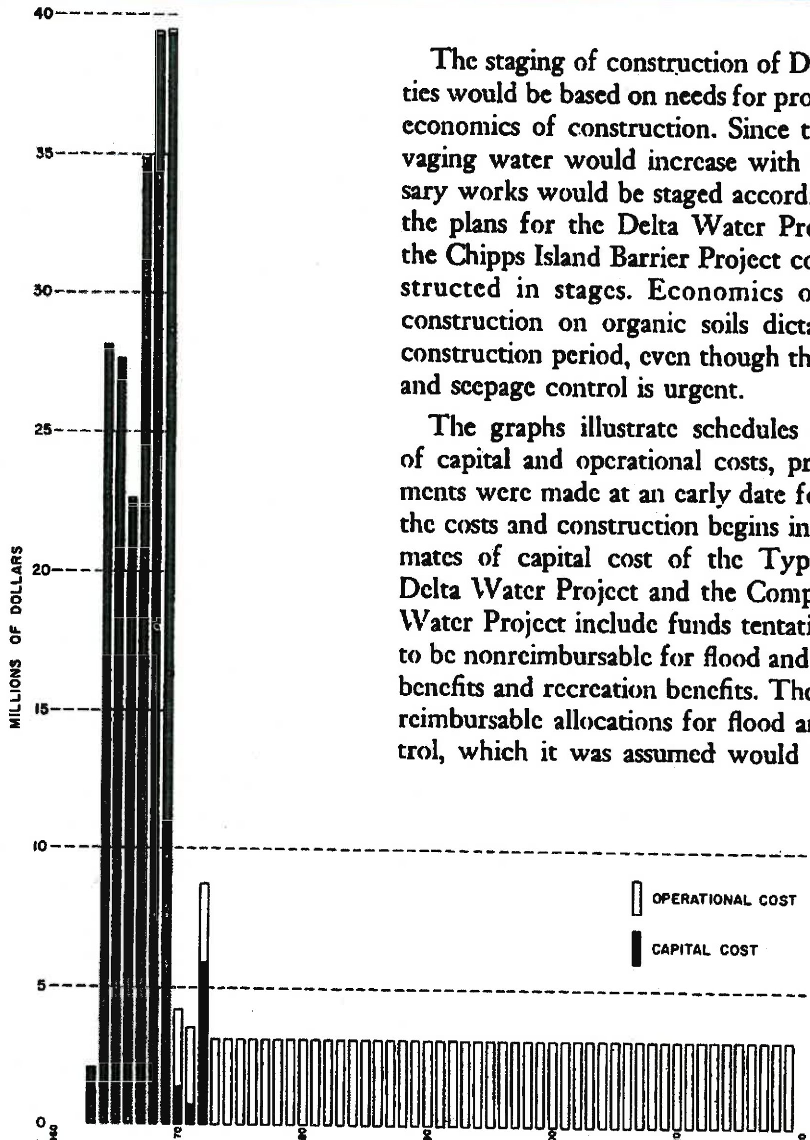
[1] Average of estimated costs during a 60-year period. Values do not necessarily reflect prices for project services.
NOTE: There would not be any vehicular transportation improvements in portions of other counties within the Delta.

Economic Aspects—repayment

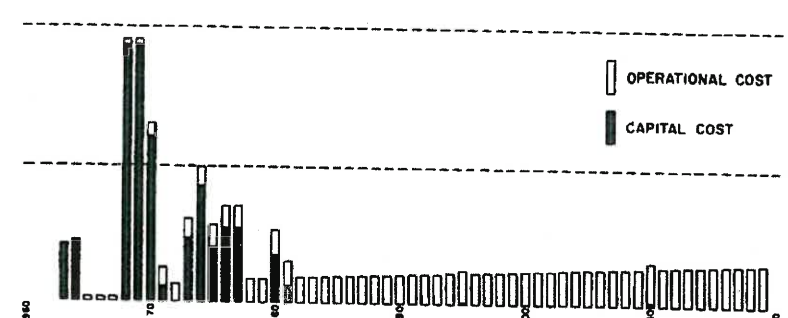
The staging of construction of Delta water facilities would be based on needs for project services and economics of construction. Since the need for salvaging water would increase with time, the necessary works would be staged accordingly for any of the plans for the Delta Water Project. However, the Chipps Island Barrier Project could not be constructed in stages. Economics of master levee construction on organic soils dictate an extended construction period, even though the need for flood and seepage control is urgent.

The graphs illustrate schedules of expenditures of capital and operational costs, provided arrangements were made at an early date for repayment of the costs and construction begins in 1963. The estimates of capital cost of the Typical Alternative Delta Water Project and the Comprehensive Delta Water Project include funds tentatively considered to be nonreimbursable for flood and seepage control benefits and recreation benefits. The estimated nonreimbursable allocations for flood and seepage control, which it was assumed would be provided by the Federal Government, amount to about $10,123,000 for the Typical Alternative Delta Water Project and $16,020,000 for the Comprehensive Delta Water Project. The estimated allocation of capital costs to recreation land and access would be $7,756,000 with the Typical Alternative Delta Water Project and $16,552,000 with the Comprehensive Delta Water Project. The corresponding allocations of annual operational costs would be $101,000 and $192,000, respectively. It was assumed that the allocated capital costs for recreation land and access would be nonreimbursable and be borne by the State of California. It was also assumed that the annual operational costs would be reimbursable from gas tax funds and nominal rental charges on land made available for recreation development.

The allocated reimbursable costs for water salvage and western Delta water supply would be repaid by water charges. The charges would be based on integrated repayment of other necessary State Water Facilities. The reimbursable costs of flood



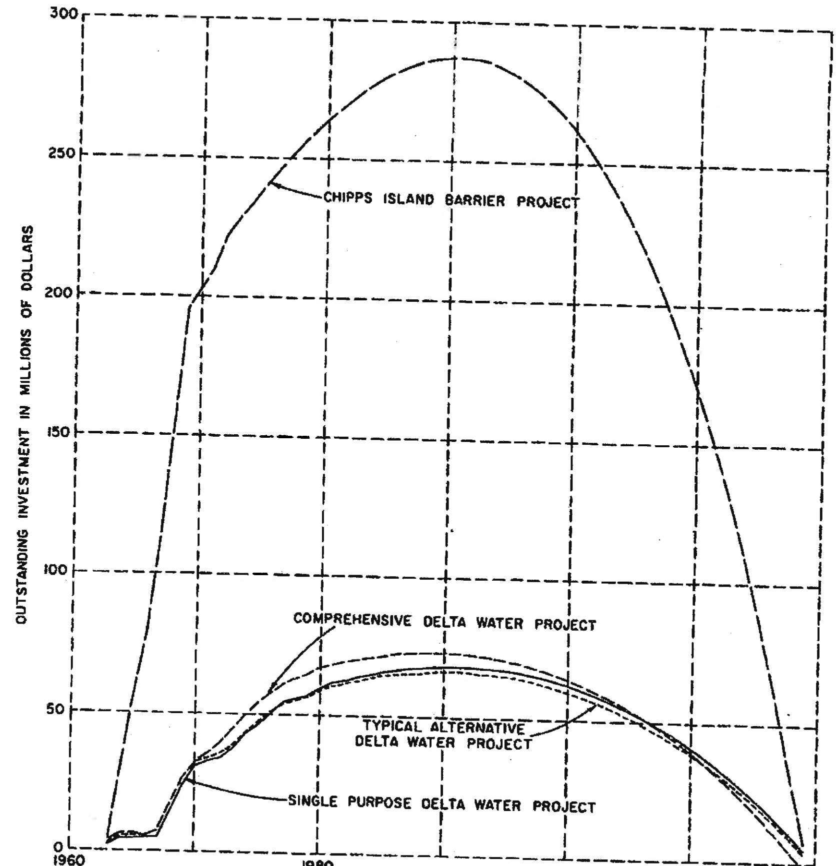
CHIPPS ISLAND BARRIER PROJECT



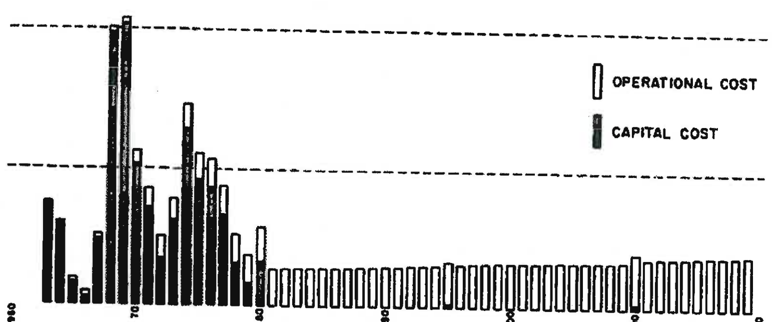
SINGLE PURPOSE DELTA WATER PROJECT

and seepage control and vehicular transportation improvements would be repaid by annual payments from the beneficiaries of flood and seepage control and from the counties, respectively. It was assumed that unassigned local costs of the Chipps Island Barrier Project would be recovered in annual payments in proportion to the projected industrial tax base. This assumed method of repayment would necessitate a rate of about $1.19 per $100 of assessed valuation throughout a 60-year period. It was also assumed that unassigned local costs of the Comprehensive Delta Water Project would be recovered in annual payments based upon the total acreage of land south of the San Joaquin River which would benefit from flood and seepage control. An annual payment of $0.86 per acre would be required.

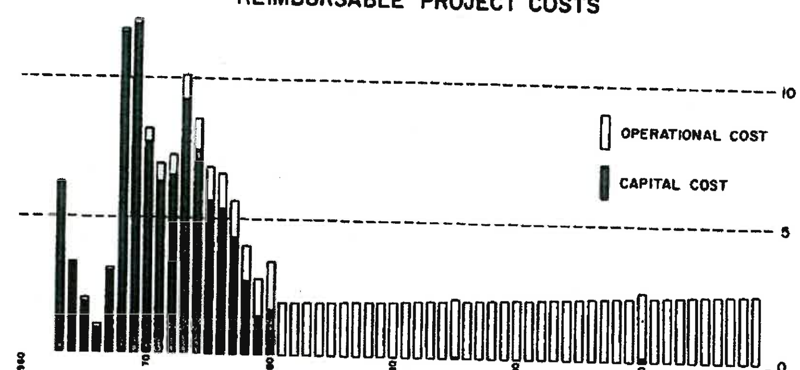
The comparative investment requirements for allocated reimbursable costs, including interest and operational costs, of the several projects are shown in the accompanying graph.



COMPARISON OF OUTSTANDING INVESTMENT REIMBURSABLE PROJECT COSTS



TYPICAL ALTERNATIVE DELTA WATER PROJECT



COMPREHENSIVE DELTA WATER PROJECT

Conclusions and Recommendations

CONCLUSIONS

GENERAL

The plans for Delta water facilities described in this report are consistent with and would accomplish the water development purposes embraced in the California Water Resources Development Bond Act approved on November 8, 1960. Additional features could be incorporated to provide flood and seepage control, transportation, and recreation benefits.

WATER SUPPLY

Problems of water quality in the western portion of the Delta necessitate early construction of facilities to provide suitable water supplies for present and future uses.

WATER SALVAGE

Without physical control works in the Delta, increasingly greater quantities of fresh water from upstream storage will be required to repel ocean salinity and maintain good quality water for use within and export from the Delta. Water salvage will be dependent upon coordinated operation of regulatory storage, export works, and Delta water facilities.

FLOOD AND SEEPAGE CONTROL

The magnitude of flood damage and the costs of flood and seepage control will become increasingly greater as the land surface of many Delta islands continues to subside. A master levee system would reduce these costs. Early initiation of construction is necessary to economically provide stable levees.

VEHICULAR TRANSPORTATION AND RECREATION

Improvements to the road system in the Delta are needed to reduce costs of vehicular shipment and to develop the recreation potential to accommodate an estimated 7,000,000 recreation-days in 1990, and 14,000,000 recreation-days in 2020.

DELTA WATER FACILITIES

1. The Chipps Island Barrier Project would be functionally feasible, would provide adequate water supplies of acceptable quality for the Delta, and would salvage water otherwise needed for salinity control amounting to an estimated annual average of 1,900,000 acre-feet based on a 60-year period. However, the net benefits would be less than the project costs in a ratio of 0.93:1. Therefore, the project would not be economically justified. The project would not be financially feasible, unless revenues could be obtained from local taxes in addition to revenues derived from water sales.

2. The alternative plans of the Delta Water Project would be functionally feasible, would permit export of full water demands on the State Water Facilities, and would provide adequate water supplies, both in quality and quantity, for the Delta. The project would salvage water otherwise needed for salinity control amounting to an estimated annual average of 2,050,000 acre-feet based on a 60-year period.

3. The Chipps Island Barrier Project would probably cause disastrous reductions in the fisheries resource of the Delta. The Single Purpose Delta Water Project would be the least detrimental of all projects and would reduce some losses of fish and

Advanced Planning, Design, and Operation Studies

It is anticipated that the results of the planning studies summarized in this bulletin and described in detail in the supporting office reports will be the basis for selection of a general plan for the Delta Water Project. However, it is recognized that definite plans, designs, and operation programs will be dependent upon further studies and negotiations on certain aspects of the project plans.

LOCAL ACTION

Early consideration should be given by local agencies to the extent of their interest in facilities which could be constructed to provide local benefits. Acute water supply problems in the western Delta, particularly in the agricultural lowlands, warrant early resolution of interest in plans for water supply facilities. Consideration should be given to creation of master districts to represent related areas of interest in flood and seepage control benefits.

UNITED STATES CORPS OF ENGINEERS

Studies for flood and seepage control benefits and estimates of the federal contribution were based on methods and preliminary studies of the Corps of Engineers. Conditions in the Delta do not precisely fit standard procedures, and it will be necessary for the Corps of Engineers to make a detailed review of these studies to determine the extent of federal interest.

UNITED STATES BUREAU OF RECLAMATION

The Delta Water Project would enhance the operation of the Federal Central Valley Project by improving and insuring the quality of water exported from the Delta and by providing good quality water in the western Delta area in lieu of salinity control. The extent of federal interest in these benefits should be jointly analyzed by the Bureau of Reclamation and the Department of Water Resources.

HIGHWAYS

The channel closures and wide landward berms of the master levee system offer excellent opportunities for enhancing the road network in the Delta. Studies should be made by the State Division of Highways and county highway departments of transportation enhancement features, such as better road surfacing and connecting roads, which might be incorporated in the project plans.

FISHERY RESOURCES

To more definitely predict the anticipated project effects on fisheries and to design the fish screens and other remedial measures, it will be necessary to study certain biological aspects of the Delta fisheries. Joint studies of the anticipated project effects should be undertaken by the Department of Fish and Game and the Department of Water Resources.

OTHER STUDIES

Advance planning studies of flow distribution, salinity incursion, water quality, and sedimentation should continue throughout the design and early operation phases of project construction.

Test levee construction now being conducted pursuant to legislative directives will be continued to determine the most economical and efficient means of construction to provide an adequate levee system.

A general plan for remedial recreation facilities and recreation enhancement has been developed. Specific plans for facilities and development of land which can be made available for recreation uses should be prepared by county agencies, the Department of Water Resources, and other appropriate state agencies.

Acknowledgments

BOARD OF CONSULTING ENGINEERS

Samuel B. Morris, Chairman
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CONSULTANTS ON SPECIAL ASPECTS

Ir. C. Biemond, Consulting Engineer
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Sheppard T. Powell, Consulting Engineer, Baltimore, Maryland
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Thomas Means, Consulting Engineer
San Francisco, California
Harry Barnes, Consulting Engineer
Madera, California
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Dr. David K. Todd, University of California, Berkeley, California
Dr. Donald Pritchard, Johns Hopkins University, Baltimore, Maryland
Dr. H. Bolton Seed, University of California, Berkeley, California
Ronald Pizer, Consultant, Sacramento, California
Don J. Cretzler, Hytech Corporation
Inglewood, California

COOPERATIVE STUDIES

U. S. Corps of Engineers
Sacramento District—flood control and navigation aspects
San Francisco District—preliminary designs, Chipps Island Barrier Project

U. S. Coast and Geodetic Survey—subsidence surveying

California Department of Fish and Game—fish and game studies

Contra Costa County Water Agency—industrial water use studies

University of California
Berkeley—electric analog model of Delta channels
Davis—organic soil salination research

Stanford University—salinity incursion analyses

Parsons, Brinckerhoff, Hall and Macdonald—recreation studies

WESTERN DELTA ADVISORY COMMITTEE

A special Western Delta Advisory Committee was established at the suggestion of the Director of Water Resources to advise the department, primarily on studies of water requirements and plans in the western Delta. Committee membership, which has not endorsed all aspects of this report, included:

Contra Costa County

W. G. Buchanan, Chairman
Thomas M. Carlson
William J. O'Connell

Sacramento County

Arthur L. Kiefer
Jack Minge
Weber Rothwell, Secretary

San Joaquin County

L. H. Bradley
Clifford B. Bull, Vice-Chairman
Richard G. Salter

Solano County

Lowell F. Bunn
Albert M. Jongeneel
Howard Stoddard

U. S. Bureau of Reclamation

Richard J. Shukle

U. S. Corps of Engineers

William A. Doyle

STAFF

Harvey O. Banks, Director
Department of Water Resources
James F. Wright, Deputy Director
Department of Water Resources
William L. Berry, Chief Engineer
Division of Resources Planning
John M. Haley, Chief
Project Development Branch
Albert J. Dolcini, Chief
California Aqueduct Section

Investigations by Delta Studies Unit

Herbert W. Greydanus, Engineer in Charge
Don H. Nance, Hydrology
Langdon W. Owen, Planning and Design
Irene E. Bailey, Executive Assistant
Marlene R. Schumaker, Stenographer

Hydrology

Joseph N. Soderstrand
Gerald C. Cox
Glenn R. Peterson
William A. Toomey
John O. Nelson
Roy F. Nelson
Gordon J. McGregor
David K. Marty
Philip W. Nahhas

Planning and Design

Robert J. Rooney
Neil M. Cline
Maurice D. Roos
James R. Cofer
Frank Davenport
Edward A. Cecil
Franklin A. Preuss
Robert G. Potter
Sam I. Ito
Gene E. Linley
Lee H. Woodward
Edward F. Huntley
Philip T. Zwanck
Virgil D. Buechler
Howard W. Wolber

Table 3. Sacramento River Multiyear Droughts (reconstructed from tree rings prior to 1900)

Period	Length (in years)	Average Runoff (MAF)
1579–82	4	12.4
1593–95	3	9.3
1618–20	3	13.2
1651–55	5	12.3
1719–24	6	12.6
1735–37	3	12.2
1755–61	6	13.3
1776–78	3	12.1
1793–95	3	10.7
1839–41	3	12.9
1843–46	4	12.3
1918–20 (actual)	3	12.0
1929–34 (actual)	6	9.8
1959–62 (actual)	4	13.0
1987–92 (actual)	6	10.0

Exhibit "C"

CALIFORNIA DEPARTMENT OF WATER RESOURCES

NEWS FOR IMMEDIATE RELEASE

NEWS FOR IMMEDIATE RELEASE

March 10, 2014

Contacts:
Jeanine Jones, Interstate Resources Manager – (916) 653-8126
Jeanine.Jones@water.ca.gov
Ted Thomas, Information Officer – (916) 653-9712
Ted.Thomas@water.ca.gov

Severity of Past Droughts Quantified by New Streamflow Reconstructions

SACRAMENTO – As part of ongoing work to improve California's drought preparedness and better adapt to climate change, the Department of Water Resources (DWR) today released a report examining tree-ring data to help better understand historic periods of drought. The report helps develop long-term reconstructions of streamflow or precipitation for the Klamath, Sacramento, and San Joaquin river basins. The report, prepared for DWR by researchers at the University of Arizona, is available is available here. Funding for part of the Klamath Basin work was provided by the U.S. Bureau of Reclamation under its WaterSMART program.

Initial work on the reconstruction project began in 2010, at a time when California was just emerging from the 2007-09 drought. Completion of the final report coincides with a new three-year drought and a Water Year 2014 that so far is one of the driest years in the historical record.

California's roughly one hundred years of observed data are, however, only a small subset of the hydrologic record that can be reconstructed by measuring tree rings and calibrating them to observed data. The tree-ring measurements made for this project allowed development of reconstructions that begin in the year 900 for the Sacramento River and San Joaquin River systems, and in the 1500s for various sites in the Klamath Basin.

"Streamflow reconstruction from tree rings takes advantage of the great longevity and climate sensitivity of several tree species in California and Oregon," said lead author David Meko, a University of Arizona research professor of dendrochronology. "The tree-ring patterns record unusual climate events and modes of variability that occurred before the short period of gaged streamflow."

Exhibit "D"

Drought is a recurring part of California's climate. The report's reconstructions show numerous periods of four or more years when streamflows were below median conditions.

In addition, the report reveals that all three river basins share common major periods of extreme low flow conditions, although the degree of severity varies from river to river. The most severe shared periods were the 1100s (20 – 50 year sustained dry periods), 1570 to early 1580s (up to decades-long periods), and 1920s -1930s (up to 20-year periods). The Sacramento and San Joaquin basins shared 1580 as the single driest year of record. The driest single year for Klamath River streamflow was 1655 (1580 was 17th driest). The graphic below illustrates notable low-flow periods in the river basins. A tabulation listing all dry periods of four or more years is attached.

Paleoclimate information such as these reconstructed streamflows captures a broader range of hydrologic variability than provided in the historical record, thereby putting our short period of observed droughts in perspective.

A repeat of the "Dustbowl Drought" of the 1920s and 1930s (our most severe historical event in terms of duration) with today's urban and agricultural development would sorely challenge California's infrastructure and institutional framework for water management. That challenge would pale in comparison to the time of the Medieval Climate Anomaly, when sustained severe drought gripped much of the western United States.

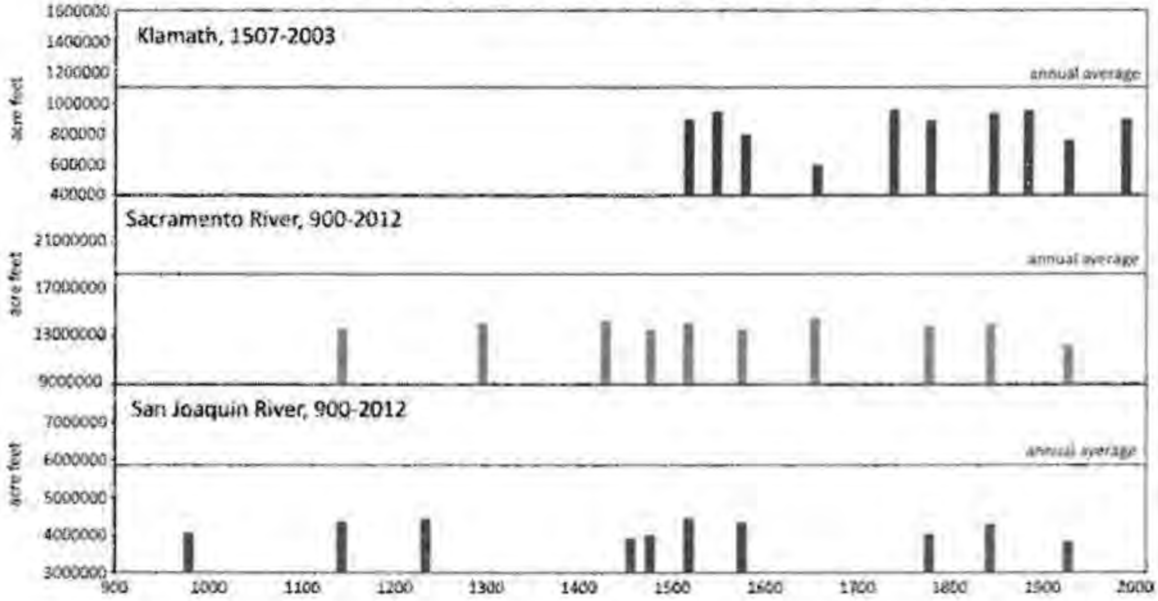
Paleoclimate information is useful in helping to understand and model natural variability in the climate system that may provide clues for improving drought prediction at the seasonal time scales important for water management.

Jeanine Jones of DWR said, "Drought prediction skillful enough to use for water management decision-making remains a research challenge for the science community. Having improved climate forecasting capabilities at time scales of months to a year in advance would provide great benefit for drought preparedness."

Looking into the future, the reconstructions also help provide context for expected impacts of climate change. The report compares drought durations seen in the paleoclimate record with those projected by downscaled global climate change models run to simulate conditions by the end of the century. The results indicate that the paleoclimate data may be useful for assessing future climate projections in the context of past centuries.

Report co-author Connie Woodhouse, professor and interim head of the University of Arizona School of Geography and Development, said, "These tree-ring records document the range of drought characteristics, including duration, that have occurred in the past, under natural climate variability. These droughts could occur in the future, but under warmer temperatures that will further exacerbate their impacts."

Lowest ten 10-year averages (non-overlapping)



Klamath = Klamath River at Keno

Sacramento River = Sacramento River runoff

San Joaquin River = San Joaquin River runoff

Sacramento River runoff is the sum of unimpaired flow in million acre-feet at:
Sacramento River above Bend Bridge

Feather River at Oroville (aka inflow to Lake Oroville)
Yuba River near Smartville

American River below Folsom Lake

San Joaquin River Runoff is the sum of unimpaired flow in million acre-feet at:

Stanislaus River below Goodwin Reservoir (aka inflow to New Melones Res.)

Tuolumne River below La Grange (aka inflow to New Don Pedro Reservoir)

Merced River below Merced Falls (aka inflow to Lake McClure)

San Joaquin River inflow to Millerton Lake

Runs[a] with length ≥4 years in three flow reconstructions

Klamath[b]		Sacramento4c		San Joaquin4[d]	
Years	N	Years	N	Years	N
1515-1522	8	921- 924	4	946- 950	5
1540-1543	4	945- 950	6	977- 981	5
1547-1552	6	975- 981	7	1072-1075	4
1578-1582	5	1072-1075	4	1143-1148	6
1592-1597	6	1130-1136	7	1155-1158	4
1642-1646	5	1143-1148	6	1172-1177	6
1648-1668	21	1150-1158	9	1210-1213	4
1738-1744	7	1170-1177	8	1233-1239	7
1756-1761	6	1233-1239	7	1294-1301	8
1764-1767	4	1292-1301	10	1395-1402	8
1775-1779	5	1390-1393	4	1407-1410	4
1783-1787	5	1395-1400	6	1425-1428	4
1792-1798	7	1407-1410	4	1450-1461	12
1843-1846	4	1425-1432	8	1463-1466	4
1848-1852	5	1451-1457	7	1471-1483	13
1873-1876	4	1475-1483	9	1505-1508	4
1880-1884	5	1515-1521	7	1518-1523	6
1912-1915	4	1540-1543	4	1540-1545	6
1917-1920	4	1569-1572	4	1569-1572	4
1924-1935	12	1578-1582	5	1578-1582	5
1987-1992	6	1592-1595	4	1592-1595	4
		1636-1639	4	1629-1632	4
		1645-1648	4	1645-1648	4
		1652-1655	4	1652-1655	4
		1753-1760	8	1688-1691	4
		1780-1783	4	1753-1757	5
		1843-1846	4	1780-1783	4
		1856-1859	4	1793-1796	4
		1917-1922	6	1843-1846	4
		1926-1935	10	1855-1859	5
		1946-1951	6	1928-1931	4
		1959-1962	4	1946-1950	5
		1987-1992	6	1959-1962	4
				1987-1992	6
				2000-2004	5

[a] runs defined as consecutive years below median
[b] Klamath River at Keno, 1507-2003; median =1113 thousand acre-feet (TAF)
[c] Sacramento River runoff, 900-2012, median=17800 TAF
[d] San Joaquin River runoff, 900-2012, median=5598 TAF

With California facing one of the most severe droughts on record, Governor Brown declared a drought State of Emergency and directed state officials to take all necessary actions to prepare for water shortages. The Governor signed legislation to immediately help communities deal with the devastating dry conditions affecting our state and to provide funding to increase local water supplies after it was passed with bipartisan support in the legislature.

Governor Brown met with President Obama about crucial federal support during the ongoing drought, and the state continues to work with federal partners to ensure coordinated drought monitoring and response. Governor Brown and the administration have also expressed support for federal legislation introduced by Senators Feinstein and Boxer and Representatives Jim Costa, Tony Cárdenas and Sam Farr.

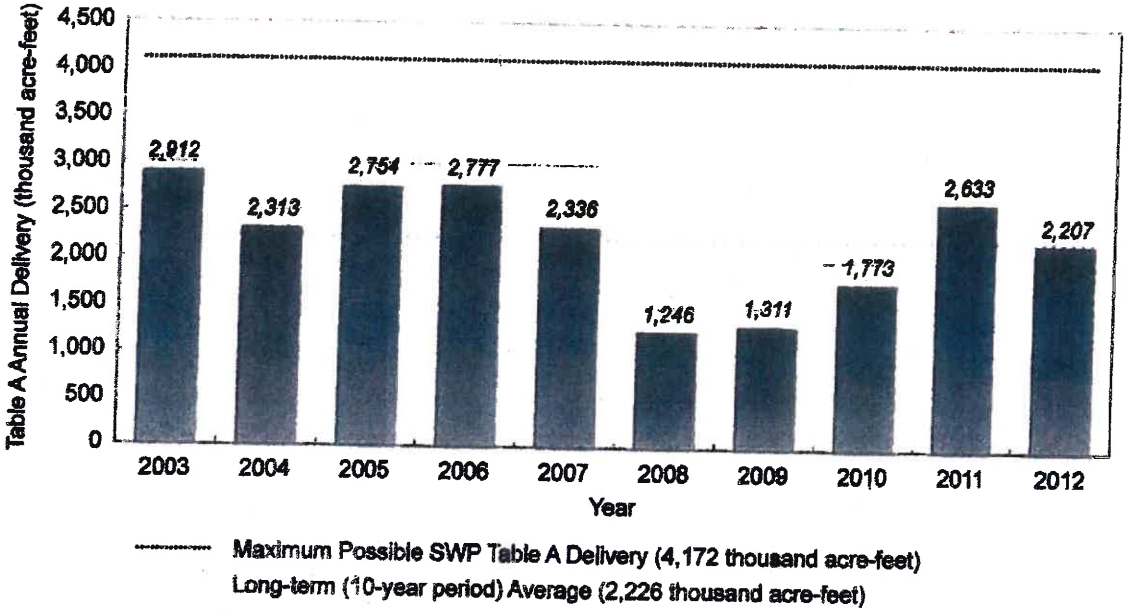
Across state government, action is being taken. The Department of General Services is leading water conservation efforts at state facilities, and the California State Architect has asked California school districts and Community Colleges to act on the Governor's call to reduce water usage. The Department of Transportation is cutting water usage along California's roadways by 50 percent. Caltrans has also launched a public awareness campaign, putting a water conservation message on their more than 700 electronic highway signs.
In January, the state took action to conserve water in numerous Northern California reservoirs to meet minimum needs for operations impacting the environment and the economy, and recently the Department of Water Resources and U.S. Bureau of Reclamation announced they would seek the authority to make water exchanges to deliver water to those who need it most. The State Water Resources Control Board announced it would work with hydropower generators and the Federal Energy Regulatory Commission to preserve water in California reservoirs, and the California Department of Fish and Wildlife and the California Fish and Game Commission restricted fishing on some waterways due to low water flows worsened by the drought.

The state is working to protect local communities from the dangers of extreme drought. The California Department of Public Health identified and offered assistance to communities at risk of severe drinking water shortages and is working with other state and local agencies to develop solutions for vulnerable communities. CAL FIRE hired additional firefighters and is continuously adjusting staffing throughout the state to help address the increased fire threat due to drought conditions. The California Department of Food and Agriculture launched a drought website to help farmers, ranchers and farmworkers find resources and assistance programs that may be available to them during the drought.

Even as the state deals with the immediate impacts of the drought, it's also planning for the future. In 2013, the California Natural Resources Agency, the California Environmental Protection Agency and CDFA released the California Water Action Plan, which will guide state efforts to enhance water supply reliability, restore damaged and destroyed ecosystems and improve the resilience of our infrastructure.

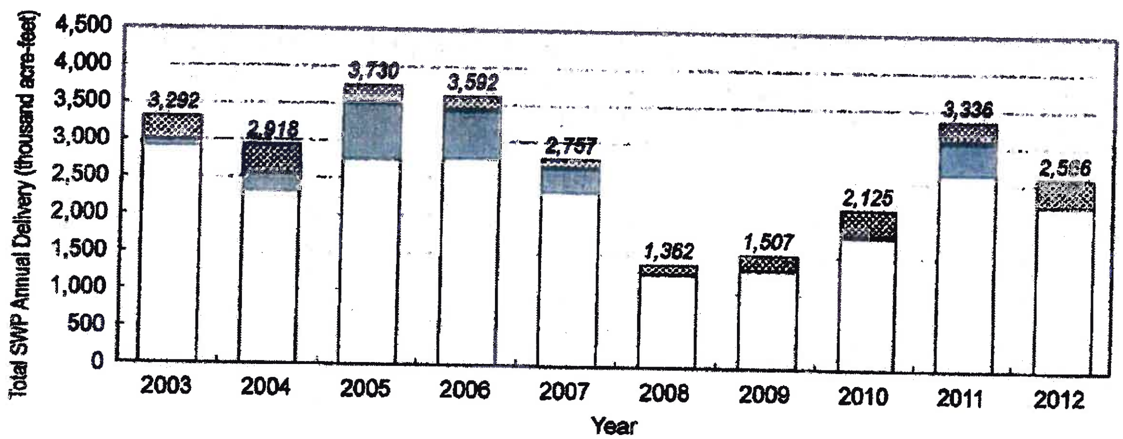
Governor Brown has called on all Californians to voluntarily reduce their water usage by 20 percent, and the Save Our Water campaign launched four public service announcements encouraging residents to conserve and has resources available in Spanish. Last December, the Governor formed a Drought Task Force to review expected water allocations and California's preparedness for water scarcity. In May 2013, Governor Brown issued an Executive Order to direct state water officials to expedite the review and processing of voluntary transfers of water.

The Department of Water Resources operates and maintains the State Water Project, provides dam safety and flood control and inspection services, assists local water districts in water management and water conservation planning, and plans for future statewide water needs.



Note: The differences in historical deliveries from the State Water Project Delivery Reliability Report 2011 are due to reclassification of the various components of water delivered to SWP contractors.

Figure 2-3. Historical Deliveries of SWP Table A Water, 2003-2012



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Carryover	290	370	207	160	95	110	188	333	251	350
Turnback	30	17	38	34	16	3	2	11	31	8
Article 21	60	218	731	621	310	3	6	8	421	1
Table A	2,912	2,313	2,754	2,777	2,336	1,246	1,311	1,773	2,633	2,207

Note: The differences in historical deliveries from the State Water Project Delivery Reliability Report 2011 are due to reclassification of the various components of water delivered to SWP contractors.

Figure 2-4. Total Historical SWP Deliveries, 2003-2012 (by Delivery Type)

Exhibit "E"

Dry-Year Deliveries of SWP Table A Water under Future Conditions

Table 6-3 and Figure 6-3 present estimates of future SWP Table A water deliveries during possible drought conditions and compare these estimates with the corresponding delivery estimates calculated for the 2011 Report. Drought scenarios for future conditions are analyzed using the historical drought-period precipitation and runoff patterns from 1922–2003 as a reference, while accounting for future conditions (e.g., land use, climate change).

The results of modeling future conditions under potential drought-year scenarios provide an estimated range of Table A deliveries that can be expected during drought periods.

The 2-year drought period (1976–1977) shows significantly lower Table A deliveries in the 2013 Report than in the 2011 Report (see Figure 6-3), because of modeling refinements (see the technical addendum at http://baydeltaoffice.water.ca.gov/) and reclassification of 1975 into a wet year rather than an above-normal year, as was used in the 2011 Report (due to the change in the assumed climate change model). Because 1975 is now considered a wet year in this 2013 Report's model, there are higher fall X2 requirements to meet and more Delta outflow is required in September. This leads to lower reservoir levels at the start of the new water year and smaller deliveries during the upcoming 2-year dry period.

Table 6-3. Estimated Average and Dry-Period Deliveries of SWP Table A Water (Future Conditions, in taf/year) and Percent of Maximum SWP Table A Amount, 4,133 taf/year

	Long-term Average (1921-2003)		Single Dry Year (1977)		Dry Periods							
					2-Year Drought (1976-1977)		4-Year Drought (1931-1934)		6-Year Drought (1987-1992)		6-Year Drought (1929-1934)	
2011 Report	2,465	60%	441	11%	1,457	35%	1,401	34%	1,226	30%	1,365	33%
2013 Report	2,400	58%	453	11%	978	24%	1,263	31%	1,055	26%	1,251	30%

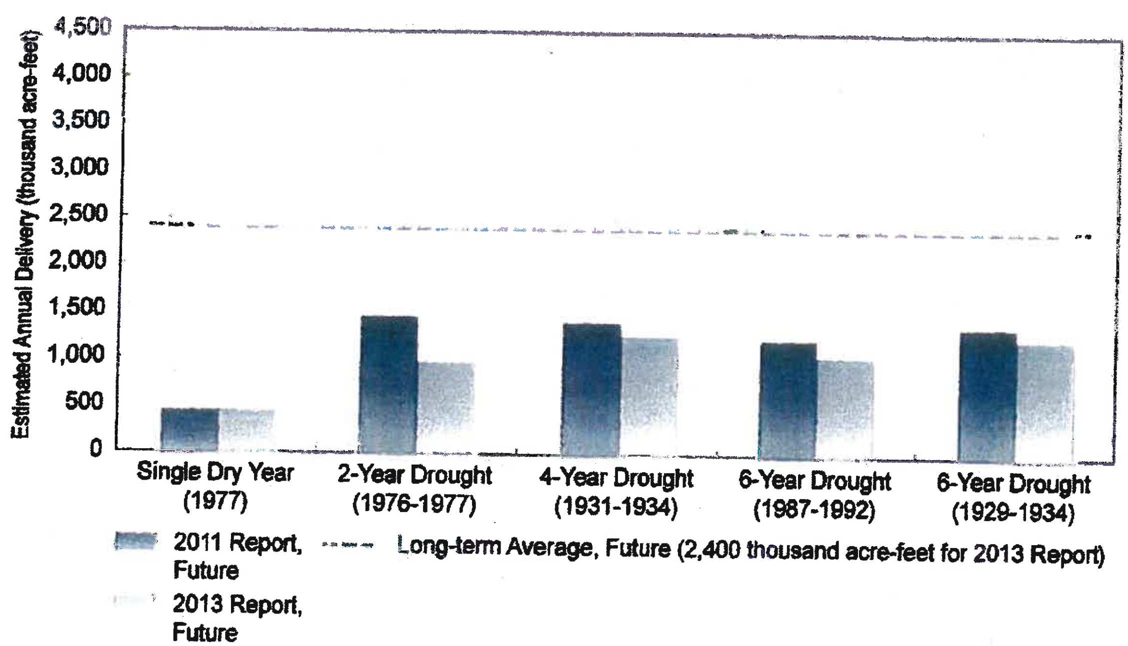


Figure 6-3. Estimated Dry-Period SWP Table A Water Deliveries (Future Conditions)

Title	**THE CALIFORNIA WATER RESOURCES DEVELOPMENT BOND ACT**
Year/Election	**1960 general**
Proposition type	bond (leg)
Popular vote	Yes: 3,008,328 (51.5%); No: 2,834,384 (48.5%)
Pass/Fail	Pass
Summary	This act provides for a bond issue of one billion, seven hundred fifty million dollars ($1,750,000,000) to be used by the Department of **Water** Resources for the development of the **water** resources of the State.

For

Argument in Favor of California Water Resources Development Bond Act

Your vote on this measure will decide whether California will continue to prosper.

This Act, if approved, will launch the statewide water development program which will meet present and future demands of all areas of California. The program will not be a burden on the taxpayer; no new state taxes are involved; the bonds are repaid from project revenues, through the sale of water and power. In other words, it will pay for itself. The bonds will be used over a period of many years and will involve an approximate annual expenditure averaging only $75 million, as compared, for example with $600 million a year we spend on highways.

Existing facilities for furnishing water for California's needs will soon be exhausted because of our rapid population growth and industrial and agricultural expansion. We now face a further critical loss in the Colorado River supply. Without the projects made possible by this Act, we face a major water crisis. We can stand no more delay.

If we fail to act now to provide new sources of water, land development in the great San Joaquin Valley will slow to a halt by 1965 and the return of cultivated areas to wasteland will begin. In southern California, the existing sources of water which have nourished its tremendous expansion will reach capacity by 1970 and further development must wholly cease. In northern California desperately needed flood control and water supplies for many local areas will be denied.

This Act will assure construction funds for new water development facilities to meet California's requirements now and in the future. No area will be deprived of water to meet the needs of another. Nor will any area be asked to pay for water delivered to another.

To meet questions which concerned, southern California, the bonds will finance completion of all facilities needed, as described in the Act. Contracts for delivery of water may not be altered by the Legislature. The tap will be open, and no amount of political maneuvering can shut it off.

Under this Act the water rights of northern California will remain securely protected. In addition, sufficient money is provided for construction of local projects to meet the pressing needs for flood control, recreation and water deliveries in the north.

A much needed drainage system and water supply will be provided in the San Joaquin Valley.

Construction here authorized will provide thousands of jobs. And the program will nourish tremendous industrial and farm and urban expansion which will develop an ever-growing source of employment and economic prosperity for Californians.

Our Legislature has appropriated millions of dollars for work in preparation, and construction is now underway. It would be tragic if this impressive start toward solution of our water problems were now abandoned.

If we fail to act now to insure completion of this constructive program, serious existing water shortages will only get worse. The success of our State is at stake. Vote "Yes" for water for people, for progress, for prosperity!

Exhibit "F"

Public Law 86-488

June 3, 1960
[S. 44]

AN ACT

To authorize the Secretary of the Interior to construct the San Luis unit of the Central Valley project, California, to enter into an agreement with the State of California with respect to the construction and operation of such unit, and for other purposes.

Central Valley Project, Calif. San Luis unit. Construction.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) for the principal purpose of furnishing water for the irrigation of approximately five hundred thousand acres of land in Merced, Fresno, and Kings Counties, California, hereinafter referred to as the Federal San Luis unit service area, and as incidents thereto of furnishing water for municipal and domestic use and providing recreation and fish and wildlife benefits, the Secretary of the Interior (hereinafter referred to as the Secretary) is authorized to construct, operate, and maintain the San Luis unit as an integral part of the Central Valley project. The principal engineering features of said unit shall be a dam and reservoir at or near the San Luis site, a forebay and afterbay, the San Luis Canal, the Pleasant Valley Canal, and necessary pumping plants, distribution systems, drains, channels, levees, flood works, and related facilities, but no facilities shall be constructed for electric transmission or distribution service which the Secretary determines, on the basis of an offer of a firm fifty-year contract from a local public or private agency, can through such contract be obtained at less cost to the Federal Government than by construction and operation of Government facilities. The works (hereinafter referred to as joint-use facilities) for joint use with the State of California (hereinafter referred to as the State) shall be the dam and reservoir at or near the San Luis site, forebay and afterbay, pumping plants, and the San Luis Canal. The joint-use facilities consisting of the dam and reservoir shall be constructed, and other joint-use facilities may be constructed, so as to permit future expansion; or the joint-use facilities shall be constructed initially to the capacities necessary to serve both the Federal San Luis unit service area and the State's service area, as hereinafter provided. In constructing, operating, and maintaining the San Luis unit, the Secretary shall be governed by the Federal reclamation laws (Act of June 17, 1902 (32 Stat. 388), and Acts amendatory thereof or supplementary thereto). Construction of the San Luis unit shall not be commenced until the Secretary has (1) secured, or has satisfactory assurance of his ability to secure, all rights to the use of water which are necessary to carry out the purposes of the unit and the terms and conditions of this Act, and (2) received satisfactory assurance from the State of California that it will make provision for a master drainage outlet and disposal channel for the San Joaquin Valley, as generally outlined in the California water plan, Bulletin Numbered 3, of the California Department of Water Resources, which will adequately serve, by connection therewith, the drainage system for the San Luis unit or has made provision for constructing the San Luis interceptor drain to the delta designed to meet the drainage requirements of the San Luis unit as generally outlined in the report of the Department of the Interior, entitled "San Luis Unit, Central Valley Project," dated December 17, 1956.

43 USC 371 and note.
Preliminary measures.

Conditions.

(b) No water provided by the Federal San Luis unit shall be delivered in the Federal San Luis service area to any water user for the production on newly irrigated lands of any basic agricultural commodity, as defined in the Agricultural Act of 1949, or any amendment thereof, if the total supply of such commodity as estimated by the Secretary of Agriculture for the marketing year in which the bulk

63 Stat. 1051.
7 USC 1421 note.

Exhibit "G"

PL 99-546, October 27, 1986, 100 Stat 3050

UNITED STATES PUBLIC LAWS
99th Congress - Second Session
Convening January 21, 1986
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DATA SUPPLIED BY THE U.S. DEPARTMENT OF JUSTICE. (SEE SCOPE)
Additions and Deletions are not identified in this document.

PL 99-546 (HR 3113)
October 27, 1986

An Act to implement the Coordinated Operations Agreement, the Suisun Marsh Preservation Agreement, and to amend the Small Reclamation Projects Act of 1956, as amended, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I -- COORDINATED OPERATIONS
PROJECT OPERATION POLICY

SEC. 101. Section 2 of the Act of August 26, 1937 (50 Stat. 850) is amended by --

(a) inserting at the beginning "(a)"; and
(b) inserting the following new subsection:
"(b)(1) Unless the Secretary of the Interior determines that operation of the Central Valley project in conformity with State water quality standards for the San Francisco Bay/Sacramento-San Joaquin Delta and Estuary is not consistent with the congressional directives applicable to the project, the Secretary is authorized and directed to operate the project, in conjunction with the State of California water project, in conformity with such standards. Should the Secretary of the Interior so determine, then the Secretary shall promptly request the Attorney General to bring an action in the court of proper jurisdiction for the purposes of determining the applicability of such standards to the project.
"(2) The Secretary is further directed to operate the Central Valley project, in conjunction with the State water project, so that water supplied at the intake of the Contra Costa Canal is of a quality equal to the water quality standards contained in the Water Right Decision 1485 of the State of California Water Resources Control Board, dated August 16, 1978, except under drought emergency water conditions pursuant to a declaration by the Governor of California. Nothing in the previous sentence shall authorize or require the relocation of the Contra Costa Canal intake.".

REIMBURSABLE COSTS

SEC. 102. Section 2 of the Act of August 26, 1937 (50 Stat. 850) is amended by inserting the following new subsection:

"(c)(1) The costs associated with providing Central Valley project water supplies for the purpose of salinity control and for complying with State water quality standards identified in exhibit A of the 'Agreement Between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project' dated May 20, 1985, shall be allocated among the project purposes and shall be reimbursed in accordance with existing Reclamation law and policy. The costs of providing water for salinity control and for complying with State water quality standards above those standards identified in the previous sentence shall be nonreimbursable.
"(2) The Secretary of the Interior is authorized and directed to undertake a cost allocation study of the Central Valley project, including the provisions of this Act, and to implement such allocations no later than January 1, 1988.".

COORDINATED OPERATIONS AGREEMENT

Exhibit "H"

SEC. 103. Section 2 of the Act of August 26, 1937 (50 Stat. 850) is amended by inserting the following new subsection:

"(d) The Secretary of the Interior is authorized and directed to execute and implement the 'Agreement Between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project' dated May 20, 1985: Provided, That --
"(1) the contract with the State of California referred to in subarticle 10(h)(1) of the agreement referred to in this subsection for the conveyance and purchase of Central Valley project water shall become final only after an Act of Congress approving the execution of the contract by the Secretary of the Interior; and
"(2) the termination provisions of the agreement referred to in this subsection may only be exercised if the Secretary of the Interior or the State of California submits a report to Congress and sixty calendar days have elapsed (which sixty days, however, shall not include days on which either the House of Representatives or the Senate is not in session because of an adjournment of more than three days to a day certain) from the date on which said report has been submitted to the Speaker of the House of Representatives and the President of the Senate for reference to the Committee on Interior and Insular Affairs of the House of Representatives and the Committee on Energy and Natural Resources of the Senate. The report must outline the reasons for terminating the agreement and, in the case of the report by the Secretary of the Interior, include the views of the Administrator of the Environmental Protection Agency and the Governor of the State of California on the Secretary's decision.".

REFUGE WATER SUPPLY INVESTIGATION

SEC. 104. The Secretary of the Interior shall not contract for the delivery of more than 75 percent of the firm annual yield of the Central Valley project not currently committed under long-term contracts until one year after the Secretary has transmitted to the Congress a feasibility report, together with his recommendations, on the "Refuge Water Supply Investigations, Central Valley Basin, California.".

ADJUSTMENT OF RATES AND ABILITY TO PAY

SEC. 105. The Secretary of the Interior shall include in all new or amended contracts for the delivery of water from the Central Valley project a provision providing for the automatic adjustment of rates by the Secretary of the Interior if it is found that the rate in effect may not be adequate to recover the appropriate share of the existing Federal investment in the project by the year 2030. The contracts shall also include a provision authorizing the Secretary of the Interior to adjust determinations of ability to pay every five years.

OPERATION AND MAINTENANCE DEFICITS

SEC. 106. The Secretary of the Interior shall include in each new or amended contract for the delivery of water from the Central Valley project provisions ensuring that any annual deficit (outstanding or hereafter arising) incurred by a Central Valley project water contractor in the payment of operation and maintenance costs of the Central Valley project is repaid by such contractor under the terms of such new or amended contract, together with interest on any such deficit which arises on or after October 1, 1985, at a rate equal to the average market yields on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the applicable reimbursement period of the project, adjusted to the nearest one-eighth of 1 percent.

TITLE II -- SUISUN MARSH PRESERVATION AGREEMENT
AUTHORITY TO ENTER AGREEMENT

SEC. 201. The Secretary of the Interior is authorized to execute and implement the agreement between the Department of the Interior, the State of California and the Suisun Resources Conservation District (dated November 1, 1985).

COST-SHARING PROVISIONS

(iii) evaluation of lower Mokelumne River floodway improvements.

(C) INTERTIES.—Activities under this subparagraph consist of—

(i) evaluation and construction of an intertie between the State Water Project California Aqueduct and the Central Valley Project Delta Mendota Canal, near the City of Tracy, as an operation and maintenance activity, except that the Secretary shall design and construct the intertie in a manner consistent with a possible future expansion of the intertie capacity (as described in subsection (f)(1)(B)); and

(ii) assessment of a connection of the Central Valley Project to the Clifton Court Forebay of the State Water Project, with a corresponding increase in the screened intake of the Forebay.

(D) PROGRAM TO MEET STANDARDS.—

(i) IN GENERAL.—Prior to increasing export limits from the Delta for the purposes of conveying water to south-of-Delta Central Valley Project contractors or increasing deliveries through an intertie, the Secretary shall, not later than 1 year after the date of enactment of this Act, in consultation with the Governor, develop and initiate implementation of a program to meet all existing water quality standards and objectives for which the Central Valley Project has responsibility. Deadline.

(ii) MEASURES.—In developing and implementing the program, the Secretary shall include, to the maximum extent feasible, the measures described in clauses (iii) through (vii).

(iii) RECIRCULATION PROGRAM.—The Secretary shall incorporate into the program a recirculation program to provide flow, reduce salinity concentrations in the San Joaquin River, and reduce the reliance on the New Melones Reservoir for meeting water quality and fishery flow objectives through the use of excess capacity in export pumping and conveyance facilities.

(iv) BEST MANAGEMENT PRACTICES PLAN.—

(I) IN GENERAL.—The Secretary shall develop and implement, in coordination with the State's programs to improve water quality in the San Joaquin River, a best management practices plan to reduce the water quality impacts of the discharges from wildlife refuges that receive water from the Federal Government and discharge salt or other constituents into the San Joaquin River.

(II) COORDINATION WITH INTERESTED PARTIES.—The plan shall be developed in coordination with interested parties in the San Joaquin Valley and the Delta.

(III) COORDINATION WITH ENTITIES THAT DISCHARGE WATER.—The Secretary shall also coordinate activities under this clause with other entities that discharge water into the San Joaquin River to reduce salinity concentrations discharged into

Exhibit "I"

the River, including the timing of discharges to optimize their assimilation.

(v) ACQUISITION OF WATER.—The Secretary shall incorporate into the program the acquisition from willing sellers of water from streams tributary to the San Joaquin River or other sources to provide flow, dilute discharges of salt or other constituents, and to improve water quality in the San Joaquin River below the confluence of the Merced and San Joaquin Rivers, and to reduce the reliance on New Melones Reservoir for meeting water quality and fishery flow objectives.

(vi) PURPOSE.—The purpose of the authority and direction provided to the Secretary under this subparagraph is to provide greater flexibility in meeting the existing water quality standards and objectives for which the Central Valley Project has responsibility so as to reduce the demand on water from New Melones Reservoir used for that purpose and to assist the Secretary in meeting any obligations to Central Valley Project contractors from the New Melones Project.

(vii) UPDATING OF NEW MELONES OPERATING PLAN.—The Secretary shall update the New Melones operating plan to take into account, among other things, the actions described in this title that are designed to reduce the reliance on New Melones Reservoir for meeting water quality and fishery flow objectives, and to ensure that actions to enhance fisheries in the Stanislaus River are based on the best available science.

(3) WATER USE EFFICIENCY.—

(A) WATER CONSERVATION PROJECTS.—Activities under this paragraph include water conservation projects that provide water supply reliability, water quality, and ecosystem benefits to the California Bay-Delta system.

(B) TECHNICAL ASSISTANCE.—Activities under this paragraph include technical assistance for urban and agricultural water conservation projects.

(C) WATER RECYCLING AND DESALINATION PROJECTS.—Activities under this paragraph include water recycling and desalination projects, including groundwater remediation projects and projects identified in the Bay Area Water Plan and the Southern California Comprehensive Water Reclamation and Reuse Study and other projects, giving priority to projects that include regional solutions to benefit regional water supply and reliability needs.

(D) WATER MEASUREMENT AND TRANSFER ACTIONS.—Activities under this paragraph include water measurement and transfer actions.

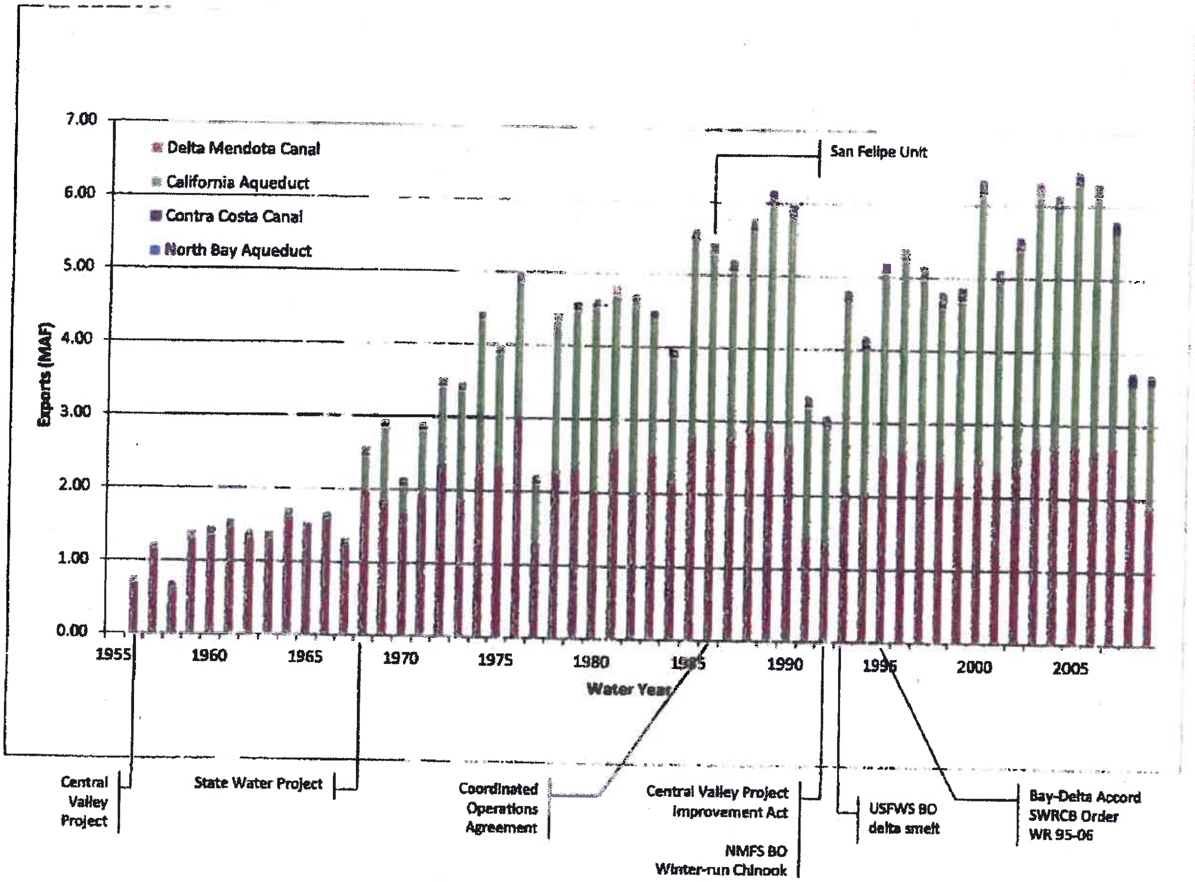
(E) URBAN WATER CONSERVATION.—Activities under this paragraph include implementation of best management practices for urban water conservation.

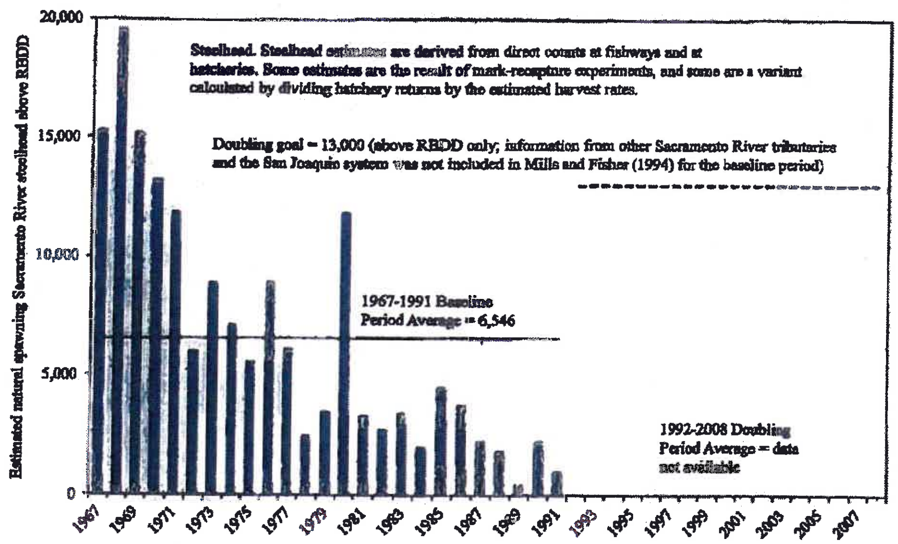
(F) RECLAMATION AND RECYCLING PROJECTS.—

Applicability.

(i) PROJECTS.—This subparagraph applies to—

(I) projects identified in the Southern California Comprehensive Water Reclamation and Reuse Study, dated April 2001 and authorized by


7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Delta Mendota Canal
California Aqueduct
Contra Costa Canal
North Bay Aqueduct
San Felipe Unit
Exports (MAF)
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Water Year
Central Valley Project
State Water Project
Coordinated Operations Agreement
Central Valley Project Improvement Act
NMFS BO Winter-run Chinook
USFWS BO delta smelt
Bay-Delta Accord SWRCB Order WR 95-06


20,000
15,000
10,000
5,000
0
Estimated natural spawning Sacramento River steelhead above RBDD
Steelhead. Steelhead estimates are derived from direct counts at fishways and at hatcheries. Some estimates are the result of mark-recapture experiments, and some are a variant calculated by dividing hatchery returns by the estimated harvest rates.
Doubling goal = 13,000 (above RBDD only; information from other Sacramento River tributaries and the San Joaquin system was not included in Mills and Fisher (1994) for the baseline period)
1967-1991 Baseline Period Average = 6,546
1992-2008 Doubling Period Average = data not available
1967
1969
1971
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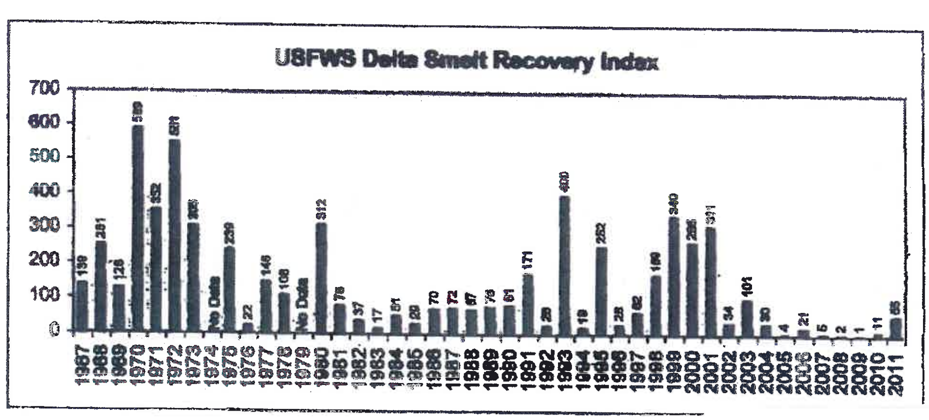
USFWS Delta Smelt Recovery Index
700
600
500
400
300
200
100
0
No Data
No Data
1967
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1969
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1972
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2011

Exhibit “J”

2-1-13

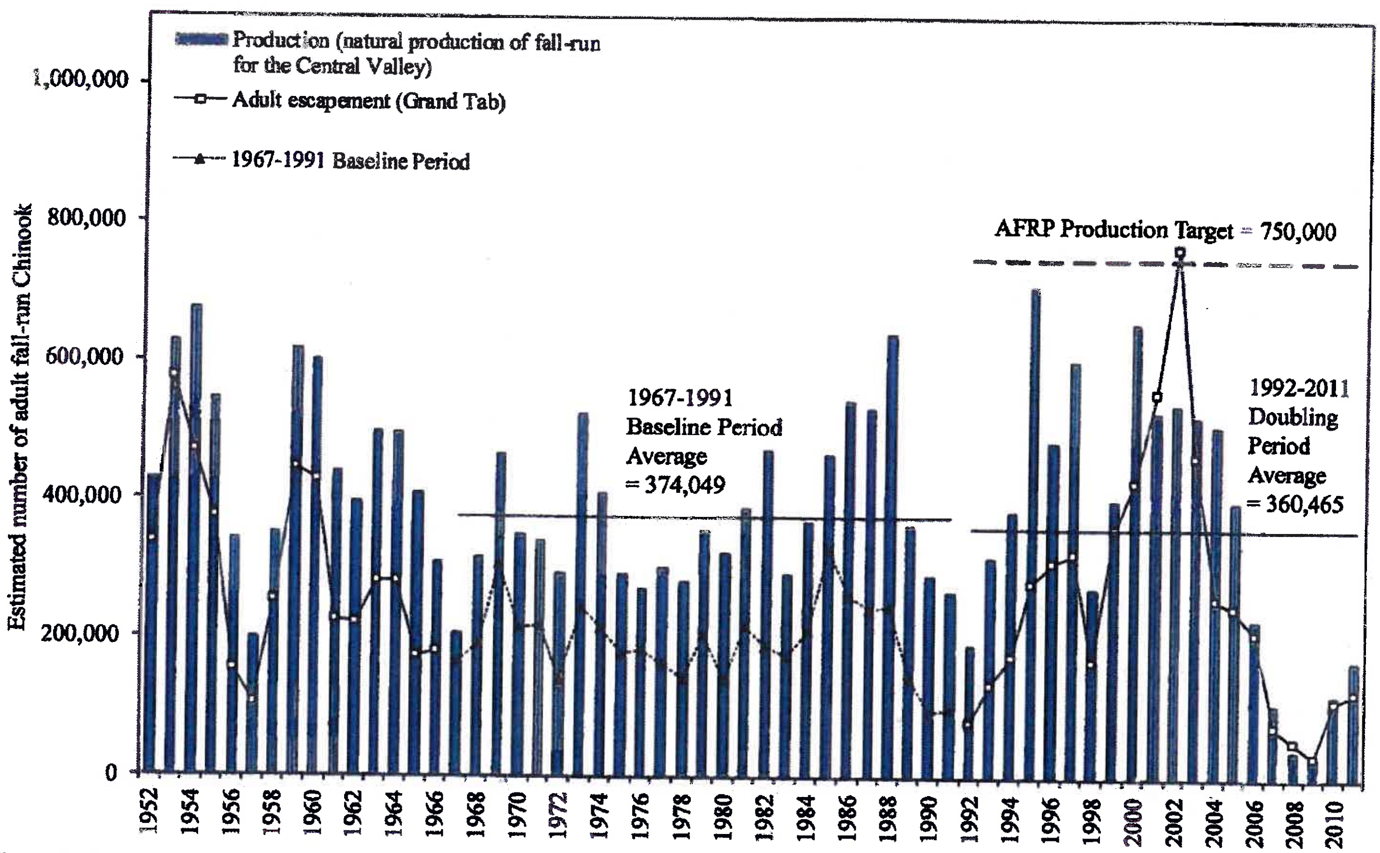


Figure 2. Estimated yearly natural production and in-river escapement of adult fall-run Chinook salmon in the Central Valley rivers and streams. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

Exhibit "K"

2-1-13

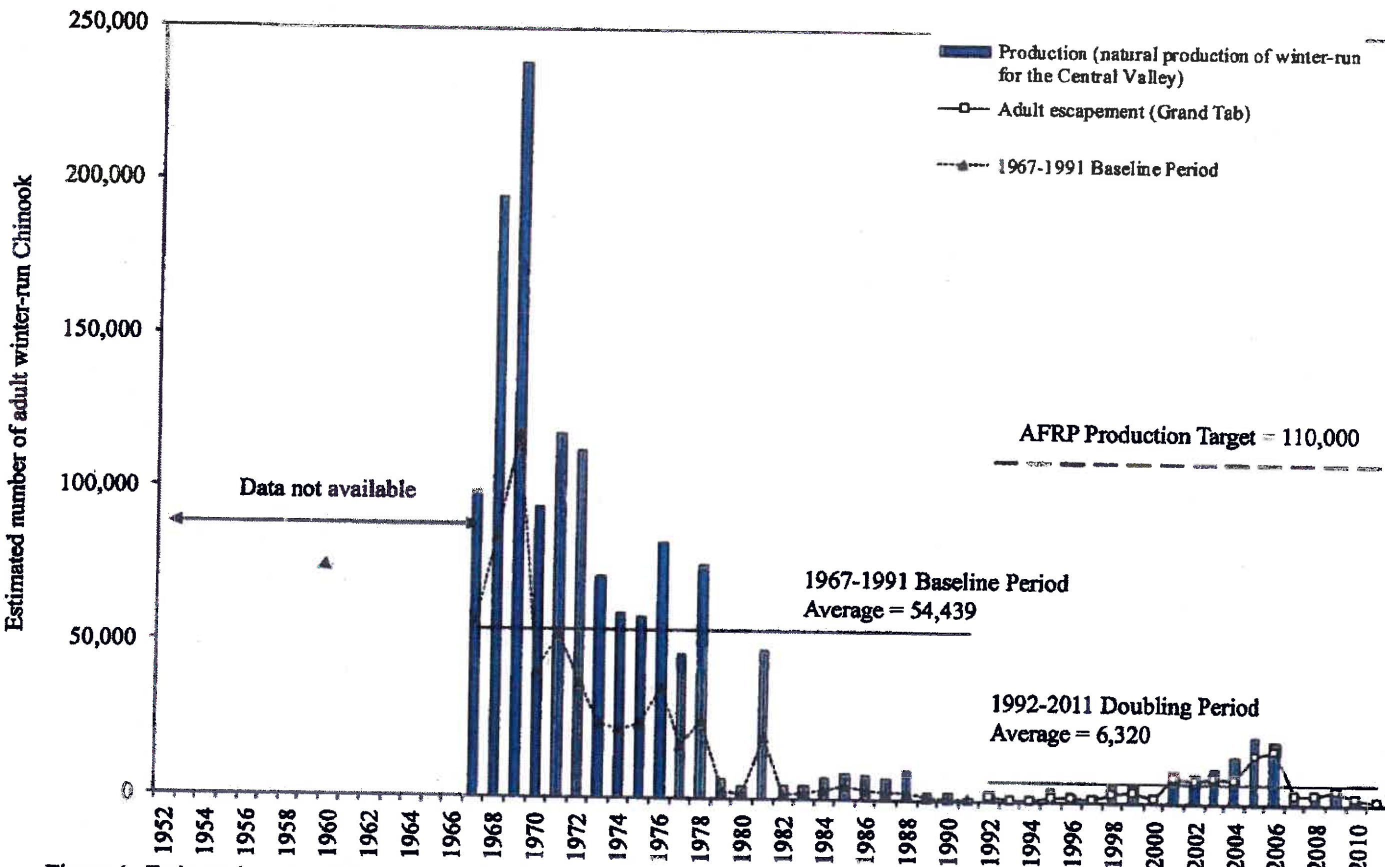


Figure 4. Estimated yearly adult natural production, and in river adult escapements of winter-run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

Exhibit "L"

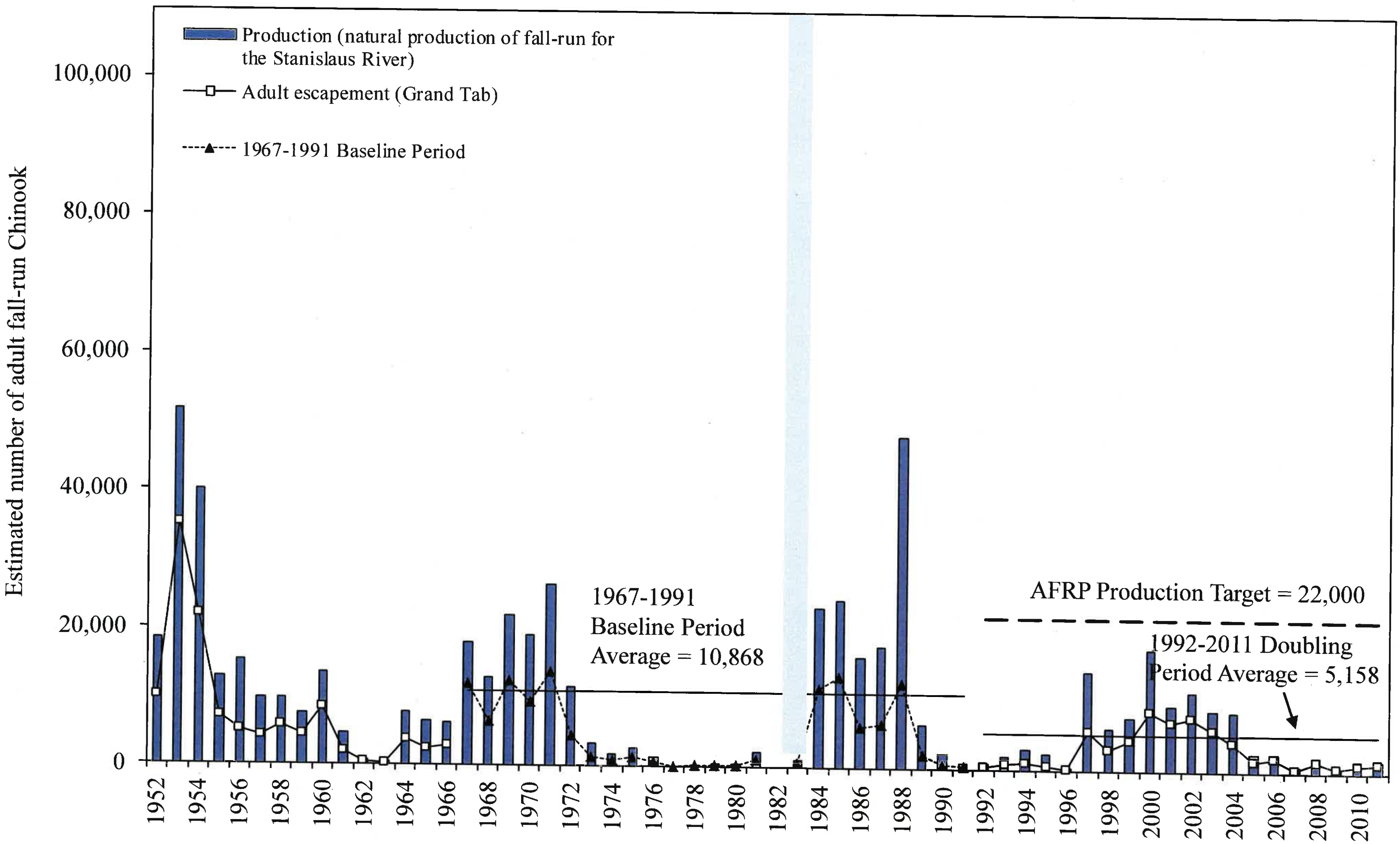


Figure 32. Estimated yearly natural production, and in river escapements of Stanislaus River adult fall-run Chinook salmon. 1952 – 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994). ▭ = data was not available for 1982.

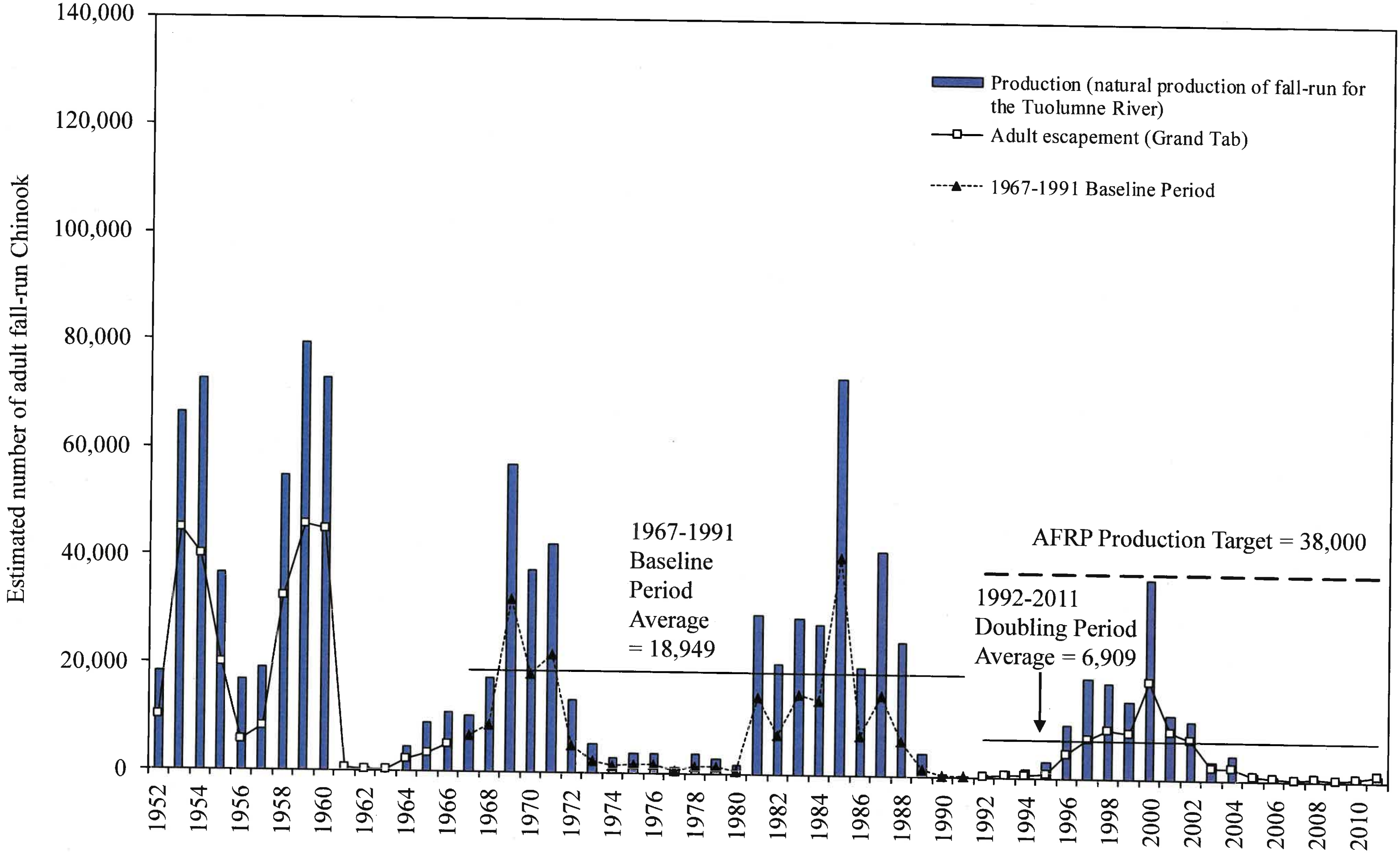


Figure 33. Estimated yearly natural production, and in river escapements of Tuolumne River adult fall-run Chinook salmon. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

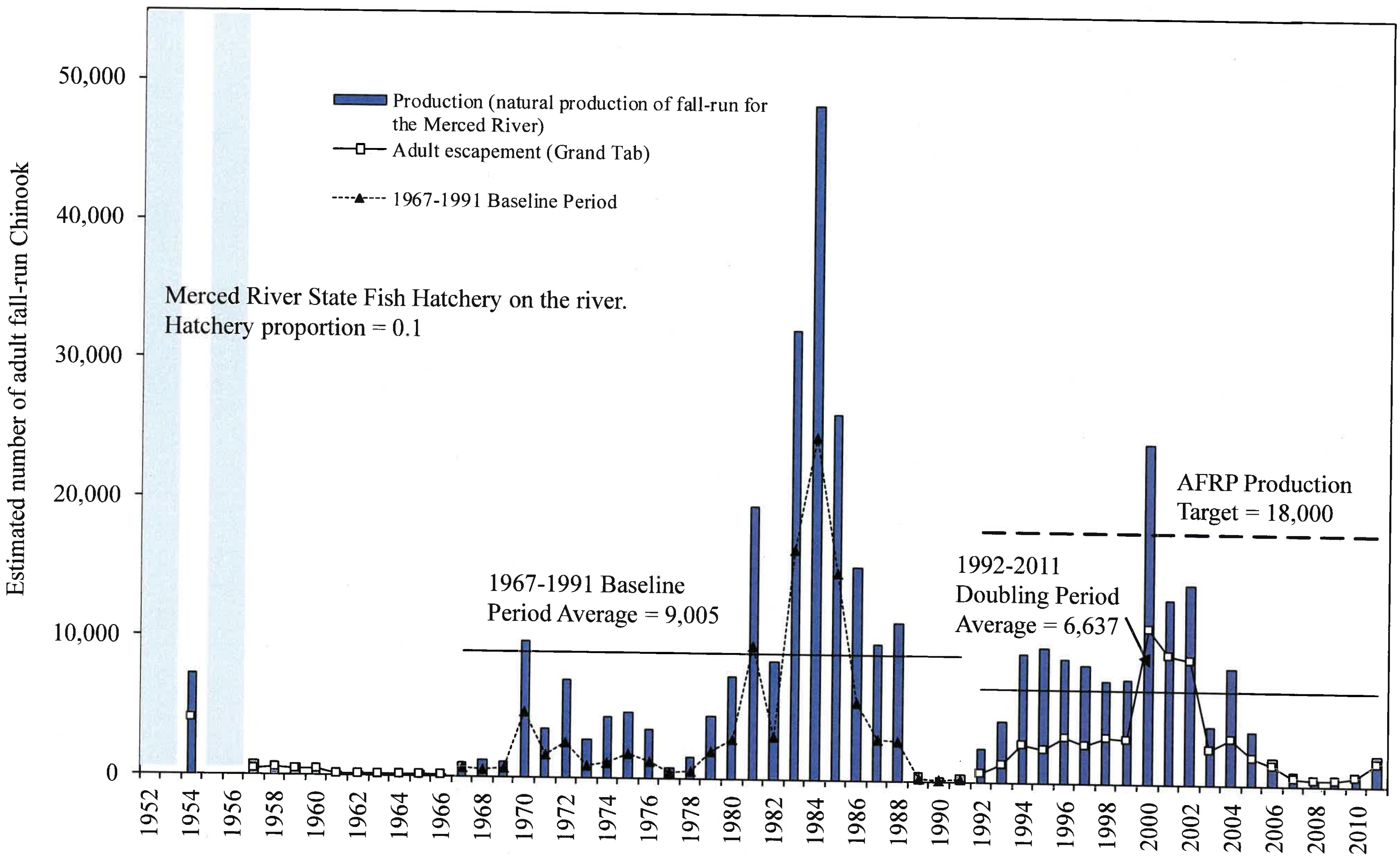


Figure 34. Estimated yearly natural production, and in river escapements of Merced River adult fall-run Chinook salmon. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). ▭ data was not available for 1952 - 1953, and 1955 - 1956. 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

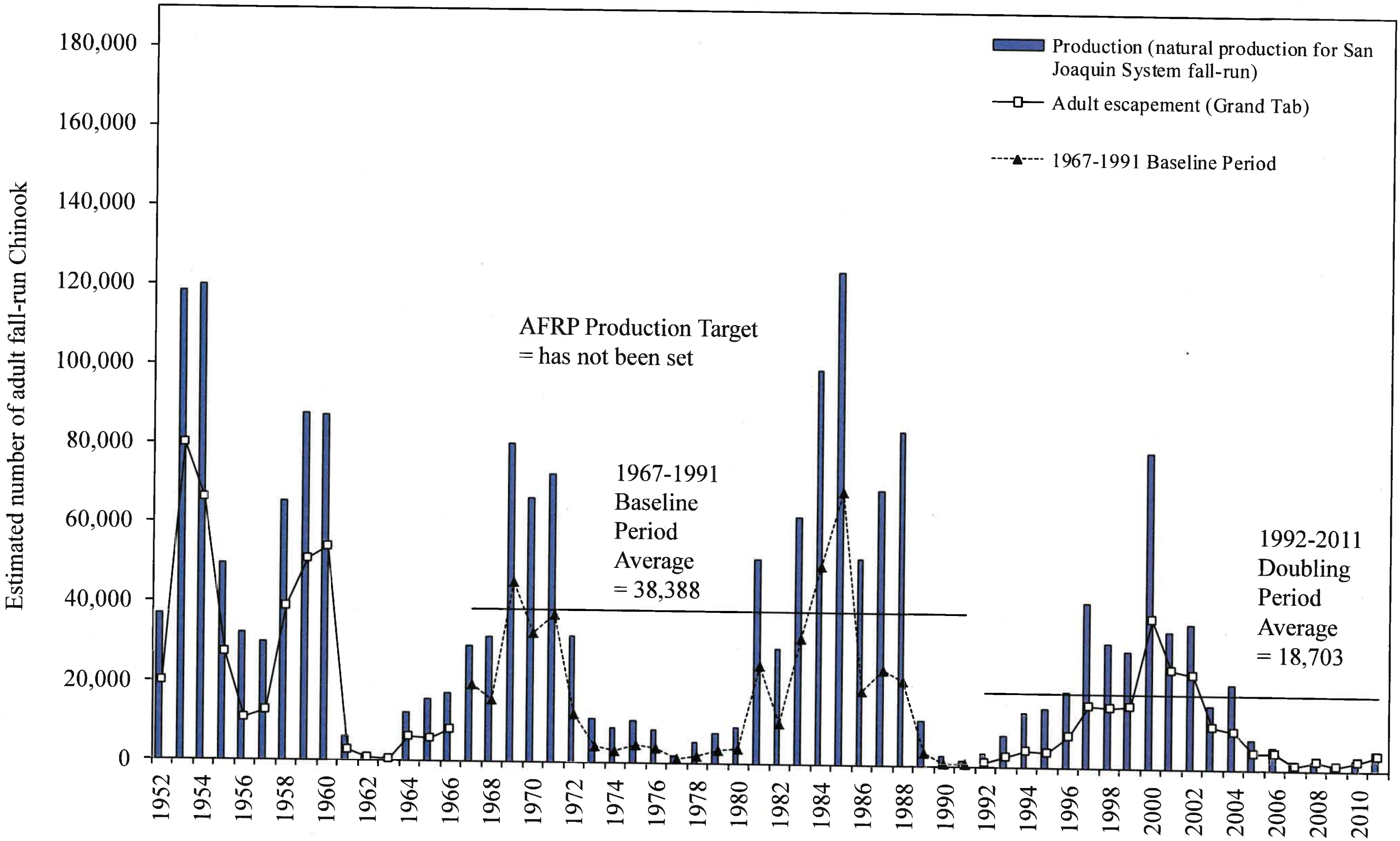
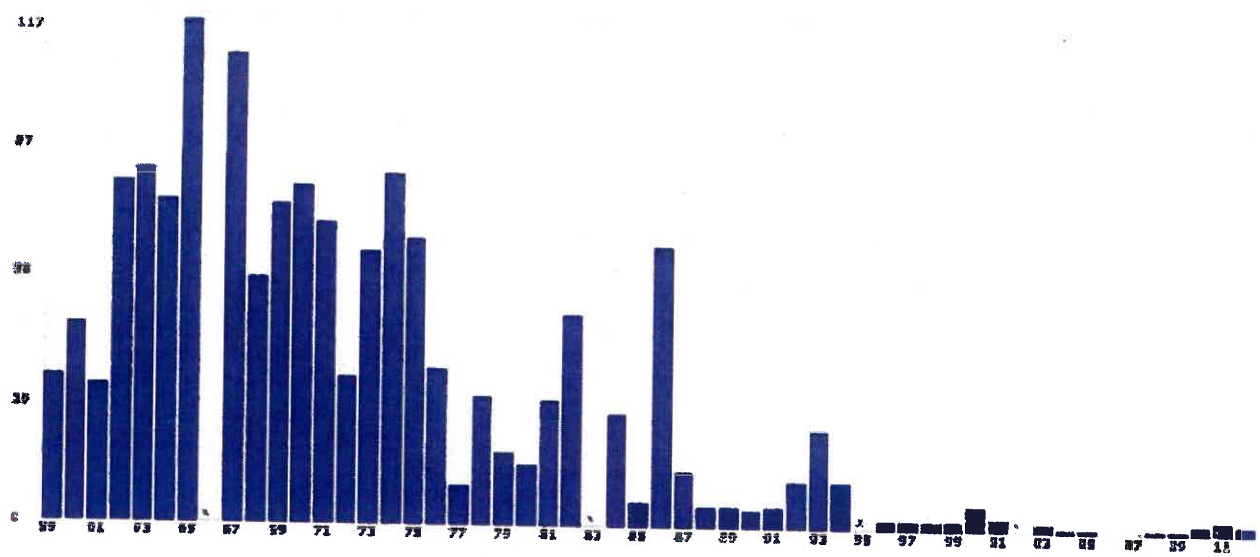


Figure 35. Estimated yearly natural production, and in river escapements of San Joaquin System adult fall-run Chinook salmon. The San Joaquin System is the sum of the Stanislaus, Tuolumne, and Merced Rivers. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

CALIFORNIA DEPARTMENT OF
FISH and WILDLIFE

Striped Bass Indices



Striped Bass Indices

YEAR	INDEXDATE	DELTA INDEX	SUISUN BAY INDEX	TOTAL INDEX
1959	12-Jul	30.7	3.0	33.7
1960	16-Jul	32.0	13.6	45.6
1961	21-Jul	25.2	6.4	31.6
1962	26-Jul	46.8	32.1	78.9
1963	3-Aug	38.2	43.5	81.7
1964	1-Aug	54.7	20.7	75.4

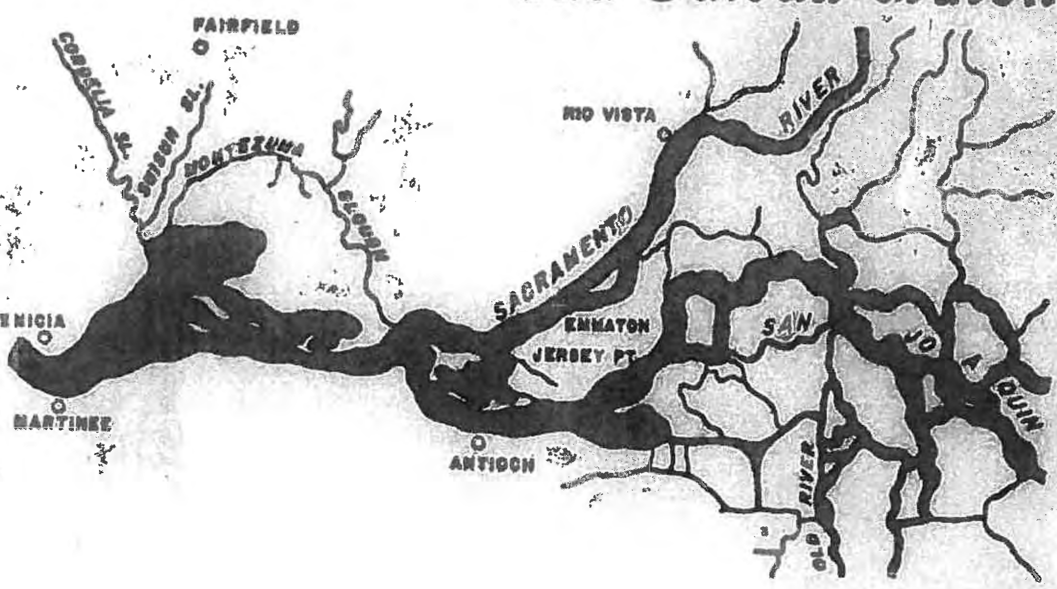
Exhibit "M"

Water Right Decision 1485

In the Matter of Permit 12720 (Application 5625) and Other Permits of United States Bureau of Reclamation for the Federal Central Valley Project and of California Department of Water Resources for the State Water Project.

DECISION IN FURTHERANCE OF JURISDICTION RESERVED IN DECISIONS D 893, D 990, D 1020, D 1250, D 1275, D 1291, D 1308, D 1356, and PERMIT ORDER 124

Sacramento-San Joaquin Delta and Suisun Marsh



August 1978

STATE WATER RESOURCES CONTROL BOARD

Exhibit "N"

executed. The criteria in the draft agreement were recommended by Fish and Game and endorsed by the Department, and were extensively analyzed by the Board staff. Based on our most current assessment, the fishery standards provide significantly higher protection than existing basin plans. The Striped Bass Index is a measure of young bass survival through their first summer. The Striped Bass Index would be 71 under without project conditions (i.e., theoretical conditions which would exist today in the Delta and Marsh in the absence of the CVP and SWP), 63 under the existing basin plans, and about 79[3/] under this decision.

D 1485
1978

While the standards in this decision approach without project levels of protection for striped bass, there are many other species, such as white catfish, shad and salmon, which would not be protected to this level. To provide full mitigation of project impacts on all fishery species now would require the virtual shutting down of the project export pumps. The level of protection provided under this decision is nonetheless a reasonable level of protection until final determinations are made concerning a cross-Delta transfer facility or other means to mitigate project impacts.

3/ There is some indication that factors other than those considered in the Board's analysis of without project levels may also affect striped bass survival. The effects of these factors are such that the without project levels would be greater than 71. However, the magnitude of this impact is unknown and cannot be quantified at this time.

NOT PROVIDED

Suisun Marsh. Full protection of Suisun Marsh now could be accomplished only by requiring up to 2 million acre-feet of freshwater outflow in dry and critical years in addition to that required to meet other standards. This requirement would result in a one-third reduction in combined firm exportable yield of State and federal projects. In theory, the existing Basin 5B Plan purports to provide full protection to the Marsh. However, during the 1976-77 drought when the basin plan was in effect, the Marsh received little if any protection because the system almost ran out of water and emergency regulations had to be imposed. This decision balances the limitations of available water supplies against the mitigation responsibility of the projects. This balance is based on the constitutional mandate "...that the water resources of the State be put to beneficial use to the fullest extent of which they are capable..." and that unreasonable use and unreasonable diversion be prevented (Article 10, Section 2, California Constitution).

The Bureau, the Department, Fish and Game, and U. S. Fish and Wildlife Service are working together to develop alternative water supplies for the Marsh. Such alternative supplies appear to represent a feasible and reasonable method for protection of the Marsh and mitigation of the adverse impacts of the projects. Under this decision the Department and Bureau are required, in cooperation with other agencies, to develop a plan for Suisun Marsh by July 1, 1979. The Suisun Marsh plan should ensure that the

Jeff Opperman
Final Report for Fellowship R/SF-4

My CALFED fellowship (R/SF-4) had three primary research areas: (1) how native fish use California floodplains; (2) developing a method to identify and quantify a particular type of floodplain in the Sacramento Valley; and (3) a white paper for CALFED that reviews, summarizes, and synthesizes research on floodplains generally, and Central Valley floodplains specifically.

1. Native fish and floodplains.
For this research I collaborated with Carson Jeffres, a graduate student at UC Davis (this research was his Master's thesis). We compared the growth rates of juvenile Chinook salmon between various floodplain and riverine habitats. This study built on previous work; (1) in the Yolo Bypass that found that juvenile Chinook grew faster in the flooded Bypass than in the nearby Sacramento River and; (2) in the Cosumnes Preserve which showed that native, wild juvenile Chinook salmon appeared to use the Cosumnes floodplain for rearing when it was inundated.

Juvenile salmon were obtained from a hatchery on the Mokelumne River and placed in enclosures within the Cosumnes River and floodplain (ten fish per enclosure). For two flood seasons (2004 and 2005), six enclosures were placed in each of three different habitat types in the floodplain and two locations in the river (30 enclosures total). Floodplain habitats included an ephemeral pond, flooded terrestrial herbaceous vegetation, and a pond that was permanent during the first year of the study and ephemeral during the second. The river locations were the river channel above the floodplain and the river channel below the floodplain.

The fish were measured at one week intervals, although measurement frequency declined during large flood events that made access difficult. In 2004 fish were measured three times over 4.5 weeks and in 2005 they were measured four times over 8 weeks. After the final measurement the fish were sacrificed and a sub-set were saved for a gut-content analysis.

In general, fish had faster growth rates in floodplain habitats than in the river. During periods of low, clear water, fish growth rates in the river site above the floodplain were comparable to those in the floodplain. However, during higher flows, with more turbid water, growth in the river above the floodplain was significantly lower than on the floodplain. Fish in the river below the floodplain, which was representative of intertidal delta habitat, were consistently low.

The main channel of the Cosumnes River, like those of many Central Valley rivers, is incised and lacks complexity. There are few side channels, backwaters, or accessible floodplain habitats (other than the Cosumnes Preserve). Thus, juvenile fish will tend to be displaced downstream during high flow events. In the Cosumnes, juvenile fish will be flushed downstream to either the intertidal delta or the floodplain. Among these two

Exhibit "O"

habitats, the floodplain appears to provide significantly better habitat for rearing (Figure 1).

Figure 1. Juvenile Chinook on the right were reared within an enclosure within the Cosumnes River floodplain while those on the left were reared within an enclosure in the river below the floodplain (intertidal Delta habitat).

This study confirms that juvenile Chinook benefit from access to floodplain habitats. While river habitats comparable to those above the floodplain can support similar growth rates as the floodplain, this habitat is more variable. During high flows the river offers poor habitat and fish living in this type of habitat will tend to be displaced downstream. The floodplain can provide optimal growing conditions during such floods and likely offers superior habitat conditions to the downstream Delta.

The risk of fish stranding on the floodplain merits further research. However, initial research on the Cosumnes suggests that native fish tend to respond to cues that facilitate emigration from the floodplain during draining and that primarily non-native fish become stranded. This work further supports the concept that floodplain restoration can be an important strategy for restoring Central Valley salmon populations.

This research is summarized in:

Jeffres, C., J. Opperman, and P. B. Moyle. *Submitted.* Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. Submitted to Environmental Biology of Fishes.

This work has also been presented at the following conferences:

1. Floodplain Management Association 2005
2. Society for Ecological Restoration 2005
3. Riverine Hydroecology (Stirling, Scotland) 2006

2. Identifying and mapping the floodplain inundated by the Floodplain Activation Flood.

Working in collaboration with Phil Williams and Associates (PWA), we worked to define, identify, and quantify a particular type of floodplain: that which is inundated by a Floodplain Activation Flood (FAF). The FAF is a relatively frequent, long duration, spring-time flood that has particular value for native fish and food web productivity (see text on floodplain conceptual model below for further description of a Floodplain Activation Flood).

The FAF was defined as follows:

1. occurs in two out of three years (67% exceedance probability)
2. duration of at least one week
3. occurs between March 15 and May 15.

These criteria were applied to a series of paired gauges along the Sacramento River and within the Yolo Bypass. This process derived a flood stage elevation that corresponded to the FAF criteria. This flood stage was then used to develop a water surface that was applied to topography for the Sacramento River and surrounding floodplain (from US Army Corps of Engineers' Sacramento-San Joaquin Comprehensive Study), estimating the area of floodplain inundated during the FAF.

We found that there is very little floodplain area inundated by the FAF in the current Sacramento Valley. Nearly all floodplain that corresponds to the FAF is found within the Yolo Bypass.

This work is further described in:

Philip Williams & Associates, L., and J. J. Opperman. 2006. The frequently activated floodplain: quantifying a remnant landcape in the Sacramento Valley, San Francisco, CA.

Williams, P., J. Opperman, E. Andrews, S. Bozkurt, and P. Moyle. Quantifying activated floodplain on a lowland regulated river. *In preparation for* San Francisco Estuary and Watershed Science.

3. The Central Valley Floodplain White Paper

I am continuing to work on the floodplain white paper along with my co-author, Peter Moyle. A central part of the white paper is a conceptual model for Central Valley floodplains, briefly described below.

This work has been presented at the following conferences:

1. Floodplain Management Association, 2005
2. American Geophysical Union and the North American Benthological Society, 2005
3. Society for Ecological Restoration, 2005

4. State of the Estuary Conference, 2005
5. CALFED Science Conference, 2006
6. Riverine Hydroecology (Stirling, Scotland), 2006
7. State of Washington, the Ecological Value of High Flows, 2006

Brief overview of conceptual model:

Floodplains support high levels of biodiversity and are among the most productive ecosystems in the world. They provide a range of ecosystem services to human society, including storage and conveyance of flood flows, groundwater recharge, open space, recreational opportunities, and habitat for a diversity of species, many of them of economic importance. Among the world's ecosystem types, Costanza et al. (1997) ranked floodplains second only to estuaries in terms of the ecosystem services provided to society. In the Central Valley, the most important ecosystem services provided by floodplains include reduction of flood risk and habitat for numerous species, including commercially and recreationally valuable species (e.g., chinook salmon and waterfowl) and for endangered species. Recent research has demonstrated that floodplains provide necessary spawning habitat for the Sacramento splittail, an endemic minnow (Sommer et al. 1997) and that juvenile chinook salmon grow faster on floodplains than in main-stem river channels (Sommer et al. 2001b) (Figure 1). Productivity from floodplains can be exported to the Sacramento-San Joaquin Delta, where food limitation is likely one of the factors contributing to the decline of fish species (Jassby and Cloern 2000, Schemel et al. 2004). Further, in places such as the Yolo Bypass, ecologically valuable floodplains can be compatible with productive agriculture (Sommer et al. 2001a).

Recognizing these valuable services, state and federal agencies have expressed policy goals to restore floodplains in the Central Valley (CALFED Bay-Delta Program 2000). Further, flood management projects in the Central Valley now generally include a floodplain restoration component. To guide these restoration efforts, we convened a floodplain working group, composed of floodplain experts drawn from academia, agencies, NGOs, and the private sector, to define ecologically functional floodplains. This group described three primary components of ecologically functional floodplains:

- ***Connectivity*** between river and floodplain.
- ***Hydrological variability***
- ***Sufficient geographic scale*** for associated ecological benefits to be meaningful on a system- or population-scale.

We developed a conceptual model of floodplain processes based on the scientific literature, our collective experiences studying floodplains, and guidance from the floodplain working group (Figure 2). This conceptual model illustrates the linkages between physical and biological processes in floodplains and can be used to inform floodplain restoration projects.

Organization of the conceptual model.
A diverse range of flows influence floodplain geomorphic and ecological processes, ranging from flows below bankfull to large, rare, and highly erosive floods. Numerous aspects of these flows have geomorphic and ecological significance, including magnitude, frequency, duration, rates of change, and seasonality, as well as antecedent conditions on the floodplain. To simplify, our conceptual model focuses on three types of 'representative floods,' characterized by their frequency and magnitude, which are found in the blue boxes in the Hydrology portion of the model. These floods perform geomorphic work, described in the brown-outline boxes in the Geomorphology portion of the model. Hydrologic and geomorphic processes create the conditions for Ecosystem Responses and Processes to occur (green-outlined boxes). The Ecosystem Responses and Processes produce Ecological Benefits, the magnitudes of which are influenced by the geographic scale of floodplain. Two representative floods, the Floodplain Activation Flood and the Floodplain Reorganization Flood are illustrated in Figures 2 and 3 and described below.

Two representative floods
Floodplain Activation Flood. The floodplain activation flood (FAF) is a small-magnitude flood that occurs relatively frequently (e.g., almost every year) (Figure 3). The FAF can be further defined in terms of seasonality and duration—for example a flood that lasts at least one week and occurs in the Spring. The following article by Betty Andrews defines a FAF in terms of frequency, season, and duration and then describes a process to map the floodplain that corresponds to the FAF in the Sacramento Valley. A long duration flood produces characteristic ecological benefits such as habitat for native fish spawning and rearing (Figure 1) and food web productivity. The duration of the flood is important as these processes cannot occur during a short event. The seasonality of the flood also influences which ecological processes occur (see the temporal scale bar (Winter Late spring) in one of the ecological process boxes). The importance of duration and seasonality for a FAF is indicated by the question mark adjacent to the flood occurring in late January on the hydrograph in Figure 2 (a short, winter-time flood). Because floodplains can remain inundated for a period of time after the loss of direct connection with river flows, a series of short connections can also function as a floodplain activation flood.
Floodplain Reorganization Flood. The floodplain reorganization flood is a greater magnitude flood that occurs less frequently (Figure 3). This higher energy flood produces geomorphic work including extensive erosion and deposition on the floodplain which creates heterogeneous floodplain topography. In turn, these dynamic events and heterogeneous topography create a diverse ecosystem with vegetation patches of varying age, species composition and structure, and floodplain water bodies of varying successional stage and connectivity to the river. The ecosystem processes that occur during a Floodplain Activation Flood take place within the mosaic of habitat features created during Floodplain Reorganization Floods.

Conclusions
The model illustrates the importance of hydrological variability for an ecologically functional floodplain. For example, a floodplain that rarely is inundated by a Floodplain

Activation Flood will not produce the ecological benefits of food web productivity or spawning and rearing habitat for native fish. A floodplain that is not subject to Floodplain Reorganization Floods will not maintain the mosaic of habitats (e.g., vegetation and water bodies of varying successional stages) that help support floodplain biodiversity. Therefore, floodplain restoration projects should not only focus on reintroducing connectivity between rivers and floodplains. Floodplain managers should also ask the following questions about this connectivity: how often, for how long, in what season, and of what magnitude? The answers to these questions will strongly influence the range of ecological benefits that the restored floodplain can provide.

CALFED Bay-Delta Program. 2000. Ecosystem restoration program plan. Volume I: Ecological attributes of the San Francisco Bay-Delta watershed. Pages 532 pp. CALFED.

Costanza, R., R. dArge, R. deGroot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. Oneill, J. Paruelo, R. G. Raskin, P. Sutton, and M. vandenBelt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260.

Jassby, A. D., and J. E. Cloern. 2000. Organic matter sources and rehabilitation of the Sacramento - San Joaquin Delta (California, USA). *Aquatic Conservation: Marine and Freshwater Ecosystems* 10: 323-352.

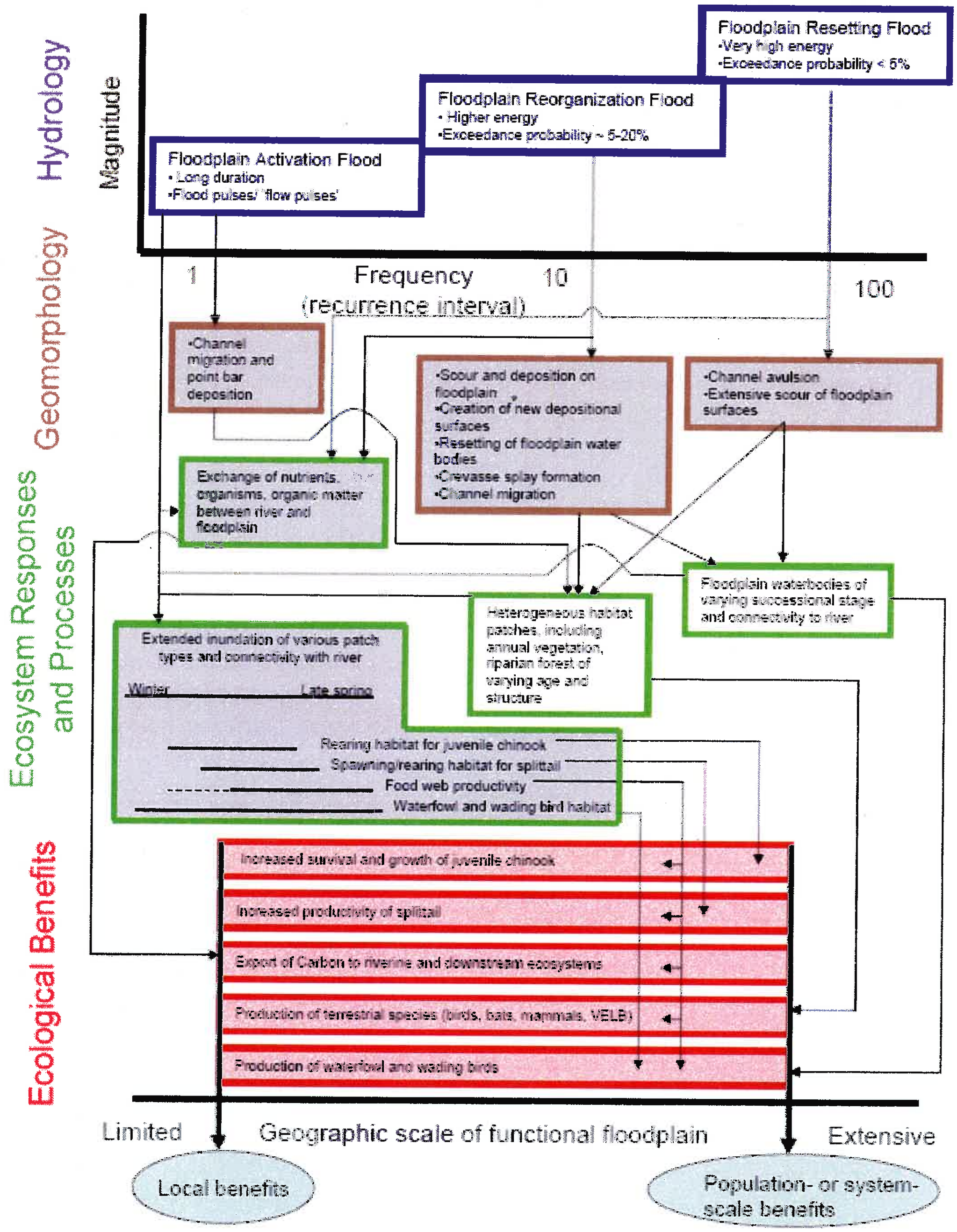
Schemel, L. E., T. R. Sommer, A. B. Muller-Solger, and W. C. Harrell. 2004. Hydrological variability, water chemistry, and phytoplankton biomass in a large floodplain of the Sacramento River, CA, USA. *Hydrobiologia* 513: 129-139.

Sommer, T., R. Baxter, and B. Herbold. 1997. Resilience of splittail in the Sacramento-San Joaquin estuary. *Trans. Am. Fish. Soc.* 126: 961-976.

Sommer, T., B. Harrell, M. Nobriga, R. Brown, P. Moyle, W. Kimmerer, and L. Schemel. 2001a. California's Yolo Bypass: evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. *Fisheries* 26: 6-16.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001b. Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 325-333.

Figure 2. Floodplain Conceptual Model



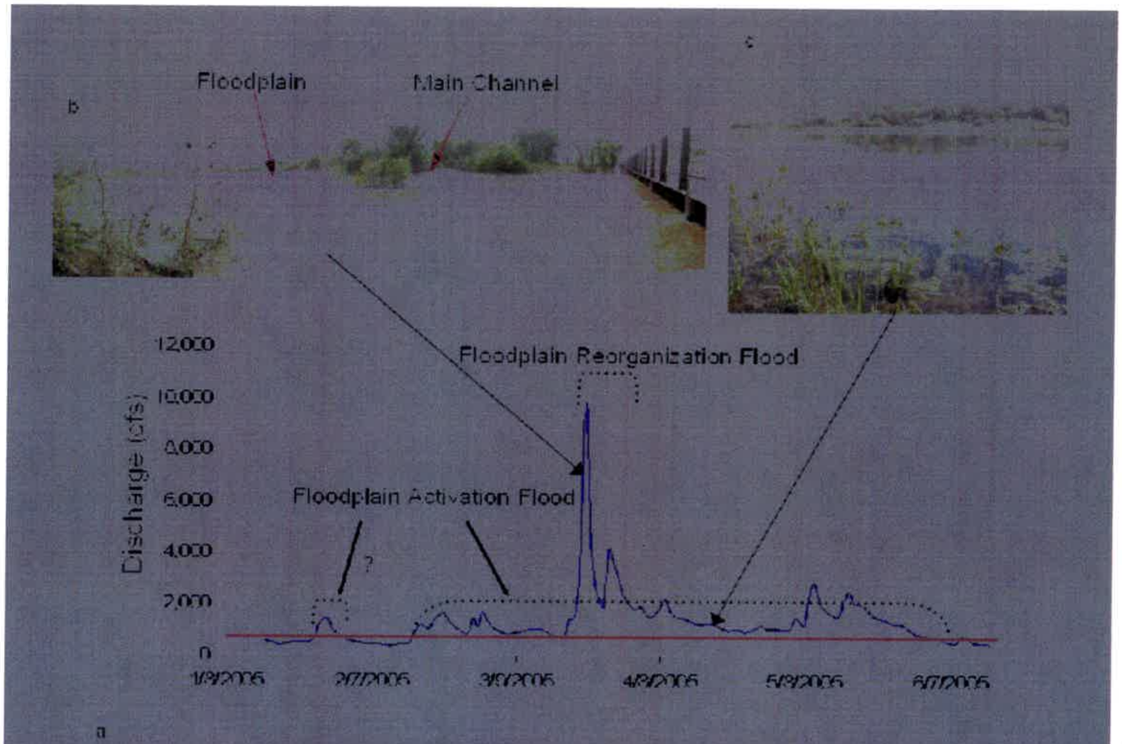


Figure 3. (a) Hydrograph from the Cosumnes River, winter and spring 2005. The red line indicates the approximate discharge at which the river and floodplain are connected. The importance of duration and seasonality for a floodplain activation flood (FAF) is indicated by the question mark adjacent to the flood occurring in late January (i.e., this short, winter-time flood may not provide the ecological benefits associated with a FAF); (b) A floodplain reorganization flood on the Cosumnes River floodplain, March 23, 2005; (c) A floodplain activation flood on the Cosumnes River floodplain, April 2005. Note the development of algal mats in the water and on the vegetation.

Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival

T.R. Sommer, M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer

Abstract: In this study, we provide evidence that the Yolo Bypass, the primary floodplain of the lower Sacramento River (California, U.S.A.), provides better rearing and migration habitat for juvenile chinook salmon (*Oncorhynchus tshawytscha*) than adjacent river channels. During 1998 and 1999, salmon increased in size substantially faster in the seasonally inundated agricultural floodplain than in the river, suggesting better growth rates. Similarly, coded-wire-tagged juveniles released in the floodplain were significantly larger at recapture and had higher apparent growth rates than those concurrently released in the river. Improved growth rates in the floodplain were in part a result of significantly higher prey consumption, reflecting greater availability of drift invertebrates. Bioenergetic modeling suggested that feeding success was greater in the floodplain than in the river, despite increased metabolic costs of rearing in the significantly warmer floodplain. Survival indices for coded-wire-tagged groups were somewhat higher for those released in the floodplain than for those released in the river, but the differences were not statistically significant. Growth, survival, feeding success, and prey availability were higher in 1998 than in 1999, a year in which flow was more moderate, indicating that hydrology affects the quality of floodplain rearing habitat. These findings support the predictions of the flood pulse concept and provide new insight into the importance of the floodplain for salmon.

Résumé : Notre étude démontre que le canal de dérivation Yolo, la principale plaine d'inondation de la région aval de la rivière Sacramento (Californie, É.-U.), offre de meilleurs habitats pour l'alevinage et la migration des jeunes Saumons Quinnat (*Onchorhynchus tshawytscha*) que les bras adjacents de la rivière. En 1998 et 1999, la taille des saumons a augmenté plus rapidement dans la plaine d'inondation agricole, sujette aux débordements saisonniers de crue, que dans la rivière, ce qui laisse croire à de meilleurs taux de croissance. De plus, des jeunes saumons marqués à l'aide de fils de métal codés et relâchés dans la plaine d'inondation étaient plus gros au moment de leur recapture et avaient des taux de croissance apparente plus élevés que des poissons relâchés dans la rivière en même temps. L'amélioration des taux de croissance dans la plaine de débordement résultait en partie d'une consommation significativement plus importante de proies, le reflet d'une plus grande disponibilité des invertébrés de la dérive. Un modèle bioénergétique laisse croire que le succès de l'alimentation a été meilleur dans la plaine d'inondation que dans la rivière, en dépit du coût métabolique d'alevinage significativement plus grand dans les eaux plus chaudes de la plaine d'inondation. Les indices de survie des poissons marqués et relâchés dans la plaine d'inondation étaient quelque peu plus élevés que ceux des poissons de la rivière, mais les différences n'étaient pas statistiquement significatives. La croissance, la survie, le succès de l'alimentation et la disponibilité des proies étaient tous supérieurs en 1998 par comparaison avec 1999, une année à débit plus modéré, ce qui indique que l'hydrologie affecte la qualité des habitats d'alevinage dans la plaine d'inondation. Nos résultats appuient les prédictions du concept de pulsion de crue (flood pulse concept) et mettent en lumière l'importance de la plaine d'inondation pour le saumon.

[Traduit par la Rédaction]

Introduction

Although the trophic structure of large rivers is frequently dominated by upstream processes (Vannote et al. 1980), there is increasing recognition that floodplains plays a major role in the productivity and diversity of riverine communities (Bayley 1995). Based largely on observations from relatively undisturbed river–floodplain systems, Junk et al. (1989) proposed the flood pulse concept, which predicts that annual inundation is the principal force determining productivity and biotic interactions in river–floodplain systems. Floodplains can provide higher biotic diversity (Junk et al. 1989) and increased production of fish (Bayley 1991; Halyk and Balon 1983) and invertebrates (Gladden and Smock 1990). Potential mechanisms for floodplain effects include increased habitat diversity and area (Junk et al. 1989), large inputs of

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T.R. Sommer.[1,2] California Department of Water Resources, Sacramento, CA 95816, U.S.A., and Department of Wildlife Fisheries and Conservation Biology, University of California at Davis, CA 95616, U.S.A.
M.L. Nobriga, W.C. Harrell, and W. Batham. California Department of Water Resources, Sacramento, CA 95816, U.S.A.
W.J. Kimmerer. Romberg Tiburon Center, San Francisco State University, Tiburon, CA 94920, U.S.A.

[1]Corresponding author (e-mail: tsommer@water.ca.gov).
[2]Present address: California Department of Water Resources, Sacramento, CA 95816, U.S.A.

Exhibit "P"

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terrestrial material into the aquatic food web (Winemiller and Jepsen 1998), and decreased predation or competition due to intermediate levels of disturbance (Corti et al. 1997). Nonetheless, the degree to which floodplains support riverine ecosystems remains poorly understood, particularly in regulated and temperate rivers. Uncertainties about river–floodplain relationships are due, in large part, to the difficulty in separating the relative contribution of floodplain versus channel processes and sampling problems in seasonal habitats, which are frequently subject to extreme environmental variation.

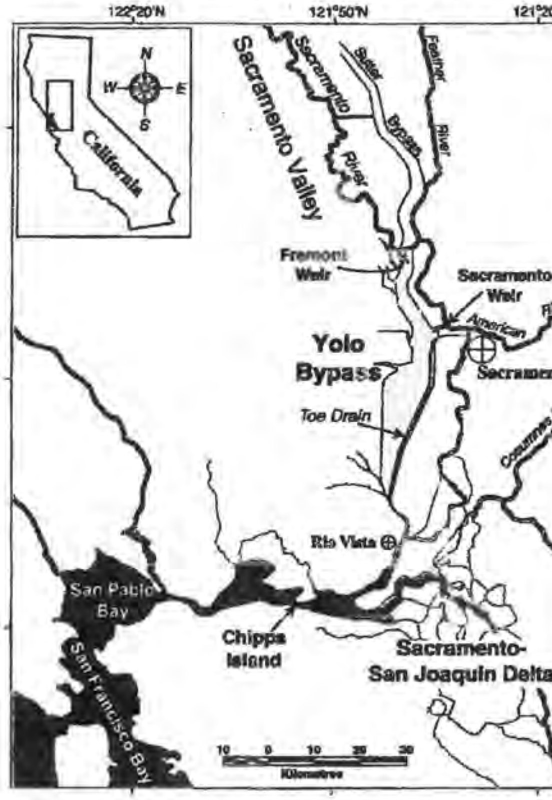
In the this study, we examined the relative importance of floodplain and riverine habitat to juvenile chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River (California, U.S.A.), a large regulated river (Fig. 1). The system is particularly well suited to a comparative study, because young salmon migrating down the lower Sacramento River to the San Francisco Estuary in wet years have two alternative paths: they may continue down the heavily channelized main river or they may pass through the Yolo Bypass, an agricultural floodplain bordered by levees. We had two reasons to believe that the floodplain might be important habitat for young salmon. First, years of high flow are known to enhance populations of a variety of species in the San Francisco Estuary (Jassby et al. 1995) and the survival of chinook salmon (Kjelson et al. 1982). However, the specific mechanisms for these benefits have not been established. Possible reasons for the positive effects of flow on fish include increased habitat availability, migration cues, food supply, larval transport, and reduced predation rates (Bennett and Moyle 1996). Floodplain inundation is one of the unique characteristics of wet years, during which the Yolo Bypass is likely to be a significant migration corridor for young chinook salmon in the Sacramento Valley. During high-flow events, the Yolo Bypass can convey >75% of the total flow from the Sacramento River basin, the major producer of salmon among tributaries of the San Francisco Estuary. Second, floodplains are known to be among the most important fish-rearing areas in a variety of river systems, yet in developed regions, the availability of this habitat has been greatly reduced by channelization and levee and dam construction (Rasmussen 1996). A high degree of habitat loss may greatly enhance the biological significance of remnant floodplains in heavily modified systems, such as the San Francisco Estuary and its tributaries.

This study tests the hypothesis that the agricultural floodplain provides better habitat quality than the adjacent river channel. For the purpose of this analysis, we focus on salmon growth, feeding success, and survival as indicators of habitat quality. Obviously, there are many other possible measures of habitat quality, such as reproductive output of adults or physiological indicators. However, we believe that the chosen suite of parameters is reasonably representative of habitat quality. For example, Gutreuter et al. (2000) successfully used growth as a factor to test the hypothesis that floodplain inundation had a major effect on fish production.

The San Francisco Estuary is one of the largest estuaries on the Pacific Coast (Fig. 1). The system includes downstream bays (San Pablo and San Francisco) and a delta, a broad network of tidally influenced channels that receive inflow from the Sacramento and San Joaquin rivers. The estuary and its tributaries have been heavily altered by levees, dams, land reclamation activities, and water diversions. The primary floodplain of the Sacramento River portion of the delta is the Yolo Bypass, a 24 000-ha leveed basin that conveys excess flow from the Sacramento Valley, including the Sacramento River, Feather River, American River, Sutter Bypass, and westside streams. The 61 km long floodplain floods seasonally in winter and spring in about 60% of years, and is designed to convey up to 14 000 $m^3 \cdot s^{-1}$. During a typical flooding event, water spills into the Yolo Bypass via the Fremont Weir when Sacramento Basin flows surpass approximately 2000 $m^3 \cdot s^{-1}$. Except during extremely high flow events, the mean depth of the floodplain is generally less than 2 m, creating broad shoal areas. During dry seasons, the Toe Drain channel, a permanent riparian corridor, remains inundated as a result of tidal action. At higher levels of Sacramento Basin flow (e.g., >5000 $m^3 \cdot s^{-1}$), the Sacramento Weir is also frequently operated. Agricultural fields are the dominant habitat type in Yolo Bypass, but approximately one-third of the floodplain area is natural vegetation, including riparian habitat, upland habitat, emergent marsh, and permanent ponds.

There are four races of chinook salmon in the Sacramento Valley: winter, spring, late fall, and fall run (Yoshiyama et al. 2000). Historical data indicate that all races have de-

Fig. 1. The location of Yolo Bypass in relation to the San Francisco Estuary and its tributaries. The San Francisco Estuary encompasses the region from San Francisco Bay upstream to Sacramento. Feather River Fish Hatchery is located on the Feather River approximately 112 km upstream of Yolo Bypass.



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creased in abundance since the 1950s, but the spring, winter, and late-fall runs have shown the most pronounced declines. There are multiple causes for these long-term reductions, including habitat loss, habitat degradation, water diversions, and oceanic conditions. In the present study, we focused on the fall run, the numerically dominant race in the Sacramento Valley. The typical life-history pattern for these salmon is for young to migrate from the tributaries to the bay–delta area at the "fry" stage (Brandes and McLain 2001), when most individuals are approximately 35- to 70-mm fork length (FL). In low flow years, there may be substantial upstream rearing in the Sacramento River. Peak juvenile emigration from the tributaries occurs during winter and spring (Kjelson et al. 1982).

Materials and methods

Physical conditions

During 1998–1999, flow measurements in Yolo Bypass and the adjacent stretch of the Sacramento River were obtained from gauges operated by the U.S. Geological Survey (USGS). Daily water temperatures for each site were calculated as the mean of maximum and minimum daily measurements for single stations in the Sacramento River (USGS) and a temperature recorder (Onset Corp.) installed in the Yolo Bypass Toe Drain channel (Fig. 1). However, from 1 February to 26 March 1998, these data were not available for Yolo Bypass. During this period, before the recorder was installed, discrete measurements were taken at the same location, typically during mid or late morning.

Fish sampling

Salmon FL (mm) was measured during January–April in 1998 and 1999 on samples collected with 15-m beach seines (4.75-mm mesh). Samples were collected weekly at five core locations located around the perimeter of the Yolo Bypass, during periods when the basin was flooded. After the bypass drained, additional samples were collected at random locations around the perimeter of ponds near the core locations. Comparative data on salmon size in the adjacent reach of the Sacramento River were collected by the U.S. Fish and Wildlife Service (USFWS) at five beach-seine sites, using techniques similar to those used when the the bypass was flooded.

FLs of salmon obtained from beach-seine sampling were compared to determine whether there was evidence of major differences in salmon size between the Yolo Bypass and the Sacramento River. However, these data were not considered unambiguous evidence of growth differences, because the two systems were open to immigration and emigration during much of the study, and migrating salmon include multiple races of salmon that cannot be readily separated. We addressed this issue by using paired releases of coded-wire-tagged (CWT) juvenile salmon in Yolo Bypass and the Sacramento River. This approach allowed comparisons of growth among fish of similar origin and provided a relative estimate of migration time and survival. The salmon were produced and tagged at the Feather River Fish Hatchery and released on 2 March 1998 and 11 February 1999. The release sites were in Yolo Bypass below Fremont Weir (52 000 in 1998; 105 000 in 1999) and in the adjacent reach of the Sacramento River (53 000 in 1998; 105 000 in 1999). The fish had a mean FL of 57.5 ± 0.5 mm (SE) in 1998 and of 56.8 ± 0.4 mm (SE) in 1999. A small portion of each group was subsequently collected by trawling at the seaward margin of the delta at Chipps Island, which is located downstream of the confluence of the Yolo Bypass and the Sacramento River (Fig. 1). The USFWS Chipps Island survey samples a single channel location with a midwater trawl towed at the surface (Baker et al. 1995; Brandes and McLain 2001). Ten 20-min tows were made each day, except during March in 1998 and 1999, when sampling was conducted every other day. Data on migration time (days) and FL (mm) were recorded for fish recaptured from each release group. Apparent growth rate was also calculated for each fish, as: (FL of individual at Chipps Island – mean FL of CWT release group) × (migration time)$^{-1}$. Survival indices of the paired CWT releases were calculated by USFWS by dividing the number of fish recovered for each release group at Chipps Island by the number released, corrected for the fraction of time and channel width sampled (Brandes and McLain 2001).

Diet

We performed diet comparisons on fall-run juvenile salmon (33–81 mm) collected in beach-seine samples during February–March of 1998 and 1999 from the Yolo Bypass (103 individuals) and the Sacramento River (109 individuals). Fish samples were tagged and stored individually in a deep freeze. After thawing, stomachs were removed from the fish and the contents were identified (using a dissecting microscope) to order (insects and arachnids), genus (crustaceans), or phylum (rarely eaten taxa such as oligochaetes). To develop average invertebrate length estimates, up to 10 individuals of each prey type encountered were measured. Prey dry weight estimates were calculated from average lengths, using regression equations for delta crustaceans obtained from J. Orsi (California Department of Fish and Game, Stockton, CA 95205, unpublished data) and from literature sources. Diet results were compared as an index of relative importance (IRI) (Shreffler et al. 1992) for each month. The index was calculated as: IRI = (% numeric composition + % weight composition) × % frequency of occurrence.

Prey availability

Invertebrates were sampled in February–March of 1998 and 1999, to examine prey availability in the Yolo Bypass and the Sacramento River. Sampling was not designed as a comprehensive evaluation of spatial and temporal variation of prey. Rather, it was intended to provide information on whether variation in salmon diets between the two locations was consistent with gross differences in prey type or relative abundance. We focused on Diptera (adults, pupae, and larvae) and crustacean zooplankton, which comprised over 90% of the diets of Yolo Bypass and Sacramento River juvenile salmon. Weekly drift samples were collected at fixed stations on the Yolo Bypass and the Sacramento River during periods when the floodplain was inundated. The sampling points were located away from overhanging vegetation and bank eddies, in water velocities of approximately 15–60 cm·s^{-1}, depending on flow. Net (500-μm mesh) dimensions were 0.46 × 0.3 m mouth and 0.91 m length. The nets were fished for approximately 30 min during mid-morning, to coincide with the time period when most fish-stomach samples were taken. Sample volume was calculated using a flowmeter (General Oceanics Model 2030R) and net dimensions. Drift samples were stored in ethanol or formaldehyde, then identified to family or order using a dissecting microscope. In 1998, zooplankton were collected in the Yolo Bypass at two fixed stations with battery-operated rotary-vane pumps with a mean flow rate of 17 L·min^{-1}. Samples were taken via pipes with outlets at multiple locations beneath the water surface. Discharge was directed into a 150 μm mesh net held in a basin on the bank. Flow rate was recorded at the beginning and end of the sample period, which varied from 1 to 6 h. No samples were taken in the Sacramento River during a comparable period in 1998. In 1999, zooplankton samples were taken with a Clarke–Bumpus net (160-μm mesh, diameter 0.13 m, length 0.76 m) placed in surface flow in the Yolo Bypass and Sacramento River. Sample volume was recorded as for the drift net. Zooplankton samples were concentrated and stored in 5%

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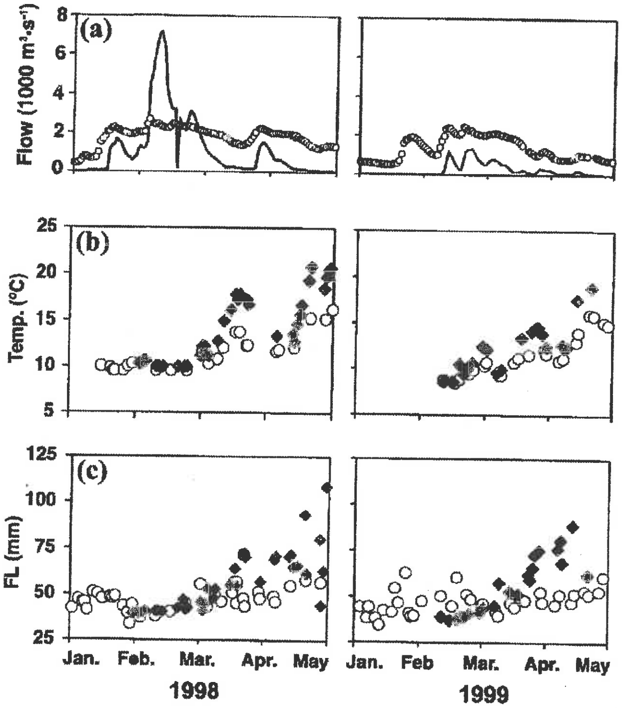
Fig. 2. Chinook salmon size versus physical conditions in Yolo Bypass and the Sacramento River during winter and spring in 1998 and 1999. (*a*) Mean daily flow ($m^3 \cdot s^{-1}$) in Yolo Bypass (solid line) and the Sacramento River (circles). (*b*) Mean water temperature (°C) in Yolo Bypass (solid symbols) and the Sacramento River (open symbols). (*c*) Mean daily chinook salmon FL for Yolo Bypass (solid symbols) and Sacramento River (open symbols) beach-seine stations. For presentation purposes, only the daily mean FLs are shown; however, individual observations for February–March were used for statistical analyses.



formaldehyde, for later identification to genus using a dissecting microscope.

Bioenergetics

Feeding success was examined in two ways: (1) prey biomass estimated from stomach contents and (2) prey biomass estimated as a function of maximum theoretical consumption. For the first measure, we used the previously described stomach-content data to calculate total-prey biomass for individual fish.

A limitation of using prey biomass as a measure of feeding success between locations is that thermal history affects how consumption alters growth rate (Hewett and Kraft 1993). As will be discussed in further detail, water temperatures were significantly higher in the Yolo Bypass floodplain than in the Sacramento River. To correct for this problem, our second approach used bioenergetic modeling to incorporate the metabolic effects of water temperature. We used methods similar to those of Rand and Stewart (1998) to calculate a wet weight ration index, which uses prey biomass for each sampled individual as a proportion of the theoretical maximum daily consumption. The stomach-content data were used as our estimate of prey biomass for individual fish. The theoretical maximum daily consumption rate (C_{max}) was modeled using Fish Bioenergetics 3.0 (Hanson et al. 1997), using observed body size and water temperature at the time each beach-seine sample was collected. The model input also required fish mass, which we estimated from FL data, using length–weight relationships from Sacramento River juvenile salmon (Petrusso 1998). The caloric value of the prey was taken from weight conversion factors provided by Hanson et al. (1997). Model parameters were derived from those of Stewart and Ibarra (1991) for chinook salmon. The model was run for individual fish collected at each sampling location in 1998 and 1999.

Table 1. Robust regression statistics for Yolo Bypass and Sacramento River salmon FLs for 1998 and 1999.

	1998		1999	
	Parameter ± SEM	*t*	Parameter ± SEM	*t*
Intercept	29.4±0.6	46.8	23.5±0.5	43.7
Location	6.4±0.6	10.2	11.1±0.5	20.6
Day	0.3±0.01	34.5	0.3±0.01	48.5
Location:day	−0.14±0.01	−18.4	−0.21±0.01	−33.6

Note: The *t* values are all highly significant ($p < 0.0001$).

We emphasize that the second approach provides an *index*, rather than an *absolute* measure of feeding success. The wet weight ration index is conceptually analogous to "*P*" in Hanson et al. (1997), a model parameter that indicates what fraction of C_{max} is obtained over the course of the day. The major difference is that *P* is based on prey consumption over a 24-hour period, whereas our wet weight ration index is based on instantaneous measurements of stomach contents, which may not represent mean trends over the entire day. An additional limitation is that the Stewart and Ibarra (1991) model parameters were developed for adult salmon and we applied the model to juveniles. We did not have sufficient field or laboratory data to develop bioenergetic-model parameters specific to the earliest life stages. Nonetheless, other studies (Rand and Stewart 1998) have demonstrated that similar wet weight ration indices can provide an effective technique for comparing relative salmonid feeding success between seasons and years.

Statistical analysis

Overlapping temperature measurements from continuous recorders and the discrete measurements during 26 March – May 1998 were analyzed with Wilcoxon's matched-pairs test, to determine whether the two methods yielded different results. Mean water temperature for Yolo Bypass and the Sacramento River during the primary period of floodplain inundation (February–March) was analyzed with a generalized linear model with a variance function that increased with the mean squared, since variances were not homogeneous (Venables and Ripley 1997). Salmon FL measurements for Yolo Bypass and the Sacramento River during February–March of 1998 and 1999 were compared with a robust iteratively reweighted least squares regression procedure ("rlm"; Venables and Ripley 1997), because we detected substantial numbers of outliers in preliminary graphical evaluations of the data. Initial analyses revealed a substantial difference in the effects of location between years, so years were analyzed separately. Results from the CWT and bioenergetic studies were analyzed using a factorial-design analysis of variance, to evaluate the effects of location (Yolo Bypass, Sacramento River) and year (1998, 1999). Residuals from each model were examined graphically, to confirm that they met the assumption of normality and homogeneity of variance. Cochran and Levene's tests were also used, to test the assumption of homogeneity of variance. Logarithmic transformation was performed where necessary.

Results

Physical conditions

Yolo Bypass was inundated in 1998 and 1999 but the hydrology was substantially different in the two years (Fig. 2).

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Table 2. Results of salmon collections at Chipps Island for 1998 and 1999 coded-wire-tagged groups released concurrently in Yolo Bypass and the Sacramento River.

	1998		1999	
	Yolo Bypass	Sacramento River	Yolo Bypass	Sacramento River
Fork length (mm)	93.7±2.0	85.7±1.4	89.0±2.6	82.1±1.7
Migration time (days)	46.2±2.3	55.4±3.5	58.2±2.8	58.6±4.1
Apparent growth rate (mm·day^{-1})	0.80±0.06	0.52±0.02	0.55±0.06	0.43±0.03
Survival index	0.16	0.09	0.09	0.07
Sample size	9	10	9	8

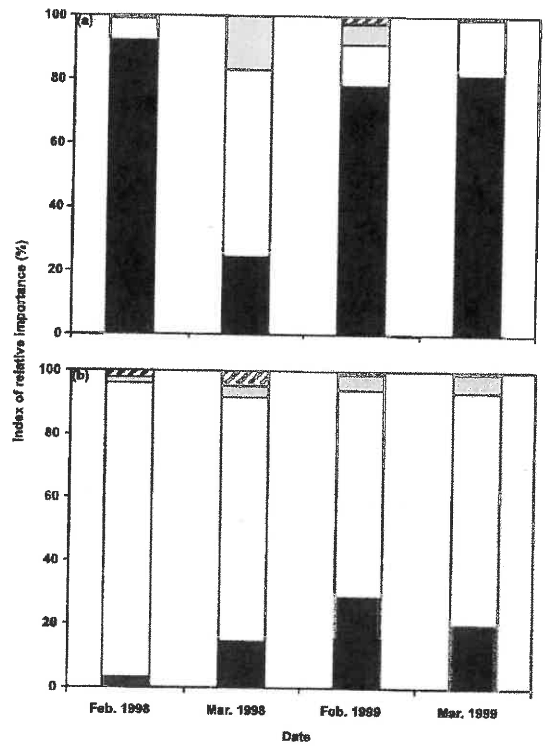
Note: Values for FL, migration time, and apparent growth rate are mean ± standard error (SEM).

The first year was extremely wet, with multiple flow pulses and a peak flow of 7200 $m^3 \cdot s^{-1}$. In 1999, floodplain hydrology was more moderate, with a peak of 1300 $m^3 \cdot s^{-1}$. Flows in the Sacramento River were much less variable than in the floodplain and generally remained at or below 2000 $m^3 \cdot s^{-1}$, a level within the design capacity (3100 $m^3 \cdot s^{-1}$) of the channel. Overlapping sampling between the continuous-temperature recorders and the discrete measurements during March–May 1998 showed a mean difference of 0.9°C between the two approaches, but this disparity was not statistically significant (Wilcoxon's matched-pairs test, $p > 0.25$). In 1998 and 1999, temperatures increased fairly steadily throughout the study period; however, in both years, temperature levels in Yolo Bypass were up to 5°C higher than those in the adjacent Sacramento River during the primary period of inundation, February–March. Temperature in the Yolo Bypass was described in 1998 by $T_y = -7.7 \pm 2.1 + (1.9 \pm 0.2)T_s$ and in 1999 by $T_y = -3.5 \pm 1.2 + (1.5 \pm 0.1)T_s$, where T_y is the temperature of the Yolo Bypass, T_s is the temperature of the Sacramento River, and the range for each value is the 95% confidence limit.

Fish growth, migration time, apparent growth rate, and survival

Salmon increased in size substantially faster in the Yolo Bypass than in the Sacramento River during each of the study years (Fig. 2). Robust regression results showed that the effect of location was highly significant ($p < 0.00001$) in each year (Table 1). This result is consistent with the CWT data (Table 2), which showed that the 1998 and 1999 Yolo Bypass CWT release groups had significantly larger mean length ($F = 14.34$, $p = 0.0006$) and higher apparent growth rates ($F = 20.67$, $p = 0.0007$) than the Sacramento River release groups. There was also a statistically significant effect of year: both release groups had larger mean sizes ($F = 4.42$, $p = 0.04$) and higher apparent growth rates ($F = 16.47$, $p = 0.0002$) in 1998 than in 1999. The 1998 Yolo Bypass CWT group showed the fastest migration time, arriving an average of at least 9 days ahead of any other release group. However, there was no statistically significant ($F = 2.22$, $p = 0.15$) effect of release location on migration time in the analysis of variance (ANOVA). As for fish size and apparent growth rate, mean migration time was slower in 1999 than in 1998 ($F = 5.60$, $p = 0.02$). There was no statistically significant interaction between location and year for salmon size ($F = 0.07$, $p = 0.78$), apparent growth rate ($F = 1.62$, $p = 0.21$), or migration time ($F = 1.8$, $p = 0.18$). The survival indices were somewhat higher for CWT groups released in the Yolo Bypass than for those released in the Sacramento River for both 1998 and 1999. However, the lowest coefficient of variation based on a Poisson distribution of the CWT recaptures is 32%, and the actual (unknown) distribution of counts is likely to have higher variance than a Poisson distribution. Clearly the confidence limits of the paired survival indices would overlap, so the differences are not statistically significant.

Fig. 3. Chinook salmon diet during February and March of 1998 and 1999 in Yolo Bypass (*a*) and the Sacramento River (*b*). The index of relative importance (*y*-axis) is defined in the text. Diptera (solid bars), zooplankton (open bars), other aquatic prey (shaded bars), and other terrestrial prey (striped bars) are shown for each month.



Diet

The diet of young salmon in the Yolo Bypass was dominated by dipterans, principally chironomid pupae and adults (Fig. 3). The second most common prey item was zooplank-

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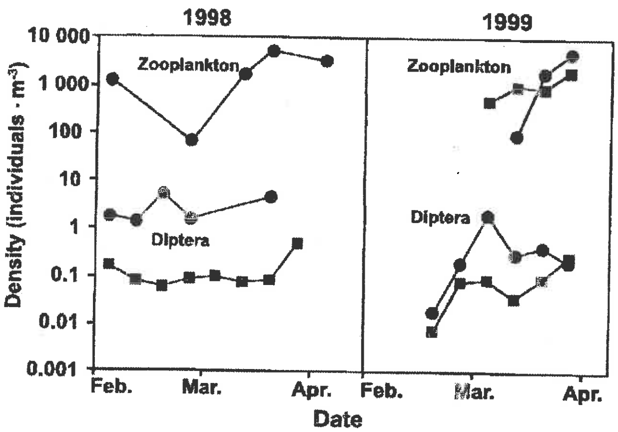
Fig. 4. Log_{10}-scaled weekly abundance (individuals·m^{-3}) of zooplankton and Diptera in Yolo Bypass (circles) and the Sacramento River (squares) during 1998 and 1999. Note that 1998 zooplankton data were not available for the Sacramento River.



ton, mostly cladocerans and copepods. Except for March 1998, zooplankton comprised less than 15% of the Yolo Bypass diets. Other aquatic (mainly amphipods and collembola) and terrestrial (mainly ants and arachnids) prey were relatively minor diet items. As for the floodplain samples, dipterans and zooplankton comprised over 90% of the diets of Sacramento River salmon; however, zooplankton were the dominant prey item in all months. Other aquatic (mostly amphipods, oligochaetes, and collembola) and terrestrial (mostly ants and other terrestrial insects) prey were consumed infrequently.

Prey availability

The drift samples contained many of the same taxa observed in the salmon diets, with Diptera (principally chironomids) as the major type at both sampling locations. However, the density of Diptera was much higher in the Yolo Bypass than in the Sacramento River (Fig. 4), particularly in 1998, when densities were consistently an order of magnitude higher. In general, dipteran drift densities were higher at each location in 1998 than in 1999. There was little difference in zooplankton density in the Yolo Bypass between 1998 and 1999 or between Yolo Bypass and the Sacramento River in 1999.

Bioenergetics

Young salmon from the Yolo Bypass had higher total-prey weights (F = 39.2, df = 1, p < 0.0001) than those from the Sacramento River (Fig. 5). The bioenergetic-modeling results showed that Yolo Bypass salmon also had higher wet weight ration indices than those from the Sacramento River (F = 19.3, df = 1, p < 0.0001). The interaction between location and year was significant for both the wet weight ration indices (F = 10.0, df = 1, p = 0.02) and the prey weights (F = 4.7, df = 1, p = 0.03).

Discussion

Chinook salmon that rear in the Yolo Bypass floodplain have higher apparent growth rates than those that remain in the adjacent Sacramento River channels. Mean length increased faster in the Yolo Bypass during each study year, and CWT fish released in the Yolo Bypass were larger and had higher apparent growth rates than those released in the Sacramento River. It is possible that these observations are due to higher mortality rates of smaller individuals in the Yolo Bypass or of larger individuals in the Sacramento River; however we have no data or reasonable mechanism to support this argument.

Apparent growth differences between the two areas are consistent with water temperature and stomach-content results. We found that the Yolo Bypass floodplain had significantly higher water temperatures and that young salmon from the floodplain ate significantly more prey than those from the Sacramento River. The wet weight ration indices calculated from bioenergetic modeling suggest that the increased prey availability in Yolo Bypass was sufficient to offset increased metabolic requirements from higher water temperatures. Higher water temperatures in the Yolo Bypass are expected as a result of the shallow depths on the broad floodplain. Increased feeding success in the Yolo Bypass is consistent with trends in prey availability. While Yolo Bypass and the Sacramento River had similar levels of zooplankton, Yolo Bypass had more dipteran prey in the drift, particularly in 1998. Studies of juvenile chinook salmon diets by Rondorf et al. (1990) showed that zooplankton were the least-favored prey items. Therefore, the dominance of zooplankton in the diets of Sacramento River salmon probably reflects a relatively low availability of other more energetically valuable prey items.

Recoveries of paired releases were too few to determine whether the higher survival indices for the Yolo Bypass release groups represent actual survival differences or random variation. Additional validation is needed from new release studies and from CWT recoveries in the adult ocean fishery and escapement. Nonetheless, the hypothesis that floodplain rearing could improve survival is substantiated by the growth data and bioenergetic modeling. Faster growth rates reflect improved habitat conditions, which would be expected to lead to improved survival, both during migration and later in the ocean. Elevated Yolo Bypass survival rates are also consistent with significantly faster migration rates in 1998, the likely result of which would be reduced exposure time to mortality risks in the delta, including predation and water diversions.

Improved survival is consistent with other habitat differences between the Yolo Bypass floodplain and the Sacramento River channel. We estimate that complete inundation of the Yolo Bypass creates a wetted area approximately 10 times larger than the reach of the Sacramento River we studied. This level of inundation is equivalent to a doubling of the wetted area of the entire delta portion of the San Francisco Estuary. Much of the floodplain habitat consists of broad shoals composed of soil and vegetation that are typical of the low-velocity conditions selected by young salmon (Everest and Chapman 1972). An increase in rearing area should reduce competition for food and space and perhaps reduce the probability of encountering a predator. In contrast, the Sacramento River channel is relatively narrow, with steep rock-reinforced banks and little shallow habitat. Migration through the Yolo Bypass corridor would also prevent

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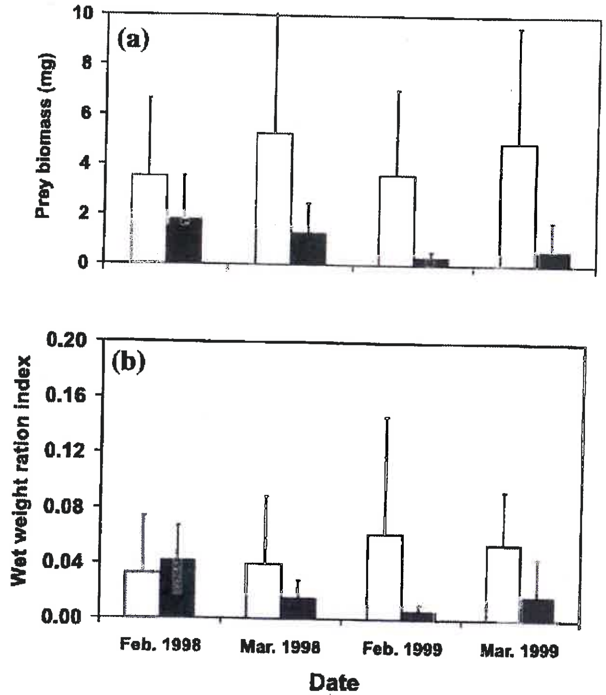
fish from entering the channels of the central delta, in which there are various risks, including major water diversions (Brandes and McLain 2001). However, the Yolo Bypass is a less-stable environment, with stranding risks when flood waters recede. The relatively well-drained topography of the Yolo Bypass floodplain may help to reduce the magnitude of this problem. This is not to say, however, that access to floodplain rearing habitat represents the only mechanism to account for possible improvements in juvenile salmon survival in wetter years. Other covariates, such as reduced water temperature (Baker et al. 1995), reduced predation losses from higher turbidity (Gregory and Levings 1998), and reduced water diversion effects (Kjelson et al. 1982), also contribute to improved wet-year survival of salmon that migrate through the San Francisco Estuary.

The results from this study suggest that hydrology may affect salmon feeding success, migration, and survival in both floodplain and river habitat. The CWT results indicate that salmon grew faster, migrated faster, and may have had better survival rates in 1998 than in 1999. One clear difference between the years is that the flow pulses were higher and of longer duration in 1998 than in 1999. Higher flow could directly increase migration rates through higher water velocities and have multiple indirect effects on growth through factors such as food supply or water temperature. The abundance of Diptera in drift samples was substantially higher in 1998 than in 1999 in both locations. The significant interaction between location and year for both prey weights and the wet weight ration index indicates that the combined effects of diet and water temperature under 1998 hydrology should have resulted in higher growth rates. Higher growth rates and faster migration times in 1998 may, in turn, have improved survival by reducing predation risk. Higher-flow conditions in 1998 increased the quantity and duration of floodplain rearing area, perhaps reducing resource competition and predator encounter rates. Increased flow duration and magnitude in 1998 could also have improved survival on the floodplain by reducing stranding risks.

These results provide new insight into the significance of seasonal floodplain habitat for salmon rearing, which has been studied primarily in perennial waterways such as estuaries and rivers (Healey 1991; Kjelson et al. 1982). Indeed, this is the first study we are aware of demonstrating that off-channel floodplain provides major habitat for chinook salmon. We do not believe that the benefits of the floodplain to chinook salmon are unique to Yolo Bypass. Initial results from the Cosumnes River, an undammed watershed in the delta, show similar growth enhancements for juvenile chinook salmon that rear on the floodplain rather than in adjacent river channels (Peter Moyle, University of California, Davis, CA 95616, personal communication). Moreover, the benefits of the floodplain to salmon are consistent with findings for other fish species. Sommer et al. (1997) found that the Yolo Bypass provides major spawning, rearing, and foraging habitat for the native cyprinid Sacramento splittail (*Pogonichthys macrolepidotus*). The spawning and rearing of fish on floodplains has been reported in diverse locations that range from small streams (Halyk and Balon 1983; Ross and Baker 1983) to large rivers (Copp and Penaz 1988) in both temperate (Gehrke 1992; Turner et al. 1994) and tropical (Winemiller and Jepsen 1998) locations. The growth effects of floodplain habitat have been described for several tropical locations (Welcomme 1979); however, the present study and the results of Gutreuter et al. (2000) represent the only examples from temperate rivers of which we are aware.

Fig. 5. Feeding success results for Yolo Bypass (open bars) and Sacramento River (solid bars) juvenile salmon during 1998 and 1999. (*a*) Estimated prey weights in stomach contents. (*b*) Wet weight ration indices. Means and standard errors are shown.



Differences between the invertebrate communities in floodplains versus river channels have been reported by Castella et al. (1991). The exceptional production of drift invertebrates on the Yolo Bypass floodplain is consistent with the results of Gladden and Smock (1990), who found that invertebrate production was one to two orders of magnitude greater on the floodplain than in adjacent streams. Although we did not monitor benthic invertebrates, results from other studies of large rivers indicate that benthic biomass may be up to an order of magnitude higher in the floodplain (Junk et al. 1989). The Yolo Bypass drift invertebrate results contrast with the results for zooplankton, which were not particularly abundant on the floodplain. This finding is comparable with that of Welcomme (1979), who reported that densities of zooplankton in natural floodplains are frequently low, except for low-water periods and localized concentrations near habitat interfaces such as shorelines.

The mechanism for greater abundance of drift invertebrates in the Yolo Bypass remains unclear, but is unlikely to be an artifact of land use on the floodplain. Possible explanations for increased drift abundance include increased food supply (e.g., primary production or detritus), more habitat, and longer hydraulic residence times. For each of these mechanisms, Yolo Bypass probably provides functions similar to more "natural" floodplains. Improved food supply is supported by the work of Jassby and Cloern (2000), whose

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modeling studies suggest that the Yolo Bypass should have enhanced phytoplankton production as a result of its large surface area and shallow depth. Inputs of fertilizers from agriculture in the Yolo Bypass would not be important contributing factors, as nitrogen and phosphorous are rarely limiting to phytoplankton production in the delta (Ball and Arthur 1979). Like less-disturbed floodplains in other regions (Junk et al. 1989), invertebrate production in the Yolo Bypass may be stimulated by an increased availability of detritus in the food web. Alternatively, the trends in invertebrate abundance we observed may be a consequence of physical differences between floodplain and channel habitat. Inundation of the floodplain may increase the amount of habitat for benthic invertebrates, a major source of drift biomass. Given the larger surface area and lower velocities in Yolo Bypass, the floodplain probably has a much longer hydraulic residence time than the Sacramento River, reducing the rate at which drift invertebrates would be flushed out of the system. Increased habitat area and hydraulic residence time would also have been functional characteristics of the historical floodplain.

In the broader context, the results for salmon and drift invertebrates are consistent with the flood pulse concept, which predicts that floodplains should yield greater fish and invertebrate production than channel habitat (Junk et al. 1989). This finding is significant in that the flood pulse concept was developed primarily on the basis of relatively undisturbed rivers, whereas our study was conducted in a regulated river with a floodplain dominated by agricultural uses. Gutreuter et al. (2000) showed similar enhancements in fish growth from floodplain inundation in the Upper Mississippi River, another large regulated river. These studies suggest that floodplains can maintain important functional characteristics even in heavily modified rivers. In the case of the San Francisco Estuary and its tributaries, we do not claim that floodplain inundation is the primary factor regulating the productivity of the system. The Yolo Bypass floodplain may be seasonally more productive than the Sacramento River for some fish and invertebrates, but we have no data regarding its contribution during dry months or years. Nonetheless, the results of the present study and of Sommer et al. (1997) are sufficient to demonstrate that the floodplain represents one of the most biologically important habitat types in the region. We believe that proposed large-scale restoration activities in the San Francisco Estuary and its tributaries (Yoshiyama et al. 2000) that would increase the area and connectivity of the floodplain offer particular promise for native fish populations such as chinook salmon and Sacramento splittail.

Acknowledgements

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References

Baker, P.F., Speed, T.P., and Ligon, P.K. 1995. Estimating the influence of temperature on the survival of chinook salmon smolts (*Oncorhynchus tshawytscha*) migrating through the Sacramento – San Joaquin River delta of California. Can. J. Fish. Aquat. Sci. **52**: 855–863.

Ball, M.D., and Arthur, J.F. 1979. Planktonic chlorophyll dynamics in the northern San Francisco bay and delta. *In* San Francisco Bay: the urbanized estuary. *Edited by* T.J. Conomos. American Association for the Advancement of Science, San Francisco, Calif. pp. 265–285.

Bayley, P.B. 1991. The flood pulse advantage and the restoration of river–floodplain systems. Regul. Rivers Res. Manag. **6**: 75–86.

Bayley, P.B. 1995. Understanding large river floodplain ecosystems. BioScience, **45**(3): 153–158.

Bennett, W.A., and Moyle, P.B. 1996. Where have all the fishes gone? Interactive factors producing fish declines in the Sacramento – San Joaquin Estuary. *In* San Francisco Bay: the ecosystem. *Edited by* J.T. Hollibaugh. American Association for the Advancement of Science, San Francisco, Calif. pp. 519–542.

Brandes, P.L., and McLain, J.S. 2001. Juvenile chinook salmon abundance, distribution, and survival in the Sacramento – San Joaquin Estuary. Calif. Dep. Fish Game Fish Bull. In press.

Castella, E., Richardot-Coulet, M., Roux, C., and Richoux, P. 1991. Aquatic macroinvertebrate assemblages of two contrasting floodplains: the Rhone and Ain rivers, France. Regul. Rivers Res. Manag. **6**: 289–300.

Copp, G.H., and Penaz, M. 1988. Ecology of fish spawning and nursery zones in the flood plain, using a new sampling approach. Hydrobiologia, **169**: 209–224.

Corti, D., Kohler, S.L., and Sparks, R.E. 1997. Effects of hydroperiod and predation on a Mississippi River floodplain invertebrate community. Oecologia, **109**: 154–165.

Everest, F.H., and Chapman, D.W. 1972. Habitat selection and spatial interaction by juvenile chinook salmon and steelhead trout in two Idaho streams. J. Fish. Res. Board Can. **29**: 91–100.

Gehrke, P.C. 1992. Diel abundance, migration and feeding of fish larvae (Eleotridae) on a floodplain billabong. J. Fish Biol. **40**: 695–707.

Gladden, J.E., and Smock, L.A. 1990. Macroinvertebrate distribution and production on the floodplains of two lowland headwater streams. Freshwater Biol. **24**: 533–545.

Gregory, R.S., and Levings, C.D. 1998. Turbidity reduces predation in migrating juvenile Pacific salmon. Trans. Am. Fish. Soc. **127**: 275–285.

Gutreuter, S., Bartels, A.D., Irons, K., and Sandheinrich, M.B. 2000. Evaluations of the flood-pulse concept based on statistical models of growth of selected fishes of the Upper Mississippi River system. Can. J. Fish. Aquat. Sci. **56**: 2282–2291.

Halyk, L.C., and Balon, E.K. 1983. Structure and ecological production of the fish taxocene of a small floodplain system. Can. J. Zool. **61**: 2446–2464.

© 2001 NRC Canada

Hanson, P.C., Johnson, T.B., Schindler, D.E., and Kitchell, J.F. 1997. Fish Bioenergetics 3.0. Center for Limnology, University of Wisconson—Madison, Madison.

Healey, M.C. 1991. Life history of chinook salmon. *In* Pacific salmon life histories. *Edited by* C. Groot and L. Margolis. University of British Columbia Press, Vancouver. pp. 311–394.

Hewett, S.W., and Kraft, C.E. 1993. The relationship between growth and consumption: comparisons across fish populations. Trans. Am. Fish. Soc. **122**: 814-821.

Jassby, A.D., and Cloern, J.E. 2000. Organic matter sources and rehabilitation of the Sacramento – San Joaquin Delta (California, U.S.A.). Aquat. Conserv.: Mar. Freshw. Ecosys. **10**(5): 323–352.

Jassby, A.D., Kimmerer, W.J., Monismith, S.G., Armor, C., Cloern, J.E., Powell, T.M., Schubel, J.R., and Vendlinski, T.J. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecol. Appl. **5**: 272–289.

Junk, W.J., Bayley, P.B., and Sparks, R.E. 1989. The flood pulse concept in river–floodplain systems. Spec. Publ. Can. J. Fish. Aquat. Sci. **106**: 110–127.

Kjelson, M.A., Raquel, P.F., and Fisher, F.W. 1982. Life history of fall-run juvenile chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento – San Joaquin Estuary, California. *In* Estuarine comparisons. *Edited by* V.S. Kennedy. Academic Press, New York. pp. 393–411.

Petrusso, P.A. 1998. Feeding habits and condition of juvenile chinook salmon in the upper Sacramento River, California. M.Sc. thesis, Michigan State University, East Lansing.

Rand, P.S., and Stewart, D.J. 1998. Dynamics of salmonine diets and foraging in Lake Ontario, 1983–1993: a test of a bioenergetic model prediction. Can. J. Fish. Aquat. Sci. **55**: 307–317.

Rasmussen, J.L. 1996. American Fisheries Society position statement: floodplain management. Fisheries (Bethesda), **21**(4):6–10.

Rondorf, D.W., Gray, G.A., and Fairly, R.B. 1990. Feeding ecology of subyearling chinook salmon in riverine and reservoir habitats of the Columbia River. Trans. Am. Fish. Soc. **119**: 16–24.

Ross, S.T., and Baker, J.A. 1983. The response of fishes to periodic spring floods in a southeastern stream. Am. Midl. Nat. **109**: 1–14.

Shreffler, D.K., Simenstad, C.A., and Thom, R.M. 1992. Foraging by juvenile salmon in a restored estuarine wetland. Estuaries, **15**: 204–213.

Sommer, T., Baxter, R., and Herbold, B. 1997. The resilience of splittail in the Sacramento – San Joaquin Estuary. Trans. Am. Fish. Soc. **126**: 961–976.

Stewart, D.J., and Ibarra, M. 1991. Predation and production by salmonine fishes in Lake Michigan, 1978–1988. Can. J. Fish. Aquat. Sci. **48**: 909–922.

Turner, T.F., Trexler, J.C., Miller, G.L., and Toyer, K.E. 1994. Temporal and spatial dynamics of larval and juvenile fish abundance in a temperate floodplain river. Copeia, 1994: 174–183.

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, F.R., and Cushing, C.E. 1980. The river continuum concept. Can. J. Fish. Aquat. Sci. **37**: 130–137.

Venables, W.N., and Ripley, B.D. 1997. Modern applied statistics with S-Plus. 2nd ed. Springer-Verlag, New York.

Welcomme, R.L. 1979. Fisheries ecology of floodplain rivers. Longman, London.

Winemiller, K.O., and Jepsen, D.B. 1998. Effects of seasonality and fish movement on tropical food webs. J. Fish Biol. **53**(Suppl. A): 267–296.

Yoshiyama, R.M., Gerstung, E.R., Fisher, F.W., and Moyle, P.B. 2000. Chinook salmon in the California Central Valley: an assessment. Fisheries (Bethesda), **25**(2): 6–20.

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[Article]

Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain

TED R. SOMMER,* WILLIAM C. HARRELL, AND MATTHEW L. NOBRIGA

California Department of Water Resources, Sacramento, California 95816, USA

Abstract.—Although juvenile Chinook salmon *Oncorhynchus tshawytscha* are known to use a variety of habitats, their use of seasonal floodplains, a highly variable and potentially risky habitat, has not been studied extensively. Particularly unclear is whether a seasonal floodplain is a net "source" or a net "sink" for salmonid production. To help address this issue, we studied salmon habitat use in the Yolo Bypass, a 24,000-ha floodplain of the Sacramento River, California. Juvenile salmon were present in the Yolo Bypass during winter–spring; fish were collected in all regions and substrates of the floodplain in diverse habitats. Experimental releases of tagged hatchery salmon suggest that the fish reared on the floodplain for extended periods (mean = 33 d in 1998, 56 d in 1999, and 30 d in 2000). Floodplain rearing and associated growth are also supported by the significantly larger size of wild salmon at the floodplain outlet than at the inlet during each of the study years. Several lines of evidence suggest that although the majority of young salmon successfully emigrated from the floodplain, areas with engineered water control structures had comparatively high rates of stranding. Adult ocean recoveries of tagged hatchery fish indicate that seasonal floodplains support survival at least comparable with that of adjacent perennial river channels. These results indicate that floodplains appear to be a viable rearing habitat for Chinook salmon, making floodplain restoration an important tool for enhancing salmon production.

A large downstream movement of fry to provide dispersal to rearing areas is typical of ocean-type Chinook salmon *Oncorhynchus tschawytcha* (Healey 1991). Rearing areas include channel and off-channel habitat in natal and nonnatal streams and their estuaries (Bjornn 1971; Kjelsen et al. 1982; Levy and Northcote 1982; Swales et al. 1986; Swales and Levings 1989; Healey 1991; Shreffler et al. 1992). Recently, Sommer et al. (2001b) observed that juvenile Chinook salmon also live on seasonal floodplains. Large rivers and streams typically have dynamic floodplains varying in size from several to thousands of hectares, unless their channels are heavily confined by topography (e.g., streams at high elevation or confined by canyons or levees). Floodplains are known to be of major importance to aquatic ecosystems in most regions; large rivers typically favor the development of a fauna adapted to colonize this habitat (Welcomme 1979; Junk et al. 1989; Sparks 1995). As a result, it is reasonable to expect dispersing salmonid fry show some ability to use seasonal habitat. In support of this hypothesis, Sommer et al. (2001b) reported that food resources and water temperatures on the seasonal floodplain of a large river were superior to those in an adjacent perennial channel, resulting in enhanced growth rates of young salmon. Despite some evidence that enhanced growth on the floodplain improved fry–smolt survival in the estuary, Sommer et al. (2001b) did not address any effects on adult production.

Intuitively, rearing in seasonal floodplains or intermittent streams seems risky because these habitats are among the most dynamic on earth (Power et al. 1995). It is still unknown whether seasonally dewatered habitats are a net "source" or a "sink" for salmonid production relative to production in permanent stream channels (Brown 2002). In particular, the high degree of seasonal flow fluctuation characteristic of floodplain habitat could cause major stranding events and increase mortality rates of young salmon (Bradford 1997; Brown 2002). For resident taxa in intermittent streams, the benefits of very large flow fluctuations appear to outweigh costs associated with a variable environment (Spranza and Stanley 2000). This issue continues to be a key concern for regulatory agencies that evaluate off-channel restoration projects or proposed flow fluctuations for possible effects on fishes (Brown 2002; Bruce Oppenheim, NOAA Fisheries, personal communication).

Here, we describe spatial and temporal trends in juvenile Chinook salmon habitat use and stranding in a large California river floodplain. Our study was conducted in the Yolo Bypass, the primary floodplain of the Sacramento River, the major pro-

* Corresponding author: tsommer@water.ca.gov

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Exhibit "Q"

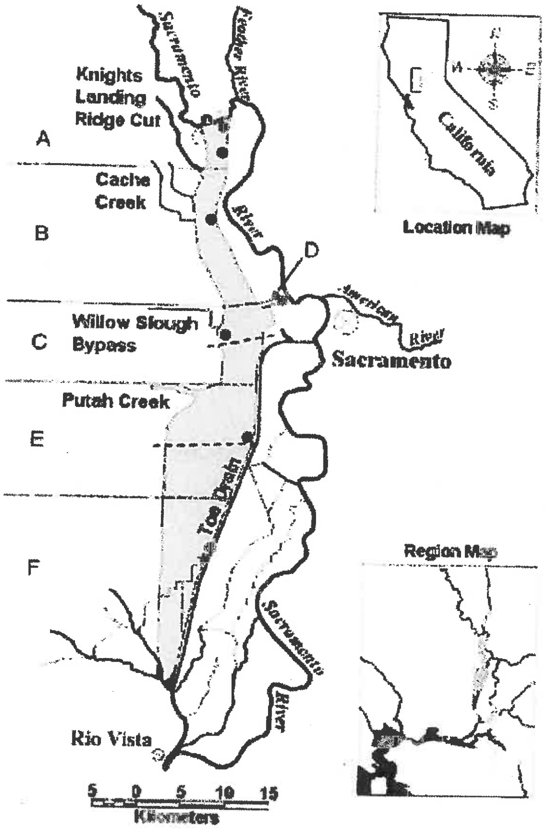


FIGURE 1.—Location of Yolo Bypass in relation to the San Francisco Bay–Delta and its tributaries. Fremont Weir is the upper (northern) edge of the Yolo Bypass. The major regions of the floodplain are delineated from north to south and correspond to the following codes: (A) Fremont Weir; (B) Cache Creek sinks; (C) Yolo Bypass Wildlife Area; (D) Sacramento Bypass; (E) Putah Creek Sinks; and (F) Liberty Island. The sampling locations are identified as follows: beach seine sites (solid circles); screw trap (star); and purse seine transects (dotted lines).

ducer of salmon in the San Francisco estuary (Figure 1). Because the Yolo Bypass can convey 75% or more of the total flow from the Sacramento River basin (Sommer et al. 2001a), this floodplain can be expected to be a migratory pathway for a substantial number of juvenile Chinook salmon. A major objective of our study was to collect basic information about the timing, duration, and habitat use of salmon on floodplains. We hoped that these data would provide insight into whether a floodplain is a net source (i.e., with rearing benefits) or a net sink (i.e., with high mortality because of stranding or predation) for salmon populations. The major hypotheses evaluated were as follows: (1) salmon occur in all major habitat types and geographic regions; (2) floodplains provide rearing habitat for salmon and are not simply a migration corridor; and (3) stranding of juvenile salmon does not have a major population-level effect on survival of the fish that use floodplain habitat. We addressed these hypotheses by sampling wild fish throughout the floodplain, experimentally releasing tagged fish, and using hydrologic modeling and measurements of physical conditions to describe how habitat varied over the study period.

Study Area

The San Francisco Estuary and its two component regions, Sacramento–San Joaquin Delta and downstream bays (Figure 1), make up one of the largest estuaries on the Pacific coast of North America. Major changes to the system have included diking and isolation of about 95% of the wetlands, introduction of exotic species, channelization, sediment inputs from hydraulic mining, and discharge of agricultural and urban chemicals (Nichols et al. 1986; Kimmerer 2002). The Estuary receives most freshwater via the Delta, which drains approximately 100,000 km^2. Most precipitation occurs upstream of the Delta during winter and spring, resulting in a greater than 10-fold seasonal range of daily freshwater flow into the estuary. However, the hydrograph is substantially altered by dams on each of the major rivers. Peak flow pulses typically occur during winter, but dam operations can reduce the magnitude of the pulses, particularly in dry years, when much of the inflow is captured behind reservoirs (Mount 1995; Kimmerer 2002). The historically prominent spring flow pulse from snowmelt is at present muted except during heavy, late-season storms. For the past several decades, much of the spring snowmelt has been stored in reservoirs and released during summer and autumn, periods of historically lower flow. As much as 65% of the net Delta flow during summer and autumn is diverted from the channels by two large water diversions (the State Water Project and the Central Valley Project); additional water is diverted by 2,200 pumps and siphons for irrigation (Kimmerer 2002).

The 24,000-ha Yolo Bypass is the primary floodplain of the Delta (Sommer et al. 2001a). The majority of the floodplain is leveed to protect surrounding cities from floodwaters, but levees confine flow through the bypass only under very high flow events. The Yolo Bypass currently floods an average of every other year, typically under high-flow periods in winter and spring. The Yolo Bypass has a complex hydrology, with inundation possible from several different sources. The floodplain typically has a peak inundation period during January–March but can flood as early as October and as late as June. The primary input to the Yolo Bypass is through Fremont Weir in the north, which conveys floodwaters from the Sacramento and Feather rivers. During major storm events (e.g., >5,000 m^3/s), additional water enters from the east via the Sacramento Weir, adding flow from the American and Sacramento rivers. Flow also enters the Yolo Bypass from several small streams on its western margin, including Knights Landing Ridge Cut, Cache Creek, and Putah Creek. During much of the winter, water-suspended sediment levels in the Yolo Bypass and Sacramento River are high, generally resulting in secchi depths of less than 0.25 m. However, hydraulic residence times are typically longer in the Yolo Bypass than in the Sacramento River (Sommer et al. 2004). Floodwaters recede from the northern and western portions of the bypass along relatively even elevation gradients of 0.09% west–east and 0.01% north–south into a perennial channel on the eastern edge of the Bypass; they then rejoin the Sacramento River near Rio Vista. The majority of the Yolo Bypass is at present managed for wildlife in a mosaic that includes riparian, wetland, upland, and perennial pond habitats; however, a dominant land use during the past two decades, agriculture has decreased in recent years because of habitat restoration activities.

Our data collection focused on the fall-run juvenile Chinook salmon, currently the numerically dominant race in the Sacramento Valley (Yoshiyama et al. 2000). There are four races of Chinook salmon in the Sacramento Valley: winter, spring, late-fall, and fall-run. Like many other native fish, Chinook salmon in the San Francisco estuary and its tributaries have been adversely affected by such factors as habitat loss, water diversions, and species introductions (Bennett and Moyle 1996); as a result, the Sacramento River winter and spring run Chinook salmon are protected under the Federal Endangered Species Act. The typical life history pattern is for young fall-run salmon fry (approximately 35–70 mm fork length) to migrate from the tributaries during winter and spring to the estuary (Brandes and McLain 2001).

Methods

Physical habitat.—Because seasonal hydrologic variability is a key characteristic of floodplain habitat, we reasoned that detailed data on changes in physical habitat would be necessary to evaluate the responses of young salmon. Daily flow data were obtained from gauging stations in the floodplain, and temperature data were collected using continuous temperature recorders (Sommer et al. 2001b). However, the vast area of Yolo Bypass made it impractical to directly measure other parameters, such as depth and surface area. As an alternative, we used a hydrologic model to estimate these parameters (Sommer et al. 2004). To summarize, the model treated Yolo Bypass as a "reservoir" described by (1) basin geometry and (2) flow and stage time series. The Yolo Bypass floodplain geometry was developed from 200 cross-sections with data collected at 300-m intervals by standard rod and level survey techniques. Mean daily stage and flow data were obtained from five gauging stations in the Yolo Bypass. For each date in the time series, we used linear interpolation between the gauging stations to estimate the stage at each cross-section. The estimated stage value was then used to calculate conveyance characteristics of each cross-section: area, width, and wetted perimeter. The daily results for each cross-section were used to estimate total surface area and mean depth. The large scale of the study reach did not allow validation of the depth estimates. As a partial validation of the model, Sommer et al. (2004) estimated total inundated area for the Yolo Bypass by using aerial photographs on days when the floodplain was inundated (February 8 and March 2, 1998) and when the floodplain was draining (April 28, 1998). To provide additional information about areas where fish stranding and consequent losses could occur, we estimated the portion of the area that was isolated ponds versus inundated area that was actively draining to the Delta (i.e., perennial channels and adjacent inundated area) on April 28, 1998.

Fish habitat use.—We used beach seine sampling to examine which regions and substrates of the floodplain were used by young salmon (hypothesis 1). During January through April of each year, a 15-m seine (3.2-mm mesh) was used to sample six regions of the Yolo Bypass (Figure 1). Fixed stations were used in each region during flooded periods. After floodplain drainage, samples were collected randomly within each region. For all periods, the primary substrate type of the habitat (sand, mud, gravel, pavement, or vegetation). fish species and size, and an estimate of the surface area swept by the seine were recorded. Habitat use during flood events was summarized in terms of the percentage of samples that contained salmon for each region and substrate type.

To provide additional information about habitat use, we conducted purse seine sampling along two transects (Figure 1). This sampling, performed in 1998 when the Yolo Bypass flow was relatively high (>850 m^3/s), used purse seines (30.5 m × 4.6 m, 4.75-mm mesh) set from a jet boat. Purse seining was conducted at 1–2 transects up to five times weekly, depending on hydrology. Hauls were made at random points in each of three habitat types (riparian, agricultural fields, and wetlands), the boundaries of which were established from aerial photographs taken before the Bypass was inundated. In the case of riparian habitat, hauls were made in clearings adjacent to trees to avoid snagging. We also recorded transect side (east or west half) for each haul because the western side of the Yolo Bypass was shallower and flow was dominated by inputs from westside streams rather than from Fremont or Sacramento weirs (Sommer et al. 2004). Most of these hauls were performed in areas exposed to at least a modest current. Additional limited paired sampling was conducted to examine possible differences between areas with and without velocity refuges. Low-velocity habitats sampled included downstream edges of levees, islands, and clusters of trees. Water velocities in randomly selected areas were approximately 0–0.05 m/s compared with greater than 0.33 m/s in adjacent exposed areas. Water depths were similar for each sampling pair. Differences in salmon densities for each habitat type were examined by using a Kruskal–Wallace test. A randomization *t*-test with 1,000 iterations (Haddon 2001) was used to compare salmon density on the east and west sides of the floodplain.

Migration trends.—To examine temporal trends in salmon migration through the floodplain (hypotheses 2 and 3), we operated a rotary screw trap (EG Solutions, Corvallis, Oregon) near the base of the Yolo Bypass during each study year. This technique was intended to provide an indication of the timing and duration of migration, rather than an absolute measure of the number of salmon emigrating the floodplain. During much of the sampling period the inundated width of the floodplain was 1–5 km, an area we considered too large for the traditional mark–recapture evaluations required to measure trap efficiency and total emigration (Roper and Scarnecchia 1996). A 1.5-m-diameter trap was used for the first 3 weeks of sampling in February 1998, after which a 2.4-m trap was used for all other sampling. We operated traps as often as 7 days each week, the daily effort varying from 1 to 24 h, depending on debris load and safety considerations. Fish number and size were recorded in all years. In 1998, young salmon were classified as fry (prominent parr marks) or transitional fish/smolts (faded parr marks, silver appearance).

Floodplain residence time and growth.—We used experimental releases of salmon with coded wire tags (CWTs) as our primary method to evaluate fish residence time on the floodplain (hypothesis 2). Fry (mean size = 57 mm fork length) from the Feather River Fish Hatchery (Figure 1) were tagged by using coded-wire half tags (Northwest Marine Technologies) and released in the Yolo Bypass below the Fremont Weir on March 2, 1998 (53,000 fry); February 11, 1999 (105,000 fry); and February 22, 2000 (55,000 fry). We assessed residence time in the Yolo Bypass from recoveries of tagged fish in the screw trap at the base of the floodplain.

We also examined, using the previously described beach seine data, whether there was evidence of long-term rearing of wild salmon in the floodplain. We compared the slopes of weekly fork length measurements for the two northern beach seine regions ("North") to the southernmost region ("South"), using a generalized linear model (GLM) with a Poisson distribution and log link variance function. We reasoned that major significant differences between the sizes of fish in the two areas provided evidence of extended rearing and growth of fish in the floodplain.

Salmon survival and stranding.—We used several independent data sources to examine whether salmon successfully emigrated from the floodplain (hypothesis 3). First, we compared survival of each of the Yolo Bypass CWT hatchery-reared salmon release groups with the survival of parallel CWT groups containing the same number of fish released into the Sacramento River (Sommer et al. 2001b). Recapture rates at the smolt stage of the 1998 and 1999 release groups had previously been analyzed by Sommer et al. (2001b); in the present study, we evaluated adult recoveries in the commercial and recreational ocean fisheries through 2003. Second, we examined stranding by using beach seine data (described previously) collected within a few weeks after the Sacramento River stopped flowing into the Yolo Bypass. Densities of salmon were compared with a randomization *t*-test (Haddon 2001) for (1) isolated earthen ponds (2) perennial channels, and any sites immediately adjacent to these water sources. The results for all years were pooled because of relatively low sample sizes for individual years. Data for each year

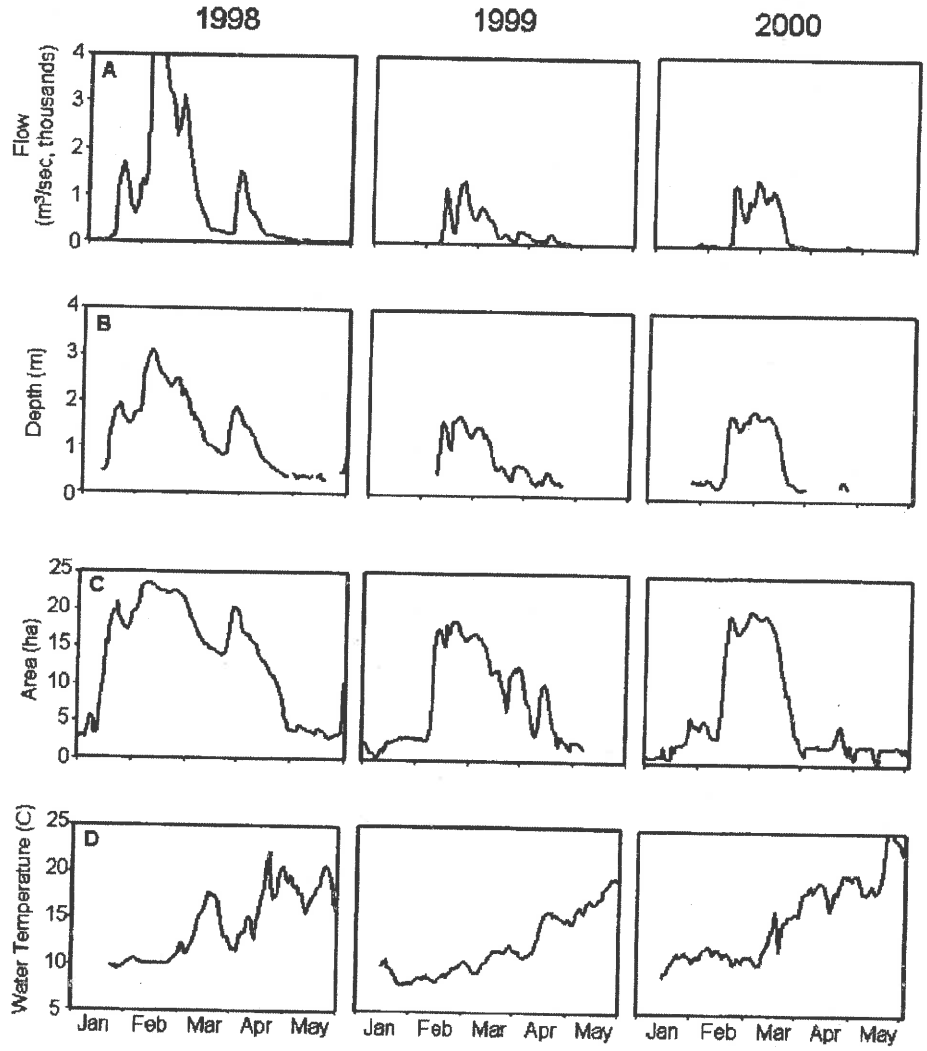


FIGURE 2.—Trends in physical variables for January–June 1998–2000: (A) mean daily flow in the Yolo Bypass; (B) simulated mean daily depth; (C) surface area; and (D) daily mean water temperature. The surface area data for 1998 and 2000 are from Sommer et al. (2004).

were first standardized for possible annual differences in abundance by conversion to z-scores; we then ran the randomization analysis using 1,000 iterations. We hypothesized that abundance of salmon would be equal in isolated ponds and contiguous water sources; that is, they would show no distinct "preferences." Our reasoning was that similar abundance levels would indicate successful emigration, because most of the water drains from the floodplain. To further understand factors that could affect stranding, we also used a randomization t-test to compare densities of fish in two types of isolated ponds: isolated earthen ponds and concrete weir scour ponds at Fremont and Sacramento weirs (Figure 1). Sampling effort was much greater in the isolated earthen ponds, so the randomization t-test was performed after randomly subsampling the earthen pond data from throughout the floodplain to provide equal sample sizes. We predicted that flood control structures would cause higher stranding than "natural" ponds. In addition, we examined trends in the catch of salmon in the screw trap data. We predicted that salmon catch would increase substantially during drainage because fish successfully emigrated the floodplain.

Results

Physical Habitat

The hydrographs varied substantially during the years of study (Figure 2A). In 1998 the hydrology was wet (4.4-year recurrence flood event) and the Yolo Bypass was inundated during mid-January through mid-April and again in early June. The flow was lower in the other 2 years, when inundation occurred between mid-February and mid-March, peak flood events being at the 1.7-year recurrence interval in 1999 and at the 2.4-year recurrence interval in 2000. Surface area in the Yolo Bypass closely followed the flow peaks, the amounts of inundated area being successively smaller in each of the study years (Figure 2C). For the April 28, 1998, photographs, the total surface area of 5,050 ha was slightly lower than the model estimate of 6,700 ha. Based on the aerial photographs, we estimated that only 600 ha of the 5,050 ha comprised isolated ponds, the remainder being water that drained to the Delta. For all but peak flood events, mean water depth remained less than 1 m (Figure 2B). During peak flood events, mean depths did not exceed 2 m except in February 1998. Water temperature showed gradual increases throughout each study year (Figure 2D).

Fish Habitat Use

We captured salmon in all regions of the floodplain and on all substrate types. During 1998–2000 flood events, salmon were captured in a high percentage of samples in each region (Figure 1) of the floodplain: (1) Fremont Weir (100%, n = 13 samples); (2) Cache Creek Sinks (50%, n = 16 samples); (3) Yolo Bypass Wildlife Area (77%, n = 22 samples); (4) Sacramento Bypass (100%, n = 7 samples); (5) Putah Creek Sinks (94%, n = 11 samples); and (6) Liberty Island (100%, n = 7 samples). Similarly, during 1998–2000 flood events we collected salmon on a high percentage of substrate types: (1) mud (70%, n = 47 samples); (2) sand (100%, n = 3 samples); (3) pavement (100%, n = 8 samples); (4) vegetation (97%, n = 32 samples); and 5) gravel (89%, n = 9 samples).

Salmon densities as estimated by purse seine sampling were not significantly different between riparian (mean abundance = 46.9/ha, SE = 10.4, n = 23), agricultural (mean abundance = 20.9/ha, SE = 6.1, n = 35), or natural vegetated habitat types (mean abundance = 27.5/ha, SE = 5.6, n = 31) based on a Kruskal–Wallis test (H = 4.38, df = 2, P = 0.112). There was also no statistically significant difference between the east (mean abundance = 29.5/ha, SE = 6.0, n = 53) and west (mean abundance = 29.9/ha, SE = 6.7, n = 36) sides of the Bypass as shown by a randomization t-test (P = 0.95). Salmon were collected in six hauls in low-velocity habitat (mean abundance = 189/ha, SE = 24/ha), but none were collected in adjacent areas exposed to a current.

Floodplain Migration Trends

Salmon migration as indicated by trends in screw trap catch was highly variable over the course of the study, but there were prominent peaks in Chinook salmon catch coincident with floodplain drainage during late March–April (Figure 3B). Additional smaller peaks in salmon catch also paralleled flow, mostly during February and March. The life history stage of salmon during 1998 was exclusively parr through the end of March, after which the majority showed signs of smoltification.

Floodplain Residence Time

Based on recoveries of tagged fish in the screw trap, the mean residence time of CWT salmon was 33 d (range, 16–46 d; n = 10) in 1998, 56 d (range, 4–76 d; n = 49) in 1999, and 30 d (range, 28–37 d; n = 25) in 2000. The size of fish was significantly larger (P<0.001; GLM) at the outlet of the floodplain than at the top (Figure 3C) during each of the study years.

Salmon Survival and Stranding

The numbers of CWT fish recovered for the Yolo Bypass were higher than in the Sacramento River in 1998, similar in 1999, and lower in 2000 (Table 1). Densities of wild Chinook salmon were highly variable during floodplain drainage events, with no statistically significant difference between densities in isolated earthen ponds and contiguous water sources (Table 2). However, densities of salmon were significantly higher (P < 0.0001; randomization t-test) in concrete weir scour ponds than in isolated earthen ponds (Table 3).

Discussion

Research on migratory fishes reveals that these species frequently have alternative life histories that may be influenced by habitat use at early life stages (Clark 1968; Secor 1999). Under Clark's (1968) "contingent hypothesis," migratory taxa have divergent migration pathways that could help the species deal with environmental variability and heterogeneity. This theory is consistent with our understanding of Chinook salmon, which are adapted to the extreme hydrologic variability in western North America and show a range of life histories (Healey 1991; Bottom et al. 2005). In this context, the use of multiple habitats—including natal and nonnatal streams (Bjornn 1971; Scriv-

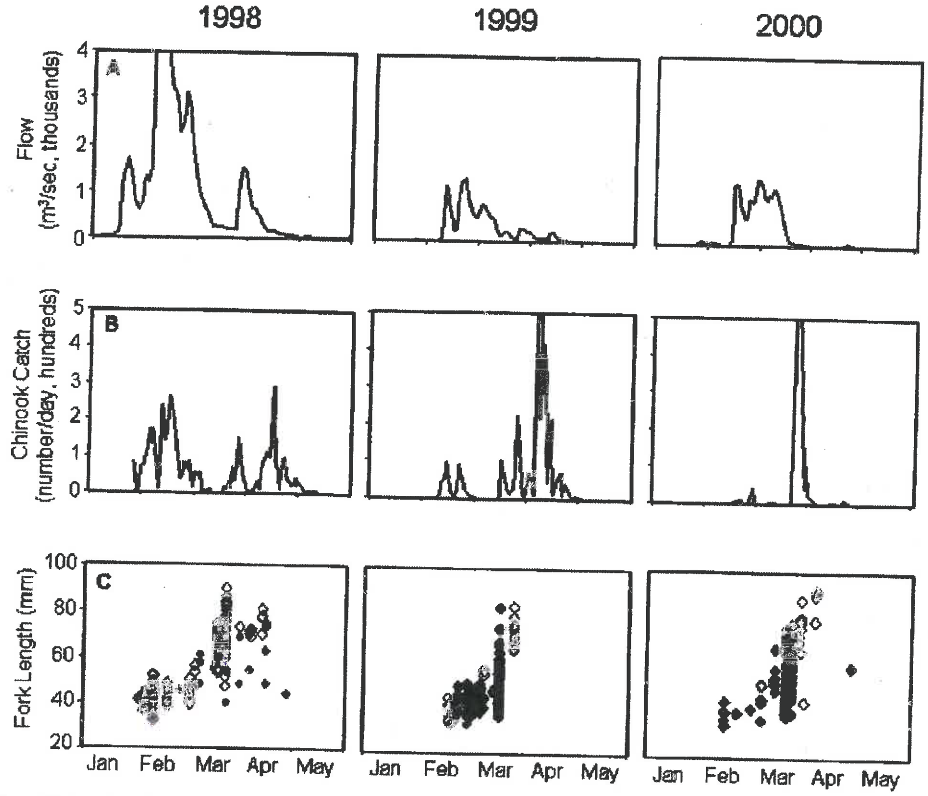


FIGURE 3.—Chinook salmon results during winter and spring 1998–2000: (A) mean daily flow; (B) salmon catch rates in screw trap sampling; and (C) salmon size for beach seine samples near the Yolo Bypass intake (solid symbols) and outlet (clear symbols).

ener et al. 1994), side channels and off-channel ponds (Swales et al. 1986; Swales and Levings 1989), low-elevation rivers (Kjelsen et al. 1982; Brown 2002), and estuaries (Healey 1991; Shreffler et al. 1992)—can be considered as part of an overall "bet-hedging" strategy that spreads risk across a variable environment. Despite the fact that seasonal floodplain represents perhaps the single most variable habitat available to salmon, our study suggests that floodplains are a viable rearing location for young fish.

TABLE 1.—Number of coded wire tags recovered in the ocean and commercial fisheries for Chinook salmon released in the Yolo Bypass and Sacramento River. The total number of tagged fish released in each location for each year is shown in parentheses. The survival ratio is calculated as the number of Yolo Bypass recoveries divided by the number of Sacramento River recoveries.

Release group	1998 (53,000)	1999 (105,000)	2000 (55,000)
Yolo Bypass	75	136	27
Sacramento River	35	138	47
Survival ratio	2.14	0.99	0.57

At the beginning of our study, our conceptual model for floodplain habitat use was that young salmon move into the floodplain during high-flow events and spread throughout the broad expanse of seasonally inundated habitat. Among the wide variety of suitable substrates and habitat types for rearing, young salmon appear to seek out low-velocity areas. Moreover, floodplain habitat apparently is not simply a migration corridor; many young salmon actively rear on the highly productive floodplain habitat for extended periods of time, resulting in high growth rates. Our findings suggest that salmon emigrate from the seasonally inundated habitat both during flood events and during drainage. Juvenile Chinook salmon do not appear to be especially prone to stranding mortality; indeed, survival may actually be enhanced by floodplain rearing in some years. Our conceptual model was supported by our results and has a variety of management implications.

Salmon were present in a broad range of habitat and substrate types and were collected in all regions and sides of the Yolo Bypass floodplain. The

TABLE 2.—Densities of Chinook salmon (number/ha ± SE, with sample size in parentheses) collected in beach seine sampling during drainage events in 1998–2000. The sample locations are divided into isolated earthen ponds and contiguous water sources. Density differences were not statistically significant between the two pond types based on a randomization *t*-test of the pooled data for all years (P = 0.79; n = 43 for isolated ponds; n = 59 for contiguous water sources).

Location type	1998	1999	2000
Isolated ponds.	206 ± 112 (30)	890 ± 491 (8)	126 ± 65 (5)
Contiguous water sources	167 ± 79 (33)	310 ± 104 (13)	463 ± 123 (13)

fact that they were present on the western half of the Bypass, where flows are dominated by Knights Landing Ridge Cut and Cache and Putah creeks, suggests that salmon spread throughout the floodplain after entering the basin by way of Fremont and Sacramento weirs. A few of these fish may have originated from a modest spawning population in Putah Creek (Marchetti and Moyle 2001). The fact that salmon were present in a wide range of habitat and substrate types and in different regions of the Yolo Bypass indicates that many areas of habitat were suitable, although this does not mean that there were no habitat preferences. Like many young fishes, much of the distribution of juvenile Chinook salmon can be explained by their association with shallow depths and low velocities (Everest and Chapman 1972; Roper et al. 1994; Bradford and Higgins 2001). The physical modeling indicated that mean depths were generally 1 m or less during all but peak flood periods, so much of the thousands of hectares of inundated habitat was probably within the shallow range typically preferred by young Chinook salmon (Everest and Chapman 1972). Our limited purse seine sampling suggested that young salmon were most abundant in low-velocity areas, which is consistent with previous studies in river and stream habitat (Everest and Chapman 1972; Roper et al. 1994; Bradford and Higgins 2001). We did not directly simulate water velocity in the present study; however, the relatively shallow water depth during flood events reflects the broad area of low-velocity rearing habitat created during flood events. We expect that this increase in rearing habitat in the Yolo Bypass provides foraging opportunities (Sommer et al. 2001b), reduced energy expenditure, and perhaps reduced probability of encounter with a predator (Ward and Stanford 1995).

Our results also suggest that fish rear in the system for extended periods rather than simply using it as a migration corridor. The mean residence time of 30–56 d for the 44-km reach between the floodplain release location and the screw trap is substantially longer than one would expect, given that (1) fingerlings are capable of migrating at rates of at least 6–24 km/d in low-elevation reaches of other large rivers (Healey 1991) and (2) one of our 1999 CWT fish was recovered just 4 days after being released, having traveled an estimated rate of 11 km/d. The fish were significantly larger at the base of the Yolo Bypass, suggesting that their period of residence in the floodplain was long enough to support substantial growth. Similarly, Sommer et al. (2001b) found that salmon showed higher growth rates in the Yolo Bypass than in the adjacent Sacramento River, primarily because of higher levels of invertebrate prey in the floodplain. A long period of rearing is also supported by the screw trap data, which showed that the densities of salmon were greatest during drainage of the floodplain. We believe that these peaks are a result of rearing salmon being forced off of the floodplain by receding flows. Temperature and salmon life history stage do not provide good alternative explanations for the emigration trends. In 1998, for example, water temperatures were relatively high by late March and salmon began smoltification shortly thereafter; yet the screw trap data indicate

TABLE 3.—Densities of Chinook salmon (number/ha ± SE, with sample size in parentheses) collected in beach seine sampling for earthen ponds and adjacent concrete weir ponds. Density differences were statistically significant between the two pond types based on a randomization *t*-test of the pooled data for all years ($P < 0.0001$; n = 26 for each pond type). Note that we used a randomly sampled subset of the earthen pond data to provide equal sample sizes for the comparison.

Location type	1998	1999	2000
Earthen ponds	186 ± 67 (63)	531 ± 200 (21)	369 ± 97 (18)
Concrete weir ponds	2,717 ± 1,115 (14)	14,208 ± 3,898 (12)	4,181 ± 1,275 (3)

that emigration did not peak until the end of April, when the floodplain drained. Perhaps the emigration trends are partially confounded by seasonal variation in salmon abundance. In the absence of trap efficiency data, we cannot estimate the proportion of the population that emigrated in winter versus spring events.

Several lines of evidence suggest that the majority of fish successfully emigrated from the floodplain. One important observation was that the area of isolated ponds was small relative to the overall area of the floodplain during both peak flood and drainage periods. As an example, in 1998, the wettest year we studied, the peak area of inundation was 24,000 ha, but the total inundated area dropped to 5,000 ha by late April. Of the 5,000 ha remaining at this point, our estimates from aerial photographs showed that isolated ponds took up only 600 ha. Put another way, isolated ponds represented just 12% of the wetted area in April and only 2.5% of the peak inundated area in winter. The same trend is evident in the area simulations for 1999 and 2000, when the peak area was 20,000 ha, but dropped to about 2,000 ha within a month. These results demonstrate that the Yolo Bypass drains fairly efficiently, leaving little isolated area where stranding can occur. This finding was somewhat unexpected, because many parts of the Yolo Bypass have natural topographic features or agricultural levees that could potentially impede drainage and fish emigration. Even if the area of isolated ponds is low, stranding could still be a substantial source of mortality if densities of fish in the remaining ponds were very high. However, we found no evidence that densities of fish stranded in isolated ponds were significantly higher than those in contiguous water sources that were draining to the Delta. The key point here is that most of the water drains from the floodplain and apparently the majority of the fish are leaving with the receding floodwaters. To help illustrate this issue, if we assume that mean densities of fish observed in Table 2 were representative of the entire wetted area of floodplain in April 1998, then the total number of fish in the 600 ha of isolated ponds would have been 123,600 salmon, lower than an estimate of 835,000 fish in the 5,000 ha of contiguous water sources. This conservative estimate also does not include the large numbers of fish that emigrated from the floodplain before April.

In addition to the beach seine and surface area data, we believe that trends in screw trap data support the hypothesis that stranding is not consistently a major problem on the floodplain. The screw trap data are somewhat ambiguous, because the large area of the floodplain makes it unreasonable to measure the efficiency of the trap. Therefore, we cannot accurately estimate the absolute number of salmon emigrating from the floodplain. However, we can at least examine the patterns of trap catch to evaluate likely mechanisms. Some of the possible patterns that we would expect to see for different factors are summarized in Figure 4. First, under the "trap efficiency" model, we would have expected dual peaks in the earliest and latest portions of flood events, when the screw trap would be sampling the highest portion of total flow (Figure 4A). If young salmon follow the "go with the flow" model, catch and flow peaks should be well-correlated (Figure 4B). Alternatively, if floodplains represent an important rearing habitat, we would expect catch trends to follow the "loitering" model, in which catch does not increase until drainage, when fish are forced from their rearing habitat by receding floodwaters (Figure 4C). Finally, if stranding were a major factor controlling catch trends, we would expect an early increase in catch as fish moved through the floodplain during inundation, but then catch should drop earlier than flow as young salmon became isolated from draining floodwaters (Figure 4D; "bathtub" model). Of these patterns, our data for the Yolo Bypass provide the strongest support for both the "go with the flow" and "loitering" models. In each year we saw obvious screw trap catch peaks associated with flow events, and additional prominent peaks associated with drainage. To summarize, apparently some of the fish move

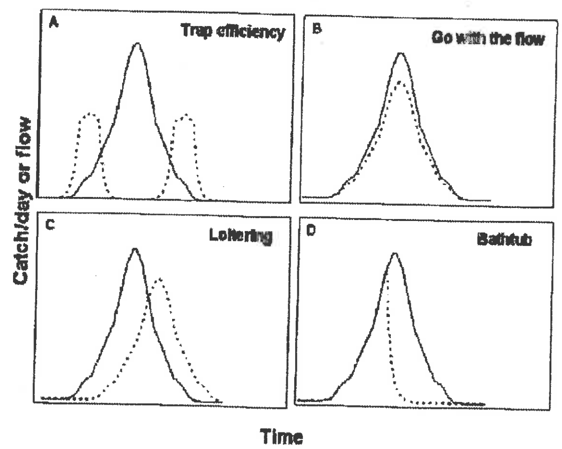


FIGURE 4.—Four conceptual models of expected screw trap catch (dotted line) relative to flow (solid line). See the Discussion for further details about each model.

through the floodplain in direct association with flow, whereas others remain as long as possible to rear on the floodplain. The screw trap trends show no evidence that stranding had a major influence on patterns of emigration.

Relatively low stranding rates on the Yolo Bypass floodplain are supported by observations from other seasonal floodplain habitat in the San Francisco estuary (Peter Moyle, University of California–Davis, personal communication) and other studies. Higgins and Bradford (1996) and Bradford (1997) report that juvenile salmonids are relatively mobile and that most avoid being stranded during moderate rates of stage change. Higgins and Bradford (1996) state that maximum recommended stage reduction levels for gravel bars of regulated rivers are typically 2.5–5 cm/h, much more than the 1 cm/h or less rates of change in mean water depth we observed during drainage in the present study. In his review of the ecology of fishes in floodplain rivers, Welcomme (1979) noted that the majority of fish emigrate from floodplain habitat during drainage.

Even if stranding is not a major source of mortality, this does not necessarily mean that floodplains are not sinks for salmon production. Of the possible sources of mortality, birds and piscivorous fishes may have benefited from stranded salmon (Brown 2002). As noted by Sommer et al. (2001a), major avian predation is unlikely because densities of wading birds are low relative to the thousands of hectares of rearing habitat available during flood events. We did not measure densities of fish predators, but believe that the creation of large areas of rearing habitat should create more refuges for young fish and decrease the probability of encounter with a predator.

Ultimately, it is survival data that allow us to differentiate source from sink habitat. The size and complexity of the San Francisco estuary made it very difficult to directly measure survival rates with statistical rigor (Newman and Rice 2002); however, our CWT release studies at least provide an indication of whether survival rates in the Yolo Bypass were substantially different from those in the Sacramento River, the adjacent migration corridor. The limited results suggest that fry–adult survival rates were at least comparable in the Yolo Bypass and the Sacramento River. Moreover, the 1998 results suggest that in some years, survival may actually be substantially higher for salmon that migrate through the floodplain. Although none of these CWT releases were replicated, the fact that Sommer et al. (2001b) reported similar results for fry-to-smolt survival for the same releases in 1998 and 1999 increases our confidence that the survival data are not spurious.

Our data indicate that floodplains are a viable rearing habitat for juvenile Chinook salmon. Hence, the most important management implication of our study is that seasonal habitat should be considered as part of restoration plans for this species. Despite frequent concerns that off-channel habitat could increase stranding mortality (Brown 2002; Bruce Oppenheim, NOAA Fisheries, personal communication), our results for a hydrologically variable seasonal floodplain suggest that one should be able to design restoration projects that do not create a population sink because of excessive mortality. This is not to say, however, that stranding mortality is never an issue on floodplain habitat. For example, in the Yolo Bypass we saw significantly higher stranding rates in the concrete weir scour ponds of Fremont and Sacramento weirs than in earthen ponds. This finding suggests that artificial water control structures can create unusual hydraulics that promote stranding. However, the total area of these concrete weir ponds was only 3 ha, much smaller than our estimate of 600 ha for total isolated pond area for April 1998 and insignificant compared with the peak inundated area of 24,000 ha area. Fixing the poor hydraulics at these water-control structures may, nonetheless, be an attractive option, particularly if the cost of the solution is relatively low or if it helps to address other fisheries issues such as adult fish passage. In the Yolo Bypass, the concrete weirs not only create stranding problems for juveniles but also frequently block upstream passage of adult salmon, sturgeon, and steelhead trout (Sommer et al. 2001a), thus creating an incentive to resolve both issues simultaneously.

Finally, we wish to acknowledge that even natural floodplain or well-designed restored floodplain habitat could at least occasionally be a population sink because of stranding or predation losses. Our study was conducted over 3 years for a single, large floodplain; we cannot rule out the possibility that floodplains may not have net benefits in other years or locations. As an example, fish densities in the Yolo Bypass were relatively low compared with those reported in some other studies (Levy and Northcote 1982; Swales et al. 1986; Swales and Levings 1989); perhaps young salmon behavior could be different at higher densities. However, the potential for such losses can still be consistent with effective management of salmon populations. Diverse life history strategies provide bet-hedging for salmon populations in the highly variable environment of coastal tributaries (Secor 1999; Bottom et al. 2005). We therefore expect that young salmon will not thrive in all habitats in every year. In the case of highly variable seasonal environments such as floodplains, stranding losses might cause excessive mortality in some years, but the risks may be offset by increased rearing habitat and food resources in other years (Sommer et al. 2001b; Brown 2002).

Acknowledgments

This study would not have been successful without the contributions of staff from the Interagency Ecological Program, which includes the California Department of Water Resources, California Department of Fish and Game, and U.S. Fish and Wildlife Service. The field assistance of W. Batham, R. Kurth, C. Messer, K. Malchow, F. Feyrer, and L. Grimaldo is gratefully acknowledged. This manuscript was substantially improved by the comments of P. Moyle, B. Herbold, F. Feyrer, T.G. Brown, and two anonymous reviewers. Funding was provided by the Interagency Ecological Program and CALFED.

References

Bennett, W. A., and P. B. Moyle. 1996. Where have all the fishes gone?: interactive factors producing fish declines in the Sacramento–San Joaquin Estuary. Pages 519–542 *in* J. T. Hollibaugh, editor. San Francisco Bay: the ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco.

Bjornn, T. C. 1971. Trout and salmon movements in two Idaho streams as related to temperature, food, streamflow, cover, and population density. Transactions of the American Fisheries Society 100:423–438.

Bottom, D. L., C. A. Simenstad, J. Burke, A. M. Baptiste, D. A. Kay, K. K. Jones, E. Casillas, and M. H. Schiewe. 2005. Salmon at river's end: the role of the estuary in the decline of Columbia River salmon. NOAA Technical Memorandum NMFS-NWFSC-68.

Bradford, M. J. 1997. An experimental study of stranding of juvenile salmonids on gravel bars and in side channels during rapid flow decreases. Regulated Rivers 13(5):95–401.

Bradford, M. J., and P. S. Higgins. 2001. Habitat-, season-, and size-specific variation in diel activity patterns of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*). Canadian Journal of Fisheries and Aquatic Sciences 58:365–374.

Brandes, P. L., and J. S. McLain. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento–San Joaquin Estuary. California Department of Fish and Game Fish Bulletin 179(2): 39–138.

Brown, T. G. 2002. Floodplains, flooding, and salmon rearing habitats in British Columbia: a review. Canadian Science Advisory Secretariat, Research Document 2002/007. Available: http://www.dfo-mpo.gc.ca/Library/274333.pdf. (May 2005)

Clark, J. 1968. Seasonal movements of striped bass contingents of Long Island Sound and the New York Bight. Transactions of the American Fisheries Society 97:320–343.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29(1):91–100.

Haddon, M. 2001. Modelling and quantitative methods in fisheries. Chapman and Hall–CRC, Boca Raton, Florida.

Healey, M. C. 1991. Life history of Chinook salmon. Pages 311–394 *in* C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press, Vancouver.

Higgins, P. S., and M. J. Bradford. 1996. Evaluation of a large-scale fish salvage to reduce the impacts of controlled flow reduction in a regulated river. North American Journal of Fisheries Management 16: 666–673.

Junk, W. J., P. B. Bayley, and R. E. Sparks. 1989. The flood pulse concept in river–floodplain systems. Canadian Special Publication of Fisheries and Aquatic Sciences 106:110–127.

Kimmerer, W. J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco estuary. Estuaries 25:1275–1290.

Kjelsen, M. A., P. F. Raquel, and F. W. Fisher. 1982. Life history of all-run juvenile Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento–San Joaquin Estuary, California. Pages 393–411 *in* V. S. Kennedy, editor. Estuarine comparisons. Academic Press, New York.

Levy, D. A., and T. G. Northcote. 1982. Juvenile salmon residence in a marsh area of the Fraser River estuary. Canadian Journal of Fisheries and Aquatic Sciences 39:270–276.

Marchetti, M. P., and P. B. Moyle. 2001. Effects of flow regime on fish assemblages in a regulated California stream. Ecological Applications 11:530–539.

Mount, J. F. 1995. California's rivers and streams: the conflict between fluvial process and land use. University of California Press, Berkeley.

Newman, K. B., and J. Rice. 2002. Modeling the survival of Chinook salmon smolts out-migrating through the lower Sacramento River system. Journal of the American Statistical Association 97:983–993.

Nichols, F. H., J. E. Cloern, S. N. Luoma, and D. H. Peterson. 1986. The modification of an estuary. Science 231:567–573.

Power, M. E., A. Sun, G. Parker, W. E. Dietrich, and J. T. Wootton. 1995. Hydraulic food-chain models: an approach to the study of food-web dynamics in larger rivers. Bioscience 45:159–167.

Roper, B., D. L. Scarnecchia, and T. J. La Marr. 1994.

Summer distribution of and habitat use by Chinook salmon and steelhead within a major basin of the South Umpqua River, Oregon. Transactions of the American Fisheries Society 123(3):298–308.

Roper, B., and D. L. Scarnecchia. 1996. A comparison of trap efficiencies for wild and hatchery age-0 Chinook salmon. North American Journal of Fisheries Management 16:214–217.

Scrivener, J. C., T. G. Brown, and B. C. Anderson. 1994. Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) utilization of Hawks Creek, a small and nonnatal tributary of the upper Fraser River. Canadian Journal of Fisheries and Aquatic Sciences 41:1139–1146.

Secor, D. H. 1999. Specifying divergent migrations in the concept of stock: the contingent hypothesis. Fisheries Research 43:13–34.

Shreffler, D. K., C. A. Simenstad, and R. M. Thom. 1992. Juvenile salmon foraging in a restored estuarine wetland. Estuaries 15:204–213.

Sommer, T. R., W. C. Harrell, A. Mueller-Solger, B. Tom, and W. J. Kimmerer. 2004. Effects flow variation on the channel and floodplain biota and habitats of the Sacramento River, California, USA. Aquatic Conservation: Marine and Freshwater Ecosystems 14:247–261.

Sommer, T. R., W. C. Harrell, M. Nobriga, R. Brown, P. B. Moyle, W. J. Kimmerer, and L. Schemel. 2001a. California's Yolo Bypass: evidence that flood control can be compatible with fish, wetlands, wildlife, and agriculture. Fisheries 26(8):6–16.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001b. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58:325–333.

Sparks, R. E. 1995. Need for ecosystem management of large rivers and their floodplains. Bioscience 45: 168–182.

Spranza, J. J., and E. H. Stanley. 2000. Condition, growth, and reproductive styles of fishes exposed to different environmental regimes in a prairie drainage. Environmental Biology of Fishes 59(1): 99–109.

Swales, S., and C. D. Levings. 1989. Role of off-channel ponds in the life cycle of coho salmon (*Oncorhynchus kisutch*) and other juvenile salmonids in the Coldwater River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 46:232–242.

Swales, S., R. B. Lauzier, and C. D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. Canadian Journal of Zoology 64:1506–1514.

Ward, J. V., and J. A. Stanford. 1995. Ecological connectivity in alluvial river ecosystems and its disruption by flow regulation. Regulated Rivers: Research and Management 11:105–119.

Welcomme, R. L. 1979. Fisheries ecology of floodplain rivers. Longman Group Limited, London.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2000. Chinook salmon in the California Central Valley: an assessment. Fisheries 25(2):6–20.

Insights into the
Problems, Progress, and Potential Solutions
for Sacramento River Basin Native Anadromous Fish Restoration

Spring-Run Chinook Salmon in Mill Creek, California (Photo by Dave Vogel)

April 2011

Prepared for:

Northern California Water Association
and
Sacramento Valley Water Users

Prepared by:

Dave Vogel, Senior Scientist
Natural Resource Scientists, Inc.
P.O. Box 1210
Red Bluff, CA 96080
dvogel@resourcescientists.com

Exhibit "R"

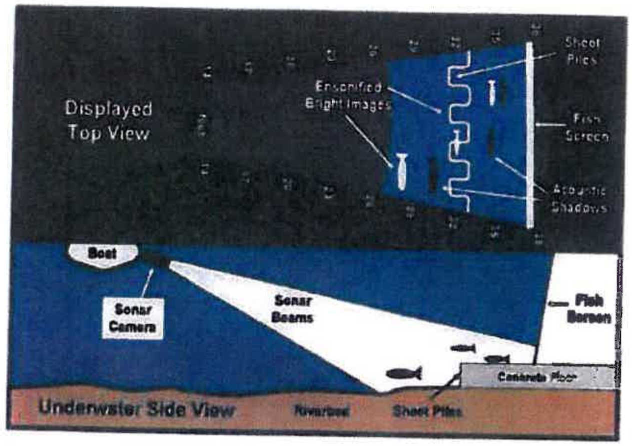


Figure 60. Schematics of DIDSON™ imaging at the base of a flat-plate fish screen. Bottom diagram shows orientation of sonar beams from the acoustic camera off the side of a boat and submerged objects at the fish screens. Top diagram shows the resultant corresponding sonar imaging of objects ensonified with acoustic shadows from the objects. (from Vogel 2008b)

From 1996 through 2010, Natural Resource Scientists, Inc. conducted 22 separate research projects on juvenile salmon (including four studies of predatory fish) in the Delta using acoustic or radio telemetry as a means to gain an improved understanding of fish movements and mortality (Vogel 2010a). The reason juvenile salmon telemetry studies were initiated in the Delta was to acquire detailed data on fish behavior, fish route selection through complex channels, and estimate fish survival in discrete reaches. Past efforts using traditional coded-wire tagging could not answer those critically important questions. Research findings from the telemetry investigations indicate that smolt survival assumptions and models must incorporate these new conclusions to avoid misinterpretation of data and improve quantitative estimates of fish survival and movements (Vogel 2010a).

The first successful use of telemetry on juvenile salmon in the Central Valley was conducted by Natural Resource Scientists, Inc. on behalf of EBMUD in 1996 and 1997. At that time, the specific behavior of juvenile salmon in the Delta was largely unknown. The initial studies quickly determined that the fish did not move as a school, but instead, dispersed, exhibiting a wide range in migratory behaviors in the complex Delta environment. Salmon moved many miles back and forth each day with the ebb and flood tides and the side channels (where flow was minimal) were largely unused. Site-specific hydrodynamic conditions present at flow splits when the fish arrived had a major affect in initial route selection. Importantly, some of the salmon were believed to have been preyed upon based on very unusual behavior patterns (Vogel 2010a).

Subsequent, additional juvenile salmon telemetry studies were conducted by Natural Resource Scientists Inc. on behalf of the USFWS and CALFED in the north Delta (Vogel 2001, Vogel 2004). Triangulating radio-tagged fish locations in real time (Figure 61) clearly demonstrated how juvenile salmon move long distances with the tides and were advected into regions with very large tidal prisms, such as upstream into Cache Slough and into the flooded Prospect and Liberty Islands (Figure 62). During the studies, it was determined that some radio-tagged salmon were eaten by predatory fish in northern Cache Slough, near the levee breaches into flooded islands (discussed below). Also, monitoring telemetered fish revealed that higher predation occurred in Georgiana Slough as compared to the lower Sacramento River (Figure 63). As discussed previously, past coded-wire tagging studies found that salmon released into northern Georgiana Slough were found to have a higher mortality rate than fish released downstream of the slough in the Sacramento River (Brandes and McLain 2001).

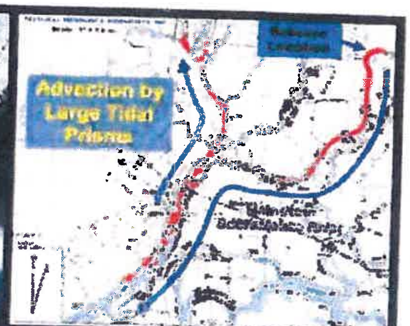


Figure 61. Left picture, mobile telemetry conducted in the north Delta. Photo by Dave Vogel.
Figure 62. Right picture, telemetered locations of approximately 100 radio-tagged salmon smolts released in the lower Sacramento River near Ryde (data from Vogel 2001 and Vogel 2004).

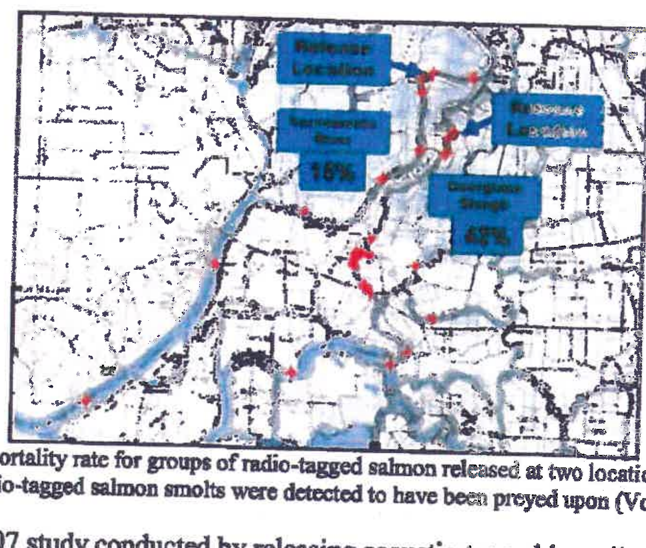
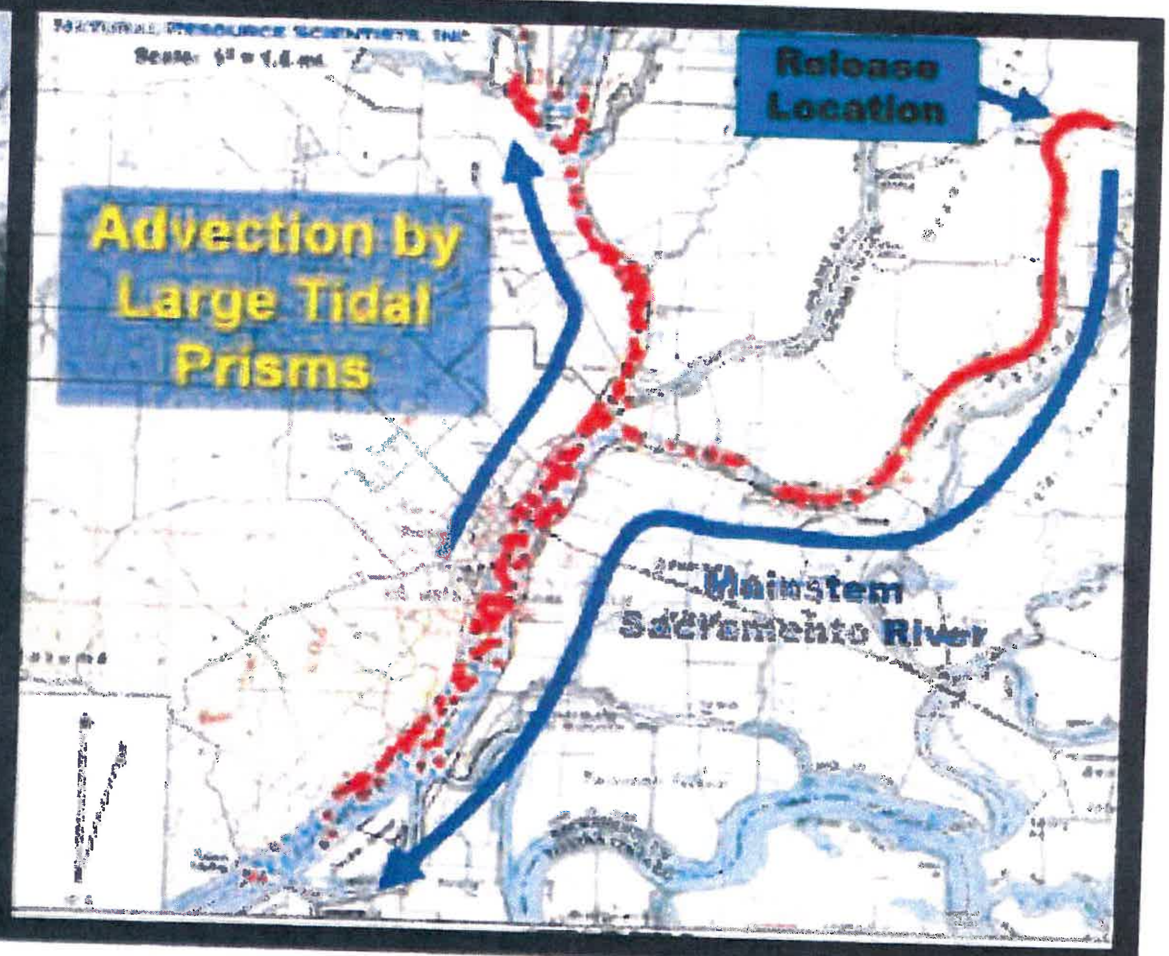


Figure 63. Estimated mortality rate for groups of radio-tagged salmon released at two locations in the north Delta and locations where radio-tagged salmon smolts were detected to have been preyed upon (Vogel 2001, Vogel 2004).

More recently, a 2007 study conducted by releasing acoustic-tagged juvenile salmon in the San Joaquin River found 116 motionless juvenile salmon transmitters in the lower San Joaquin River near the Stockton Waste Water Treatment Plant and a nearby bridge (Figure 64) (Vogel 2007b). This was an all-time record for the largest number of dead radio- or acoustic-telemetered juvenile



ducted in the north Delta. Photo by Dave Vogel.
ıs of approximately 100 radio-tagged salmon smolts released in the

vegetation at some sites in the Delta and water clarity. Increased water clarity for sight predators such as black bass and striped bass would presumably favor predatory fish over prey (*e.g.*, juvenile salmon). Fewer native fish species are found in *Egeria* stands compared to introduced fish species (Grimaldo and Hymanson 1999). Additionally, it has been hypothesized that high densities of *Egeria* in portions of the Delta may restrict juvenile salmon access to preferred habitats, forcing salmon to inhabit deep water or channel areas where predation risks may be higher (Grimaldo *et al.* 2000).

During recent years, there has been an emphasis to reclaim or create shallow, tidal wetlands to assist in re-recreating the form and function of ecosystem processes in the Delta with the intent of benefitting native fish species (Simenstad *et al.* 1999). Among a variety of measures to create such wetlands, Delta island levees either have been breached purposefully or have remained unrepaired so the islands became flooded. A recent example is the flooding of Prospect Island which was implemented under the auspices of creating shallow water habitat to benefit native fish species such as anadromous fish (Christophel *et al.* 1999). Initial fish sampling of the habitat created in Prospect Island suggested the expected benefits may not have been realized due to an apparent dominance of non-native fish (Christophel *et al.* 1999). Importantly, a marked reduction of sediment load to the Delta in the past century (Shvidchenko *et al.* 2004) has implications in the long-term viability of natural conversion of deep water habitats on flooded Delta islands into shallow, tidal wetlands. The very low rates of sediment accretion on flooded Delta islands indicate it would take many years to convert the present-day habitats to intertidal elevations which has potentially serious implications for fish restoration (Nobriga and Chotkowski (2000) due to likely favorable conditions for non-salmonid fish species that can prey on juvenile salmon. Studies of the shallow water habitats at flooded Delta islands showed that striped bass and largemouth bass represented 88 percent of the individuals among 20 fish species sampled (Nobriga *et al.* 2003).

There have likely been significant adverse, unintended consequences of breaching levees in the Delta. There is a high probability that site-specific conditions at the breaches have resulted in hazards for juvenile anadromous fish through the creation of favorable predator habitats. The breaches have changed the tidal prisms in the Delta and can change the degree in which juvenile fish are advected back and forth with the tides (Figure 61; previously discussed). Additionally, many of the breaches were narrow which have created deep scour holes favoring predatory fish. Sport anglers are often seen fishing at these sites during flood or ebb tides. Breaching the levees at Liberty Island is an example (Figure 72 and 73). Recent acoustic-tagging of striped bass in this vicinity confirmed a high presence of striped bass (Figure 74, D. Vogel, unpub. data).

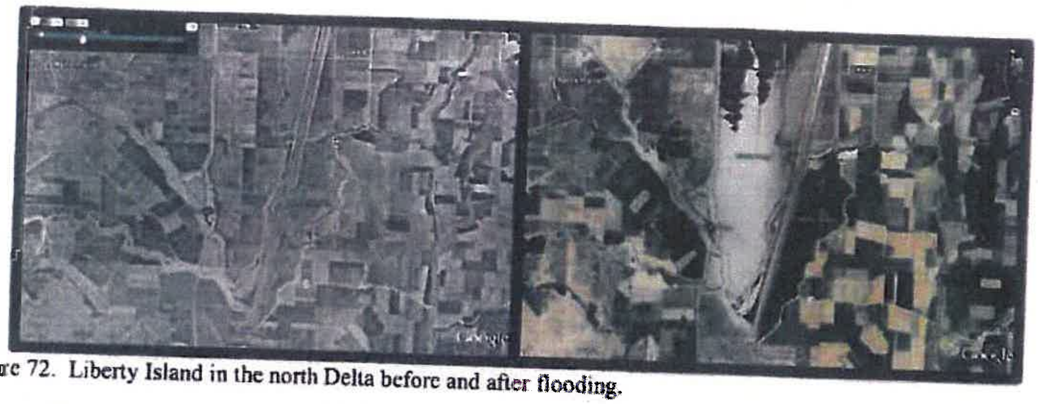


Figure 72. Liberty Island in the north Delta before and after flooding.

Figure 73. Liberty Island in the north Delta before and after flooding showing locations of narrow breaches in the levee.

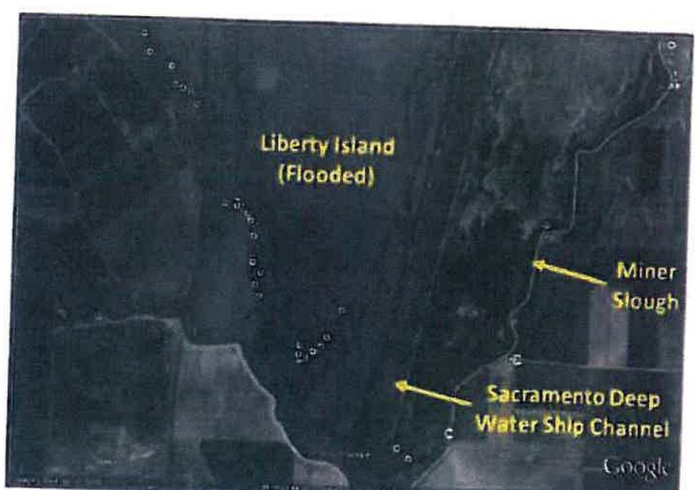


Figure 74. Locations (squares) where predatory striped bass were acoustic-tagged with transmitters during the winter of 2008 – 2009 in the north Delta near Liberty Island (D. Vogel, unpublished data).

STATE OF CALIFORNIA
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DIVISION OF WATER RESOURCES
EDWARD HYATT, State Engineer

SACRAMENTO-SAN JOAQUIN WATER SUPERVISOR'S REPORT

FOR YEAR

1931

By
HARLOWE M. STAFFORD
Water Supervisor

Under the supervision of
HAROLD CONKLING
Deputy State Engineer

August, 1932

Exhibit "S"

TABLE 69

UNIT CONSUMPTIVE USE OF WATER IN SACRAMENTO-SAN JOAQUIN DELTA**
Acre-feet per Acre

Crop or Classification	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total Seasonal Use	Total Annual Use
Alfalfa	(.06)	(.08)	.10	.30	.40	.50	.65	.55	.50	.20	(.10)	(.07)	3.20	3.51
Asparagus	.05	.05	.05	.05	.08	.14	.40	.68	.55	.42	.12	.10	2.69	2.69
Beans	(.06)	(.08)	(.08)	(.16)	(.20)	.14	.24	.58	.37	(.09)	(.07)	(.05)	1.33	2.12
Beets	(.06)	(.08)	(.08)	.13	.32	.51	.61*	.53*	.20*	(.13)	(.10)	(.07)	2.30	2.82
Celery	(.04)	(.04)	(.04)	(.08)	(.10)	.10	.10	.20	.25	.30	.20	.05	1.20	1.50
Corn	(.04)	(.04)	(.04)	(.08)	(.10)	.24	.85	.84*	.40*	.10	(.10)	(.07)	2.43	2.90
Fruit	(.04)	(.04)	(.04)	.18	.32	.50	.57	.40	.23	.07	(.07)	(.05)	2.27	2.51
Grain and Hay	(.04)	(.04)	.07	.60	.83	.20	(.14)	(.23)	(.21)	(.14)	(.07)	(.05)	1.70	2.62
Onions	(.04)	(.04)	.08	.13	.27	.49	.43	.20	(.16)	(.13)	(.10)	(.07)	1.60	2.14
Pasture	.08	.10	.20	.25	.25	.25	.25	.25	.20	.15	.10	.08	2.16	2.16
Potatoes	(.06)	(.08)	(.08)	(.16)	.15	.38	.52	.30	.15	(.09)	(.07)	(.05)	1.50	2.09
Seed	(.06)	(.08)	(.08)	.10	.25	.50	.50	.50	.35	.10	(.10)	(.07)	2.30	2.69
Truck	(.06)	(.08)	.10	.10	.25	.50	.45	.45	.30	.15	.10	(.07)	2.40	2.61
Tules	.16	.09	.30	.74	1.10	1.28	1.53	1.32	1.18	.98	.59	.36	9.63	9.63
Willows	.05	.03	.09	.22	.33	.38	.46	.40	.35	.29	.18	.10	2.88	2.88
Bare Land	.04	.04	.04	.08	.10	.13	.14	.13	.11	.09	.07	.05	1.02	1.02
Idle Land with Weeds***	.06	.08	.08	.16	.20	.26	.28	.24	.16	.13	.10	.07	1.82	1.82
Open Water Surfaces	.08	.13	.23	.34	.60	.76	.84	.78	.60	.33	.14	.08	4.91	4.91

NOTE: Figures shown in brackets ( ) represent estimated consumptive use on cropped areas before planting and after harvest. (Evaporation from bare land, use by weeds, etc.).

* Includes estimated additional use by weeds during these months.

** These are the data as determined for and published in Bulletin No. 27 - "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay" - Table 1.

*** Average for land below elevation 5.0 U.S.G.S. datum. Use on unirrigated lands above elevation 5.0 is considered zero.

STATE OF CALIFORNIA
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EDWARD HYATT, State Engineer

SACRAMENTO-SAN JOAQUIN

WATER SUPERVISOR'S

REPORT

FOR YEAR

1931

By
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Under the supervision of
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Deputy State Engineer

August, 1932

Exhibit “T”

TABLE 74

USE OF WATER BY CAT-TAILS GROWN IN TANKS, NEAR CLARKSBURG, RECLAMATION DISTRICT 999, 1931

TANK NO.	USE OF WATER - ACRE-FEET PER ACRE												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
2	0.22	0.22	0.58	1.08	2.28	2.28	2.96	2.51	1.66	0.91	0.43	0.23	15.36
3	0.21	0.20	0.49	1.12	1.94	2.11	2.51	1.92	1.36	0.83	0.51	0.22	13.42
4	0.20	0.21	0.52	1.30	2.51	2.78	3.34	2.78	1.90	1.04	0.54	0.29	17.41
5	0.23	0.25	0.50	1.15	1.98	1.83	2.04	1.82	1.28	0.76	0.37	0.13	12.34
6	0.22	0.24	0.60	1.44	2.80	2.77	3.51	—UNDER TEST FOR LEAKAGE→					
MEANS	0.22	0.22	0.54	1.22	2.30	2.35	2.87	*2.26	*1.55	*0.94	*0.46	*0.22	*14.63

*MEAN OF FOUR TANKS

TABLE 75

USE OF WATER BY TULES GROWN IN TANKS, NEAR CLARKSBURG, RECLAMATION DISTRICT 999, 1931

TANK NO.	USE OF WATER - ACRE-FEET PER ACRE												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
7	0.21	0.23	0.54	1.32	3.02	2.88	4.35	—UNDER TEST FOR LEAKAGE—					
8	0.20	0.24	0.48	1.18	2.45	2.39	3.02	2.59	1.78	1.01	0.51	0.20	16.05
9	0.20	0.26	0.48	1.12	2.14	2.20	2.76	1.98	1.37	0.82	0.41	0.20	13.94
10	0.19	0.24	0.51	1.08	2.07	2.26	2.88	1.71	1.23	0.66	0.43	0.23	13.49
11	0.21	0.19	0.40	0.90	1.84	1.65	1.63	1.32	1.16	0.72	0.39	0.19	10.60
12	0.20	0.20	0.25	0.84	1.75	1.26	2.75	2.36	1.72	1.09	0.61	0.27	13.30
MEANS	0.20	0.23	0.44	1.07	2.21	2.11	2.90	*1.99	*1.45	*0.86	*0.47	*0.22	*13.48

*MEAN OF FIVE TANKS

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

PUBLICATIONS OF THE
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EDWARD HYATT, State Engineer

SACRAMENTO-SAN JOAQUIN WATER SUPERVISOR'S REPORT

FOR YEAR

1931

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Under the supervision of
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Deputy State Engineer

August, 1932

Exhibit "U"

TABLE 77

USE OF WATER BY CAT-TAILS AND TULES GROWN IN TANKS AT CAMP 3, KING ISLAND
1931

TANK NUMBER	PLANT	WATER SURFACE ABOVE GROUND SURFACE FEET	USE OF WATER – ACRE-FEET PER ACRE													COMPARATIVE PLANT SIZE (2)
			JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC. (3)	YEAR (4)	
1	CAT-TAILS	0.0	0.14	0.13	0.25	0.52	0.52	0.31	0.33	0.18	0.13	0.15	0.07		2.8	UNDERSIZE
2	CAT-TAILS	1.0	–	NO USABLE	RECORD	–	(1)0.72	0.82	0.92	0.82	0.67	0.53	0.26		6.2	UNDERSIZE
3	TULES	1.0	–	NO USABLE	RECORD	–	(1)1.33	1.13	1.32	1.16	0.80	0.51	0.19		8.0	NORMAL
4	TULES	0.0	0.17	0.15	0.45	0.58	1.00	0.88	0.88	0.71	0.53	0.15	0.07		5.7	UNDERSIZE

(1) INCLUDES APRIL 29TH AND 30TH.
(2) THE COMPARISON FOR SIZE IS WITH SURROUNDING PATCH PLANTS OF THE SAME KIND. PLANTS IN TANKS NUMBERS 1 AND 2 WERE UNDERSIZE ALL SEASON. PLANTS IN TANK NUMBER 4 WERE NORMAL SIZE AT BEGINNING OF SEASON.
(3) HEAVY RAINS DERANGED CONDITIONS SO THAT NO RELIABLE RECORD FOR DECEMBER WAS OBTAINED.
(4) ESTIMATED. CLOSELY FOR TANKS NUMBERS 1 AND 4. ROUGHLY FOR TANKS NUMBERS 2 AND 3.

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TABLE 78

USE OF WATER BY TULES GROWN IN TANKS AT SIMMONS ISLAND, NEAR BAY POINT, 1931

TANK NO.	WATER SURFACE ABOVE GROUND SURFACE FEET	USE OF WATER – ACRE-FEET PER ACRE													NUMBER OF STALKS IN JULY*
		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.*	DEC.	YEAR (APPROX)	
1	1.0	0.11	0.15	0.23	0.28	0.38	0.48	0.61	0.48	0.43	0.21	0.11	(0.11)	3.58	11
2	0.0	(0.11)	(0.11)	(0.12)	0.14	0.94	0.80	0.69	0.52	0.36	0.22	0.11	(0.11)	4.23	19
3	1.0	(0.11)	(0.15)	(0.28)	0.34	1.01	0.87	0.84	0.67	0.60	0.46	0.29	(0.11)	5.73	35
4	0.0	(0.11)	(0.15)	(0.24)	0.29	0.96	0.89	0.78	0.59	0.54	(0.30)	0.14	(0.11)	5.10	30
MEANS		(0.11)	(0.14)	(0.22)	0.26	0.82	0.76	0.73	0.57	0.48	(0.30)	0.16	(0.11)	4.66	

NOTE: FIGURES IN PARENTHESES ARE ESTIMATED.
* THERE WERE SOME NEW SPROUTS IN ALL TANKS IN JULY.

1.C.2.2 Attachments to Comments of Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District

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ATTACHMENT A

The Bureau of Reclamation (BOR) has proposed to operate New Melones Reservoir to try to meet a water temperature target of 65°F (7 day average daily max; 7DADM) at Goodwin Dam from April 1, 2015 through October 31, 2015. This target would be in lieu of the water temperature objectives recommended by the BiOp. Flows downstream of Goodwin Dam would be those described in table 2e of the BiOP, and no additional water would be released for temperature management. Tri-Dam Project, OID, and SSJID are providing this memorandum and information in support of BOR's proposed operations.

Water temperatures downstream of Goodwin Dam were modeled based on BOR's proposed operating strategy and this information is provided as Attachment 1. Two scenarios were considered with regard to power generation. A base case run assumed all released water passes through the generators until power generation ceases when reservoir elevation falls below the power intake. In an alternate run, power generation is gradually bypassed as the water surface elevation in New Melones Reservoir approaches the elevation of the powerhouse inlet. This allows for blending of warmer surface water released through the powerhouse with cooler water released through the low level outlet.

The model runs predict that water temperatures at Goodwin Dam would reach approximately 70°F in early August under the base case, and would then abruptly drop to approximately 60°F when power generation ceases due to the reservoir elevation falling below the power intake. These extremes can be moderated by gradually bypassing power generation as simulated in the alternate run. Gradually bypassing power generation as the reservoir elevation approaches the elevation of the powerhouse inlet allows for blending of warm water released through the powerhouse with colder water released through the low level outlet. Bypassing power generation through the entire summer would quickly deplete the coolest water stored in the reservoir, resulting in higher water temperatures than the alternate run.

Under the alternate run which reduces temperature extremes by gradually bypassing power generation, BOR's proposed target of 65°F at Goodwin Dam is generally met from April through October[1]. End of September storage under this scenario is projected to be approximately 130,000 AF. A second set of base case and alternate power bypass runs were made assuming higher carryover storage of approximately 200,000 AF to explore the potential influence of higher carryover storage on release temperatures. Comparison of the two sets indicated no apparent improvement in temperature conditions during October with higher carryover storage.

What does this mean for fish?

BOR's proposal would target 65°F at Goodwin for spring outmigration, *O. mykiss* oversummering, and for adult upstream migration during the fall. Each of these periods is discussed in the following sections with regard to the BiOp water temperature objectives, projected temperature conditions, and potential impacts to fish.

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[1] Projected water temperatures range from 65.2°F to 66.1°F during July 31 through August 13.

Spring outmigration conditions
The BiOp includes water temperature objectives of 52°F at Knights Ferry and 55°F at Orange Blossom Bridge (OBB) January 1 through May 31 for *O. mykiss* smoltification. Water temperature modeling in Attachment 1, and also reflected in Figure 1, demonstrate that these objectives cannot be met in 2015 since water temperatures at release from Goodwin Dam are expected to exceed the objectives. Modeled temperatures at Goodwin Dam are slightly cooler than observed temperatures during April and May 2014.

A pulse flow intended by the BiOp to provide outmigration flow cues to enhance likelihood of anadromy and for conveyance and maintenance of downstream migratory habitat quality, occurred during March 24 through April 2. No *O. mykiss* smolts were captured in the rotary screw traps and no untagged *O. mykiss* smolts were captured at the Mossdale trawl in response to the 1,500 cfs pulse flow. Similarly, there was no apparent response of Chinook salmon to the pulse flow, likely due to the timing being in the lull between fry and smolt migrations. A second pulse flow of larger volume is scheduled to occur April 7 through April 19 for the same purpose.

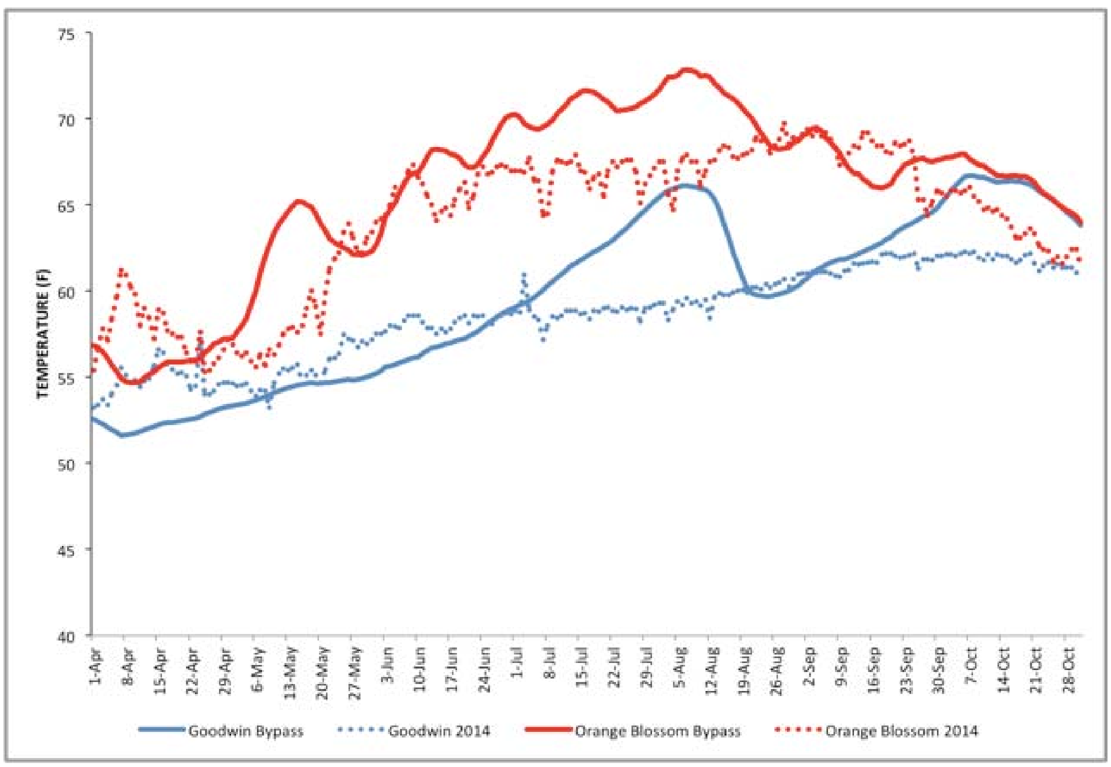

Figure 1. Projected 2015 7DADM water temperature and observed 2014 daily maximum water temperature at Goodwin Dam and OBB.

Oversummering conditions
The BiOp includes an oversummering water temperature objective of 65°F at OBB June 1 through September 30. This objective has consistently been exceeded during the past three years,

and the objective was not met on a single day during 2014 (Figure 2). The Stanislaus River Operations Group (SOG) report showed that June-September 2014 maximum water temperatures at OBB approached, but did not exceed 70°F (SOG 2014).

Summer water temperatures during July and August 2015 are projected to be warmer than during 2014. Temperatures are expected to decrease during September to levels similar to 2014 as releases would be made entirely through the low level outlet. However, this reduction in temperature is short-lived as temperatures are projected to rise in October when cold water storage behind New Melones Dam is depleted. BOR's proposed target of 65°F at Goodwin is projected to generally be met during the oversummering period. Projected water temperatures range from 65.2°F to 66.1°F during July 31 through August 13.

Annual surveys of *O. mykiss* abundance and distribution conducted annually by the Districts since 2009 have documented a relatively stable population (Figure 3). River-wide abundance estimates from 2009 to 2014 have averaged just over 20,220 *O. mykiss* (all life stages combined) and have never been estimated to be less than about 14,000 (2009). High index densities of *O. mykiss* have been consistently observed in the Goodwin Canyon reach over the past six monitoring seasons. This reach can be generally classified as a high gradient reach that contains a higher relative amount of fast-water habitats (riffles and rapids). Relative to the lower reaches of the Stanislaus River, the Goodwin Canyon reach has more, smaller units (about 22 habitat units per mile). The number of habitat units in this reach may provide more habitat complexity than other reaches of the Stanislaus River. Key factors that may contribute to higher-than-average abundances on the Stanislaus (relative to other San Joaquin River tributaries) include high gradient reaches that are typically associated with higher amount of fast-water habitats, especially in Goodwin Canyon. Surveys planned for 2015 will provide data to detect any changes from baseline abundance and distribution that may occur in response to the ongoing drought.

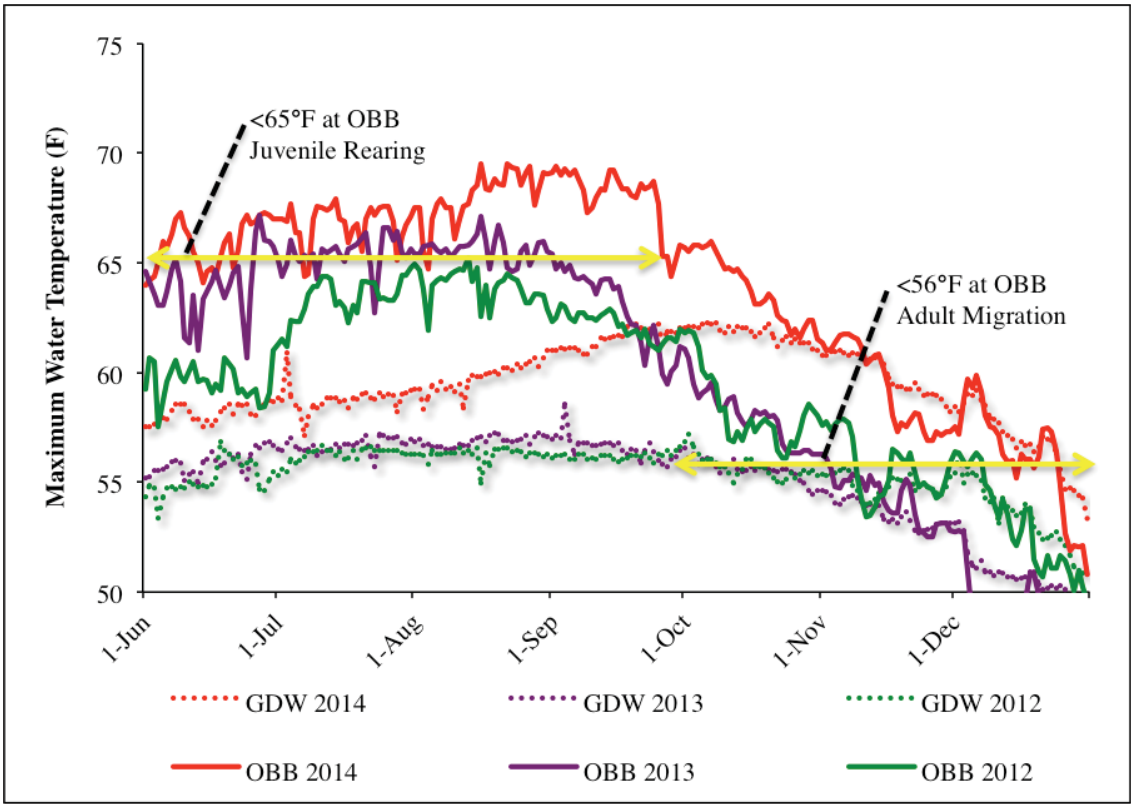

Figure 2. June 1 – December 31, 2012-2014 daily maximum water temperature at Orange Blossom Bridge and Goodwin Dam.

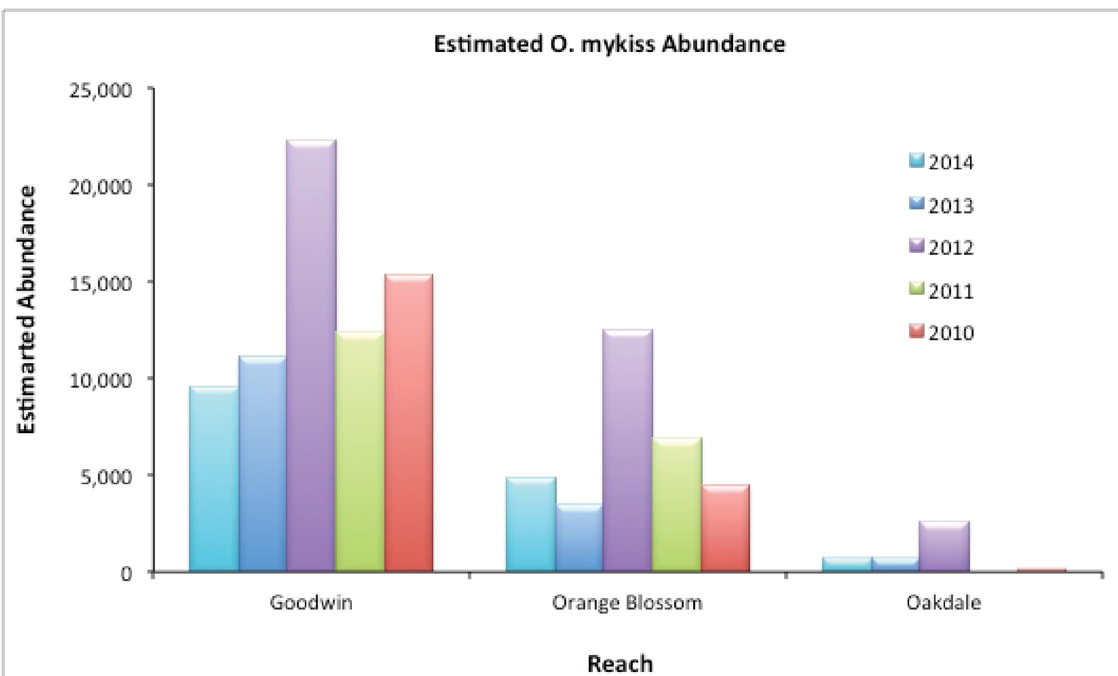

Figure 3. Distribution of *O. mykiss* in the Stanislaus River between Goodwin Dam and Oakdale during 2009-2014.

Fall conditions

The BiOp includes an adult *O. mykiss* migration water temperature objective of 56°F at OBB during October 1 through December 31. Release temperatures at Goodwin exceeded this objective until December during 2014 (Figure 2). Water temperatures are projected to be warmer during October 2015 than observed during October 2014 (Figure 1). BOR's proposed target of 65°F at Goodwin is projected to be met through October.

Any upstream migrating adult *O. mykiss* or Chinook salmon would have already migrated through much warmer water temperatures downstream in the San Joaquin River and Delta. October is also early for *O. mykiss* upstream migration. At the Stanislaus River weir, migration of *O. mykiss* > 16 inches has been observed as early as October 8 and median passage typically occurs during late December.

Fall-run Chinook salmon are not protected under the ESA, and there are currently no water temperature objectives for fall-run in the Stanislaus River. However, the fall pulse flows and water temperature objectives in the BiOp were largely based on the purported needs of fall-run Chinook as a proxy for *O. mykiss*. Based on redd surveys conducted by FISHBIO, peak spawning typically occurs in November with roughly 7% of spawning occurring prior to November 1. During late-September and early October, median redd location is typically near the upper end of Goodwin Canyon where temperatures are coolest (Attachment 2). By late October, spawning increases in downstream locations as water temperatures decrease due to decreasing ambient air temperatures, and median redd location is typically Knights Ferry. While the warm release temperatures at Goodwin Dam predicted by the model will decrease the incubation success of eggs deposited by any early arriving fall-run Chinook salmon that may spawn during October, this is a consequence of the unprecedented drought conditions which would have likely resulted in no flow under unimpaired conditions. During November as ambient air temperatures decrease, the stream begins to cool naturally as it flows downstream from Goodwin Dam. While this is expected to provide for greater success of fall-run Chinook salmon spawning in November and December relative to October, temperature impacts to incubating fall-run Chinook salmon during fall 2015 are now unavoidable.

Summary

There is a difficult management decision to be made at New Melones this year. BOR can operate in the traditional method through the powerhouse and water temperatures at Goodwin will exceed 65°F during the summer. If the powerhouse and bypass are blended 65°F at Goodwin can mostly be achieved during the summer. However, using the bypass in July or August depletes the coldwater mass behind New Melones resulting in elevated water temperatures for fall-run Chinook that arrive in the Stanislaus River before November 1. The amount of carryover storage in the two runs, 200,000AF and 115,000AF, indicate no apparent improvement in water temperatures in October.

ATTACHMENT 1

Stanislaus River Water Temperature Model Results

Stanislaus Temperature Modeling
2015 Proposed Operations

1. Objective

The objective of this work is to assess, using the HEC-5Q Model, the expected temperature conditions at discrete points along the Stanislaus River, given the currently proposed water release schedule from New Melones through the end of 2015.

2. Background

Review of snow pack data from several CDEC stations in or near the Stanislaus watershed indicates that the runoff this year will likely be the lowest of the past 30+ years (see Figure 3).

The Tri-Dam Project is estimating that the total inflow to New Melones from March 1 to September 30 of this year will be in the order of 90,000 acre-feet with the majority of the inflow occurring in March, April and May. For modeling purposes, it is also assumed that the inflow in October will be in the order of 3,000 acre-feet.

The closest historical hydrologic condition to the current year appears to be the dry year of 1987 and even then, the historical inflow to New Melones exceeded the current runoff projection.

3. Modeling Approach

The modeling approach under this scope of work is to use 1987 as an example year in terms of the climate conditions and pattern of runoff, yet to scale down the historical inflow to New Melones to match the 90,000 and 3,000 acre-feet projections, as follows:

			Historical inflow , AF	Ratio:Historical to 90 & 3 TAF
1-Mar	thru	30-Sep-1987	**295,412**	**0.305**
1-Oct	thru	31-Oct-1987	**12,175**	**0.246**

Figure 1: Scaling Factors from Historical Inflow to Projected Inflow

Then, set the New Melones storage to the current state (605,600 acre-feet on February 28), superimpose the release and diversion schedule that is currently being proposed (see Diversion and Release Schedule below), and operate the system accordingly.

This approach will enable estimating the temperature conditions that might be experienced at various locations along the Stanislaus (e.g., below Goodwin Dam, Knights Ferry, Orange Blossom Bridge and Oakdale) through the end of 2015.

It should be noted that given the extremely low water level in New Melones at the present time, it is probable that the old Melones Dam will be exposed, similar to what had happened in the drought of 1987-1992. The model will simulate the old-new dam interaction, including the switch from power plant flow to low-level outlet release and the ramification of this kind of operation on the temperature response below Goodwin Dam and downriver.

4. Diversion and Release Schedule

The proposed diversion schedule from the Goodwin Pool to OID and SSJID and the release to the river from Goodwin Dam, as obtained from the stakeholders, are as follows:

Month	Water Right Type	2014 Diversion to Storage (acre-feet)	2014 Direct Diversion acre-feet
January:	Riparian:		
	Pre1914:		
February:	Riparian:		
	Pre1914:		
March:	Riparian:		
	Pre1914:		28,209
April:	Riparian:		
	Pre1914:		40,666
May:	Riparian:		
	Pre1914:		58,906
June:	Riparian:		
	Pre1914:	2,972	73,314
July:	Riparian:		
	Pre1914:		75,030
August:	Riparian:		
	Pre1914:		67,925
September:	Riparian:		
	Pre1914:		42,338
October:	Riparian:		
	Pre1914:		8,111
November:	Riparian:		
	Pre1914:		
December:	Riparian:		
	Pre1914:		

(Note: Diversion to Storage is ignored)

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan
	563	600	559	488	385	299	206	119	63	49	54	61	63

Monthly Stanislaus River Releases — use these

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan
TAF:	14	25	30	29	16	19	14	9	35	15	13	18
cfs:	255	403	503	465	270	316	232	153	573	260	205	295

Figure 2: Proposed Diversion and Release Schedule

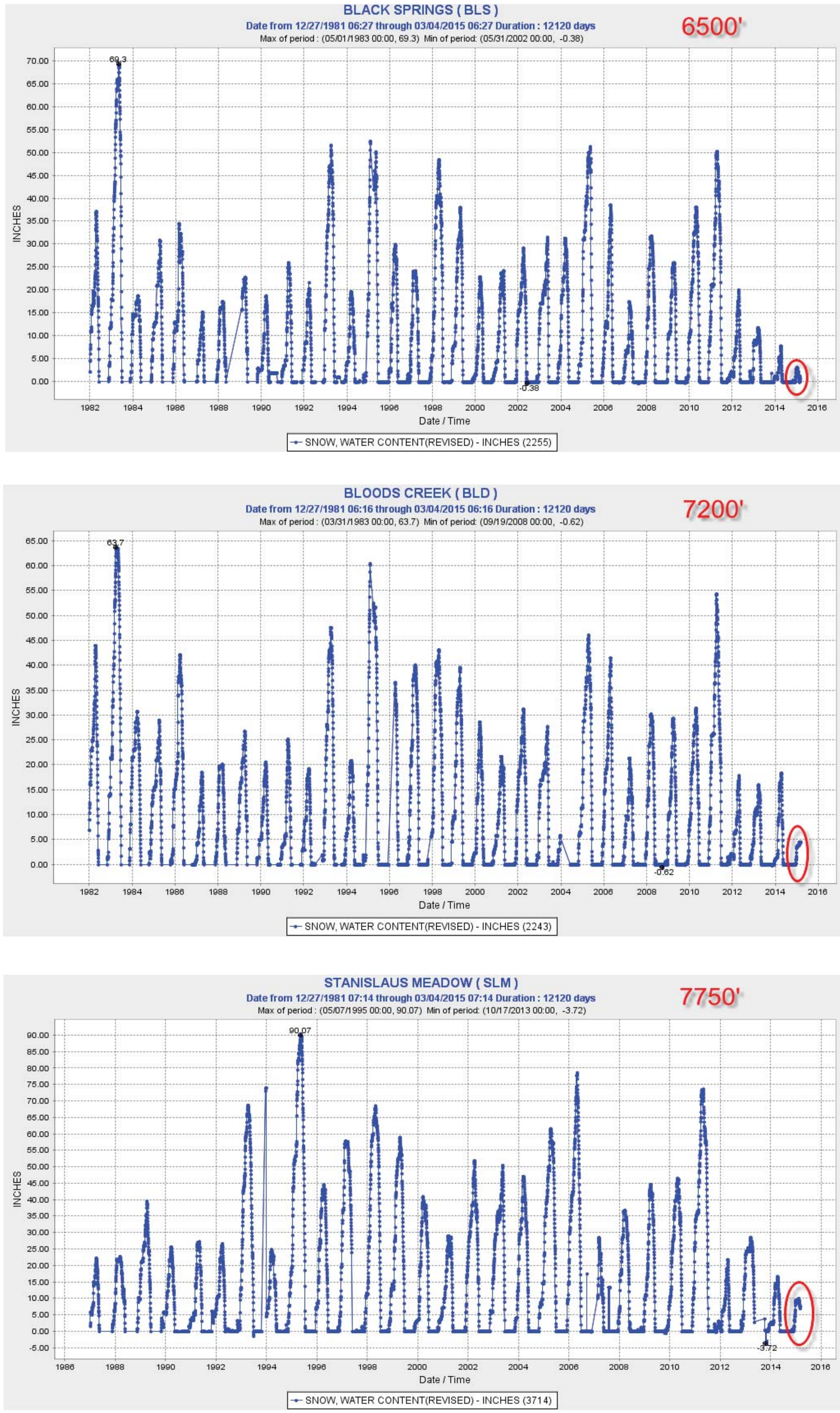

Figure 3: Snow Pack Data from Several CDEC Stations near the Stanislaus watershed

5. Tasks:

1. Set up the data to run a year similar to 1987:
   a. Process the hydrological and meteorological data.
   b. Define volume such that the storage at the end of February 28 is 605,600 acre-feet.
   c. Scale down the May - September flow & October flows by the ratios shown in Figure 1.
   d. Assume monthly average diversion and New Melones outflow, as specified the Diversion and Release Schedule in Figure 2.
   e. Prepare DSS inputs for the above.
2. Set up the model to run the modified 1987.
3. Run the model - generate output as directed.
4. QA/QC of results with emphasis on new-old dam interaction.
5. Analyze the results in terms of the expected temperatures at the specified locations along the Stanislaus River from day 1 of the simulation to end-of-year 2015.
6. Evaluate the merit of different strategies for switching from power plant flow to low-level outlet release from New Melones.
7. Compile a short write up about study findings.
8. Present results to the client.

Modeling, Analysis and Findings

1. Model Setup

The HEC-5Q was set to simulate a single year similar to 1987 in terms of the pattern of inflow to New Melones except that the rate of the inflow was scaled down in accordance with Figure 1 above. The meteorological conditions were also set to match the historical conditions in 1987.

In order to prime the model, the simulation started on January 1, 1987 where by New Melones storage was set in such a way that by February 28 the total volume of water in the reservoir would equal to the observed volume on that date, i.e., 605,600 acre-feet. The computed temperature profiles in New Melones and Tulloch were then compared with observed data near March 1 from other years (see Figure 4 below) to ensure that the boundary condition as far as the thermal structures in the reservoirs are reasonable (note that in Figure 4 the New Melones elevation is completely different, however the temperature ranges and profile shapes are similar in both reservoirs).

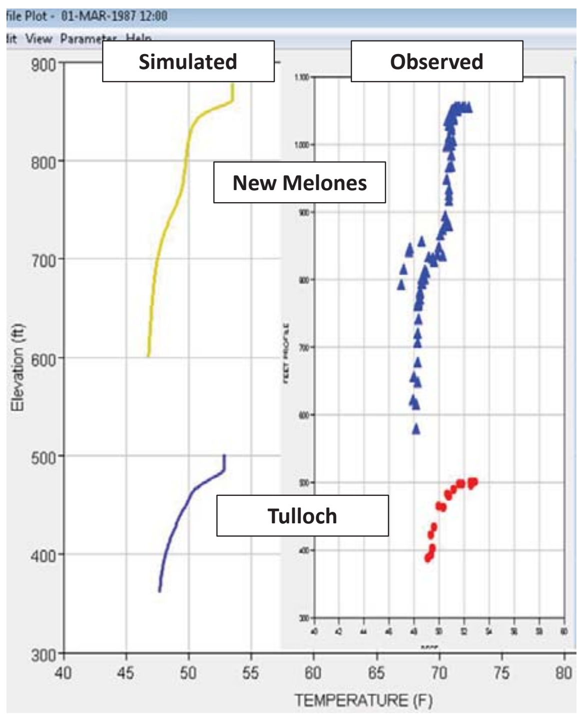

Figure 4: Computed and Observed Thermal Profiles in New Melones and Tulloch Reservoirs near March 1

2. Simulation Modes

The HEC-5Q was run in two modes:

a) No-Bypass Operation – under this mode, New Melones was operated in a way where the water is released through the power plant until the water level in the reservoir reaches the minimum power pool elevation.

b) Bypass Operation – under this mode, New Melones was operated in a way where the release is switched gradually from power release to low-level outlet release in advance of reaching minimum power pool elevation.

For the latter, several strategies for bypass operation were analyzed in terms of the starting date and the rate of transitioning from no-bypass to full-bypass operation, as explained below.

3. Projected New Melones Storage

The effect on New Melones Storage is essentially the same for the two operation modes described above. Mass-balance calculation on New Melones for the period March 1 through Oct 31, 2015 is shown in Figure 5 below:

	Release to River	Diversion (OID & SSJID)	Total Outflow	NM Storage	NM Elev
Beginning:	(CFS)	(CFS)	(TAF)	(TAF)	(FT)
Mar	200	459	41	605	879
Apr (1)	200	683	26		
Apr (16)	500	683	35		
May (1)	500	958	43		
May (16)	150	958	35		
Jun	150	1,232	82		
Jul	150	1,220	84		
Aug	150	1,105	77		
Sep	150	712	51		
Oct	175	132	19		
Nov				181	768
Total (TAF)	124	394	494		
Projected Inflow to NM			93		
Reduction in storage in NM (excluding evap and local runoff)			401		
Reduction in storage in NM (including evap and local runoff)			424		

Figure 5: Mass balance on New Melones for the period March 1 to October 31, 2015

The figure shows that the projected storage in New Melones on November 1 is 181 TAF corresponding to El. 768. This reduction in storage takes into consideration the net effect of New Melones and Tulloch evaporation, including local runoff to Tulloch (which was assumed to be similar to 1987).

The gradual decline of water levels in the reservoir from March through December is shown in Figure 6 below. The figure shows that given the assumed inflow to New

Melones and proposed outflow (diversion plus release to river), the water will probably not recede to the point where the submerged old Melones Dam will be exposed. However, the depressed water levels in the reservoir will greatly affect the water temperatures downstream as the warm water epilimnion (the top-most layer) will be discharged from the reservoir through the power intake. It should be noted that in both operation modes power flow will cease as the reservoir reaches the minimum power pool at El. 785 (usually around September 1) and water will be discharged at that point thorough the low-level outlet in New Melones Dam.

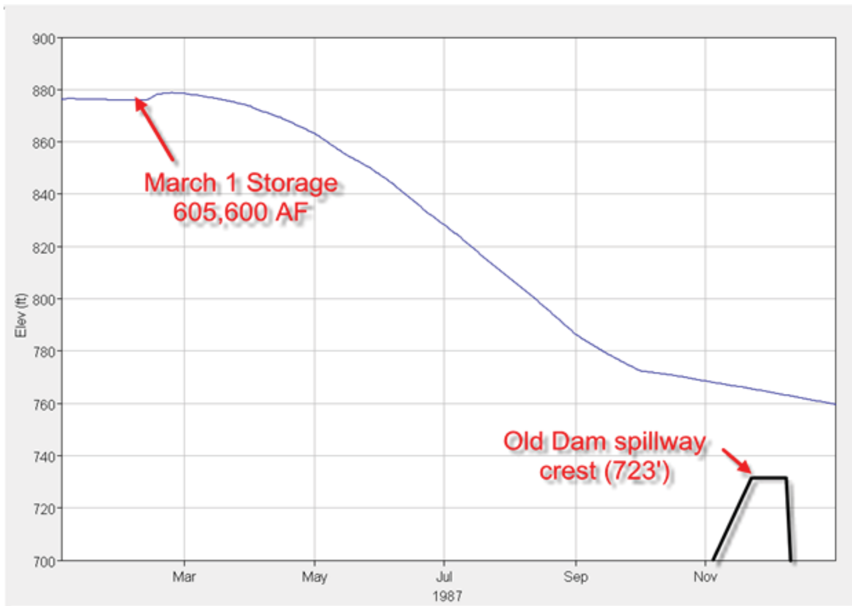

Figure 6: Projected New Melones Water Levels in 2015

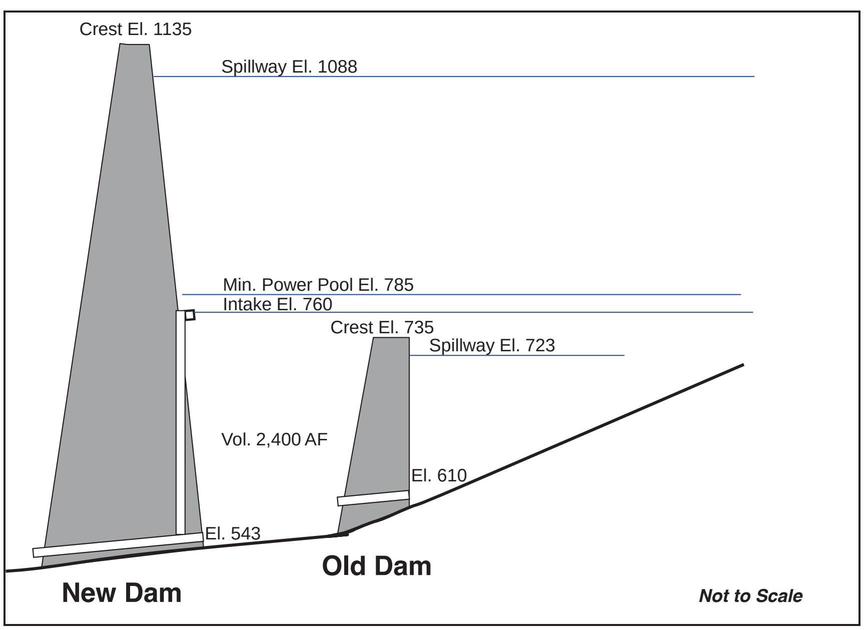

Figure 7: New-Old Dam Interaction

4. Projected Downriver Temperature Response – No-Bypass Operation

The following tables show the results for the temperature response at six discrete points along the Stanislaus River:

1) Below Goodwin Dam
2) Knights Ferry
3) Orange Blossom Bridge
4) Highway 120 Bridge (Oakdale)
5) Ripon Gage (Highway 99)
6) Above the confluence with the San Joaquin River

The results are presented in terms of the 7-Days Average of Daily Maximums (7DADM). In other words, each number in the table is the sum of the maximum daily temperatures in past seven days divided by 7. This term is consistent with EPA's recommended criterion for assessing fish viability.

Notice the precipitous drop of temperatures (almost 10 Deg-F below Goodwin Dam) from September on. This is due to the abrupt switch from no-bypass to full-bypass operation on September 1 (due to power constraints).

Table 1: Temperature Response – 7DADM
March-April, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Mar	50.5	50.6	52.2	52.3	55.4	55.6
2-Mar	50.6	50.8	52.5	52.5	55.7	55.9
3-Mar	50.8	51.1	53.0	53.1	56.4	56.6
4-Mar	50.8	51.2	53.3	53.5	56.9	57.1
5-Mar	50.7	51.2	53.4	53.8	57.2	57.5
6-Mar	50.7	51.3	53.6	54.1	57.5	57.8
7-Mar	50.8	51.4	53.8	54.4	57.9	58.2
8-Mar	50.9	51.5	53.9	54.6	58.1	58.4
9-Mar	51.0	51.5	54.0	54.7	58.4	58.6
10-Mar	51.0	51.5	54.0	54.7	58.4	58.7
11-Mar	51.3	51.7	54.1	54.8	58.6	58.8
12-Mar	51.6	52.0	54.6	55.2	59.2	59.3
13-Mar	51.8	52.2	54.9	55.6	59.7	59.8
14-Mar	51.8	52.2	54.9	55.7	59.9	59.9
15-Mar	51.9	52.3	54.8	55.7	60.0	60.0
16-Mar	51.9	52.3	54.8	55.6	60.0	60.1
17-Mar	52.0	52.4	54.9	55.6	60.0	60.2
18-Mar	52.0	52.4	54.8	55.6	59.8	60.1
19-Mar	51.9	52.3	54.6	55.3	59.5	59.8
20-Mar	51.9	52.3	54.4	55.1	59.1	59.5
21-Mar	52.0	52.3	54.4	55.0	58.9	59.3
22-Mar	52.1	52.5	54.6	55.1	58.9	59.3
23-Mar	52.2	52.5	54.5	55.0	58.8	59.1
24-Mar	52.2	52.5	54.5	55.0	58.7	58.9
25-Mar	52.3	52.7	54.7	55.2	58.8	59.0
26-Mar	52.5	52.8	55.0	55.5	59.2	59.3
27-Mar	52.6	53.0	55.3	55.9	59.5	59.7
28-Mar	52.8	53.3	55.8	56.4	60.1	60.3
29-Mar	52.9	53.5	56.2	56.9	60.5	60.7
30-Mar	53.1	53.8	56.8	57.5	61.1	61.4
31-Mar	53.3	54.1	57.3	58.0	61.7	61.9
1-Apr	53.3	54.3	57.7	58.6	62.2	62.5
2-Apr	53.4	54.4	58.0	59.0	62.7	62.9
3-Apr	53.4	54.5	58.2	59.3	63.1	63.2
4-Apr	53.4	54.5	58.3	59.5	63.4	63.5
5-Apr	53.3	54.6	58.4	59.6	63.7	63.8
6-Apr	53.3	54.6	58.5	59.8	64.1	64.2
7-Apr	53.3	54.7	58.7	60.0	64.7	64.7
8-Apr	53.3	54.8	58.8	60.2	65.2	65.2
9-Apr	53.4	54.8	58.9	60.4	65.7	65.7
10-Apr	53.4	54.9	59.0	60.6	66.1	66.3
11-Apr	53.5	55.0	59.1	60.8	66.5	66.7
12-Apr	53.7	55.1	59.4	61.1	66.9	67.2
13-Apr	53.8	55.3	59.7	61.4	67.4	67.7
14-Apr	53.9	55.5	60.0	61.8	67.9	68.3
15-Apr	53.8	55.5	60.1	62.0	68.4	68.8
16-Apr	53.8	55.4	60.0	61.9	68.8	69.4
17-Apr	53.8	55.4	59.8	61.7	69.0	69.9
18-Apr	53.7	55.2	59.4	61.3	68.8	69.9
19-Apr	53.6	55.1	59.0	60.8	68.4	69.8
20-Apr	53.5	54.9	58.6	60.3	67.8	69.4
21-Apr	53.5	54.8	58.1	59.7	67.2	68.9
22-Apr	53.5	54.7	57.9	59.3	66.4	68.2
23-Apr	53.6	54.7	57.7	59.0	65.6	67.4
24-Apr	53.7	54.8	57.8	58.9	65.1	66.7
25-Apr	53.8	55.0	58.1	59.2	65.1	66.6
26-Apr	53.9	55.2	58.4	59.6	65.3	66.7
27-Apr	54.0	55.4	58.7	60.0	65.8	67.0
28-Apr	54.1	55.4	58.8	60.2	66.0	67.2
29-Apr	54.2	55.5	59.0	60.3	66.3	67.4
30-Apr	54.2	55.6	59.0	60.4	66.5	67.6

Table 2: Temperature Response – 7DADM
May-June, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-May	54.2	55.5	58.9	60.3	66.4	67.6
2-May	54.2	55.5	58.8	60.2	66.4	67.5
3-May	54.2	55.4	58.7	60.0	66.1	67.3
4-May	54.1	55.4	58.5	59.8	65.8	67.0
5-May	54.1	55.4	58.6	59.8	65.7	67.0
6-May	54.2	55.5	58.7	59.9	65.8	67.0
7-May	54.2	55.6	58.9	60.2	66.1	67.3
8-May	54.3	55.8	59.2	60.5	66.6	67.8
9-May	54.4	55.9	59.4	60.9	67.1	68.3
10-May	54.5	56.1	59.8	61.3	67.7	68.9
11-May	54.6	56.2	60.1	61.6	68.2	69.4
12-May	54.7	56.3	60.2	61.9	68.6	69.9
13-May	54.8	56.4	60.4	62.1	69.0	70.3
14-May	54.8	56.5	60.6	62.3	69.4	70.7
15-May	54.9	56.6	60.7	62.5	69.7	71.1
16-May	55.0	56.8	60.8	62.6	69.8	71.1
17-May	55.0	56.9	61.1	62.8	69.8	71.1
18-May	55.1	57.2	61.5	63.1	69.8	71.0
19-May	55.1	57.4	61.8	63.4	69.8	70.8
20-May	55.1	57.4	61.9	63.6	69.5	70.5
21-May	55.2	57.7	62.3	63.9	69.4	70.2
22-May	55.2	57.9	62.7	64.3	69.5	70.0
23-May	55.2	58.0	63.1	64.9	69.8	70.0
24-May	55.2	58.0	63.3	65.3	70.2	70.3
25-May	55.2	58.1	63.5	65.6	70.5	70.6
26-May	55.2	58.1	63.5	65.7	70.7	70.7
27-May	55.1	58.0	63.4	65.7	70.9	70.8
28-May	55.2	58.0	63.4	65.8	71.0	71.0
29-May	55.2	58.0	63.4	65.8	71.2	71.1
30-May	55.2	58.1	63.5	65.9	71.4	71.4
31-May	55.3	58.2	63.7	66.0	71.7	71.6
1-Jun	55.3	58.3	64.0	66.3	72.0	72.0
2-Jun	55.4	58.6	64.6	66.9	72.8	72.8
3-Jun	55.6	59.1	65.4	67.8	73.9	73.8
4-Jun	55.6	59.2	65.7	68.3	74.5	74.4
5-Jun	55.6	59.3	66.0	68.7	74.9	74.8
6-Jun	55.6	59.4	66.3	69.1	75.4	75.3
7-Jun	55.7	59.6	66.7	69.6	76.0	75.9
8-Jun	55.8	59.7	67.0	69.9	76.4	76.4
9-Jun	55.8	59.7	67.0	70.1	76.6	76.6
10-Jun	55.9	59.8	67.0	70.1	76.6	76.6
11-Jun	56.0	60.0	67.3	70.4	76.9	76.9
12-Jun	56.2	60.3	67.8	70.8	77.4	77.4
13-Jun	56.3	60.5	68.1	71.2	77.8	77.8
14-Jun	56.3	60.5	68.2	71.4	77.9	77.9
15-Jun	56.4	60.5	68.1	71.3	77.9	77.8
16-Jun	56.4	60.5	68.0	71.3	77.8	77.7
17-Jun	56.4	60.4	67.8	71.1	77.6	77.6
18-Jun	56.5	60.4	67.7	70.9	77.5	77.5
19-Jun	56.5	60.3	67.5	70.7	77.4	77.3
20-Jun	56.5	60.1	67.1	70.4	77.0	77.0
21-Jun	56.6	60.1	66.9	70.1	76.7	76.7
22-Jun	56.7	60.2	66.9	70.0	76.6	76.6
23-Jun	56.8	60.3	67.1	70.0	76.6	76.7
24-Jun	57.0	60.6	67.5	70.4	77.0	77.0
25-Jun	57.1	60.8	67.9	70.8	77.4	77.5
26-Jun	57.2	61.1	68.3	71.3	77.9	78.0
27-Jun	57.3	61.4	68.8	71.9	78.6	78.6
28-Jun	57.4	61.6	69.2	72.5	79.3	79.2
29-Jun	57.5	61.7	69.6	72.9	79.9	79.8
30-Jun	57.6	61.8	69.7	73.2	80.2	80.2

Table 3: Temperature Response – 7DADM
July-August, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Jul	57.7	61.9	69.7	73.3	80.3	80.3
2-Jul	57.8	61.8	69.5	73.1	80.2	80.2
3-Jul	57.8	61.7	69.1	72.7	79.8	79.8
4-Jul	57.9	61.6	68.9	72.4	79.5	79.5
5-Jul	58.1	61.7	68.8	72.1	79.2	79.3
6-Jul	58.2	61.7	68.7	71.9	78.9	79.0
7-Jul	58.4	61.9	68.8	71.9	78.9	78.9
8-Jul	58.6	62.0	69.0	72.0	78.9	78.9
9-Jul	58.7	62.2	69.2	72.2	78.9	78.9
10-Jul	58.9	62.5	69.5	72.5	79.1	79.1
11-Jul	59.1	62.6	69.8	72.8	79.3	79.3
12-Jul	59.2	62.9	70.0	73.0	79.5	79.4
13-Jul	59.4	63.1	70.3	73.3	79.8	79.7
14-Jul	59.6	63.2	70.5	73.5	79.9	79.8
15-Jul	59.7	63.4	70.7	73.8	80.2	80.0
16-Jul	59.8	63.5	70.7	73.9	80.3	80.2
17-Jul	59.9	63.5	70.6	73.8	80.3	80.2
18-Jul	60.1	63.5	70.5	73.7	80.2	80.2
19-Jul	60.2	63.5	70.3	73.5	80.1	80.0
20-Jul	60.3	63.4	70.1	73.2	79.8	79.8
21-Jul	60.4	63.4	69.9	72.9	79.5	79.5
22-Jul	60.6	63.3	69.6	72.5	79.1	79.1
23-Jul	60.7	63.3	69.3	72.1	78.6	78.7
24-Jul	60.9	63.4	69.3	71.9	78.4	78.5
25-Jul	61.1	63.6	69.4	71.9	78.3	78.3
26-Jul	61.2	63.7	69.4	71.8	78.1	78.2
27-Jul	61.4	63.8	69.4	71.8	78.0	78.1
28-Jul	61.6	64.0	69.6	71.9	78.0	78.1
29-Jul	61.8	64.1	69.7	72.0	78.0	78.1
30-Jul	62.0	64.3	69.9	72.2	78.1	78.1
31-Jul	62.1	64.5	70.0	72.3	78.1	78.1
1-Aug	62.3	64.7	70.3	72.5	78.3	78.3
2-Aug	62.5	64.9	70.6	72.8	78.6	78.6
3-Aug	62.8	65.2	70.9	73.2	79.0	79.0
4-Aug	62.9	65.2	70.9	73.2	79.0	79.1
5-Aug	63.1	65.4	71.0	73.3	79.0	79.2
6-Aug	63.3	65.6	71.2	73.5	79.3	79.4
7-Aug	63.5	65.7	71.2	73.6	79.3	79.4
8-Aug	63.6	65.8	71.2	73.5	79.2	79.3
9-Aug	63.8	65.8	71.2	73.4	79.1	79.2
10-Aug	63.9	65.8	71.0	73.2	78.8	78.8
11-Aug	64.2	66.0	71.1	73.1	78.7	78.7
12-Aug	64.4	66.1	71.0	73.0	78.5	78.5
13-Aug	64.5	66.0	70.8	72.8	78.2	78.1
14-Aug	64.7	66.1	70.6	72.5	77.8	77.8
15-Aug	64.9	66.1	70.5	72.3	77.5	77.5
16-Aug	65.1	66.3	70.5	72.2	77.3	77.3
17-Aug	65.4	66.5	70.6	72.2	77.3	77.3
18-Aug	65.7	66.6	70.6	72.2	77.2	77.2
19-Aug	65.9	66.8	70.6	72.2	77.0	77.1
20-Aug	66.3	67.0	70.7	72.2	76.9	76.9
21-Aug	66.6	67.2	70.8	72.2	76.9	76.9
22-Aug	67.0	67.4	70.9	72.2	76.8	76.8
23-Aug	67.3	67.6	70.8	72.1	76.6	76.5
24-Aug	67.6	67.8	70.9	72.1	76.4	76.3
25-Aug	68.0	68.0	70.9	72.1	76.3	76.2
26-Aug	68.3	68.4	71.2	72.2	76.3	76.2
27-Aug	68.6	68.7	71.5	72.4	76.5	76.4
28-Aug	68.9	69.1	71.9	72.8	76.7	76.6
29-Aug	69.2	69.5	72.3	73.2	77.1	77.0
30-Aug	69.5	69.9	72.8	73.6	77.6	77.4
31-Aug	69.7	70.1	73.1	74.0	77.9	77.7

Table 4: Temperature Response – 7DADM
September-October, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS	NO BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Sep	70.0	70.5	73.5	74.5	78.3	78.1
2-Sep	70.2	70.7	73.8	74.8	78.7	78.4
3-Sep	70.5	70.9	74.2	75.2	79.0	78.8
4-Sep	70.6	71.0	74.3	75.4	79.2	78.9
5-Sep	70.3	70.9	74.1	75.3	79.0	78.7
6-Sep	69.6	70.6	73.7	74.9	78.5	78.3
7-Sep	68.7	70.2	73.4	74.5	78.1	77.9
8-Sep	67.5	69.7	73.0	74.1	77.7	77.5
9-Sep	66.3	69.0	72.5	73.7	77.3	77.0
10-Sep	64.9	68.1	71.8	73.1	76.6	76.4
11-Sep	63.6	67.1	71.2	72.5	76.0	75.9
12-Sep	62.6	66.2	70.5	71.9	75.5	75.4
13-Sep	61.9	65.4	70.0	71.5	75.2	75.1
14-Sep	61.4	64.6	69.2	70.8	74.7	74.6
15-Sep	61.1	63.9	68.5	70.2	74.2	74.1
16-Sep	60.8	63.2	67.7	69.5	73.6	73.5
17-Sep	60.6	62.7	67.1	68.9	73.2	73.1
18-Sep	60.5	62.3	66.6	68.3	72.8	72.7
19-Sep	60.4	62.1	66.3	67.9	72.6	72.6
20-Sep	60.3	61.9	66.0	67.6	72.4	72.4
21-Sep	60.3	61.9	66.1	67.6	72.6	72.7
22-Sep	60.3	61.9	66.1	67.7	72.7	72.8
23-Sep	60.3	61.9	66.1	67.8	72.9	73.0
24-Sep	60.2	61.8	66.1	67.8	72.9	73.1
25-Sep	60.1	61.7	65.9	67.7	72.8	73.1
26-Sep	60.1	61.7	65.8	67.6	72.8	73.0
27-Sep	60.1	61.6	65.7	67.4	72.6	72.9
28-Sep	60.0	61.4	65.4	67.2	72.3	72.6
29-Sep	60.0	61.3	65.2	66.9	72.1	72.4
30-Sep	60.1	61.3	65.1	66.8	72.0	72.3
1-Oct	60.3	61.4	65.2	66.7	72.0	72.3
2-Oct	60.6	61.5	65.3	66.8	72.1	72.4
3-Oct	60.7	61.6	65.4	66.9	72.2	72.5
4-Oct	61.0	61.8	65.6	67.1	72.3	72.7
5-Oct	61.2	62.0	65.8	67.3	72.6	72.9
6-Oct	61.4	62.1	65.9	67.4	72.7	73.1
7-Oct	61.4	62.1	65.7	67.3	72.5	72.9
8-Oct	61.2	62.1	65.5	67.0	72.2	72.7
9-Oct	61.0	61.9	65.2	66.6	71.8	72.3
10-Oct	60.8	61.8	64.9	66.2	71.4	72.0
11-Oct	60.5	61.5	64.5	65.7	70.8	71.4
12-Oct	60.3	61.3	64.0	65.2	70.1	70.8
13-Oct	60.1	61.0	63.5	64.5	69.3	70.1
14-Oct	60.1	60.8	63.2	64.1	68.8	69.6
15-Oct	60.1	60.7	63.0	63.8	68.3	69.1
16-Oct	60.1	60.6	62.9	63.5	67.9	68.7
17-Oct	60.1	60.5	62.7	63.3	67.5	68.3
18-Oct	60.1	60.5	62.6	63.2	67.1	67.9
19-Oct	60.1	60.5	62.5	63.1	66.8	67.5
20-Oct	60.0	60.4	62.3	62.9	66.5	67.1
21-Oct	60.0	60.3	62.2	62.7	66.2	66.8
22-Oct	59.8	60.0	61.7	62.3	65.7	66.1
23-Oct	59.9	59.9	61.5	62.0	65.4	65.7
24-Oct	59.9	59.8	61.3	61.7	65.0	65.3
25-Oct	59.9	59.7	61.2	61.5	64.8	65.0
26-Oct	59.9	59.6	61.0	61.3	64.5	64.7
27-Oct	59.9	59.6	60.9	61.2	64.3	64.5
28-Oct	59.8	59.6	60.8	61.0	64.1	64.3
29-Oct	59.8	59.6	60.8	61.0	64.1	64.2
30-Oct	59.7	59.5	60.7	60.9	63.9	64.1
31-Oct	59.6	59.4	60.5	60.7	63.7	63.9

5. Projected Downriver Temperature Response – Bypass Operation

Bypass operation changes the thermal structure of both New Melones and Tulloch reservoirs and the temperature release below Goodwin, as such. The best way to explain this phenomenon is by way of example:

Figure 8 shows the computed temperature profiles in New Melones and Tulloch reservoirs on September 1 for two cases: A no-bypass case and a bypass case beginning on July 1.

- In the no-bypass case, warmer water outflow from New Melones resulting in little cool water remaining in Tulloch.
- In the bypass case, blending of colder water through the low-level outlet result in a larger warm water epilimnion in New Melones and cooler water in Tulloch (warm water remains in New Melones and not in the river below Goodwin).

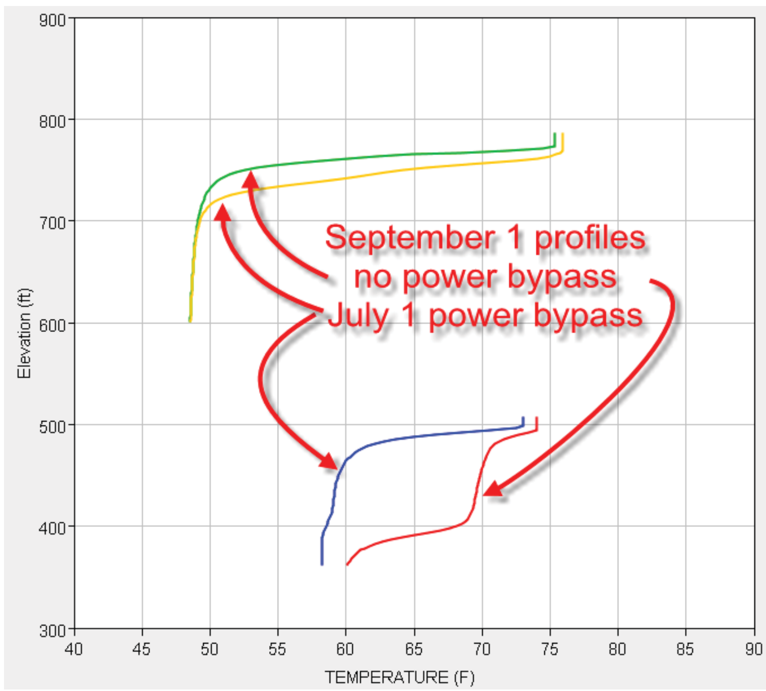

Figure 8: Temperature profiles in New Melones and Tulloch With and Without Bypass Operation

Four options for bypass operations have been considered:

1) Bypass starting July 1
2) Bypass starting July 15
3) Bypass starting August 1
4) Bypass starting August 15.

In all cases, the bypass operation was done gradually (assumed linear transition) from the specified starting date until full bypass by early September when New Melones reached its minimum power pool elevation.

The ramification of the bypass operation is a reduction in water temperature below Goodwin Dam (and downriver) in comparison with the no-bypass case, as illustrated in Figure 9 below:

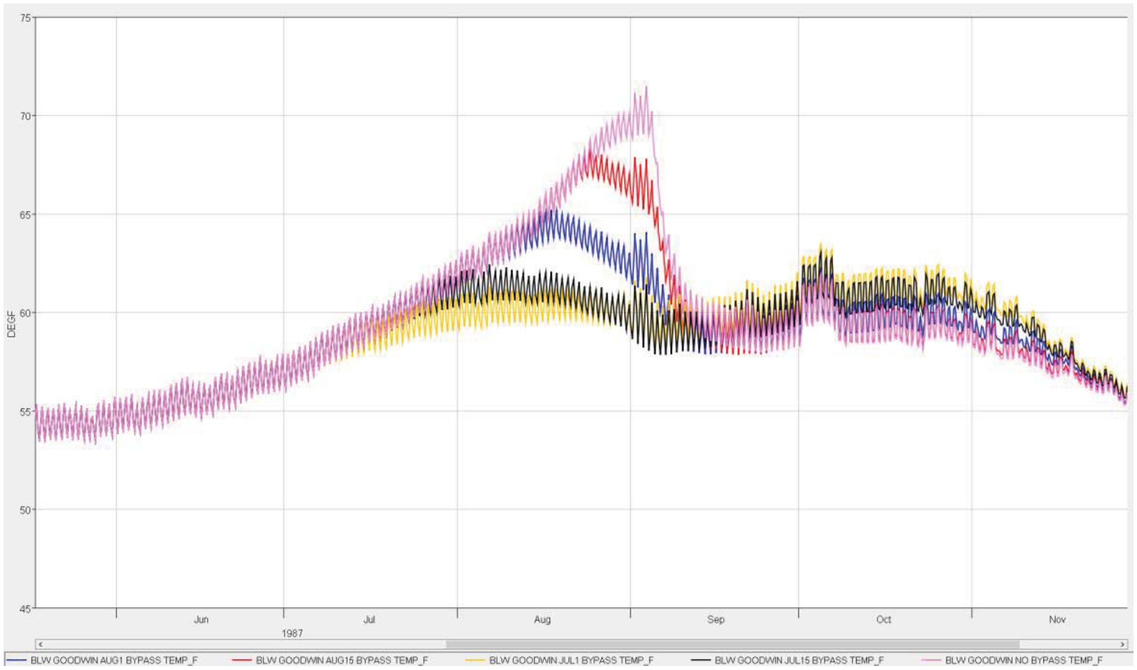

Figure 9: Effects of Power Bypass on Temperature Below Goodwin Dam

Figure 9 shows, that the most dramatic reduction in temperature in late August and early September could be achieved by starting the bypass operation on July 1. However, this type of operation would deplete cold water in New Melones, resulting in elevated water temperature in October. The question which of those bypass operation options provides the most thermal benefit should be dealt with in the context of impact on fish which is not the subject of this analysis.

In addition, the loss of energy production due to the power bypass should also be considered. A simplified power analysis related to this issue is provided below.

Based on visual inspection of the results, the July 15 bypass case was selected as the representative bypass case as it shows an overall moderation of temperatures throughout the bypass period. The results for this case in terms of 7DADM are presented in the following tables:

Table 5: Temperature Response – 7DADM
March-April, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Mar	50.5	50.6	52.2	52.3	55.4	55.6
2-Mar	50.6	50.8	52.5	52.5	55.7	55.9
3-Mar	50.8	51.1	53.0	53.1	56.4	56.6
4-Mar	50.8	51.2	53.3	53.5	56.9	57.1
5-Mar	50.7	51.2	53.4	53.8	57.2	57.5
6-Mar	50.7	51.3	53.6	54.1	57.5	57.8
7-Mar	50.8	51.4	53.8	54.4	57.9	58.2
8-Mar	50.9	51.5	53.9	54.6	58.1	58.4
9-Mar	51.0	51.5	54.0	54.7	58.4	58.6
10-Mar	51.0	51.5	54.0	54.7	58.4	58.7
11-Mar	51.3	51.7	54.1	54.8	58.6	58.8
12-Mar	51.6	52.0	54.6	55.2	59.2	59.3
13-Mar	51.8	52.2	54.9	55.6	59.7	59.8
14-Mar	51.8	52.2	54.9	55.7	59.9	59.9
15-Mar	51.9	52.3	54.8	55.7	60.0	60.0
16-Mar	51.9	52.3	54.8	55.6	60.0	60.1
17-Mar	52.0	52.4	54.9	55.6	60.0	60.2
18-Mar	52.0	52.4	54.8	55.6	59.8	60.1
19-Mar	51.9	52.3	54.6	55.3	59.5	59.8
20-Mar	51.9	52.3	54.4	55.1	59.1	59.5
21-Mar	52.0	52.3	54.4	55.0	58.9	59.3
22-Mar	52.1	52.5	54.6	55.1	58.9	59.3
23-Mar	52.2	52.5	54.5	55.0	58.8	59.1
24-Mar	52.2	52.5	54.5	55.0	58.7	58.9
25-Mar	52.3	52.7	54.7	55.2	58.8	59.0
26-Mar	52.5	52.8	55.0	55.5	59.2	59.3
27-Mar	52.6	53.0	55.3	55.9	59.5	59.7
28-Mar	52.8	53.3	55.8	56.4	60.1	60.3
29-Mar	52.9	53.5	56.2	56.9	60.5	60.7
30-Mar	53.1	53.8	56.8	57.5	61.1	61.4
31-Mar	53.3	54.1	57.3	58.0	61.7	61.9
1-Apr	53.3	54.3	57.7	58.6	62.2	62.5
2-Apr	53.4	54.4	58.0	59.0	62.7	62.9
3-Apr	53.4	54.5	58.2	59.3	63.1	63.2
4-Apr	53.4	54.5	58.3	59.5	63.4	63.5
5-Apr	53.3	54.6	58.4	59.6	63.7	63.8
6-Apr	53.3	54.6	58.5	59.8	64.1	64.2
7-Apr	53.3	54.7	58.7	60.0	64.7	64.7
8-Apr	53.3	54.8	58.8	60.2	65.2	65.2
9-Apr	53.4	54.8	58.9	60.4	65.7	65.7
10-Apr	53.4	54.9	59.0	60.6	66.1	66.3
11-Apr	53.5	55.0	59.1	60.8	66.5	66.7
12-Apr	53.7	55.1	59.4	61.1	66.9	67.2
13-Apr	53.8	55.3	59.7	61.4	67.4	67.7
14-Apr	53.9	55.5	60.0	61.8	67.9	68.3
15-Apr	53.8	55.5	60.1	62.0	68.4	68.8
16-Apr	53.8	55.4	60.0	61.9	68.8	69.4
17-Apr	53.8	55.4	59.8	61.7	69.0	69.9
18-Apr	53.7	55.2	59.4	61.3	68.8	69.9
19-Apr	53.6	55.1	59.0	60.8	68.4	69.8
20-Apr	53.5	54.9	58.6	60.3	67.8	69.4
21-Apr	53.5	54.8	58.1	59.7	67.2	68.9
22-Apr	53.5	54.7	57.9	59.3	66.4	68.2
23-Apr	53.6	54.7	57.7	59.0	65.6	67.4
24-Apr	53.7	54.8	57.8	58.9	65.1	66.7
25-Apr	53.8	55.0	58.1	59.2	65.1	66.6
26-Apr	53.9	55.2	58.4	59.6	65.3	66.7
27-Apr	54.0	55.4	58.7	60.0	65.8	67.0
28-Apr	54.1	55.4	58.8	60.2	66.0	67.2
29-Apr	54.2	55.5	59.0	60.3	66.3	67.4
30-Apr	54.2	55.6	59.0	60.4	66.5	67.6

Table 6: Temperature Response – 7DADM
May-June, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-May	54.2	55.5	58.9	60.3	66.4	67.6
2-May	54.2	55.5	58.8	60.2	66.4	67.5
3-May	54.2	55.4	58.7	60.0	66.1	67.3
4-May	54.1	55.4	58.5	59.8	65.8	67.0
5-May	54.1	55.4	58.6	59.8	65.7	67.0
6-May	54.2	55.5	58.7	59.9	65.8	67.0
7-May	54.2	55.6	58.9	60.2	66.1	67.3
8-May	54.3	55.8	59.2	60.5	66.6	67.8
9-May	54.4	55.9	59.4	60.9	67.1	68.3
10-May	54.5	56.1	59.8	61.3	67.7	68.9
11-May	54.6	56.2	60.1	61.6	68.2	69.4
12-May	54.7	56.3	60.2	61.9	68.6	69.9
13-May	54.8	56.4	60.4	62.1	69.0	70.3
14-May	54.8	56.5	60.6	62.3	69.4	70.7
15-May	54.9	56.6	60.7	62.5	69.7	71.1
16-May	55.0	56.8	60.8	62.6	69.8	71.1
17-May	55.0	56.9	61.1	62.8	69.8	71.1
18-May	55.1	57.2	61.5	63.1	69.8	71.0
19-May	55.1	57.4	61.8	63.4	69.8	70.8
20-May	55.1	57.4	61.9	63.6	69.5	70.5
21-May	55.2	57.7	62.3	63.9	69.4	70.2
22-May	55.2	57.9	62.7	64.3	69.5	70.0
23-May	55.2	58.0	63.1	64.9	69.8	70.0
24-May	55.2	58.0	63.3	65.3	70.2	70.3
25-May	55.2	58.1	63.5	65.6	70.5	70.6
26-May	55.2	58.1	63.5	65.7	70.7	70.7
27-May	55.1	58.0	63.4	65.7	70.9	70.8
28-May	55.2	58.0	63.4	65.8	71.0	71.0
29-May	55.2	58.0	63.4	65.8	71.2	71.1
30-May	55.2	58.1	63.5	65.9	71.4	71.4
31-May	55.3	58.2	63.7	66.0	71.7	71.6
1-Jun	55.3	58.3	64.0	66.3	72.0	72.0
2-Jun	55.4	58.6	64.6	66.9	72.8	72.8
3-Jun	55.6	59.1	65.4	67.8	73.9	73.8
4-Jun	55.6	59.2	65.7	68.3	74.5	74.4
5-Jun	55.6	59.3	66.0	68.7	74.9	74.8
6-Jun	55.6	59.4	66.3	69.1	75.4	75.3
7-Jun	55.7	59.6	66.7	69.6	76.0	75.9
8-Jun	55.8	59.7	67.0	69.9	76.4	76.4
9-Jun	55.8	59.7	67.0	70.1	76.6	76.6
10-Jun	55.9	59.8	67.0	70.1	76.6	76.6
11-Jun	56.0	60.0	67.3	70.4	76.9	76.9
12-Jun	56.2	60.3	67.8	70.8	77.4	77.4
13-Jun	56.3	60.5	68.1	71.2	77.8	77.8
14-Jun	56.3	60.5	68.2	71.4	77.9	77.9
15-Jun	56.4	60.5	68.1	71.3	77.9	77.8
16-Jun	56.4	60.5	68.0	71.3	77.8	77.7
17-Jun	56.4	60.4	67.8	71.1	77.6	77.6
18-Jun	56.5	60.4	67.7	70.9	77.5	77.5
19-Jun	56.5	60.3	67.5	70.7	77.4	77.3
20-Jun	56.5	60.1	67.1	70.4	77.0	77.0
21-Jun	56.6	60.1	66.9	70.1	76.7	76.7
22-Jun	56.7	60.2	66.9	70.0	76.6	76.6
23-Jun	56.8	60.3	67.1	70.0	76.6	76.7
24-Jun	57.0	60.6	67.5	70.4	77.0	77.0
25-Jun	57.1	60.8	67.9	70.8	77.4	77.5
26-Jun	57.2	61.1	68.3	71.3	77.9	78.0
27-Jun	57.3	61.4	68.8	71.9	78.6	78.6
28-Jun	57.4	61.6	69.2	72.5	79.3	79.2
29-Jun	57.5	61.7	69.6	72.9	79.9	79.8
30-Jun	57.6	61.8	69.7	73.2	80.2	80.2

Table 7: Temperature Response – 7DADM
July-August, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Jul	57.7	61.9	69.7	73.3	80.3	80.3
2-Jul	57.8	61.8	69.5	73.1	80.2	80.2
3-Jul	57.8	61.7	69.1	72.7	79.8	79.8
4-Jul	57.9	61.6	68.9	72.4	79.5	79.5
5-Jul	58.1	61.7	68.8	72.1	79.2	79.3
6-Jul	58.2	61.7	68.7	71.9	78.9	79.0
7-Jul	58.4	61.9	68.8	71.9	78.9	78.9
8-Jul	58.6	62.0	69.0	72.0	78.9	78.9
9-Jul	58.7	62.2	69.2	72.2	78.9	78.9
10-Jul	58.9	62.5	69.5	72.5	79.1	79.1
11-Jul	59.1	62.6	69.8	72.8	79.3	79.3
12-Jul	59.2	62.9	70.0	73.0	79.5	79.4
13-Jul	59.4	63.1	70.3	73.3	79.8	79.7
14-Jul	59.6	63.2	70.5	73.5	79.9	79.8
15-Jul	59.7	63.4	70.7	73.8	80.2	80.0
16-Jul	59.8	63.5	70.7	73.9	80.3	80.2
17-Jul	59.9	63.5	70.6	73.8	80.3	80.2
18-Jul	60.1	63.5	70.5	73.7	80.2	80.2
19-Jul	60.2	63.5	70.3	73.5	80.1	80.0
20-Jul	60.3	63.4	70.1	73.2	79.8	79.8
21-Jul	60.4	63.4	69.9	72.9	79.5	79.5
22-Jul	60.6	63.3	69.6	72.5	79.1	79.1
23-Jul	60.7	63.3	69.3	72.1	78.6	78.7
24-Jul	60.9	63.4	69.3	71.9	78.4	78.5
25-Jul	61.0	63.5	69.3	71.9	78.3	78.3
26-Jul	61.1	63.6	69.4	71.8	78.1	78.2
27-Jul	61.3	63.8	69.4	71.8	78.0	78.1
28-Jul	61.4	63.9	69.6	71.9	78.0	78.1
29-Jul	61.5	64.0	69.7	72.0	78.0	78.1
30-Jul	61.6	64.2	69.9	72.2	78.1	78.1
31-Jul	61.7	64.3	70.0	72.3	78.1	78.1
1-Aug	61.7	64.4	70.2	72.5	78.3	78.3
2-Aug	61.8	64.6	70.5	72.7	78.6	78.6
3-Aug	61.9	64.8	70.8	73.1	79.0	79.0
4-Aug	61.9	64.7	70.7	73.1	79.0	79.1
5-Aug	62.0	64.8	70.7	73.2	79.0	79.1
6-Aug	62.1	64.9	70.9	73.4	79.3	79.4
7-Aug	62.1	64.9	70.9	73.4	79.3	79.4
8-Aug	62.1	64.9	70.8	73.3	79.2	79.3
9-Aug	62.1	64.8	70.7	73.2	79.1	79.2
10-Aug	62.1	64.7	70.4	72.9	78.7	78.8
11-Aug	62.2	64.8	70.5	72.8	78.7	78.7
12-Aug	62.2	64.7	70.4	72.7	78.5	78.5
13-Aug	62.1	64.6	70.1	72.4	78.1	78.1
14-Aug	62.1	64.4	69.8	72.1	77.8	77.8
15-Aug	62.0	64.4	69.6	71.8	77.4	77.5
16-Aug	62.0	64.3	69.5	71.6	77.2	77.3
17-Aug	62.0	64.3	69.5	71.5	77.2	77.3
18-Aug	62.0	64.3	69.4	71.5	77.0	77.1
19-Aug	61.9	64.2	69.3	71.4	76.9	77.0
20-Aug	61.9	64.2	69.3	71.3	76.8	76.9
21-Aug	61.9	64.2	69.3	71.3	76.7	76.8
22-Aug	61.8	64.1	69.2	71.2	76.6	76.7
23-Aug	61.7	64.0	69.0	71.0	76.3	76.4
24-Aug	61.6	63.9	68.8	70.8	76.1	76.2
25-Aug	61.5	63.8	68.7	70.7	76.0	76.1
26-Aug	61.4	63.8	68.8	70.7	76.0	76.1
27-Aug	61.3	63.8	68.8	70.8	76.1	76.2
28-Aug	61.2	63.8	69.0	70.9	76.3	76.4
29-Aug	61.1	63.8	69.1	71.2	76.7	76.8
30-Aug	61.0	63.9	69.4	71.4	77.1	77.2
31-Aug	60.9	63.9	69.5	71.7	77.4	77.4

Table 8: Temperature Response – 7DADM
September-October, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS	JUL15 BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Sep	60.9	63.9	69.7	71.9	77.7	77.8
2-Sep	60.9	63.8	69.8	72.1	78.0	78.1
3-Sep	61.0	63.9	70.0	72.4	78.3	78.4
4-Sep	60.9	63.8	70.0	72.4	78.4	78.5
5-Sep	60.8	63.5	69.6	72.2	78.2	78.3
6-Sep	60.7	63.2	69.1	71.7	77.7	77.8
7-Sep	60.6	62.9	68.7	71.2	77.3	77.4
8-Sep	60.4	62.6	68.2	70.7	76.8	77.0
9-Sep	60.4	62.4	67.8	70.2	76.3	76.5
10-Sep	60.2	62.1	67.1	69.5	75.6	75.9
11-Sep	60.1	61.8	66.6	68.8	75.0	75.3
12-Sep	60.1	61.6	66.1	68.3	74.4	74.7
13-Sep	60.1	61.6	65.9	68.0	74.0	74.4
14-Sep	60.1	61.5	65.6	67.5	73.4	73.9
15-Sep	60.2	61.4	65.3	67.1	72.9	73.3
16-Sep	60.2	61.2	64.9	66.7	72.3	72.8
17-Sep	60.2	61.2	64.7	66.4	71.8	72.3
18-Sep	60.3	61.2	64.6	66.1	71.4	71.9
19-Sep	60.3	61.3	64.7	66.0	71.3	71.7
20-Sep	60.4	61.3	64.7	66.0	71.1	71.6
21-Sep	60.5	61.5	65.1	66.3	71.4	71.8
22-Sep	60.6	61.7	65.3	66.6	71.6	71.9
23-Sep	60.7	61.9	65.6	66.9	71.8	72.2
24-Sep	60.7	61.9	65.7	67.1	72.0	72.3
25-Sep	60.7	61.9	65.7	67.2	72.0	72.3
26-Sep	60.8	62.0	65.7	67.2	72.0	72.3
27-Sep	60.8	62.0	65.7	67.2	72.0	72.3
28-Sep	60.8	61.9	65.5	67.0	71.8	72.1
29-Sep	60.8	61.9	65.4	66.9	71.6	71.9
30-Sep	60.9	61.9	65.4	66.8	71.6	71.9
1-Oct	61.2	62.0	65.5	66.9	71.7	71.9
2-Oct	61.5	62.2	65.7	67.0	71.9	72.1
3-Oct	61.7	62.3	65.8	67.1	72.0	72.2
4-Oct	62.0	62.5	66.0	67.4	72.3	72.5
5-Oct	62.3	62.8	66.3	67.6	72.5	72.8
6-Oct	62.5	63.0	66.5	67.8	72.7	73.0
7-Oct	62.5	63.0	66.3	67.7	72.5	72.8
8-Oct	62.4	63.0	66.1	67.5	72.3	72.7
9-Oct	62.2	62.9	65.8	67.1	71.9	72.3
10-Oct	62.1	62.8	65.6	66.7	71.5	72.0
11-Oct	61.8	62.6	65.2	66.3	70.9	71.5
12-Oct	61.7	62.3	64.8	65.7	70.3	70.9
13-Oct	61.5	62.1	64.3	65.2	69.6	70.3
14-Oct	61.5	62.0	64.1	64.8	69.0	69.8
15-Oct	61.6	61.9	63.9	64.5	68.5	69.3
16-Oct	61.6	61.9	63.8	64.3	68.2	68.9
17-Oct	61.7	61.9	63.7	64.1	67.8	68.5
18-Oct	61.7	61.8	63.6	64.0	67.5	68.1
19-Oct	61.7	61.9	63.5	63.9	67.2	67.8
20-Oct	61.7	61.8	63.4	63.7	66.9	67.4
21-Oct	61.7	61.7	63.3	63.6	66.6	67.0
22-Oct	61.5	61.5	62.8	63.1	66.1	66.4
23-Oct	61.6	61.4	62.6	62.8	65.8	66.0
24-Oct	61.6	61.2	62.4	62.6	65.4	65.6
25-Oct	61.6	61.2	62.3	62.4	65.2	65.3
26-Oct	61.6	61.1	62.1	62.2	64.9	65.0
27-Oct	61.6	61.1	62.0	62.0	64.7	64.7
28-Oct	61.5	61.1	61.9	61.9	64.5	64.6
29-Oct	61.5	61.1	61.9	61.9	64.5	64.5
30-Oct	61.4	61.1	61.8	61.8	64.3	64.4
31-Oct	61.4	61.0	61.7	61.6	64.1	64.2

6. Projected Energy Loss Due to Bypass Operation

A simplified hydropower calculation was performed to estimate the energy loss due to the bypass operation. The no-bypass case was compared with the July 15 bypass case, as follows:

	No Bypass	July 15 Bypass	Energy Loss
	MWh	MWh	MWh
Jan			
Feb			
Mar	13,296	13,296	0
Apr	20,728	20,728	0
May	25,176	25,176	0
Jun	23,731	23,731	0
Jul	22,891	21,124	(1,768)
Aug	18,471	7,423	(11,047)
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	134,546	121,731	(12,815)

Figure 10: Projected Energy Loss Due to Bypass Operation

Figure 10 shows that the energy loss during the bypass period, July 15 through August 31, 2015, will be in the order of 12,815 MWh. Based on PG&E SRAC (Short-Term Avoided Cost) for qualifying facilities, the cost per KWh in July and August of 2014 was approximately 5 cents. If we use the same price rate for this year, the loss of energy could amount to $640,747.

Stanislaus Temperature Modeling
2015 Proposed Operations
Water Allocation Schedule – March 25, 2015

General:

The objective of this work is to assess, using the HEC-5Q Model, the expected temperature conditions at discrete points along the Stanislaus River, given the most recent projections of inflow to New Melones Reservoir and the proposed water release schedule from March 25, 2015 through the December 31, 2015.

Tasks:

1. Set up the data to run a year similar to 1987:
   a. Prime the model by setting New Melones to the March 25 condition (storage and temperature profile wise).
   b. Disaggregate the estimated monthly NM inflow to daily (see the New Melones Inflow, Diversion and Release Schedule below).
   c. Assume monthly average diversion for OID/SSJID and for Goodwin release to river, as specified in the New Melones Inflow, Diversion and Release Schedule below.
   d. Prepare DSS inputs for the above.
2. Run the model in two modes:
   - No Hydro Bypass
   - Hydro Bypass starting July 15
3. Analyze the results in terms of the expected temperatures (7DADM) at the specified locations along the Stanislaus River from day 1 of the simulation to end-of-year 2015.
4. Estimate the energy loss due to Hydro Bypass operation

New Melones Inflow, Diversion and Release Schedule:

Beginning	NM Inflow	Goodwin OID/SSJID	Goodwin To River -2E
	TAF	TAF	CFS
March 1, 2015	31.3	16.4	200
March 26, 2015	5.0	4.8	200
April 1, 2015	9.0	26.1	677
April 15, 2015	9.0	29.8	709
May 1, 2015	8.7	37.6	200
May 16, 2015	9.3	40.1	200
June 1, 2015	12.0	77.3	150
July 1, 2015	12.0	82	150
August 1, 2015	11.0	78.4	150
September 1, 2015	11.0	48.8	150
October 1, 2015	3.0	0	577
November 1, 2015	1.1	0	200
December 1, 2015	1.3	0	200
December 31, 2015			

Figure 1: Estimated New Melones Inflow and Water Allocation in 2015

15 Sullivan Drive . Moraga . California 94556 . U.S.A . (925) 631-9890 . E-Mail: avry@aol.com

Modeling, Analysis and Findings

1. Priming the Mode

The HEC-5Q was set to simulate a single year similar to 1987 in terms of the pattern of inflow to New Melones except that the volume of the inflow was scaled down to match the monthly estimates specified in Figure 1 above. The meteorological conditions were also set to match the historical conditions in 1987.

In order to prime the model, the simulation started on January 1, 1987 where by New Melones storage was set in such a way that by March 25 the total volume of water in the reservoir equaled approximately to the observed volume on that date, i.e., 584,600 acre-feet. The computed temperature profiles in New Melones and Tulloch were also set to match typical conditions for these reservoirs during this time of the year.

2. Simulation Modes

The HEC-5Q was run in two modes:

a) No-Bypass Operation – under this mode, New Melones was operated in a way where the water was released through the power plant until the water level in the reservoir reached the minimum power pool elevation. At that point the release was switched to the low-level outlet in the dam.

b) Bypass Operation – under this mode, New Melones was operated in a way where the release was switched gradually from power release to low-level outlet release in advance of reaching the minimum power pool elevation.

3. Projected New Melones Storage

From the storage prospective, there is no difference between the two operations modes described above. Mass-balance calculation for New Melones for the period March 1 through December 31, 2015 is shown in Figure 2 below.

New Melones Ops - Projected Storage and Water Levels

Beginning	NM Inflow	Goodwin OID/SSJID	Goodwin To River -2E	NM Projected Storage	NM Projected Elevation
	TAF	TAF	CFS	TAF	FT
March 1, 2015	31.3	16.4	200	614	880
March 26, 2015	5.0	4.8	200	585	875
April 1, 2015	9.0	26.1	677	580	874
April 15, 2015	9.0	29.8	709	542	866
May 1, 2015	8.7	37.6	200	494	856
May 16, 2015	9.3	40.1	200	454	847
June 1, 2015	12.0	77.3	150	414	838
July 1, 2015	12.0	82	150	337	818
August 1, 2015	11.0	78.4	150	255	794
September 1, 2015	11.0	48.8	150	176	766
October 1, 2015	3.0	0	577	131	747
November 1, 2015	1.1	0	200	104	733
December 1, 2015	1.3	0	200	93	727
December 31, 2015				82	720

Figure 2: Mass balance for New Melones: March 1 to December 31, 2015

The figure shows that the projected storage in New Melones on November 1 is 104 TAF corresponding to El. 733. This reduction in storage takes into consideration the net effect of New Melones and Tulloch evaporation, including local runoff to Tulloch (which was assumed to be similar to 1987).

The gradual decline of water levels in the reservoir from March through December is shown in Figure 3 below. The figure shows that given the assumed inflow to New Melones and proposed outflow (diversion plus release to river), the water will probably recede to the point where the submerged old Melones Dam will emerge around December 19.

In addition, the depressed water levels in the reservoir will greatly affect the water temperatures downstream as the warm water epilimnion (the top-most layer) will be discharged from the reservoir through the power intake. It should be noted that in both operation modes power flow will cease as the reservoir reaches the minimum power pool at El. 785 (around end-of-day August 11) and water will be discharged at that point thorough the low-level outlet in the New Melones Dam.

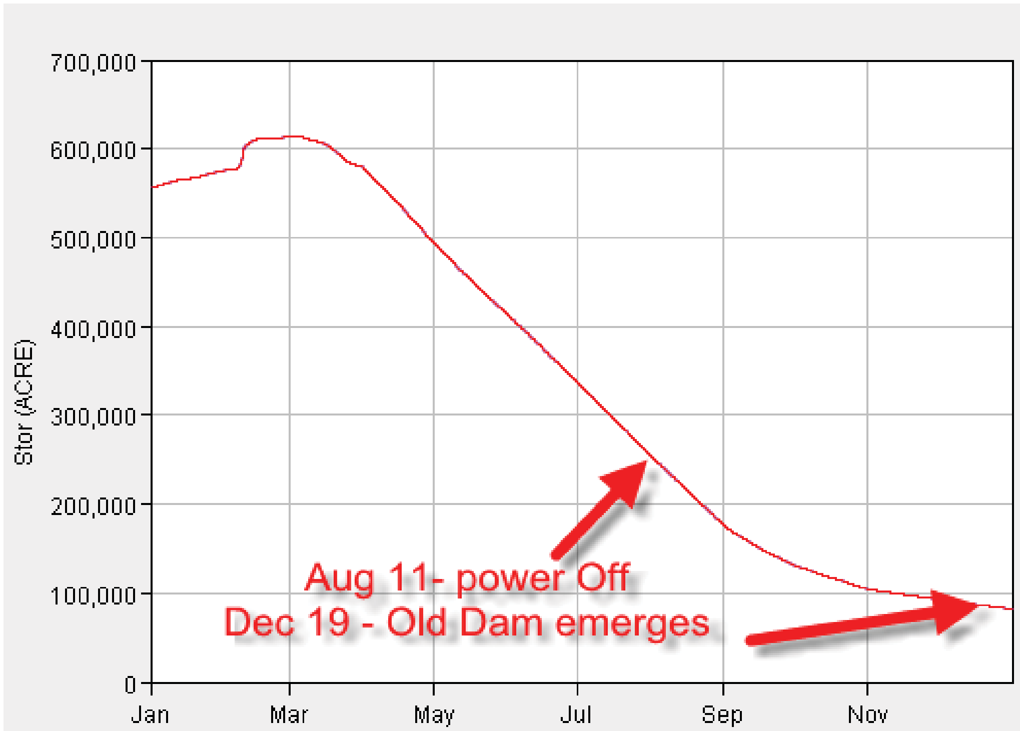

Figure 3: Projected New Melones Storage in 2015

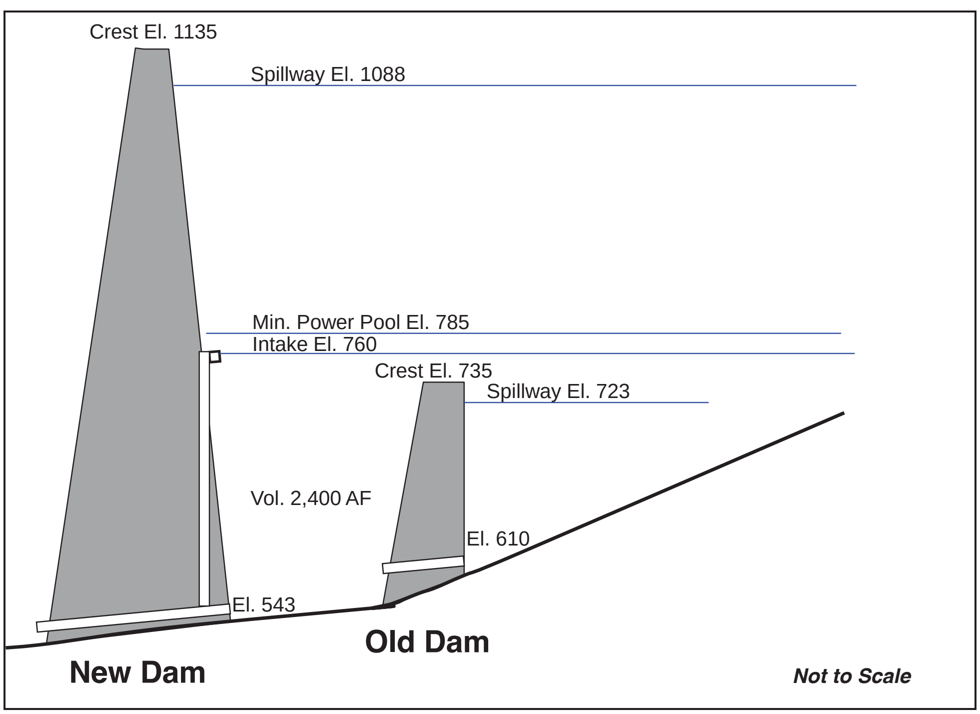

Figure 4: New-Old Dam Interaction

4. Projected Downriver Temperature Response – No-Bypass Operation

The following figures and tables show the results for the temperature response at six discrete points along the Stanislaus River:

1) Below Goodwin Dam
2) Knights Ferry
3) Orange Blossom Bridge
4) Highway 120 Bridge (Oakdale)
5) Ripon Gage (Highway 99)
6) Above the confluence with the San Joaquin River

The results are presented in two ways:

A. Graphical form - showing the daily maximum temperatures

B. Tabular form - showing the 7-Days Average of Daily Maximums (7DADM).

Notice the precipitous drop of temperatures (almost 10 Deg-F below Goodwin Dam) in mid-August under the No-Bypass mode. This is due to the abrupt switch from no-bypass to full-bypass operation on August 11 (due to power shutoff).

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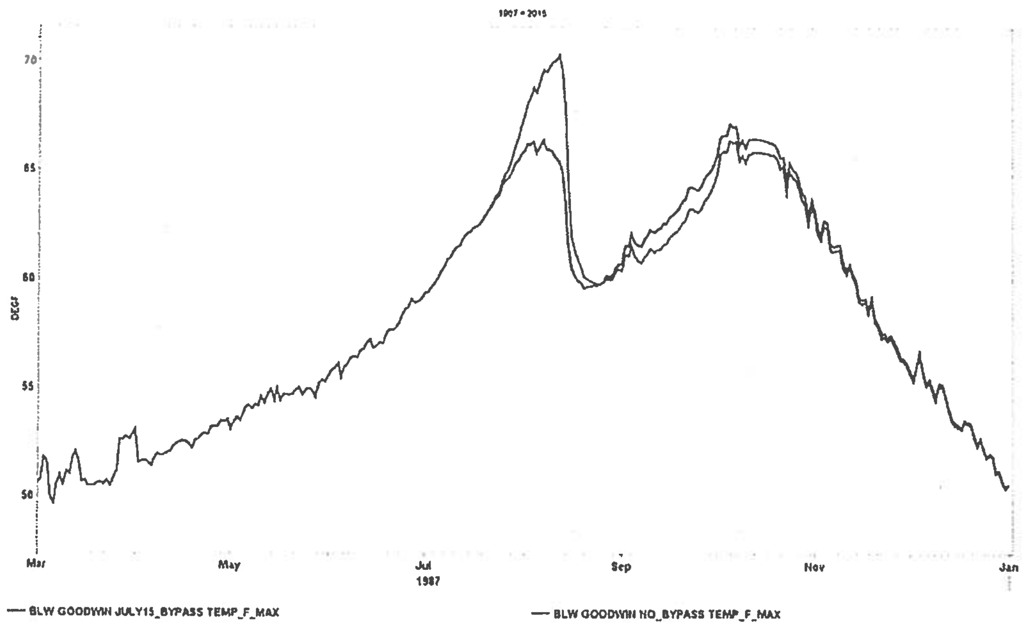


Figure 5 : Maximum Daily Temperatures below Goodwin Dam

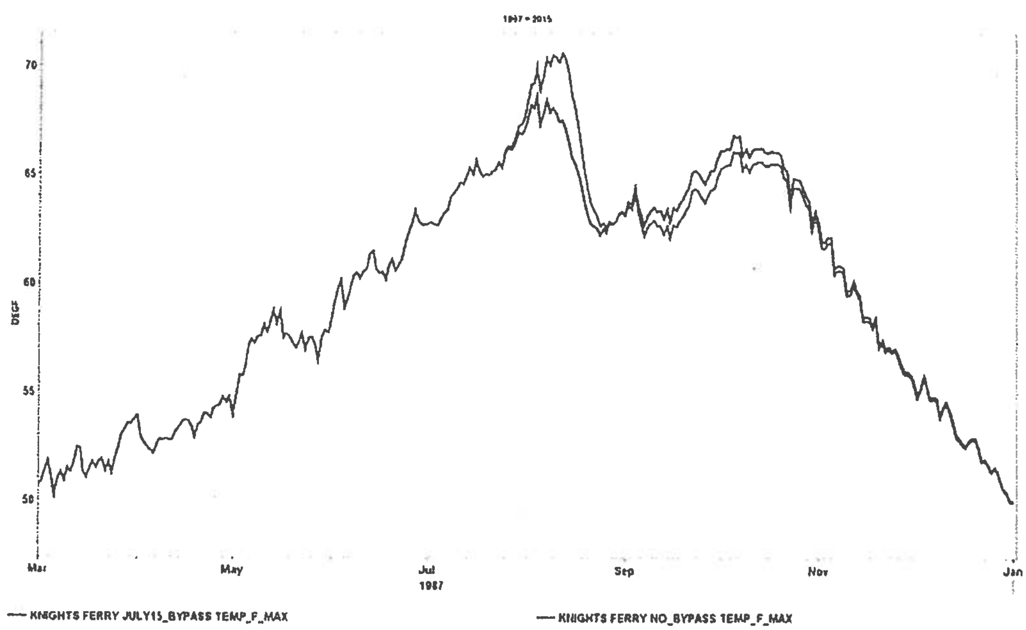


Figure 6 : Maximum Daily Temperatures at Knights Ferry

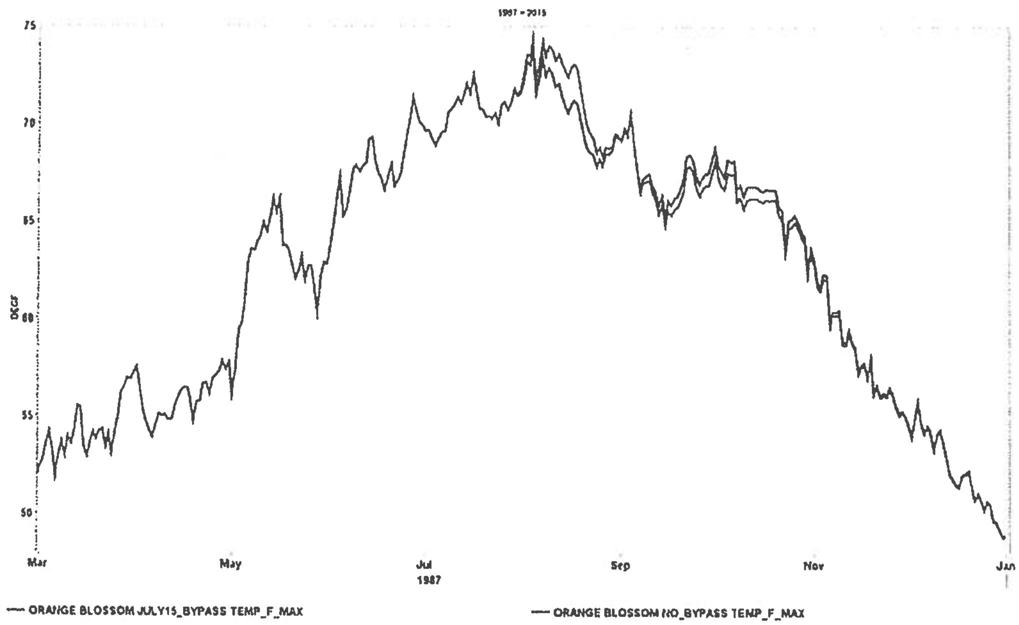


Figure 7 : Maximum Daily Temperatures at Orange Blossom Bridge

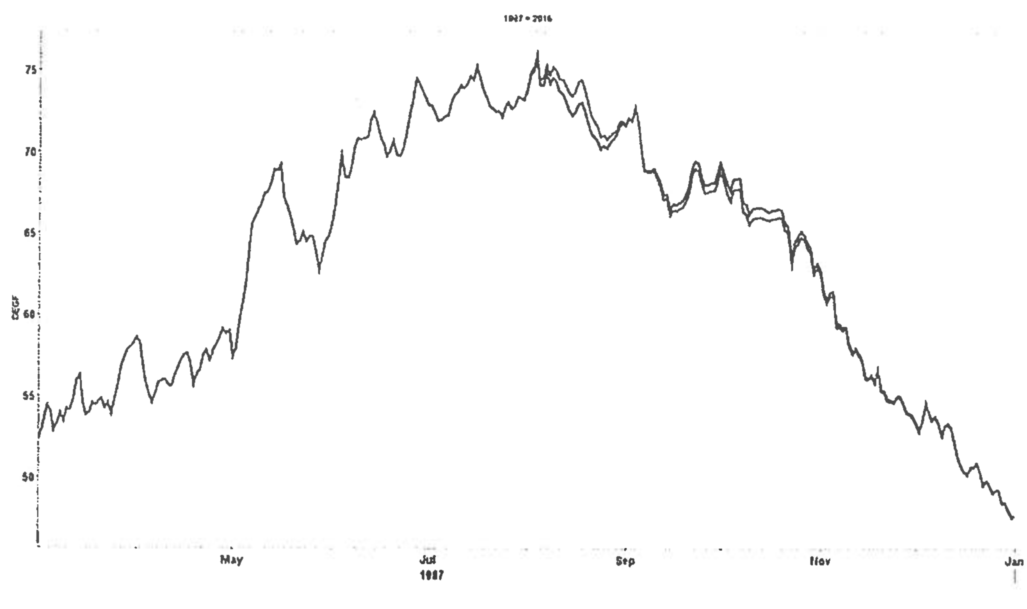


Figure 8 : Maximum Daily Temperatures below Highway 120 (Oakdale)

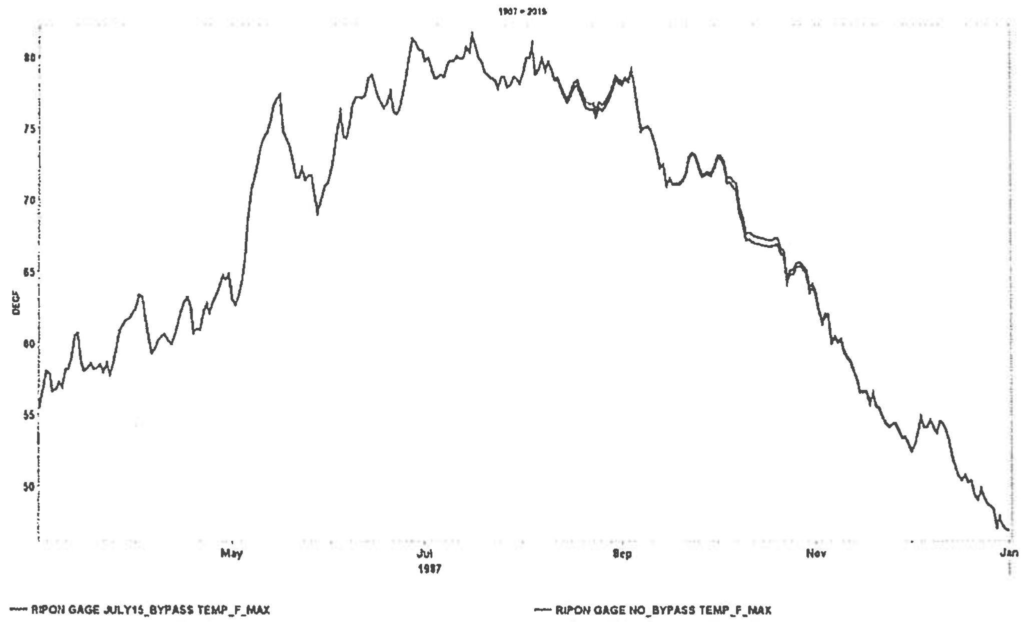


Figure 9 : Maximum Daily Temperatures at Ripon Gage (Highway 99)

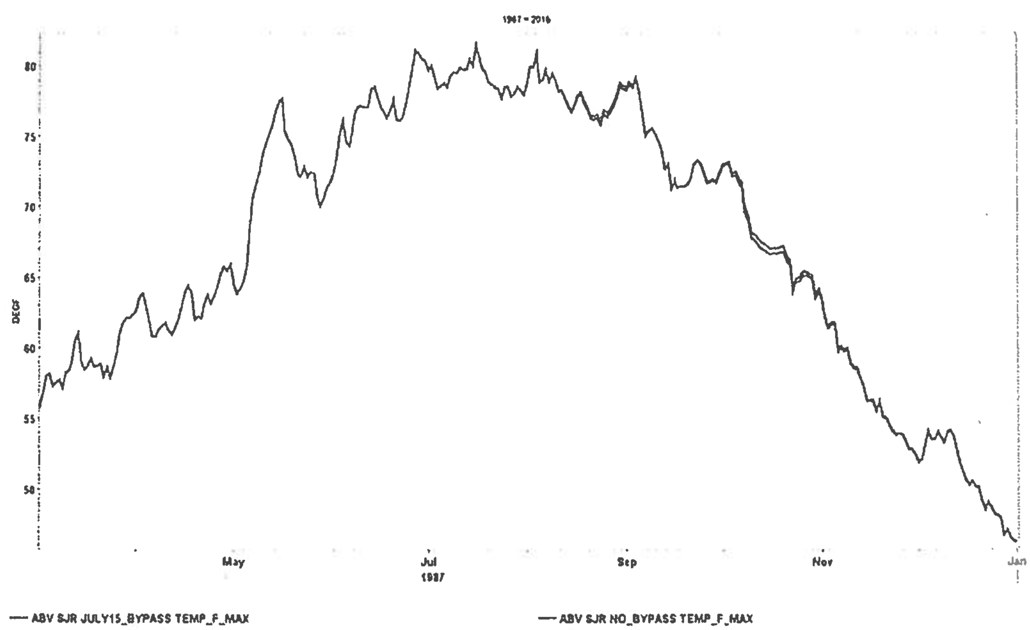


Figure 10 : Maximum Daily Temperatures above the Confluence with the San Joaquin River

Table 1: Temperature Response – 7DADM
March-April, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Mar	50.2	50.1	51.5	51.5	54.2	54.5
2-Mar	50.4	50.3	51.9	51.9	54.7	54.9
3-Mar	50.8	50.7	52.4	52.4	55.4	55.6
4-Mar	50.8	50.9	52.8	52.9	56.0	56.2
5-Mar	50.7	50.9	52.8	53.1	56.4	56.6
6-Mar	50.7	51.0	53.0	53.3	56.7	57.0
7-Mar	50.7	51.1	53.2	53.6	57.0	57.3
8-Mar	50.7	51.1	53.2	53.7	57.2	57.5
9-Mar	50.6	51.1	53.3	53.8	57.4	57.7
10-Mar	50.5	51.0	53.2	53.7	57.4	57.8
11-Mar	50.8	51.1	53.3	53.8	57.5	57.9
12-Mar	51.1	51.4	53.8	54.2	58.1	58.3
13-Mar	51.2	51.6	54.2	54.7	58.7	58.8
14-Mar	51.2	51.6	54.2	54.8	58.9	59.0
15-Mar	51.2	51.7	54.1	54.8	59.0	59.2
16-Mar	51.1	51.7	54.1	54.8	59.0	59.3
17-Mar	51.1	51.7	54.2	54.8	59.1	59.4
18-Mar	50.9	51.7	54.1	54.8	59.0	59.4
19-Mar	50.7	51.6	53.9	54.6	58.7	59.1
20-Mar	50.6	51.5	53.8	54.4	58.4	58.8
21-Mar	50.5	51.5	53.8	54.4	58.3	58.6
22-Mar	50.5	51.6	53.9	54.5	58.3	58.7
23-Mar	50.5	51.6	53.9	54.5	58.3	58.6
24-Mar	50.6	51.6	53.9	54.5	58.3	58.5
25-Mar	50.7	51.7	54.1	54.7	58.4	58.6
26-Mar	51.0	51.9	54.3	54.9	58.8	59.0
27-Mar	51.3	52.1	54.7	55.3	59.2	59.4
28-Mar	51.6	52.4	55.2	55.8	59.7	60.0
29-Mar	51.8	52.7	55.6	56.3	60.2	60.5
30-Mar	52.2	53.0	56.2	56.9	60.8	61.1
31-Mar	52.5	53.3	56.6	57.5	61.3	61.7
1-Apr	52.5	53.4	56.8	57.8	61.9	62.2
2-Apr	52.4	53.3	56.7	57.9	62.2	62.6
3-Apr	52.3	53.2	56.5	57.7	62.3	62.8
4-Apr	52.1	53.1	56.1	57.3	62.1	62.7
5-Apr	51.9	52.9	55.7	56.8	61.8	62.5
6-Apr	51.8	52.7	55.3	56.4	61.4	62.3
7-Apr	51.6	52.5	54.9	56.0	61.1	62.1
8-Apr	51.7	52.5	54.7	55.6	60.7	61.8
9-Apr	51.7	52.6	54.7	55.5	60.3	61.5
10-Apr	51.8	52.6	54.7	55.5	60.1	61.3
11-Apr	51.8	52.7	54.7	55.6	60.0	61.2
12-Apr	51.9	52.8	55.0	55.8	60.2	61.3
13-Apr	52.0	52.9	55.1	56.0	60.4	61.5
14-Apr	52.1	53.0	55.3	56.2	60.7	61.7
15-Apr	52.2	53.2	55.5	56.4	61.1	62.1
16-Apr	52.3	53.3	55.7	56.7	61.4	62.4
17-Apr	52.4	53.4	55.9	56.9	61.8	62.8
18-Apr	52.4	53.4	55.9	56.9	61.9	63.0
19-Apr	52.4	53.4	55.9	56.9	61.9	63.1
20-Apr	52.5	53.5	55.9	56.9	61.9	63.1
21-Apr	52.5	53.5	55.9	56.9	61.9	63.1
22-Apr	52.6	53.6	56.0	57.0	61.9	63.1
23-Apr	52.6	53.6	55.9	56.9	61.7	62.9
24-Apr	52.7	53.7	56.1	57.0	61.7	62.8
25-Apr	52.8	53.9	56.4	57.4	62.1	63.2
26-Apr	52.9	54.0	56.6	57.7	62.5	63.6
27-Apr	53.1	54.2	56.9	58.0	63.1	64.1
28-Apr	53.1	54.3	57.0	58.2	63.4	64.5
29-Apr	53.2	54.4	57.2	58.4	63.7	64.8
30-Apr	53.3	54.4	57.2	58.4	63.9	65.0

Table 2: Temperature Response – 7DADM
May-June, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-May	53.3	54.5	57.3	58.4	63.6	65.0
2-May	53.4	54.7	57.6	58.6	63.9	65.0
3-May	53.4	54.9	58.0	58.9	63.9	64.9
4-May	53.5	55.1	58.4	59.3	64.1	64.9
5-May	53.5	55.5	59.2	60.1	64.7	65.4
6-May	53.6	55.9	60.0	61.0	65.5	66.0
7-May	53.8	56.3	61.0	62.2	66.7	67.1
8-May	53.9	56.7	62.0	63.5	68.2	68.3
9-May	54.0	57.0	62.7	64.5	69.6	69.6
10-May	54.1	57.3	63.4	65.5	71.1	71.1
11-May	54.2	57.5	63.9	66.3	72.3	72.4
12-May	54.3	57.7	64.3	66.9	73.3	73.4
13-May	54.4	57.9	64.6	67.3	74.1	74.2
14-May	54.4	58.0	64.9	67.7	74.9	75.1
15-May	54.5	58.2	65.2	68.1	75.6	75.8
16-May	54.6	58.2	65.2	68.2	75.7	76.0
17-May	54.6	58.1	65.0	68.1	75.7	76.1
18-May	54.7	58.1	64.8	67.9	75.6	76.0
19-May	54.6	57.9	64.5	67.5	75.2	75.7
20-May	54.6	57.7	63.9	66.8	74.5	75.0
21-May	54.7	57.6	63.5	66.2	73.7	74.3
22-May	54.7	57.4	63.0	65.6	73.0	73.6
23-May	54.7	57.3	62.8	65.2	72.5	73.1
24-May	54.8	57.3	62.6	64.9	72.1	72.8
25-May	54.8	57.3	62.5	64.8	71.8	72.5
26-May	54.8	57.3	62.4	64.6	71.5	72.2
27-May	54.8	57.2	62.1	64.3	71.1	71.8
28-May	54.9	57.2	62.1	64.2	70.9	71.6
29-May	54.9	57.2	62.1	64.1	70.7	71.4
30-May	55.0	57.3	62.2	64.2	70.7	71.4
31-May	55.1	57.5	62.3	64.3	70.7	71.4
1-Jun	55.2	57.7	62.6	64.6	70.9	71.5
2-Jun	55.4	58.1	63.3	65.2	71.6	72.2
3-Jun	55.6	58.6	64.3	66.2	72.6	73.0
4-Jun	55.6	58.8	64.7	66.9	73.2	73.6
5-Jun	55.7	59.0	65.1	67.5	73.7	74.0
6-Jun	55.8	59.3	65.7	68.1	74.3	74.5
7-Jun	55.9	59.6	66.2	68.8	74.9	75.1
8-Jun	56.0	59.8	66.7	69.4	75.5	75.6
9-Jun	56.1	59.9	66.8	69.7	75.8	75.9
10-Jun	56.2	59.9	66.9	69.8	76.0	76.0
11-Jun	56.4	60.2	67.3	70.2	76.4	76.4
12-Jun	56.5	60.5	67.8	70.7	77.0	77.0
13-Jun	56.7	60.7	68.2	71.2	77.5	77.4
14-Jun	56.8	60.8	68.2	71.4	77.7	77.6
15-Jun	56.8	60.8	68.2	71.4	77.7	77.6
16-Jun	56.9	60.8	68.1	71.3	77.7	77.5
17-Jun	57.0	60.7	68.0	71.2	77.6	77.4
18-Jun	57.1	60.8	67.9	71.0	77.5	77.4
19-Jun	57.2	60.7	67.7	70.9	77.3	77.3
20-Jun	57.2	60.6	67.3	70.5	77.0	76.9
21-Jun	57.3	60.6	67.2	70.2	76.7	76.7
22-Jun	57.5	60.7	67.2	70.1	76.6	76.6
23-Jun	57.7	60.9	67.4	70.2	76.6	76.7
24-Jun	57.9	61.2	67.8	70.5	77.0	77.0
25-Jun	58.1	61.5	68.2	71.0	77.4	77.5
26-Jun	58.3	61.8	68.7	71.5	78.0	78.0
27-Jun	58.5	62.1	69.2	72.2	78.7	78.6
28-Jun	58.6	62.4	69.7	72.8	79.3	79.3
29-Jun	58.8	62.6	70.0	73.2	79.9	79.8
30-Jun	58.9	62.8	70.2	73.5	80.2	80.2

Table 3: Temperature Response – 7DADM
July-August, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Jul	59.0	62.8	70.2	73.6	80.4	80.4
2-Jul	59.2	62.8	70.1	73.5	80.3	80.3
3-Jul	59.3	62.7	69.7	73.1	79.9	79.9
4-Jul	59.4	62.7	69.5	72.8	79.6	79.6
5-Jul	59.6	62.8	69.4	72.6	79.3	79.3
6-Jul	59.8	62.9	69.4	72.4	79.0	79.0
7-Jul	60.0	63.1	69.5	72.4	79.0	79.0
8-Jul	60.3	63.3	69.7	72.5	79.0	78.9
9-Jul	60.5	63.5	69.9	72.7	79.0	79.0
10-Jul	60.8	63.8	70.3	73.0	79.3	79.2
11-Jul	61.0	64.0	70.5	73.3	79.4	79.3
12-Jul	61.2	64.3	70.8	73.5	79.6	79.5
13-Jul	61.4	64.5	71.2	73.9	79.9	79.8
14-Jul	61.6	64.7	71.3	74.1	80.0	79.8
15-Jul	61.8	64.9	71.6	74.4	80.3	80.1
16-Jul	62.0	65.0	71.7	74.5	80.4	80.3
17-Jul	62.1	65.1	71.6	74.5	80.4	80.3
18-Jul	62.3	65.2	71.5	74.4	80.4	80.2
19-Jul	62.4	65.2	71.4	74.2	80.2	80.1
20-Jul	62.6	65.1	71.1	73.9	80.0	79.9
21-Jul	62.8	65.2	70.9	73.6	79.7	79.6
22-Jul	63.0	65.2	70.7	73.2	79.3	79.2
23-Jul	63.2	65.2	70.4	72.9	78.8	78.8
24-Jul	63.5	65.3	70.5	72.7	78.6	78.6
25-Jul	63.8	65.5	70.5	72.7	78.5	78.5
26-Jul	64.1	65.7	70.6	72.7	78.4	78.3
27-Jul	64.4	65.9	70.7	72.7	78.3	78.2
28-Jul	64.8	66.2	70.9	72.8	78.3	78.2
29-Jul	65.2	66.5	71.0	72.9	78.3	78.2
30-Jul	65.6	66.8	71.3	73.1	78.3	78.2
31-Jul	66.0	67.1	71.5	73.2	78.4	78.3
1-Aug	66.5	67.5	71.8	73.5	78.6	78.5
2-Aug	67.0	67.9	72.2	73.9	78.9	78.8
3-Aug	67.4	68.4	72.7	74.3	79.3	79.2
4-Aug	67.8	68.6	72.8	74.5	79.3	79.2
5-Aug	68.2	69.0	73.0	74.6	79.4	79.4
6-Aug	68.6	69.4	73.4	74.9	79.6	79.6
7-Aug	68.8	69.6	73.5	75.1	79.7	79.6
8-Aug	69.1	69.8	73.6	75.1	79.6	79.6
9-Aug	69.3	70.0	73.6	75.1	79.5	79.4
10-Aug	69.5	70.0	73.4	74.9	79.2	79.0
11-Aug	69.7	70.2	73.6	74.9	79.2	79.0
12-Aug	69.8	70.4	73.6	74.8	79.0	78.8
13-Aug	69.5	70.3	73.4	74.6	78.6	78.4
14-Aug	68.8	70.1	73.3	74.4	78.4	78.1
15-Aug	67.7	69.7	73.1	74.2	78.0	77.8
16-Aug	66.5	69.3	73.0	74.1	77.9	77.7
17-Aug	65.2	68.7	72.9	74.1	77.9	77.6
18-Aug	63.8	68.0	72.7	74.0	77.8	77.5
19-Aug	62.4	67.1	72.3	73.8	77.7	77.4
20-Aug	61.3	66.2	71.9	73.6	77.6	77.3
21-Aug	60.7	65.5	71.5	73.4	77.5	77.3
22-Aug	60.4	64.7	71.0	73.1	77.4	77.2
23-Aug	60.1	64.1	70.3	72.6	77.2	76.9
24-Aug	60.0	63.6	69.8	72.1	76.9	76.7
25-Aug	59.9	63.2	69.3	71.7	76.8	76.6
26-Aug	59.9	63.0	69.0	71.4	76.7	76.6
27-Aug	59.9	62.9	68.8	71.2	76.8	76.7
28-Aug	59.9	62.8	68.7	71.2	77.0	76.9
29-Aug	59.9	62.8	68.8	71.2	77.2	77.3
30-Aug	60.0	62.9	68.9	71.3	77.5	77.6
31-Aug	60.1	63.0	68.9	71.4	77.7	77.8

Table 4: Temperature Response – 7DADM
September-October, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS	NO_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Sep	60.3	63.1	69.1	71.6	78.0	78.2
2-Sep	60.5	63.2	69.2	71.8	78.2	78.4
3-Sep	60.7	63.4	69.5	72.0	78.5	76.7
4-Sep	60.8	63.4	69.5	72.1	78.5	78.7
5-Sep	60.9	63.4	69.2	71.8	78.2	78.4
6-Sep	61.0	63.2	68.8	71.4	77.7	77.9
7-Sep	61.0	63.2	68.5	71.0	77.2	77.4
8-Sep	61.0	63.0	68.1	70.5	76.7	77.0
9-Sep	61.1	63.0	67.8	70.0	76.2	76.5
10-Sep	61.1	62.8	67.2	69.4	75.5	75.8
11-Sep	61.1	62.7	66.8	68.9	74.9	75.3
12-Sep	61.2	62.6	66.5	68.4	74.3	74.7
13-Sep	61.3	62.6	66.4	68.2	73.9	74.4
14-Sep	61.4	62.6	66.1	67.8	73.4	73.8
15-Sep	61.5	62.6	65.9	67.5	72.8	73.3
16-Sep	61.6	62.5	65.6	67.1	72.3	72.7
17-Sep	61.7	62.5	65.5	66.8	71.8	72.3
18-Sep	61.8	62.6	65.5	66.7	71.5	71.9
19-Sep	62.0	62.8	65.6	66.6	71.3	71.7
20-Sep	62.2	62.9	65.7	66.7	71.2	71.6
21-Sep	62.4	63.2	66.1	67.0	71.5	71.8
22-Sep	62.6	63.5	66.4	67.4	71.7	72.0
23-Sep	62.7	63.7	66.7	67.7	72.0	72.2
24-Sep	62.9	63.8	66.9	68.0	72.2	72.4
25-Sep	63.0	63.9	67.0	68.1	72.2	72.4
26-Sep	63.1	64.0	67.0	68.2	72.3	72.4
27-Sep	63.3	64.1	67.1	68.2	72.3	72.4
28-Sep	63.4	64.1	66.9	68.1	72.1	72.2
29-Sep	63.6	64.2	66.9	68.0	72.0	72.1
30-Sep	63.8	64.4	67.0	68.0	72.0	72.1
1-Oct	64.2	64.6	67.0	68.0	72.1	72.2
2-Oct	64.6	64.8	67.1	68.0	72.2	72.4
3-Oct	64.9	65.0	67.1	67.9	72.1	72.4
4-Oct	65.3	65.3	67.2	67.9	72.1	72.5
5-Oct	65.6	65.5	67.3	67.9	72.0	72.5
6-Oct	65.9	65.7	67.3	67.8	71.7	72.3
7-Oct	66.0	65.7	67.0	67.5	71.2	71.9
8-Oct	66.0	65.7	66.8	67.2	70.6	71.3
9-Oct	65.9	65.6	66.7	66.9	69.8	70.5
10-Oct	65.9	65.6	66.6	66.8	69.2	69.9
11-Oct	65.8	65.6	66.4	66.5	68.6	69.2
12-Oct	65.7	65.5	66.2	66.3	68.1	68.5
13-Oct	65.7	65.4	66.1	66.0	67.5	67.9
14-Oct	65.7	65.5	66.1	66.0	67.2	67.5
15-Oct	65.7	65.5	66.0	65.9	67.0	67.1
16-Oct	65.8	65.5	66.1	66.0	66.9	67.0
17-Oct	65.8	65.5	66.1	66.0	66.9	66.9
18-Oct	65.8	65.5	66.1	66.0	66.8	66.8
19-Oct	65.7	65.5	66.1	66.0	66.8	66.7
20-Oct	65.6	65.4	66.0	65.8	66.7	66.6
21-Oct	65.5	65.3	65.8	65.7	66.6	66.5
22-Oct	65.3	65.0	65.4	65.3	66.2	66.1
23-Oct	65.2	64.9	65.2	65.1	66.0	65.8
24-Oct	65.0	64.7	65.0	64.9	65.7	65.6
25-Oct	64.8	64.5	64.9	64.7	65.5	65.3
26-Oct	64.6	64.3	64.7	64.5	65.2	65.1
27-Oct	64.4	64.2	64.5	64.3	65.1	64.9
28-Oct	64.2	64.0	64.3	64.2	64.9	64.8
29-Oct	64.0	63.8	64.2	64.1	64.8	64.7
30-Oct	63.7	63.6	64.0	63.9	64.7	64.6
31-Oct	63.5	63.4	63.7	63.6	64.5	64.4

5. Projected Downriver Temperature Response – Bypass Operation

For the purpose of this analysis, the bypass operation started on July 15 and decreased at a rate of 1.0 percent per day, as illustrated in Figure 11 below:

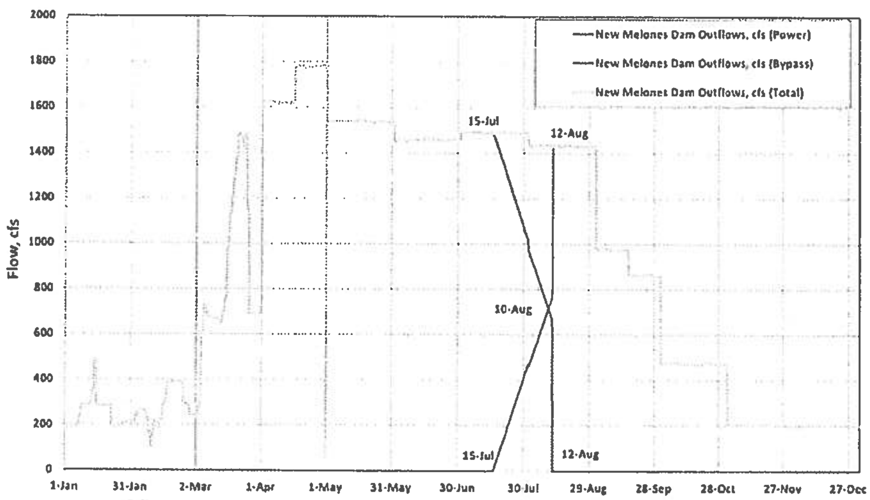


Figure 11: New Melones Power Bypass Operation

The rational for selecting 1.0 percent reduction of power flow per day when transitioning to bypass flow, is that it provides an overall moderation of temperatures throughout the bypass period. This would also keep the peak temperature in early August at approximately the same level as the peak temperature in early October, as illustrated in Figure 12 below:

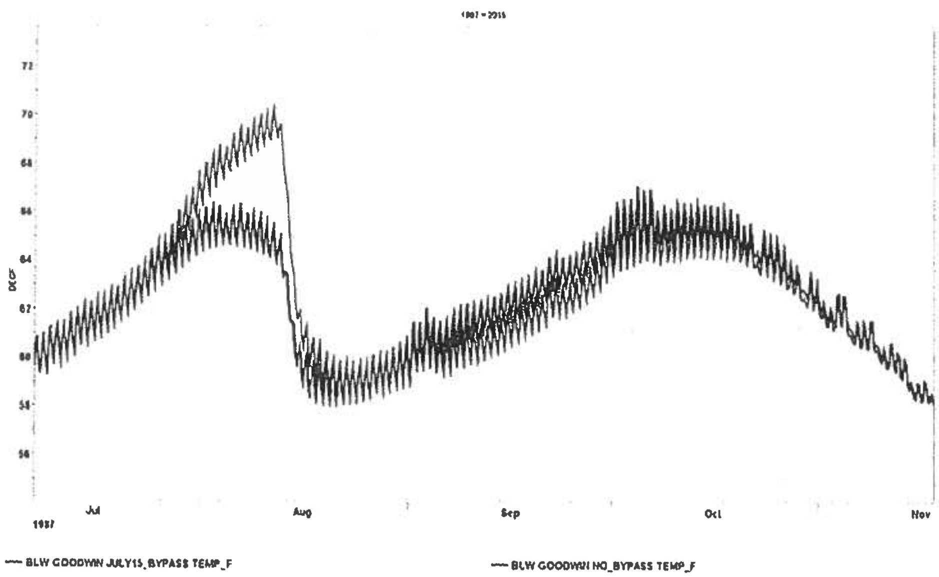


Figure 12: Effects of Power Bypass on Temperature Below Goodwin Dam

The results for the bypass case in terms of 7DADM are presented in the following tables:

Table 5: Temperature Response – 7DADM
March-April, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Mar	50.2	50.1	51.5	51.5	54.2	54.5
2-Mar	50.4	50.3	51.9	51.9	54.7	54.9
3-Mar	50.8	50.7	52.4	52.4	55.4	55.6
4-Mar	50.8	50.9	52.8	52.9	56.0	56.2
5-Mar	50.7	50.9	52.8	53.1	56.4	56.6
6-Mar	50.7	51.0	53.0	53.3	56.7	57.0
7-Mar	50.7	51.1	53.2	53.6	57.0	57.3
8-Mar	50.7	51.1	53.2	53.7	57.2	57.5
9-Mar	50.6	51.1	53.3	53.8	57.4	57.7
10-Mar	50.5	51.0	53.2	53.7	57.4	57.8
11-Mar	50.8	51.1	53.3	53.8	57.5	57.9
12-Mar	51.1	51.4	53.8	54.2	58.1	58.3
13-Mar	51.2	51.6	54.2	54.7	58.7	58.8
14-Mar	51.2	51.6	54.2	54.8	58.9	59.0
15-Mar	51.2	51.7	54.1	54.8	59.0	59.2
16-Mar	51.1	51.7	54.1	54.8	59.0	59.3
17-Mar	51.1	51.7	54.2	54.8	59.1	59.4
18-Mar	50.9	51.7	54.1	54.8	59.0	59.4
19-Mar	50.7	51.6	53.9	54.6	58.7	59.1
20-Mar	50.6	51.5	53.8	54.4	58.4	58.8
21-Mar	50.5	51.5	53.8	54.4	58.3	58.6
22-Mar	50.5	51.6	53.9	54.5	58.3	58.7
23-Mar	50.5	51.6	53.9	54.5	58.3	58.6
24-Mar	50.6	51.6	53.9	54.5	58.3	58.5
25-Mar	50.7	51.7	54.1	54.7	58.4	58.6
26-Mar	51.0	51.9	54.3	54.9	58.8	59.0
27-Mar	51.3	52.1	54.7	55.3	59.2	59.4
28-Mar	51.6	52.4	55.2	55.8	59.7	60.0
29-Mar	51.8	52.7	55.6	56.3	60.2	60.5
30-Mar	52.2	53.0	56.2	56.9	60.8	61.1
31-Mar	52.5	53.3	56.6	57.5	61.3	61.7
1-Apr	52.5	53.4	56.8	57.8	61.9	62.2
2-Apr	52.4	53.3	56.7	57.9	62.2	62.6
3-Apr	52.3	53.2	56.5	57.7	62.3	62.8
4-Apr	52.1	53.1	56.1	57.3	62.1	62.7
5-Apr	51.9	52.9	55.7	56.8	61.8	62.5
6-Apr	51.8	52.7	55.3	56.4	61.4	62.3
7-Apr	51.6	52.5	54.9	56.0	61.1	62.1
8-Apr	51.7	52.5	54.7	55.6	60.7	61.8
9-Apr	51.7	52.6	54.7	55.5	60.3	61.5
10-Apr	51.8	52.6	54.7	55.5	60.1	61.3
11-Apr	51.8	52.7	54.7	55.6	60.0	61.2
12-Apr	51.9	52.8	55.0	55.8	60.2	61.3
13-Apr	52.0	52.9	55.1	56.0	60.4	61.5
14-Apr	52.1	53.0	55.3	56.2	60.7	61.7
15-Apr	52.2	53.2	55.5	56.4	61.1	62.1
16-Apr	52.3	53.3	55.7	56.7	61.4	62.4
17-Apr	52.4	53.4	55.9	56.9	61.8	62.8
18-Apr	52.4	53.4	55.9	56.9	61.9	63.0
19-Apr	52.4	53.4	55.9	56.9	61.9	63.1
20-Apr	52.5	53.5	55.9	56.9	61.9	63.1
21-Apr	52.5	53.5	55.9	56.9	61.9	63.1
22-Apr	52.6	53.6	56.0	57.0	61.9	63.1
23-Apr	52.6	53.6	55.9	56.9	61.7	62.9
24-Apr	52.7	53.7	56.1	57.0	61.7	62.8
25-Apr	52.8	53.9	56.4	57.4	62.1	63.2
26-Apr	52.9	54.0	56.6	57.7	62.5	63.6
27-Apr	53.1	54.2	56.9	58.0	63.1	64.1
28-Apr	53.1	54.3	57.0	58.2	63.4	64.5
29-Apr	53.2	54.4	57.2	58.4	63.7	64.8
30-Apr	53.3	54.4	57.2	58.4	63.9	65.0

Table 6: Temperature Response – 7DADM
May-June, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-May	53.3	54.5	57.3	58.4	63.8	65.0
2-May	53.4	54.7	57.6	58.6	63.9	65.0
3-May	53.4	54.9	58.0	58.9	63.9	64.9
4-May	53.5	55.1	58.4	59.3	64.1	64.9
5-May	53.5	55.5	59.2	60.1	64.7	65.4
6-May	53.6	55.9	60.0	61.0	65.5	66.0
7-May	53.8	56.3	61.0	62.2	66.7	67.1
8-May	53.9	56.7	62.0	63.5	68.2	68.3
9-May	54.0	57.0	62.7	64.5	69.6	69.6
10-May	54.1	57.3	63.4	65.5	71.1	71.1
11-May	54.2	57.5	63.9	66.3	72.3	72.4
12-May	54.3	57.7	64.3	66.9	73.3	73.4
13-May	54.4	57.9	64.6	67.3	74.1	74.2
14-May	54.4	58.0	64.9	67.7	74.9	75.1
15-May	54.5	58.2	65.2	68.1	75.6	75.8
16-May	54.6	58.2	65.2	68.2	75.7	76.0
17-May	54.6	58.1	65.0	68.1	75.7	76.1
18-May	54.7	58.1	64.8	67.9	75.6	76.0
19-May	54.6	57.9	64.5	67.5	75.2	75.7
20-May	54.6	57.7	63.9	66.8	74.5	75.0
21-May	54.7	57.6	63.5	66.2	73.7	74.3
22-May	54.7	57.4	63.0	65.6	73.0	73.6
23-May	54.7	57.3	62.6	65.2	72.5	73.1
24-May	54.8	57.3	62.6	64.9	72.1	72.8
25-May	54.8	57.3	62.5	64.8	71.8	72.5
26-May	54.8	57.3	62.4	64.6	71.5	72.2
27-May	54.8	57.2	62.1	64.3	71.1	71.8
28-May	54.9	57.2	62.1	64.2	70.9	71.6
29-May	54.9	57.2	62.1	64.1	70.7	71.4
30-May	55.0	57.3	62.2	64.2	70.7	71.4
31-May	55.1	57.5	62.3	64.3	70.7	71.4
1-Jun	55.2	57.7	62.6	64.6	70.9	71.5
2-Jun	55.4	58.1	63.3	65.2	71.6	72.2
3-Jun	55.6	58.6	64.3	66.2	72.6	73.0
4-Jun	55.6	58.8	64.7	66.9	73.2	73.6
5-Jun	55.7	59.0	65.1	67.5	73.7	74.0
6-Jun	55.8	59.3	65.7	68.1	74.3	74.5
7-Jun	55.9	59.6	66.2	68.8	74.9	75.1
8-Jun	56.0	59.8	66.7	69.4	75.5	75.6
9-Jun	56.1	59.9	66.8	69.7	75.8	75.9
10-Jun	56.2	59.9	66.9	69.8	76.0	76.0
11-Jun	56.4	60.2	67.3	70.2	76.4	76.4
12-Jun	56.5	60.5	67.6	70.7	77.0	77.0
13-Jun	56.7	60.7	68.2	71.2	77.5	77.4
14-Jun	56.8	60.8	68.2	71.4	77.7	77.6
15-Jun	56.8	60.8	68.2	71.4	77.7	77.6
16-Jun	56.9	60.8	68.1	71.3	77.7	77.5
17-Jun	57.0	60.7	68.0	71.2	77.6	77.4
18-Jun	57.1	60.8	67.9	71.0	77.5	77.4
19-Jun	57.2	60.7	67.7	70.9	77.3	77.3
20-Jun	57.2	60.6	67.3	70.5	77.0	76.9
21-Jun	57.3	60.6	67.2	70.2	76.7	76.7
22-Jun	57.5	60.7	67.2	70.1	76.6	76.6
23-Jun	57.7	60.9	67.4	70.2	76.6	76.7
24-Jun	57.9	61.2	67.8	70.5	77.0	77.0
25-Jun	58.1	61.5	68.2	71.0	77.4	77.5
26-Jun	58.3	61.8	68.7	71.5	78.0	78.0
27-Jun	58.5	62.1	69.2	72.2	78.7	76.6
28-Jun	58.6	62.4	69.7	72.8	79.3	79.3
29-Jun	58.8	62.6	70.0	73.2	79.9	79.8
30-Jun	58.9	62.6	70.2	73.5	80.2	80.2

Table 7: Temperature Response – 7DADM
July-August, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Jul	59.0	62.8	70.2	73.6	80.4	80.4
2-Jul	59.2	62.8	70.1	73.5	80.3	80.3
3-Jul	59.3	62.7	69.7	73.1	79.9	79.9
4-Jul	59.4	62.7	69.5	72.8	79.6	79.6
5-Jul	59.6	62.8	69.4	72.6	79.3	79.3
6-Jul	59.8	62.9	69.4	72.4	79.0	79.0
7-Jul	60.0	63.1	69.5	72.4	79.0	79.0
8-Jul	60.3	63.3	69.7	72.5	79.0	78.9
9-Jul	60.5	63.5	69.9	72.7	79.0	79.0
10-Jul	60.8	63.8	70.3	73.0	79.3	79.2
11-Jul	61.0	64.0	70.5	73.3	79.4	79.3
12-Jul	61.2	64.3	70.8	73.5	79.6	79.5
13-Jul	61.4	64.5	71.2	73.9	79.9	79.8
14-Jul	61.6	64.7	71.3	74.1	80.0	79.8
15-Jul	61.8	64.9	71.6	74.4	80.3	80.1
16-Jul	62.0	65.0	71.7	74.5	80.4	80.3
17-Jul	62.1	65.1	71.6	74.5	80.4	80.3
18-Jul	62.3	65.2	71.5	74.4	80.4	80.2
19-Jul	62.4	65.2	71.4	74.2	80.2	80.1
20-Jul	62.6	65.1	71.1	73.9	80.0	79.9
21-Jul	62.8	65.2	70.9	73.6	79.7	79.6
22-Jul	63.0	65.1	70.7	73.2	79.3	79.2
23-Jul	63.2	65.2	70.4	72.9	78.8	78.8
24-Jul	63.4	65.3	70.5	72.7	78.6	78.6
25-Jul	63.7	65.5	70.5	72.7	76.5	78.5
26-Jul	63.9	65.7	70.6	72.7	78.4	78.3
27-Jul	64.2	65.8	70.7	72.7	78.3	78.2
28-Jul	64.4	66.1	70.9	72.8	78.3	78.2
29-Jul	64.7	66.3	71.0	72.9	78.3	78.2
30-Jul	64.9	66.5	71.2	73.1	78.3	78.2
31-Jul	65.2	66.7	71.4	73.2	78.4	78.3
1-Aug	65.4	67.0	71.7	73.4	78.6	78.5
2-Aug	65.6	67.3	72.0	73.8	78.9	78.8
3-Aug	65.8	67.6	72.4	74.2	79.2	79.2
4-Aug	65.9	67.7	72.4	74.3	79.3	79.2
5-Aug	66.0	67.6	72.5	74.4	79.4	79.3
6-Aug	66.1	68.0	72.8	74.7	79.6	79.6
7-Aug	66.1	68.1	72.6	74.7	79.6	79.6
8-Aug	66.1	68.0	72.8	74.7	79.6	79.5
9-Aug	66.0	68.0	72.7	74.6	79.5	79.4
10-Aug	65.9	67.8	72.4	74.3	79.1	79.0
11-Aug	65.9	67.9	72.5	74.2	79.1	78.9
12-Aug	65.7	67.8	72.4	74.1	78.9	78.7
13-Aug	65.3	67.5	72.0	73.8	78.5	78.4
14-Aug	64.7	67.2	71.8	73.5	78.2	78.1
15-Aug	63.9	66.8	71.5	73.2	77.9	77.7
16-Aug	63.1	66.4	71.3	73.0	77.7	77.6
17-Aug	62.3	66.0	71.2	72.9	77.6	77.5
18-Aug	61.5	65.5	70.9	72.7	77.5	77.4
19-Aug	60.7	64.9	70.6	72.6	77.4	77.3
20-Aug	60.2	64.4	70.3	72.4	77.3	77.2
21-Aug	59.9	63.9	70.0	72.2	77.2	77.1
22-Aug	59.8	63.5	69.6	71.9	77.1	77.0
23-Aug	59.7	63.1	69.2	71.5	76.8	76.7
24-Aug	59.7	62.8	68.8	71.2	76.5	76.5
25-Aug	59.7	62.6	68.4	70.8	76.4	76.4
26-Aug	59.8	62.5	68.3	70.6	76.3	76.3
27-Aug	59.8	62.5	68.2	70.6	76.4	76.4
28-Aug	59.9	62.6	68.3	70.6	76.6	76.7
29-Aug	60.0	62.7	68.4	70.7	76.9	77.0
30-Aug	60.1	62.8	68.6	71.0	77.2	77.3
31-Aug	60.3	62.9	68.7	71.1	77.4	77.6

Table 8: Temperature Response – 7DADM
September-October, 2015

	BLW GOODWIN	KNIGHTS FERRY	ORANGE BLOSSOM	HYW 120 BRIDGE	RIPON GAGE	ABV SJR
	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS	JULY15_BYPASS
	7DADM	7DADM	7DADM	7DADM	7DADM	7DADM
	DEGF	DEGF	DEGF	DEGF	DEGF	DEGF
1-Sep	60.5	63.1	69.0	71.4	77.7	77.9
2-Sep	60.7	63.3	69.1	71.6	78.0	78.2
3-Sep	61.0	63.5	69.4	71.9	78.3	78.5
4-Sep	61.2	63.6	69.5	72.0	78.3	78.5
5-Sep	61.4	63.6	69.3	71.8	78.0	78.2
6-Sep	61.5	63.5	68.9	71.4	77.5	77.7
7-Sep	61.7	63.5	68.6	71.0	77.1	77.3
8-Sep	61.7	63.4	68.3	70.5	76.6	76.9
9-Sep	61.8	63.4	66.0	70.1	76.2	76.4
10-Sep	61.8	63.3	67.5	69.5	75.5	75.8
11-Sep	61.9	63.2	67.1	69.0	74.8	75.2
12-Sep	62.0	63.2	66.8	68.6	74.3	74.6
13-Sep	62.2	63.3	66.8	68.4	73.9	74.4
14-Sep	62.3	63.3	66.5	68.0	73.4	73.8
15-Sep	62.4	63.3	66.3	67.7	72.8	73.3
16-Sep	62.5	63.2	66.1	67.4	72.3	72.7
17-Sep	62.7	63.3	66.0	67.2	71.9	72.3
18-Sep	62.8	63.4	66.0	67.0	71.5	71.9
19-Sep	63.0	63.5	66.1	67.0	71.4	71.7
20-Sep	63.1	63.7	66.2	67.1	71.3	71.6
21-Sep	63.4	64.0	66.6	67.4	71.6	71.9
22-Sep	63.6	64.3	67.0	67.8	71.9	72.1
23-Sep	63.7	64.5	67.3	68.2	72.1	72.3
24-Sep	63.9	64.7	67.5	68.4	72.3	72.5
25-Sep	64.0	64.8	67.6	68.6	72.4	72.5
26-Sep	64.2	64.9	67.6	68.6	72.5	72.5
27-Sep	64.3	65.0	67.7	68.7	72.5	72.5
28-Sep	64.4	65.0	67.6	68.6	72.3	72.3
29-Sep	64.6	65.1	67.5	68.4	72.2	72.2
30-Sep	64.8	65.2	67.6	68.4	72.2	72.2
1-Oct	65.1	65.4	67.7	68.5	72.3	72.3
2-Oct	65.5	65.6	67.8	68.5	72.4	72.5
3-Oct	65.8	65.8	67.8	68.4	72.4	72.6
4-Oct	66.1	66.1	67.9	68.4	72.3	72.6
5-Oct	66.4	66.3	67.9	68.5	72.2	72.7
6-Oct	66.6	66.4	67.9	68.4	72.1	72.6
7-Oct	66.7	66.4	67.6	68.1	71.6	72.1
8-Oct	66.7	66.4	67.5	67.8	70.9	71.6
9-Oct	66.6	66.4	67.3	67.5	70.2	70.9
10-Oct	66.6	66.3	67.3	67.4	69.7	70.3
11-Oct	66.5	66.3	67.1	67.1	69.1	69.6
12-Oct	66.4	66.2	66.9	66.9	68.6	68.9
13-Oct	66.3	66.1	66.7	66.6	68.0	68.3
14-Oct	66.4	66.1	66.7	66.6	67.7	67.9
15-Oct	66.4	66.1	66.6	66.5	67.5	67.6
16-Oct	66.4	66.1	66.7	66.5	67.4	67.4
17-Oct	66.4	66.1	66.7	66.5	67.3	67.3
18-Oct	66.3	66.1	66.7	66.5	67.3	67.2
19-Oct	66.3	66.1	66.6	66.5	67.3	67.2
20-Oct	66.1	65.9	66.5	66.4	67.2	67.0
21-Oct	66.0	65.8	66.3	66.2	67.0	66.9
22-Oct	65.8	65.5	65.9	65.8	66.6	66.5
23-Oct	65.6	65.3	65.7	65.5	66.3	66.2
24-Oct	65.4	65.2	65.5	65.3	66.0	65.9
25-Oct	65.3	65.0	65.3	65.1	65.8	65.6
26-Oct	65.0	64.7	65.0	64.9	65.6	65.4
27-Oct	64.8	64.6	64.9	64.7	65.4	65.2
28-Oct	64.6	64.4	64.7	64.5	65.2	65.0
29-Oct	64.3	64.2	64.5	64.4	65.1	65.0
30-Oct	64.1	64.0	64.3	64.2	65.0	64.9
31-Oct	63.8	63.7	64.0	63.9	64.7	64.6

6. Projected Energy Loss Due to Bypass Operation

A simplified hydropower calculation was performed to estimate the energy loss due to the bypass operation. The no-bypass case was compared with the July 15 bypass case, as follows:

	No Bypass	July 15 Bypass	Energy Loss
	MWh	MWh	MWh
Jan			
Feb			
Mar	16,497	16,497	0
Apr	31,130	31,130	0
May	27,797	27,797	0
Jun	24,097	24,097	0
Jul	23,811	21,969	(1,842)
Aug	5,625	3,419	(2,206)
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	128,958	124,910	(4,048)

Figure 13: Projected Energy Loss Due to Bypass Operation

Figure 13 shows that the energy loss during the bypass period, July 15 through August 11, 2015, will be in the order of 4,048 MWh. Based on PG&E SRAC (Short-Term Avoided Cost) for qualifying facilities, the cost per KWh in July and August of 2014 was approximately 5 cents. If we use the same price rate for this year, the loss of energy could amount to $202,381.

ATTACHMENT 2

Fall-run Chinook salmon redd distribution and water temperatures in the Stanislaus River during 2009-2014.

Spatial distribution of fall-run Chinook salmon redds on the Stanislaus River

Methods

Annual redd surveys on the Stanislaus River have been conducted since 2007 to estimate the spawning distribution of fall-run Chinook salmon. In general, the entire spawning area is surveyed every other week (occasionally more frequently) to document the number of new redds. The results below represent preliminary data analyses to describe the relationship of redd deposition (a proxy for spawning activity) throughout the reproductive season (time) and by river location (river mile [RM]; space). For these particular analyses, six seasons of distribution data was used. Daily water temperatures throughout the Stanislaus River have been monitored concurrently, allowing an assessment of spawning distribution in relation to daily water temperatures. Water temperature recorders were located at seven stations, Goodwin Dam, Knights Ferry, Lover's Leap Restoration Area, Honolulu Bar, Orange Blossom Bridge, Oakdale, and at the Stanislaus River Weir.

We used a combination of graphical analyses and linear regression analyses to describe the spawning distributions of Chinook salmon from 2009 to 2014. For each season, the median location and downstream-most location of redds was summarized for each survey week. Water temperatures were often negatively related to the location of the water temperature logger (i.e. more upstream locations had cooler water temperatures with a predictable increase with increased distance downstream). However, this relationship occasionally did not remain constant or predictable throughout the spawning season. Therefore, we interpolated daily maximum water temperatures at the seven stations over the spawning season.

Results

As illustrated in Figure 1, spawning distribution was limited early in the season (i.e., redds only observed in the upper few river miles), but expanded to lower reaches as the spawning season progressed. Median locations of redd distribution decreased (in river mile [RM]) over the first five surveys during each year (Figure 1). During the late-September and early October, median locations were located near the upper end of Goodwin Canyon. However, by late October, median locations were typically centered around RM 54 (around Knights Ferry). Similarly, the downstream-most redd locations decreased in river mile over the first five surveys of each season. The decrease was more drastic than the decrease in median locations. New redds were typically observed as low as RM 32 (Riverbank) until early December. Results from linear regression analyses indicated statistically significant relationships between median locations and date (slope = -0.63; $P < 0.001$) *and* between downstream-most locations (slope = -2.64; $P \ll 0.001$; Figure 1).

Figures 2 through 7 each represent the interpolated daily maximum water temperatures at each station. The interpolations provide a general pattern in water temperatures across both time and space. The addition of the redd distributions show the timing and locations of spawning activity in relation to the water temperature regime during and prior each survey week. Overall daily maximum water temperatures were coolest during the 2011 spawning season (Figure 4) and were the warmest during 2014 (Figure 7). Spawning activity (i.e., new redds were observed) occurred from the 48 - 50°F range (late December 2011; Figure 4) to as high as 62 – 64°F range (mid October 2014; Figure 7). Most spawning activity during the other four seasons occurred between temperature ranges between 52°F and 56°F.

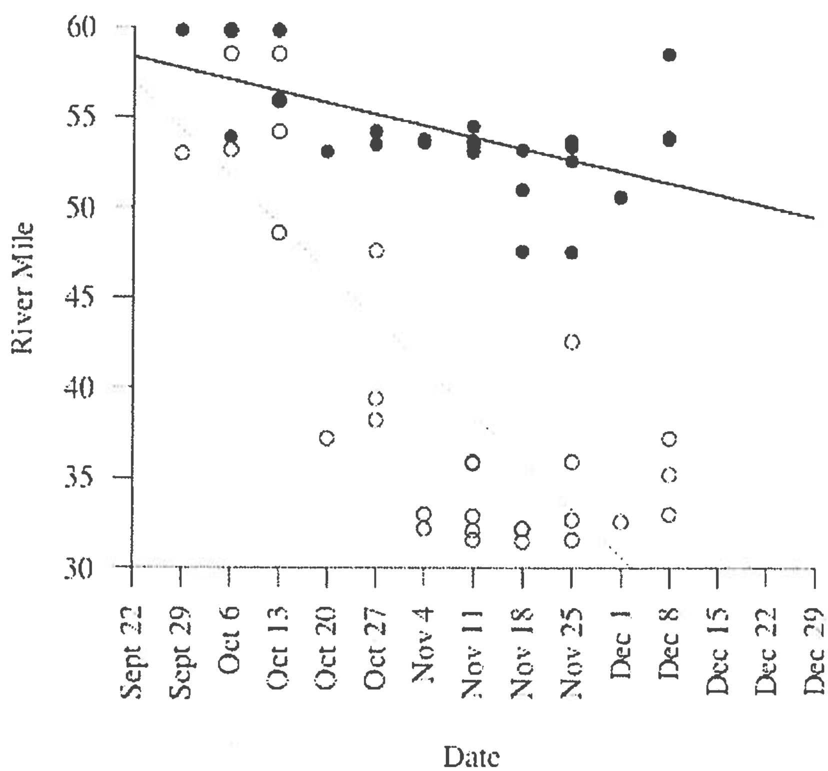


Figure 1. Relationship between median locations of Chinook redds (filled circles) and downstream-most locations (open circles) and date. Solid black line represents the best-fit line for the linear relationship between date and median locations (slope = -0.63; P < 0.001). Dotted line represents the best-fit line for the linear relationship between date and downstream-most locations (slope = -2.64; P << 0.001). For reference, Goodwin Dam is located at RM 60.

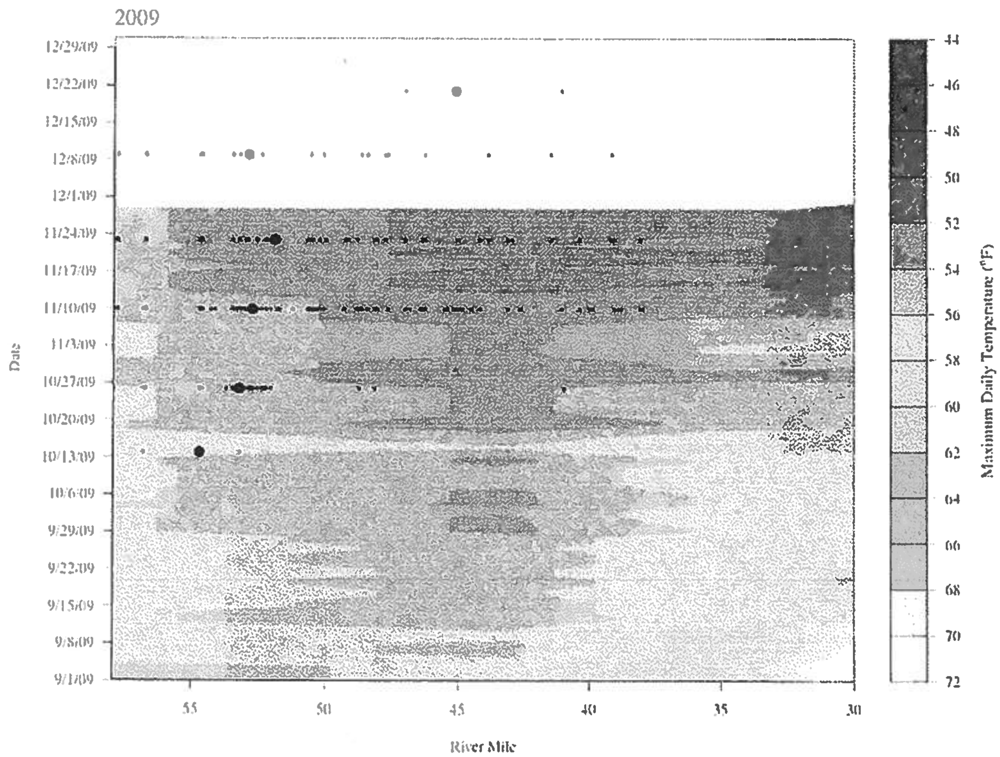


Figure 2. Interpolated daily maximum water temperatures from the Stanislaus River over the spawning season. Overall spatial distribution (small grey) and median location (larger filled circles) of observed Chinook salmon redds on the Stanislaus River by week during fall/winter 2009. Water year type in 2009 was below normal (BN). White areas on the graph indicate missing data or water temperatures outside the range of temperatures used.

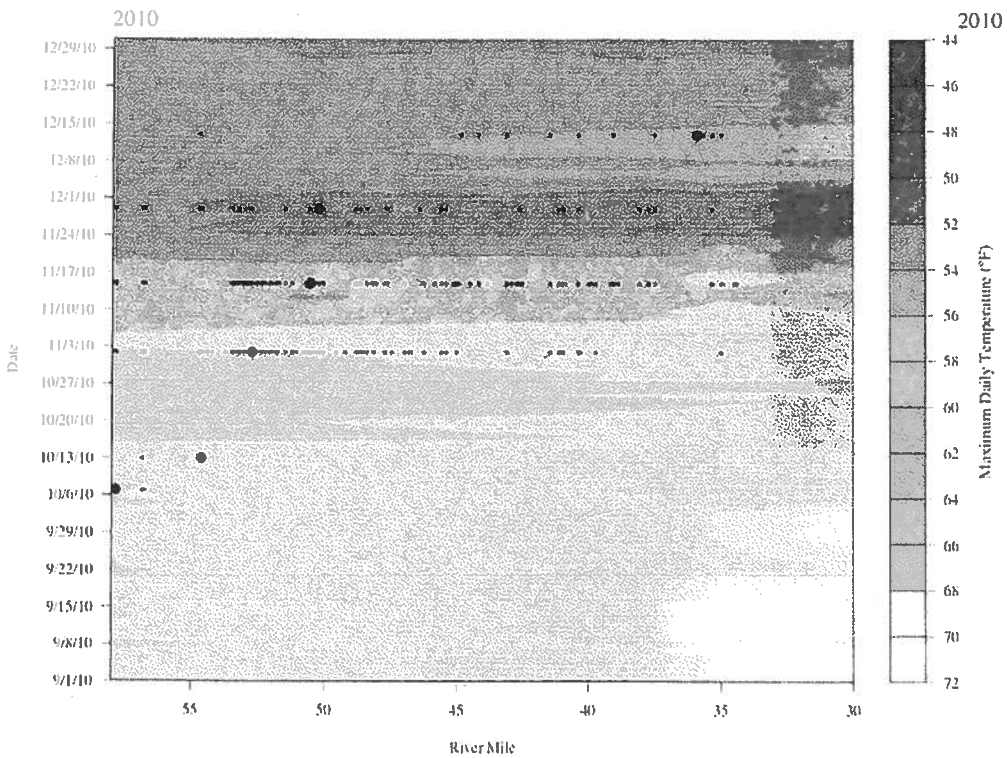


Figure 3. Interpolated daily maximum water temperatures from the Stanislaus River over the spawning season. Overall spatial distribution (small grey) and median location (larger filled circles) of observed Chinook salmon redds on the Stanislaus River by week during fall/winter 2010. Water year type in 2010 was above normal (AN). White areas on the graph indicate missing data or water temperatures outside the range of temperatures used.

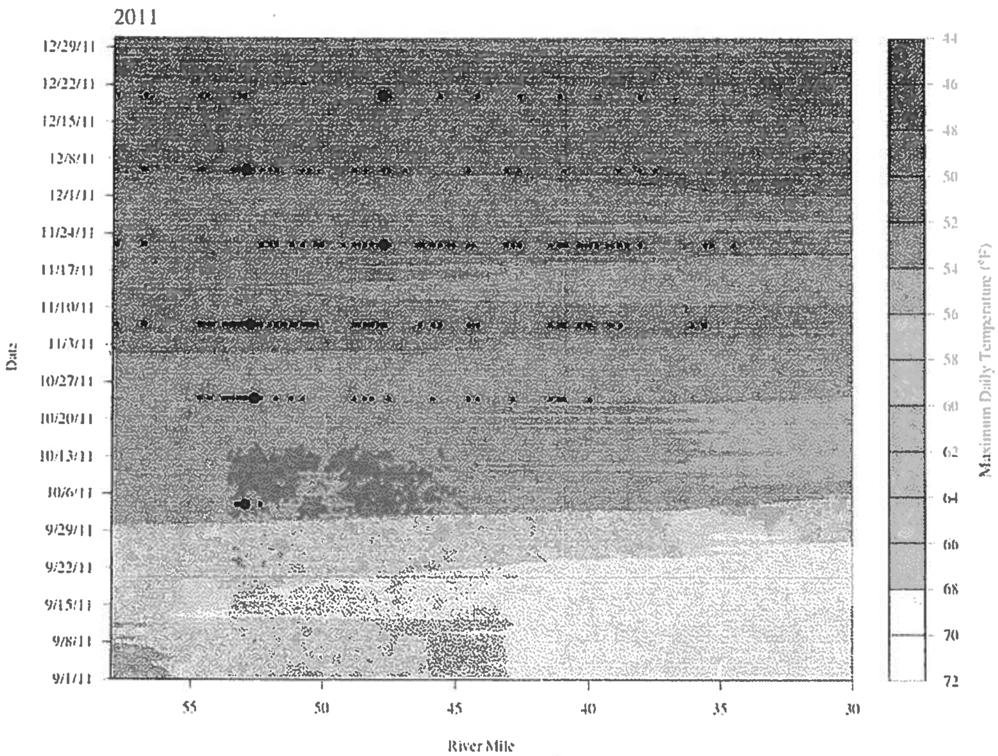


Figure 4. Interpolated daily maximum water temperatures from the Stanislaus River over the spawning season. Overall spatial distribution (small grey) and median location (larger filled circles) of observed Chinook salmon redds on the Stanislaus River by week during fall/winter 2011. Water year type in 2011 was wet (W). White areas on the graph indicate missing data or water temperatures outside the range of temperatures used.

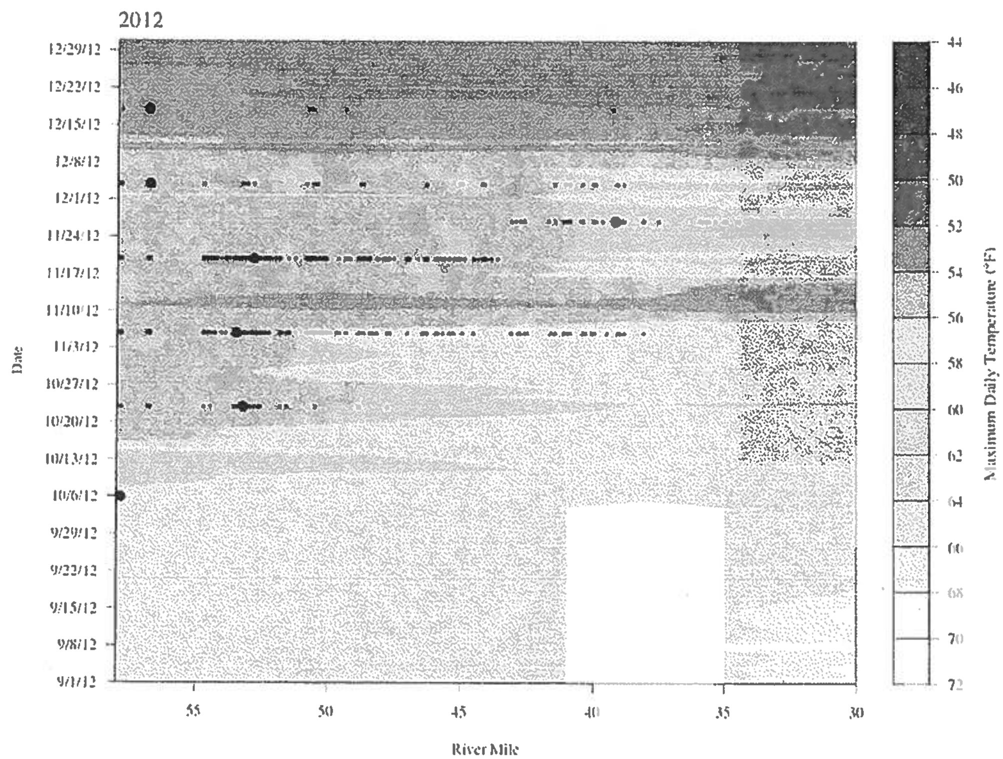


Figure 5. Interpolated daily maximum water temperatures from the Stanislaus River over the spawning season. Overall spatial distribution (small grey) and median location (larger filled circles) of observed Chinook salmon redds on the Stanislaus River by week during fall/winter 2012. Water year type in 2012 was dry (D). White areas on the graph indicate missing data or water temperatures outside the range of temperatures used.

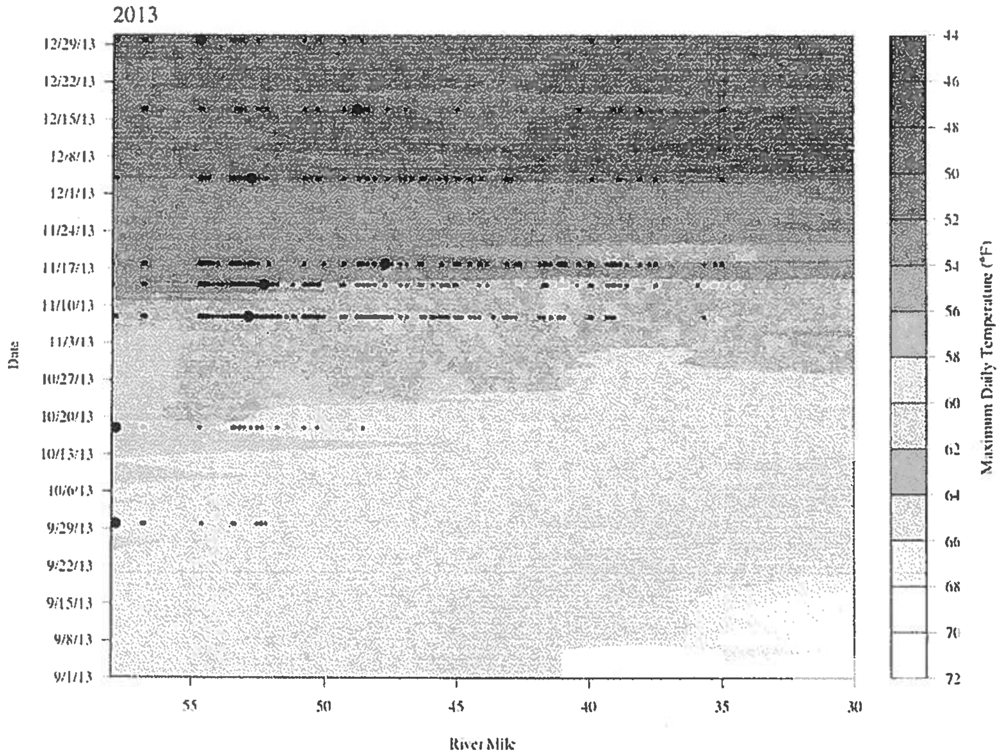


Figure 6. Interpolated daily maximum water temperatures from the Stanislaus River over the spawning season. Overall spatial distribution (small grey) and median location (larger filled circles) of observed Chinook salmon redds on the Stanislaus River by week during fall/winter 2013. Water year type in 2013 was critically dry (CD). White areas on the graph indicate missing data or water temperatures outside the range of temperatures used.

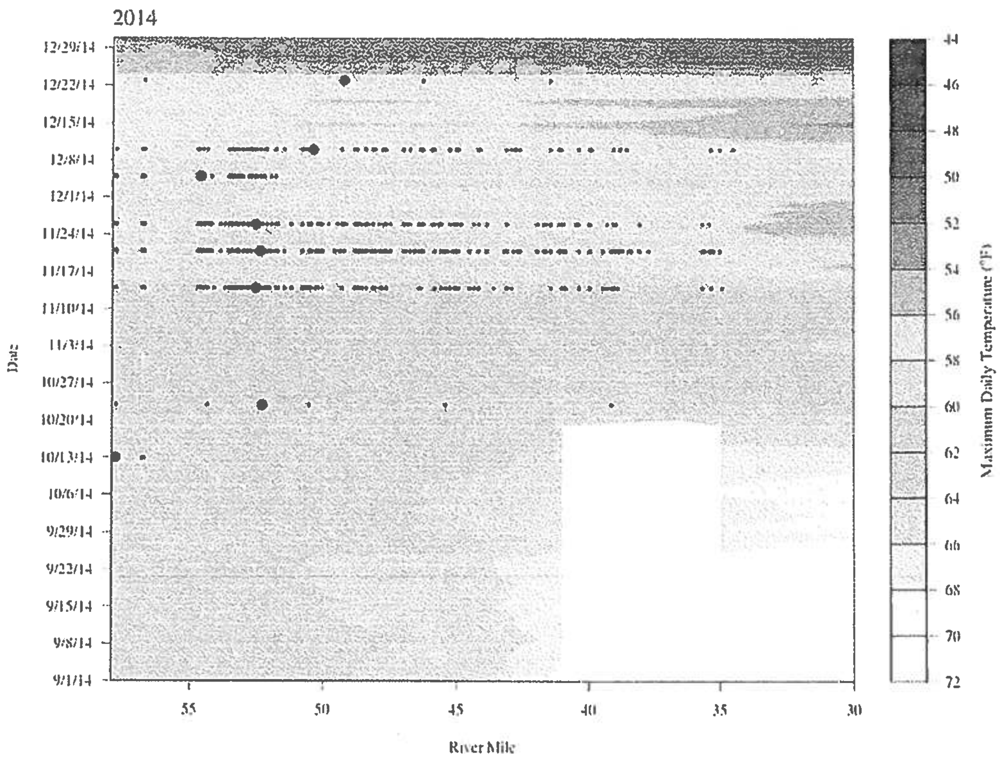
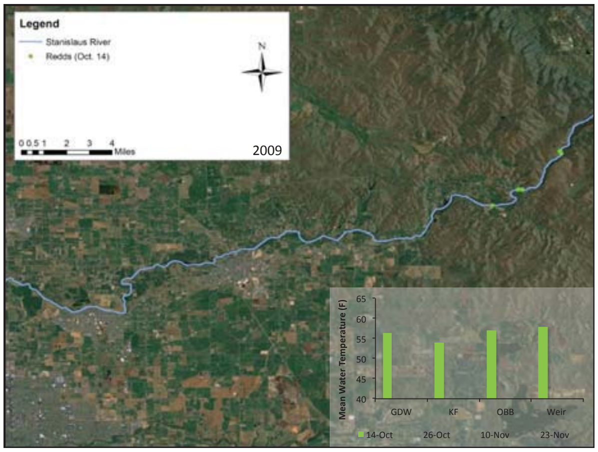
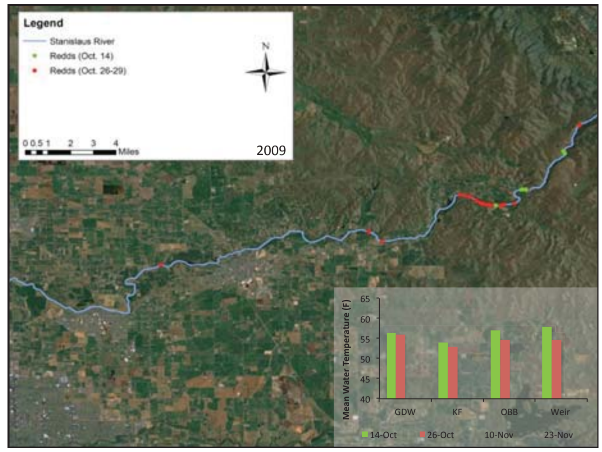
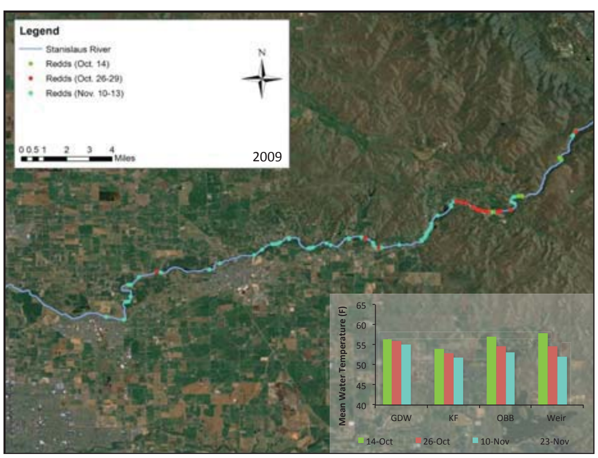
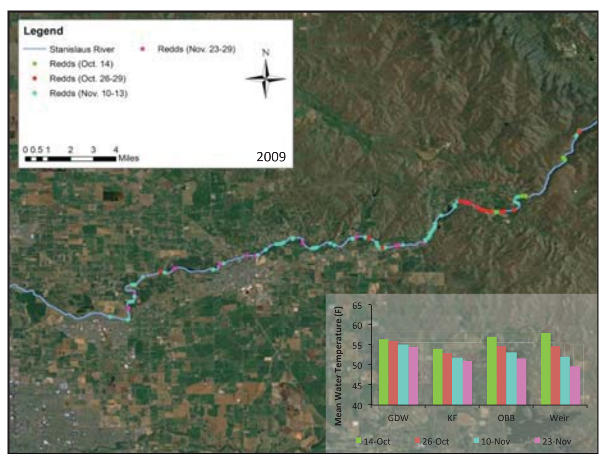


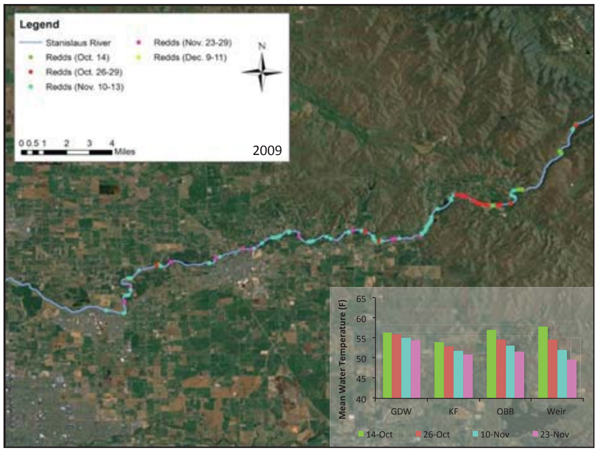
Figure 7. Interpolated daily maximum water temperatures from the Stanislaus River over the spawning season. Overall spatial distribution (small grey) and median location (larger filled circles) of observed Chinook salmon redds on the Stanislaus River by week during fall/winter 2014. Water year type in 2014 was critically dry (CD). White areas on the graph indicate missing data or water temperatures outside the range of temperatures used.

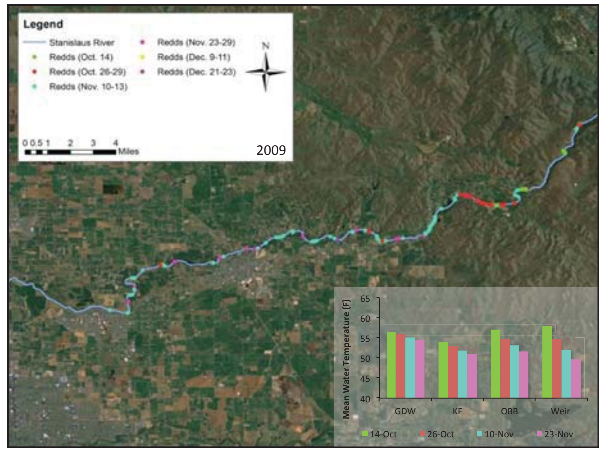

Legend
Stanislaus River
Redds (Oct. 14)
N
0 0.5 1 2 3 4 Miles
2009
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
14-Oct 26-Oct 10-Nov 23-Nov

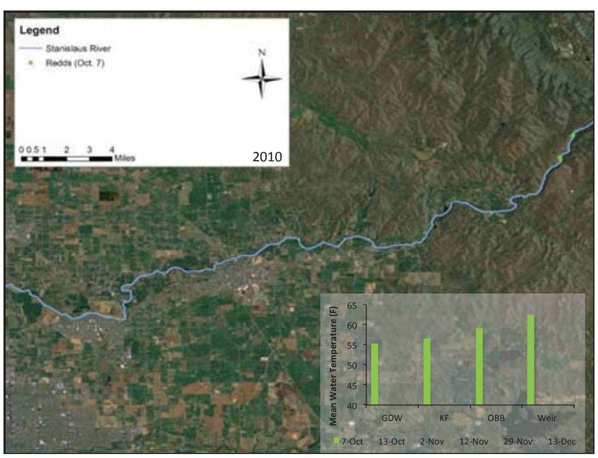

Legend
Stanislaus River
Redds (Oct. 14)
Redds (Oct. 26-29)
N
0 0.5 1 2 3 4 Miles
2009
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
14-Oct 26-Oct 10-Nov 23-Nov

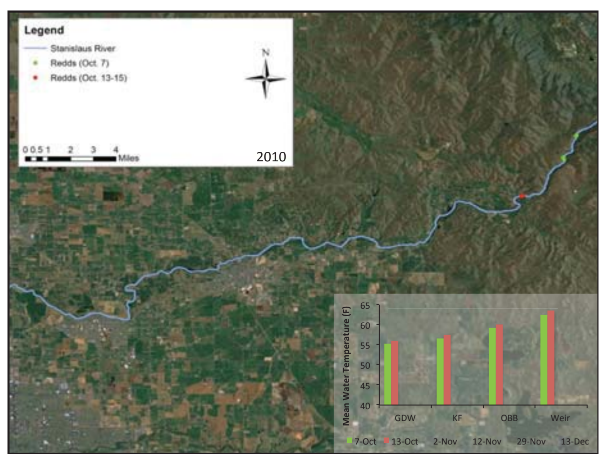

Legend
Stanislaus River
Redds (Oct. 14)
Redds (Oct. 26-29)
Redds (Nov. 10-13)
N
0 0.5 1 2 3 4 Miles
2009
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
14-Oct 26-Oct 10-Nov 23-Nov

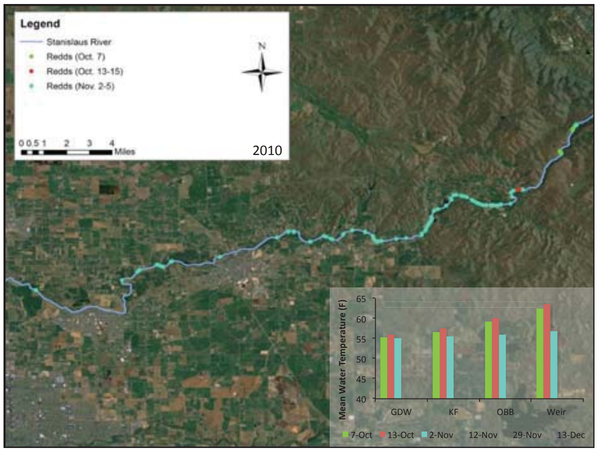

Legend
Stanislaus River
Redds (Nov. 23-29)
Redds (Oct. 14)
Redds (Oct. 26-29)
Redds (Nov. 10-13)
N
0 0.5 1 2 3 4 Miles
2009
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
14-Oct 26-Oct 10-Nov 23-Nov

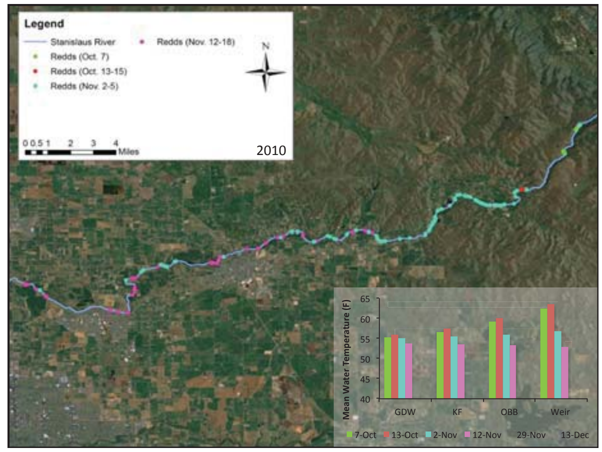

Legend
Stanislaus River
Redds (Oct. 14)
Redds (Oct. 26-29)
Redds (Nov. 10-13)
Redds (Nov. 23-29)
Redds (Dec. 9-11)
N
0 0.5 1 2 3 4 Miles
2009
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
14-Oct
26-Oct
10-Nov
23-Nov

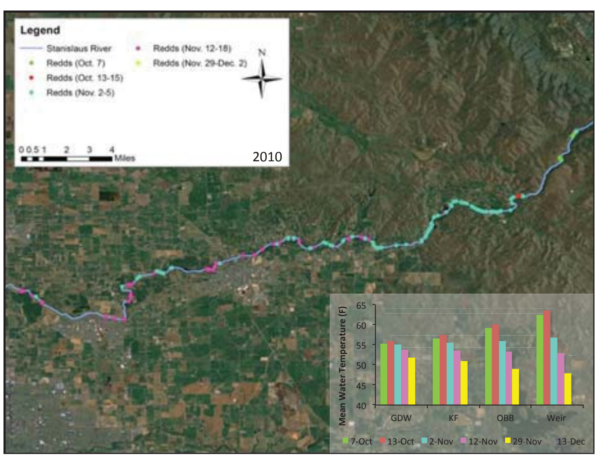

Legend
Stanislaus River
Redds (Oct. 14)
Redds (Oct. 26-29)
Redds (Nov. 10-13)
Redds (Nov. 23-29)
Redds (Dec. 9-11)
Redds (Dec. 21-23)
N
0 0.5 1 2 3 4 Miles
2009
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
14-Oct
26-Oct
10-Nov
23-Nov

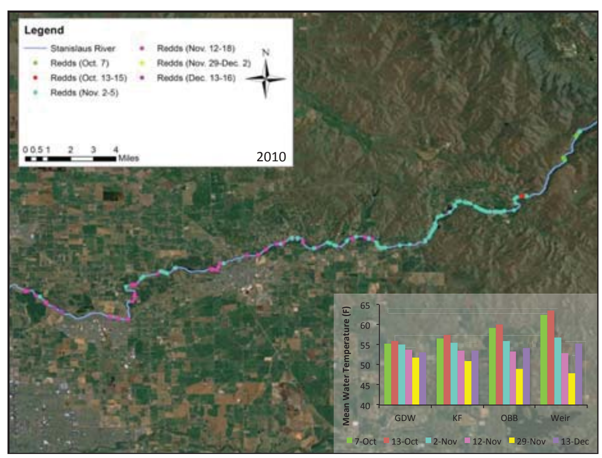

Legend
Stanislaus River
Redds (Oct. 7)
N
0 0.5 1 2 3 4 Miles
2010
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
7-Oct
13-Oct
2-Nov
12-Nov
29-Nov
13-Dec

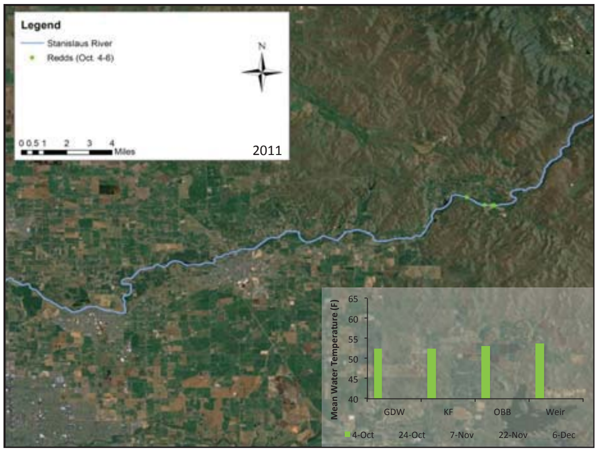

Legend
Stanislaus River
Redds (Oct. 7)
Redds (Oct. 13-15)
N
0 0.5 1 2 3 4 Miles
2010
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
7-Oct
13-Oct
2-Nov
12-Nov
29-Nov
13-Dec

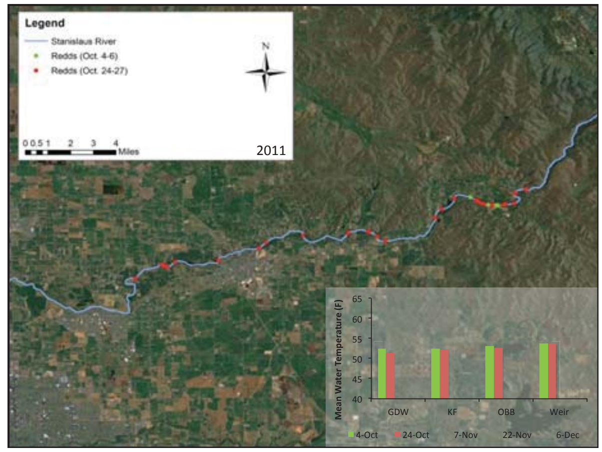

Legend
Stanislaus River
Redds (Oct. 7)
Redds (Oct. 13-15)
Redds (Nov. 2-5)
N
0 0.5 1 2 3 4 Miles
2010
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
7-Oct
13-Oct
2-Nov
12-Nov
29-Nov
13-Dec

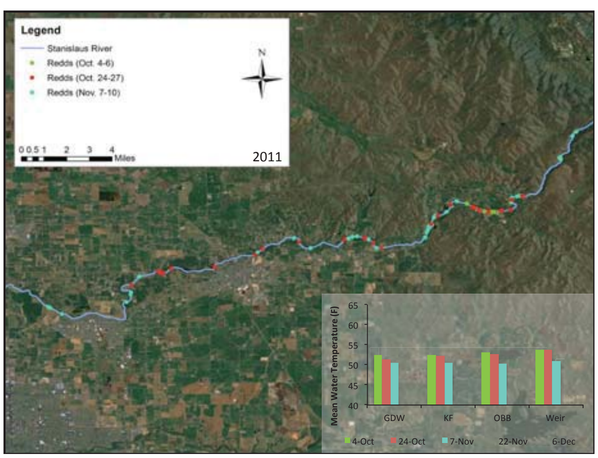

Legend
Stanislaus River
Redds (Oct. 7)
Redds (Oct. 13-15)
Redds (Nov. 2-5)
Redds (Nov. 12-18)
N
0 0.5 1 2 3 4 Miles
2010
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
7-Oct
13-Oct
2-Nov
12-Nov
29-Nov
13-Dec

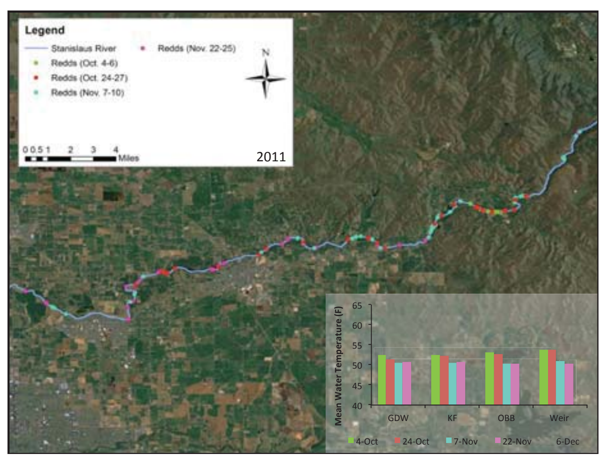

Legend
Stanislaus River
Redds (Oct. 7)
Redds (Oct. 13-15)
Redds (Nov. 2-5)
Redds (Nov. 12-18)
Redds (Nov. 29-Dec. 2)
N
0 0.5 1 2 3 4 Miles
2010
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
7-Oct
13-Oct
2-Nov
12-Nov
29-Nov
13-Dec

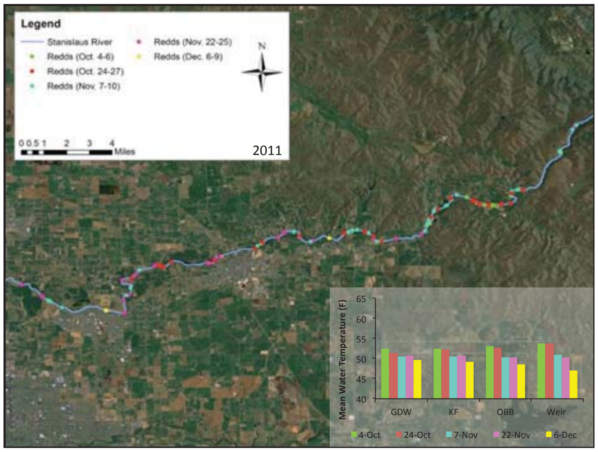

Legend
Stanislaus River
Redds (Oct. 7)
Redds (Oct. 13-15)
Redds (Nov. 2-5)
Redds (Nov. 12-18)
Redds (Nov. 29-Dec. 2)
Redds (Dec. 13-16)
N
0 0.5 1 2 3 4 Miles
2010
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
7-Oct
13-Oct
2-Nov
12-Nov
29-Nov
13-Dec

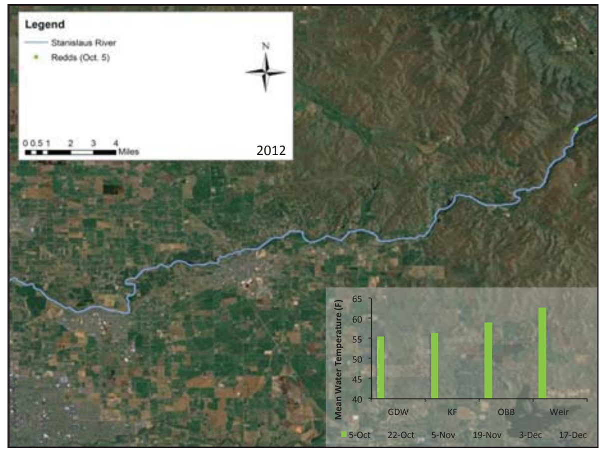

Legend
Stanislaus River
Redds (Oct. 4-6)
N
0 0.5 1 2 3 4 Miles
2011
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
4-Oct
24-Oct
7-Nov
22-Nov
6-Dec

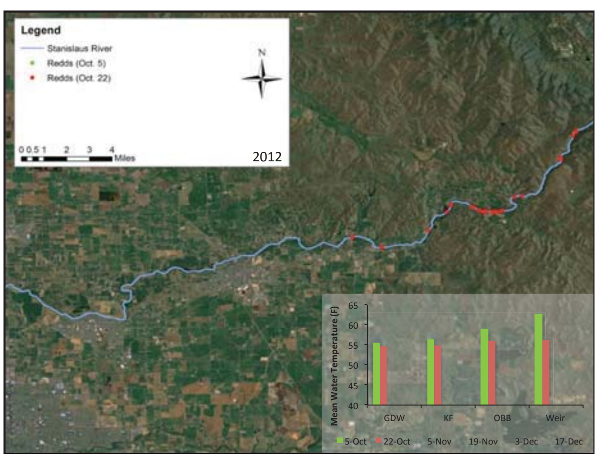

Legend
Stanislaus River
Redds (Oct. 4-6)
Redds (Oct. 24-27)
N
0 0.5 1 2 3 4 Miles
2011
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
4-Oct
24-Oct
7-Nov
22-Nov
6-Dec

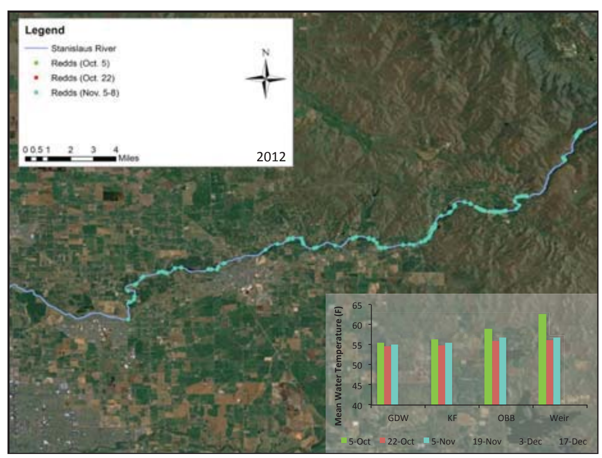

Legend
Stanislaus River
Redds (Oct. 4-6)
Redds (Oct. 24-27)
Redds (Nov. 7-10)
N
0 0.5 1 2 3 4 Miles
2011
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
4-Oct
24-Oct
7-Nov
22-Nov
6-Dec

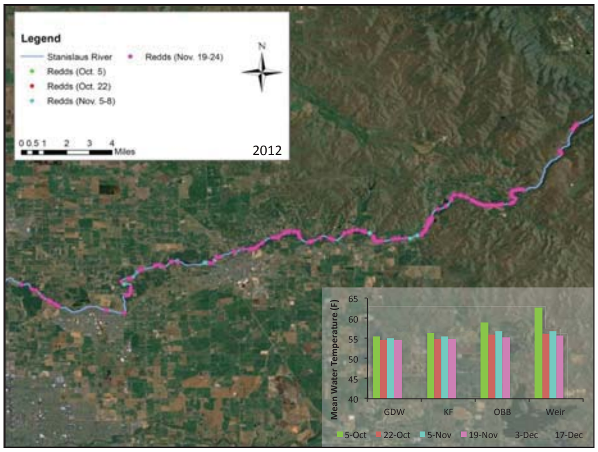

Legend
Stanislaus River
Redds (Nov. 22-25)
Redds (Oct. 4-6)
Redds (Oct. 24-27)
Redds (Nov. 7-10)
N
0 0.5 1 2 3 4 Miles
2011
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
4-Oct
24-Oct
7-Nov
22-Nov
6-Dec

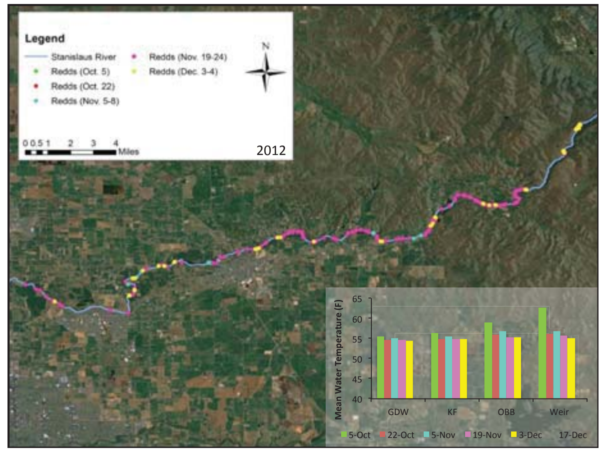

Legend
Stanislaus River
Redds (Oct. 4-6)
Redds (Oct. 24-27)
Redds (Nov. 7-10)
Redds (Nov. 22-25)
Redds (Dec. 6-9)
N
0 0.5 1 2 3 4 Miles
2011
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
4-Oct 24-Oct 7-Nov 22-Nov 6-Dec

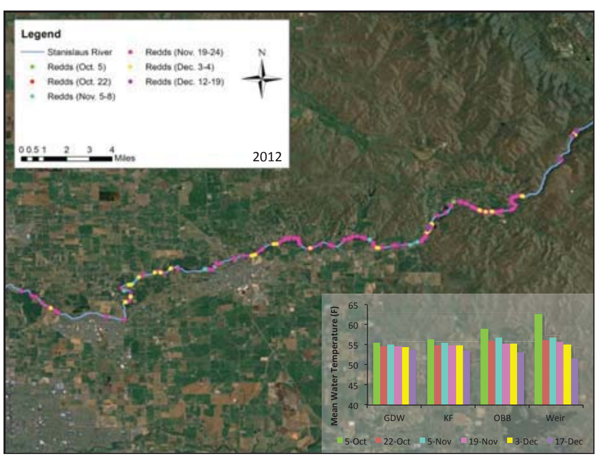

Legend
Stanislaus River
Redds (Oct. 5)
N
0 0.5 1 2 3 4 Miles
2012
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
5-Oct 22-Oct 5-Nov 19-Nov 3-Dec 17-Dec


Legend
Stanislaus River
Redds (Oct. 5)
Redds (Oct. 22)
N
0 0.5 1 2 3 4 Miles
2012
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
5-Oct 22-Oct 5-Nov 19-Nov 3-Dec 17-Dec


Legend
Stanislaus River
Redds (Oct. 5)
Redds (Oct. 22)
Redds (Nov. 5-8)
N
0 0.5 1 2 3 4 Miles
2012
Mean Water Temperature (F)
65 60 55 50 45 40
GDW KF OBB Weir
5-Oct 22-Oct 5-Nov 19-Nov 3-Dec 17-Dec


Legend
Stanislaus River
Redds (Oct. 5)
Redds (Oct. 22)
Redds (Nov. 5-8)
Redds (Nov. 19-24)
N
0 0.5 1 2 3 4 Miles
2012
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
5-Oct
22-Oct
5-Nov
19-Nov
3-Dec
17-Dec


Legend
Stanislaus River
Redds (Oct. 5)
Redds (Oct. 22)
Redds (Nov. 5-8)
Redds (Nov. 19-24)
Redds (Dec. 3-4)
N
0 0.5 1 2 3 4 Miles
2012
Mean Water Temperature (F)
65
60
55
50
45
40
GDW
KF
OBB
Weir
5-Oct
22-Oct
5-Nov
19-Nov
3-Dec
17-Dec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Redds (Oct. 22)
Redds (Nov. 5-8)
Redds (Nov. 19-24)
Redds (Dec. 3-4)
Redds (Dec. 12-19)
N
0 0.5 1 2 3 4 Miles
2012
Mean Water Temperature (F)
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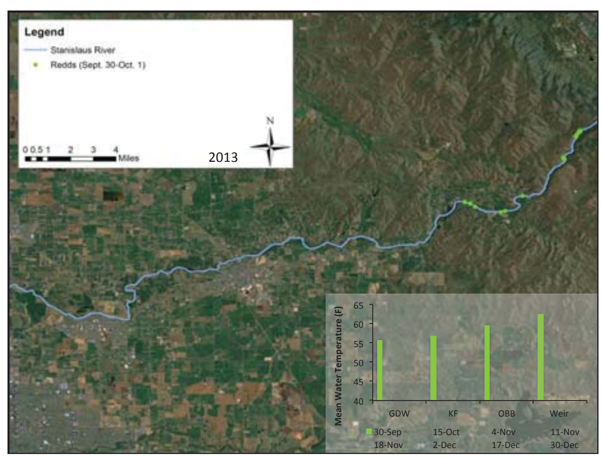
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Redds (Sept. 30-Oct. 1)
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Mean Water Temperature (F)
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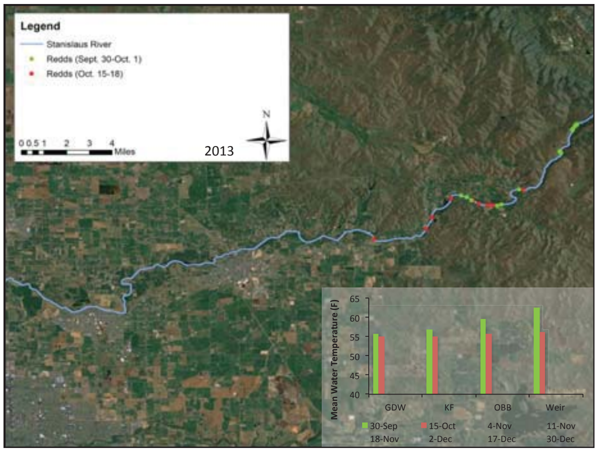
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Redds (Sept. 30-Oct. 1)
Redds (Oct. 15-18)
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Mean Water Temperature (F)
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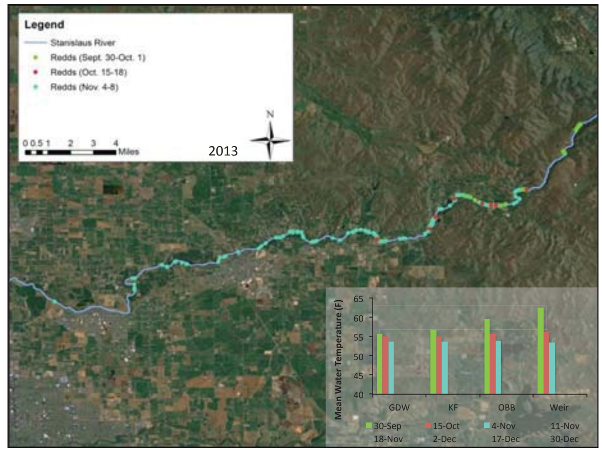
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Redds (Nov. 4-8)
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2013
Mean Water Temperature (F)
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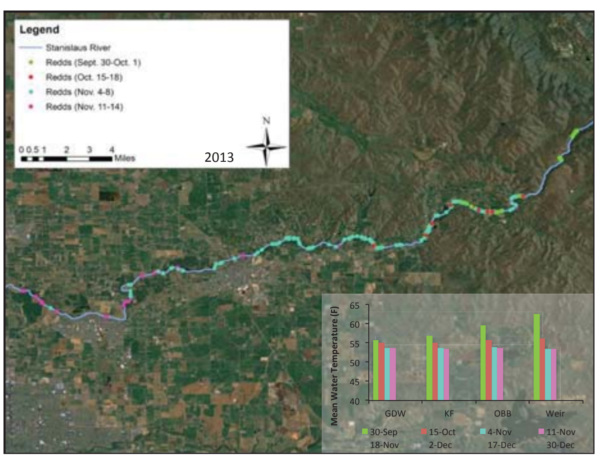
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Redds (Nov. 11-14)
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Mean Water Temperature (F)
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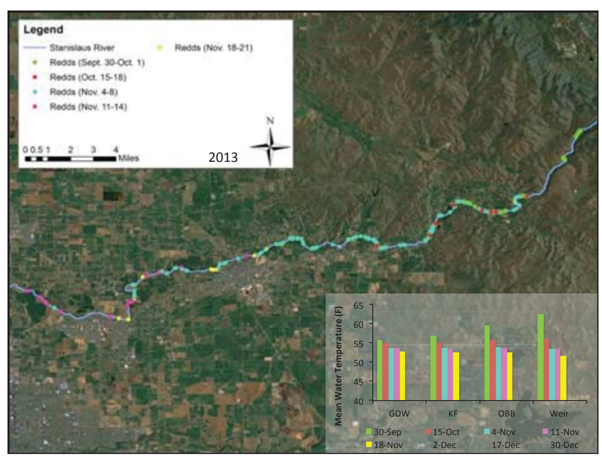
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Mean Water Temperature (F)
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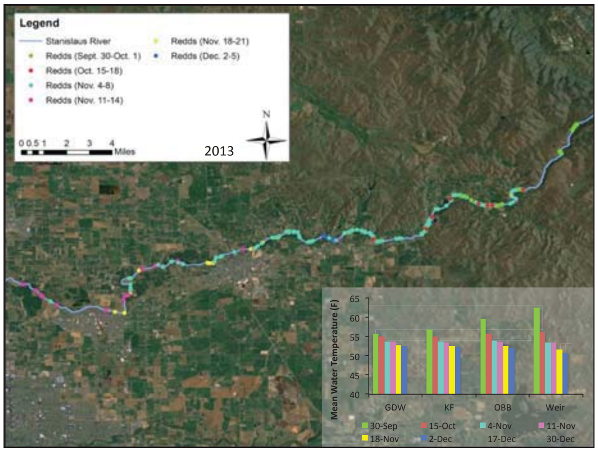
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Redds (Sept. 30-Oct. 1)
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Redds (Nov. 18-21)
Redds (Dec. 2-5)
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2013
Mean Water Temperature (F)
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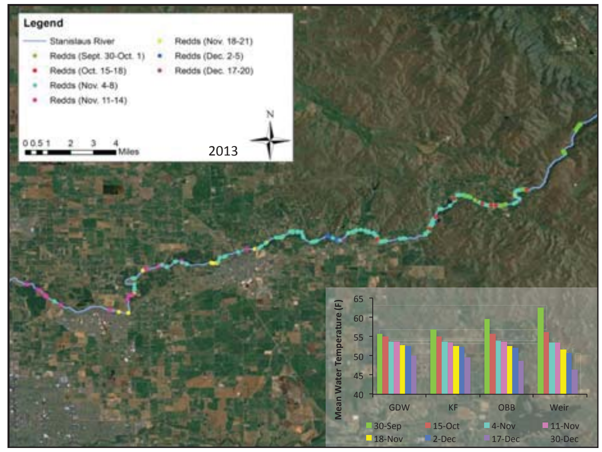
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Redds (Dec. 17-20)
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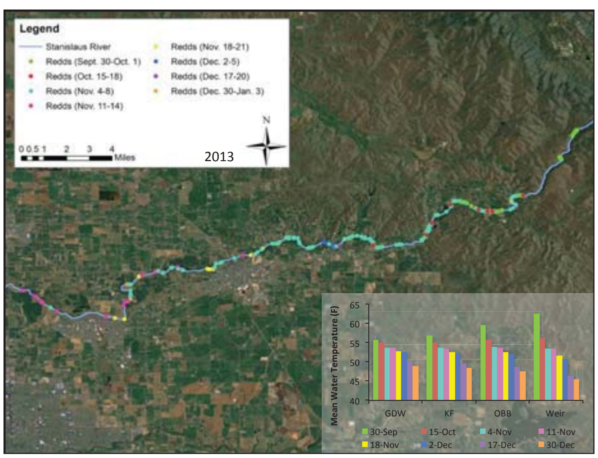
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Redds (Nov. 11-14)
Redds (Nov. 18-21)
Redds (Dec. 2-5)
Redds (Dec. 17-20)
Redds (Dec. 30-Jan. 3)
N
0 0.5 1 2 3 4 Miles
2013
Mean Water Temperature (F)
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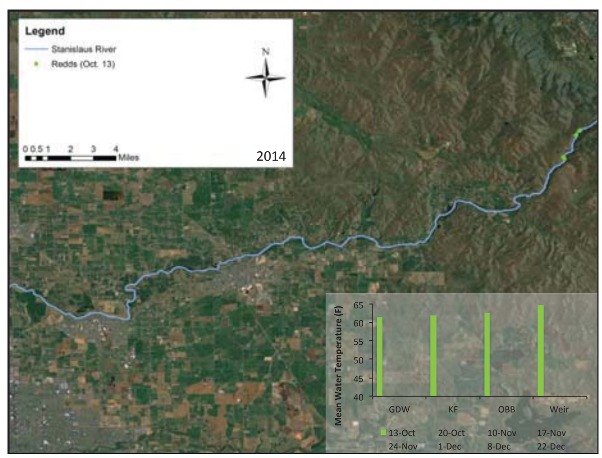
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Stanislaus River
Redds (Oct. 13)
N
0 0.5 1 2 3 4 Miles
2014
Mean Water Temperature (F)
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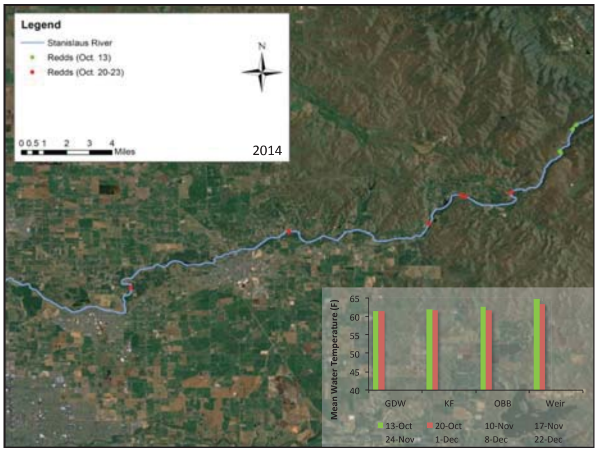
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Redds (Oct. 13)
Redds (Oct. 20-23)
N
0 0.5 1 2 3 4 Miles
2014
Mean Water Temperature (F)
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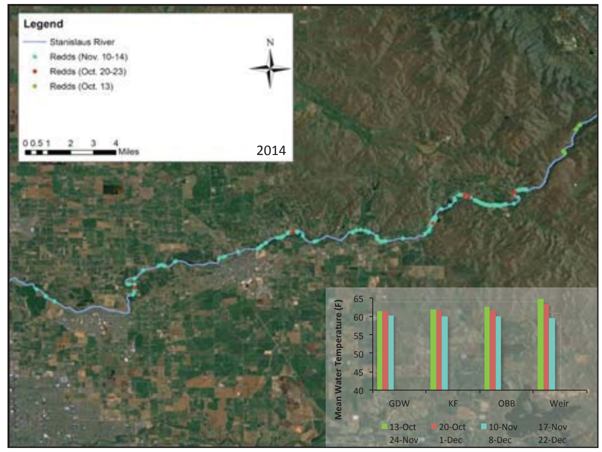
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Redds (Oct. 20-23)
Redds (Oct. 13)
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0 0.5 1 2 3 4 Miles
2014
Mean Water Temperature (F)
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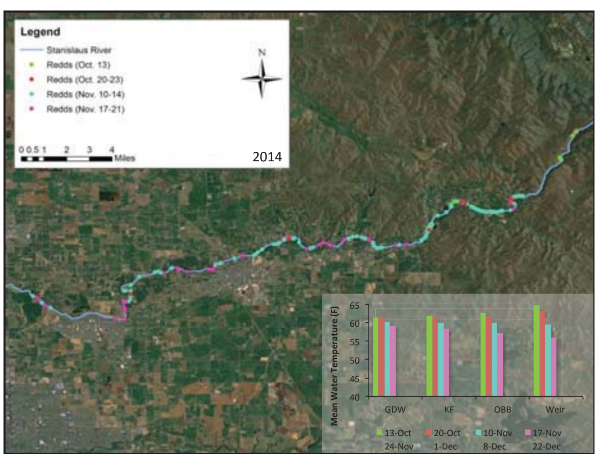
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Mean Water Temperature (F)
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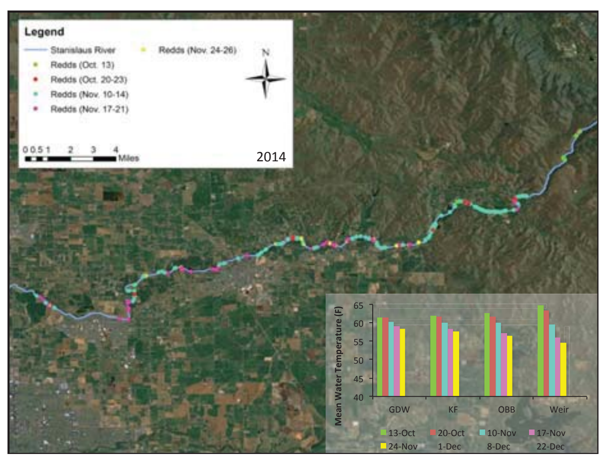
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Redds (Nov. 17-21)
N
0 0.5 1 2 3 4 Miles
2014
Mean Water Temperature (F)
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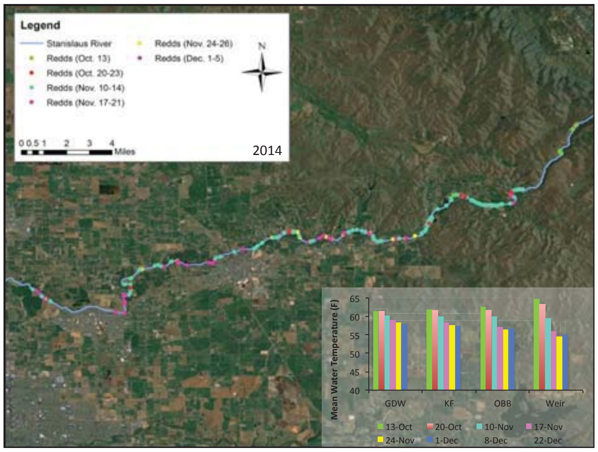
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Redds (Nov. 24-26)
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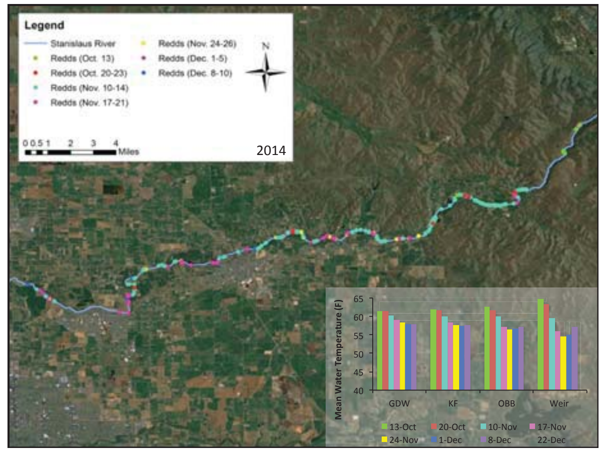
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2014
Mean Water Temperature (F)
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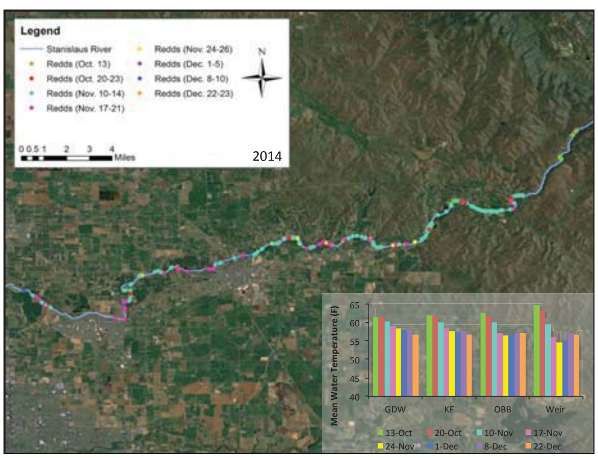
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Redds (Nov. 17-21)
Redds (Nov. 24-26)
Redds (Dec. 1-5)
Redds (Dec. 8-10)
Redds (Dec. 22-23)
N
0 0.5 1 2 3 4 Miles
2014
Mean Water Temperature (F)
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GDW
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13-Oct
20-Oct
10-Nov
17-Nov
24-Nov
1-Dec
8-Dec
22-Dec

ATTACHMENT B

Summary of Scientific Certainty Regarding San Joaquin Basin Chinook Salmon

Prepared for State Water Resources Control Board
Phase II Comprehensive Review Workshops
Workshop 2, "Bay-Delta Fisheries" to be held October 1-2, 2012

Prepared by
Doug Demko, Michael Hellmair, Matt Peterson, Shaara Ainsley,
Michele Palmer, and Andrea Fuller

On behalf of the
San Joaquin Tributaries Authority

September 14, 2012

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SPRING FLOWS

Scientific Certainty: High

- ***High, unmanaged spring flood flows (above 18,000 cfs), can increase smolt survival through the Delta.***
- ***Without the Head of Old River [Physical] Barrier in place, no significant relationship exists between spring flows in the managed range (below 7,000 cfs) and smolt survival through the Delta.***
- ***Flow related science relied upon by the SWRCB's Technical Report (2012) are flawed, have been discredited, are not the best available science, and should not be used as primary justification to modify flow objectives.***

Key Supporting Science

Existing scientific evidence does not support the conclusion that late winter and spring flow (February to June) in the San Joaquin River is the "primary limiting factor" to smolt survival and subsequent abundance.

- The VAMP independent scientific review panel determined that "simply meeting certain flow objectives at Vernalis is unlikely to achieve consistent rates of smolt survival through the Delta" (Dauble et al., 2010).
- NMFS (2009) states that "flows below approximately 5,000 cfs have a high level of variability in the adult escapement returning 2.5 years later, indicating that factors other than flow may be responsible for the variable escapement returns. Flows above approximately 5,000 to 6,000 cfs begin to take on a linear form and adult escapement increase in relation to flow."
- Baker and Morhardt 2001 indicates that there are no data points between 11,000-18,000 cfs, so there is no ability to identify a linear trend beginning at 5,000 cfs. Also, Baker and Morhardt (2001) state "when only the data below 10,000 cfs are considered, there appears to be a negative relationship between flow and smolt survival."
- "The complexities of Delta hydraulics in a strongly tidal environment, and high and likely highly variable predation, appear to affect survival rates more than flow, by itself, and complicate the assessment of flow effects of on survival rates." (Dauble et al. 2010).
- Choice of emigration route may be more important to survival than flow (Perry et al. 2010).
- The VAMP Peer Review (Dauble et. al 2010) indicates that consideration should be given regarding the role of Delta survival for the smolt life stage in the larger context of the entire life cycle of the fall-run Chinook (i.e., life cycle model), including survival in the upper watershed, the Bay and the ocean and fry rearing in the Delta.

The SWRCB's Technical Report's (2012) conclusion that higher spring flows result in increased adult abundance is based almost exclusively on analyses that are flawed and have been discredited (e.g., DFG 2005, 2010a; Mesick et al 2007; Mesick 2009), as well as similar non-peer-reviewed analyses (e.g., various Mesick documents, AFRP 2005, TBI & NRDC 2010a-c).

- The DFG's San Joaquin River Fall-run Chinook Salmon Population Model (SJRFRCS Model) (DFG 2005, DFG 2010a) has been found to be flawed through both peer and professional reviews (Demko et. al 2010).
- Mesick, TBI & NRDC 2010a-c and AFRP 2005 references have not been peer-reviewed and their analyses are the same/similar to those used in DFG's SJRFRCS Model.
- At least two Mesick documents have been rejected previously by FERC (2009a-b) due to
    - the "fallacy of focusing entirely on flow" and failure to consider the influence of other possible limiting factors (Tuolumne River Limiting Factors Analysis; Mesick et al. 2007); and
    - failing to consider other Central Valley populations, the effects of hatchery introductions on Tuolumne River Chinook salmon, and other potential factors (Tuolumne River Risk of Extinction Analysis; Mesick 2009).
- No factors other than flow were investigated in a rigorous fashion in the models suggesting a causal relationship between spring flow and adult returns.
- Bay Delta Conservation Program and Delta Stewardship Council are not using these analyses and an independent review panel recently recommended that NMFS develop a life cycle model for CV salmonids to examine water management and Biological Opinion Reasonable and Prudent Actions (Rose et. al. 2011).

FLOODPLAIN

Scientific Certainty: High

- ***Floodplains with characteristics like those shown to provide benefits to Chinook salmon (i.e., large, continuous expanses of shallow-water habitat) cannot be created through managed flows in the San Joaquin Basin.***
- ***Juvenile steelhead are not are not likely to use floodplains and thus would not benefit from floodplain inundation, regardless of the season.***

Scientific Certainty: Deficient

- ***Benefits of floodplain habitat on Chinook abundance have not been quantified.***

Key Supporting Science

Floodplains in the San Joaquin Basin have different characteristics than the Yolo and Cosumnes and will not provide similar salmon growth and survival benefits.

- Floodplains in the Yolo and Cosumnes bypasses consist of virtually one large, continuous expanse of mostly shallow-water habitat; while the San Joaquin Basin consists of several disconnected, smaller areas of largely deep-water habitat (oxbow features). This deep-water habitat is similar to isolated pond habitats in the Yolo Bypass where alien fish dominate and no Chinook salmon were found (Feyrer et al. 2004).
- San Joaquin Basin inundation zones estimated by the cbec analysis (cbec 2010) represent the maximum area available under a range of flows, not the quality of that habitat for salmon (i.e., depth and velocities). Even though these estimates are a best-case scenario and include areas which would not be considered beneficial to rearing salmon (i.e., deep ox-bows), the total area is still dwarfed in comparison to the Yolo Bypass or Cosumnes Preserve.
- Growth differences between juveniles rearing in floodplains versus in-river were found after a two-week period (Jeffres et al. 2008). There is no data that supports the conclusion that similar benefits occur if rearing is less than a two-week inundation period.
- Increased growth on floodplains is likely related to several factors including warmer water temperatures resulting from shallower depths and greater surface area than found in-river, as well as lower velocities and better food sources (Sommer et al. 2001). Shallow water floodplain habitat is not prevalent in the San Joaquin Basin.

<u>Juvenile steelhead are not likely to use floodplains and thus would not benefit from floodplain inundation, regardless of the season.</u>

- Juvenile steelhead are not likely to use floodplains known to rear in floodplain habitats to any great degree at any time of year (Bustard and Narver 1975, Swales and Levings 1989, Keeley et al. 1996, Feyrer et al. 2006, Moyle et al. 2007).

<u>Floodplain rearing may help increase the size/weight of Chinook outmigrants, but has not been shown to increase the *abundance* of outmigrants or the *number of adult returns*.</u>

- No clear evidence that juvenile floodplain rearing increases adult recruitment.

<u>Floodplain inundation in the San Joaquin River tributaries only visually inferred from flow-area graphs by DFG (2010).</u>

- Wetted surface area increases more quickly between 3,000-5,000 cfs (Merced) and between 4,000-6,000 cfs (Tuolumne) indicating greater increases in width, which suggests bank overtopping or floodplain inundation; Stanislaus did not have a well-defined floodplain in the 100-10,000 cfs flow range examined (DFG 2010b, SWRCB Technical Report 2012).

<u>Tributary floodplain inundation thresholds exceed the SWRCB's Technical Report (2012) maximum monthly tributary target flows.</u>

- Maximum monthly target flows (i.e., median unimpaired) specified for each tributary in the SWRCB's Technical Report (2012) are 2,500 cfs for the Stanislaus River; 3,500 cfs for the Tuolumne River; and 2,000 cfs for the Merced River.
- Assuming minimum thresholds to begin inundating floodplains are 3,000 cfs for the Merced and Stanislaus Rivers, and 4,000 cfs for the Tuolumne River, all three of these minimums exceed the maximum flows proposed in the SWRCB's Technical Report (2012).

SWRCB's Technical Report (2012) emphasizes the need for creating more floodplain in the San Joaquin Basin through higher flows, but "floodplain habitat" is not defined nor quantified for the San Joaquin Basin.

- The attributes of "floodplain habitat," such as depth, velocity, cover, and water temperature, are not defined.
- No information/data is presented as to how much floodplain habitat exists in the San Joaquin Basin, how much could be gained at various flows, or what the benefit to Chinook salmon would be.

FLOW QUANTITY AND TIMING

Scientific Certainty: High

- ***Under specific conditions, salmon migration can be temporarily stimulated through flow management.***

Scientific Certainty: Deficient

- ***The benefit of temporary migratory stimulation on the survival of Chinook fry or smolts through the tributaries, lower San Joaquin River, and Delta is uncertain.***
- ***The importance of attraction flows to spawning migration and subsequent spawning success is uncertain.***

Key Supporting Science

Juvenile Chinook migration out of the upper tributaries is ***temporarily*** stimulated by changes in flow, but long duration pulse flows do not "flush" fish out of the tributaries.

- Juvenile Chinook migration can be stimulated by changes in flow, but the effect is short lived (few days) (Demko et al. 2001, 2000, 1996; Demko and Cramer 1995).

Higher flows increase fry (but not necessarily parr or smolt) survival in the tributaries; benefits to adult escapement are uncertain.

- Stanislaus River flows have a strong positive relationship with migration survival of Chinook fry, but weak associations with parr and smolt survival (Pyper and Justice 2006).
- Smolt survival (CWT) studies conducted by CDFG at flows ranging from 600 cfs to 1500 cfs and at 4,500 cfs have shown that smolt survival is highly variable and not improved by higher flows in the Stanislaus River (SRFG 2004; CDFG unpublished data).
- Smolt survival indices in the San Joaquin River from the Merced River downstream to Mossdale indicate little relationship to flow (TID/MID 2007).
- The contribution of fry emigrants (Feb/March) to total salmon production in the San Joaquin Basin is uncertain (Baker and Morhardt 2001; SRFG 2004; SJRGA 2008; Pyper and Justice 2006).

<u>Fall flow pulses ***temporarily*** stimulate upstream migration of Chinook salmon into San Joaquin Basin tributaries, but no evidence that attraction flows are needed.</u>

- Prolonged, high-volume fall pulse flows are not warranted, since equivalent stimulation of adult migration may be achieved through modest pulses (Pyper and others 2006).
  - Relatively modest pulse-flow event (increase of ~200 cfs for 3 days) was found to stimulate migration, but only for a short duration (increased for 2-3 days).
- Migration rate and timing are not dependent upon flows, exports, water temperature or dissolved oxygen concentrations (Mesick 2001; Pyper and others 2006).
- No evidence that low flows (1,000 to 1,500 cfs) in the San Joaquin River are an impediment to migration (Mesick 2001).

<u>Flow does not explain low Delta survival of juvenile Chinook observed since 2003, so more flow is not likely the solution.</u>

- Flood flows of approximately 10,000 cfs and 25,000 cfs during outmigration in 2005 and 2006 did not increase survival near levels when flows were moderately high (5,700 cfs) in 2000 (SJRGA 2007b).
- Since recent smolt survival has been far lower than it was historically, models based on historical data are not representative of recent conditions and should not be used to predict future scenarios (VAMP Technical Team 2009).

WATER TEMPERATURE

<u>**Scientific Certainty: High**</u>

- ***Water temperatures in the San Joaquin River and South Delta are controlled by air temperatures.***
- ***Releases from tributary reservoirs will not impact water temperatures in the San Joaquin River or South Delta.***
- ***San Joaquin River restoration flows will adversely affect water temperatures from the confluence of the Merced River downstream.***

Scientific Certainty: Deficient

- ***Salmon and steelhead survival benefits of releasing large quantities of water to decrease water temperatures in the tributaries are uncertain.***

Key Supporting Science

The dominant factor influencing water temperature is ambient air temperatures, not flow.

- Ambient air temperature is the primary factor affecting water temperature; by the end of May, water temperatures at Vernalis range between 65°F and 70°F regardless of flow levels between 3,000 cfs and 30,000 cfs. (SRFG 2004)

There is no evidence that water temperatures are unsuitable for adult Chinook upstream migration

- DFG demonstrated that pre-spawn mortality is quite low (i.e., 0%-4.5%) and appears to be density, not water temperature, dependent (Guignard 2005 through 2008).
- No associations between adult migration timing and conditions for water temperature, dissolved oxygen (DO), or turbidity (Pyper et. al 2006; Mesick 2001).
- San Francisco Bay water temperatures over 65°F in September when fish are migrating (CDEC; various stations) and water temperatures at Rough and Ready Island (RRI) are typically above 70°F during early migration season.

There is no evidence that water temperatures for juvenile rearing and migration need to be colder or maintained through June.

- Nearly all juvenile Chinook migrate prior to May 15, and <1% migrate after May 31, except in wet and above normal water years. 90-99% of non ad-clipped salvaged *O. mykiss* are encountered between January and May depending on water year type.
- Existing 7 Day Average Daily Maximum water temperatures are generally $\leq$68ºF (20°C) in the San Joaquin River and the eastside tributaries through May 15.

The restoration of the San Joaquin River upstream of the Merced River (San Joaquin River Restoration Program; SJRRP) will adversely affect water temperatures in the lower San Joaquin River during the spring and fall.

- The lower San Joaquin River downstream of the Merced River confluence is identified as temperature impaired (USEPA 2010). According to water temperature modeling conducted by AD Consultants, SJRRP flows will be the same as the ambient temperature (SJRGA 2007a).

Releases from tributary reservoirs will not impact water temperatures in the San Joaquin River or South Delta.

- Increasing flows from the tributaries will not decrease water temperatures in the mainstem San Joaquin River downstream of the Merced confluence (SJRGA 2007a).

DISSOLVED OXYGEN

Scientific Certainty: High

- ***Low dissolved oxygen concentrations are limited to the DWSC and are the result of anthropogenic manipulation of channel geometry.***
- ***Existing DO concentrations do not impact salmon and steelhead migration.***

Key Supporting Science

Low dissolved oxygen (DO) concentrations are limited to the Deep Water Ship Channel (DWSC), and are the result of anthropogenic manipulation of channel geometry.

- The eastside rivers (Tuolumne, Stanislaus and Merced) discharge high-quality Sierra Nevada water which has low planktonic algal content and oxygen demand, and are not a major source of oxygen demand contributing to the low DO problem in the DWSC (Lee and Jones-Lee 2003).
- DO concentrations in the DWSC can be ameliorated by installation of the Head of Old River Barrier (Brunell et al. 2010).

Existing DO concentrations do not impact salmon and steelhead migration.

- Contrary to Hallock et al. (1970) indicating adult migration is prevented under low DO, migration has been observed at DO $<$ 5mg/L (Pyper and others 2006). Adult upstream migration rate and timing is not dependent on DO concentrations (Pyper and others 2006).
- Smolt survival experiments indicate that juvenile salmon survival is not correlated with existing DO concentrations (SRFG 2004; SJRGA 2002 and 2003). Salmon and steelhead migrate in the upper portion of the water column where DO concentrations are highest (Lee & Jones-Lee 2003).

FOOD

Scientific Certainty: High

- ***Salmon and steelhead are not impaired by food availability in the San Joaquin Basin.***
- ***Projected food production from inundated areas will be realized in short inundation periods.***

Key Supporting Science

Out-migrating Chinook smolts are not food-limited during their 3-15 day migration through the lower San Joaquin River below Vernalis and the South Delta.

- The SWRCB's Technical Report (2012) provides evidence that, in other systems, unregulated rivers have more and better food resources than regulated rivers. However, the report does not provide any evidence that increasing flows in an already highly degraded system has the capability to return primary and secondary production quantity and quality to its pre-regulated state.
- Based on acoustic VAMP studies in 2008, Holbrook et al. (2009) found that smolts took 3-15 days (median 6-9 days) for migration through the lower San Joaquin River and South Delta, therefore the demand for food production over such a short duration is questionable.
- Increases in primary and secondary production due to restoration or changes in management likely occur over longer periods of time, rather than by short-term pulse flows.

CONTAMINANTS

Scientific Certainty: Moderate

- ***Influence of higher flows on contaminant concentrations is variable; dilution may occur in some instances but increase in others.***
- ***Providing a percent of unimpaired flows may increase contaminant concentrations.***

Key Supporting Science

No evidence supports the idea that higher inflows reduce contaminant concentrations.

- The SWRCB's Technical Report (2012, p. 3-29) states, "Higher inflows also provide better water quality conditions by reducing temperatures, increasing dissolved oxygen levels, and ***reducing contaminant concentrations***" but does not provide any references or further discussion to support this statement.
- The SWRCB's Technical Report (2012) may infer that higher flows act to dilute suspended contaminants. However, the influence of higher flows on contaminant concentrations is variable; dilution may occur in some instances but increases may occur in others.

Unimpaired flows may increase contaminant concentrations.

- High flows can increase contaminant concentrations through resuspension of contaminants in sediments (McBain and Trush, Inc 2002). These resuspended contaminants can enter the food web and have longer residence times in rivers and estuaries than water (Bergamaschi et al. 1997).
- Pesticides and herbicides were found in every sample of surface water sites along the

San Joaquin River and in the Old River before, during and after the VAMP month-long pulse flow and some contaminants increased throughout these three periods (Orlando and Kuivila 2005).

- "Perhaps the greatest risks to potential restoration actions within the San Joaquin River study reaches relate to uncertainties regarding remobilization of past deposits of […] pesticides, i.e., DDT and mercury" (McBain and Trush 2002).

TRANSPORT OF SEDIMENTS, BIOTA AND NUTRIENTS

Scientific Certainty: High

- ***Transport of sediment, biota, and nutrients benefits are closely linked to the availability and connectivity of floodplain habitat, and cannot be expected in a highly modified system such as the San Joaquin Basin.***

Key Supporting Science

Transport benefits from floodplain habitat are not realized in the South Delta and lower San Joaquin River because the majority of the floodplain in the lower San Joaquin River has been eliminated or is isolated behind levees.

- Transport of sediment, biota, and nutrients is directly related to the floodplains of a river-floodplain complex, which has nearly been eliminated from the lower San Joaquin River and its tributaries (cbec 2010; Williams 2006).
- "[F]ormer floodplains now behind manmade levees will remain isolated from the river, assuming no long-term changes in flood stages or flood protection policy" (Junk et al. 1989).
- "In unaltered large river systems with floodplains […], the overwhelming bulk of the riverine animal biomass derives directly or indirectly from production within the floodplains and not from downstream transport of organic matter produced elsewhere in the basin" (Junk et al. 1989).
- The FPC focuses on the lateral exchange of water, nutrients and organisms between the river channel and the connected floodplain. The floodplain is considered as an integral part of the system (Junk and Wantzen 2003).

Transport of sediment, biota, and nutrients differs between the large river-floodplain systems described by Junk et al. (1989) and the anthropogenic, leveed river channels of the South Delta.

- Under natural conditions, sediments would be downstream from upper tributaries, but dams limit natural sediment inputs such as gravels (Schoellhamer et al. 2007).
- Human activities (mining, urbanization and agriculture) have increased erosion and the supply of fine river sediments (Schoellhamer et al. 2007).
- Schoellhamer et al. (2007) states that the present day modified system, "would tend to

transport more sediment to the Delta because 1) the flood basins were a sink for fine sediments, and 2) the leveed channels will experience greater bed shear stress because more flow is kept in the channel. . . It follows that levee setbacks and floodplain restoration would tend to decrease sediment supply to the Delta by promoting floodplain deposition along upstream reaches."

- Sediment inputs into the South Delta from the San Joaquin River are the result of increases in suspended sediments from run-off events and are generally not associated with managed flow pulses (SJRG 2004).

VELOCITY

Scientific Certainty: High

- ***No significant relationship exists between mean smolt migration time and San Joaquin River flow.***

Key Supporting Science

No evidence that higher spring flows "facilitate transport."

- The SWRCB's Technical Report (2012) did not define "facilitate transport so it is unclear by what mechanisms spring flows may facilitate transport of smolts, what the benefits are, and how the benefits may be influenced by factors such as flow level, duration, turbidity, etc. The SWRCB's Technical Report (2012) may be suggesting that increased flows result in increased ***velocity***, which may lead to decreased juvenile salmonid travel time through the region, thus 'facilitating transport'.

"It seems intuitively reasonable that increased flows entering the Delta from the San Joaquin River at Vernalis would decrease travel times and speed passage, with concomitant benefits to survival. The data, however, show otherwise" (Baker and Morhardt 2001).

- No significant relationships at the 95% confidence level between mean smolt migration times from three locations (one above and two below the HORB to Chipps Island) and San Joaquin River flow (average for the seven days following release), but
- Smolt migration rate increases with **size** of released smolts (Baker and Morhardt 2001).

Juvenile salmonids are actively swimming, rather than moving passively with the flow, as they migrate towards the ocean (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167, Peake McKinley 1998).

- Movements of juvenile salmonids depend on their species and size, water temperature and local hydrology, and many other factors (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167).

- Baker and Morhardt (2001) provide an example of a study which compared the speed of smolt passage to that of tracer particles (particle tracking model - PTM), "in which 80% of the smolts were estimated to have been recovered after two weeks, but only 0.55% of the tracer particles were recovered after two months."
- Chinook released at Mossdale traveled to Chipps Island 3.5 times faster than the modeled particles (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167).

<u>Results from VAMP studies (using acoustic tags) have generally shown short travel times between reaches, suggesting active swimming.</u>

- In 2009, mean travel times were reported for each reach, and all were under 2.5 days (SJRGA 2009).

<u>Increased flows may slightly increase velocity near the boundary of the Delta, but do not substantially increase velocity through the Delta.</u>

- Velocities at the Head of Old River may increase by about 1 ft/s with an additional 6,000 cfs San Joaquin River flow, but additional flow provides little to no change IN velocity (<0.5 ft/s) at other stations in the South Delta (Paulsen et al. 2008).

PHYSICAL HABITAT

<u>Scientific Certainty: High</u>

- ***Physical habitat has been substantially reduced by non-flow measures (e.g., land reclamation activities, levees).***
- ***Shallow water rearing habitat (important for almost all native fish), has virtually been eliminated from the Delta.***
- ***Restoring the Delta and mainstem San Joaquin River shallow water habitat cannot be accomplished through flow management.***
- ***Non-native species thrive in the highly altered San Joaquin Basin.***

<u>Key Supporting Science</u>

<u>Physical habitat for San Joaquin Basin and Delta native fishes has been substantially reduced and altered.</u>

- Diverse habitats historically available in the Delta have been simplified and reduced by development of the watershed (Lindley et al. 2009).
- Spawning and rearing habitat have been severely reduced, total abundance and salmon diversity reduced from past alterations (McEvoy, 1986; Yoshiyama et al., 1998, 2001; Williams 2006).
- Major change in system is loss of shallow rearing habitat (Lindley et al. 2009).
- 95% of wetlands/floodplains lost to levee construction and agricultural conversion since the mid 1800s (TBI 2003, Williams 2006).
- Only ~10% of historical riparian habitat remains, with half of the remaining acreage

disturbed or degraded (Katibah 1984).

- Shallow water habitats are essentially non-existent since the "current configuration of largely rip-rapped, trapezoidal channels in the Delta provides little habitat for covered species and contributes to a high degree of predation." (Essex 2009).

Levees and off-channel oxbows restrict ability to create shallow water habitat with increased flows.

- The primary purpose of levees is to provide flood protection and prevent high flows from entering adjacent floodplains. There are approximately 443 miles of levees in the lower San Joaquin River downstream of the Stanislaus River confluence and South Delta.
- Inundation of off-channel oxbows creates deep water instead of shallow water habitat.

Habitat alterations are linked with invasive species expansions.

- *Egeria densa* (Brazilian waterweed) expansion has increased habitat and abundance of largemouth bass and other invasive predators (Baxter et al. 2008).
- Current habitat structure benefits exotic predators more than natives (Brown 2003).

Habitat influences growth, survival and reproduction.

- Estuaries provide important rearing habitat for Chinook; salmon fry in Delta grew faster than in river (Healey 1991, Kjelson et al. 1982).
- Shallow water habitats support high growth of juvenile Chinook (Sommer et al. 2001; Jeffres et al. 2008; Maslin et al. 1997, 1998, 1999; Moore 1997). However, as mentioned above, there is little presently available.

Water quality aspect of habitat is highly variable.

- Variability in habitat likely causes regional differences in relationship between Delta smelt abundance and water quality (Baxter et al. 2008).
- Reduced pumping lowered salinity in Western Delta (as desired), but led (unexpected) result of increased salinity in Central Delta (Monsen et al. 2007).

Improving habitat for increased abundance of native fishes.

- Habitat quantity, quality, spatial distribution and diversity must be improved to promote life history diversity that will increase resilience and stability of salmon populations (Lindley et al. 2009).

GEOMORPHOLOGY

Scientific Certainty: High

- ***Managed flow range is insufficient to provide channel mobilizing flows in the San Joaquin River Basin.***
- ***In leveed systems, true channel mobilization flows are not possible because of flood control.***

Scientific Certainty: Deficient

- ***Releasing large quantities of water for channel mobilizing flows in the tributaries for uncertain benefits to salmon and steelhead.***

Key Supporting Science

Under natural conditions, channel formation and maintenance is directly influenced and modified by flow; however, the morphology of leveed rivers cannot be modified by flow (Jacobson and Galat 2006).

- The "five critical components of the ["natural," i.e., unaltered by humans] flow regime that regulate ecological processes in river ecosystems are the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions (Poff et al. 1997, Poff and Ward 1989, Richter et al. 1996, Walker et al.1995).
- In [a highly modified] a system, flow-related factors like timing of floods, water temperature, and turbidity may be managed; but, in absence of a "naturalized morphology, or flow capable of maintaining channel-forming processes, the hydrologic pulses will not be realized in habitat availability."

Due to land use changes, higher flows do not necessarily provide the channel maintenance that would occur under natural conditions.

- In leveed systems, true channel mobilization flows are not possible because of flood control. In fact, higher flows can result in increased detrimental incision in upstream tributary areas (like the Stanislaus River) where existing riparian encroachment is armored and cannot be removed by high flow events, limiting "river migration and sediment transport processes" (Kondolf et al. 2001, page 39).
- Urban and agricultural developments have encroached down to the 8,000 cfs line, "effectively limiting the highest flows to no more than the allowable flood control" (i.e., 8,000 cfs, Kondolf et al. 2001).
- Where flood pulses are not available to provide maintenance of channel habitat, "mimicking certain geomorphic processes may provide some ecological benefits" (Poff et al. 1997) [e.g., gravel augmentation, stimulate recruitment of riparian trees like cottonwoods with irrigation].

In the absence of floodplain connectivity, the functions attributed to higher "pulse flows" cannot be achieved.

- Historically, the San Joaquin River was a channel connected with its floodplain. Flood pulses in the winter and spring would have provided the beneficial functions of floodplains identified by Junk et al. (1989) and by Junk and Wantzen (2003). However, anthropomorphic changes in the lower river (e.g., levees), particularly below Vernalis (the focus of the 2012 Technical Report), have substantially reduced this floodplain connectivity and the region can no longer be considered a "large river-floodplain system."

HEAD OF OLD RIVER BARRIER

Scientific Certainty: High

- ***Salmon smolt survival can be increased through installation of the Head of Old River Barrier (HORB).***

Key Supporting Science

Operation of a rock barrier at the Head of Old River improves salmon smolt survival through the Delta by 16-61% (Newman 2008).

- HORB reduces entrainment into Old River from more than 58% to less than 1.5%.
- Physical (rock) HORB increases San Joaquin River flow.
- Installation of the HORB doubles through-Delta survival by directing juvenile salmonids through the San Joaquin River mainstem (compared to the Old River route, NMFS 2012).

In the absence of a rock barrier at the Head of Old River, a statistically significant relationship between San Joaquin River flow and salmon survival does not exist (Newman 2008).

- HORB cannot be installed or operated during high flow events
    - Temporary rock barrier requires flows less than 5,000 cfs for installation and flows less than 7,000 cfs for operation (SJRTC 2008).

Head of Old River Barrier Predation and "Hot Spots".

- Mean predation rate at HORB was 27.5% in 2009 and 23.5% in 2010.
- 2007 telemetry tracking found that 20% of released fish were potentially consumed by predators at three "hot spots": Stockton Water Treatment Plant, Tracy Fish Facility trashracks and Old River / San Joaquin River split.

PREDATION

Scientific Certainty: High

- ***Predation by non-native species (especially striped bass)) is a major impediment to salmon smolt survival through the lower San Joaquin River and Delta more than river flow.***
- ***Evidence from other basins (i.e., Columbia) indicates that predation can be easily and cost-effectively reduced.***

Key Supporting Science

The VAMP review panel concluded that "high and likely highly variable impacts of predation appear to affect survival rates more than the river flow" (Dauble et al. 2010).

- All fishery agencies have acknowledged that striped bass are a major stressor on Chinook populations in the Central Valley and recovery will not occur without significant reduction in their populations and/or predation rates (DFG 2011).

Recent San Joaquin Basin VAMP studies conducted from 2006–2010 provide direct evidence of high predation rates on Chinook salmon in the lower San Joaquin River and South Delta.

- In 2007, 20% of released fish were potentially consumed by predators at three "hotspots" (Stockton Treatment Plant, Tracy Fish Facility trashracks, and the HOR).
- In 2009, mortality rates (likely due to predation) between Durham Ferry and the HOR ranged from 25.2% to 61.6% (mean 40.8%), and predation rates at HOR ranged from 11.8% to 40% (mean 27.5) (Bowen et al. 2009).
- In 2010, mortality rates (likely due to predation) between Durham Ferry and the HOR ranged from 2.8% to 20.5% (mean 7.8%) and predation rates at HOR ranged from 17% to 37% (mean 23.5%) (Bowen and Bark 2010).

Reducing striped bass predation on juvenile Chinook is the simplest, fastest, and most cost-effective means of increasing outmigration survival.

- High predation occurs at "hot spots," which can be the focus of a control program.
- Encouraging increased angling pressure on salmonid predators has successfully increased the number of adult returns in other basins on the West Coast (Radtke et al. 2004).
- Columbia River predator suppression program has cut predation on juvenile salmonids by 36% (Porter 2011).
- California Fish and Game Commission (CFGC 2012) rejected DFG's recommendation to amend striped bass sport fishing regulations, which included increasing bag limits and decreasing size limits.

REFERENCES

AFRP (Anadromous Fish Restoration Program). 2005. Recommended Streamflow Schedules to Meet the AFRP Doubling Goal in the San Joaquin River Basin. September 27, 2005.

Baker P. F. and J. E. Morhardt. 2001. Survival of Chinook Salmon Smolts in the Sacramento-San Joaquin Delta and Pacific Ocean. In: Brown RL, editor. Fish Bulletin 179: Contributions to the biology of Central Valley salmonids. Volume 2. Sacramento (CA): California Department of Fish and Game. www.stillwatersci.com/resources/2001BakerMorhardt.pdf

Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, M. Gingras, B. Herbold A. Mueller-Solger, M. Nobriga, T. Sommer, K. Souza. 2008. Pelagic Organism Decline Progress Report: 2007, Synthesis of Results. Interagency Ecological Program for the San Francisco Estuary. http://www.science.calwater.ca.gov/pdf/workshops/POD/IEP_POD_2007_synthesis_report_031408.pdf

Bergamaschi, B.A., K.L. Crepeau, and K.M. Kuivila. 1997. Pesticides associated with suspended sediments in the San Francisco Bay Estuary, California U.S. Geological Survey Open-File Report 97-24.

Bowen, Mark, D., et al. 2009. 2009 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA), Technical Memorandum 86-68290-09-05, September 2009. U.S. Bureau of Reclamation.

Bowen, M.B., R. Bark,. 2010. (DRAFT) 2010 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). U.S. Department of Interior/Bureau of Reclamation. Technical Memorandum 86-68290-10-07.

Brown, L. R. 2003. Will Tidal Wetland Restoration Enhance Populations of Native Fishes? In: Larry R. Brown, editor. Issues in San Francisco Estuary Tidal Wetlands Restoration. San Francisco Estuary and Watershed Science. Vol. 1, Issue 1 (October 2003), Article 2. http://repositories.cdlib.org/jmie/sfews/vol1/iss1/art2

Brunell, M., G.M. Litton, J.C. Monroe & ICF International. 2010. Effects of the Head of Old River Barrier on flow and water quality in the San Joaquin River and Stockton Deep Water Ship Channel. Report to the Department of Water Resources. http://baydeltaoffice.water.ca.gov/sdb/af/docs/HORB_Report_Final_3-17-2010.pdf

Bustard, D.R. and D.W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (*Oncoryhnchus kisutch*) and steelhead trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada* 32:667-680.

cbec. 2010. San Joaquin Floodplain inundation mapping. cbec, Inc, Sacramento, California. 24pp. Report provided as Attachment 4 in *Comments pertaining to the "Scientific Basis for Developing Alternate San Joaquin River Delta Inflow Objectives" described in the State Water Resources Control Board's October 29, 2010, Draft Technical Report on the Scientific Basis for Alternative San Joaquin*

River Flow and Southern Delta Salinity Objectives submitted on December 6, 2010 to the State Water Source Control Board by Demko et al. on behalf of the San Joaquin River Group Authority.

CFGC [California Fish and Game Commission]. 2012. Agenda item 9- Request for authorization to publish notice of commission intent to amend striped bass sport fishing regulations. Staff Summary, Meeting of February 2, 2012. State of California Fish and Game Commission, Sacramento, California.

Dauble, D., Hankin, D., Pizzimenti J.J., and Smith P. 2010. The Vernalis Adaptive Management Program (Vamp): Report of The 2010 Review Panel. http://www.sjrg.org/peerreview/review_vamp_panel_report_final_051110.pdf

Demko, D.B. and S.P. Cramer. 1995. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual Report for 1995. Prepared by S.P. Cramer & Associates, Inc. for the Oakdale Irrigation District, Oakdale, CA, and South San Joaquin Irrigation District, Manteca, CA.

Demko, D.B. and others. 1996. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual Report for 1996. Prepared by S.P. Cramer & Associates, Inc. for the Oakdale Irrigation District, Oakdale, CA, and South San Joaquin Irrigation District, Manteca, CA.

Demko, D.B., A. Phillips and S.P. Cramer. 2000. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual Report for 1999. Prepared by S.P. Cramer & Associates for the Tri-Dam Project.

Demko, D.B., A. Phillips and S.P. Cramer. 2001. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual report for 2000 prepared for Tri-Dam project.

DFG. 2005. Final Draft. San Joaquin River Fall-run Chinook Salmon Population Model. San Joaquin Valley Southern Sierra Region. 87 pages.

DFG. 2010a. Flows Needed in the Delta to Restore Anadromous Salmonid Passage from the San Joaquin River at Vernalis to Chipps Island. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/dfg/dfg_exh3.pdf.

DFG. 2010b. California Department of Fish and Game Comments on the Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_pla n/water_quality_control_planning/comments120610/carl_wilcox.pdf

DFG. 2011. Report and Recommendation to the Fish and Game Commission in Support of a Proposal to Revise Sportfishing Regulations for Striped Bass.

Essex Partnership. 2009. DRERIP Evaluations of BDCP Draft Conservation Measures – Summary Report. http://www.science.calwater.ca.gov/pdf/workshops/workshop_eco_052209_BDCP-DRERIP_Summary_with_Appendices1.pdf

Feyrer, F., T.R. Sommer, S.C. Zeug, G. O'Leary, and W. Harrell. 2004. Fish assemblages of perennial floodplain ponds of the Sacramento River, California (USA), with implications for the conservation of native fishes. *Fisheries Management and Ecology* 11: 335-344.

Feyrer, F, T.R. Sommer, W. Harrell. 2006. Importance of flood dynamics versus intrinsic physical habitat in structuring fish communities: evidence from two adjacent engineered floodplains on the Sacramento River, California. *North American Journal of Fisheries Management* 26: 408-417.

Feyrer, F., M. Nobriga, and T. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences 64:723-734. http://iep.water.ca.gov/AES/FeyrerNobrigaSommer2007.pdf

Guignard, J. 2005. Stanislaus River Fall Chinook Salmon Escapement Survey 2004. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract # R0440003.

Guignard, J. 2006. Stanislaus River Fall Chinook Salmon Escapement Survey 2005. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract #R0540004.

Guignard, J. 2007. Stanislaus River Fall Chinook Salmon Escapement Survey 2006. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract # R0640001.

Guignard, J. 2008. Stanislaus River Fall Chinook Salmon Escapement Survey 2007. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract #R0740005.

Hallock, R.J., R.F. Elwell, and D.H. Fry Jr. 1970. Migrations of Adult King Salmon *Onchorhynchus tshawytscha* in the San Joaquin Delta as Demonstrated by the Use of Sonic Tags. Fish Bulletin 151.

Healey MC. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). In: Groot C, Margolis L, editors. Pacific salmon life histories. Vancouver (BC): University of British Columbia Press. p 311-394.

Holbrook, C.M., Perry, R.W., and Adams, N.S., 2009, Distribution and joint fish-tag survival of juvenile Chinook salmon migrating through the Sacramento-San Joaquin River Delta, California, 2008: U.S. Geological Survey Open-File Report 2009-1204, 30 p. http://www.sjrg.org/technicalreport/2009/2008-USGS-Fish-Survival-Report.pdf

Jacobson, R.B. and D.L. Galat. 2006. Flow and form in rehabilitation of large-river ecosystems: An example from the Lower Missouri River: *Geomorphology* 77 (2006) 249-269.

Jeffres, C.A., J.J. Opperman, and P.B. Moyle. 2008. Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. *Environmental Biology of Fishes* 83:449-458.

Junk, W.J., P.B., Bayley, and R.E. Sparks. 1989. The Flood Pulse Concept in River-Floodplain Systems. Special publication. *Canadian Journal of Fisheries and Aquatic Science* 106:110–127.

Junk, W.J. and K.M. Wantzen. 2003. The flood pulse concept: New aspects, approaches and applications-an update. Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries: Volume II. 23 pp.

Katibah, E.F. 1984. A brief history of the riparian forests in the central valley of California. In: Warner, R.E.; Hendrix, K.M., editors. California riparian systems:

ecology conservation and productive management. Berkeley, CA: University of California Press; 23-29.

Keeley, E.R. , P.A. Slaney and D. Zaldokas. 1996. Estimates of production benefits for salmonid fishes from stream restoration initiatives. Watershed Restoration Management Report No. 4. Watershed Restoration Program, Ministry of Environment, Lands and Parks and Ministry of Forests, British Columbia. 20 pp.

Kjelson, MA, Raquel, PF, Fisher, FW. 1982. Life history of fall-run juvenile Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin Estuary, California. In: Kennedy, VS, editor. Estuarine comparisons. New York: Academic Press. p. 393-411.

Kondolf, G.M., A. Falzone, and K.S. Schneider. 2001. Reconnaissance-level assessment of channel change and spawning habitat on the Stanislaus River below Goodwin Dam. USFWS, March, 2002.

Lee, G. F. and A. Jones-Lee. 2000. Issues in developing the San Joaquin River Deep Water Ship Channel DO TMDL. Report to Central Valley Regional Water Quality Board, Sacramento, CA, August 2000.

Lindley, S. T., C. B. Grimes, M. S. Mohr, W. Peterson, J. Stein, J. T. Anderson, L.W. Botsford, , D. L. Bottom, C. A. Busack, T. K. Collier, J. Ferguson, J. C. Garza, A. M. Grover, D. G. Hankin, R. G. Kope, P. W. Lawson, A. Low, R. B. MacFarlane, K. Moore, M. Palmer-Zwahlen, F. B. Schwing, J. Smith, C. Tracy, R. Webb, B. K. Wells, and T. H. Williams. March 18, 2009. What caused the Sacramento River fall Chinook stock collapse? Pre-publication report to the Pacific Fishery Management Council. http://swr.nmfs.noaa.gov/media/SalmonDeclineReport.pdf

Maslin, P, Lenox, M, Kindopp, J, McKinney, W. 1997. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*). California State University Chico, Dept. of Biological Sciences.

Maslin, PLM, Kindopp, J. 1998. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*): 1998 update. California State University Chico, Dept. of Biological Sciences.

Maslin, P, Kindopp, J, Storm, C. 1999. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*): 1999 update. California State University Chico, Dept. of Biological Sciences.

McBain and Trush, Inc. editor. 2002. San Joaquin River Restoration Study background report. Prepared for Friant Water Users Authority. Lindsay, California and Natural Resources Defense Council, San Francisco, California. Arcata, California. December 2000.

McEvoy, A. F. 1986. The fisherman’s problem: ecology and law in the California fisheries. Cambridge University Press, New York, New York.

Mesick, C. 2001. The effects of the San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that Stray. In: R.L. Brown (ed.) Contributions to the Biology of Central Valley Salmonids. California Department of Fish and Game. Fish Bulletin 179(2): 139-162.

Mesick, C.F. and D. Marston. 2007. Provisional Draft: Relationships Between Fall-Run Chinook Salmon Recruitment to the Major San Joaquin River Tributaries and Stream Flow, Delta Exports, the Head of the Old River Barrier, and Tributary Restoration Projects from the Early 1980s to 2003.

Monsen, N.E., J.E. Cloern, and J.R. Burau. 2007. Effects of flow diversions on water and habitat quality; examples from California's highly manipulated Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science 5, Issue 3, Article 2. http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1119&context=jmie/sfews

Moore, TL. 1997. Condition and feeding of juvenile Chinook salmon in selected intermittent tributaries of the upper Sacramento River [ms thesis]. California State University, Chico.

Moyle, P.B., P.K. Crain, and K. Whitener. 2007. Patterns in the Use of a Restored California Floodplain by Native and Alien fishes. *San Francisco Estuary and Watershed Science* 5:1–27. http://repositories.cdlib.org/jmie/sfews/vol5/iss3/art1

Newman, K. B. and D. G. Hankin. 2004. Statistical Procedures for Detecting the CVPIA Natural Chinook Salmon production Doubling Goal and Determining Sustainability of Production Increases. Prepared for CH2M Hill (subcontract 73603). June 21, 2004.

NMFS. 2009. Biological opinion and conference opinion on the long-term operations of the Central Valley Project and State Water Projects. NMFS Endangered Species Act, Section 7 Consultation. 844 pp.

NMFS. 2012. Summary of the expected benefits to salmonid survival of a rock barrier at the Head of Old River & preferential use of the Central Valley Project export facility. http://baydelta.files.wordpress.com/2012/01/2012_horb_survival-benefits_nmfs.pdf

Orlando, J.L., and K. M. Kuivila. 2005. Concentrations of organic contaminants detected during managed flow conditions, San Joaquin River and Old River, California, 2001: U.S. Geological Survey Data Series 120, 13 pp.

Paulsen, S. and E.J. List. 2008. Effect of increased flow in the San Joaquin River on stage, velocity, and water fate, Water Years 1964 and 1988. Prepared by Flow Science, Inc., for San Joaquin River Group Authority. 107 pages.

Peake, S. and R.S. McKinley. 1998. A re-evaluation of swimming performance in juvenile salmonids relative to downstream migration. *Canadian Journal of Fisheries and Aquatic Sciences* 55: 682-687.

Perry, R.W., J.R. Skalski, P.L. Brandes, P.T. Sandstrom, A.P. Klimley, A. Ammann, and B. MacFarlane. 2010. Estimating survival and migration route probabilities of Chinook salmon in the Sacramento-San Joaquin River delta. North American Journal of Fisheries Management 30: 142-156.

Poff, N.L. and J.V. Ward. 1989. Implications of streamflow variability and predictability for lotic community structure- a regional-analysis of streamflow patterns. *Canadian Journal of Fisheries and Aquatic Sciences* 46: 1805-1818.

Poff, N.L., J.K. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The Natural Flow Regime. *Bioscience* 47: 769-784.

Porter, R. 2011. Report on the predation index, predator control fisheries, and program evaluation for the Columbia River Basin experimental Northern Pikeminnow management program. 2011 Annual Report by R. Portern for the Pacific States Marine Fisheries Commission.

Pyper, B, J.B. Lando, and C. Justice. 2006. Analyses of Weir Counts and Spawning Surveys of Adult Chinook Salmon in the Stanislaus River. September 2006.

Pyper, B. and C. Justice. 2006. Analyses of rotary screw trap sampling of migrating juvenile Chinook salmon in the Stanislaus River, 1996-2005. August 2006.

Radtke, H.D., C.N. Carter, and S.W. Davis, 2004. Economic evaluation of the Northern Pikeminnow Management Program. Pacific States Marine Fisheries Commission, June, 2004.

Richter, B.D., J.V. Baumgartner, J. Powell, and D.P. Braun. 1996. A method for assessing hydrologic alteration within ecosystems. *Conservation Biology*. 10: 1163-1174. Blackwell Publishing Ltd. (RBI 2007)

Rose, K., J. Anderson, M. McClure and G. Ruggerone. 2011. Salmonid Integrated Life Cycle Models Workshop. Report of the Independent Workshop Panel. Prepared for the Delta Stewardship Council.

Schoellhamer, D., S. Wright, J. Drexler and M. Stacy. 2007. Sedimentation conceptual model. Sacramento, (CA): Delta Regional Ecosystem Restoration Implementaiton Plan.

SRFG Stanislaus River Fish Group. 2004. A Summary of Fisheries Research In The Lower Stanislaus River (Working Draft), 10 March 2004. Source: http://www.delta.dfg.ca.gov/srfg/restplan/Fisheries_Research_03-08-04.doc

SJRGA 2003. 2002 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2003. 125 pgs. Source: http://www.sjrg.org/technicalreport/2002/2002_sjrg_report.pdf

SJRGA. 2002. 2001 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2002. 125 pgs. Source: http://www.sjrg.org/technicalreport/default.htm

SJRGA. 2007a. San Joaquin River Group Authority Written Comments to Proposal by Central Valley Regional Water Quality Control Board to List the San Joaquin, Tuolumne, Merced and Stanislaus Rivers as Impaired Bodies of Water for Temperature Pursuant to Section 303(D). 19 November 2007.

SJRGA San Joaquin River Group Authority. 2007b. 2006 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2007. 137 pgs. Source: http://www.sjrg.org/technicalreport/default.htm <http://www.sjrg.org/technicalreport/default.htm>

SJRGA San Joaquin River Group Authority. 2008. 2007 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2008. 127 pgs. Source: http://www.sjrg.org/technicalreport/default.htm

SJRGA. 2009. San Joaquin River Agreement Vernalis Adaptive Management Plan 2007 Annual Technical Report. Prepared for California Water Resource Control Board in compliance with D-1641. http://www.sjrg.org/technicalreport/2009/2009-SJRGA-Annual-Technical-Report.pdf

SJRTC (San Joaquin River Technical Committee), 2008, Summary Report of the Vernalis Adaptive Management Plan (VAMP) for 2000-2008, Report prepared for the Advisory Panel Review conducted by the Delta Science Program, December 22, 2008, 84 p.

Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 325-333.

[SRFG] Stanislaus River Fish Group. 2004. A Summary of Fisheries Research In The Lower Stanislaus River (Working Draft), 10 March 2004. Source: http://www.delta.dfg.ca.gov/srfg/restplan/Fisheries_Research_03-08-04.doc

Swales, S. and C.D. Levings. 1989. Role of off-channel ponds in the life-cycle of coho salmon (*Oncorhynchus kisutch)* and other juvenile salmonids in the Coldwater River, British Columbia. *Canadian Journal of Fisheries & Aquatic Sciences* 46: 232-242.

SWRCB. 2012. Technical report on the scientific basis for alternative San Joaquin river flow and Southern Delta salinity objectives. 202 pp.

TBI and NRDC [The Bay Institute and Natural Resources Defense Council]. 2010a. Exhibit 1 - Written Testimony of Jonathan Rosenfield. Ph.D., Christina Swanson, Ph.D., John Cain, and Carson Cox Regarding General Analytical Framework.

TBI & NRDC. 2010b. Exhibit 2 -Written Testimony of Jonathan Rosenfield, Ph.D., and Christina Swanson, Ph.D., Regarding Delta Outflows.

TBI & NRDC. 2010c. Exhibit 3 -Written Testimony of Christina Swanson, Ph.D., John Cain, Jeff Opperman, Ph.D., and MarkTompkins, Ph.D. Regarding Delta Inflows.

TID/MID. 2007. 2006 Lower River Annual Report. United States of America Before the Federal Energy Regulatory Commission FERC 2299 Report. March 2007. Source: http://www.tuolumnerivertac.com/Documents

VAMP Technical Team. 2009. Summary report for the Vernalis Adaptive Management Plan (VAMP) for the experimental determination of juvenile chinook salmon survival within the lower san Joaquin River in response to river flow and State Water Project (SWP) and Central Valley Project (CVP) exports (2000-2008).

Walker, K.F., F. Sheldon, and J.T. Puckridge. 1995. A perspective on dryland river ecosystems. *Regulated Rivers* 11: 85-104.

Williams, J.G. 2006. Central Valley Salmon: A Perspective on Chinook and Steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science, 4-3.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley region of California. North American Journal of Fisheries Management 18:487–521.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historic and present distribution of chinook salmon in the Central Valley drainage of California. In Fish Bulletin 179: Contributions to the biology of Central Valley salmonids., R. L. Brown, editor, volume 1, pages 71–176. California Department of Fish and Game, Sacramento, CA.

ATTACHMENT C

Review of Scientific Information Pertaining to SWRCB's February 2012 Technical Report on the Scientific Basis for Alternative San Joaquin River Flow Objectives

Prepared for State Water Resources Control Board
Phase II Comprehensive Review Workshops
Workshop 2, "Bay-Delta Fisheries" to be held October 1-2, 2012

Prepared by
Doug Demko, Michael Hellmair, Matt Peterson, Shaara Ainsley,
Michele Palmer, and Andrea Fuller

On behalf of the
San Joaquin Tributaries Authority

September 14, 2012

1. SPRING FLOWS

Overview

Increasing spring flows in the San Joaquin River (SJR) basin is one of the main goals in Section 3 of the February 2012 SJR Flow and Southern Delta Salinity Technical Report (SWRCB Technical Report 2012). Justifications for the increased flows are based on research conducted by Dr. Carl Mesick, California Department of Fish and Game (DFG; largely based on Mesick research), Anadromous Fish Restoration Program (AFRP; again largely based on Mesick research), The Bay Institute/ Natural Resources Defense Council (TBI/NRDC 2010a-c), and a variety of survival studies conducted from the early 1980s to 2010. Increased spring flows (occurring in the months of February through June) are thought to be the main factor influencing juvenile Chinook salmon (*Oncorhynchus tshawytscha*) survival and subsequent adult spawning abundance.

Research investigating the relationship between flows in the SJR, the Sacramento-San Joaquin Delta (Delta) and various aspects of Chinook salmon life history (e.g. smolt survival, escapement) has been conducted for nearly 35 years. Much of the research has been inconclusive and early studies are well summarized by Baker and Morhardt (2001) and more recently by the Vernalis Adaptive Management Program (VAMP) independent review panel (Dauble et al. 2010). Some key points from Dauble et al. (2010, pages 3 and 4) are:

- "Panel members are in agreement that simply meeting certain flow objectives at Vernalis is unlikely to achieve consistent rates of smolt survival through the Delta over time."
- "The complexities of Delta hydraulics in a strongly tidal environment, and high and likely highly variable impacts of predation, appear to affect survival rates more than the river flow, by itself, and greatly complicate the assessment of effects of flow on survival rates of smolts."
- "Apparent downstream migration survival of juvenile Chinook salmon was very poor during 2005 and 2006 even though Vernalis flows were unusually high (10,390 cfs and 26,020 cfs, respectively). These recent data serve as an important indicator that high Vernalis flow, *by itself*, cannot guarantee strong downstream migrant survival."
- "Although some positive statistical associations between San Joaquin River flow and salmon survival have been identified, there is also very large variation in the estimated survival rates at specific flow levels and there is a disturbing temporal trend to reduced survival rates at all flows. This large variability and associated temporal decline in survival rates strongly supports a conclusion that survival is a function of a complex set of factors, of which San Joaquin River flow at Vernalis is just one."

In addition, Baker and Morhardt (2001) and Dauble et al. (2010) both identify data gaps, experimental deficiencies, and high variability in survival rates for specific flows. Both reach some similar conclusions: that more research should be conducted, the variable of flow is likely not the only factor, and that a precise flow target set by management policies would likely not provide reliable survival rates on a year-to-year basis. These two documents were "buried" deep within section 3 of the SWRCB's Technical Report (2012; pages 3-32 for Baker and Morhardt [2001] and pages 3-38 and 3-39 for Dauble et al. [2010]).

These findings are in contrast with much of the literature cited in the SWRCB's Technical Report (2012) related to flow. Specifically, much of the cited material is based on analyses conducted by DFG (2005, 2010a) and Mesick (Mesick and Marston 2007, Mesick et. al 2007, Mesick 2009), as well as similar analyses by TBI and NRDC (2010a-c) and AFRP (2005), which all generally conclude that increased spring flows would increase both smolt survival and future escapement. These analyses do not adequately account for variables other than flow that could affect smolt survival or adult escapement, and rely on improper interpretations of simplistic linear regression relationships between complex variables. The linear relationships suffer from poor fits and violate many standard assumptions of linear regression analyses (see Attachment 1 and Demko et al. 2010 for more detailed reviews).

SWRCB's Technical Report (2012) Assertions Regarding Relationship Between San Joaquin River Flows and Salmon Survival

Bold statements below indicate the SWRCB's Technical Report (2012) assertions regarding the relationship between SJR flows and salmon survival, followed by supporting/contrary evidence, as follows:

SWRCB Assertion 1: The number of Chinook salmon spawners returning to the San Joaquin system are correlated with river flows during the February-June rearing and outmigration period 2 1/2 years earlier (pages 3-32 and 3-35).

- This flow/outmigration relationship was first mentioned during 1976 SWRCB proceedings by DFG (1976).
- Since 1976, this regression of flow and escapement 2.5 years later has been mentioned in numerous documents, which were cited throughout the SWRCB 2012 report. However, the statistical analyses used in these reports do not take into account the age composition of returning adults (made up of 2–5 year old adults). Instead, they lump all ages into age-3 adults, which are typically the dominant age group among returning adults in a given year. Therefore, simply grouping adult salmon of other ages into the escapement (the dependent variable in the relationship) is the incorrect way to conduct this type of analysis and adds additional uncertainty into the purported flow/outmigration relationship. For instance, using a simple example illustrating this issue, let us say that 1,000 adult salmon (made up of ages 2-5) return in 2011. For simplicity, let's also say that 10% of that escapement class is age-2 ("jacks"), 50% are age-3, 35% are age-4, and 5% are age-5. Using that age composition, there would be 100 age-2 salmon, 500 age-3 salmon, 350 age-4 salmon, and 50 age-5 salmon. Based on life history of fall-run Chinook salmon, that would mean that the 100 age-2 salmon that returned to spawn in Fall 2011 migrated to the ocean during the spring of approximately 1.5 years earlier, during the Spring of 2010. Similarly, the 500 age-

3 adult salmon entered the ocean approximately 2.5 years earlier (Spring of 2009), age-4 adult salmon entered approximately 3.5 years earlier (Spring of 2008), and age-5 adult salmon entered the ocean approximately 4.5 years earlier (Spring of 2007). The regression of flow and escapement 2.5 years later simply does not account for the well-known life history characteristics of fall-run Chinook salmon in the Central Valley (CV) and should not be used. A more appropriate cohort-specific analysis, would relate escapement of each age group with the conditions that each age group experienced in freshwater or during the outmigration period. Therefore, time-series data of escapement of age-2 salmon would need to be analyzed with the proper time-series data of outmigration conditions approximately 1.5 years earlier, not 2.5 years earlier. Similar corrections would need to be made with the older age groups as well. Due to this additional uncertainty, cohort-specific analyses and models (i.e., those that include age composition) should be used instead of the cited analyses. Flow management decisions should not be made using such potentially unreliable analyses.

SWRCB Assertion 2: In the SJR basin, it is recognized that the most critical life stage for salmonid populations is the spring juvenile rearing and migration period (DFG 2005, Mesick and Marston 2007, Mesick et al. 2007, and Mesick 2009) (pages 1-3 and 3-2).

- Most research from the Pacific Northwest suggests that the period after ocean entry is the most critical life stage for juvenile salmonids (i.e., where most of the mortality occurs) and largely determines year-class strength (or escapement, i.e., number of spawning adults in a given year) (Pearcy 1992, Gargett 1997, Beamish and Mahnken, 2001).
- The documents cited by SWRCB's Technical Report (2012) to support this claim are not peer reviewed and all based on work conducted by Mesick and others.

SWRCB Assertion 3: Analyses indicate that the primary limiting factor for salmon survival and subsequent abundance is reduced flows during the late winter and spring (February through June) when juveniles are completing the freshwater rearing phase of their life cycle and migrating from the SJR basin to the Delta (DFG 2005; Mesick and Marston 2007; Mesick et al. 2007; Mesick 2009) (page 3-28).

- The VAMP independent scientific review panel determined that "simply meeting certain flow objectives at Vernalis is unlikely to achieve consistent rates of smolt survival through the Delta" (Dauble et al., 2010).
- Based on Figure 11 from Baker and Morhardt (2001), NMFS (2009) states that "flows below approximately 5,000 cfs have a high level of variability in the adult escapement returning 2.5 years later, indicating that factors other than flow may be responsible for the variable escapement returns. Flows above approximately 5,000 to 6,000 cfs begin to take on a linear form and adult escapement increase in relation to flow."
    - However, Baker and Morhardt (2001) indicates that there are no data points between 11,000-18,000 cfs, so there is no ability to identify a linear trend beginning at 5,000 cfs. Also, Baker and Morhardt (2001) state,

        - "when only the data below 10,000 cfs are considered, there appears to be a negative relationship between flow and smolt survival."
- No factors other than flow (e.g., ocean conditions, predation, etc.) were investigated in a rigorous fashion in the models suggesting a causal relationship between spring flow and adult returns.
    - "The complexities of Delta hydraulics in a strongly tidal environment, and high and likely highly variable predation, appear to affect survival rates more than flow, by itself, and complicate the assessment of flow effects of on survival rates." (Dauble et al. 2010).
    - Choice of emigration route may be more important to survival than flow (Perry et al. 2010).
- The documents cited by the SWRCB's Technical Report (2012) to support this claim are not peer reviewed and all based on work conducted by Mesick and others.
- Bay Delta Conservation Program and Delta Stewardship Council are not using these analyses and an independent review panel recently recommended that NMFS develop a life cycle model for CV salmonids to examine water management and Biological Opinion Reasonable and Prudent Actions (Rose et. al. 2011).

Other Potential Factors That Influence Survival of Juvenile Salmon Not Accounted for in SWRCB's Technical Report (2012) or in Analyses Cited

Timing of outmigration:

- Survival of later-migrating juvenile Chinook smolts in the Columbia and Snake Rivers generally decreases compared to early-migrating smolts (Anderson 2003, Figures 10 and 24).
- Smolt-to-adult survival (cohort-specific) related to migration timing. Chinook smolts that migrated earlier in outmigration season are more likely to survive to adulthood (Scheurell et al. 2009).
- Snake River fall-run Chinook survival to Lower Granite Rapids Dam had the highest correlation with release date and water quality parameters (water temperature), which co-vary (Anderson et al. 2000, NMFS 2000a).

Route-Specific Migration Probabilities and Survival Probabilities:

- Perry et al. (2010) clearly shows the complicated nature of estimating survival in a highly complex, dendritic water body such as the Delta. Perry's work adds additional uncertainty to the survival estimates used by Mesick. The variation in survival estimates in years with high flows may be due to the route(s) that fish selected instead of the actual flows themselves. Higher survival rates could be due to a higher proportion of CWT-tagged salmon migrating into a route with a higher reach-specific survival rate.

Ocean Conditions:

- The SWRCB's Technical Report (2012) largely ignores the great influence that ocean conditions can have on survival and year-class strength of CV salmon. This reflects the reliance of the SWRCB's document on analyses that largely dismisses the role of ocean conditions (Mesick and Marston 2007, Mesick et. al 2007, Mesick 2009, TBI and NRDC 2010a-c, AFRP 2005).

- Lindley et al. (2007) states that a "broad body of evidence suggests that anomalous conditions in the coastal ocean in 2005 and 2006 resulted in unusually poor survival of the 2004 and 2005 broods of the SRFC (Sacramento River Fall-run Chinook)."
- Both the 2004 and 2005 broods entered the ocean during a period of weak upwelling, warm sea surface temperatures, and low densities of prey items (Lindley et al. 2009).

Accumulated Thermal Units (ATUs) – or Thermal Experience:

- In the Columbia River, migration patterns (onset of outmigration) of Chinook smolts were most associated with accumulated thermal units (a positive relationship); while increasing flow had a negative influence (Sykes et al. 2009). Thermal experience was found to have more influence on migration than daily mean water temperature.

Distance Traveled:

- Hatchery Chinook smolt survival varied inversely with the distance traveled to Lower Granite Rapids Dam (Muir et al. 2001).
- Smolt survival in the Columbia and Snake Rivers depends on distance traveled more than travel time (Anderson 2003, Bickford and Skalski, 2000) or migration velocity (Anderson et. al. 2005).

Additional Information regarding Flow and Juvenile Salmon Survival Relationships

Central Valley:

- Survival estimates for acoustically-tagged late-fall Chinook in a December release group were lower than for the January release group despite higher discharge and shorter travel times (Perry et al. 2010, p. 151). Some of this difference, however, was due to the proportion of each group that migrated between three different routes.

Outside Central Valley:

- No consistent relationship was found between years for either flow (study used a flow exposure index) or change in flow and Chinook smolt survival from Lower Granite Dam and McNary Dam (Smith et al. 2002). However, median travel times in each year decreased with increased flow exposure index (Smith et al. 2002). There was no relationship between median travel times and survival.
- No correlation present between daily flow and daily smolt survival probabilities (spring-run Chinook) through one reach of the Columbia River (Skalski 1998).
- On the Columbia River (spring-run Chinook) - Increased survival rates in the 1990s compared to the mid to late 1970s was not a function of flows. No significant differences were found between mean daily flows between the two periods (Williams et al., 2001).

- No relationship between fall-run Chinook survival and flow-travel time (Giorgi et al., 1994).
- No within-year flow-survival relationship for spring-run Chinook salmon smolts (Smith et al. 1997a).
- No within-year flow-survival relationship for fall-run Chinook salmon smolts (Giorgi et al. 1997, Smith et al. 1997b).
- No flow-survival relationship for Snake River spring-run Chinook smolts (NMFS 2000a).

2. FLOODPLAIN HABITAT

Overview

Creation of floodplains, one of the functions supported by spring flows according to the SWRCB's Technical Report (2012), has the potential to affect salmonid populations in various ways. While the ecology of floodplains in temperate regions, particularly on salmonid bearing streams, has been poorly studied, and some literature indicates that floodplain rearing increases growth and survival of Chinook salmon. In addition, floodplains provide important ephemeral spawning and rearing habitat to which native fish fauna has adapted.

While potential floodplain benefits to salmon fry are relatively undisputed, the main issue on the SJR and its tributaries appears to be the lack of low lying areas that can be regularly inundated by elevated discharge to provide productive floodplain habitat, which SWRCB's Technical Report (2012) fails to recognize. Inundation projections from modeling exercises often derive their floodplain estimates based solely on inundated surface area, without giving consideration to characteristics of inundated habitat (depths, substrate, vegetation, etc.).

Citations presented in the SWRCB's Technical Report (2012) illustrating the benefit of floodplain to rearing fishes are based on research conducted in river basins that are not directly comparable to the SJR and its tributaries (e.g., Mississippi River, neotropical and Southeast Asia systems). While there is some supporting evidence regarding the positive effects of frequent, long duration inundation of shallow floodplains on Chinook fry rearing in California (e.g., Sommer et al 2001, 2005; Moyle et al. 2007), such habitat is extremely limited in the SJR due to extensive habitat alteration and levee construction (Essex 2009). It follows that potential implied benefits of a more variable flow regime outlined in SWRCB's Technical Report (2012) may not be realized or will be severely curtailed in the SJR basin.

SWRCB's Technical Report (2012) Assertions regarding Floodplain Habitat

Bold statements below indicate the SWRCB's Technical Report (2012) assertions regarding floodplain habitat, followed by supporting/contrary evidence, as follows:

SWRCB Assertion 1. Warm, shallow-water floodplain habitats allow steelhead juveniles to grow faster (page 3-27).

- Juvenile steelhead are not known to rear in floodplain habitats to any great degree at any time of year (Bustard and Narver 1975, Swales and Levings 1989, Keeley et al. 1996, Feyrer et al. 2006, Moyle et al. 2007).
- Based on multi-year studies in the Cosumnes River, Moyle et al. (2007) concluded that steelhead were not adapted for floodplain use and the few steelhead observed were inadvertent floodplain users (i.e., uncommon and highly erratic in occurrence) that were "presumably…carried on to the floodplain by accident."

SWRCB Assertion 2. Successful Chinook salmon rearing is often associated with connectivity between river channel and riparian and floodplain habitat (page 3-19).

- Juvenile Chinook salmon are known to use floodplains, when available, for rearing. They benefit from floodplain use during the rearing phase through higher growth and greater feeding success (e.g. Sommer et al. 2001, Moyle et al. 2007).
- Chinook salmon have been documented to utilize the floodplain habitat in the Sutter Bypass, Yolo Bypass, and in the Cosumnes River (Feyrer et al. 2006, Sommer et al. 2001, Sommer et al. 2005, Moyle 2007).
    - In the Cosumnes River (annual floodplain inundation ranged from 6 to 158 days), Moyle et al. (2007) found that Chinook salmon were the most abundant species found in February and March. Likewise, Feyrer et al. (2006) found that juvenile Chinook salmon were common in the Sutter Bypass from January through May, but were relatively rare in June; on the Yolo Bypass they occurred primarily in March.

SWRCB Assertion 3. Floodplain rearing increases growth and survival in Chinook salmon (page 3-19).

- Chinook salmon that rear on floodplains have been shown to grow more rapidly than those rearing in the main river channel (Sommer et al. 2001).
- "1998 results *suggest* that in *some* years, survival *may* actually be substantially higher for salmon that migrate through the floodplain" (Sommer et al. 2005). However, clear conclusions regarding survival effects of juvenile floodplain use on adult recruitment are not available, and increased survival of these fish is often based on the inference that increased size at outmigration reduces mortality.

SWRCB Assertion 4. Floodplain inundation in the spring may benefit native species (pages 3-41 to 3-42).

- Historically, floodplains were important spawning and rearing habitats for at least some native fishes (e.g., obligate floodplain spawners, such as splittail), but their importance to river-spawners and slough residents (sucker and blackfish, respectively) is not well understood (Crain et. al 2004).
- "Today, floodplains appear important to native fishes mainly early in the season (February– April)" (Crain et. al 2004, page 15).
- Non-native species dominate the floodplain community later in the season (April-July) particularly permanent residents of ponds, ditches, and sloughs on the

floodplain) due to warmer water temperatures and lower flows (Crain et. al 2004). This is of special importance to floodplain management in the SJR Basin, as high abundances of non-native predators may benefit from floodplain inundation during proposed period, predominantly from April-June.

SWRCB Assertion 5. Shallow-water floodplain habitat provides rearing Chinook with refuge from predatory species (page 3-44).

- Shallow-water floodplains in the Sacramento River provide a refuge from large pelagic (i.e., open water) predators (e.g., Sacramento pikeminnow and striped bass) that, due to their pelagic nature, are unlikely to invade shallow, cover-rich habitats such as inundated fields of the Yolo Bypass.
- Much of the inundated floodplain habitat in the SJR that could be provided in the managed flow range are associated with oxbow features (cbec 2010), which are unlikely to provide predator refuge benefits because predation, particularly by ambush predators (e.g., largemouth bass), is expected to increase in such habitats (Saiki 1984, Brown 2000, Grimaldo et al. 2000, Feyrer & Healey 2003). These predators have been shown to be more efficient at capturing prey in complex habitat and in turbid conditions than pelagic piscivores (Greenberg et al. 1995, Nobriga & Feyrer 2007).
- The presence of high densities of exotic piscivorous fish in the perennial oxbows would likely result in heavy mortality of juvenile salmonids that entered the flooded oxbow areas.

SWRCB Assertion 6. "Floodplain inundation provides flood peak attenuation and promotes exchange of nutrients, organic matter, organisms, sediment, and energy between the terrestrial and aquatic systems" (SWRCB 2012, page 3-43).

- This is contradictory to the content of section 3.7.6 of the SWRCB's Technical Report (2012), which lists nutrients as a main factor contributing to poor water quality in the SJR and concludes that higher flows would serve to dilute this and other constituents of water quality:

> "Eutrophication from the dissolution of natural minerals from soil or geologic formations (e.g., phosphates and iron), fertilizer application (e.g., ammonia and organic nitrogen), effluent from sewage-treatment plants (e.g., nitrate and organic nitrogen), and atmospheric precipitation of nitrogen oxides may cause chronic stress to fish (McBain and Trush 2002). Algae and plant growth under eutrophic (high nutrient) conditions, along with their subsequent decomposition in the water column, lead to increase oxygen consumption and decreased dissolved oxygen conditions, reduced light penetration and reduced visibility. These conditions may render areas unsuitable for salmonid species, and favor other species (e.g., sucker, blackfish, carp, and shad)" (SWRCB 2012, page 3-49).

Clearly, the explanation of proposed benefits of changes to the flow regime with regards to nutrient supplementation (or dilution) is in need of refinement, and a more detailed evaluation of the relationship between proposed flow alterations and food web benefits is required.

SWRCB Assertion 7. Floodplain inundation provides benefits to downstream reaches in the form of nutrient supply (page 3-43).

- This assertion is erroneously attributed to Mesick (2009) by SWRCB's Technical Report (2012). Mesick (2009) did not study floodplains and their relationship to increased smolt survival, and did not investigate nutrient flow in the Tuolumne River.
- Levels of dissolved nutrients are seldom limiting factors for primary production in the main channel of rivers (Junk et al. 1989).
- The role of floodplains in nutrient cycling has not been extensively studied in California, but studies from other parts of the world indicate that floodplains can be both sources and sinks for nutrients, depending on geology, inundation duration, riverine nutrient loading, and many other factors (Junk et. al 1989). A study from the Cosumnes River suggests that floodplain inundation can reduce the amount of nitrate transported to downstream reaches (Sheibley et al. 2002).

Additional Information regarding Floodplain Inundation and Rearing of Juvenile Chinook in the SJR Basin

Floodplain conditions in the SJR Basin differ greatly from those in other river systems.

- Floodplains in the Yolo and Cosumnes bypasses consist of virtually one, large continuous expanse of mostly shallow-water habitat; while the San Joaquin Basin consists of several disconnected, smaller areas of largely deep-water habitat (oxbow features). This deep-water habitat is similar to isolated pond habitats in the Yolo Bypass where alien fish dominate and no Chinook salmon were found (Feyrer et al. 2004).
- Floodplains consisting of large expanses of shallow (mostly <1 m), slow velocity (mostly <0.3 mps) water have shown increased productivity of food organisms for fish and increased growth of juvenile Chinook salmon (Sommer et al. 2001). Limited studies in the Cosumnes River Preserve found that growth of juvenile Chinook was slower in isolated pond areas than in adjacent flooded pastures and woodlands (Jeffries et al. 2008).
- San Joaquin Basin inundation zones estimated by the cbec analysis (cbec 2010) only indicate the amount of maximum floodplain area available under a range of flows, but do not indicate the proportion of that habitat that could be used by salmon since they did not identify habitat quality (i.e., depth and velocities).
- Growth differences between juveniles rearing in floodplains versus in-river were found after a two-week period (Jeffres et al. 2008): expecting same benefits after less than two-week inundation period not warranted.
- Increased growth on floodplains is likely related to several factors including warmer water temperatures resulting from shallower depths and greater surface area than found in-river, as well as lower velocities and better food sources (Sommer et al. 2001).

Stranding risk associated with floodplain draining.

- Sommer et al. (2005) suggests that the majority of fish successfully emigrated from the Yolo Bypass because this particular floodplain drains fairly efficiently due to the low percentage of isolated pond area under both peak flood and draining periods; yet over 120,000 Chinook may have been stranded during that study (Sommer et al. 2005).
- Compared to the Yolo Bypass, where ponds are relatively rare and the Bypass is gradually sloped into a parallel toe drain, oxbow channel features characteristic of the lower SJR may not provide ideal rearing habitat for outmigrating salmonids and flooded oxbows are likely to result in significant stranding of juvenile salmon.

Achieving floodplain inundation is questionable under the maximum monthly target flows identified for each tributary by SWRCB (2012).

- DFG (2010c) visually inferred floodplain inundation from graphs of flow-area relationships
    - Wetted surface area increases on the graphs more quickly between 3,000-5,000 cfs (Merced) and between 4,000-6,000 cfs (Tuolumne) indicating greater increases in width, which suggests bank overtopping or floodplain inundation
    - The Stanislaus River channel did not appear to have a well-defined floodplain within the 100 to 10,000 cfs flow range examined (SWRCB 2012, DFG 2010); note: other unpublished studies of a small portion of the Stanislaus River (5.7 miles) indicates that a minimum of 3,000 cfs would be required for this portion of the river.
    - Therefore, minimum floodplain thresholds considered 3,000 cfs for the Merced and Stanislaus Rivers, and 4,000 cfs for the Tuolumne River.
- Assuming minimum floodplain thresholds above (i.e., 3,000 cfs for the Merced and Stanislaus Rivers, and 4,000 cfs for the Tuolumne River), all three minima exceed the maximum monthly target flows as specified for each tributary by the SWRCB's Technical Report (2012)(i.e., 2,500 cfs for the Stanislaus River; 3,500 cfs for the Tuolumne River; and 2,000 cfs for the Merced River). It is unknown at this time how the SWRCB's Technical Report (2012) intends that these maximum flow targets would be achieved (i.e., maximum daily amounts per month, or maximum average daily amounts per month), but if the SWRCB intends for these to be maximum daily targets, then floodplain inundation thresholds (3,000-4,000 cfs) exceed all targets.

Brief floodplain inundation (< two weeks) has not shown benefit.

- Assuming that floodplain does begin to inundate at these minimum floodplain inundation threshold flows identified above (i.e., 3,000-4,000 cfs, which is questionable), it remains to be discerned whether inundation periods <two-weeks are of sufficient duration to provide measurable benefits to rearing salmonids. Growth differences between floodplain-reared and in-river juveniles have been found after a two-week growth period in the Cosumnes River (Jeffres et al. 2008),

yet expecting similar growth increases in San Joaquin River floodplains after <2-week inundation periods is not warranted. Furthermore, Sommer et al. (2001) indicated that characteristics that possibly accounted for an increased growth rate on floodplain habitats included warmer water temperatures than in-river resulting from shallower depths and greater surface area, as well as lower velocities and better food sources (Sommer et al. 2001). Warmer water temperatures did not become apparent until ambient air temperatures began to increase, beginning in March. As mentioned previously, shallow water floodplain habitat is not prevalent in the San Joaquin Basin.

Late spring floodplain inundation.

- Increasing air temperatures in late spring (late May and June) are expected to lead to warmer water on the floodplains than in the river channels. According to Feyrer et al. (2006), the water temperatures on the Sutter and Yolo bypasses rose to about 24°C by June 2002 and 2004. These temperatures are approaching the chronic upper lethal limit for CV Chinook salmon (approximately 25°C) and according to Myrick and Cech (2001), juvenile Chinook salmon reared at water temperatures between 21 and 24°C were more vulnerable to striped bass predation than those reared at lower water temperatures.

SWRCB's Technical Report (2012) emphasizes the need for creating more floodplain in the San Joaquin Basin through higher flows, but "floodplain habitat" is not defined nor quantified for the San Joaquin Basin.

- The attributes of "floodplain habitat," such as depth, velocity, cover, and water temperature, are not defined.
- No information/data is presented as to how much floodplain habitat exists in the San Joaquin Basin, how much could be gained at various flows, or what the benefit to Chinook would be.

Recent Information Not Previously Available to the SWRCB

USBR technical feedback committee meeting SJRPP, July 2012.

Recent presentations at the USBR technical feedback committee meeting for the San Joaquin River Restoration Program (SJRRP) (USBR 2012), while summarizing the current state of salmon restoration science in the SJR, clearly illustrated the lack of specific information that is required for sound decision making.

Estimates of in-river habitat (including floodplain) requirements for successful rearing of enough juvenile salmon to meet management goals currently rely on many unrealistic assumptions, and are based on "territory size" required by juvenile salmonids at various developmental stages (e.g., fry require less "territory" than smolts). It should be noted that available suitable habitat (ASH) does not directly correspond to total habitat requirements, as it doesn't take into consideration the amount of river channel, riparian vegetation, sediment input, etc. needed to support the ASH.

Survival simulations indicate that, under current estimated mortality rates (based on other watersheds), the production goal of 44,000-1.6 million (spring run) and 63,000 – 750,000 (fall run) successful juvenile outmigrants would require 121 million spring-run and 173 million fall-run fry hatched at the spawning grounds. As juveniles move downstream and their sizes increase (and abundance decreases), territory size requirements are applied to abundance modeling based on a length-territory size relationship for salmonids from Grant and Kramer (1990). Preliminary estimates for maximum required suitable rearing habitat (in acres) are summarized in the table below:

Reach	**Spring-Run**	**Fall-Run**	**Both Runs**
Lower 1B	73	158	231
2A	121	276	397
3	59	183	242
4A	13	88	101
4B1	14	40	54
4B2	6	10	16
5	7	5	12
Total	**365**	**861**	**1226**

As SJR tributaries are deficient in shallow-water floodplain habitat, higher flows are proposed to reduce available habitat requirements, as fish are moved out of the system in a conveyor belt like fashion (Dr. Merz) and will therefore spend less time rearing in-river. However, note that data from other rivers in both the northern and southern CV are used to inform simulations for the SJR, which may not be applicable or sound. In addition, the model was purposely kept simple, and many potentially important habitat characteristics (variable flow timing) were not included in the simulations.

Available floodplain modeling for the SJR is also still in its infancy, and so far only three water year scenarios have been examined (dry, normal, wet), and overall results were far too variable to draw clear conclusions:

- Overall available habitat results varied wildly depending on levee alignment;
- For each different levee alignment, the results varied drastically dependent on flow;
- Results also varied dependent on vegetative cover options;
- Some scenarios resulted in a small surplus of adequate floodplain habitat; others resulted in a deficiency of thousands of acres.

Furthermore, definitions of vegetative cover are not sufficiently refined, as shrub cover (which perhaps comprises most of the available habitat) is not included in the model since it cannot be estimated from aerial photography.

Current results from physical and biological model integration were not presented, but will be made available on the SJRRP website in the near future.

Stanislaus River Floodplain Versus Flow Relationships- USFWS results March 7, 2012.

A brief description of Stanislaus Floodplain modeling was provided in a March 2012 report (USFWS 2012) and presented at a Stanislaus Operations Group (SOG) meeting in May 2012 (SOG 2012). The goal was to develop a two-dimensional hydraulic model to quantify the relationship between floodplain area and flow for the Ripon to Jacob Myers reach of the Stanislaus River (RM 17.2 to 34.7), for flows ranging from 250 to 5,000 cfs.

Floodplain was defined based on a modeled wetted area versus flow relationship. First, a graph of total wetted area versus flow was examined to determine the flow at which floodplain inundation begins, as indicated by an inflection point in the graph (the wetted area vs. flow graph from which the inflection point was determined is the figure supplied as part of the meeting notes, inundation begins at ~1250 cfs). Then, the total wetted area at higher flows is subtracted from the total wetted area at which floodplain inundation begins to determine the inundated floodplain area at each flow (meaning that floodplain is essentially considered 0 at ~1,250 and then accrues as flows increase above this amount). Based on this standard methodology, floodplain inundation is expected to encompass low flow channels since the inflection point is likely not observed until other areas also become inundated.

No floodplain depths were specified in the graph provided in the meeting notes. However, in the report, there is one figure that provides depths of floodplain (red) expected at 1,500 cfs, which ranged from 0-2 meters deep (0-6 feet). Due to the color codes used, it is difficult to ascertain whether these depths are closer to zero or closer to 6 feet, which would affect whether these inundated areas would provide good rearing habitat. USFWS is only interested in total floodplain area (macrohabitat level), so indicated that wouldn't be providing any additional depth related figures, nor will velocities and water temperatures (microhabitat level) be incorporated into the floodplain model since the floodplain analysis is being done on a macrohabitat basis and there is no consideration of microhabitat variability (e.g., velocity or water temperature). In addition, the model used is not suitable for microhabitat level analysis given its coarse spatial scale resolution, so any efforts to look at those variables would require a different model.

USFWS' results for the Orange Blossom Bridge to Knight's Ferry reach (7.4 miles) indicate that 35 acres of floodplain accrue between flows of 1,500 cfs to 3,000 cfs with an additional 32.1 acres between 3,000 cfs and 5,000 cfs.

USFWS' future plans include conducting hydraulic models for additional reaches (Jacob Myers to Orange Blossom Bridge and Ripon to SJR confluence), and the results for all four reaches probably won't be presented in a report until February or March of 2013.

3. FLOW QUANTITY AND TIMING

Overview

Managed flow pulses are frequently used to stimulate migration of salmonids in the San Joaquin Basin. Under specific conditions, migration of returning spawners, as well as emigrating juveniles, can be temporarily stimulated through increases in discharge. However, there is no evidence that such flows are required for successful adult migration or that they can reduce straying rates of natural-origin fish.

Higher flows increase fry survival in the tributaries, but not necessarily true for parr and smolts; and the benefits to adult escapement are uncertain. Fry migrants from SJR tributaries exhibit higher survival during periods of higher flows; however, our understanding of the contribution of fry to adult recruitment is quite limited. Since 2003, survival through the South Delta has been very low, and high flow events have failed to increase survival to levels observed when flows ranged between 5,000 and 6,000 cfs, despite flood flows of up to 25,000 cfs during the juvenile emigration period.

Relevant Information Regarding Flow Quantity and Timing

Juvenile Chinook migration out of the tributaries is *temporarily* stimulated by changes in flow, but long duration pulse flows do not "flush" fish out of the tributaries.

- Juvenile Chinook migration can be temporarily stimulated by changes in flow, but the stimulatory effect is short lived (few days) and only affects fish that are ready to migrate (Demko and Cramer 1995; Demko et al. 1996, 2000, 2001).
- Juvenile migration from the tributaries typically begins in January and nearly all juveniles migrate out of the tributaries by May 15 (SJRGA 2008).
- Except in wet and above normal years, 0.7% or less of total juvenile salmon (i.e., fry, parr, and smolts), and 0.8% or less of salmon smolt outmigrate during June.

Higher flows increase fry survival in the tributaries, but not necessarily true for parr and smolts; benefits to adult escapement are uncertain.

- Over a decade of rotary screw trap monitoring in the Stanislaus River shows that flow has a strong positive relationship with migration survival of Chinook fry (Pyper et al. 2006).
- Smolt survival (CWT) studies conducted by CDFG at flows ranging from 600 cfs to 1500 cfs and at 4,500 cfs have shown that smolt survival is highly variable and not improved by higher flows in the Stanislaus River (SRFG 2004; CDFG unpublished data).
- Similarly, analyses of rotary screw trap data found that abundance ratios for parr and smolts were only weakly correlated with flows (Pyper and Justice 2006).
- Smolt survival indices in the San Joaquin River from the Merced River downstream to Mossdale indicate little relationship to flow (TID/MID 2007).
- The contribution of fry emigrants (Feb/March) to total salmon production in the San Joaquin Basin is unknown (Baker and Morhardt 2001; SRFG 2004; SJRGA 2008; Pyper and Justice 2006).
    - However, a sample (n=100) of Central Valley fall-run Chinook salmon (unknown tributary origins) captured in the 2006 ocean fisheries were comprised of an average 20.1% (± 5.4%) individuals that emigrated as fry in 2003 and 2004 (Miller et al. 2010).

A flow regime based upon 60% (or lower) of unimpaired flows in February or in June is not likely to provide the potential benefits that the SWRCB's Technical Report (2012) identified, and providing such flows in February and June is not

consistent with the States's policy to "achieve the highest water quality consistent with maximum benefit to the people of the state."

- See Palmer et. al (2012) and Fuller et. al (2012) for details.

Flow does not explain the low Delta survival of juvenile Chinook observed since 2003, so more flow is unlikely the solution.

- South Delta survival has been low since 2003. During this period, flood flows of approximately 10,000 cfs and 25,000 cfs during outmigration in two years (2005 and 2006) did not increase survival near levels when flows were moderately high (5,700 cfs) in 2000. It is unclear why smolt survival between 2003 and 2006 has been so low (SJRGA 2007b).
- Smolt survival during 2003-2006 was unexpectedly far lower than it was historically. Models based on historical data that do not accurately represent recent conditions (e.g., Newman 2008 and others) should not be used to predict future scenarios (VAMP Tech. Team 2009).

Fall flow pulses *temporarily* stimulate upstream migration of adult Chinook salmon into San Joaquin Basin tributaries, but no evidence that attraction flows benefit the species.

- Prolonged, high volume pulse flows in the fall are not warranted. Equivalent stimulation of adult migration may be achieved through relatively modest pulse flows (Pyper et. al 2006).
    - Relatively modest pulse-flow event (an increase of roughly 200 cfs for 3 days) was found to stimulate migration.
    - Stimulatory effect of both pulse-flow and attraction flows were short in duration (migration increased for 2-3 days).
- Adult migration rate and timing is not dependent upon water temperature or dissolved oxygen concentrations (Pyper et. al 2006).
    - No evidence that low flows (1,000 to 1,500 cfs) in the SJR are an impediment to migration.
- Migration appears to be stimulated by pulse flows, but no evidence that natural origin fish would stray or not migrate to San Joaquin tributaries if no pulse.
    - "Consistent movement patterns [Klamath fall Chinook migrants] with or without pulse flows is compelling evidence that these flows did not trigger upriver movement or otherwise substantially alter migration behavior" (Strange 2007).
    - No clear relationship between increased water flow and stimulated Atlantic salmon migration was found in River Mandalselva (southern Norway) (Thorstad and Heggberget 1998).
    - To attract adult Atlantic salmon migration into rivers, flows must occur in conjunction with other cues such as cooler weather or natural freshets (Mills 1991).
- Fall pulse flows may attract out-of-basin hatchery fish.
    - The Constant Fractional Marking Program, which began in 2007, is just now providing more complete information regarding straying rates, and

results indicate that hatchery straying may be substantial in the SJR Basin. In 2010, fall-run spawners in the Stanislaus River were 50% hatchery-origin despite the lack of a hatchery on the river; of those the majority came from either Nimbus Fish Hatchery fall-run net pen releases (31%), Mokelumne River Hatchery fall-run net pen releases (26%), or the Mokelumne River Hatchery fall-run trucked releases without net pen acclimation (23%)(Kormos et al. 2012).

4. WATER TEMPERATURE

Overview

The temperature tolerances of CV salmon stocks are likely distinct from those of other stocks in the Pacific Northwest, and the applicability of laboratory derived tolerance values to stocks that have evolved in (and are adapted to) habitats at the southernmost extent of the species' range is questionable. High growth and survival of natural Chinook stocks in the CV at temperatures considered higher than optimal for most stocks (based on data from northern stocks) indicate high thermal tolerance of these stocks. There is no clear evidence that San Joaquin Basin stocks are adversely impacted by the current temperature regime. Neither adult nor juvenile migration appear impeded by temperatures observed under current flow management, as indicated by the absence of high pre-spawn mortality or temperature dependent migration timing of adults. Furthermore, the vast majority of juveniles emigrate prior to increases in water temperature resulting from warming air temperatures (the main factor influencing water temperatures) in late spring.

Relevant Information Regarding Water Temperature

The dominant factor influencing water temperature is ambient air temperature.

- Ambient air temperature is the primary factor affecting water temperature.
- By the end of May, water temperatures at Vernalis range between 18 and 21°C (65°F and 70°F) regardless of flow levels between 3,000 cfs and 30,000 cfs (SRFG 2004).
    - On average, maximum daily water temperatures are at or above 20°C (68°F) at Vernalis, Mossdale, and RRI after May 15, and by June 16-30, even the coolest year on record (2005) was only slightly below 20°C at Vernalis, at 20°C at Mossdale, and above 20°C RRI.
- Based on data from the Western Regional Climate Center for Stockton during 1948-2006 (station 048558 WSO; http://www.wrcc.dri.edu), the average daily air temperature at Stockton during June is 22.6°C (72.7°F), and therefore the guideline used by the EPA, which is nearly 3°C cooler, will never be met during June.

Water temperature criteria from Pacific Northwest stocks do not apply to San Joaquin salmon and steelhead; and little is known about the responses of Central Valley species to in-river water temperatures.

- The SJR represents the southernmost extent of the current range of Chinook salmon. Southernmost stocks have evolved under much warmer and drier meteorological conditions than stocks in the Northwest; therefore, criteria based on northern stocks are not directly applicable.
- The applicability of thermal criteria derived from the laboratory has long been debated, and there has been no validation of the growth vs. water temperature relationship for any of the listed species in the CV to assess if laboratory results are transferable to these southern stocks (Myrick and Cech 2004).
- Wild Chinook salmon in the Central Valley often experience water temperatures higher than "optimal" (as based on northern stock data) yet still have high growth and survival. It is this flexibility that has made Chinook salmon so successful in the CV and able to thrive where less temperature tolerant salmonids cannot (Moyle 2005).
- Juvenile Chinook can survive exposure to water temperatures of 24ºC (75.2ºF), depending on their thermal history, availability of refuges in cooler water, and night-time water temperatures (Moyle 2005).
- While much information is available on lifestage-specific water temperature ranges of Chinook salmon and steelhead in the Pacific Northwest, little is known about the specific responses of CV species to water temperature (Williams et al. 2007).
- Water temperature standards are often based on a seven-day average of the daily maximums (7DADM) not to be exceeded; this approach does not reflect the duration of exposure and the range of temperatures that fish may experience. It is possible for Chinook salmon to maintain populations even when they experience periods of suboptimal or even near-lethal conditions. For example, the most productive spring-run Chinook salmon stream in California (i.e., Butte Creek) can experience daily maxima up to 24ºC (75.2ºF) with minima of 18-20ºC (64.4-68.0ºF) for short periods of time in pools where juveniles are rearing and adults are holding (Ward et al. 2003).
- Anecdotal evidence suggests that some species of CV salmonids are heat tolerant: "the high temperature tolerance of San Joaquin River fall run salmon, which survived temperatures of 80°F (26.7ºC), inspired interest in introducing those salmon into the warm rivers of the eastern and southern US (Yoshiyama 1996)."
- Historically, the San Joaquin Basin has had higher water temperatures than all the other rivers that support Chinook salmon and so it is possible that the San Joaquin race has evolved to withstand higher temperatures than 18.3ºC (65°F) (CALFED 1999).
- Additionally, southern steelhead stocks of the CV may have greater thermal tolerance than those in the Pacific Northwest (Myrick and Cech 2004).
- The optimum growth temperature for American River steelhead was nearly 3ºC (5ºF) warmer than the optimum growth temperature for more northern stocks (Wurtsbaugh and Davis 1977; Myrick and Cech 2004; Myrick and Cech 2001).

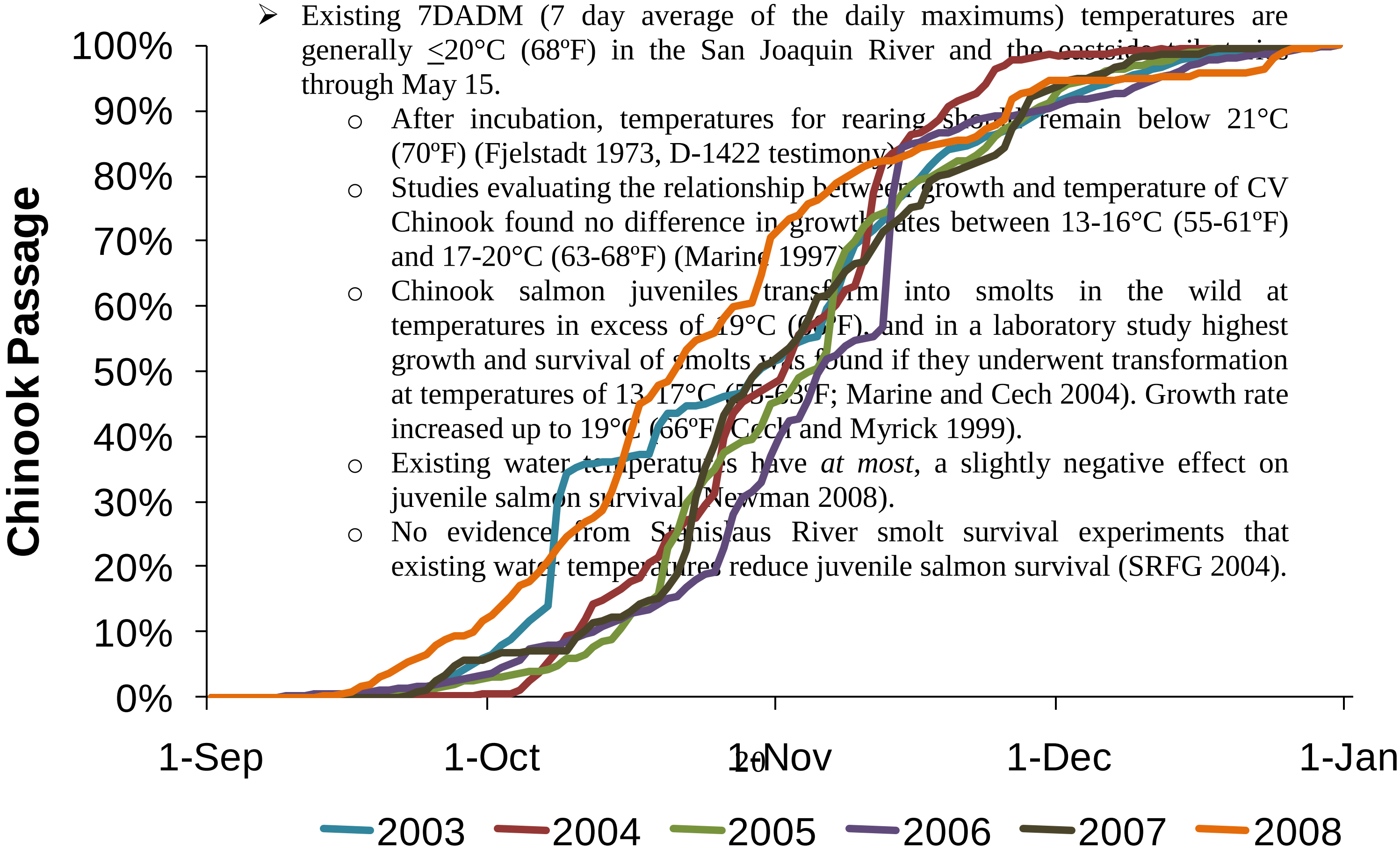
There is no evidence that temperatures are unsuitable for adult fall-run Chinook upstream migration in the San Joaquin Basin.

- Adult migration timing was unrelated to temperature, dissolved oxygen (DO), or turbidity conditions (Pyper et. al 2006).
- Although temperatures were exceptionally cool during September 2006, salmon did not migrate earlier than during 2003-2005. During September 2006, temperatures were as much as 3ºC (5ºF) cooler in the SJR at Rough and Ready Island (RM 37.9), Mossdale (RM 56.3), and Vernalis (RM 72.3), and as much as 5ºC (9°F) cooler in the Stanislaus River at Ripon (RM 15.7) as compared to monthly average temperatures at the same locations during 2003-2005. September flows in the Stanislaus and SJR exceeded average unimpaired flow conditions during all of these years (CDEC; Ripon gauge).
- Temperatures at Rough and Ready Island (RRI) typically above 21ºC (70°F) during early migration season; larger fraction of early migrants traveled under higher temperatures in 2003 than other years (Pyper et. al 2006).
- Managed flows in the San Joaquin Basin during September are higher than historic unimpaired (computed natural) flows. Natural SJR flows were lowest during September and flows were extremely low or nonexistent in dry years. During 1922-1992, the average unimpaired flows during September were 117 cfs in the Stanislaus River, 185 cfs in the Tuolumne River, 84 cfs in the Merced River, and 808 cfs in the SJR (CDWR 1994). Elevated discharge levels of cool water from reservoir storage actually increase flow and decreases temperature during these time intervals.
- If temperatures were a problem for adult migrants in the SJR Basin, high pre-spawn mortality would be expected. However, studies conducted by DFG demonstrated that the incidence of pre-spawn mortality is quite low (i.e., 0%-4.5%) and appears to be density, not temperature, dependent (Guignard 2005 through 2008).
- Bay temperatures over 18ºC (65°F) in September when fish are migrating (CDEC; various stations).

Figure 1. Cumulative upstream passage at the Stanislaus River Weir during 2003-2008 (FISHBIO 2009).

There is no evidence that temperatures for juvenile rearing and migration need to be colder than existing conditions or maintained through June 15.

- Nearly all juvenile Chinook migrate prior to May 15, and <1% migrate after May, except in wet and above normal water years. Also, 90-99% of non ad-clipped salvaged *O.mykiss* are encountered between January and May depending on water year type.
- Existing 7DADM (7 day average of the daily maximums) temperatures are generally <u><</u>20°C (68°F) in the San Joaquin River and the eastside tributaries through May 15.
    - After incubation, temperatures for rearing should remain below 21°C (70°F) (Fjelstadt 1973, D-1422 testimony).
    - Studies evaluating the relationship between growth and temperature of CV Chinook found no difference in growth rates between 13-16°C (55-61°F) and 17-20°C (63-68°F) (Marine 1997).
    - Chinook salmon juveniles transform into smolts in the wild at temperatures in excess of 19°C (66°F), and in a laboratory study highest growth and survival of smolts was found if they underwent transformation at temperatures of 13-17°C (55-63°F; Marine and Cech 2004). Growth rate increased up to 19°C (66°F; Cech and Myrick 1999).
    - Existing water temperatures have *at most*, a slightly negative effect on juvenile salmon survival (Newman 2008).
    - No evidence from Stanislaus River smolt survival experiments that existing water temperatures reduce juvenile salmon survival (SRFG 2004).



The restoration of the SJR upstream of the Merced River (San Joaquin River Restoration Program; SJRRP) will adversely affect water temperatures in the lower SJR during the spring and fall.

- The lower SJR downstream of the Merced River confluence is identified as temperature impaired (USEPA 2010). According to water temperature modeling conducted by AD Consultants (SJRGA 2007a), although the SJRRP flows will add more water in this reach, the travel time is such that when the new water reaches the Merced River confluence, it approaches equilibrium with ambient temperature. Even though it is anticipated that the water temperature at the confluence of the Merced and San Joaquin Rivers will be the same with and without the anticipated SJRRP flows, the SJRRP flows themselves are of such a large volume that it would take a comparatively large volume of water from the Merced River to reduce temperatures in the lower San Joaquin River downstream of the Merced confluence. Given the storage capacity of Lake McClure, it is not possible to provide the volume of releases that would be necessary to reduce these water temperatures without quickly exhausting the available water supply.

Releases from tributary reservoirs will not impact water temperatures in the San Joaquin River or South Delta.

- Increasing flows from the tributaries will not decrease water temperatures in the mainstem SJR (SJRGA 2007a).

5. DISSOLVED OXYGEN

Overview

Low dissolved oxygen (DO) levels have been measured in the SJR, in particular in the Deep Water Ship Channel from the Port of Stockton seven miles downstream to Turner Cut. These conditions are the result of increased residence time of water combined with high oxygen demand in the anthropogenically modified channel, which leads to DO depletion, particularly near the sediment-water interface. Despite these conditions, salmon and steelhead migration are not adversely impacted, and has been observed at concentrations as low as 5 mg/L. In addition, salmonids migrate in the upper portions of the water column where DO concentrations are highest.

It has been shown that low DO conditions in the SJR can be ameliorated through installation of the Head of the Old River Barrier (which increases SJR flow and juvenile salmonid survival by preventing fish from entering the Old River and subsequent entrainment), but there is no basis for requiring year-round DO objectives for SJR tributaries (e.g., Stanislaus at Ripon), as fish and aquatic habitat that could benefit from these DO levels are located far upstream of the SJR confluence during the summer months.

Relevant Information regarding Dissolved Oxygen

Low dissolved oxygen concentrations are limited to the Deep Water Ship Channel (DWSC), and are the result of anthropogenic manipulation of channel geometry.

- The eastside rivers (Tuolumne, Stanislaus and Merced) discharge high-quality Sierra Nevada water to the SJR which has low planktonic algal content and oxygen demand, and are not a major source of oxygen demand contributing to the low DO problem in the DWSC (Lee and Jones-Lee 2003).
- The DWSC, starting at the Port of Stockton where the SJR drops from 8-10 feet deep to 35-40 feet deep, is a major factor in DO depletion below the water quality objective. If the DWSC did not exist, there would be few, if any, low DO problems in the channel.
- The critical reach of the SJR DWSC for low DO problems is approximately the seven miles just downstream of the Port to Turner Cut (Lee and Jones-Lee 2003).

Dissolved oxygen concentrations in the DWSC are influenced by Delta exports, but can be ameliorated by installation of the Head of Old River Barrier (Brunell et al. 2010).

- Delta export pumping artificially changes the flows in the South Delta, which results in more of the SJR going through Old River. Water diverted through Old River can significantly reduce the SJR flow through the DWSC, thereby directly contributing to low DO in the DWSC.
- The physical (rock) HORB is installed to improve DO levels in fall.

Existing dissolved oxygen concentrations do not impact salmon and steelhead migration.

- Migration rate and timing is not dependent upon existing dissolved oxygen concentrations.
    - Contrary to the often cited Hallock et al. (1970) report that indicates adult migration was impeded under low dissolved oxygen, migration has been observed at DO less than 5mg/L (Pyper et. al 2006).
- Salmon and steelhead migrate in the upper portion of the water column where DO concentrations are highest due to photosynthesis and atmospheric surface aeration (Lee and Jones-Lee 2003).
- Smolt survival experiments indicate that juvenile salmon survival is not correlated with existing DO concentrations (SRFG 2004; SJRGA 2002 and 2003).

DO objective for DWSC is inconsistent with U.S. EPA national standard.

- The current U.S. EPA national water quality criterion for DO allows for averaging and for low DO concentrations to occur near the sediment-water interface. Central Valley Regional Water Quality Control Board Basin Plan DO water quality objective does not include these adjustments (Lee and Jones-Lee 2003).
- DO concentrations near the bottom in the DWSC waters are sometimes 1-2 mg/L lower than those found in the surface waters (Lee and Jones-Lee 2003).

DO objective on the Stanislaus River at Ripon is not needed year round to protect the salmon or steelhead fishery.

- While the Stanislaus River contains native fish and aquatic habitat that benefit from a minimum DO concentration of 7.0 mg/L, such fish and aquatic habitat are located more than 30 miles upstream of the Ripon compliance point during the summer months.
- Salmonids migrate through the area during late September though May. Neither salmon nor steelhead are typically located anywhere in the Stanislaus River downstream of Orange Blossom Bridge from June through August each year.

Species	Stage	Timing	Geographic Location
Fall-run Chinook salmon			
	Adult Migration	Late September - December	Goodwin Dam to confluence
	Spawning	October – December	Goodwin Dam to Riverbank
	Egg Incubation	October – March	Goodwin Dam to Riverbank
	Juvenile Rearing	Mid December – May	Goodwin Dam to Riverbank
		June – mid December	Goodwin Dam to Orange Blossom Bridge
	Juvenile Migration	January – May	Goodwin Dam to confluence
Steelhead			
	Adult Migration	Late September - March	Goodwin Dam to confluence
	Spawning	December – March	Goodwin Dam to Riverbank
	Egg Incubation	December – July	Goodwin Dam to Riverbank
	Juvenile Rearing	Year-round	Goodwin Dam to Riverbank
	Juvenile Migration	February – May	Goodwin Dam to confluence

6. FOOD

Overview

The SWRCB's Technical Report (2012) purports that increased flows in the early spring will improve food production for early spring salmon rearing (page 3-29): "These flows may also provide for increased and improved edge habitat (generally inundated areas with vegetation) in addition to increased food production for the remainder of salmon that are rearing in-river.". Juvenile salmonids depend on a healthy aquatic food web to survive and grow rapidly. The SWRCB's Technical Report (2012; page 3-42 to 3-43) makes the case that a more natural flow regime would shift the benthic macroinvertebrate community in favor of more palatable prey for fish. While they do not provide any evidence that salmonids are food limited in the SJR and South Delta, they provide evidence that in unregulated streams there are generally more beneficial algae and diatoms, and high winter flows reduce predator-resistant invertebrates. In contrast, the benthic communities of the regulated streams are species-poor, impaired, and with higher relative abundance of predator-resistant invertebrates. However, the report does not provide any support to show that increasing flows in an already highly degraded system has the capability to return primary and secondary production quantity and quality to its pre-regulated state. Furthermore, the Technical Report (2012) does not explain the temporal and spatial scales under consideration for food production.

Relevant Information Regarding Food

Outmigrating Chinook smolts are not food limited during their 3-15 day migration through the lower SJR below Vernalis and the South Delta.

- The SWRCB's Technical Report (2012, page 3-42) provides evidence that, in northern California (unspecified location), ***unregulated*** rivers have more and better food resources than regulated rivers. However, the report does not provide any evidence that increasing flows in an already highly degraded system has the capability to return primary and secondary production quantity and quality to its pre-regulated state.
  - Furthermore, the SWRCB's Technical Report (2012) does not define how it would measure changes in food production (quality or quantity) or the mechanisms thought to drive food production in response to short-term increases in flow.
- The SWRCB's Technical Report (2012) also does not explain temporal and spatial scales under consideration for food production.
  - Based on acoustic VAMP studies in 2008, Holbrook et al. (2009) found that smolts took 3-15 days (median 6-9 days) for migration through the lower San Joaquin River and South Delta; demand for food production over such a short duration is questionable.
  - Increases in primary and secondary production that occur due to restoration or changes in management likely occur over longer periods of time, rather than that targeted by short-term pulse flows.
  - Spatial scale is important too, as impacts to food resources are generated at different rates and via different processes depending on where they are located in the river continuum.

7. CONTAMINANTS

Overview

According to the SWRCB's Technical Report (2012), contaminants are one of several "stressors" or "other factors" in the SJR Basin. One of the functions supported by spring flows according to the SWRCB's Technical Report (2012) is that higher inflows provide better water quality conditions by reducing contaminant concentrations. The influence of higher flows on contaminant concentrations in the SJR is variable and not well understood; dilution may occur in some instances but increases may occur in others (Orlando and Kuivila 2005). Dissolved contaminants and suspended contaminants respond differently to changes in flow. While higher flows may dilute some contaminants, such as selenium, mercury and DDT, contaminants in the bottom sediments of the SJR could also be remobilized during higher flows (McBain and Trush, Inc 2002). Citations were not presented in the SWRCB's Technical Report (2012) in support of the statement that higher inflows reduce contaminant concentrations.

The SWRCB's Technical Report (2012) also states that higher spring flows will reduce travel time and exposure of smolts to contaminants. Despite concerns over the threat contaminants may pose to threatened and endangered salmonid species, little is known regarding the effects of these contaminants on the health and survival of juvenile Chinook salmon in the Delta and its tributaries (Orlando et al. 2005). More studies are needed to determine the potential effects of short-term exposure to contaminants for outmigrating Chinook smolts, which pass through the South Delta relatively quickly.

Relevant Information Regarding Contaminants

No evidence or citations were provided to support the idea that higher inflows reduce contaminant concentrations.

- The SWRCB's Technical Report (2012; 3-29) states, "Higher inflows also provide better water quality conditions by reducing temperatures, increasing dissolved oxygen levels, and ***reducing contaminant concentrations***" (Emphasis added; pages 48 & 49); however, the report does not provide any references or further discussion to support this statement.
- The SWRCB's Technical Report (2012) may be inferring that higher flows would act to dilute already suspended contaminants. However, the influence of higher flows on contaminant concentrations is variable; dilution may occur in some instances but increases may occur in others.

SWRCB failed to consider that higher flows may also lead to increased suspended contaminant concentrations.

- High flows can also lead to increases in contaminant concentrations resulting from the resuspension of contaminants located in riverbed sediments. Contaminants in suspended sediments may affect the ecosystem differently from dissolved contaminants, since filter feeding organisms consume suspended sediments and organic material (allowing the contaminants in the sediments to enter into the food web) and may have longer residence times in the rivers and estuaries in comparison with water (Bergamaschi et al. 1997).

- Research has begun to focus on the relationship between freshwater flow and contaminant transport to and through the Delta. Although increased flows can result in reduced dissolved or suspended sediment concentrations of some contaminants, they can also lead to increased pesticide loading.
- In a study conducted just downstream of Vernalis, the U.S. Geological Survey (USGS) examined the concentrations of organic contaminants in surface water sites along the SJR and in the Old River before, during and after the VAMP month-long pulse flow (Orlando and Kuivila 2005).
  - Of the 13 total pesticides detected, diazinon and three herbicides (metolachlor, simazine, and trifluralin) were found in every sample.
  - Although it might be expected that the higher flows would dilute the contaminants, the results were mixed. Diazinon and simazine were highest at SJR and OR sites before VAMP (4/2/01 and 4/6/01), showed intermediate values during the VAMP period (5/14/01 and 5/18/01) and then reached lowest values during the post-VAMP period (5/31/01 and 6/4/01). Metolachlor showed the opposite trend at SJR and OR sites and increased throughout the three periods. Trifluralin showed a peak during the VAMP period for most sites. Suspended sediments were highest in the SJR during VAMP; however, the opposite was true for the Old River, suspended sediments were lower during VAMP compared to just before and after the VAMP period. This was likely influenced by the operations of the Head of the Old River Barrier (HORB), which was installed during the 2001 VAMP period. All six culvert slide gates were open from April 26 to May 26, allowing some water to pass into the Old River. Suspended sediment concentrations generally increase with increasing streamflow, but there are likely nonlinear relationships between streamflow, suspended sediment concentration, and contaminant concentration.
  - Limited conclusions can be drawn from a study with such a narrow spatial and temporal scope, however it is clear that increased flows do not necessarily lead to reduced contaminant concentrations. Undoubtedly, more research is needed to clarify this process.
- Furthermore, the relationship between flow and contaminants is not obvious upstream of Vernalis. As summarized in the Background Report for the San Joaquin River Restoration Study (McBain and Trush, Inc 2002), while higher flows may dilute some contaminants, such as selenium, mercury and DDT, contaminants in the bottom sediments of the SJR could also be remobilized during higher flows.
  - McBain and Trush (2002) found that "although water quality conditions on the SJR relating to conservative ions, (e.g., salt and boron), and some nutrients are likely to improve under increased flow conditions, it is unclear how these and other potential restoration actions will impact many of the current TMDL programs and existing contaminant load estimates. This is most true of constituents with complex oxidation reduction chemistry, and sediment/water/biota compartmentalization (e.g.,

pesticides, trace metals). Perhaps the greatest risks to potential restoration actions within the San Joaquin River study reaches relate to uncertainties regarding remobilization of past deposits of organochlorine pesticides, i.e., DDT and mercury."

It remains unknown whether, or to what extent, migrating salmonids may be affected by suspended contaminants.

- It is generally recognized that contaminants can have a negative effect on aquatic ecosystems, however despite the extensive studies conducted in the field of toxicology, the direct ('acute toxicity' leading to death; or 'chronic' or 'sublethal toxicity' leading to decreased physical health; NMFS 2009a) and indirect effects (reduction of invertebrate prey sources, reducing energetically favorable prey species relative to less energetically profitable or palatable prey; Macneale et al. 2010) of pollutants on salmon in the wild are not well understood.
- Despite concerns over the threat contaminants may pose to threatened and endangered salmonid species, little is known regarding the effects of these contaminants on the health and survival of juvenile Chinook salmon in the Delta and its tributaries (Orlando et al. 2005).
- In a small scale, pilot study of contaminant concentrations in fish from the Delta and lower SJR, resident species were tested for some of the contaminants listed above; however, no salmonid species were tested (Davis et al. 2000).
    - The study found that 11 out of 19 adult largemouth bass sampled exceeded the mercury screening values, with a general pattern of lower concentrations downstream in the SJR toward the central Delta. DDT concentrations were exceeded in 6 of 11 white catfish, but only 1 of 19 largemouth bass. All samples above the DDT screening value were obtained from the South Delta or lower SJR watershed, indicating that the South Delta is still influenced by historic DDT use in the SJR basin. Two of the listed organophosphate pesticides were measured; diazinon was not detected in any sample and chlorpyrifos was detected in 11 of 47 samples analyzed, but at concentrations well below the screening value.
    - With regards to salmonids, however, it is important to consider that resident fish may experience chronic exposure to these chemicals, while outmigrating Chinook smolts pass through the South Delta in a relatively short period of time.
- A study by Meador et al. (2002) focused on estimating threshold PCB concentrations for juvenile Chinook salmon migrating through urban estuaries. PCBs were a concern because they had been shown to alter thyroid hormones important for the process of smoltification. During smoltification, salmonids tend to show declines in muscle lipids, the main lipid storage organ for salmonids, causing the PCBs to be redistributed to, and concentrated in, other organs (Meador et al. 2002).
    - Results of this study indicate that tissue concentrations below 2.4 mg PCB g-1 lipid should protect juvenile salmon migrating through urban estuaries from adverse effects specifically due to PCB exposure. This does not take

into account any effects of other contaminants likely to also be in estuarine waters such as the Delta.

Bioaccumulation, rather than exposure to dissolved contaminants, is likely the main concern for migrating juvenile Chinook.

- Pesticides in the water column may be dissolved contaminants or they may accumulate in suspended sediments associated with organic matter.
  - Dissolved contaminants can be absorbed through the gills or skin and this uptake may show more variability than the other exposure routes depending on concentrations, temperature and stress (Meador et al. 2002).
  - Contaminants that accumulate in riverbed sediments may be resuspended (Pereira et al. 1996), and enter the food chain through filter-feeding benthic or pelagic organisms, such as Corbicula clams. In turn, bottom feeder fish species (e.g., carp and catfish) consume filter-feeding invertebrates (Brown 1997). This process leads to bioaccumulation of the contaminants up the food chain.
  - Bioaccumulation, rather than exposure to dissolved contaminants, is likely the main concern for migrating juvenile Chinook (Meadnor et al. 2002). Factors that affect bioaccumulation include: variable uptake and elimination rates, reduced bioavailability, reduced exposure, and insufficient time for sediment–water partitioning or tissue steady state can affect (Meador et al. 2002).

8. VELOCITY

Overview

According to the SWRCB Technical Report (2012; page 3-29), higher spring flows "facilitate transfer of fish downstream" and "provide improved transport". The term "facilitate transport" is undefined and is too vague to evaluate adequately. Although the SWRCB's Technical Report (2012) cites DOI's comments to the State Water Board (DOI 2010) regarding this function, there is no reference to "facilitate transport" anywhere in the DOI (2010) text. Therefore, it is unclear by what mechanisms spring flows facilitate transport of smolts, what the benefits are, and how the benefits may be influenced by factors such as flow level and duration.

Nonetheless, the SWRCB's Technical Report (2012) may be suggesting that increased flows result in increased ***velocity***, which may lead to decreased juvenile salmonid travel time through the region, thus 'facilitating transport'. Modeling suggests that velocities at the Head of Old River may increase by about 1 ft/s with an additional 6,000 cfs SJR flow, but the model predicts little to no change in velocity at other stations in the South Delta (Paulsen et al. 2008). Thus, increased flows may increase velocity near the boundary of the Delta, but do not substantially increase velocity through the Delta.

SWRCB's Technical Report (2012) Assertions Regarding Relationship Between San Joaquin River Flows and Velocity (Transport)

Bold statements below indicate the SWRCB's Technical Report (2012) assertions regarding relationship between SJR flows and transport, followed by supporting/contrary evidence, as follows:

SWRCB Assertion 1. In the late winter and spring, increased flows provide or facilitate improved transport of fish downstream (page 3-29).

- No evidence is provided that higher spring flows "facilitate transport," or present any potential mechanisms by which "facilitation" could be measured.
- The term "facilitate transport" is undefined in the SWRCB's Technical Report (2012) and it is unclear by what mechanisms spring flows facilitate transport of smolts, what the benefits are, and how the benefits may be influenced by factors such as flow level, duration, turbidity, etc.
  - The SWRCB's Technical Report (2012) cites an early USFWS exhibit submitted to the SWRCB (USFWS 1987) in support of the hypothesis that increased SJR flows are positively related to smolt migration rates, "with smolt migration rates more than doubling as inflow increased from 2,000 to 7,000 cfs." However, the original reference does not specify how and when these data were gathered and analyzed.
  - Presumably, these data (USFWS 1987) are part of the work conducted by the USFWS as part of the Interagency Ecological Program for the Sacramento-San Joaquin Delta (IEP). As in other documents related to IEP and other early studies, data have often been misinterpreted, or there were factors not considered such as the potential for different sized fish to be released (different sized fish behave differently giving the appearance that migration rates were influenced by flows).
- In 2001, these hypotheses regarding flow and migration rates were already in question as evidenced by Baker and Morhardt (2001), which stated that "initially it seems intuitively reasonable that increased flows entering the Delta from the SJR at Vernalis would decrease travel times and speed passage, with concomitant benefits to survival. The data, however, show otherwise."
  - Baker and Morhardt (2001) examined the relationship between mean smolt migration times from three locations (one above and two below the Head of the Old River to Chipps Island) and San Joaquin flow (average for the seven days following release) and found no significant relationships at the 95% confidence level, and a significant relationship at the 90% confidence level for only Old River releases.
  - Although flows were not found to facilitate transport, there was evidence of an increase in smolt migration rate with increasing size of released smolts (Baker and Morhardt 2001), which again highlights the limitation of the "black box approach" and emphasizes a need for a better understanding of the mechanisms underlying the relationship of survival and flow. This increase in migration rate with increasing size may be explained by the one factor that definitely helps facilitate the transport of salmon through the Delta: the

salmon itself. Juvenile salmonids are actively swimming, rather than moving passively with the flow, as they migrate towards the ocean (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167, Peake McKinley 1998), and the movements of juvenile salmonids depend on their species and size, water temperature, local hydrology, and many other factors (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167).

  - Baker and Morhardt (2001) provide an example of a study which compared the speed of smolt passage to that of tracer particles (particle tracking model - PTM), "in which 80% of the smolts were estimated to have been recovered after two weeks, but only 0.55% of the tracer particles were recovered after two months." According to documents filed in the Consolidated Salmon Cases (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167), simulations of PTM were compared to actual mark and recapture CWT data for Chinook salmon released at Mossdale on the SJR, and it was found that smolts traveled to Chipps Island 3.5 times faster than the modeled particles, with a significant difference in the time to first arrival ($df=76$, $T=9.92$, $p<0.001$).

- In recent years, VAMP has used acoustic tags to monitor smolt outmigration survival, therefore more detailed travel times have been estimated for the various SJR and South Delta reaches.
  - Results have generally shown short travel times between reaches, suggesting active swimming. In 2009, the average travel times were reported for each reach, and all were under 2.5 days (SJRGA 2010). For example, the average travel time between Lathrop and Stockton was only 2.29 days.
- Juvenile salmonids are actively swimming, rather than moving passively with the flow, as they migrate towards the ocean (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167, Peake McKinley 1998).
  - Movements of juvenile salmonids depend on their species, size, water temperature, local hydrology, and many other factors (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167).
  - Recall the Baker and Morhardt (2001 example of a study, which compared the speed of smolt passage to that of tracer particles (i.e., PTM), discussed above.
  - Chinook released at Mossdale traveled to Chipps Island 3.5 times faster than the modeled particles (Cramer Decl., Case 1:09-cv-01053-OWW-DLB Document 167).
- Increased flows may slightly increase velocity near the boundary of the Delta, but do not substantially increase velocity through the Delta.
  - Modeling suggests that velocities at the Head of Old River may increase by about 1 ft/s with an additional 6,000 cfs SJR flow; however, the model predicts little to no change in velocity (<0.5 ft/s) at other stations in the South Delta (Paulsen et al. 2008).

9. PHYSICAL HABITAT

Overview

The historically diverse SJR and South Delta aquatic habitats have been substantially reduced, simplified and altered by development. One of the major changes in the system is the loss of shallow rearing habitat behind levees. Furthermore, aquatic vegetation growth and expansion over the past 20 years has increased water clarity by trapping suspended solids, affecting the composition of the fish communities (Nobriga et al. 2005). The current habitat structure now benefits introduced predators (Brown 2003).

The SWRCB's Technical Report (2012) maintains that the flow regime is the "master variable" that regulates the ecology of rivers, and the other habitat factors affecting community structure (e.g., temperature, water chemistry, physical habitat complexity), "are to some extent determined by flow (Moyle et al. 2011)." The report often refers to increases in physical habitat associated with increasing flow, however it lacks recognition of the limitations due to the substantially altered physical habitat. Much of the lower SJR and South Delta are banked by steep levees (about 443 miles downstream of Stanislaus River; Figure 2), limiting access to floodplain habitat and restricting true channel mobilization flows. For additional information see the discussions in the chapters "Floodplain Habitat" and "Geomorphology".

Relevant Information Regarding Physical Habitat

The physical habitat for native San Joaquin Basin and South Delta fishes has been substantially reduced and altered.

- Diverse habitats historically available in the Delta have been simplified and reduced by development of the watershed (Lindley et al. 2009).
- Spawning and rearing habitat have been severely reduced, salmon total abundance is down, and salmon diversity is reduced (McEvoy, 1986; Yoshiyama et al., 1998, 2001; Williams 2006).
- Major change in system is the loss of shallow rearing habitat (Lindley et al. 2009).
- An estimated 95% of wetlands/floodplains lost to levee construction and agricultural conversion since the mid 1800s (TBI 1998, Simenstad and Bollens 2003, Williams 2006).
- Only ~10% of historical riparian habitat remains, with half of the remaining acreage disturbed or degraded (Katibah 1984).
- Reduction in suitable physical habitat for delta smelt has reduced carrying capacity (Feyrer et al. 2007).

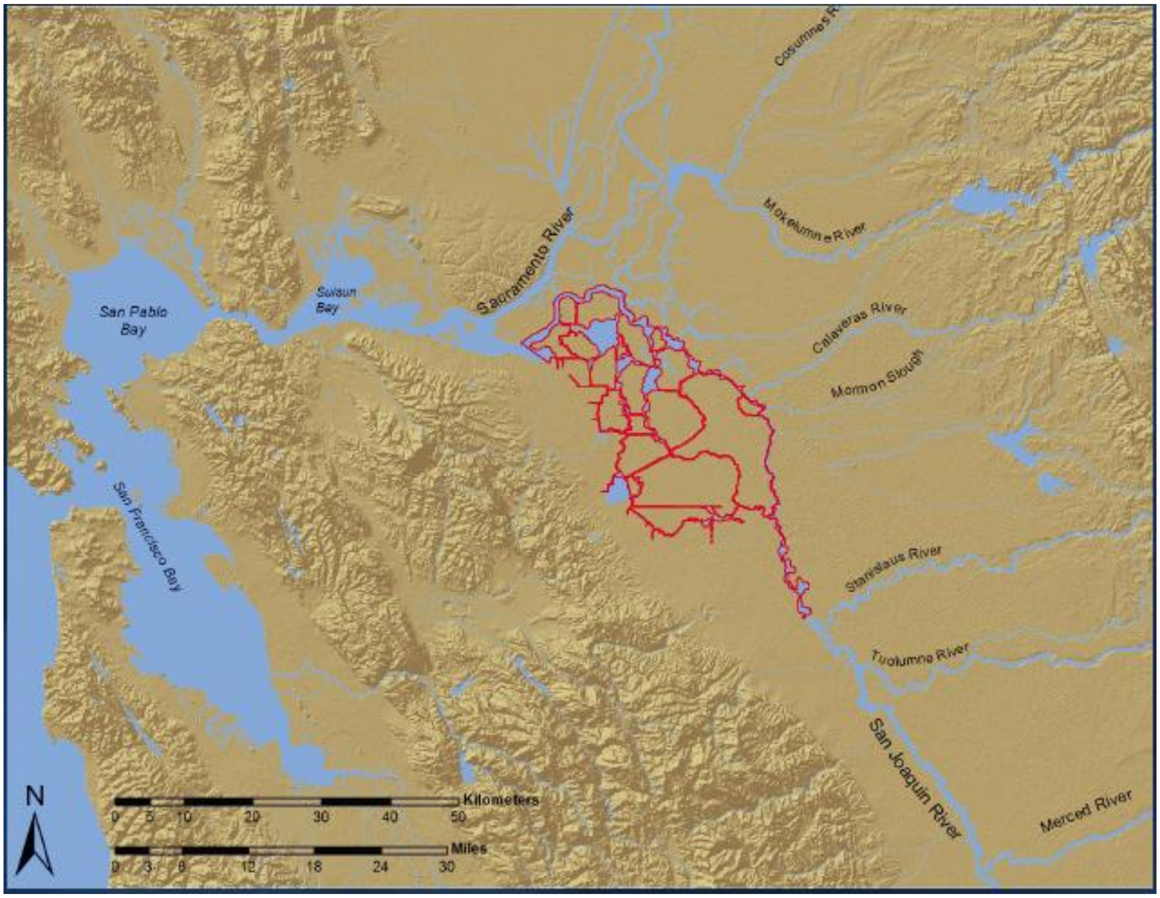


Figure 2. Levees in the South Delta and lower San Joaquin River downstream of the Stanislaus River confluence.

Habitat alterations are linked with invasive species expansions.

- *Egeria densa* (Brazilian waterweed) expansion has increased habitat and abundance of largemouth bass and other invasive predators (Baxter et al. 2008).
- The area near the CVP intake has significant amounts of *E. densa* (Baxter et al. 2008).

- Current habitat structure benefits introduced predators more than natives (Brown 2003).
- *Egeria* has strong influence on results of habitat alterations as different fish communities are found in its presence (Brown 2003).

Habitat influences growth, survival and reproduction through biological and physical mechanisms.

- Estuaries provide important rearing habitat for Chinook; salmon fry in Delta grew faster than in river (Healey 1991, Kjelson et al. 1982).
- Shallow water habitats support high growth in CV; juvenile Chinook had higher growth rates in small tributaries of Sacramento River than in the main Sacramento (Sommer et al. 2001; Jeffres et al. 2008; Maslin et al. 1997, 1998, 1999; Moore 1997).

Water quality aspect of habitat is highly variable.

- Aquatic vegetation increase, especially *E. densa*, over the past 20 years has increased water clarity by trapping suspended solids, with measurable effects on fish communities (Nobriga et al. 2005).
- Variability in habitat likely causes regional differences in the relationship between Delta smelt abundance and water quality (Baxter et al. 2008).
- Reduced pumping from the SWP in October of 2001 lowered salinity in western Delta (as desired), but led to opposite and unexpected result of increased salinity in central Delta (Monsen et al. 2007).

Improving habitat for increased abundance of native fishes.

- Increase productive capacity with access to floodplains, streams, and shallow wetlands (Lindley et al. 2009).
- Habitat quantity, quality, spatial distribution and diversity must be improved to promote life history diversity that will increase resilience and stability of salmon populations (Lindley et al. 2009).

10. GEOMORPHOLOGY

According to the SWRCB's Technical Report (2012), a more natural flow regime will improve geomorphic processes including scour and bed mobilization and will increase the number of turbidity events.

SWRCB's Technical Report (2012) Assertions Regarding Effects of Implementing a More Natural Flow Regime on Geomorphic Processes

Bold statements below indicate the SWRCB's Technical Report (2012) assertions regarding effects of implementing a more natural flow regime on geomorphic processes, followed by supporting/contrary evidence, as follows:

Assertion 1. A more natural flow regime will improve bed scour and mobilization and provide associated benefits such as creating a "less homogenous channel with

structures that are important for fish habitat, such as meanders, pools, riffles, overhanging banks, and gravel substrates of appropriate sizes…and rejuvenate riparian forests and clean gravel for salmon…" (SWRCB Technical Report 2012; page 3-48).

The natural flow paradigm assumes that channel formation and maintenance is directly influenced and modified by flow, which is generally true under natural conditions; however, leveed rivers can be nearly independent of flow. Poff et al. (1997, page 770), identify "five critical components of the ["natural," i.e., unaltered by humans] flow regime that regulate ecological processes in river ecosystems: the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions (Poff and Ward 1989, Richter et al. 1996, Walker et al.1995)." The authors also recognize that most rivers are highly modified and allude to the possibility that restoration of a natural flow regime may be limited "depending on the present extent of human intervention and flow alteration affecting a particular river (Poff et al. 1997, Page 780)." The natural flow paradigm assumes that channel form is directly influenced and modified by flow, which is generally true under natural conditions (a potential exception being a bedrock controlled channel); however, the morphology of a highly engineered river (e.g., levees) can be practically independent of flow (Jacobson and Galat 2006). In such a system, flow-related factors like timing of floods, water temperature, and turbidity may be managed; but, in absence of a "naturalized morphology, or flow capable of maintaining channel-forming processes, the hydrologic pulses will not be realized in habitat availability" (Jacobson and Galat 2006, page 250).

With minimal floodplains remaining in the San Joaquin Basin due to land use changes, higher flows do not necessarily provide the channel maintenance that would occur under natural conditions. In leveed systems such as the San Joaquin Basin, true channel mobilization flows are not possible because of flood control. In some instances, higher flows can actually result in increased detrimental incision in upstream tributary areas like the Stanislaus River where existing riparian encroachment is armored and cannot be removed by high flow events, which limits "river migration and sediment transport processes" (Kondolf et al. 2001, page 39). In addition, the ability to provide a more natural flow regime is hampered by "urban and agricultural developments that have encroached down to the 8,000 cfs line," which effectively limit the highest flows to no more than the allowable flood control (i.e., 8,000 cfs) (Kondolf et al. 2001, page 46). Also, in the case of the Stanislaus River, there is limited opportunity to provide mechanical restoration of floodplains due to private landowners and flood control. In instances where flood pulses can no longer provide functions such as ***maintenance of channel habitat***, Poff et al. (1997) states, "mimicking certain geomorphic processes may provide some ecological benefits [e.g., gravel augmentation, stimulate recruitment of riparian trees like cottonwoods with irrigation]."

In the absence of floodplain connectivity, the functions attributed to higher "pulse flows" cannot be achieved as described by the Flood Pulse Concept (FPC) (Junk et al. 1989; Junk and Wantzen 2003). Under natural conditions, the SJR was a river channel connected with its floodplain. Flood pulses in the winter and spring would have provided the functions identified by Junk et al. (1989) and by Junk and Wantzen (2003). However, anthropomorphic changes in the lower river (e.g., levees), particularly below Vernalis (the focus of the SWRCB's Technical Report 2012), have substantially reduced this floodplain connectivity and the region can no longer be considered a "large river-floodplain system." In fact, the extent of inundated floodplain in the SJR between the confluence of the Stanislaus River and Mossdale only exceeds 2,000 acres at the maximum modeled flow of 25,000 cfs (cbec 2010). In comparison, the Yolo Bypass is approximately 59,000-acres (Sommer et. al 2005) and the Cosumnes floodplain is about 1,200 acres (Swenson et al. 2003).

11. HEAD OF OLD RIVER BARRIER

Overview

Although the SWRCB's Technical Report (2012) mentions the Head of Old River Barrier (HORB) in several contexts, there is no cohesive discussion about the substantial impact that the HORB has on juvenile salmon survival through the lower SJR and South Delta.

Relevant Information Regarding Head of Old River Barrier

Operation of a rock barrier at the Head of Old River improves salmon smolt survival through the Delta by 16-61% (Newman 2008).

- HORB reduces entrainment into Old River from more than 58% to less than 1.5%.
- Survival appears to be lower in the Old River than it is in the main stem San Joaquin River (Newman, 2008).
- Physical (rock) HORB increases SJR flow.
- Installation of the HORB doubles through-Delta survival by directing juvenile salmonids through the SJR mainstem (compared to the Old River route, NMFS 2012).

Absence of Head of Old River Barrier

- In the absence of the physical (rock) HORB, a statistically significant relationship between flow and survival does not exist (Newman 2008); therefore there is no justification for increasing flows when the barrier is not in operation.
  - The temporary HORB rock barrier requires flows less than 5,000 cfs for installation and flows less than 7,000 cfs for operation (SJRTC 2008).

Head of Old River Barrier Timeline.

- Initiated as a part of the South Delta Temporary Barriers Project in 1991 to be a temporary rock-fill physical barrier to prevent juvenile Chinook salmon from entering Old River at the Head of the Old River (HOR).
- Installation of the HORB had been utilized each spring (except in high water years) from 1992-2007 (see status table below).
- Between 2008 and 2011, installation of the physical barrier was prohibited by a Federal Court decision by U.S. District Court Judge Wanger due to concerns for delta smelt.
- In 2009 and 2010, a non-physical barrier (Bio-Acoustic Fish Fence; BAFF) was installed to replace the spring time HORB.

- In 2012, the physical barrier was installed as a part of a Joint Stipulation order by US District Court Judge O'Neil.
- Installation status of HORB each spring since 1992 includes:

YEAR	Type of HORB Installed	Reason
2012	Rock	Court ruling (Joint stipulation)
2011	Not installed	High Flows
2010	BAFF	VAMP/BOR study
2009	BAFF	VAMP/BOR study
2008	Not installed	Court Ruling
1992-2007	Rock installed annually with exception of high flow years	Not installed 1993, 1995, 1998, 1999, 2005, and 2006 due to high flows

Salmon versus Delta smelt.

- The HORB physical barrier in spring stops the juvenile Chinook salmon from entering the Old River, avoiding entrainment in the state and federal pumps. But, USFWS has taken the position that the physical barrier causes a negative flow to occur in the Middle and Old Rivers (OMR), which creates a situation that elevates Delta smelt entrainment.
- USFWS contends that negative OMR flows up to 1,250 cfs do not increase entrainment of Delta smelt, but negative OMR flows greater than 1,250 cfs do.
- A Joint Stipulation issued by Judge O'Neil regarding the 2012 CVP and SWP operations includes flow restrictions for OMR flows in April between -1,250 and -3,500 cfs; in May between -1,250 and -5,000 cfs.

Head of Old River Bio-Acoustic Fish Fence (BAFF; Bowen et. al 2008, 2009a-b, 2010).

- Beginning in the Spring of 2009, a three-year study was initiated by the U.S. Bureau of Reclamation (USBR) to install and monitor the effectiveness of a non-physical barrier at the head of Old River called a Bio-Acoustic Fish Fence (BAFF). The BAFF was installed in 2009 and 2010, but was not installed in 2011 because of high water.
- The BAFF consisted of three parts: a sound emitting device, a bubble curtain and a light system of strobe hi-intensity LEDs.
- In 2009, when the BAFF was on it was over 80% efficient at deterring tagged salmon smolts from entering Old River. When the BAFF was off, only 25% of tagged salmon smolts did not enter Old River.
- In 2010, the alignment of the BAFF was changed; it was set out further in the channel, lengthened to 136 m, the angle changed to 30 degrees and the downstream end of the BAFF changed from a straight layout to a "hockey stick" configuration.
- It was thought that the 2009 alignment, while being efficient in deterring acoustically tagged smolts from entering Old River, may have guided them into or near the large scour hole immediately down the SJR of the HOR. Later, the USBR

biologists attributed the high mortality of the tagged smolt to low flows in 2009, stating that the low flow consolidated the smolt path "So, prey may have been forced into a smaller volume of water with predator*s*", thus increasing predation (Bowen 2009).

Comparison of HORB BAFF efficiencies in 2009 and 2010

	2009 Range (%)	2009 Mean (%)	2010 Range (%)	2010 Mean (%)
Mortality rates between Durham Ferry and HORB	25.2 to 61.6	40.8	2.8 to 20.5	7.8
Predation rates at HORB	11.8 to 40	27.5	17 to 37	23.5
Deterrence rate of Barrier		81.4 total		23.0 total
Protection Efficiency	14 to 62	31	31 to 60	43.1

Head of Old River Barrier Predation and "Hot Spots."

- Predation Rate at HORB
  - 2009 11.8 – 40% (mean 27.5%)
  - 2010 17 – 37% (mean 23.5%)

Head of Old River Flow conditions during VAMP releases and tracking period.

- 2009 – 75/25% split in flows; with 75% heading into Old River, 25% into the mainstem San Joaquin (dates of operation: 4/22 – 6/13/2009)
- 2010 – 58/42% split; with 58% heading into Old River 42% into the mainstem San Joaquin (dates of operation: 4/25 – 6/25/2010)

12. PREDATION

Overview

Numerous studies have found that striped bass and other piscivorous fish prey on outmigrating salmon (Shapovalov 1936, Stevens 1966, Thomas 1967, Pickard et al. 1982, Merz 2003, Gingras 1997, Tucker et al. 1998). While striped bass are likely the most significant predator of Chinook salmon and Delta smelt (Nobriga and Feyrer 2007), several other invasive predators occur in the Delta and may also contribute to the predation losses including white catfish, black crappie, smallmouth bass, and spotted bass. The predation appears to be patchy both seasonally and spatially, with higher levels of predation documented in the spring, in areas of anthropogenic influence such as near water diversion structures and dams (Gingras 1997, Tucker et al. 1998, Merz 2003, Clark et al. 2009). In recent years it has become clear that predation on salmon may significantly limit salmon recovery efforts (NMFS 2009b; Dauble et al., 2010). The NMFS Draft Recovery Plan (2009b) for Chinook salmon and CV steelhead considered "predation on juveniles" one of the most important specific stressors.

The SWRCB's Technical Report (2012) indicates that flow can operate indirectly through other factors that directly influence survival, including predation. The report makes several statements regarding the relationship between flows and predation, asserting that increased flows will reduce the impacts of predation on outmigrating salmonids.

Relevant Information Regarding Predation

The VAMP review panel concluded that "high and likely highly variable impacts of predation, appear to affect survival rates more than the river flow" (Dauble et al. 2010).

- All fishery agencies have acknowledged that striped bass are a major stressor on Chinook populations in the CV and recovery will not occur without significant reduction in their populations and/or predation rates (DFG 2011).

Striped bass prey on juvenile Chinook.

- Many studies have found that striped bass eat salmon (Shapovalov 1936, Stevens 1966, Thomas 1967, Pickard et al. 1982, Merz 2003, Gingras 1997, Tucker et al. 1998).
- Striped bass stomachs have been collected with juvenile Chinook composing up to 65% (by volume) of the total contents (Thomas 1967).
- Waddell Creek stomach contents in April of 1935 found that large striped bass fed heavily on young salmon and trout (30.8% by number of occurrence) (Shapovalov 1936).
- In the Mokelumne River, 11 to 51% of the estimated salmon smolts were lost to striped bass predation in the Woodbridge Dam afterbay in 1993. Chinook were 24% (by volume) of juvenile bass stomach content in the spring in the Mokelumne River (Stevens 1966).
- Below Red Bluff Diversion Dam juvenile salmon outweighed other food types in striped bass stomach samples by a three to one margin (Tucker et al. 1998).
- Almost any fish occurring in the same habitat as striped bass will appear in the bass diet (Moyle 2002).
- There are roughly 1 million adult striped bass in the Delta and their abundance remains relatively high despite curtailment of a stocking program in 1992 (CDFG 2009).
- Recent concerns about the survival of endangered winter-run Chinook salmon in the Sacramento River have focused on the impacts of striped bass predation on outmigrants and the effects of striped bass population enhancement on winter-run Chinook population viability (Lindley and Mohr 1999). It was estimated that at a population of 765,000 striped bass adults, 6% of Sacramento River winter Chinook salmon outmigrants would be eaten each year (Lindley and Mohr 1999, 2003).

- "CDFG documented in their 2002 annual report to NMFS that an adult striped bass (420 mm) collected in May 2002 at Miller Ferry Bridge had 39 juvenile salmonids in its stomach (DFG022703)." (Hanson 2009).

Striped bass in the San Joaquin River and South Delta prey on juvenile Chinook to such an extent that they significantly reduce the number of Chinook returning to the San Joaquin Basin.

- High predation losses at the State Water Project (SWP) are particularly detrimental to SJR Chinook salmon populations since over 50% of juvenile salmon from the SJR travel through Old River on their way to the ocean, exposing them to predation at Clifton Court Forebay (CCF) and causing substantially reduced survival.
- Predation rates in CCF are as high as 66-99% of salmon smolts (Gingras 1997; Buell 2003; Kimmerer and Brown 2006).
- Striped bass are generally associated with the bulk of predation in CCF since their estimated populations have ranged between 30,000 and 905,000 (Healey 1997; Cohen and Moyle 2004); however, studies indicate that six additional invasive predators occur in the CCF (i.e., white catfish, black crappie, largemouth bass, smallmouth bass, spotted bass, redeye bass) with white catfish being the most numerous, having estimated populations of 67,000 to 246,000 (Kano 1990).
- Yoshiyama et al. (1998) noted that "[S]uch heavy predation, if it extends over large portions of the Delta and lower rivers, may call into question current plans to restore striped bass to the high population levels of previous decades, particularly if the numerical restoration goal for striped bass (2.5 to 3 million adults; USFWS 1995; CALFED 1997) is more than double the number of all naturally produced CV Chinook salmon (990,000 adults, all runs combined; USFWS 1995)."
- Hanson (2005) conducted a pilot investigation of predation on acoustically tagged steelhead ranging from 221-275mm, and estimated that 22 of 30 (73%) were preyed upon.
- Nobriga and Feyrer (2007) state: "Striped bass likely remains the most significant predator of Chinook salmon, *Oncorhyncus tschawytscha* (Lindley and Mohr 2003), and threatened Delta smelt, *Hypomesus transpacificus* (Stevens 1966), due to its ubiquitous distribution in the Estuary and its tendency to aggregate around water diversion structures where these fishes are frequently entrained (Brown et al. 1996)."

Recent San Joaquin Basin VAMP studies conducted from 2006–2010 provide direct evidence of high predation rates on Chinook salmon in the lower San Joaquin River and South Delta.

- An acoustic tag monitoring study was conducted from 2006 – 2010 to evaluate survival of salmon smolts emigrating from the SJR through the Delta (SJRGA 2011).
  - In 2006, results indicated that without the, "Head of Old River Barrier in place and during high-flow conditions many (half or more) of the acoustic-tagged fish, released near Mossdale, migrated into Old River."

- In 2007, a total of 970 juvenile salmon were tagged with acoustic transmitters and were detected by a combination of receivers:
  - Mobile tracking found that 20% of released fish (n=192) were potentially consumed by predators at three "hotspots" located near Stockton Treatment Plant (n=116), just upstream of the Tracy Fish Facility trashracks (n=57), and at the head of Old River flow split downstream of Mossdale (n=19).
  - Stationary detections indicate an average 45% loss, potentially attributable to predation, which does not account for losses at the largest "hotspot" at Stockton Treatment Plant, nor in the greater Delta past Stockton and Hwy 4.
- In 2008, the only tagged fish entering Old River to survive were fish collected (salvaged) at two large water conveyance projects and transported through the Delta by truck (Holbrook et al. 2009).
- In 2009, the combined loss rate from Durham Ferry to the HORB and the loss rate in the vicinity of the HORB (BAFF in) combined to show a loss rate between 60 -76% of the seven groups released at Durham Ferry (SJRGA 2010).
  - Mortality rates (likely due to predation) between Durham Ferry and the BAFF ranged from 25.2% to 61.6% (mean 40.8%) (Bowen et al. 2009).
  - Predation rates near the BAFF ranged from 11.8% to 40% (mean 27.5) (Bowen et al. 2009).
- In 2010, Old River supplemental smolt releases concluded of 162 of 247 (65.6%) tags were classified as coming from a predator rather than a smolt (SJRGA 2011).
  - Mortality rates (likely due to predation) between Durham Ferry and the BAFF ranged from 2.8% to 20.5% (mean 7.8%) (Bowen and Bark 2010).
  - Predation rates near the BAFF ranged from 17% to 37% (mean 23.5%) (Bowen and Bark 2010).

Significant predation losses are also occurring in the San Joaquin Basin tributaries due to non-native predators.

- Radio tracking studies conducted during May and June of 1998 and 1999, respectively (Demko et. al 1998; FISHBIO unpublished data), indicated that the survival of large, naturally produced and hatchery juveniles (105 to 150 mm fork length) was less than 10% in the Stanislaus River downstream of the Orange Blossom Bridge.
- Individual based, spatially explicit model – Piscivores consume an estimated 13-57% of fall-run Chinook in Tuolumne River (Jager et al. 1997).
- Significant numbers of striped bass migrate into the Stanislaus River each spring, as detected at the weir (Anderson et. al 2007; FISHBIO unpublished data), and are thought to prey heavily on outmigrating Chinook smolts.

The overwhelming majority of predation on juvenile Chinook is the result of non-native predators that were intentionally stocked by CDFG, and whose abundance can be reduced to minimize the impacts on Chinook.

- Most of the non-native fish species (69%) in California, including major predators, were intentionally stocked by CDFG for recreation and consumption beginning in the 1870s. All of the top predators responsible for preying on native fish are currently managed to maintain or increase their abundance. Historically, the Delta consisted of approximately 29 native fish species, none of which were significant predators. Today, 12 of these original species are either eliminated from the Delta or threatened with extinction, and the Delta and lower tributaries are full of large non-native predators such as striped bass that feed "voraciously" throughout long annual freshwater stays (McGinnis 2006).
    - Lee (2000) found a remarkable increase in the number of black bass tournaments and angler effort devoted to catching bass in the Delta over the last 15 years.
    - According to Nobriga and Feyrer (2007), "largemouth bass likely have the highest per capita impact on nearshore fishes, including native fishes," and concludes that "shallow water piscivores are widespread in the Delta and generally respond in a density-dependent manner to seasonal changes in prey availability."
    - "In recent years, both spotted bass (*Micropterus punctulatus*) and redeye bass (*M. coosae*) have invaded the Delta. While their impact in the Delta has not yet been determined, the redeye bass has devastated the native fish fauna of the Cosumnes River Basin, a Delta tributary" (Moyle *et al.* 2003 as cited by Cohen and Moyle 2004).
    - Black crappie were responsible for a high level of predation during a 1966/67 CDFG study (Stevens 1966). As many as 87 recognizable fish were removed from the stomach of one crappie, and counts of 40 to 50 were common. Most of the fish were undigested, hence not in the stomachs for very long.
- A lawsuit by the Coalition for a Sustainable Delta against DFG was settled in April 2011. Under the settlement, a comprehensive proposal to address striped bass predation in the Delta must be developed by state and federal fishery management agencies. As part of the settlement DFG must make appropriate changes to the bag limit and size limit regulations to reduce striped bass predation on the listed species, develop an adaptive management plan to research and monitor the overall effects on striped bass abundance, and create a $1 million research program focused on predation of protected species.
    - DFG (2011) proposed changing striped bass regulations to include raising the daily bag limit for striped bass from 2 to 6 fish with a possession limit of 12, and lowering the minimum size for striped bass from 18 to 12 inches. Proposed regulations included a "hot spot" for striped bass fishing at Clifton Court Forebay with a daily bag limit of 20 fish, a possession limit of 40 fish and no size limit. Fishing the hot spot would require a report card to be filled out and deposited in an iron ranger or similar receptacle.
    - With significant pressure from striped bass fishing groups, the California Fish and Game Commission denied the changes proposed by agency biologists in favor of keeping striped bass protections (CFGC 2012).
- According to NMFS (2009b), Priority Recovery Actions (1.5.4) Implement programs and measures designed to control non-native predatory fish (e.g., striped

bass, largemouth bass, and smallmouth bass), including harvest management techniques, non-native vegetation management, and minimizing structural barriers in the Delta, which attract non-native predators and/or that delay or inhibit migration.

Reducing striped bass predation on juvenile Chinook is the simplest, fastest, and most cost-effective means of increasing outmigration survival.
High predation likely occurs at specific "hot spots", which can be the focus of a control program. The predation on salmonids appears to be patchy both seasonally and spatially, with higher levels of predation documented in the spring, in areas of anthropogenic influence such as near water diversion structures and dams (Gingras 1997, Tucker et al. 1998, Merz 2003, Clark et al. 2009). Stevens (1966) reported a "highly localized" situation at the Paintersville Bridge; in June he found some of the highest predations rates for the region, when 90.7% of all bass with food in their stomachs had consumed Chinook salmon (198 salmon in 97 stomachs). In 1993, a diet study estimated that 11 to 28% of the natural production of salmon smolts in the Mokelumne River was lost to striped bass predation in the Woodbridge Dam afterbay (Merz 2003). Likewise, below Red Bluff Diversion Dam on the Sacramento River juvenile salmon were found in high numbers in the stomachs of striped bass (Tucker et al. 1998). In addition, striped bass are generally associated with the bulk of predation in Clifton Court Forebay, where pre-screen loss rate (attributed to predation) was estimated at 63-99% for juvenile Chinook salmon and 78-82% for steelhead migrating through the Clifton Court Forebay (Gingras 1997, Clark et al. 2009). Furthermore, during a study of predation on salvaged fish (that had already survived the Forebay) the researchers noted a lack of predators at the non-release, control sites, suggesting "that the salvaged fish releases at the release sites were the principal attractants of predators as opposed to some other factor such as the presence of a man-made structure" (Miranda et al. 2010).

The predatory fishes such as striped bass and largemouth bass prey on covered fish species and can be locally abundant at predation hot spots. Adult striped bass are pelagic predators that often congregate near screened diversions, underwater structures, and salvage release sites to feed on concentrations of small fish, especially salmon. Striped bass are a major cause of mortality of juvenile salmon and steelhead near the SWP south Delta diversions (Clark et al. 2009). Largemouth bass are nearshore predators associated with beds of invasive aquatic vegetation (BDCP 2012).

Targeted predator removal at hot spots would reduce local predator abundance, thus reducing localized predation mortality of covered fish species. Predator hot spots include submerged structures, scour holes, riprap, and pilings. Removal methods will include electrofishing, gill netting, seining, and hook and line (BDCP 2012).

Altered Delta habitat has benefited non-native predator species and increased the vulnerability of outmigration juvenile salmonids.

> "The structure of the Delta, particularly in the central and southern Delta, has been significantly altered by construction of manmade channels and dredging, for shipping traffic and water conveyance. Intentional and unintentional

introductions of non-native plant and animal species have greatly altered the Delta ecosystem. Large predatory fish such as striped bass and largemouth bass have increased the vulnerability of emigrating juveniles and smolts to predation, while infestations of aquatic weeds such as *Egeria densa* have diminished the useable near- shore, shallow water habitat needed by emigrating salmonids for rearing (NMFS 2011)."

REFERENCES

AFRP [Anadromous Fish Restoration Program]. 2005. Recommended Streamflow Schedules to Meet the AFRP Doubling Goal in the San Joaquin River Basin. September 27, 2005.

Allan, J. D. 1995. Stream ecology: structure and function of running waters. Chapman & Hall, London.

Anderson, J.J. 2003. An analysis of smolt survival with implications to flow management. Columbia Basin Research, School of Aquatic and Fishery Sciences, University of Washington, 52 pp.

Anderson J.J., E. Gurarie, and R. W. Zabel (2005). Mean free-path length theory of predator- prey interactions: application to juvenile salmon migration. *Ecological Modelling* 186:196-211.

Anderson, J.T., C.B. Waltry, and Ayesha Gray. 2007. Upstream Fish Passage at a Resistance Board Weir Using Infrared and Digital Technology in the Lower Stanislaus River, California 2006-2007 Annual Data Report. 40 pp.

Anderson, J. J., R. H. Hinrichsen, and C. Van Holmes. 2000. Effects of flow augmentation on Snake River Fall Chinook. 64 pages. Report to the Committee of Nine and the Idaho Water Users Association D.

Baker P. F. and J. E. Morhardt. 2001. Survival of Chinook Salmon Smolts in the Sacramento-San Joaquin Delta and Pacific Ocean. In: Brown RL, editor. Fish Bulletin 179: Contributions to the biology of Central Valley salmonids. Volume 2. Sacramento (CA): California Department of Fish and Game. www.stillwatersci.com/resources/2001BakerMorhardt.pdf

Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, M. Gingras, B. Herbold A. Mueller-Solger, M. Nobriga, T. Sommer, K. Souza. 2008. Pelagic Organism Decline Progress Report: 2007, Synthesis of Results. Interagency Ecological Program for the San Francisco Estuary. http://www.science.calwater.ca.gov/pdf/workshops/POD/IEP_POD_2007_synthesis_report_031408.pdf

BDCP [Bay Delta Conservation Plan]. 2012. Appendix 5.f, Biological stressors on covered fish, administrative draft http://baydeltaconservationplan.com/Library/DocumentsLandingPage/BDCPPlanDocuments.aspx

Beamish, R.J. and C. Mahnken. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change. Progress in Oceanography 49: 423-437.

Bergamaschi, B.A., K.L. Crepeau, and K.M. Kuivila. 1997. Pesticides associated with suspended sediments in the San Francisco Bay Estuary, California U.S. Geological Survey Open-File Report 97-24.

Bickford, S.A., and Skalski, J.R. 2000. Reanalysis and interpretation of 25 years of Snake–Columbia River juvenile salmonid survival studies. N. Am. J. Fish. Manag. 20: 53–68.

Bowen, M.D., L. Hanna, R. Bark, V. Maisonneuve, and S. Hiebert, 2008. Non-physical barrier evaluation, Physical Configuration I. US Department of the Interior, Bureau of Reclamation. Technical Memorandum. Technical Service Center. Denver, CO, US.

Bowen, M. D., S. Hiebert, C. Hueth, and V. Maisonneuve. 2009a. Draft 2009 effectiveness of a non-physical fish barrier at the divergence of the Old and San Joaquin Rivers (CA). Technical Memorandum 86-68290-11. U.S. Bureau of Reclamation Denver, CO. September 2009.

Bowen, M. D., Hiebert, S., Hueth, C. and V. Maisonneuve, 2009b. 2009 Effectiveness of a Non- Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA) (Draft). U. S. Department of Interior, Bureau of Reclamation Technical Memorandum 86-68290-11, Sept 2009.

Bowen, M.D. and R Bark, 2010. 2010 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA) (Draft). U. S. Department of Interior, Bureau of Reclamation Technical Memorandum 86-68290-10-07, Sept 2010.

Brown, R, Greene, S, Coulston, P, Barrow, S. 1996. An evaluation of the effectiveness of fish salvage operations at the intake of the California Aqueduct, 1979-1993, p. 497-518 In Hollibaugh, JT (ed.) San Francisco Bay: the ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco.

Brown, L.R. 1997 Concentrations of chlorinated organic compounds in biota and bed sediment in streams of the San Joaquin Valley, California. *Archives of Environmental Contamination and Toxicology.*

Brown, L.R. 2000. Fish Communities and their Associations with Environmental Variables, Lower San Joaquin River Drainage, California. *Environmental Biology of Fishes*. 57: 251-269.

Brown, L. R. 2003. Will Tidal Wetland Restoration Enhance Populations of Native Fishes? In: Larry R. Brown, editor. Issues in San Francisco Estuary Tidal Wetlands Restoration. San Francisco Estuary and Watershed Science. Vol. 1, Issue 1 (October 2003), Article 2. http://repositories.cdlib.org/jmie/sfews/vol1/iss1/art2

Buell, J. 2003. Sources of direct mortality: Understanding the data, assumptions, and uncertainties in estimating fish entrainment loss at the south delta export facilities. Presentation at Science Symposium on long term water project operations. Sacramento State University, June 19-20, 2003.

Brunell, M., G.M. Litton, J.C. Monroe & ICF International. 2010. Effects of the Head of Old River Barrier on flow and water quality in the San Joaquin River and Stockton Deep Water Ship Channel. Report to the Department of Water Resources.

http://baydeltaoffice.water.ca.gov/sdb/af/docs/HORB_Report_Final_3-17-2010.pdf

Bustard, D.R. and D.W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (*Oncoryhnchus kisutch*) and steelhead trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada* 32:667-680.

CSPA/CWIN [California Sportfishing Protection Alliance and California Water Impact Network. 2010. CWIN Exhibit 2 - Written Testimony of Tim Stroshane on Optimal Conditions for Public Trust Resource Protection and Recovery in the San Francisco Bay-Delta Estuary.

CALFED 1997. Draft ecosystem restoration program plan. Sacramento, Calif.: CALFED Bay-Delta Program.

CALFED. 1999. CALFED's Comprehensive Monitoring, Assessment, and Research Program for Chinook Salmon and Steelhead in Central Valley Rivers. CALFED Bay-Delta Program, Sacramento, CA.

cbec. 2010. San Joaquin Floodplain inundation mapping. cbec, Inc, Sacramento, California. 24pp. Report provided as Attachment 4 in *Comments pertaining to the "Scientific Basis for Developing Alternate San Joaquin River Delta Inflow Objectives" described in the State Water Resources Control Board's October 29, 2010, Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* submitted on December 6, 2010 to the State Water Source Control Board by Demko et al. on behalf of the San Joaquin River Group Authority.

CDWR [California Department of Water Resources]. 1994. California Central Valley Unimpaired Flow Data.

CDEC [California Data Exchange Center]. http://cdec.water.ca.gov/

Cech, J.J., Jr. and Myrick, C.A. 1999. Steelhead and Chinook salmon bioenergetics: temperature, ration, and genetic effects. Technical Completion Report. UCALWRC-W-885, University of California Water Resources Center, Davis, CA, 72 pp.

CFGC [California Fish and Game Commission]. 2012. Agenda item 9- Request for authorization to publish notice of commission intent to amend striped bass sport fishing regulations. Staff Summary, Meeting of February 2, 2012. State of California Fish and Game Commission, Sacramento, California.

Clark, K. W., M. D. Bowen, R. B. Mayfield, K. P. Zehfuss, J. D. Taplin, and C. H. Hanson. 2009. Quantification of Pre-Screen Loss of Juvenile Steelhead in Clifton Court Forebay. March. Prepared by California Department of Water Resources and National Marine Fisheries Service, Sacramento, CA.

Cohen, A. N., Moyle, P. B. 2004. Summary of data and analyses indicating that exotic species have impaired the beneficial uses of certain California waters. San Francisco Estuary Institute.

Crain, P.K., K. Whitener and P.B. Moyle. 2004. Use of a restored central California floodplain by larvae of native and alien fishes. American Fisheries Society Symposium 39: 125-140.

Dauble, D., Hankin, D., Pizzimenti J.J., and Smith P. 2010. The Vernalis Adaptive Management Program (Vamp): Report of The 2010 Review Panel. http://www.sjrg.org/peerreview/review_vamp_panel_report_final_051110.pdf

Davis, J.A., M.D. May, G. Ichikawa, and D. Crane. 2000. Contaminant concentrations in fish from the Sacramento-San Joaquin Delta and Lower San Joaquin River, 1998. San Francisco Estuary Institute, Richmond, CA.

Demko, D.B. and S.P. Cramer. 1995. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual Report for 1995. Prepared by S.P. Cramer & Associates, Inc. for the Oakdale Irrigation District, Oakdale, CA, and South San Joaquin Irrigation District, Manteca, CA.

Demko, D.B. and S.P. Cramer. 1996. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual Report for 1996. Prepared by S.P. Cramer & Associates, Inc. for the Oakdale Irrigation District, Oakdale, CA, and South San Joaquin Irrigation District, Manteca, CA..

Demko, D.B., C Gemperle; and A. Phillips. 1998. Evaluation of juvenile Chinook behavior, migration rate and location of mortality in the Stanislaus River through the use of radio tracking.

Demko, D.B., A. Phillips and S.P. Cramer. 2000. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual Report for 1999. Prepared by S.P. Cramer & Associates for the Tri-Dam Project.

Demko, D.B., A. Phillips and S.P. Cramer. 2001. Effects of pulse flows on juvenile Chinook migration in the Stanislaus River. Annual report for 2000 prepared for Tri-Dam project.

Demko, D., M. Palmer, S. Snider, A. Fuller, S. Ainsley, M. Allen, and T. Payne. 2010. Comments pertaining to the "Scientific Basis for Developing Alternate San Joaquin River Delta Inflow Objectives" described in the State Water Resources Control Board's October 29, 2010, *Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives*. Prepared on behalf of the San Joaquin River Group Authority, 75 pp.

DFG [California Department of Fish and Game]. 1976. Report to the State Water Resources Control Board on the impact of water development on fish and wildlife resources in the Sacramento-San Joaquin Estuary. Exhibit 3, California Department of Fish and Game, Sacramento, California.

DFG. 2005. Final Draft. San Joaquin River Fall-run Chinook Salmon Population Model. San Joaquin Valley Southern Sierra Region. 87 pages.

DFG. 2009. Striped Bass Population Estimate. http://www.delta.dfg.ca.gov/stripedbass/sbpe.asp

DFG. 2010a. Flows Needed in the Delta to Restore Anadromous Salmonid Passage from the San Joaquin River at Vernalis to Chipps Island.

DFG. 2010b. Effects of Water Temperature on Anadromous Salmonids in the San Joaquin River Basin.

DFG. 2010c. California Department of Fish and Game Comments on the Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/comments120610/carl_wilcox.pdf

DFG 2011. Report and Recommendation to the Fish and Game Commission in Support of a Proposal to Revise Sportfishing Regulations for Striped Bass. Department of Fish and

Game, December 2011. 44 pp.
DOI [U.S. Department of the Interior]. 2010. Comments regarding the California State Water Resources Control Board notice of public informational proceeding to develop Delta flow criteria for the Delta ecosystem necessary to protect public trust resources (Exhibit 1).
Essex Partnership. 2009. DRERIP Evaluations of BDCP Draft Conservation Measures – Summary Report. http://www.science.calwater.ca.gov/pdf/workshops/workshop_eco_052209_BDCP-DRERIP_Summary_with_Appendices1.pdf
FERC [Federal Energy Regulatory Commission]. 2009a. Order on rehearing, amending license, denying late intervention, denying petition, and directing appointment of a presiding judge for a proceeding on interim conditions. Turlock and Modesto Irrigation Districts Project nos. 2299-065 and 2299-053. Issued July 16, 2009. 20090716-3060 FERC PDF
FERC. 2009b. Administrative Law Judge's certification?of the final report of the Presiding Judge on interim measures: Turlock and Modesto Irrigation Districts Project nos. 2299-065 and 2299-053. Issued December 01, 2009. 20091129-0001 FERC PDF.
Feryer, F. and M.P. Healey. 2003. Fish Community Structure and Environmental Correlates in the Highly Altered Southern Sacramento-San Joaquin Delta. *Environmental Biology of Fishes* 66: 123-132.
Feyrer, F., T.R. Sommer, S.C. Zeug, G. O'Leary, and W. Harrell. 2004. Fish assemblages of perennial floodplain ponds of the Sacramento River, California (USA), with implications for the conservation of native fishes. *Fisheries Management and Ecology* 11: 335-344.
Feyrer, F, T.R. Sommer, W. Harrell. 2006. Importance of flood dynamics versus intrinsic physical habitat in structuring fish communities: evidence from two adjacent engineered floodplains on the Sacramento River, California. *North American Journal of Fisheries Management* 26: 408-417.
Feyrer, F., M. Nobriga, and T. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences 64:723-734.
http://iep.water.ca.gov/AES/FeyrerNobrigaSommer2007.pdf
FISHBIO 2009. 2008/09 Stanislaus River Weir Data Report. Submitted to Tri-Dam, Strawberry, CA.
Fuller, A., M. Palmer, and S. Ainsley. 2012. Review of the scientific basis for increasing San Joaquin River flows during June to facilitate outmigration of juvenile Central Valley fall-run Chinook salmon and Central Valley steelhead through the Delta. Technical Memorandum sent to Tim O'Laughlin on February 23, 2012.
Gargett, A.E. 1997. The optimal stability 'window': a mechanism underlying decadal fluctuations in North Pacific salmon stocks? Fisheries Oceanography 6: 109-117
Gingras, M. 1997. Mark/recapture experiments at Clifton Court Forebay to estimate pre-screening loss to juvenile fishes: 1976-1993. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. Technical Report. http://198.31.87.66/pdf/MarkRecaptureCliftonCourt.pdf

Giorgi, A. E., D. R. Miller, and B. P. Sanford. 1994. Migratory characteristics of juvenile ocean-type salmon, *Oncorhynchus tshawytscha,* in the John Day Reservoir on the Columbia River. Fishery Bulletin 92: 872-879.

Giorgi, A. E., T. W. Hillman, J. R. Stevenson, S. G. Hays, and C. M. Pevin. 1997. Factors that influence the downstream migration rate through the hydroelectric system in the Mid-Columbia River basin. North American Journal of Fisheries Management 17: 268-282.

Grant, W. S. 1997. Genetic effects of straying of non-native fish hatchery fish into natural populations: proceedings of the workshop. Page 130. U.S. Department of Commerce.

Grant, J.W.A. and D.L. Kramer. 1990. Territory size as a predictor of the upper limit to population density in stream-dwelling salmonids. Canadian Journal of Fisheries and Aquatic Sciences. 47:1724-1737.

Greenberg, L.A., C.A. Paszkowski, W.M. Tonn. 1995. Effects of prey species composition and habitat structure on foraging by two functionally distinct piscivores. *Oikos* 74:522-532.

Greene, S. 2009. Central Valley Chinook Salmon Catch and Escapement IEP Newsletter 22:9-12.

Grimaldo, L., C. Peregrin, and R.M. Miller. 2000. Examining the relative predation risks of juvenile Chinook salmon in shallow water habitat: the effects of submerged aquatic vegetation. Interagency Ecological Program for the Sacramento-San Joaquin Estuary, *IEP Newsletter* 13(1):57-61.

Guignard, J. 2005. Stanislaus River Fall Chinook Salmon Escapement Survey 2004. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract # R0440003.

Guignard, J. 2006. Stanislaus River Fall Chinook Salmon Escapement Survey 2005. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract #R0540004.

Guignard, J. 2007. Stanislaus River Fall Chinook Salmon Escapement Survey 2006. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract # R0640001.

Guignard, J. 2008. Stanislaus River Fall Chinook Salmon Escapement Survey 2007. California Department of Fish and Game. Prepared for United States Bureau of Reclamation Contract #R0740005.

Hallock R.J., R.F. Elwell, and D.H. Fry, Jr. 1970. Migrations of adult king salmon *Oncorhynchus tshawytscha* in the San Joaquin Delta; as demonstrated by the use of sonic tags. Calif. Dept. Fish and Game, Fish Bulletin 151.

Hanson, C. 2005. 2005 Pilot-Scale Investigation of Steelhead Predation within Clifton Court Forebay - Charles Hanson, Hanson Environmental Inc. Preseted at Fish Losses Due to Predation at the State Water Project and Central Valley Project Delta Intakes - The final reports and supporting materials for the CALFED Technical Workshop held on June 22 and 23, 2005. http://www.science.calwater.ca.gov/pdf/workshops/SP_workshop_predation_Hanson_062205.pdf

Hanson, C. 2009. Striped Bass Predation On Listed Fish Within The Bay-Delta Estuary And Tributary Rivers. Expert Report Coalition for a Sustainable Delta et al. v. Koch, E.D. Cal. Case No. CV 08-397-OWW. Hanson Environmental, Inc. Walnut Creek, CA. 63 pp.

Hasler, A.D., A.T. Scholz, and R.M. Hornall. 1978. Olfactory imprinting and homing in salmon. American Scientist 66:347-355.

Healey, M. P. 1997. Estimates of sub-adult and adult striped bass abundance in Clifton Court Forebay: 1992-1994. DRAFT. http://www.science.calwater.ca.gov/pdf/workshops/SP_workshop_predation_Food_Hab.pdf

Healey MC. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). In: Groot C, Margolis L, editors. Pacific salmon life histories. Vancouver (BC): University of British Columbia Press. p 311-394.

Holbrook, C.M., Perry, R.W., and Adams, N.S., 2009, Distribution and joint fish-tag survival of juvenile Chinook salmon migrating through the Sacramento-San Joaquin River Delta, California, 2008: U.S. Geological Survey Open-File Report 2009-1204, 30 p. http://www.sjrg.org/technicalreport/2009/2008-USGS-Fish-Survival-Report.pdf

Jacobson, R.B. and D.L. Galat. 2006. Flow and form in rehabilitation of large-river ecosystems: An example from the Lower Missouri River: *Geomorphology* 77 (2006) 249-269.

Jager, H. I., H. E. Cardwell, M. J. Sale, M. S. Bevelhimer, C. C. Coutant, and W. Van Winkle. 1997. Modelling the linkages between flow management and salmon recruitment in rivers. Ecol. Mod. 103:171–191.

Jeffres, C.A., J.J. Opperman, and P.B. Moyle. 2008. Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. *Environmental Biology of Fishes* 83:449-458.

Junk, W.J., P.B., Bayley, and R.E. Sparks. 1989. The Flood Pulse Concept in River-Floodplain Systems. Special publication. *Canadian Journal of Fisheries and Aquatic Science* 106:110–127.

Junk, W.J. and K.M. Wantzen. 2003. The flood pulse concept: New aspects, approaches and applications-an update. Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries: Volume II. 23 pp.

Kano, R.M. 1990 Occurrence and abundance of predator fish in Clifton Court Forebay, California. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report 24.

Katibah, E.F. 1984. A brief history of the riparian forests in the Central Valley of California. In: Warner, Richard E., and Kathleen M. Hendrix, editors California Riparian Systems: Ecology, Conservation, and Productive Management. Berkeley: University of California Press. http://ark.cdlib.org/ark:/13030/ft1c6003wp/

Keeley, E.R. , P.A. Slaney and D. Zaldokas. 1996. Estimates of production benefits for salmonid fishes from stream restoration initiatives. Watershed Restoration Management Report No. 4. Watershed Restoration Program, Ministry of Environment, Lands and Parks and Ministry of Forests, British Columbia. 20 pp.

Kimmerer, W. and R. Brown. 2006. A summary of the June 22 -23 ,2005 Predation

Workshop. Prepared for the CALFED Science Program, Sacramento, CA.

Kjelson, MA, Raquel, PF, Fisher, FW. 1982. Life history of fall-run juvenile Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin Estuary, California. In: Kennedy, VS, editor. Estuarine comparisons. New York: Academic Press. p. 393-411.

Kondolf, G.M., A. Falzone, and K.S. Schneider. 2001. Reconnaissance-level assessment of channel change and spawning habitat on the Stanislaus River below Goodwin Dam. USFWS, March, 2002.

Kormos, B., M. Palmer-Zwahlen, and A. Low. 2012. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2010. Fisheries Branch Administrative Report 2012-02. California Department of Fish and Game. March 2012.

Lee, DP. 2000. The Sacramento-San Joaquin Delta largemouth bass fishery. Interagency Ecological Program for the San Francisco Estuary Newsletter 13(3):37-40.

Lee, G. F. and Jones-Lee, A. 2003. Summary of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel near Stockton, CA. Report of G. Fred Lee & Associates, El Macero, CA, March 2003. http://www.gfredlee.com/psjriv2.htm

Lindley, S.T., and M.S. Mohr. 1999. The effect of striped bass predation on recovery of the endangered Sacramento River winter chinook: a Bayesian population viability analysis. Pages 177-181 *in* Management implications of co-occurring native and introduced fishes: proceedings of the workshop. October 27-28,

Lindley, S. T. and M. S. Mohr. 2003. Modeling the effect of striped bass (*Morone saxatillis*) on the population viability of Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Bulletin 101:321-331. http://fishbull.noaa.gov/1012/10lindle.pdf

Lindley, S. T., C. B. Grimes, M. S. Mohr, W. Peterson, J. Stein, J. T. Anderson, L.W. Botsford, , D. L. Bottom, C. A. Busack, T. K. Collier, J. Ferguson, J. C. Garza, A. M. Grover, D. G. Hankin, R. G. Kope, P. W. Lawson, A. Low, R. B. MacFarlane, K. Moore, M. Palmer-Zwahlen, F. B. Schwing, J. Smith, C. Tracy, R. Webb, B. K. Wells, and T. H. Williams. March 18, 2009. What caused the Sacramento River fall Chinook stock collapse? Pre-publication report to the Pacific Fishery Management Council. http://swr.nmfs.noaa.gov/media/SalmonDeclineReport.pdf

MacFarlane, R. B., and E. C. Norton. 2002. Physiological ecology of juvenile chinook salmon (Oncorhynchus tshawytscha) at the southern end of their distribution, the San Francisco Estuary and Gulf of the Farallones, California. Fishery Bulletin 100(2):244-257.

Macneale, K.H., P.M. Kiffney, and N.L. Scholz. 2010. Pesticides, aquatic food webs, and the conservation of Pacific salmon. *Front Ecol Environ* 8(9): 475-482.

Marine, K.R. and Cech, J.J., Jr. 2004. Effects of high water temperature on growth, smoltification, and predator avoidance in juvenile Sacramento River Chinook salmon. N. Am. J. Fish. Manage. 24, 198–210.

Marine, K.R. 1997. Effects of elevated water temperature on some aspects of the physiological and ecological performance of juvenile Chinook salmon (*Oncorhynchus tshawytscha*): implications for management of California's Central Valley salmon stocks [ms thesis]. University of California Davis.

Maslin, P, Lenox, M, Kindopp, J, McKinney, W. 1997. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*). California State University Chico, Dept. of Biological Sciences.

Maslin, PLM and Kindopp, J. 1998. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*): 1998 update. California State University Chico, Dept. of Biological Sciences.

Maslin, P, J. Kindopp, and C. Storm. 1999. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*): 1999 update. California State University Chico, Dept. of Biological Sciences.

McBain and Trush, Inc. editor. 2002. San Joaquin River Restoration Study background report. Prepared for Friant Water Users Authority. Lindsay, California and Natural Resources Defense Council, San Francisco, California. Arcata, California. December 2000.

McEvoy, A. F. 1986. The fisherman's problem: ecology and law in the California fisheries. Cambridge University Press, New York, New York.

McGinnis, S. M. 2006. Field Guide to Fresh Water Fishes of California. University of California Press, Berkeley and Los Angeles, California.

Meador, J.P., T.K. Collier, and J.E. Stein. 2002. Use of tissue and sediment-based threshold concentrations of polychlorinated biphenyls (PCBs) to protect juvenile salmonids listed under the US Endangered Species Act. *Aquatic Conservation: Marine and Freshwater Ecosystems* 12: 493-516. http://www.restoresjr.net/program_library/05-Pre-Settlement/index.html

Merz, J.E. 2003. Striped bass predation on juvenile salmonids at the Woodbridge Dam afterbay, Mokelumne River, California. Unpublished draft document. East Bay Municipal Utility District. 4 pages plus 6 figures.

Mesick, C. 2001. The effects of the San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that Stray. In: R.L. Brown (ed.) Contributions to the Biology of Central Valley Salmonids. California Department of Fish and Game. Fish Bulletin 179(2): 139-162.

Mesick, C.F. and D. Marston. 2007. Provisional Draft: Relationships Between Fall-Run Chinook Salmon Recruitment to the Major San Joaquin River Tributaries and Stream Flow, Delta Exports, the Head of the Old River Barrier, and Tributary Restoration Projects from the Early 1980s to 2003.

Mesick, C.F., J.S. McLain, D. Marston, and T. Heyne. 2007. Limiting Factor Analyses & Recommended Studies for Fall-Run Chinook Salmon and Rainbow Trout in the Tuolumne River. California Department of Fish and Game. Prepared for the U. S. Fish and Wildlife Service. Draft Report.

Mesick, C.F. 2009. The High Risk of Extinction for the Natural Fall-Run Chinook Salmon Population in the Lower Tuolumne River due to Insufficient Instream Flow Releases. U.S. Fish and Wildlife Service, Energy and Instream Flow Branch, Sacramento, CA. 4 September 2009. Exhibit No. FWS-50.

Mills, D. 1991. Ecology and Management of Atlantic salmon. Chapman and Hall, University Press, Cambridge, U.K. 351 p.

Miranda, J., R. Padilla, J. Morinaka, J. DuBois, and M. Horn. 2010. Release Site Predation Study. Sacramento, CA. Available: http://baydeltaoffice.water.ca.gov/announcement/Element2FinalReport5-2010.pdf

Monsen, N.E., J.E. Cloern, and J.R. Burau. 2007. Effects of flow diversions on water and habitat quality; examples from California's highly manipulated Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science 5, Issue 3, Article 2. http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1119&context=jmie/sfews

Moore, TL. 1997. Condition and feeding of juvenile Chinook salmon in selected intermittent tributaries of the upper Sacramento River [ms thesis]. California State University, Chico.

Moyle, P.B. 1976. Fish introductions in California: history and impact on native fishes. Biol. Conserv. 9: 101-118.

Moyle, P. B. 2002. Inland fish of California, 2nd edition. University of California Press, Berkeley, California.

Moyle P. B., Craina P. K., Whitener K. and Mount J. F. 2003. Alien fishes in natural streams: fish distribution, assemblage structure, and conservation in the Cosumnes River, California, U.S.A. *Environmental Biology of Fishes* 68: 143–162.

Moyle, P.B. 2005. Rebuttal Expert Report of Professor Peter B. Moyle, PhD. Case No. Civ-S-88-1658. September 2005.

Moyle, P.B., P.K. Crain, and K. Whitener. 2007. Patterns in the Use of a Restored California Floodplain by Native and Alien fishes. *San Francisco Estuary and Watershed Science* 5:1–27. http://repositories.cdlib.org/jmie/sfews/vol5/iss3/art1

Moyle, P.B., Williams, J.G., and Kiernan, J.D. 2011. Improving Environmental Flow Methods Used in California FERC Licensing. California Energy Commission, PIER. http://watershed.ucdavis.edu/pdf/Moyle%20et%20al.%20PIER%20final_Jan%202011.pdf

Muir, W.D., Smith, S.G., J.G. Williams Hockersmith, and Skalski, 2001. Survival Estimates for Migrant Yearling Chinook Salmon and Steelhead Tagged with Passive Integrated Transponders in the Lower Snake and Lower Columbia Rivers, 1993–1998. North American Journal of Fisheries Management 21(2) 269-282.

Myers, K. W., and H. F. Horton. 1982. Temporal use of an Oregon estuary by hatchery and wild juvenile salmon. *In* Estuarine comparisons (V. S.Kennedy, ed.), p. 377–392. Academic Press, New York, NY.

Myrick, C.A., and J.J. Cech Jr. 2001. Temperature effects on Chinook salmon and steelhead: A review focusing on California’s Central Valley populations. *Bay-Delta Modeling Forum Technical Publication* 01-1. 57 pages.

Myrick, C and J. Cech. 2004. Temperature effects on juvenile anadromous salmonids in California’s Central Valley: what don’t we know? Reviews in Fish Biology and Fisheries 14:113-123.

Newman, K. B. 2008. An evaluation of four Sacramento-San Joaquin River Delta juvenile salmon survival studies. Project Report for Cal-Fed Science Program Project number SCI-06-G06-299. March 31, 2008.

NMFS. [National Marine Fisheries Service]. 2000a. White paper: Salmonid travel time and survival related to flow in the Columbia River Basin. Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle, Washington 98112

NMFS. 2000b. Endangered Species Act - Reinitiated Section 7 Consultation. Biological Opinion and Incidental Take Statement. Effects of The Pacific Coast Salmon Plan on California Central Valley Spring-Run Chinook, and California Coastal Chinook Salmon. Consultation Conducted by National Marine Fisheries Service, Protected Resources Division. April 28, 2000.

NMFS. 2009a. Biological opinion and conference opinion on the long-term operations of the Central Valley Project and State Water Projects. NMFS Endangered Species Act, Section 7 Consultation. 844 pp. National Marine Fisheries Service, Southwest Region, Sacramento, CA.

NMFS. 2009b. 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 Winter-run. National Marine Fisheries Service Southwest Regional Office Sacramento, California. http://www.nmfs.noaa.gov/pr/recovery/plans.htm

NMFS. 2010. Endangered Species Act Section 7 Consultation Biological Opinion on the authorization of ocean salmon fisheries pursuant to the Pacific Coast Salmon Fishery Management Plan and additional protective measures as it affects Sacramento River winter Chinook salmon. Southwest Region, Protect Resources Division. April 30, 2010.

NMFS. 2011. Letter from to Rodney R. McInnis (Regional Administrator, Southwest Region, National Marine Fisheries Service) Donald Glaser (Regional Director, Mid-Pacific Region, U.S. Bureau of Reclamation) regarding the 2011 amendments to the NMFS OCAP RPA. NMFS, Southwest Region, Long Beach, CA, April 7, 2011. Available at http://www.swr.noaa.gov/ocap.htm.

NMFS. 2012. Summary of the expected benefits to salmonid survival of rock barrier at the head of Old River & preferential use of the Central Valley Project export facility. http://baydelta.files.wordpress.com/2012/01/2012_horb_survival-benefits_nmfs.pdf

Nobriga, M.L., F. Feyrer, R.D. Baxter, and M. Chotkowski. 2005. Fish community ecology in an altered river delta: spatial patterns in species composition, life history strategies, and biomass. *Estuarie*s 28:776-785.

Nobriga, M.L. and F. Feyrer. 2007. Shallow-water piscivore-prey dynamics in California's Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 5(2): Article 4. NRDC 2005.

O'Laughlin & Paris LLP. 2007. San Joaquin River Group Authority's Written Comments to Proposal by Central Valley Regional Water Quality Control Board to List the San Joaquin, Tuolumne, Merced and Stanislaus Rivers as Impaired Bodies of Water for Temperature Pursuant to Section 303(d).

Opperman, J. 2006. An Investigation of Floodplain Habitat for California's Native Fish Species. Research Summaries, California Sea Grant College Program, UC San Diego.

Orlando, J.L., and K. M. Kuivila. 2005. Concentrations of organic contaminants detected during managed flow conditions, San Joaquin River and Old River, California, 2001: U.S. Geological Survey Data Series 120, 13 pp.

Palmer, M. Hellmair, and A. Fuller. 2012. Review of State Water Resources Control Board's Technical Report (SWRCB 2012) pertaining to the scientific basis for modifying San Joaquin River flow objectives during February to improve juvenile survival of fall-run Chinook salmon and Central Valley steelhead through the Delta. Technical Memorandum sent to Tim O'Laughlin On April 23, 2012.

Paulsen, S. and E.J. List. 2008. Effect of increased flow in the San Joaquin River on stage, velocity, and water fate, Water Years 1964 and 1988. Prepared by Flow Science, Inc., for San Joaquin River Group Authority. 107 pages.

Peake, S. and R.S. McKinley. 1998. A re-evaluation of swimming performance in juvenile salmonids relative to downstream migration. *Canadian Journal of Fisheries and Aquatic Sciences* 55: 682-687.

Pearcy, W.G. 1992. Ocean Ecology of North Pacific Salmonids. Washington Sea Grant Program, Seattle, Washington.

Pereira, W.E., J.L. Domagalski, F.D. Hostettler, L.R. Brown, and J.B. Rapp. 1996. Occurrence and accumulation of pesticides and organic contaminants in river sediment, water and clam tissues from the San Joaquin River and tributaries, California. *Environmental Toxicology and Chemistry* 15(2): 172-180.

Perry, R.W., J.R. Skalski, P.L. Brandes, P.T. Sandstrom, A.P. Klimley, A. Ammann, and B. MacFarlane. 2010. Estimating survival and migration route probabilities of Chinook salmon in the Sacramento-San Joaquin River delta. North American Journal of Fisheries Management 30: 142-156.

Pickard, A., A. Grover, and F.A. Hall, Jr. 1982. An evaluation of predator composition at three locations on the Sacramento River. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 2. ftp://ftp.delta.dfg.ca.gov/Adult_Sturgeon_and_Striped_Bass/Striped%20bass%20predation%20California%201982.pdf

Poff, N.L. and J.V. Ward. 1989. Implications of streamflow variability and predictability for lotic community structure- a regional-analysis of streamflow patterns. *Canadian Journal of Fisheries and Aquatic Sciences* 46: 1805-1818.

Poff, N.L., J.K. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The Natural Flow Regime. *Bioscience* 47: 769-784.

Poff, N.L, J.D. Olden, D.M. Merritt and D.M. Pepin. 2007. Homogenization of regional river dynamics by dams and global biodiversity implications. PNAS 104(14): 5732-5737.

Pyper, B, J.B. Lando, and C. Justice. 2006. Analyses of Weir Counts and Spawning Surveys of Adult Chinook Salmon in the Stanislaus River. September 2006.

Richter, B.D., J.V. Baumgartner, J. Powell, and D.P. Braun. 1996. A method for assessing hydrologic alteration within ecosystems. *Conservation Biology*. 10: 1163-1174. Blackwell Publishing Ltd. (RBI 2007).

Rose, K., J. Anderson, M. McClure and G. Ruggerone. 2011. Salmonid Integrated Life Cycle Models Workshop. Report of the Independent Workshop Panel. Prepared for the Delta Stewardship Council.

Saiki, M.K. 1984. Environmental conditions and fish faunas in low elevation rivers on the irrigated San Joaquin Valley Floor, California. *California Fish and Game* 70(3):145-157.

Scheurell, M.D., R.W. Zabel and B.P. Sandford. 2009. Relating juvenile migration timing and survival to adulthood in two species of threatened Pacific salmon (*Oncorhynchus* spp.). Journal of Applied Ecology 46: 983-990.

Shapovalov, L. 1936. Food of striped bass. CA Fish and Game 22(4): 261-271. ftp://ftp.delta.dfg.ca.gov/Adult_Sturgeon_and_Striped_Bass/Striped%20bass%20food%20habits%20California%201936.pdf

Sheibley, R.W., D.S. Ahearn, P. Santoriello and R.A. Dahlgren. 2002. Nitrate loss from a restored floodplain on the lower Cosumnes River, California. American Geophysical Union, Fall Meeting 2002, abstract #H51D-06.

Simenstad, C. and S. Bollens.. 2003. Into the BREACH: Tidal Marsh Restoration in the San Francisco Estuary. Estuarine Research Federation Newsletter. Winter 2002/2003. http://www.erf.org/news/breach-tidal-marsh-restoration-san-francisco-estuary

Simenstad, C. A., K. L. Fresh, and E. O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. In Estuarine comparisons. (V. S. Kennedy, ed.), p. 343–364. Academic Press, New York, NY.

SJRGA [San Joaquin River Group Authority]. 2002. 2001 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2002. 125 pgs. Source: http://www.sjrg.org/technicalreport/default.htm

SJRGA. 2003. 2002 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2003. 125 pgs. Source: http://www.sjrg.org/technicalreport/2002/2002_sjrg_report.pdf

SJRGA. 2007a. San Joaquin River Group Authority Written Comments to Proposal by Central Valley Regional Water Quality Control Board to List the San Joaquin, Tuolumne, Merced and Stanislaus Rivers as Impaired Bodies of Water for Temperature Pursuant to Section 303(D). 19 November 2007.

SJRGA San Joaquin River Group Authority. 2007b. 2006 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2007. 137 pgs. Source: http://www.sjrg.org/technicalreport/default.htm

SJRGA. 2008. 2007 Annual Technical Report on the Implementation and Monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January 2008. 127 pgs. Source: http://www.sjrg.org/technicalreport/default.htm

SJRGA. 2010. 2009 Annual Technical Report on the implementation and monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. Prepared for California Water Resource Control Board in compliance with D-1641. http://www.sjrg.org/technicalreport/2009/2009-SJRGA-Annual-Technical-Report.pdf

SJRGA. 2011. 2010 Annual Technical Report on the implementation and monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan, September 2011. http://www.sjrg.org/technicalreport/2010/2010_SJRGA_Annual_Technical_Report.pdf

SJRTC [San Joaquin River Technical Committee]. 2008. Summary Report of the Vernalis Adaptive Management Plan (VAMP) for 2000-2008, Report prepared for the Advisory Panel Review conducted by the Delta Science Program, December 22, 2008, 84 p.

Skalski J.R. 1998. Estimating season-wide survival rates of outmigrating salmon smolt in the Snake River, Washington. Can. J. Fish. Aquat. Sci. 55: 761-769.

Smith, S. G., W. D. Muir, E. E. Hockersmith, S. Achord, M. B. Eppard, T. E. Ruehle, and J. G. Williams. 1997a. Draft: Survival estimates for the passage of juvenile salmonids through Snake River dams and reservoirs. Annual Report, 1996. US Dept. of Energy, Bonneville Power Administration, Contract Number DE-AI79-93BP10891.

Smith, S. G., W. D. Muir, E. E. Hockersmith, M. B. Eppard, and W. P. Connor. 1997b. Passage survival of natural and hatchery subyearling fall chinook salmon to Lower Granite, Little Goose, and Lower Monumental Dams. In: Williams, J.G., and T.C. Bjornn. 1995. Annual Report: Fall chinook salmon survival and supplementation studies in the Snake River reservoirs, 1995. Bonneville Power Administration, Public Information Center, Portland, Oregon.

Smith, S.G., W.D. Muir, J.G. Williams and J.R. Skalski. 2002. Factors associated with travel time and survival of migrant yearling Chinook salmon and steelhead in the Lower Snake River. North American Journal of Fisheries Management 22: 385-405.

SOG (Stanislaus Operations Group). 2012. Draft Meeting Notes. Stanislaus Operations Group Meeting, May 16, 2012, Central Valley Operations Office, Sacramento, CA.

Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 325-333.

Sommer, T.R., W.C. Harrell, and M.L. Nobriga. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. *North American Journal of Fisheries Management* 25: 1493-1504. Swales, S., and C.D. Levings. 1989. Role of off-channel ponds in the life cycle of coho salmon (*Oncorhynchus kisutch*) and other juvenile salmonids in the Coldwater River, British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 46: 232-242.

Sparks, R.E., J.C. Nelson and Y. Yin. 1998. Naturalization of the flood regime in regulated rivers. BioScience 48: 706-720.

SRFG [Stanislaus River Fish Group]. 2004. A Summary of Fisheries Research In The Lower Stanislaus River (Working Draft), 10 March 2004. Source: http://www.delta.dfg.ca.gov/srfg/restplan/Fisheries_Research_03-08-04.doc

Stevens, D. E. 1966. Food habits of striped bass, *Roccus Saxatilis*, in the Sacramento-San Joaquin Delta. In: CA Fish and Game. Fish Bulletin 136: Ecological Studies of The Sacramento-San Joaquin Delta. Part II: Fishes of The Delta.

http://content.cdlib.org/xtf/view?docId=kt8h4nb2t8&brand=calisphere&doc.view=entire_text

Strange, J. 2007. Adult Chinook Salmon Migration in the Klamath River Basin: 2005 Sonic Telemetry Study Final Report. Yurok Tribal Fisheries Program, and School of Aquatic and Fishery Sciences - University of Washington; in collaboration with Hoopa Valley Tribal Fisheries. 96 pp.

Stevens, D. E. 1966. Food habits of striped bass, *Roccus Saxatilis*, in the Sacramento-San Joaquin Delta. In: CA Fish and Game. Fish Bulletin 136: Ecological Studies of The Sacramento-San Joaquin Delta. Part II: Fishes of The Delta. http://content.cdlib.org/xtf/view?docId=kt8h4nb2t8&brand=calisphere&doc.view=entire_text

Swales, S. and C.D. Levings. 1989. Role of off-channel ponds in the life-cycle of coho salmon (*Oncorhynchus kisutch)* and other juvenile salmonids in the Coldwater River, British Columbia. *Canadian Journal of Fisheries & Aquatic Sciences* 46: 232-242.

Swenson RO, Whitener K, Eaton M (2003) Restoring floods on floodplains: riparian and floodplain restoration at the Cosumnes River Preserve. In: Faber PM (ed) California riparian systems: processes and floodplains management, ecology, and restoration. 2001 Riparian Habitat and Floodplains Conference Proceedings. Riparian Habitat Joint Venture. Riparian Habitat Joint Venture, Sacramento, CA, pp 224–229.

SWRCB [State Water Resources Control Board]. 2012. Technical report on the scientific basis for alternative San Joaquin river flow and Southern Delta salinity objectives. 202 pp.

Sykes, G. E., C. J. Johnson, and J. M. Shrimpton. 2009. Temperature and Flow Effects on Migration Timing of Chinook Salmon Smolts. Transactions of the American Fisheries Society 138:1252-1265.

TBI and NRDC [The Bay Institute and Natural Resources Defense Council]. 2010a.Exhibit 1 - Written Testimony of Jonathan Rosenfield Ph.D., Christina Swanson, Ph.D., John Cain, and Carson Cox Regarding General Analytical Framework.

TBI and NRDC. 2010b. Exhibit 2 - Written Testimony of Jonathan Rosenfield, Ph.D., and Christina Swanson, Ph.D., Regarding Delta Outflows.

TBI and NRDC. 2010c. Exhibit 3 - Written Testimony of Christina Swanson, Ph.D., John Cain, Jeff Opperman, Ph.D., and Mark Tompkins, Ph.D. Regarding Delta Inflows.

Thomas, J. 1967. The diet of juvenile and adult striped bass, *Roccus saxatilis*, in the Sacramento-San Joaquin river system. CA Fish and Game 53(1): 49-62.

Thorstad, E. B. and T. G. Heggberget. 1998. Migration of adult Atlantic salmon (*Salmo salar*); the effects of artificial freshets. *Hydrobiologia* 371/372: 339–346. http://www.springerlink.com/content/p3414p744865j228/fulltext.pdf?page=1

Tucker, M. E., C. M. Williams, and R. R. Johnson.1998. Abundance, food habits and life history aspects of Sacramento squawfish and striped bass at the Red Bluff Diversion Complex, including the Research Pumping Plant, Sacramento, California, 1994-1996. Red Bluff, California: U. S. Fish and Wildlife Service.

USBR [U.S. Bureau of Reclamation]. 2012. Restoration Goal Technical Feedback Group Meeting. July 19, 2012. San Joaquin River Restoration Program. Modesto, CA.

http://www.restoresjr.net/group_activities/TFMB-RestGoals/index.html
USFWS [U.S. Fish and Wildlife Service]. 1987. Exhibit 31: The needs of Chinook salmon, *Oncorhyncus tshawytscha*, in the Sacramento-San Joaquin Estuary. Entered by the U.S. Fish and Wildlife Service for the State Water Resources Control Board, 1987 Water Quality/Water Rights Proceeding on the San Francisco Bay/Sacramento-San Joaquin Delta.
USFWS. 1995. Working paper: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 2. May 9, 1995. Prepared for the U.S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group, Stockton, California.
USFWS. 2012. Identification of the Instream Flow Requirements for Anadromous Fish in the Streams Within the Central Valley of California and Fisheries Investigations. Annual Progress Report Fiscal Year 2011. Restoration and Monitoring Program, Sacramento Fish and Wildlife Service, Sacramento, CA.
VAMP [Vernalis Adaptive Management Program]Technical Team. 2009. Summary report for the Vernalis Adaptive Management Plan (VAMP) for the experimental determination of juvenile chinook salmon survival within the lower san Joaquin River in response to river flow and State Water Project (SWP) and Central Valley Project (CVP) exports (2000-2008).
Vick, V, A. Keith, and P. Baker. 2000. 1999 Lower Tuolumne River Annual Report, Report 99-5, 1999 Tuolumne River Upper Rotary Screw Trap Report. March 2000. *In* 1999 Lower Tuolumne River Annual Report. Submitted by Turlock Irrigation District and Modesto Irrigation District to the Federal Energy Regulatory Commission. March 2000.
Walker, K.F., F. Sheldon, and J.T. Puckridge. 1995. A perspective on dryland river ecosystems. *Regulated Rivers* 11: 85-104.
Ward, P.D., McReynolds, T.R., Garman, C.E. 2003. Butte Creek spring-run Chinook salmon, Oncorhynchus tshawytscha pre-spawn mortality evaluation, 2003. Chico, California: California Department of Fish and Game. Inland Fisheries Administrative Report No. 2004-5.
Williams, J. G., Smith, S.G., and Muir, W.D. 2001. Survival Estimates for Downstream Migrant Yearling Juvenile Salmonids through the Snake and Columbia Rivers Hydropower System, 1966–1980 and 1993–1999. North American Journal of Fisheries Management 21(2) 310-317.
Williams, J.G. 2006. Central Valley Salmon: A Perspective on Chinook and Steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science, 4-3.
Williams, J.G., J.J. Anderson, S. Greene, C. Hanson, S.T. Lindley, A. Low, B.P. May, D. McEwan, M.S. Mohr, R.B. MacFarlane, and C. Swanson. 2007. Monitoring and research needed to manage the recovery of threatened and endangered Chinook and steelhead in the Sacramento-San Joaquin basin. NOAA Tech. Memo. NMFSSWFSC-399 (2007).
Wurtsbaugh, W. A. and G. E. Davis. 1977. Effects of temperature and ration level on the growth and food conversion efficiency of *Salmo gairdneri*, Richardson. Journal of Fish Biology 11: 87 - 98.
Yoshiyama, RM, Gerstung, ER, Fisher, FW, Moyle, PB. 1996. Historical and present distributions of Chinook salmon in the Central Valley drainage of California. In:

Sierra Nevada Ecosystem Project, Status of the Sierra Nevada, Volume III. Final Report. p. 309-362.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley region of California. North American Journal of Fisheries Management 18:487–521.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historic and present distribution of chinook salmon in the Central Valley drainage of California. In Fish Bulletin 179: Contributions to the biology of Central Valley salmonids. R. L. Brown, editor, volume 1, pages 71–176. California Department of Fish and Game, Sacramento, CA.

Attachment A

Technical Memorandum

Review regarding use of select references by SWRCB in their Draft and Final *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* (SWRCB 2010 and 2011) and DFG in their *Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta* report (DFG 2010)

TO: Tim O'Laughlin

FROM: Doug Demko, Michele Palmer, Andrea Fuller

DATE: January 30, 2012

SUBJECT: Review regarding use of select references by SWRCB in their Draft and Final *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* (SWRCB 2010 and 2011) and DFG in their *Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta* report (DFG 2010)

This memorandum has been developed to present results of a review regarding use of select references by SWRCB in their Draft and Final *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives* (SWRCB 2010 and 2011) and DFG in their *Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta* report (DFG 2010). We focused our review on those references that were used in one or both documents to support the position that inadequate spring (Feb-Jun) flows are the primary cause of salmon decline including, in chronological order, Kjelson et al. 1981, Kjelson and Brandes 1989, AFRP 1995, Baker and Mohardt 2001, Brandes and McLain 2001, Mesick 2001, DFG 2005a, DFG 2009, Mesick and Marston 2007, Mesick et al. 2007, Mesick 2008, Mesick 2009, Mesick 2010a-e, and USDOI 2010. In addition, we examined peer reviews conducted on the SWRCB (2011) and DFG (2010) documents (Quinn et al. 2011 and Gross et al. 2010, respectively). A summary of key points is provided below followed by a detailed discussion of the findings of our review.

Summary of Key Points

- **References used by the SWRCB and DFG to support their position that inadequate spring (Feb-Jun) flows are the primary cause of salmon decline are NOT the best available science for evaluating current flow/survival relationships due to a variety of reasons including:**
    - All references prior to 2008 (i.e., Kjelson et al. 1981, Kjelson and Brandes 1989, AFRP 1995, Baker and Mohardt 2001, Brandes and McLain 2001, Mesick 2001, Mesick and Marston 2007, Mesick et al. 2007) are outdated and lack recent data reflecting major anthropogenic changes to the Delta ecosystem resulting in a regime shift in about 2000-2001; and are also statistically limited and have been superseded by superior Bayesian analyses conducted by Newman (2008)[1].

[1] In 2008, a more robust Bayesian analysis was designed and conducted by Newman using data from 1985 through 2006 (Newman 2008) to address the limitations of all the previous coded wire tag data analyses presented in pre-2008 reports.

- The DFG's San Joaquin River Fall-run Chinook Salmon Population Model (SJRFRCS Model) (DFG 2005a, DFG 2009) has been found to be flawed through both peer and professional reviews, as identified in previous comments submitted to the SWRCB (Demko et. al 2010).

- Mesick references have not been peer-reviewed and their analyses are the same/similar to those used in DFG's SJRFRCS Model.

- At least two Mesick documents have been rejected previously by FERC because the authors

  - presented a "fallacy of focusing entirely on flow" and did not consider the influence of other possible limiting factors (Tuolumne River Limiting Factors Analysis; Mesick et al. 2007); and

  - improperly analyzed the Tuolumne River in isolation of other Central Valley populations, did not consider effects of hatchery introductions on Tuolumne River Chinook salmon, and discounted other potential factors (Tuolumne River Risk of Extinction Analysis; Mesick 2009).

- Additionally, Mesick 2009 and supporting references (Mesick et al. 2009 a, b) have apparently been rejected for publication.

- **Currently, the best available science that should be used to evaluate potential flow/survival relationships, which were mentioned in the SWRCB technical reports but were inappropriately applied, include the following:**

  - Newman 2008 has been subject to extensive peer-review and is a published work (unlike Mesick documents); and uses higher quality information (paired releases versus non-paired releases used in other Mesick analyses).

  - VAMP Peer Review indicates that consideration should be given regarding the role of Delta survival for the smolt life stage in the larger context of the entire life cycle of the fall-run Chinook, including survival in the upper watershed, the Bay and the ocean and fry rearing in the Delta.

- **Peer review of SWRCB's final technical report indicates several areas for improvement, which are consistent with our previously and presently submitted comments and peer review comments are also applicable to the DFG QBO report:**

  - Due to limited review time, it is likely that Peer reviewers for the SWRCB's final technical report were not aware of previous findings regarding DFG's SJRFRCS Model or of this model's similarity to the Mesick analyses, which may have affected their comments.

- Nonetheless, even with limited information and review time, Peer reviewers found several areas for improvement including, but not limited to:
    - Implausibly high linkage of higher spring flows to adult escapement;
    - Other processes besides flow have likely contributed to declines, and will continue to hinder salmon recovery;
    - Holistic view (considering other factors besides flow) would be more tenable;
    - Contradictory statements regarding influence of ocean conditions;
    - Relies too heavily on secondary sources;
    - Several figures are not clear and could be better expressed with different analyses, or some figures do not support statements.

- **Peer review of DFG's QBO report indicates several areas for improvement, which are consistent with our previously and presently submitted comments, and peer review comments are also applicable to the SWRCB's technical reports:**
    - Using the best available science means:
        - Agencies may not manipulate their decisions by unreasonably relying on some sources to the exclusion of others.
        - Agencies may not disregard scientifically superior evidence.
    - Many concerns about the use (or lack of use) of citations.
        - Citations are to support an argument, not establish a fact.
        - References must be accurately and clearly cited.
        - Peer-reviewed literature preferred.
        - Frequent use of some references to exclusion of scientifically superior sources.
    - Uncertainties and assumptions are not provided.
    - Assumption that flow alone will restore fish populations is poorly founded.
    - Salmon objectives do not distinguish between hatchery and naturally produced fish.

REVIEW OF FINDINGS

1. References used by the SWRCB and DFG to support their position that inadequate spring (Feb-Jun) flows are the primary cause of salmon decline are NOT the best available science for evaluating current flow/survival relationships due to a variety of reasons including:

- **All studies prior to 2008 (i.e., Kjelson et al. 1981, Kjelson and Brandes 1989, AFRP 1995, Baker and Mohardt 2001, Brandes and McLain 2001, Mesick 2001, Mesick and Marston 2007, Mesick et al. 2007) are outdated and lack recent data reflecting major anthropogenic changes to the Delta ecosystem resulting in a regime shift in**

about 2000-2001; and are also statistically limited and have been superseded by superior Bayesian analyses conducted by Newman (2008)[2].

Three of the references cited prior to 2001 (Kjelson et al 1981, Kjelson and Brandes 1989, AFRP 1995) present regressions of spring flow at Vernalis vs. escapement 2.5 years later, and it is hypothesized from these regressions that smolt survival is positively correlated with river flow. Since smolt survival in the San Joaquin River was not measured, the influence of river flow on smolt survival could not be assessed.

In 2001, the first multi-year analyses of smolt survival data from mark-recapture studies was conducted to estimate salmon survival relative to flow at Vernalis were conducted by Baker and Morhardt (2001) and Brandes and McLain (2001). While Brandes and McLain (2001) identified a statistically significant relationship between smolt survival from Dos Reis to Chipps Island and river flow at Stockton, Baker and Morhardt (2001) concluded that "smolt survival through the Delta may be influenced to some extent by the magnitude of flows from the San Joaquin River, but this relationship has not been well quantified yet, especially in the range of flows for which such quantification would be most useful." Baker and Morhardt (2001) noted several weaknesses in the available data including low recapture numbers which generated imprecise estimates of survival, a lack of control of flow and export conditions during individual experiments, and lack of a statistical design in combinations of flows and exports.

The Vernalis Adaptive Management Plan (VAMP) studies were designed to address these weaknesses in previous CWT data and provided additional data through 2006. CWT data continued to be analyzed in piecemeal fashion through 2006 and the analyses were eventually superseded in 2008 by superior Bayesian analyses conducted by Newman (2008).[1] During the VAMP studies an abrupt, downward shift in smolt survival was documented.

- **The DFG's San Joaquin River Fall-run Chinook Salmon Population Model (SJRFRCS Model) (DFG 2005a, DFG 2009) has been found to be flawed through both peer and professional reviews, as identified in previous comments submitted to the SWRCB (Demko et. al 2010).**

Both the SWRCB and DFG refer to the SJRFRCS Model to support the idea that more spring flows are necessary to create more Chinook salmon in the San Joaquin Basin. As identified in our previous comments (Demko et al. 2010), which the SWRCB has not incorporated into their final technical report, the SJRFRCS Model uses inappropriate statistical models that do not represent the best available science; two versions of the SJRFRCS Model have been reviewed and found to contain substantial flaws (DFG 2005a version reviewed by Deas et al. 2006 and Pyper et al. 2006, and DFG 2009 version reviewed by Lorden and Bartoff 2010).

Demko et al. (2010) stated that

> The most recent version of the DFG [SJRFRCS] model (DFG 2009) is still considered inappropriate for use by the SWRCB for a number of reasons, including the previously mentioned incomplete revisions and the lack of peer-review. Our comments, highlighting the problems with the statistical validity of the current DFG model, are summarized under the next 12 issue statements. Details regarding these statements are provided in Attachment 1 [of Demko et.al. 2010].
>
> - DFG Model Issue 1. It is clear that in order to have a statistically sound model for escapement, one needs to incorporate environmental variables other than, or in addition to flow, such as dissolved oxygen, exports, and water temperature.
> - DFG Model Issue 2. The proposed simple linear regression model of escapement versus flow is inconsistent with the most recent data from 1999-2009, which shows a negative correlation between flow and escapement.
> - DFG Model Issue 3. The proposed model is inconsistent over different flow ranges. For example, when dividing the range of flow observations into 4 equally sized bins, one of the bins shows a negative correlation between flow and escapement.
> - DFG Model Issue 4. There are a small number of overly influential observations in the flow versus escapement data. For example, if one selects a moderately sized subset of these paired observations at random, the model fit varies widely and one frequently observes a negative correlation between flow and escapement.
> - DFG Model Issue 5. The Ecological Fallacy: The well-known phenomenon that averaging over subgroups (as has been done with the flow data) falsely inflates the strength of a linear relationship.
> - DFG Model Issue 6. Outliers are present in the flow versus escapement data.
> - DFG Model Issue 7. The residuals from the flow versus escapement model exhibit non-normality.
> - DFG Model Issue 8. Heteroscedasticity: The estimated errors in the flow versus escapement model exhibit a non-constant error rate.
> - DFG Model Issue 9. Nonlinearity is observed in the flow versus escapement data.
> - DFG Model Issue 10. The estimated errors in the flow versus escapement model exhibit dependence.
> - DFG Model Issue 11. The flow versus escapement model has a low R_2 value of around 0.27.
> - DFG Model Issue 12. The Regression Fallacy: That correlation implies causation.

- **Mesick references have not been peer-reviewed and their analyses are the same/similar to those used in DFG's SJRFRCS Model. Not peer-reviewed/similar analyses to DFG's SJRFRCS Model**. The SWRCB and DFG rely on several Mesick documents to support the position that inadequate spring (Feb-Jun) flows are the primary cause of salmon decline (i.e., both rely on Mesick 2009; Mesick et al. 2007; SWRCB also relies on Mesick 2001 and Mesick 2010a-e; and DFG also relies on Mesick 2008 and Marston 2007) as well as the SJRFRCS Model (DFG 2005, 2008, and 2009. Mesick documents have not been peer-reviewed, and their analyses are the same/similar to those used in DFG's SJRFRCS Model (DFG 2005a, DFG 2009).

Peer-reviewed literature is preferred since supporting evidence for an argument or position is stronger as a result of independent experts critical reviews of the papers; while citations to agency reports (e.g., Mesick documents) frequently provide weaker supporting evidence because they have not been independently reviewed by recognized experts (Gross et al. 2010).

As indicated in the previous section, DFG's SJRFRCS Model (DFG 2005a, DFG 2009) has been found to be flawed through peer (Deas et al. 2006) and professional (Pyper et al. 2006, Lorden and Bartoff 2010) reviews. Mesick references are largely based on the same linear regression approach used in DFG's SJRFRCS Model, and this approach continues to be re-packaged with slight variations by Mesick, as well as by DFG (2005a, 2009), and the U.S. Fish and Wildlife Service's (USFWS) Anadromous Fish Restoration Program (AFRP 2005). Although the regressions indicate a correlation between flow at Vernalis and escapement 2 ½ years later, the use of linear regressions to assess these effects is too simple an approach particularly given the fact that all authors include violations of simple linear regression; inadequate inclusion of other environmental factors (e.g., temperature) that are clearly important (e.g., predation, temperature); and the tendency for other factors to be correlated with each other (Lorden and Bartroff 2010). Some of the major problems with the linear regression approaches used by all of these authors include:

- Averaging (such as over months of flows) reduces variation that may exist (masking biologically important variations in flow) and has potential to falsely inflate the strength of linear relationship or make one appear when there is a more complex relationship or none at all. Authors have a responsibility to show that the variation lost in averaging does not affect the inferred relationship.
- Lack of robustness in the linear regression model fit does not support a cause-effect relationship between flow and escapement.
- Small number of data points overly influence and inflate the linear relationship between escapement and flows.
- Analysis assumes that escapement is normally distributed, but it is been shown to be non-normally distributed.
- Assumes that escapement is subject to random variations whose scale is constant and which averages out to zero; however, residual plots indicate both a bias (non-zero average) and non-constant scale of variations. Also, there are outliers contributing to the bias.
- Correlation does not imply causation (Lorden and Bartroff 2010).

Therefore, although linear regression relationship results suggest that flow may affect juvenile survival, the results do not imply a direct cause-effect relationship between juvenile salmon survival and flow, or that increasing flow will cause juvenile salmon survival to increase.

- **At least two Mesick documents have previously been rejected by FERC because the authors**
    - **presented a "fallacy of focusing entirely on flow" and did not consider the influence of other possible limiting factors (Tuolumne River Limiting Factors Analysis; Mesick et al. 2007); and**
    - **improperly analyzed the Tuolumne River in isolation of other Central Valley populations, did not consider effects of hatchery introductions on Tuolumne River Chinook salmon, and discounted other potential factors (Tuolumne River Risk of Extinction Analysis; Mesick 2009).**

Tuolumne River Limiting Factors Analysis (Mesick et al. 2007) Rejected by FERC. During recent FERC proceedings (FERC 2009a) regarding the operation of the New Don Pedro Project on the Tuolumne River, FERC rejected the findings of the Limiting Factors Analysis conducted as part of the Tuolumne River Management Conceptual Model by Mesick et al. (2007) because the authors presented a "fallacy of focusing entirely on flow" and did not consider the influence of other possible limiting factors (e.g., Delta exports, ocean conditions, and unscreened diversions). Key points made by FERC in a FERC Order issued July 16, 2009 (FERC 2009a) regarding the problems associated with Mesick et al. (2007) analyses include the following:

- Page 20, ¶70. Mesick et al. (2007) identifies Tuolumne River flows as having the greatest impact on juvenile Chinook salmon survival… however, they do not include any studies to ascertain the influence of other possible limiting factors, such as pumping at the state and federal water projects in the San Francisco Bay Delta, ocean conditions, and unscreened diversions in the Tuolumne River and in the Delta. In response to these concerns, we find that it may be inappropriate to focus on flow-related studies to the exclusion of other, possibly significant, limiting factors.
- Page 29, ¶74. Our review of the Limiting Factor Analysis does not suggest that the recent collapse of the Tuolumne River fall-run Chinook salmon can be attributed to the Article 37 flow regime. Rather, the analysis simply shows that, up to a point, higher flows produce more fish. This is not surprising. However, no significant increase in run size could occur if conditions outside the river system are unfavorable. Because fall-run Chinook salmon failed in the entire Sacramento and San Joaquin River system, it seems likely that one or more factors common to all of these runs may have caused the collapse. Further, we note that in recent Congressional testimony, NMFS agreed with this conclusion, stating that "the cause of the decline is likely a survival factor common to salmon runs from different rivers and consistent with the poor ocean conditions hypothesis being the major causative factor.
- Page 29, ¶75. The Limiting Factor Analysis states that Tuolumne River spring flows in excess of 3,000 cfs are necessary to ensure successful Chinook returns. However, the fallacy of focusing entirely on flows is illustrated by the fact that

the average spring flow in 2006 and 2007 (from February 1 through May 31) exceeded 3,500 cfs, yet the returns of both jack and adult fall-run Chinook salmon in 2008 and 2009 were extremely low.

- Page 31, ¶78. The Limiting Factor Analysis also discounts the effects of ocean conditions on the Tuolumne River stock. A report by the National Oceanic and Atmospheric Administration in 2006 and a recent report prepared for the Pacific Fishery Management Council in 2009 document that poor ocean conditions in 2005 and 2006 were the primary cause for the collapse of the Sacramento River Basin fall-run Chinook salmon.

Tuolumne River Risk of Extinction Analysis (Mesick 2009) Rejected by FERC. Mesick (2009) was originally submitted to FERC as Exhibit No. FWS-50 and was reviewed by Noah Hume (Senior Aquatic Ecologist at Stillwater Sciences, a scientific consulting firm). Hume testified that Mesick's (2009) risk of extinction analysis was improperly applied and pointed out that San Joaquin salmon populations have dropped well below the minimums necessary to maintain genetic viability in several periods in the past but have rebounded within a few years. Although Hume indicated that he did not have enough time to thoroughly review Mesick's document, he pointed out the following: (1) analyzing the population demographics and trends of the Tuolumne River population in isolation of other San Joaquin and Sacramento basin populations is suspect because the Tuolumne River population is not recognized as a distinct population segment (DPS) but is part of the Central Valley faIl/late fall-run Chinook evolutionary significant unit (ESU), which is not listed as endangered or threatened [status: Species of Special Concern]; (2) no consideration was given regarding the effects of hatchery introductions on Tuolumne Chinook salmon and the influence of inbreeding; and (3) no basis was given for discounting the influence of other factors (e.g., Delta and ocean conditions).

Based on Hume's testimony and corroborating testimony from Dr. Peter Moyle (professor at the University of California, Davis), FERC found

> the Tuolumne Chinook salmon population may be subject to extirpation, but is not at risk of extinction pending relicensing. Recent declines in Chinook salmon escapement levels are comparable to those occurring in other San Joaquin River tributaries and based on past patterns of high and low spawning returns, escapement levels in the Tuolumne River and other tributaries, are likely to rebound. More monitoring is needed to determine what factors, in addition to instream flows, are adversely impacting the salmon. (FERC 2009b, ¶275)

These findings are also applicable to other San Joaquin basin populations (i.e., Stanislaus and Merced).

- **Additionally, Mesick 2009 and supporting references (Mesick et al. 2009 a, b) have apparently been rejected for publication.**

  According to Carl Mesick's Curriculum Vitae (CSPA_exh8 Carl Mesick CV), he submitted several reports to the *California Fish and Game Scientific Journal* for publication in October 2009 (i.e., Mesick 2009 and Mesick et al. 2009a, b). However, none of these papers has been published in this journal as of their Summer 2011 issue, which indicates that these papers were not adequate for publication.

  Despite being rejected for publication and by FERC, these papers were used directly (i.e., Mesick 2009) or as sub-references to other Mesick documents within the SWRCB technical report including:
  (1) Mesick et al. 2009a, b, were used as basis for risk of extinction analyses in Mesick 2009;
  (2) Mesick 2009 used as supporting evidence for the risk of extinction of Tuolumne River salmon in Mesick 2010d;
  (3) Mesick et al. 2009a used as the basis for analyses regarding the relationship of flow, temperature and exports with adult recovery rates in Mesick 2010c; and
  (4) Mesick 2009 and Mesick et al. 2009a, b used in a synthesis of these analyses in Mesick 2010a, e.

2. Currently, the best available science that should be used to identify flow/survival relationships, which were mentioned in the SWRCB technical reports but were inappropriately applied, include the following:

- **Newman 2008.** Various analyses (e.g., Mesick 2010c, Baker and Mohardt 2001, Brandes and McLain 2001, Mesick 2001, Mesick and Marston 2007, Mesick et al. 2007) regarding smolt survival through the San Joaquin River Delta are used instead of superior analyses (i.e., Newman 2008). As an example, there are several reasons why the analyses presented in Mesick 2010c are inferior to Newman 2008, including the following:

  - Newman 2008 was subject to extensive peer-review and is a published work; unlike Mesick 2010c, which has not been peer-reviewed.
  - Mesick's approach does not use paired releases to address the effects of differences in sampling effort or the influence of conditions beyond the San Joaquin Delta. The quality of the information from the 35 paired releases used by Newman is superior to the 158 non-paired releases used by Mesick.
  - There are several problems with the way the Mesick 2010c analysis is presented including:
    - Basic statistics to describe the fit or significance of trend lines shown for each regression are noticeably absent from Mesick 2010c. For instance, there are no r^2 values reported for what appear to be very poor fits.
    - It is not clear whether the 13 instances of zero recoveries shown in Table 1 were included the analyses.

- The y-axis scale of 0-3% used for the graphs is an attempt to exaggerate the purported influence of flow and water temperature on recovery rates. This is an extremely narrow range, particularly when one considers expected noise in the data, and the potential effects of sampling effort.

Besides being inferior to Newman (2008), Mesick 2010c does not support the statement on pages 3-26 and 3-51 that "numerous studies indicate the primary limiting factor for FRCS tributary abundances is reduced spring flow, and that populations on the tributaries are highly correlated with tributary, Vernalis, and Delta flows". Mesick 2010c does not support the first part of this statement because in order to identify a primary limiting factor for FRCS tributary abundances, one would need to explore the relative impacts of all factors affecting each lifestage of FRCS in the tributaries, the San Joaquin River Delta, and in the ocean. For instance, Mesick 2010c did not explore whether survival during smolt outmigration is more limiting than ocean harvest. This analysis also did not explore whether river flow is the primary factor influencing smolt survival through the San Joaquin River Delta, since the recovery rates used were inclusive of smolt survival beyond Chipps Island and adult survival.

Similarly, Mesick 2010c also does not support the statement that "populations on the tributaries are highly correlated with tributary, Vernalis, and Delta flows". This analysis did not explore how population abundance, presumably escapement, may be correlated with flow. The analysis attempted to focus on the influence of San Joaquin River Delta flow on adult return rates, however the method used did not isolate smolt survival through the Delta from survival in the Bay, the Ocean, and during adult upstream migration.

- **Vamp Peer Review.** While the Technical Report discusses findings of a peer review of the VAMP conducted in 2010 (Dauble et al. 2010), an important recommendation to the SWRCB was omitted, which provides context for interpretation of the flow and survival relationships in terms of revision to the flow objectives. Specifically, the Panel was asked "*How can the results from the VAMP to date be used to inform the SWRCB's current efforts to review and potentially revise the San Joaquin River flow objectives and their implementation?"* The first part of their response, which was not included in the SWRCB's Technical Report, states that "In our answer to question 1, we attempted to summarize the scientific information obtained from the VAMP studies related to salmon survival through the Delta and the three factors of flow, exports, and the HORB. For several reasons, it is not straightforward to use that information to inform the Board's current efforts to review and revise San Joaquin River flow objectives. Because our review focused on the survival and passage of salmon smolts through the Delta, we did not evaluate other factors that may be limiting future salmon production. In setting flow objectives, we believe the Board **should consider the role of Delta survival for the smolt life stage in the larger context of the entire life cycle of the fall-run Chinook, including survival in the upper watershed, the Bay and the ocean and fry rearing in the Delta** [emphasis added] (SJRTC 2008)." The Technical Report fails to address this recommendation.

3. Peer review of SWRCB's final technical report indicates several areas for improvement, which are consistent with our previously and presently submitted comments and are also applicable to the DFG QBO report:

Peer reviewers were given a short time frame (30 days) to review the SWRCB's final technical report and were likely not aware of previous findings regarding DFG's SJRFRCS Model (i.e., peer review by Deas et al. 2006, Pyper et al 2006, Lorden and Bartroff 2010); or of the model's similarity to the Mesick analyses, which may have affected their comments.

Even in absence of this background material, peer reviewers for SWRCB's final technical report found areas for improvement including:

- Relies too heavily on secondary sources.
- Several figures are not clear, could be better expressed with different analyses, or do not support statements.
- Implausibly high linkage of higher spring flows to adult escapement.
- Other processes besides flow have likely contribute to declines, and will continue hinder their recovery.
- Holistic view (considering other factors besides flow) would be more tenable.
- Contradictory statements regarding influence of ocean conditions.

Relevant excerpts from peer reviewers are provided in Attachment 1.

4. Peer review of DFG's QBO indicates several areas for improvement, which are consistent with our previously and presently submitted comments, and are applicable to the SWRCB's technical reports:

- "Using the best available scientific information" means (page 3):
    - Agencies may not manipulate their decisions by unreasonably relying on some sources to the exclusion of others.
    - Agencies may not disregard scientifically superior evidence.
- Many concerns about the use (or lack of use) of citations.
    - Citations are to support an argument, not establish a fact. "Citations, even to the peer-reviewed literature, are not like theorems in mathematics, and do not establish validity."(page 3)
    - References must be accurately and clearly cited.
    - "Whenever possible, references should be to peer-reviewed literature, not internal technical reports or testimony." (page 6)
    - "Frequently relies on some sources to the exclusion of scientifically superior sources… it cites outdated analyses by Kjelson and Brandes instead of superior analyses (Newman and Rice 2002; Newman 2003)… It relies on an unpublished work by Marston [i.e., Marston 2007] and ignores superior studies by Newman [i.e., Newman 2008] and others involved with VAMP, and by Terry Speed (1993). It fails to cite many relevant, more recent papers (Appendix A3), including a long review on

Central Valley Chinook and steelhead (Williams 2006) that would have drawn DFG's attention to the superior sources just noted." (page 6)

- "Does not acknowledge the uncertainty associated with most of the modeling work referred to in the Draft." (page 6)
- "Critical assumptions and areas of major uncertainty are not described." (page 6)
- "assum[tion] that flow alone will restore natural processes and restore/reconnect critical habitats for [many] species… is poorly founded." (page 7)
- "objectives for salmon fail to distinguish hatchery and naturally produced fish" (page 9)

Relevant excerpts from peer reviewers are provided in Attachment 1.

References

AFRP [Anadromous Fish Restoration Program]. 1995. Working Paper on Restoration Needs: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California. Volume 3. Prepared for the U.S. Fish and Wildlife Services under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, CA.

AFRP. 2005. Recommended streamflow schedules to meet the AFRP doubling goal in the San Joaquin River Basin. 27 September 2005.

Baker, P.F., and Morhardt., J.E. 2001. Survival of Chinook Salmon Smolts in the Sacramento-San Joaquin Delta and Pacific Ocean. Contributions to the Biology of Central Valley Salmonids 2: 163-182.

Brandes, P.L. and McLain, J.S. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. In: R.L. Brown, editor, Contributions to the biology of Central Valley salmonids. Volume 2. California Department of Fish and Game Fish Bulletin 179:39-136.

Dauble, D., D. Hankin, J.J. Pizzimentieti, and P. Smith. 2010. The Vernalis Adaptive Management Program (VAMP): Report of the 2010 Review Panel. May 2010.

[Deas, M., B. Herbold, H. Jager, J. Korman, and K.Rose]. 2006. Peer Review of Final Draft 11-28-05 San Joaquin River Fall-run Chinook Salmon Population Model. San Joaquin River Fall-run Chinook Salmon Population Model External Scientific Review Forms prepared by five reviewers and submitted as requested to CALFED.

Demko, D., M. Palmer, S. Snider, A. Fuller, S. Ainsley, M. Allen, and T. Payne. 2010. Comments pertaining to the "Scientific Basis for Developing Alternate San Joaquin River Delta Inflow Objectives" described in the State Water Resources Control Board's October 29, 2010, *Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives. Submitted to the* State Water Resources Control Board on behalf fan Joaquin River Group Authority, December 6, 2010.

DFG [California Department of Fish and Game]. 2010. Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta.

DFG [California Department of Fish and Game]. 2009. San Joaquin River Fall-run Chinook salmon population model version 1.6. Report to the State Water Resources Control Board. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/comments040609/comments040609/dfg051509.pdf

DFG. 2005a. California Department of Fish and Game (DFG). 2005a. California Department of Fish and Game Supplemental Comments and Recommendations on the Vernalis Flow and Salmon Doubling Objectives in the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin River Delta Estuary. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/1995wqcp/exhibits/dfg/dfg-exh-10.pdf

DFG 2005b. San Joaquin River Fall-Run Chinook salmon population model. Report to the State Water Resources Control Board. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/sds_srjf/sjr/docs/sjrf_fallrun_chinooksalmon.pdf [as cited by DFG]

FERC [Federal Energy Regulatory Commission]. 2009a. Order on rehearing, amending license, denying late intervention, denying petition, and directing appointment of a presiding judge for a proceeding on interim conditions. Turlock and Modesto Irrigation Districts Project nos. 2299-065 and 2299-053. Issued July 16, 2009. 20090716-3060 FERC PDF

FERC. 2009b. Administrative Law Judge's certification of the final report of the Presiding Judge on interim measures: Turlock and Modesto Irrigation Districts Project nos. 2299-065 and 2299-053. Issued December 01, 2009. 20091129-0001 FERC PDF.

Gross, W.S., G.F. Lee, C.A. Simenstad, M. Stacey, and J.G. Williams. 2010. Panel Review of the CA Department of Fish and Game's Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta.

Kjelson, M.A., Raquel, P.F., and Fisher, F.W. 1981. Influences of freshwater inflow on Chinook salmon (Oncorhynchus tshawytscha) in the Sacramento-San Joaquin Estuary. In P.D. Cross and D.L. Williams, editors, Proceedings of the National Symposium on Freshwater Inflow to Estuaries, pp. 88-108. U.S. Fish and Wildlife Service, FWS/OBS- 81-04.

Kjelson, M.A. and Brandes, P.L., 1989. The use of smolt survival estimated to quantify the effects of habitat changes on salmonid stocks in the Sacramento-San Joaquin River, CA. Canadian Special Publication of Fisheries Aquatic Science 105: 100-115.

Lorden, G. and J. Bartroff. 2010. Report on flow vs. escapement model and environmental data: Lordenstats, December 1, 2010. Report provided in Appendix 1 of Demko et al. 2010.

Marston, D. 2007. San Joaquin River Fall-run Chinook Salmon and Steelhead Rainbow Trout

Historical Population Trend Summary. California Department of Fish and Game Report to the Central Valley Regional Water Quality Control Board in Support of Petition to List San Joaquin River Basin Waters as Water Temperature Impaired.

Mesick, C.F. 2001. Unpublished. Factors that Potentially Limit the Populations of Fall-Run Chinook Salmon in the San Joaquin River Tributaries.

Mesick, C. 2008. The [moderate to] high risk of extinction for the natural fall-run Chinook salmon population in the lower Tuolumne River due to insufficient instream flow releases. U.S. Fish and Wildlife Service, Stockton Fishery Resource Office, Stockton, California.

Mesick, C.F. 2009. The High Risk of Extinction for the Natural Fall-Run Chinook Salmon Population in the Lower Tuolumne River due to Insufficient Instream Flow Releases. Report submitted to the State Water Resources Control Board. Revised draft 4 September 2009. Manuscript submitted to California Fish and Game Scientific Journal, October 2009. [as cited in CSPA_exh8 Carl Mesick CV]

Mesick, C.F. 2010a. Testimony of Carl Mesick regarding Statement of Key Issues on the Volume, Quality, and Timing of Delta Outflows Necessary for the Delta Ecosystem to Protect Public Trust Resources with Particular Reference to Fall-Run Chinook Salmon in the San Joaquin River Basin. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/cspa/cspa_exh7_mesick_test.pdf

Mesick, C.F. 2010b. Relationships between Flow and Water Temperature in the Stanislaus, Tuolumne, and Merced Rivers Near Their Confluences with the San Joaquin River and in the San Joaquin River near Mossdale form March15 to May 15. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/cspa/cspa_exh9.pdf

Mesick, C.F. 2010c. Relationships between Flow, Water Temperature, and Exports in the San Joaquin River Delta and the Rate that Adult Merced River Hatchery Fall-Run Chinook Salmon with Coded-Wire-Tags Were Recovered in the Central Valley Escapement and the Ocean Fisheries. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/cspa/cspa_exh10.pdf

Mesick, C.F. 2010d. Instream Flow Recommendations for the Stanislaus, Tuolumne, and Merced Rivers to Maintain the Viability of the Fall-Run Chinook Salmon Populations. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/cspa/cspa_exh11.pdf

Mesick, C.F. 2010e. Statement of Key Issues on the Volume, Quality, and Timing of Delta Outflows Necessary for the Delta Ecosystem to Protect Public Trust Resources with Particular Reference to Fall-Run Chinook Salmon in the San Joaquin River Basin.

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/cspa/cspa_exh7_mesick_test.pdf

Mesick, C.F., and Marston, D. 2007. Provisional Draft: Relationships Between Fall-Run Chinook Salmon Recruitment to the Major San Joaquin River Tributaries and Stream Flow, Delta Exports, the Head of the Old River Barrier, and Tributary Restoration Projects from the Early 1980s to 2003.

Mesick, C.F., D. Marston, and T. Heyne. 2009a. Estimating the total number of coded-wire-tagged adult fall-run Chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley rivers. El Dorado, CA. Manuscript submitted to California Fish and Game Scientific Journal, October 2009. [as cited in CSPA_exh8 Carl Mesick CV]

Mesick, C.F., D. Marston, and T. Heyne. 2009b. Estimating recruitment for fall-run Chinook salmon populations in the Stanislaus, Tuolumne, and Merced rivers. El Dorado, CA. Manuscript submitted to California Fish and Game Scientific Journal, October 2009. [as cited in CSPA_exh8 Carl Mesick CV]

Mesick, C.F., J.S. McLain, D. Marston, and T. Heyne. 2007(also cited as 2008). Limiting factor analyses & recommended studies for Fall-Run Chinook salmon and rainbow trout in the Tuolumne River. California Department of Fish and Game. Prepared for the U. S. Fish and Wildlife Service. Draft Report.

Newman, K.B. 2003. Modelling paired release-recovery data in the presence of survival and capture heterogeneity with application to marked juvenile salmon. Statistical Modelling 3(3): 157-177.

Newman, Ken B. 2008. An evaluation of four Sacramento-San Joaquin River Delta juvenile salmon survival studies. USFWS, Stockton.

Newman, K.B., Rice J. 2002. Modeling the Survival of Chinook Salmon Smolts Outmigrating Through the Lower Sacramento River System. Journal of the American Statistical Association 97(460): 983-993.

Pyper B., S. Cramer, and M. Simpson. 2006. Review of the California Department of Fish and Game's "San Joaquin River Fall-run Chinook Salmon Population Model."

[Quinn, T., J.D. Olden, and M.E. Grismer]. 2011. External Peer Review of: State Water Resources Control Board California Environmental Protection Agency "Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives."

SJRTC (San Joaquin River Technical Committee), 2008, Summary Report of the Vernalis Adaptive Management Plan (VAMP) for 2000-2008, Report prepared for the Advisory Panel Review conducted by the Delta Science Program, December 22, 2008, 84 p.

SWRCB [State Water Resources Control Board]. 2010. Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.

SWRCB [State Water Resources Control Board]. 2011. Final Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.

Speed, T. 1993. Modeling and managing a salmon population. In: Barnett, V., Turkman, K.F., editors. Statistics for the Environment. John Wiley & Sons. p. 265-290.

U.S. Department of the Interior (DOI). 2010. Comments regarding the California State Water Resources Control Board notice of public informational proceeding to develop Delta flow criteria for the Delta ecosystem necessary to protect public trust resources (Exhibit 1).

Williams, J.G. 2006. Central Valley salmon: a perspective on Chinook and steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science 4: http://repositories.cdlib.org/jmie/sfews/vol4/iss3/art2.

ATTACHMENT 1

EXCERPTS FROM A PEER REVIEW OF THE STATE WATER RESOURCES CONTROL BOARD'S FINAL TECHNICAL REPORT ON THE SCIENTIFIC BASIS FOR ALTERNATIVE SAN JOAQUIN RIVER FLOW AND SOUTHERN DELTA SALINITY OBJECTIVES

[Quinn, T., J.D. Olden, and M.E. Grismer]. 2011. External Peer Review of: State Water Resources Control Board California Environmental Protection Agency "Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives"

Quinn, Page 5
In general the report relies too heavily on secondary sources (e.g., Moyle 2002; NMFS 2009a, 2009b; Williams 2006). There is nothing wrong with these references *per se* but their use compels the reader to get that reference and find the relevant place in it. In cases where the secondary source is lengthy or not readily available, this is no small task. In addition, the referencing of work outside the basin and outside California is limited. I understand that the report has a sharp focus on the San Joaquin River but there are a number of places where work done elsewhere would be relevant.

In terms of conclusions, the report makes a strong case that the shortages of salmon and steelhead are in large part related to the heavy modification of this river system. The mean flows and variances in flow that are normal in rivers of this region and for which the fish evolved have been radically altered (see more detailed comments below). It seems likely, however, that other processes have played a role over the years in the decline of these fishes, and will continue to hinder their recovery. Some of these processes may be synergistic with flows such as, perhaps, chemical contaminants or predation in streams, whereas other may operate independently such as fisheries management, ocean conditions, predation by marine mammals, etc.

Quinn, Page 7
The use of olfaction to locate natal streams deserves better citations than (NMFS 2009a, DFG 2010a). It would be better to cite Hasler and Scholz (1983) or perhaps Dittman and Quinn (1996).

[TR] P. 70 The statement "However, if natal streams have low flows and salmon cannot perceive the scent of their natal stream, straying rates to other streams typically increases." demands more details. There should be information on this important feature of the adult phase and appropriate references. I was surprised to find that there have been no tracking studies on the movements and travel rate of salmon in this system. Can this be true, and if so, why have none been done? This is off-the-shelf technology and clearly important to inform

management in many ways.
I also have some sense (though I confess to not being sure precisely where I learned it) that there are much higher straying rates from the SJR than are considered normal, and that these result from transportation of hatchery juveniles downstream, and also from the difficulties that returning adults experience in detecting odors, given the altered flow regimes. Forgive me if I am mistaken in this regard but if there is any truth to the statement that straying is more prevalent than is normal, this certainly merits more attention in the report. There should be coded wire tagging data from the main hatcheries, I would think, and the analysis of them should be simple.

Quinn, Page 8
The statement that "streamflow alteration, dictated by the dams on the major SJR tributaries, affect [sic] the distribution and quantity of spawning habitat " seems to call for more information. Presumably, the dams have reduced the sediment transport patterns but some detail and references to this would be helpful, or at least an explanation of the processes. The peak flows will play a role in these kinds of sediment transport processes. Is there a loss of intermediate gravel sizes, leaving cobbles and silt? Has the gravel become embedded and so less suitable?

Figure 3.1, which seems to be copied from the NMFS BiOp, needs a proper caption; as is, it is hard to interpret.

Figure 3.2 is quite interesting. Are there similar data for other years, and if so, perhaps a summary table or figure could be produced. Are the redd counts referring to new redds, or all that were counted on each survey? Were they flagged, and so how does the total redd count relate to the number of live fish? Were there tagging studies of stream life and generation of "area-under-the-curve" estimates? In general, I find myself wanting more detail about this kind of data.

Quinn, Page 9
"... since 1952, the average escapement of fall-run Chinook salmon has shown a steady decline. "
This statement is contradicted by the figure (3.5) associated with it. There is no obvious trend downward but rather there are a series of pronounced peaks (a pair of peaks around 1954 and 1960, then discrete ones around 1970, 1985, and 2003). Each of the peaks lasted about 8 years, with distinct "troughs" in between. I think the conclusion that this was a "steady decline" is not supported. Can there be some more sophisticated analyses? What we have seems like a visual examination. What can we make of these peaks and troughs?

Quinn, Page 11
[TR] Page 80 "The limited data that do exist indicate that the steelhead populations in the SJR basin continue to decline (Good et al. 2005) and that none of the populations are [sic] viable at this time (Lindley et al. 2007)."

This latter is a very strong statement and could use some elaboration. Presumably, the implication is that only exchange with resident trout maintains the steelhead phenotype. This should be stated more explicitly, and the biological basis for this exchange merits discussion. I am surprised that the interesting recent papers on California *O. mykiss* were not cited (e.g., those by Satterthwaite, Mangel and co-authors), nor relevant papers from elsewhere (e.g., Narum and Heath). This is not merely a matter of getting some additional references but it is fundamental to the status and recovery prospects for these fish. If the anadromous life history is latent in the resident trout then changes in environmental conditions may allow it to express itself, whereas if the forms are very discrete, as is the case with sockeye salmon and kokanee (the anadromous and non-anadromous forms of *O. nerka*: e.g., Taylor et al. 1996), then the loss of one form is likely more permanent. This extent of plasticity is directly relevant to the efforts to address the chronic environmental changes to which these fishes have been subjected, and the prospects for recovery.

It is also worth noting that the migratory behavior of steelhead differs markedly from that of sub- yearling Chinook salmon. Sub-yearlings spend a lot more time in estuaries and littoral areas whereas steelhead seem to migrate more rapidly (as individuals), exit estuaries quicker (as a population), and occupy offshore waters to a much greater extent. There was extensive sampling in the Columbia River system by Dawley, McCabe and co-workers showing this, and many references to the use of estuaries.

The summary of the importance of spring flows for Chinook salmon seems very reasonable but it would be good to actually see more of the data on which these statements are based. What relationship might there be to pre-spawning mortality or incomplete spawning of adults, or egg- fry survival?

Quinn, Page 12
Figure 3.8 would be better expressed after adjustment for the size of the parent escapement and some density-dependence. Plotting numbers of smolts vs. flow suggests a connection but I would think that multi-variate relationships should be explored.

[TR] Page 84-85. “In a 1989 paper, Kjelson and Brandes once again reported a strong long term correlation (*R2* of 0.82) between flows at Vernalis during the smolt outmigration period of April through June and resulting SJR basin fall-run Chinook salmon escapement (2.5 year lag) (Kjelson and Brandes 1989).

This relationship should be easy to update and I would like to see the recent data. Frankly, I find this correlation implausibly high. There are so many factors affecting marine survival that even a perfect estimate of the number of smolts migrating to sea will not have an R2 of 0.82 with total adult return, much less with escapement (including both process and measurement error). I do not doubt that higher flows make for speedier passage and higher survival, but to link them so closely with adult escapement is stretching it. Indeed, it would seem that NMFS (2009) came to a similar conclusion. After acknowledging the shortcomings in this approach, it seems odd to see Figure 3.10, which is a time-series with flow during the smolt period and lagged escapement. If we much have escapement as the metric rather than smolt survival, can we not at least plot flow on the x-axis rather than date, and some form of density-adjusted recruit per spawner metric on the y-axis? I find it very difficult to see the relationship when plotted as time series.

Figure 3.12. This figure is a poor quality reproduction, and the y-axis is not defined. What is CDRR? (It is not in the list of acronyms). This report is pretty dense in terms of jargon and acronyms and abbreviation, so any effort to state things in plain English will be appreciated.

The text on the Importance of Flow Regime (3.7) is very sensible. It would be helpful to know what sources of the salmon mortality are most directly affected by flow reduction but, given the obvious data gaps, this seems unlikely. Thus overall correlations with survival and basic ecological principles have to carry the day. The text on fish communities, however, is rather confusing. I expected to see information of species composition, comparative tolerances to warm and cool water by various native and non-native fishes, ecological roles with respect to salmon, etc. However, there was a shift to population structure and importance of genetic and life history diversity for the success of salmon. This text (which would benefit from basic references such as Hilborn et al. 2003 for sockeye salmon, and the more recent papers by Moore and by Carlson on salmon in areas more extensively affected by humans) is fine but the reference to variable ocean conditions and marine survival seems to contradict the earlier statements that only smolt number going to sea really matter. Overall, I think this holistic view is more tenable than one only emphasizing the link between flow and smolt production. There is no question that marine survival varies from year to year but all you can ask from a river is that it produce juvenile salmon.

With respect to water temperature, the relationships between physical factors (local air temperature, water depth, solar radiation, groundwater, and heat loss, etc.) are quite well understood so it should be possible to hind-cast the thermal regime that would have occurred in the SJR and its tributaries had the dams and diversions not taken place.

Quinn, Page 13
Delta Flow Criteria
"Finally, the relationship between smolts at Chipps Island and returning adults to Chipps Island was not significant, suggesting that perhaps ocean conditions or other factors are responsible for mortality during the adult ocean phase. " This statement, referring to DFG data, also seems to contradict the earlier statements that marine conditions do not matter and that flow is all that matters. It would seem more correct to state that flow is the most important, among the things under our control.

On Table 3.15, it would be very helpful to present the status quo, so we can see the difference between the flows that DFG concluded are needed to double smolt production from present levels.

[TR] Page 105 "State Water Board determined that approximately 60 percent of unimpaired flow during the February through June period would be protective of fish and wildlife beneficial uses in the SJR. It should be noted that the State Water Board acknowledged that these flow criteria are not exact, but instead represent the general timing and magnitude of flow conditions that were found to be protective of fish and wildlife beneficial uses when considering flow alone."

This would seem to be a critical, overall conclusion: Higher and more variable flows are needed, and can be ca. 60% of unimpaired flows. This is logical and well supported by basic ecological principles, as these flows would provide benefits specific to salmon at several life history stages, and broader ecosystem benefits a well. The various exceedance plots (Figures 3.15 to 3.20) indicate that there is substantial improvement from flow at the 60% level whereas 20% and 40% achieve much less in the important late winter and early spring periods. As the report correctly notes, this is inevitably a bit arbitrary (why 60% - might 59% not do just as well?). Just as with agriculture and wildlife, fish production depends on complex interactions among a number of factors, of which flow is very important but not the only one. Extrapolation from lab studies to the field, where so many things go on at once and where history cannot be played back in a different scenario. So, one can pick at this value, just as one might pick at any specific value, and ask whether the fish can get by with a little less overall, or at some time of the year. Likewise, how much water do crops really need? Can we give the farmers less without hurting production? Obviously, that would depend on soil, temperature, distribution of the water, insects (beneficial and otherwise), and many other factors too. I think that this value (60%) is well- supported, given these kinds of uncertainties.

Olden, Page 4
Time series for fall-run Chinook salmon escapement exceed 50 years in length, highlighting steady declines since 1952 (Figure 3.5), and evidence is presented that hatchery-produced fish constitute a majority of the natural fall-run spawners in the Central Valley (Figure 3.6). The Technical Report and scientific papers discussed within collectively highlight the decadal long declines in Chinook salmon and steelhead trout (albeit limited data in the latter case) in the San Joaquin River basin. The Technical Report also correctly emphasizes that escapement numbers for the three tributaries are comparable in many years, thus suggesting the importance of coordinating flow management across the tributary systems. Indeed, discrete contributions from different tributaries may provide a portfolio effect by decreasing inter-annual variation in salmon runs across the entire system, thus stabilizing the derived ecosystem services (*sensu* Schindler et al. 2010, but within basins).

Olden, Page 6
The benefits of flow restoration may be enhanced if riverine thermal regimes are also considered. One example supporting this notion is in the lower Mississippi River where research has shown that growth and abundance of juvenile fishes are only linked to floodplain inundation when water temperatures are greater than a particular threshold. Schramm and Eggleton (2006) reported that the growth of catfishes (*Ictaluridae* spp.) was significantly related to the extent of floodplain inundation only when water temperature exceeded 15°C; a threshold temperature for active feeding and growth by catfishes. Under the current hydrographic conditions in the lower Mississippi River, the authors report that the duration of floodplain inundation when water temperature exceeds the threshold is only about 1 month per year) on average. Such a brief period of time is believed to be insufficient for

floodplain-foraging catfishes to achieve a detectable energetic benefit (Schramm and Eggleton 2006). These results are consistent with the 'thermal coupling' hypothesis offered by Junk et al. (1989) whereby the concordance of both hydrologic and thermal cycles is required for maximum ecological benefit.

Grismer, Page 2

Overall, this subject is difficult scientifically in terms of appropriate data collection and analyses. For example, the curve in Figure 3.8 on p.3-27 is practically meaningless given the few points available; perhaps this why no R2 value is provided. I suggest simply eliminating the curve. In Figure 3.10, there is extremely low fish "escapement" from the Merced River during 1950-1968 that would seem to "skew" results. Is there any explanation for this dearth of salmon in this period? Is it real or an artifact of sampling? In Figure 3.11, there is clearly an increase in recovered salmon as a function of the number released as might be expected, but the statistical interpretation is strained. Basically, averaging the 2-3 data points per number released indicates that approximately 2.5% salmon 'recovery' at releases of ~50,000 and 2.8% 'recovery' at releases twice as great (~100,000), leading to the possible observation that for releases up to ~100,000 fish recoveries between 2.5-3% might be expected. The single point at large value release (~128,000) suggests a greater recovery fraction (~5%), but it is only one point. Given the wide variability in the recovery numbers, I suspect that these recovery fractions are not statistically different. Perhaps a different analysis is more appropriate here.

ATTACHMENT 2

EXCERPTS FROM A PEER REVIEW OF THE CALIFORNIA DEPARTMENT OF FISH AND GAME'S QUANTIFIABLE BIOLOGICAL OBJECTIVES AND FLOW CRITERIA FOR AQUATIC AND TERRESTRIAL SPECIES OF CONCERN DEPENDENT ON THE DELTA

Gross, W.S., G.F. Lee, C.A. Simenstad, M. Stacey, and J.G. Williams. 2010. Panel Review of the CA Department of Fish and Game's Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta.

Gross et al. 2010, Page 3
We interpreted "using the best available scientific information" in terms of the following statements (from NRC 2004-a):

1) The agencies may not manipulate their decisions by unreasonably relying on some sources
to the exclusion of others;
2) The agencies may not disregard scientifically superior evidence;
3) Relatively minor flaws in scientific data do not render the data unreliable;
4) The agencies must use the best data available, not the best data possible;
5) The agencies must rely on even inconclusive or uncertain information is that is the best available at the time of the decision;
6) The agencies cannot insist on conclusive data to make a decision;
7) The agencies are not required to conduct independent research to improve the pool of available data.

…citation is supporting an argument, not establishing a fact. Citations, even to the peer-reviewed literature, are not like theorems in mathematics, and do not establish validity. For example, Stevens and Miller (1983) is in a peer-reviewed journal, but commits an elementary statistical error that vitiates its findings about the effects of Delta inflows on juvenile Chinook salmon (probably the authors and the reviewers missed the error because it was masked by the use of an index).

Gross et al. 2010, Page 4
Thinking of citations as supporting an argument explains why citations to the peer-reviewed literature are preferred. They provide stronger support for an argument because independent people thought to be qualified are supposed to have read the papers carefully. Citations to agency reports provide weaker support, even if the reports are conceptually and technically sound, because they are not independently reviewed. Citations to personal communications generally provide even weaker support, unless the person cited is a recognized authority, etc.

Gross et al. 2010, Page 6

- References must be accurately cited. It is the responsibility of the authors to ensure that they are correctly citing facts, results or conclusions from particular references and attributing them correctly. There are a number of examples in the Draft (discussed below in section 4.4.1) where a conclusion or fact is attributed incorrectly to a particular reference, which leaves the statement without a scientific basis.
- References must be clearly cited. Relying on references that are "personal communication" or obscurely cited ("NMFS 3 in SWRCB 2010") makes it difficult to evaluate the underlying science.
- Whenever possible, references should be to peer-reviewed literature, not internal technical reports or testimony. In many cases, this will require that the authors trace back through the literature to determine the original source of the information, but that is part of providing BAS.
- The Draft frequently relies on some sources to the exclusion of scientifically superior sources. As three examples, it cites outdated analyses by Kjelson and Brandes instead of superior analyses (Newman and Rice 2002; Newman 2003). It cites an outdated study by Brett (1952) and a consulting report and testimony by Alice Rich on the temperature tolerance of juvenile salmon instead of scientifically superior studies by Myrick and Cech (2001, 2002, 2004) and Marine and Cech (2004). It relies on an unpublished work by Marston and ignores superior studies by Newman2 and others involved with VAMP, and by Terry Speed (1993). It fails to cite many relevant, more recent papers (Appendix A3), including a long review on Central Valley Chinook and steelhead (Williams 2006) that would have drawn DFG's attention to the superior sources just noted.
- The Draft refers to a vague source (DFG 2010a) on key points, such as "Random rare and unpredictable poor ocean conditions may cause stochastic high mortality of juvenile salmon entering the ocean, but the overwhelming evidence is that more spring flow results in higher smolt abundance, and higher smolt abundance equates to higher adult production (DFG 2010a)" at p. 47. This sentence is also misleading; it is true that rare ocean conditions can cause high mortality of juvenile salmon entering the ocean, but so can more common conditions. This claim seems to be an attempt to defend the Marston results from the criticism that fitting models to smolt-adult survival data without taking variable ocean survival into account will give misleading results (a claim that is dubious to start with, but even more so without a supporting reference).

Gross et al. 2010, Page 7

- For many species, the Draft seems to assume that flow alone will restore natural processes and restore/reconnect critical habitats for these species. This assumption is poorly founded.
- Similarly, hypothesized responses by species and species assemblages should have been placed in context of DRERIP conceptual models (see: http://science.calwater.ca.gov/drerip/drerip_index.html for peer-reviewed models and documentation; these models are being prepared for future publication in *San Francisco Estuary and Watershed Science*).

Gross et al. 2010, Page 8

- The basic (not necessarily the Delta-specific) information on coastal wetland requirements and use by juvenile Chinook salmon is relatively parochial and out of date. There has been considerable information emerging over the past decade that continues to validate at least two relevant aspects of their life history:
  - Life history diversity of Chinook salmon, whether genetic or tactical, is influenced by habitat diversity and opportunity and is considered important to population resilience; and,
  - Several life history types express strong fidelity toward prolonged estuarine wetland occupancy, fidelity toward particularly geomorphic habitat features and specific locations, and selectivity toward particular estuarine food web pathways. Miller et al. (2010) provide evidence that a substantial proportion of juvenile Central Valley fall Chinook leave fresh water at <56 mm fork length. Given that most Central Valley fall Chinook are hatchery fish, as shown by Barnett-Johnson et al. (2005) and the proportion of marked fish observed in the 2009 carcass surveys, and that fish leaving fresh water at < 56 mm are unlikely to be hatchery fish, juveniles that leave fresh water before they reach "smolt" size may be the dominant part of the naturally produced fraction of the run. The objectives in the Draft ignore these fish.

Gross et al. 2010, Page 9

- The objectives for salmon fail to distinguish hatchery and naturally produced fish. The objectives refer to the salmon protection water quality objective, which seems to be: "Water quality conditions shall be maintained, together with other measures in the watershed, sufficient to achieve a doubling of natural production of Chinook salmon from the average production of 1967-1991, consistent with the provisions of State and federal law." There is a key phrase in this language, "natural production," that is defined in the CVPIA. This excludes hatchery-reared salmon. The Draft does not deal with the difference between hatchery and natural production of salmon and steelhead.
- The first three objectives embody the notion that river flows "transport salmon smolts through the Delta." As discussed in Ch. 6 of Williams (2006), the migration of juvenile salmon is much more complicated than this and for most juvenile Chinook life history types cannot, and should not, be separated from rearing in the Delta.

Gross et al. 2010, Page 10

Year-to-year variability to meet biological objectives is missing, or is based on water year type. If we are to use functional flows, then the water year type should not be a factor – the biological requirements should be independent of the hydrology. If there is a need for year-to-year variability, then this should be stated as such (this is something that Fleenor et al. (2010) did very well). The biological objectives and required flows should not depend on the specific realization of hydrologic flows. To be clear, if we have 10 straight wet years, or 10 straight dry years, the required flows for meeting the biological objectives will be incorrect. It is possible that the DFG was using criteria based on water year type to create year-to-year variability, but the scientific basis for this approach is not established. To built this up scientifically, the authors would need to (a) define what degree of year-to-year variability in flows benefits the species (not done in the Draft); (b) establish the temporal variability of year types in the historical record (also not done here, but analysis exists); and (c) develop projections of the frequency of water year types for future conditions (the CASCaDE project the USGS has been pursuing may inform this).

Gross et al. 2010, Page 12

- The connection between Delta water temperatures and river flows is not established in the literature. The criterion proposed here (flows >5000 cfs in April-May keep Delta water temperatures below 65 F) does not have any scientific citation associated with it (in the Draft this criterion is based on testimony from the Bay Institute). Exploration of temperature in the Delta and the connection to flows has been pursued in a fundamental sense by Monismith et al. (2008) and in view of the effects of climate change in a paper that is in review by Wagner et al. (part of the USGS CASCaDE project).

Gross et al. 2010, Page 13-14

The use of testimony (unavailable for review – or at least difficult to track down) or another unreviewed technical report (SWRCB 2010) is not enough to justify conclusions. In one case (for the flow requirement to prevent flow reversal at Georgiana Slough), a fact is attributed to the SWRCB report, but in that report the fact is referenced to "personal communication" or to some testimony that is unavailable for review. Other examples include references to Snider and Titus (DFG technical reports), Allen and Titus (which is actually a proposal!) and testimony from groups like American Rivers or the Natural Heritage Institute. To ensure scientific transparency, references should be given to their original source. Otherwise, a personal communication or a proposal begins to have the appearance of a reviewed scientific reference.

Gross et al. 2010, Page 14

- Statements without scientific references are sprinkled throughout the Draft. One example lies in the statement that as natural flows have been reduced, flow conditions have become more favorable to non-native species. While this might be true, the inclusion of the modifier "flow" on "conditions" makes it a more specific statement than is likely to be defensible scientifically (i.e., the more vague statement "…as natural flows have been reduced, conditions have become more favorable to non-native species" is probably better established in the literature). As a second example, the discussion of the decline in San Joaquin River Chinook from 26000 to 13000 states "Flow related conditions are likely to be a major cause of this decline," but there is no reference to support the statement. Further, the use of non-peer-reviewed information undermines much of the results presented. The flows required to prevent salmon entrainment at Georgiana Slough, for example, are referenced from Perry et al. 2008 and 2009, but these are just technical reports, and have not been peer-reviewed; at least some of this work has been published and that should be cited.
- In most cases the report does not clarify the degree of scientific certainty/uncertainty associated with individual flow objectives. Therefore it is not clear to what extent each individual objective is supported scientifically.
- Minimal detail of relevant modeling studies has been provided. In any case where flow criteria have been based in part upon modeling studies, the modeling studies should be

briefly described in the Draft. Direct references of relevant papers and reports should be provided.

- There are a number of cases where the actual sources of a piece of information are inaccurately referenced – at times in ways that are quite deceiving. For example, the Draft attributes population declines since 1985 to flows based on Fleenor et al. (2010). Fleenor et al. (2010) do not make that statement. (It is bad enough that such a fundamental point to this whole process is being based on an unreviewed document.). They do compare 1949-1968 ('when fish were doing better') to 1986-2005 ('when fish were doing poorer') and note that the flows have changed – but they do ***not*** conclude that this is causative.
- In the first paragraph of page 75, an entrainment loss estimate of up to 40% was attributed to "PTM results" by Kimmerer (2008). The bulk of the entrainment losses estimated in Kimmerer (2008) were estimated based on survey observations, flow observations and several assumptions. Figure 16 and a small part of the text discuss particle tracking model results which estimate percent loss to the population. However, it should be noted that this is assuming no natural mortality. Kimmerer (2008) also estimates population losses by a more complete method which does take account of natural mortality but does not utilize any particle tracking results. These (lower) estimates are more appropriate to cite, preferably noting that the estimated error bounds for the calculated population losses are quite large.
- It is not entirely clear in which cases the Biological Objectives and Flow Criteria have been directly adopted from other documents such as the ERP Plan or OCAP (NMFS 2008). This should be clarified for each Biological Objective and Flow Criteria.
- The report commonly references SWRCB 2010 and DFG 2010a. SWRCB 2010 refers to the State Water Resources Control Board document. Some of the information in that document is associated with an information proceeding. This document summarizes existing information and scientific understanding. DFG 2010a refers to the participation of CDFG in the State Water Resources Control Board Informational Proceeding. Whenever possible original scientific literature should be cited as opposed to summary documents.

Gross et al. 2010, Page 15

- Fleenor et al. (2010) is referenced frequently when the citation should have been to the original scientific source material, especially when this was a peer-reviewed journal publication.
- The Draft misinterprets several important references. For example, at p. 40: "Based on the mainly oceantype life history observed (*i.e.*, fall-run), MacFarlane and Norton (2002) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry." The first clause in this sentence is incorrect; MacFarlane and Norton (2002) were contrasting their results with those from other ocean-type populations of Chinook. Moreover, MacFarlane and Norton (2002) defined the estuary in terms of salinity, rather than tidal influence, so their study applies only to the bays, not to the Delta. Further, their data collection did not begin until late spring, whereas most naturally produced fall

Chinook move into the Delta in winter or early spring.

- A large section of text regarding salmon (pp 36-39) that contain errors and poor scholarship, including the misreading just discussed, was taken from the 2009 OCAP BO without attribution. The Draft does note that "Much of this section is excerpted and adapted from DFG (2010a, 2010b) and SWRCB (2010)," and indeed much of the language also appears in SWRCB (2010). It does not seem, however, that the language was original with DFG, as suggested by the reference to DFG (2010a; 2010b), which were submissions to the process resulting in SWRCB (2010). We realize that Section 85084.5 directs DFG to develop its recommendations to the SWRCB in consultation with NMFS, but this is carrying consultation too far, and violates ordinary standards for scientific writing.

ATTACHMENT D

UNITED STATES BUREAU OF RECLAMATION
NEW MELONES RESERVOIR – WATER RIGHT PERMITS 16597, 16600, 20245
(APPLICATIONS 14858, 19304, 14858B)

PETITION TO CHANGE STANISLAUS RIVER DISSOLVED OXYGEN (DO) COMPLIANCE POINT

- OID/SSJID and SEWD prepared this petition for Reclamation to request the State Water Board change the compliance point for dissolved oxygen on the Stanislaus River in Reclamation water right permits for New Melones Reservoir.
- Petition contains a summary of the water right process leading up to issuance of the permits, including testimony regarding the fishery needs on the Stanislaus River.
- Monitoring of fishery resources in the Stanislaus River, as well as a review of the temperature data, indicates that fish are not rearing at Ripon as temperatures exceed what is needed for the fish.
- Petition requests the State Water Board exercise its reserved jurisdiction to move the Stanislaus River DO compliance point from Ripon (River Mile 16) to Orange Blossom Bridge (River Mile 46.9) from June 1 through August 31.

UNITED STATES BUREAU OF RECLAMATION
NEW MELONES RESERVOIR – WATER RIGHT PERMITS 16597, 16600, 20245
(APPLICATIONS 14858, 19304, 14858B)

PETITION TO CHANGE STANISLAUS RIVER DISSOLVED OXYGEN COMPLIANCE POINT

I. INTRODUCTION.

Pursuant to the requirements of State Water Resources Control Board ("SWRCB") Decision 1422 ("D-1422), Decision 1616 ("D-1616"), Decision 1641 ("D-1641") and the Water Quality Control Plan, Central Valley Region, Fourth Edition, for the Sacramento River Basin (5A) and San Joaquin River Basin (5B) ("2004 CRWQCB Basin Plan"), the United States Bureau of Reclamation ("USBR") is required to release stored water from New Melones Reservoir to maintain a dissolved oxygen ("DO") concentration of 7.0 mg/L in the Stanislaus River as measured at Ripon.

The establishment of the 7.0 mg/L DO concentration is intended to preserve or enhance aquatic habitats, and spawning and rearing of salmon and steelhead. While the Stanislaus River contains fish and aquatic habitat that benefit from a minimum DO concentration of 7.0 mg/L, such fish and aquatic habitat are located far upstream of the Ripon compliance point during the summer months. As such, the USBR contends that the SWRCB should exercise its reserved jurisdiction to move the Stanislaus River DO compliance point from Ripon (River Mile 16) to Orange Blossom Bridge (River Mile 46.9) from June 1 through August 31.

II. BACKGROUND.

A. D-1422

In D-1422, the SWRCB required the USBR to release conserved water from New Melones Reservoir for water quality control purposes, including DO in the Stanislaus River. (D-1422, Condition 8). The SWRCB did not identify the DO concentration that the USBR would need to achieve in D-1422, but rather required the USBR to meet whatever DO concentration was required by any current and applicable Water Quality Control Plan. (Id.). Although no DO concentration requirement was established, D-1422 did establish that any Stanislaus River DO concentration requirement was to be met at Ripon, unless an alternative compliance location was approved by the SWRCB. (Id.).

The express purpose of the original request that a DO concentration in the Stanislaus River be met was "to protect the salmon fishery." (D-1422, p. 12, citing RT 526). However, it is unclear from the hearing transcripts and written testimony considered at the hearings which culminated in D-1422 how the DO requirement would protect the salmon fishery generally, or why the compliance point was established at Ripon.

Mr. Maurice Fjelstad authored a large portion of Chapter 2 of the California Department of Fish and Game's ("CDFG") "Report to the California State Water Resources Control Board On Effects of the New Melones Project on Fish and Wildlife Resources of the Stanislaus River and Sacramento-San Joaquin Delta ("1972 CDFG Report") which dealt with the predicted impact of the New Melones Project on the existing fishery resources of the Stanislaus River. (RT 520). His testimony is cited by the SWRCB in D-1422 in that the DO concentration is necessary to protect the salmon fishery of the Stanislaus River. (D-1422, p. 12). However, the citation relied upon by the SWRCB is of little specific assistance as to the importance of the DO concentration to salmon as it was just one part of a general answer given by Mr. Fjelstad in response to the question "Could you tell the board the specifics of – well, what the salmon need to survive?" Mr. Fjelstad responded to this question as follows:

> "Well,..., the salmon's primary requirement is water at the right time and at the right place. They require suitable water temperature. Fifty to fifty-two degrees is ideal for spawning. The temperature during spawning should be below 58 degrees. After spawning, after incubation, the temperatures should remain below 70 degrees. They require suitable dissolved oxygen which should be no less than seven parts per million. And, as I said before, they require adequate flows for upstream migration, spawning, incubation of the eggs, and downstream migration." (RT 526).

While Mr. Fjelstad further testified in detail about the specific needs of the various life-stages of salmon, as was also provided in Chapter 2 of the 1972 CDFG Report, neither Mr. Fjelstad nor the 1972 CDFG Report provide any further detail as to the what particular life stages of salmon require a minimum DO concentration.

This lack of a discussion about how DO affects any or all of the salmon life stages is critical, as virtually all of the other proposed requirements are associated with a specific life stage. For example, CDFG recommended a minimum flow of 200 cfs from Goodwin Dam to the confluence with the San Joaquin River between October and December for purposes of allowing upstream migration and spawning and incubation of eggs. (1972 CDFG Report, p. 2-11, 2-12 and Errata Sheet).CDFG recommended a minimum flow of 150 cfs from January 1 through February 28 between Goodwin Dam and the confluence with the San Joaquin River for incubation and a variety of flows between Goodwin Dam and Ripon during the January through June migration period. (1972 CDFG Report, p. 2-12 – 2-17 and Errata Sheet). CDFG further recommended a flow of 100 cfs between Goodwin Dam and the confluence with the San Joaquin River during July, August and September to control vegetative encroachment on spawning gravels, maintain suitable temperature and maintain suitable DO. (1972 CDFG Report, p. 2-17).

While there is a specific reference to DO during the summer months, this reference is particularly vague when compared to the other recommendations. In fact, it is not at all clear whether or not the reference to DO in the summer months has anything to do with fall run salmon at all. CDFG specifically stated

> "Summer flows are essential...in maintaining suitable dissolved oxygen and temperature levels for resident fishes and any steelhead and spring-run salmon populations which might develop in the Stanislaus River and will sustain juvenile salmon that stay in fresh water for one year."
> (1972 CDFG Report, p. 2-17).

From the construction of the sentence, CDFG is certainly stating that DO will assist resident fish and any steelhead or spring-run salmon, but it is not clear if CDFG is stating that DO is needed by juvenile salmon, or if the recommended summer *flows* will "sustain" such fish. Indeed, given that Mr. Paul Jensen, testifying on behalf of CDFG, stated that "juvenile fall run king salmon would not normally be expected to be in the river much beyond June," (RT 620) and that therefore summer temperatures were not a concern or limiting factor for salmon, it seems that the statement on page 2-17 of the 1972 CDFG Report must be read to state that DO in the summer is only important for steelhead and spring-run salmon if such populations might develop. This conclusion is bolstered further by Mr. Jensen's testimony that "[i]n July, August and September the salmon are gone." (RT 635).

A complete review of the evidence and testimony submitted to the SWRCB does not resolve the ambiguity. Clearly, at least as a general matter, the CDFG is recommending that a DO requirement is needed to protect the salmon fishery in the Stanislaus River. However, since there is no specific discussion as to the specific life stage or stages that the DO requirement is to protect or promote, there is no geographic area at which such DO requirement must be met. As noted above, the specific purpose that the other recommended conditions – such as flow or temperature – was to promote or protect determined where, in a geographic sense, such condition would be applicable. Thus, flows recommended for upstream migration were applicable throughout the Stanislaus River, whereas other flow recommendations were applicable primarily between Goodwin Dam and Ripon.

Despite the lack of specificity as to the purpose of the DO requirement requested by CDFG (beyond the general "for the protection of the salmon fishery") and therefore the lack of geographic location(s) at which such requirement must be met, the SWRCB nonetheless agreed to condition the USBR's permits on, among other things, the requirement that the USBR make releases of conserved water from New Melones for the purpose of meeting DO. (D-1422, p. 31, Condition 5). Additionally, although there is apparently no discussion as to the purpose of the DO requirement, and therefore no geographic area of compliance, the SWRCB nonetheless established the DO compliance point at Ripon. (Id.).[1]

B. D-1616

D-1422 dealt with the USBR's request for permits to divert water into New Melones for storage. In D-1616, the SWRCB considered the USBR's request for permits for direct diversion at New Melones.

While granting the permits requested by the USBR, the SWRCB prohibited any direct diversion for consumptive use if the DO concentration, as measured at Ripon, is less than that specified in the April 1975 version of the SWRCB's Water Quality Control Plan, San Joaquin River Basin 5C. (D-1616, Condition 12 and 13). As in D-1422, the SWRCB left open the possibility that it would consider and approve an alternate location for measuring compliance with the Stanislaus River DO concentration requirement. (D-1616, Condition 13).

CDFG did initially protest the USBR's permit application, but the protest was resolved before the conclusion of D-1616 through an agreement between the USBR and CDFG. As such, the SWRCB made no specific statements or findings regarding either the purpose of the continued DO concentration requirement or the continued use of Ripon as the compliance point of such requirement.

C. Current Permit Conditions

The USBR's permits for the New Melones Project were modified by the SWRCB in D-1641. These modifications were minor and still require the USBR to release stored water and/or refrain from directly diverting water unless and until the DO concentration at Ripon is met. (D-1641, p. 160 and 162).

The DO concentration requirement itself has changed over time since it was first required in D-1422. Now, the DO concentration requirement at Ripon is that specified in the 2004 CRWQCB Basin Plan. According to this plan, DO objectives are established based upon general needs of the fishery resource specific to a particular river or stream in the basin. That is, as a general matter, streams are designated as "WARM," meaning the fishery resources of that water body are rely primarily on warm water habitat (such as sunfish or catfish), "COLD," meaning the fishery resources of that water body rely primarily on cold water habitat (such as rainbow trout or sculpins) and "SPWN," meaning the fishery resources of that water body utilize the water body for reproduction and early development (such as salmon or steelhead trout), and a general DO

[1] In a personal communication with Mr. John Renning of the USBR in 2004, he suggested that Ripon was chosen as the compliance point not because of salmon, but rather due to the existence of numerous canneries in Ripon. These canneries had discharges of effluent that were high in biological or chemical oxygen demand. Mr. Renning's suggestion makes sense, as the SWRCB noted in D-1422 that the then-applicable water quality control plan included a requirement in the Stanislaus River for DO "as a result of waste discharges..." (D-1422, p. 12).

concentration is established for each of these fishery purposes. Unless an exception is made that requires either less or more stringent concentrations, water bodies designated as WARM shall not have DO concentrations that fall below 5.0 mg/L and water bodies designated as COLD or SPWN shall not have DO concentrations fall below 7.0 mg/L. (2004 CRWQCB Basin Plan, page III-5.00).

Since the Stanislaus River is designated COLD and SPWN, the DO concentration requirement is 7.0 mg/L. (2004 CRWQCB Basin Plan, p. II-8.00). Although the 2004 CRWQCB Basin Plan does not establish compliance points, the DO concentration of 7.0 mg/L must be met at Ripon as required by the USBR's permits for the New Melones Project.

III. DO CONCENTRATION COMPLAINCE POINT AT RIPON IS NOT NEEDED YEAR ROUND TO PROTECT THE SALMON OR STEELHEAD FISHERY.

The CDFG originally recommended a DO concentration requirement in the Stanislaus River "to protect the salmon fishery." (D-1422, p. 12, citing RT 526). Similarly, the current DO concentration requirement established by the CWRQCB is designed to protect the cold-water fishery and spawning fishes, which in the Stanislaus are primarily salmon and steelhead. While it is undisputed that salmon and steelhead exist in the Stanislaus River and that a DO concentration in the Stanislaus River for the protection of such fishery is appropriate, the compliance point of Ripon is not always appropriate for the protection of such fishery.

Geographically, the Stanislaus River extends approximately 60 miles from Goodwin Dam to the confluence with the San Joaquin River. Ripon is located approximately 44 miles downstream of Goodwin Dam, and approximately 16 miles upstream from the confluence of the Stanislaus and San Joaquin Rivers. As noted earlier, many requirements regarding flow, temperature, water quality, gravel size and other items are designed and intended to support, enhance or protect certain specific salmonid life stages. Salmon and steelhead in the Stanislaus River have five basic life stages: adult migration, spawning, egg incubation, juvenile rearing, and juvenile migration. By examining the timing and locations of these five life stages of salmon utilizing the Stanislaus River, it can be seen that the DO concentration requirement is not needed at Ripon on a year-round basis.

A. Fishery Resources

1. Fall-Run Chinook Salmon

a. Adult Fall-Run Chinook Migration

In 1972, the CDFG reported that adult salmon migrated up the Stanislaus River between early October and late December, with migration reaching a peak in Late October and early November. (1972 CDFG Report, p. 2-4). Although this description of migration timing is over 30 years old, it remains fairly accurate. Since 1972, data collected by private fishery consultants, non-profit organizations, and the CDFG demonstrate the majority of adults migrate upstream from late September through December with peak migration occurring from late October through early November (Table 1, Cramer Fish Sciences [CFS] unpublished data; Fishery Foundation of California [FFC] unpublished data; CDFG annual spawning survey reports). Yet, some adult migration has been observed as early as September and as late as January (Table 1).

In terms of location, adult migration in the Stanislaus River extends upstream from the river's confluence with the San Joaquin River to the spawning grounds located between Riverbank (River Mile 33) and Goodwin Dam (River Mile 58.4).

Table 1. Generalized upstream migration timing pattern observed at the Stanislaus River Weir near Riverbank (River Mile 31.2) during 2003-2005.

Date	***% Adult Chinook***
Sep 1-15	0.02%
Sep 16-30	2.72%
Oct 1-15	18.35%
Oct 16-31	26.60%
Nov 1-15	32.69%
Nov 16-30	12.68%
Dec 1-15	5.60%
Dec 16-31	1.16%
Jan 1-15	0.15%
Jan 16-31	0.02%

b. Fall-Run Chinook Spawning

Adult fall-run Chinook salmon spawn soon after they complete their upstream migration and arrive at the spawning grounds. For Stanislaus River salmon, spawning generally takes place between October and December based on spawning surveys (Table 2). However, there is evidence from spawning surveys (Table 2) that indicates a small amount (i.e., 1.2%) of spawning activity may occur as early as September or as late as January. In addition, juvenile outmigration studies (CFS unpublished data) indicate that spawning activity can occur as late as February based on estimated incubation requirements (i.e., 40 to 60 days) and the presence of newly emerged fry observed in late April.

According to the Stanislaus River Fish Group's (SRFG) "A summary of fisheries research in the lower Stanislaus River" ("SRFG 2004"), the spawning reach is about 25 miles long and extends from Goodwin Dam (River Mile 58.4) downstream to Riverbank (River Mile 33).

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Table 2. Generalized timing pattern of spawning in the Stanislaus River based on redd counts from CDFG spawning surveys conducted 1998 to 2005. (CDFG annual reports).

Date	***% redds observed***
Before Oct 1	0.1%
Oct 1-15	1.5%
Oct 16-31	10.5%
Nov 1-15	29.4%
Nov 16-30	29.4%
Dec 1-15	19.0%
Dec 16-31	9.0%
Jan 1-15	1.1%

c. Fall-Run Chinook Egg Incubation

The duration of salmon egg incubation varies significantly with water temperature, and Chinook salmon eggs require the accumulation of 888 Fahrenheit degree days (e.g., 1°F above freezing for one day) from the time that they are deposited by spawning adults until juveniles hatch and emerge from the gravel. (Piper and others 1982). Temperatures vary between years, within years, and by location, but based on typical fall/winter temperatures in the Stanislaus this translates to an incubation period of approximately 40 to 60 days. Based on documented spawn timing (CDFG annual reports) and the estimated number of days until hatching and emergence based on degree days, egg incubation generally extends from October through March.

Incubation occurs within the 25 mile spawning reach that extends from Goodwin Dam (River Mile 58.4) downstream to Riverbank (River Mile 33).(SRFG 2004).

d. Fall-Run Chinook Juvenile Rearing

Juvenile Chinook rearing in the Stanislaus River primarily occurs from mid December through May between Goodwin and Riverbank. However, some rearing may occur at different times and locations. For instance, some rearing may occur throughout the lower river below Riverbank from mid December through May when temperatures in the lower river are within tolerable ranges. However, the number of juveniles rearing in this lower reach is anticipated to be small based on abundance trends, migration timing, and fish size observed between Oakdale and Caswell; and any rearing that occurs below Orange Blossom Bridge is generally believed to be associated with fish migration or with displacement during pulse flows or flood control events

In addition, although most rearing juveniles migrate prior to June, some juveniles may continue to rear in the river above Orange Blossom Bridge (River Mile 46.9) throughout the summer and fall where temperatures are within tolerable ranges. However, based on snorkel surveys and outmigration data, it appears that very few juvenile salmon oversummer in the river. For instance, relatively low salmon densities are observed within the river after mid September (FFC unpublished data) and very few juveniles are observed migrating the following winter (i.e., three to 29 individuals captured annually at Oakdale and Caswell combined; CFS unpublished data).

e. Fall-Run Chinook Juvenile Migration

For over a decade, rotary screw traps located at Caswell (River Mile 8.6) have collected data on out-migrating juvenile salmon. Rotary screw trap data indicate that about 99% of salmon juveniles migrate out of the Stanislaus River from January through May. (SRFG 2004). Fry migration generally occurs from January through March, followed by smolt migration from April through May. However, some juveniles have been captured at Caswell as early as December 22 (<1% migrating prior to January) and as late as July 3 (<1% migrating after May). (CFS unpublished data reports).

In the Stanislaus River, out-migration of juvenile salmon extends from rearing areas below Goodwin Dam (River Mile 58.4) to the river's confluence with the San Joaquin River (River Mile 0.0).

f. Summary Fall-run Chinook Salmon Life Stage Timing and Geographic Location

From the above information, fall-run Chinook salmon life stage timing and geographic location within the Stanislaus River can be generalized as follows:

Stage	Timing	Geographic Location
Adult Migration	Late September - December	Goodwin Dam to confluence
Spawning	October – December	Goodwin Dam to Riverbank
Egg Incubation	October – March	Goodwin Dam to Riverbank
Juvenile Rearing	mid December – May	Goodwin Dam to Riverbank
	June – mid December	Goodwin Dam to Orange Blossom Bridge
Juvenile Migration	January – May	Goodwin Dam to confluence

2. Steelhead

a. Steelhead Adult Migration

Steelhead adults typically migrate from the ocean and into tributaries to spawn. However, unlike salmon, some adult steelhead may repeat their migration downstream out of the river after spawning to return to the ocean. (Shapovalov and Taft 1954; McEwan 2001).

In the Stanislaus River, there is little data regarding the migration patterns of adult steelhead since adults generally migrate during periods when river flows and turbidity are high making fish difficult to observe with standard adult monitoring techniques. A counting weir has been operated on the Stanislaus River from September to March in 2003-2004, September to April in 2004-2005, and September to December in 2005. Only two adult steelhead upstream migrants have been observed during these three years of monitoring. Of these two adult upstream migrants, one was observed in early January 2005 and the other during mid October 2005. Based upon this very limited data, it appears that adult steelhead may migrate into the Stanislaus River from at least October through January (CFS unpublished data). On the neighboring Mokelumne River, a longer time series of data (i.e., 12 years) exists to describe adult steelhead migration timing in the San Joaquin Basin. Results from the Mokelumne River study suggest that 97.7% of adult steelhead migration occurs from late September through March, although some fish have been observed as early as August 16 (Table 3; East Bay Municipal Utilities District unpublished data).

Limited data exists to describe the timing and frequency of occurrence of downstream migration after spawning. During three years of weir monitoring, nine spawned out adults that may have been migrating downstream out of the river to return to the ocean have been observed as early as December 27 and as late as March 18. It is generally believed that downstream migration of spawned out adults occurs soon after they have spawned. Based on this coupled with the few observations at the weir, adult downstream migration may occur from December through March.

Adult migration takes place in the Stanislaus River between the confluence with the San Joaquin River (River Mile 0.0) and Goodwin Dam (River Mile 58.4).

Table 3. Generalized adult steelhead upstream migration timing pattern observed on the Mokelumne River at Woodbridge Dam during 1990-2001. Source: East Bay Municipal Utility District unpublished data.

Date	***% Adult Steelhead***
Aug 1-15	0.0%
Aug 16-31	1.1%
Sep 1-15	1.1%
Sep 16-30	4.6%
Oct 1-15	7.4%
Oct 16-31	8.3%
Nov 1-15	14.0%
Nov 16-30	8.3%
Dec 1-15	9.5%
Dec 16-31	10.9%
Jan 1-15	7.2%
Jan 16-31	10.3%
Feb 1-15	8.9%
Feb 16-28	3.2%

Mar 1-15	3.4%
Mar 15-31	1.7%

b. Steelhead Spawning

As a result of poor visibility from high flows and turbid water conditions, there is little hard data regarding the spawning of steelhead in the Stanislaus River. However, based upon observations in the nearby Sacramento Basin (Hallock and others 1961) and limited data from the Stanislaus River (i.e., CFS unpublished weir and juvenile migration data), it is believed that steelhead spawn primarily between December and March.

During three years of weir monitoring, spawned out steelhead kelts have been observed as early as December 27 and as late as March 18 suggesting that spawning extends from at least late December through mid March (Table 4). Fry emergence is also an indicator of spawn timing and typically occurs 47 to 122 days after spawning (Barnhart 1986; Shapovalov and Taft 1954). Newly emerged rainbow/steelhead trout fry (i.e., ≤45 mm) are typically observed in the Oakdale screw trap from March through May, and have been captured as early as January 24. Similarly, young rainbow/steelhead trout have been observed during snorkel surveys conducted by the FFC beginning in April. (Kennedy and Cannon 2002). These fry observations corroborate that spawning may extend from late December through mid March.

Table 4. Monthly observations of steelhead kelts at the Stanislaus River weir during three seasons of monitoring.

	2003-2004	2004-2005	2005-2006
December	1	0	0
January	2	1	No sample
February	2	0	No sample
March	1	2	No sample

Although no steelhead spawning surveys have been conducted in the Stanislaus River, it is believed that steelhead spawning primarily takes place between Goodwin Dam and Orange Blossom Bridge. (SRFG 2004).

c. Steelhead Egg Incubation

Steelhead egg incubation occurs from the time that eggs are deposited by spawning adults until they hatch and juveniles emerge. Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable; hatching varies from about 19 days at an average temperature of 60EF to about 80 days at an average of 42EF. (Barnhart 1986) After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another four to six weeks. (Shapovalov and Taft 1954); thus, incubation (i.e., deposition to emergence) may extend from 47 to 122 days. Based on estimated spawn timing, typical incubation temperatures, and emergent fry observations (CFS unpublished juvenile migration data and FFC unpublished snorkel survey data observations), incubation in the Stanislaus River may occur from December through June.

d. Steelhead Juvenile Rearing

Juvenile rainbow/steelhead trout rearing in the Stanislaus River occurs year-round primarily between Goodwin Dam (River Mile 58.4) and Orange Blossom Bridge (River Mile 46.9). (CFS unpublished data; Kennedy and Cannon 2002). However, some rearing may occur at different times and locations. For instance, snorkel surveys by FFC indicate that the majority of steelhead rearing in the summer months takes place upstream of Orange Blossom Bridge, with the greatest abundance observed at Goodwin (River Mile 57.5) and Two-Mile Bar (River Mile 56.6). (Kennedy and Cannon 2002). In addition, some rearing may occur throughout the lower river below Orange Blossom Bridge during the winter months when temperatures in the lower river are within tolerable ranges. However, the number of juveniles rearing in this lower reach is anticipated to be small based on habitat suitability, angler observations, and limited snorkel survey data; and any rearing that occurs below Orange Blossom Bridge is generally believed to be associated with fish migration or with displacement during pulse flows or flood control events.

e. Steelhead Juvenile Migration

Over the past decade, the rotary screw traps at Caswell have typically been operated from January through June and the data indicates that steelhead outmigrate primarily from February through May (i.e., 95%). However, migration can begin as early as January and extend into June (CFS unpublished data reports).

The migration timing suggested by the Caswell data is also corroborated by observations made downstream at Mossdale on the San Joaquin River and in the neighboring Sacramento River Basin. To monitor emigration from the San Joaquin Basin, CDFG and the U.S. Fish and Wildlife Service (USFWS) operate a Kodiak trawl on the San Joaquin River near Mossdale on more of a year-round schedule and the trawl is believed to be more effective than rotary screw traps in capturing steelhead smolts. Similar to the timing suggested by catches at Caswell, steelhead were only captured from February through early June and 95% of the catch occurred from mid-March through May (USFWS unpublished data; Table 5). Additionally, Hallock and others (1961) found that juvenile steelhead in the Sacramento Basin migrated downstream during most months of the year, but the peak period of emigration occurred in the spring.

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Table 5. Generalized timing pattern of steelhead outmigration from the San Joaquin Basin developed from Mossdale trawl catch data collected by CDFG and the USFWS from 1996 to 2004.

Date	***% Juvenile Steelhead***
Feb 1-15	1.6%

Feb 16-29	0.0%
Mar 1-15	1.6%
Mar 16-31	3.1%
Apr 1-15	21.9%
Apr 16-30	29.7%
May 1-15	29.7%
May 16-31	10.9%
Jun 1-15	1.6%
Jun 16-30	0.0%

In the Stanislaus River, out-migration of juvenile steelhead extends from rearing areas below Goodwin Dam (River Mile 58.4) to the river's confluence with the San Joaquin River (River Mile 0.0).

f. Summary Steelhead Life Stage Timing and Geographic Location

From the above, steelhead life stage timing and geographic location within the Stanislaus River can be expressed as follows:

Stage	Timing	Geographic Location
Adult Migration	Late September – March	Goodwin Dam to confluence
Spawning	December - March	Goodwin Dam to Orange Blossom Bridge
Egg Incubation	December – July	Goodwin Dam to Orange Blossom Bridge
Juvenile Rearing	Year-round	Goodwin Dam to Orange Blossom Bridge
Juvenile Migration	February – May	Goodwin Dam to confluence

B. Change in DO Compliance Point is Appropriate

The above information shows that neither salmon nor steelhead are located anywhere in the Stanislaus River downstream of Orange Blossom Bridge from June through August each year. Orange Blossom Bridge is located 31 miles upstream of Ripon. Yet, even though no salmon or steelhead are located between downstream of Orange Blossom Bridge from June through August, the current USBR permits require the DO concentration objective of 7.0 mg/L to be met at Ripon during this time period. Since the express purpose of the DO concentration requirement in the Stanislaus River is to support, protect and enhance the river's salmon and steelhead fishery, it does not make any sense to require the USBR to continue to meet the DO concentration requirement at

Ripon during times of the year when there are no salmon or steelhead to benefit from such concentration.[2] In order to continue to protect the salmon and steelhead fishery while maximizing the available New Melones water for other beneficial uses,[3] the DO concentration compliance point for the period between June 1 and August 31 each year should be changed from Ripon to Orange Blossom Bridge.

Such a change is not unprecedented. Currently, there are four locations where more stringent DO concentration requirements than the general requirements established by the CRWQCB apply during certain specific times of the year. In the Sacramento River, the DO concentration between Keswick Dam and Hamilton City is 9.0 mg/L from June 1 through August 31. (2004 CRWQCB Basin Plan, p. III-5.00). In the Feather River, the DO concentration between Fish Barrier Dam to Honcut Creek is 8.0 mg/L from September 1 to the following May 31. (Id.). In the Merced River, the DO concentration is 8.0 mg/L all year from Cressy to New Exchequer Dam. (Id.). Finally, in the Tuolumne River, the DO concentration from Waterford to La Grange is 8.0 mg/L from October 15 to the following June 15. (Id.). Except for these specified times and locations, the general DO concentration limits established by the CRWQCB apply.

In each of these four instances, while it is not entirely clear as to the rationale behind the establishment of the more stringent DO concentration requirements for these specific reaches of river,[4] it appears that the reaches themselves constitute the primary spawning and rearing areas for salmon and/or steelhead. (*See* S.P. Cramer & Associates for Tuolumne and Merced Rivers; "Factors Affecting Chinook Salmon Spawning in the Lower Feather River (Fish Bulletin 179; Vol. 1 (2001)) p. 272 for Feather River, and NMFS (1997) for Sacramento River [winter run Chinook salmon]). That is, the DO concentration selected was then applied only to that portion of the river necessary to achieve the goal associated with the establishment of the DO concentration in the first place.

The same type of analysis should apply in the Stanislaus River. There are no salmon or steelhead downstream of Orange Blossom Bridge between June 1 and August 31 of each year. As such, the establishment and maintenance of the 7.0 mg/L DO concentration for some 31 miles between Orange Blossom Bridge and Ripon does not provide any benefit to either the salmon or steelhead fishery. The SWRCB should exercise the jurisdiction it has expressly reserved itself and change the DO concentration

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[2] The DO concentration of 7.0 mg/L requirement adopted by the CRWQCB is far in excess of what is needed by non-salmonid fishery resources. According to the E.P.A., DO concentrations in excess of 6.5 mg/L have no negative impact on non-salmonid fish at any life stage. (USEPA 1986).

[3] It must be remembered that the USBR's permits require it to "release" water from water stored by the New Melones project to meet and maintain the DO concentration at Ripon. Since Orange Blossom Bridge is significantly closer to New Melones than is Ripon, it is expected that changing the compliance point will result in significant water savings during the critical summer months that could be made available for other beneficial uses consistent with the enumerated purposes of the New Melones project and the CVP.

[4] At least for the more stringent DO concentrations on the Tuolumne and Merced Rivers, there are no written records explaining how or why the reaches were chosen or the more stringent DO concentrations selected. (Personal communication between S.P. Cramer & Associates and Betty Yee of the CRWQCB, 2005).

compliance point between June 1 and August 31 of each year from Ripon to Orange Blossom Bridge.

IV. CONCLUSION

The over-riding legal and policy consideration regarding the development and use of water is to avoid waste and to maximize the reasonable and beneficial use of the scarce resource. In the case of the Stanislaus River salmon and steelhead fishery, the existing requirement that the DO concentration level be met year-round at Ripon is not in accordance with the overall policy of reasonable use. The needs of the salmon and steelhead fishery, for which the DO concentration level was specifically adopted, demonstrate that the compliance point for the DO concentration can be changed to Orange Blossom Bridge from June 1 through August 31 of each year. By so doing, the salmon and steelhead fisheries in the Stanislaus River will continue to be protected, and valuable water in New Melones reservoir can be applied to other beneficial uses that are not presently being met in full.

The USBR strongly urges the SWRCB to amend its permits for both storage at New Melones and direct diversion from the Stanislaus River at New Melones to change the DO compliance point from Ripon to Orange Blossom Bridge between June 1 and August 31 of each year.

Dated: October 1, 2006

REFERENCES

Barnhart, R.A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)—steelhead. USFWS Bio. Rep. 82(11.60). 21 pp.

Carl Mesick Consultants [CMC]. 2002. Task 5 initial post-project evaluation report, fall 2000, Knights Ferry Gravel Replenishment Project. Final report produced for the CALFED Bay Delta Program and the Stockton East Water District. Carl Mesick Consultants, El Dorado, California. 14 January 2002.

Hallock, R.J., W.F. Van Woert, and L. Shapovalov. 1961. An evaluation of stocking hatchery-reared steelhead rainbow trout (*Salmo gairdnerii gairdnerii*), in the Sacramento River system. Calif. Dept. Fish and Game, Fish Bulletin 114, 73 pp.

McEwan, D.R. 2001. Central Valley steelhead. In Brown, R.L. ed. Contributions to the biology of Central Valley salmonids. Calif. Dept. of Fish and Game Fish Bull. No. 179, vol 1:1-43.

Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. Fish Hatchery Management. Department of the Interior, U.S. Fish and Wildlife Service. Washington, D.C.

Shapovalov, L., and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdnerii gairdnerii*) and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. Calif. Dept. Fish and Game, Fish Bulletin 98. 375 pp.

Stanislaus River Fish Group [SRFG] 2004. A summary of fisheries research in the lower Stanislaus River. Working draft, March 2004. Available online at http://www.delta.dfg.ca.gov/srfg/restplan.asp

S.P. Cramer and Associates, Inc. 2001. 2001 Stanislaus River Data Report. Final Data Report, S.P. Cramer & Associates, Gresham, Oregon.

S.P. Cramer and Associates, Inc. 2002. 2002 Stanislaus River Data Report Supplement. Final Data Report, S.P. Cramer & Associates, Gresham, Oregon.

S.P. Cramer and Associates, Inc. 2003. 2003 Stanislaus River Data Report Supplement. Final Data Report, S.P. Cramer & Associates, Gresham, Oregon.

S.P. Cramer and Associates, Inc. 2004. 2004 Stanislaus River Data Report Supplement. Final Data Report, S.P. Cramer & Associates, Gresham, Oregon.

S.P. Cramer and Associates, Inc. 2005. 2005 Stanislaus River Data Report Supplement. Final Data Report, S.P. Cramer & Associates, Gresham, Oregon.

COUNSEL IDENTIFICATION AT END

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF CALIFORNIA

CONSOLIDATED SALMON CASES	LEAD CASE NO: 1:09-cv-1053 OWW-DLB
SAN LUIS & DELTA-MENDOTA WATER AUTHORITY, et al. v. LOCKE, et al.	Consolidated Cases: 1:09-cv-1090 OWW-DLB 1:09-cv-1378 OWW-DLB 1:09-cv-1520 OWW-SMS 1:09-cv-1580 OWW-DLB 1:09-cv-1625 OWW-SMS
STOCKTON EAST WATER DISTRICT v. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, et al.	**DECLARATION OF AVRY DOTAN IN SUPPORT OF STANISLAUS RIVER PLAINTIFFS' MOTION FOR SUMMARY JUDGMENT**
STATE WATER CONTRACTORS v. LOCKE, et al.,	
KERN COUNTY WATER AGENCY, et al. v. U.S. DEPARTMENT OF COMMERCE, et al.	Date: November 18-19, 2010 Time: 9:00 A.M. Courtroom: 3 Judge; Hon. Oliver W. Wanger
OAKDALE IRRIGATION DISTRICT, et al. v. U.S. DEPARTMENT OF COMMERCE, et al.	
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA v. NATIONAL MARINE FISHERIES, et al.	

HERUM CRABTREE ATTORNEYS

Declaration of Avry Dotan

1. I, Avry Dotan, declare that the facts set forth below are true and correct based on my own personal knowledge and I could and would testify to them if called to do so.
2. I am a hydrologist and the owner and sole principal of AD Consultants, 15 Sullivan Drive, Moraga, CA 94556.
3. I have over 25 years experience in modeling for water resources, environmental and hydroelectric projects. I am specializing in computer modeling of complex water supply projects, hydrology analysis, water temperature modeling, project operations, feasibility and economic studies, and FERC licensing and re-licensing.
4. Since 1999 I have been the acting project manager and co-developer of the Stanislaus River Water Temperature Model, Stanislaus-Lower SJR Temperature Model (CALFED ERP-02-P28) and the San Joaquin River Basin-wide Water Temperature Model (CALFED ERP-06D-S20).
5. I have developed these models in association with my sub-consultants Resource Management Associates, Inc. (RMA) and Watercourse Engineering, Inc.

DEVELOPMENT OF STANISLAUS RIVER TEMPERATURE MODEL

6. Water temperature modeling of the San Joaquin River basin started as a grass-root project in December 1999 when a group of Stanislaus river stakeholders decided to analyze the relationship between operational alternatives, water temperature regimes and fish mortality in the Stanislaus River. These stakeholders included the United States Bureau of Reclamation ("USBR"), United States Fish and Wildlife Service ("FWS"), California Department of Fish and Game ("CDFG"), Oakdale Irrigation District ("OID"), South San Joaquin Irrigation District ("SSJID"), and Stockton East Water District ("SEWD") (collectively the "Stanislaus Stakeholders"). The Stanislaus Stakeholders decided to join resources and fund the development of a high resolution reservoir operation - water temperature computer model built on the HEC-5Q computer program.
7. The HEC-5Q is a generalized water quality computer program (software) designed by the US Army Corps of Engineers that can be configured for any reservoir-river system. The HEC-5Q

is public domain software and can be obtained at no cost from the US Army Corps of Engineers.

8. The HEC-5Q is widely accepted software that has been applied to numerous reservoir-river systems in the US and worldwide. Examples of application of the HEC-5Q in the State of California in recent years (other than the Stanislaus and San Joaquin River) are: Russian River (Sonoma County Water Agency), Sacramento River (US Bureau of Reclamation) and the reach below Friant Dam in the upper San Joaquin River (US Bureau of Reclamation). The latter was subsequently connected to the San Joaquin Basin Wide Model, as discussed further.

9. The HEC-5Q allows assessing temperature and a conservative water quality constituent (such as dissolved oxygen and electrical conductivity) in basin-scale planning and management decision-making. For the Stanislaus (and later the San Joaquin River), however, only water temperature was considered.

10. The steps necessary to apply the HEC-5Q to a given system include: representation of the physical system (e.g, characteristics of reservoirs, water conveyers, rivers geometry, etc.), assembling hydrological and meteorological data (e.g., flows and weather data) and defining operating rules (e.g., flood control rules, diversions, in-stream flow requirements).

11. Once all of the above is implemented, the model is then calibrated. Calibration is a process in which various parameters are adjusted (e.g, heat exchange coefficients for air-water and sediment-water interface, stream bed roughness coefficients, etc.) until a good-fit of observed vs. simulated conditions (e.g, temperature profile in the reservoirs and temperatures along the stream) is obtained.

12. Model set up and calibration is usually the most labor intensive effort in the implementation of the HEC-5Q. Once the model is calibrated, running hypothetical scenarios are usually straight forward tasks as they involved replacing the historical data sets with new data sets that are usually defined outside the model itself (e.g, hypothetical diversions and in-stream flow scenarios). For example, some of the scenarios that we studied for the Stanislaus Stakeholders during the course of the work for the group were based on output from the

CALSIM II model.

13. For the Stanislaus Water Temperature Model, physical representation of the system included the characteristics of New Melones Reservoir, Tulloch Reservoir, Goodwin Pool and approximately 60 miles downstream to the confluence of the San Joaquin River.

14. In addition, special code was added to the model to accommodate several unique attributes, including complex geometry of the submerged (old) dam in New Melones Reservoir and the short residence time and unique diversion characteristics of Goodwin Pool

15. The old-new dam interaction came into play during the 1992 drought when New Melones was drawn down to almost dead-storage levels. Fortunately (modeling wise), extensive flow and temperature data were collected during that period that allowed us to calibrate the model for those critical conditions and ensure that this special code is properly implemented in the model. The old-new dam interaction is especially important when operating the system more aggressively as appears to be the case when operating for temperature control per Action III.1.2 of the BO.

16. The Stanislaus Water Temperature Model was calibrated for temperature data collected during the 1990 - 1999 historical period. The simulation period (i.e., the period for which the model conducted operations studies) was 1980 to 1999. This period was selected because it covered the full period since New Melones started filling up after the construction of the new Dam to the study date at the time. The simulation period was subsequently extended as the model evolved over the years.

17. The simulation period could have been extended to years prior to 1980, similar to the period modeled with CALSIM II, relatively easily using pre-processor tools already developed by RMA for this purpose. However, the Stanislaus Stakeholders agreed that the proposed study period 1980 to 1999 covers sufficient range of hydrologic condition (wet, normal, dry and critically dry), as well as filling and emptying cycle of New Melones, to provide the insight for temperature response in the system under hypothetical operational scenarios.

18. Furthermore, when modeling water temperature in a reservoir-stream system, the level of resolution of the model is by far more important than the length of the simulation period

itself. In the case of the Stanislaus River temperature modeling, the need to compute the temperature variation and extremes was very important as they are directly related to fish habitat conditions (i.e, egg development, fish survival and growth, out-migration, in-migration, etc.).

19. Once the Stanislaus Water Temperature was completed in 2001, the model was used by the Stanislaus Stakeholders to evaluate water temperature objectives at critical points in the river system that would enhance habitat conditions for fall-run Chinook salmon and Steelhead rainbow trout. This was done by running the model for different operational scenarios proposed, primarily, by the irrigation districts and CDFG (objectives were examined for each fish species individually, and then combined into one envelope of conditions for the two).

20. The HEC-5Q can simulate temperature conditions at any specified time interval resolution. For the Stanislaus Water Temperature Model, a 6-hour time interval was selected as it provided an adequate balance between run time (the shorter the time step the longer it takes to execute a run) and the level of resolution needed in order to capture the diurnal temperature variability in the stream (6-hour interval captures the minimum daily temperature, usually around 6:00 AM, and maximum daily temperature usually around 6:00 PM). This "sub-daily" modeling is very important factor when studying temperature response in streams as temperatures could fluctuate significantly throughout the day as function of travel time and meteorological conditions (the farther the water travels from the source the closer it gets to ambient conditions). Sub-daily modeling is especially important when temperature objectives are also defined on a sub-daily basis. Modeling that would have coarse time steps (e.g., daily, weekly and monthly) tend to be biased towards the average and underestimate the extremes. **As a rule, modelers should employ time steps that are compatible with the level of resolution by which the results are tested**. This rationale was one of the primary reasons why the Stanislaus Water Temperature Model was developed, as the Stanislaus Stakeholders realized the need to evaluate the temperature regime in the basin on a sub-daily basis.

21. The Stanislaus Water Temperature Model was peer reviewed by Dr. Michael Deas, a

consultant retained by the Stanislaus Stakeholders to evaluate the suitability of the model for its intended purpose. After Dr. Deas submitted the peer review report in 2002 the model was unanimously accepted by the Stanislaus Stakeholders and adopted as the primary water temperature planning tool for the Stanislaus River. The Stanislaus River Water temperature Model has since been used by/on behalf the irrigation districts, CDFG and USBR.

FIRST EXPANSION OF THE MODEL

22. Upon reviewing modeling results, the Stanislaus Stakeholders recognized the need to extend the model to the Lower San Joaquin River thus enabling it to study the relationship between Stanislaus River operations and the temperature regime in the lower San Joaquin River as it flows to the Bay-Delta.

23. Due to limited funding available to the group, the Stanislaus Stakeholders asked me to submit a proposal to CALFED for the extension of the model.

24. In 2003, CALFED decided to fund the extension of the Stanislaus River Water Temperature Model to include the lower San Joaquin River (CALFED ERP-02-P28). A principal priority of this CALFED sponsored project was to develop a model capable of evaluating a wide range of alternatives for flow and water temperature management in the Stanislaus River and lower San Joaquin River. The project team was expanded and included Watercourse Engineering, Inc. and a peer review panel was assigned to assist in developing temperature criteria for the evaluation of model alternatives.

25. Once the model expansion was completed, the Stanislaus Stakeholders authorized the model to be used again to simulate different Stanislaus River operation scenarios, using water temperature objectives at critical points developed by CDFG, to estimate the magnitude and duration of water temperature conditions at critical points in the river and the effect on water supply and storage at New Melones. In 2006 I submitted a draft report to the Stanislaus Stakeholders describing the expanded model, the simulations conducted, and identifying the results of each simulation. In 2007 I submitted the final report to CALFED and released the final version of the model to the Stanislaus Stakeholders.

SECOND EXPANSION OF THE MODEL

26. The success of the Stanislaus work and the interest in this model expressed by the stakeholders from adjacent tributaries to the San Joaquin River (e.g. Tuolumne and Merced rivers), prompted CALFED to amend our existing contact and fund a second expansion of the model in 2004 (the work was done in parallel to finalizing our project report for the Stanislaus – Lower San Joaquin River Model). This extended the model to the entire San Joaquin River Basin below Stevinson (see the model extent on the map below). A beta version of the extended model, called the San Joaquin River Water Temperature Model ("SJRWTM") was completed in 2006, peer reviewed by a group of scientists selected by CALFED, and approved by CALFED as a Directed Action (CALFED ERP-06D-S20) for further refinement and completion.

27. Through this second expansion, the Stanislaus Water Temperature Model became one component of the overall SJRWTM (the model can be run separately for each San Joaquin River tributary or for the entire San Joaquin River Basin as a whole).

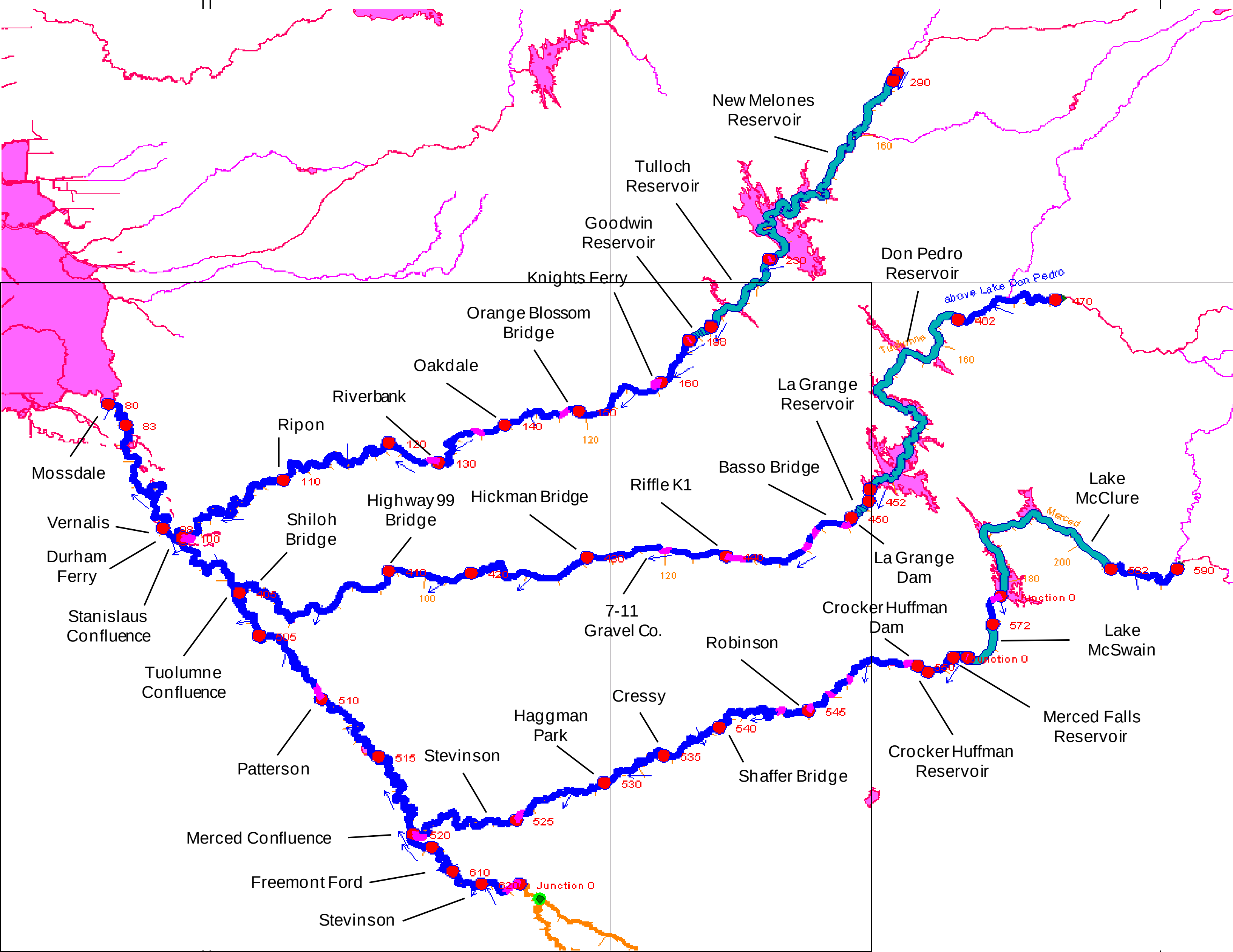
28. As such, any references from now on in my declaration to the Stanislaus River Water Temperature Model imply the model developed for the Stanislaus River <u>prior</u> to the implementation of SJRWTM. Any references in my declaration to the SJRWTM imply the Stanislaus component within the SJRWTM.

29. As part of the development of SJRWTM, the simulation period was also extended through December 2007 and the model was re-calibrated given the additional data collected over this time period (hydrological, meteorological and observed temperature in reservoirs and streams).

30. In addition, more features were coded into the model to automate the computation process. Until then, the model was designed to compute the temperature response downstream to the reservoirs given prescribed release schedule. This so-called "top-down" approach is the classical way by which the original HEC-5Q operates. The new features used the "bottom-up" approach where target temperatures at compliance points are identified (could be at multiple locations and times in the year) and the model computes how much water should be

released from the reservoirs and when (taking into account travel time) in an attempt to meet the target temperature. Special constraints are imposed to ensure that the model's proposed releases are compatible with the physical system as well as with the operator's ability to manage those releases (e.g., ramping rates, channel capacity, maximum volume of water available to managers to mitigate temperature violations, etc.).

31. Upon finalizing the model, the HEC-5Q representation of the Friant reach, a separate model developed by the USBR under a contract with my sub-contractor RMA, was added to the model, thus making it a full San Joaquin Basin-wide model.



testing phase of the model, the model was used to perform three broad categories of modeling studies: historical operations, alternative operations, and temperature target specification scenarios.

- Historical operations scenario – utilized historical hydrology and operations to form a baseline for comparative analysis with the other scenarios.
- Alternative operations scenario – focused primarily on the Stanislaus, where a set of prescriptive operations, such as instream flows, water allocations, and structural and/or operational changes, were implemented into the model.
- Temperature target specification scenarios – applied to the four-river model (all basins); temperature at key locations was specified and the system was re-operated to achieve those values.

33. The SJRWTM has already been used in several proceedings, including: analyses related to instream/temperature studies for the Stanislaus River, Friant Restoration Project, presentations for the SWRCB [303(d)/305(b)] workshop in 2007 (studies performed by the San Joaquin River Group Authority and CDFG), USBR Delta-Mendota Canal Recirculation Project, Tuolumne instream studies, and Tuolumne and Merced hydropower relicensing.

34. It is my understanding that the SJRWTM is intended to be the primary modeling and decision support tool for water temperature management in the San Joaquin River basin in the future.

OUTREACH, COLLABORATION AND TRAINING

35. Since both the Stanislaus Water Temperature Model (including the expansion to include the lower San Joaquin River) and the SJRWTM were developed collaboratively by a variety of stakeholders, and beginning in 2002 with grant funding from CALFED, regular meetings were held by and among the stakeholders to discuss refinement, development, calibration and use of the two models.

36. Regarding the Stanislaus River Water Temperature Model, a standing committee known as the "Technical Advisory Committee" ("TAC") was created. The TAC included representatives from the USBR and FWS.

37. On September 25, 2001, as part of the meetings of the TAC, we conducted a training session at the offices of OID in Oakdale and on how to run and use the Stanislaus River Water Temperature Model. Participants were asked to bring their individual laptops. During the training session the model was installed on their computers. Donald Smith, my sub-contractor from RMA presented an overview of the model's graphical user interface (GUI) which allows users to view modeling results, and then showed the steps needed to perform an actual run of the model. The model remained in the possession of the participants, and they were encouraged to continue to practice running the model after the training session. Two of the attendees at this training session were Randi Field of the USBR and Cesar Blanco of FWS. (See attendance sheet attached hereto as Exhibit A).

38. Regarding the SJRWTM, a kick-off meeting was held on April 22, 2005 at my office in Moraga, California. Representatives from NMFS, USBR and FWS all attended. The USBR attendee, Chief of Planning Lloyd Peterson, stated that the USBR was very pleased with their experience in using the HEC-5Q for the Sacramento River developed by exclusively for the USBR by RMA. He also mentioned the fact that the USBR is in the process of constructing a further extension of the model that would cover the area between Stevinson and Friant Dam on the upper San Joaquin River. The attendee from NMFS, Mr. Jeff McClain, indicated that one of NMFS' goals for the SJRWTM was to have a tool that would assess temperature on a sub-daily time step. (See Meeting Notes for April 22, 2005 meeting, attached hereto as Exhibit B).

39. During the April 22, 2005 kick-off meeting for the SJRWTM, a standing committee known as the "Super TAC" was established. The purpose of the Super TAC was to oversee implementation of the SJRWTM and development of alternatives to be evaluated with the SRJWTM. The Super TAC was expected to meet 4-5 times per year, and included representatives from the USBR, FWS and NMFS. (Also in Exhibit B).

40. Since 2000, there have been numerous TAC, Super TAC and other stakeholder meetings regarding the Stanislaus Water Temperature Model and the SJRWTM. Attendees have included Jack Rowel, Lloyd Peterson, Dave Robinson, Bill Green, Brian Deason, John

Hannon, Randi Field, Ken Yokoyama, Michael Tansey, Peggy Manza, Rick Johnson, Meri Moore, Lenore Thomas, Claire Hsu and Russ Yaworsky from the USBR, Madelyn Martinez, Jeff Mclain, Dennis Smith, Craig Anderson, and Erin Strange from NMFS, and Derek Hilts, Joseph Terry, Craig Fleming, Scott Spaulding, Carl Mesick, Cesar Blanco, J.D. Wikert and Andrew Hamilton from FWS. (See various sign-up sheets, attached hereto as Exhibit C).

41. On October 30, 2007, we conducted another training session, this time for SJRWTM. The training session took place at the offices of Modesto Irrigation District in Modesto. The training was in the form of a presentation using a computer and projector by Donald Smith of RMA, and included step by step instruction on how to run the SJRWTM and view results. All the participants already had the SJRWTM installed on their laptop computer (the model itself and instructions how to install the model, run it, and view results were provided to the stakeholders several weeks in advance). During the presentation, a staff member of RMA and I walked around the room and provided assistance to people who struggled with keeping up with the pace of the training. Once again, the model loaded onto the participants' laptops remained in their possession and the participants were encouraged to continue practice using the model. Attendees at this training session included, among other stakeholders, Claire Hsu, David Mooney and John Hannon from the USBR, and Joseph Terry from FWS. (See attendance sheet attached hereto as Exhibit D).

42. On November 19, 2008, I sent again an email to all of the stakeholders for the SJRWTM, including the USBR, FWS and NMFS, which provided links to ftp site where the most recent version SJRWTM could be downloaded and detailed instructions for installing and running the model. (See, eg., AR 00089085-00089086). This was essentially the official pre-release of the SJRWTM with the intent to provide access to the model to stakeholders other than those who participated in the training session a year earlier.

43. On October 2009, I submitted the final project report to CALFED along with the final version of the model. Although the 2009 version was almost identical in terms of its functionality to the 2008 one, I have encouraged the stakeholders to use the latest version of the model as the best and final to eliminate any confusion about the various versions.

REVIEW AND EVALUATION OF TEMPERATURE MODELING DONE FOR BO

44. I was asked by the Stanislaus River Plaintiffs to review and evaluate the temperature modeling for the June 2009 Biological Opinion (BO), as it relates to the Stanislaus River. Based on this review, I have formed the following opinions:

45. **Opinion 1 - The absence in the record of the actual temperature modeling tool used by Reclamation and NMFS limits the ability to assess whether the temperature modeling performed by the agencies provides any support for the Temperature Requirements of Action III.1.2**

46. On Wednesday, July 7, 2010, counsel for Stanislaus River Plaintiffs sent to me via e-mail one (1) Excel spreadsheet file, identified by the title "Field attached file – OCAP_2008_WaterTemp_Stanislaus_FWSFlows_042109.xls." ("Federal Defendants' Stanislaus Temperature Results"). This file contains the results of a model run by the USBR regarding the impacts to temperature under one of the draft RPAs developed in 2009, but not of the RPA actually contained in the final BO. Counsel also forwarded to me, on the same day, a .pdf version of an e-mail from the NMFS administrative record, identified as NMFS AR 00211982. This email identifies the specific CALSIM II simulation that was the subject of the temperature run. On July 14, 2010 I received from counsel for Stanislaus River Plaintiffs a DVD which contained the specific CALSIM II simulation identified in NMFS AR 00211982, including all of the assumptions, inputs and other related materials. These materials can be found in the AR in the modeling DVD provided by the USBR.

47. In May 2010, and again in July 2010, I reviewed Appendix H of the August 2008 OCAP Biological Assessment which generally describes what is variously identified as either the "Reclamation Temperature Model" or "USBR Temperature Model." According to information provided to me by counsel for Stanislaus River Plaintiffs, the USBR Temperature Model" described in Exhibit H of the August 2008 OCAP BA is the model used to generate the results contained in the Federal Defendants' Stanislaus River Temperature Results.

48. Appendix H to the 2008 OCAP BA does not contain a copy of the USBR Temperature

Model. It directs readers to look at three reports, written by Rowell in 1979, 1990 and 1997, for a more detailed explanation of the USBR Temperature Model. I was not able to find any of those reports on-line, nor are they in the administrative record for this case.

49. Since the actual USBR Temperature Model that was used by Reclamation and NMFS was not made available in the administrative record for this case I was not able to evaluate its code to determine exactly how it works or to verify the results that are reported in the record. Moreover, without the actual model source code and/or its documentation, especially model calibration results, I was unable to determine whether the results it yields are valid or not. Thus, my review of the temperature modeling performed by the agencies relies on the limited information about the model that is in the record.

50. It is my understanding, and as explained in Appendix H to the 2008 OCAP BA, that "No formal process documented the quality assurance and data quality of the Reclamation Temperature Model. This model was developed at a time where specific documentation requirements were less stringent. A peer review of the Reclamation Temperature model has not been performed".

51. Moreover, in absence of model calibration results, the agency modelers should have at least performed quality assurance (QA) checks for the USBR Temperature Model as part of the documentation of the BO itself. This could have been accomplished by simply simulating with the model the historical conditions in the river (e.g., a period for which water temperature data have been recorded) and comparing the simulated results with the observed data. I have not found any evidence in the record that the agency modelers performed these QA checks with the USBR Temperature Model in connection with the development of the BO.

52. **Opinion 2 – Mean Monthly Water Temperature data provide meaningless information regarding the temperature regime in the Stanislaus River in the context of meeting the temperature requirements of Action III.1.2.**

53. The BO specifies that compliance with the Stanislaus River temperature criteria set forth in Action III.1.2 "shall be measured based on a seven-day average daily maximum

temperature." (BO, p. 621). The 7DADM is computed at the end of each day by adding the maximum temperature of the past seven consecutive days and dividing by seven. In practicality, this means that water managers must: a) keep track of the maximum temperature observed at the compliance point in the river every day and b) operate the system in any given day (i.e., make the appropriate release from Goodwin Dam for temperature control at the compliance location) in a way where the maximum temperature in that day added to the maximum temperature in the past six days and divided by seven, would not exceed the temperature required per Action III.1.2.

54. The fundamental question that a reasonably prudent temperature modeler must address, before even dealing with which is the appropriate computer model to be used in connection with the BO is how does the temperature in the river vary throughout the day and month and what level of resolution will provide meaningful information to assess temperature compliance per Action III.1.2.

55. To answer that question, I examined the observed water temperature at Orange Blossom Bridge (OBB), as recorded by the California Data Exchange Center (CDEC) maintained by the California Department of Water Resources (DWR). Figure 1 shows temperature variation in March 2010 at OBB. The figure shows that temperature could vary over 4˚ Fahrenheit (F) per day and over 8˚ F, from approximately 50˚ F to 58˚ F, throughout the month. The Mean Monthly Temperature in this case is 54˚ F, which is approximately 4˚ F below the monthly maximum and 4˚ F above the monthly minimum.

56. Figure 2 shows the computed 7DADM per the specification of Action III.1.2. The figure clearly shows that if the target temperature for the month is 55˚ F (which happened to be the temperature requirements for the month of March), then a Mean Monthly Temperature measurement would have shown 100% compliance with this requirements. However, if the measure for compliance is 7DADM, rather than a monthly mean, then approximately 50% of the time temperature would exceed the target and be out of compliance.

57. The USBR Temperature Model results provided by Federal Defendants, and which I reviewed, present temperature solely on a Mean Monthly basis with no mention to daily

maximums and/or 7DADM. From the description of the Reclamation Temperature Model in the record, this is the only type of temperature measurement that this model was capable of producing.

58. No reasonably prudent modeler could conclude that using a model that is only capable of assessing Mean Monthly Temperature should be used to predict compliance with respect to Action III.1.2, which requires compliance using the much finer 7DADM temperature measurement.

59. **Opinion 3 – The USBR Temperature Model is Too Coarse to Simulate, Predict or Evaluate the Feasibility of or the Impacts Associated With Meeting the Stanislaus River Temperature Requirements of Action III.1.2.**

60. To verify my Opinion 2, I sought to duplicate the analysis that Reclamation performed with the USBR Temperature Model with the SJRWTM to determine if there was a substantial difference in the results. Given that the record did not contain the USBR Temperature Model or any documentation about the methodology and assumptions embedded in the model to simulate temperatures in the Stanislaus River system, I had to evaluate the merit of the model as a modeling tool in the context of establishing the Stanislaus River Temperature Requirements per Action III.2.1, by reviewing the model results provided by the Federal Defendants. The evaluation process involved three steps:

61. First – I ran the SJRWTM for one case study produced by the Federal Defendants, as explained below.

62. Second – I compared the temperature variability at OBB, one of two compliance locations per Action III.1.2, as computed by the SJRWTM and the USBR Temperature Model.

63. Third – I evaluated the results of the two models in relation to the Temperature Requirements of Action III.1.2.

64. The case study that I have selected was labeled "Study 8.0 w/FWS Flows". This case was identified to me by the Stanislaus River Plaintiff's Counsel as the most conservative case upon which Action III.1.2 was ultimately based.

65. In order to produce the run with the SJRWTM, I had to match the total diversions at

Goodwin Dam and total release from Goodwin Dam to the Stanislaus River with those obtained from the CALSIM II results for this case. The CALSIM II results were extracted from the file: "20090409_OCAP_Future_Study8_wQ4WQCPvnsQreqts_&_StanRPAw98\CONV\DSS\2020D09EDV.DSS". This file was given to me by Mr. Dan Steiner, a consultant to the Stanislaus River Plaintiff's Counsel. Mr. Steiner told me that this run contains the input hydrology that was used to run the USBR Temperature Model for the "Study 8.0 w/FWS Flows" case.

66. For quality assurance I have compared the New Melones storage as computed by the two models, as shown in Figure 3. The figure shows an overall good match between the two runs with minor mismatches in 1980 and early 2000. These mismatches are attributed to different boundary conditions in the two runs (CALSIM II starts at 1922 while the SJRWTM starts from the flood control rule curve in 1980) and probably slight differences in flood control rules between the two models. However, these mismatches are insignificant, in my opinion, as far as temperature outflow from New Melones is concerned.

67. My conclusion from the quality control check is that if there are discrepancies between the temperatures computed with the SJRWTM and the USBR Temperature Model, they must be attributed to the accuracy of the models themselves and not to the mass-balance calculations (i.e., inflow to New Melones, Goodwin diversion, Goodwin release, and the resulting storage in New Melones).

68. Next, I have examined the temperature at OBB as computed by the SJRWTM and the USBR Temperature Model. As shown in the example in Figure 4, temperature at OBB varies on an hourly basis within the day and on a daily basis within the month. While the SJRWTM computes the temperature variation throughout at 6-hour intervals and thus captures the daily maximums (and minimums), the USBR Temperature Model assumes constant temperature for the entire month.

69. Like with the previous example (observed data for the month of March 2010), the Mean Monthly Temperature as computed by the USBR Temperature Model, erroneously predicts

100% compliance with respect to the target, as shown in Figure 5. The SJRWTM, however, uses the 7DADM as a measure for compliance and shows a violation approximately 50% of the time, as also shown in Figure 5.

70. Figure 6 shows more examples where the Mean Monthly Temperature computed by the USBR Temperature Model predicts compliance with regard to the target while the SJRWTM that uses the 7DADM as a measure for compliance shows a violation.

71. It should be emphasized that none of results produced with the USBR Temperature Model that I was able to find in my review of the model discussed the relationship between the Mean Monthly Temperature and 7DADM which is the governing criterion for compliance.

72. In conclusion - the results generated by the USBR Temperature Model were so inaccurate that no reasonably prudent modeler could conclude that the USBR Temperature Model could serve as a useful tool for predicting compliance based upon a 7DADM compliance criterion.

73. **Opinion 4 – Even with the inaccuracy of the USBR Temperature Model, the modeling results demonstrate that the temperature requirements per Action III.1.2 are not attainable a significant percent of the time. This observation is even more pronounced using the SJRWTM.**

74. Figure 7 is a summary showing frequencies of meeting temperature targets (and violation of targets) specified for OBB per Action III.1.2. The case study again is "Study 8.0 w/FWS Flows". The table in Figure 7 shows two columns for each month. One for modeling results produced by the SJRWTM (labeled "5Q") and one produced by the USBR Temperature Model (labeled "NMFS").

75. As shown in Figure 7, the NMFS' results underestimate violations of the target 8 months out of the year (February to September). The NMFS violations are higher for October and November.

76. Given the above mentioned observation it is not clear to me what the rationale was for the temperature requirements set forth in Action III.1.2 as it is quite apparent that those objectives are not attainable a significant amount of the time even using the USBR Temperature Model as a predictive tool.

77. In conclusion – had the Federal Defendants used the SJRWTM to simulate the temperature condition under "Study 8.0 w/FWS Flows", it would have been apparent that the temperature requirements under Action III.1.2 are not attainable even more often than estimated with the USBR Temperature Model.

78. **Opinion 5 – The USBR Temperature Model is deficient because it failed to evaluate the impact on New Melones storage when Action III.1.2 would be in place and therefore the feasibility of this proposed action.**

79. To analyze the feasibility of Action III.1.2, modeling wise, requires a two-step approach: First – minimum instream flow below Goodwin Dam is imposed on the system. Instream flow is the required minimum releases from Goodwin Dam downstream to the Stanislaus River as defined in Table 2E of the BO (Action III.1.3). Second – the temperature response to the minimum instream flow at the compliance locations is computed. If the 7DADM at the compliance location exceeds the target set forth in Action III.1.2 (temperature violation) there is a need to augment the minimum flow until the target is met. This type of analysis could be done either by a trial and error (probably the only option available when using the USBR Temperature Model) or by activating the "bottom up" feature in the SJRWTM as described above.

80. I have already discussed the fact that the USBR Temperature Model is not capable of assessing the 7DADM but rather is using Mean Monthly Temperature. But even at this coarse level of resolution, there is nothing in the record that indicates that the federal agencies took the second step and tried to quantify how much water is needed over and above the minimum flows specified in Table 2E (Action III.1.3) to prevent violations of the new temperature restrictions in Action III.1.2. Without this analysis, agency staff could not determine the additional impact on water system storage of imposing Action III.1.2.

81. The SJRWTM on the other hand, was available and could have been used to perform exactly this analysis. To illustrate the impact of Action III.1.2, I did so. I ran the SJRWTM in the two modes explained earlier: "top-down" mode where instream flows per Table 2E were imposed and "bottom-up" where minimum flows prescribed in Table 2E were augmented to

mitigate temperature violations at the compliance location (OBB in case). The difference between the two runs: 2E and Augmented 2E (labeled as case 2EA) provided the answers to key questions: 1) What would be the impact of the augmentation for temperature on New Melones storage, 2) To what extent the augmentation succeed to mitigate temperature violation, and 3) Are there any consequences for this type of operation (i.e., would aggressive operation for temperature in some years cause unmitigated conditions the following years, especially in dry and critically dry years).

82. It should be noted that one of the assumptions used in this analysis is that in any given month, only up to 1000 cfs could be used for temperature control (i.e., augmenting the amounts specified in Table 2E by up to 1000 additional cfs). The logic was to set a limit on the total release to prevent from draining the reservoir indefinitely.

83. The need to define this limit raises another fundamental question regarding the concepts associated with the development of the terms and conditions set forth in Action III.1.2. Modeling of reservoir-river system is essentially mathematical representation of the physical system and the rules by which it operates. When simulating system operation, models are design to mimic as close as possible a real-life decision making of water managers and facility operators by employing a set of rules and considerations for system limits and constraints. In the case of temperature control, rules and considerations could include: Are there ramping rates (how fast to increase or decrease releases from the dam when operating for temperature control)? How much water should be released before operators' give-up the ability to lower temperature to meet the target? Should releases for temperature control be made at all if the temperature outflow from the dam already exceed the target (but yet could improve temperature conditions at the target)? Should a minimum storage volume in the reservoirs be defined as a threshold for ceasing temperature control?

84. To the best of my knowledge, none of the above mentioned rules and considerations are mentioned as part of Action III.1.2, only temperature targets and the fact the water should be released to meet those targets. To me it appears that there is disconnect between Action III.1.2 and the practical aspects of this action, or, at best, that Action III.1.2 is simply

incomplete

85. Figures 8 to 12 show the results for the above-mentioned analysis, as follows:

86. Figure 8 shows the New Melones storage under cases 2E and 2EA. The figure shows that New Melones storage would be depleted by as much as 717 TAF during the 1987-1995.

87. Figure 9 shows the amount of water needed on a monthly and annual basis for temperature control. The figure shows that the annual amount would vary between 22 TAF and 190 TAF with average amount equal to almost 84 TAF.

88. Figure 10 shows the effectiveness of the temperature control: In the summer, temperature at OBB could be reduced down to the target levels as measured using the 7DADM criterion. However, the model shows that an additional 1000 cfs would not be sufficient to lower the temperature to the target in the spring and fall.

89. Figure 11 shows that successive operation for temperature would eventually cease to be effective as New Melones' cold pool of water would be depleted. In other words, conserving water in New Melones by limiting releases in the spring and fall, when the ability to reduce the temperature to the target is questionable, could be a more effective way for temperature control in the long run.

90. Figure 12 shows that even after operating for temperature control (from 2E to 2EA), there are still significant violations of the target temperatures.

91. **In conclusion – The USBR Temperature Model failed to provide the level of analysis necessary to allow the regulatory agencies to realize all the impacts associated with imposing the terms and conditions set forth in Action III.1.2.**

92. **In contrast, the SJRWTM is the most advanced temperature model that has ever been developed for the Stanislaus and the San Joaquin River, as whole. The SJRWTM was designed to directly address all the implications associated with temperature response to flow and storage in the system thus providing a realistic check about what can and cannot be achieved as far as temperature control is concerned. Also, the SJRWTP has a built-in logic to model the old-new dam interaction. This unique feature is especially important when operating the system more aggressively, as appears to be the case when**

operating for temperature control per Action III.1.2 of the BO, because as the water level in New Melones approaches the crest of the old dam, the cold pool of water behind the old dam is isolated and cannot be released for temperature control. Instead, warmer water is skimmed of the top layer of the pool behind the old dam, which exacerbates the thermal condition downstream. Based on the information in the record describing the USBR Temperature Model, there is nothing to suggest that the USBR Temperature Model has the capability to address this issue.

93. **It should be noted that in 2006, in the peer review report of the OCAP, the panel addressed the weaknesses of monthly time-step models when applied to the needs of anadromous fish. The panel also identified the Stanislaus River Temperature Model as the preferred model for this task.**

94. **The Stanislaus River Temperature Model and then the SJRWTP were available to the Federal Defendants for almost six years. Unfortunately, they have not been used by the very same people who funded, supported and actively participated in their development since their infancy. Instead, the Federal Defendants have chosen an inferior model that raises more doubts about the validity of the results then insightful information that could lead to making informed decisions.**

95. **Beyond my conclusion that temperature targets are not attainable a significant amount of time, Action III.1.2 also has number of deficiencies that surfaced during my water temperature investigation and modeling. Action III.1.2 lacks in my opinion, basic rules, guidelines and constraints as to how the system should be operated for temperature control. There is disconnect between Action III.1.2 and the practical aspects of this action, or at best, Action III.1.2 is simply incomplete.**

Executed this 5th of August, 2010 in Moraga, California.

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AVRY DOTAN

IDENTIFICATION OF COUNSEL:

JEANNE M. ZOLEZZI, SBN: 121282
KARNA E. HARRIGFELD, SBN: 162824
JENNIFER L. SPALETTA, SBN: 200032
ALEXIS GALBRAITH, SBN: 260756
HERUM \ CRABTREE
A California Professional Corporation
2291 West March Lane, Suite B100
Stockton, CA 95207
Telephone: (209) 472-7700

Attorneys for Plaintiff
STOCKTON EAST WATER DISTRICT

TIM O'LAUGHLIN
WILLIAM C. PARIS III
KENNETH PETRUZZELLI
KATIE J. SHEA
O'LAUGHIN & PARIS LLP
2571 California Park Drive, Suite 210
Chico, CA 95928
Telephone: (530) 899-9755
Facsimile: (530) 899-1367

Attorneys for Plaintiffs
OAKDALE IRRIGATION DISTRICT and
SOUTH SAN JOAQUIN IRRIGATION DISTRICT

MODELING DEMONSTRATES THAT NEW MELONES IS INCAPABLE OF REALSING SUFFICIENT WATER TO MEET THE REQUIREMENTS OF RPA ACTION III.1.2

Action III.1.2 requires USBR to make cold water releases from New Melones to provide suitable temperatures for CV steelhead. (BO, p. 621). The compliance point is at Orange Blossom Bridge (OBB) downstream of Goodwin Dam, and temperature compliance shall be measured based on a seven (7) day average daily maximum temperature (7DADM). (BO, p. 622).

1. USBR used the Reclamation Temperature Model (not provided in the AR, described in Appendix H to the 2008 OCAP BA) to evaluate feasibility of meeting the temperature criteria.
    a. The Reclamation model was not peer reviewed. (H-6)
    b. The Reclamation model present temperature on a mean monthly basis, and cannot depict daily maximums or 7DADM. (H-9; Milligan Decl., ¶ 12)
    c. The Reclamation model does not capture diurnal temperature variability. (Milligan Decl., ¶ 12).
    d. Reclamation model cannot simulate actual operations strategies used to meet temperature objectives. (Milligan Decl., ¶ 12).
    e. No modeling was done to assess potential impacts on storage due to flows released for temperature compliance. (Reed Decl., ¶ 30).
    f. NMFS/USBR did not quantify how much water would need to be released to meet temperature. (Reed Decl., ¶ 31).

2. Modeling performed using the Reclamation model showed that there will be temperature exceedances. (BO, p. 622; US Reply Br., p. 132; Reed Decl. ¶ 25).

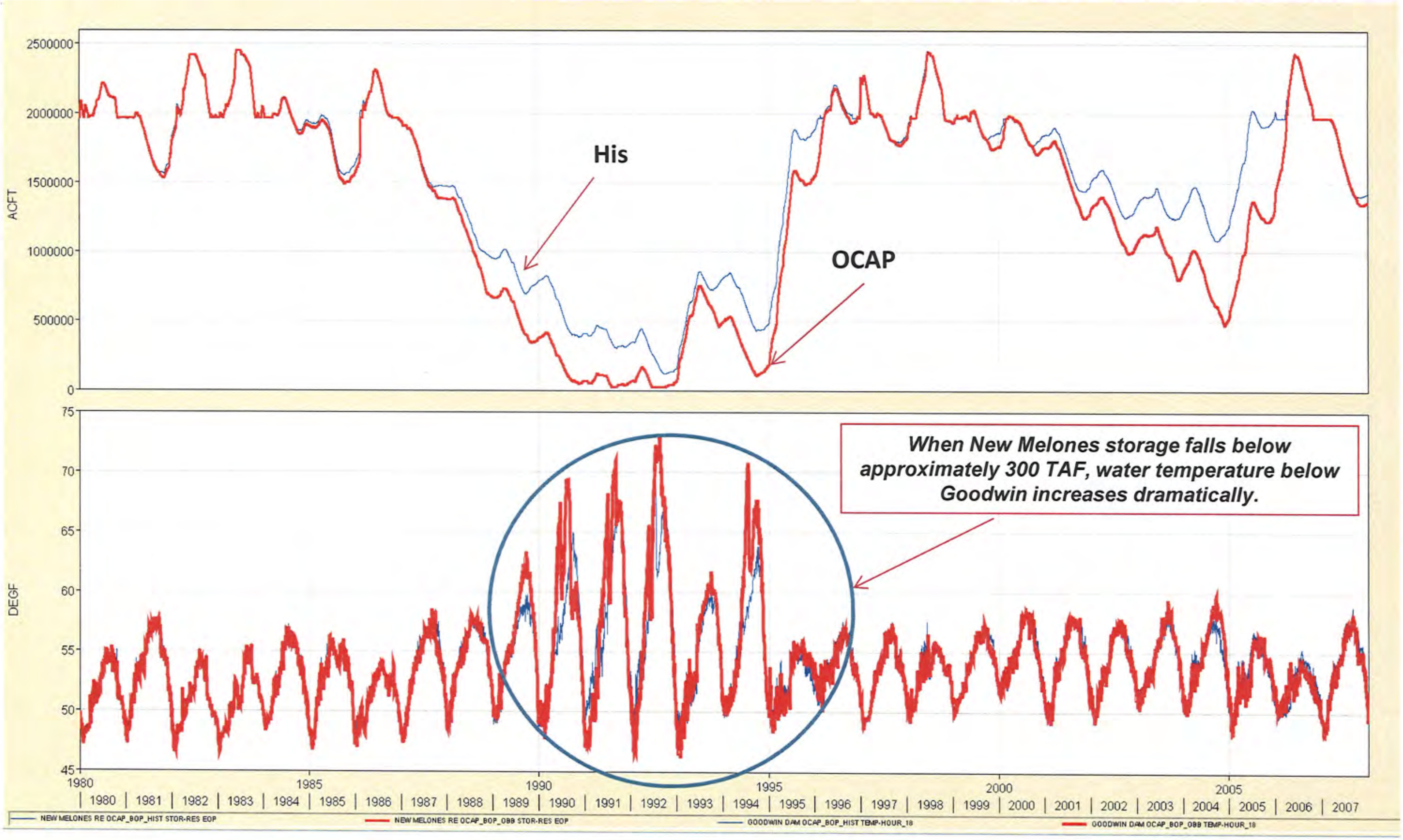
3. Dotan replicated the use of the Reclamation model using the San Joaquin River Water Temperature Model (SJRWTM). (Dotan Decl., ¶ ¶ 60-77).
    a. The model run shows that there are temperature exceedances in every month except December, January and February, exceedances occur more than 25% of the time in the months of May, July, October and November, and 92% of the time in October. (Dotan Decl., ¶¶ 73-77, Fig. 7).
    b. Dotan ran same data using the SJRWTM, which has a 6 hour timestep. Those runs found exceedances in all months except December and January, exceedances occur more than 18% of the time in the months of March, April, May, June, July, August, September, October and November, and exceedances of more than 40% of the time occur in the months of April, May, July, and October. (Dotan Decl., Fig. 7).

4. Dotan used the SJRWTM to model impacts to New Melones storage in releasing water to meet temperature requirement. Dotan modeled the required Appendix 2E flows, and ordered the model to use up to an additional 1,000 cfs to meet temperature. (Dotan Decl., ¶ 82).
    a. In the period 1987-1995, New Melones storage would need to be depleted by as much as 717,000 AF when compared with required 2E releases to meet temperature. (Dotan Decl., ¶ 86, Fig. 8).
    b. Even using up to an additional 1000 cfs does not result in 100% compliance. Still exceedances occur in every month except January, with exceedances occurring

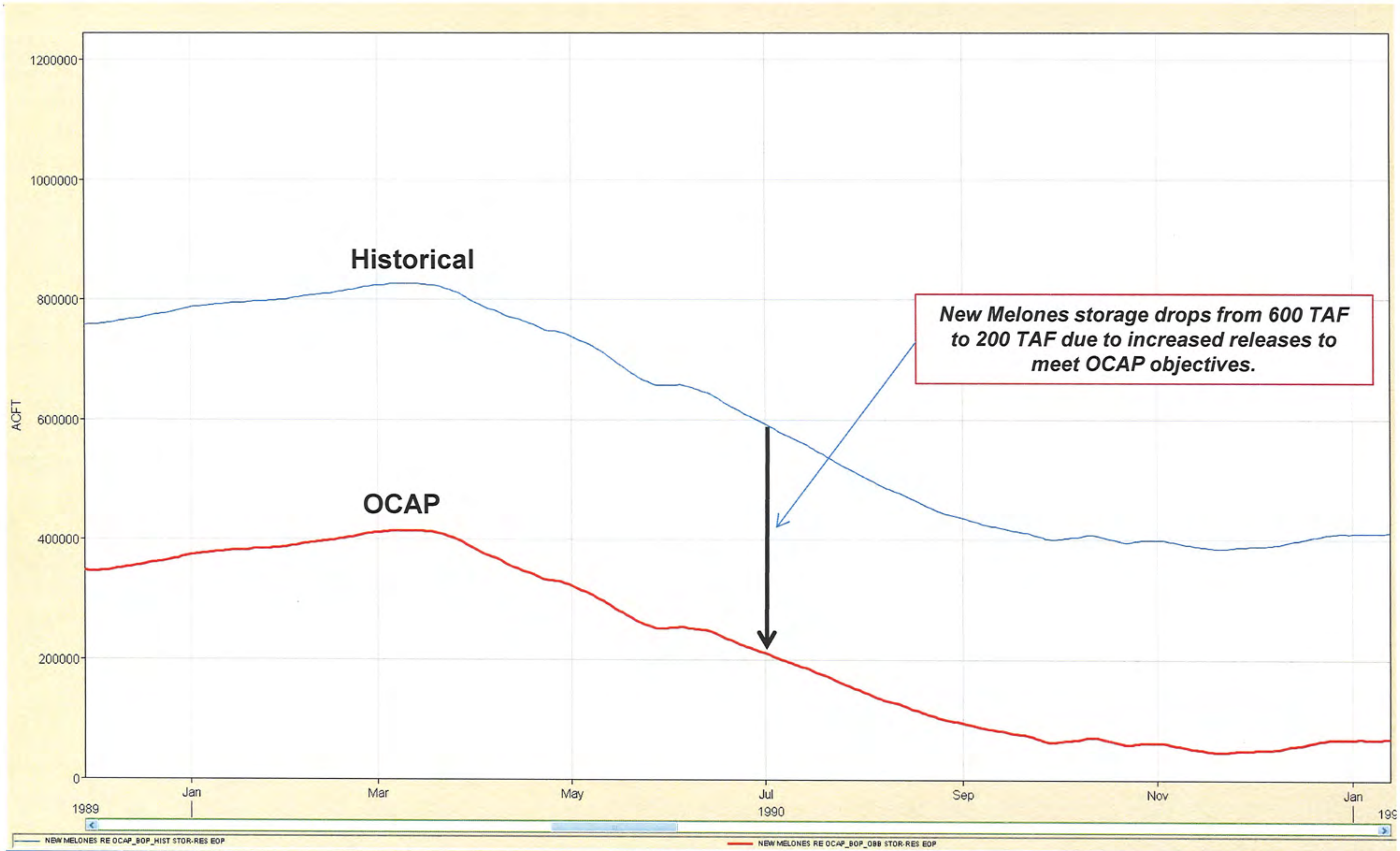
25% of the time or more in March, April, May, June, July, August, and October. (Dotan Decl., ¶ 90, Fig. 12).

c. Successive operation to meet temperature will eventually deplete cold water pool. (Dotan Decl., ¶ 89, Fig. 11).

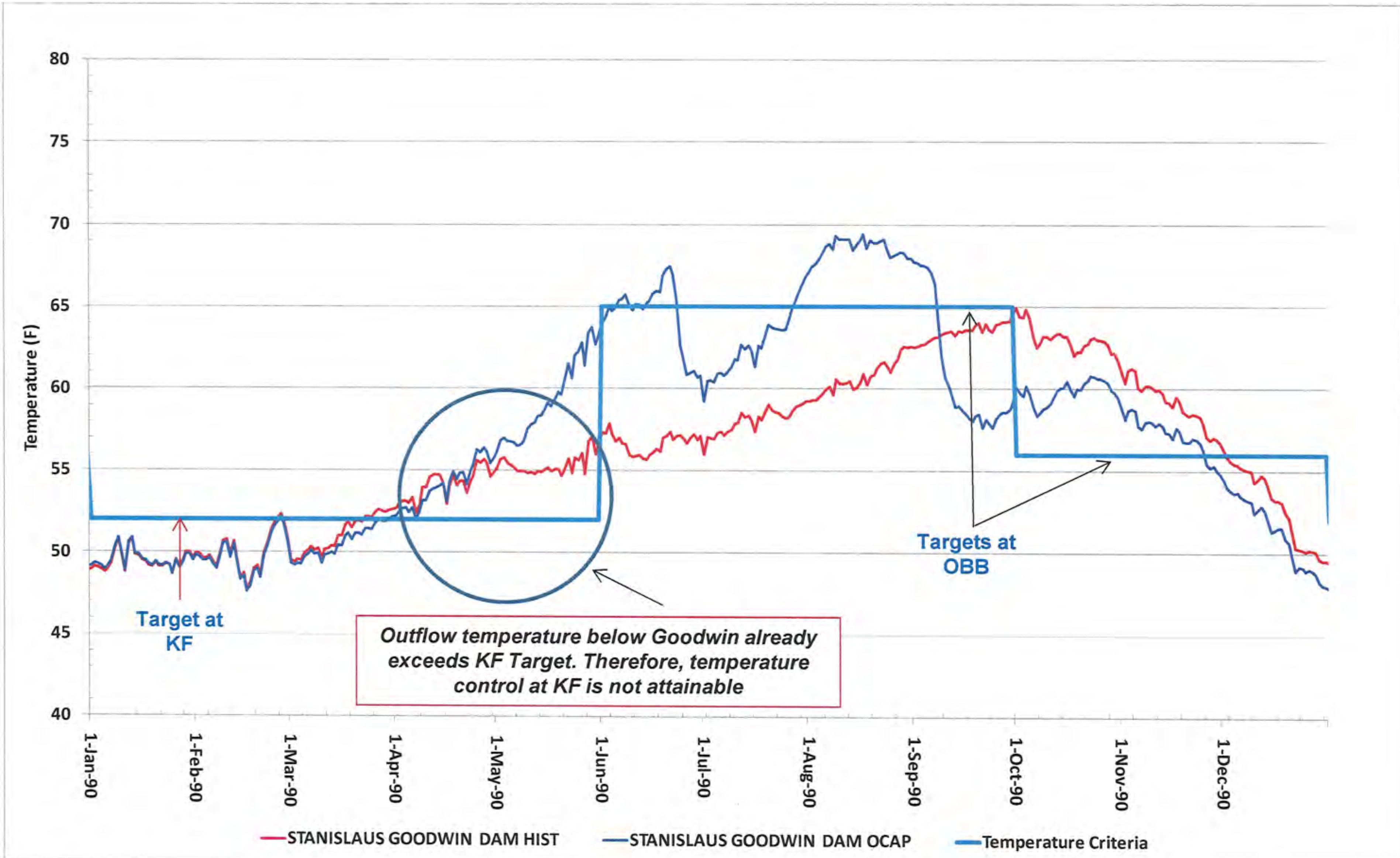
New Melones Storage is depleted due to increased releases above Historical to meet OCAP Temperature Targets (1980-2007)



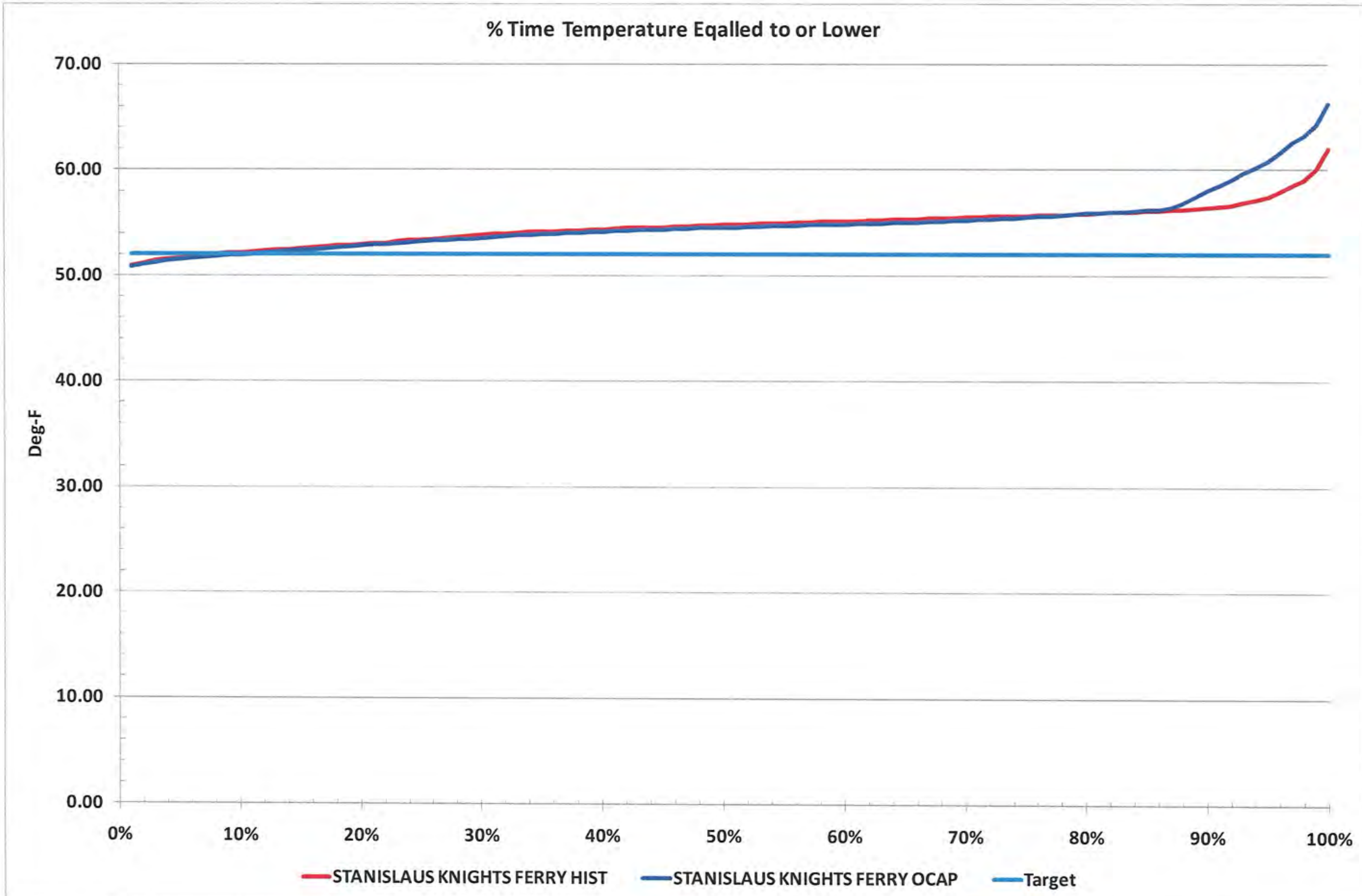
New Melones Storage - Critical Year 1990



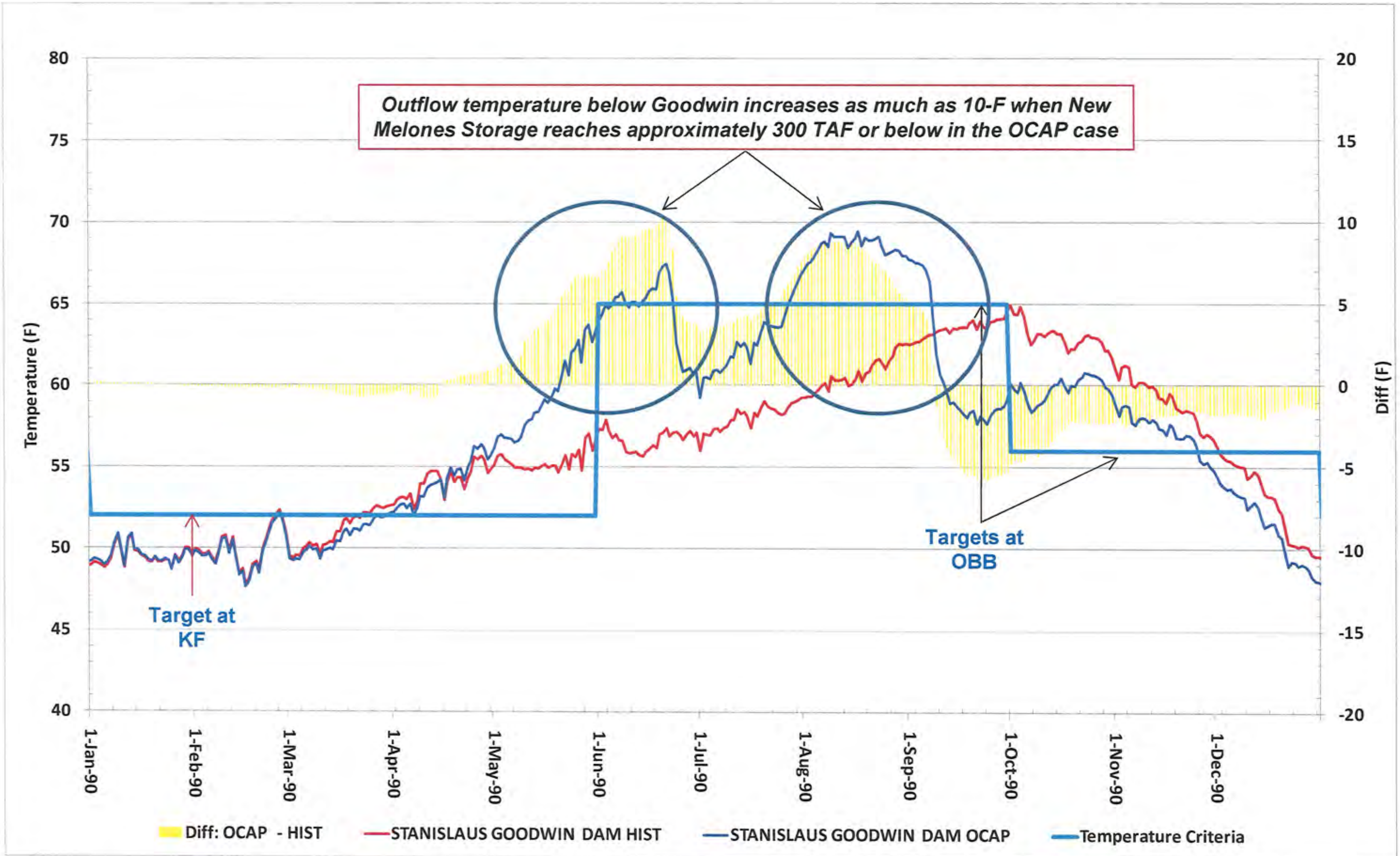
Temperature Below Goodwin Dam in Relation to Target Temperature at Knights Ferry (KF) and Orange Blossom Bridge (OBB)
Example: 1990 (similar phenomenon would occur 90% of the time)



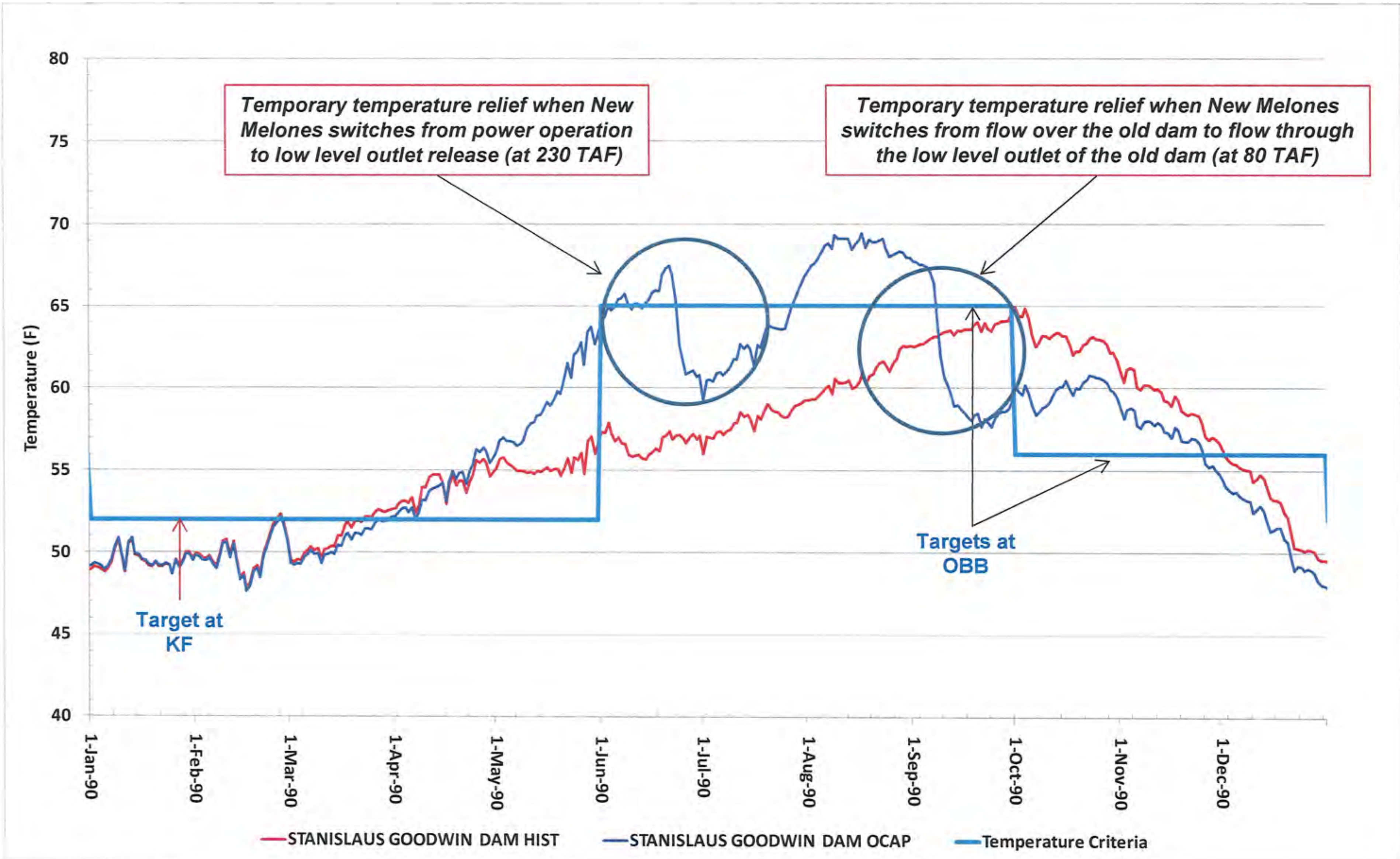
Target temperature at Knights Ferry can be met only about 10% of the time in the month of May with or without flow augmentation



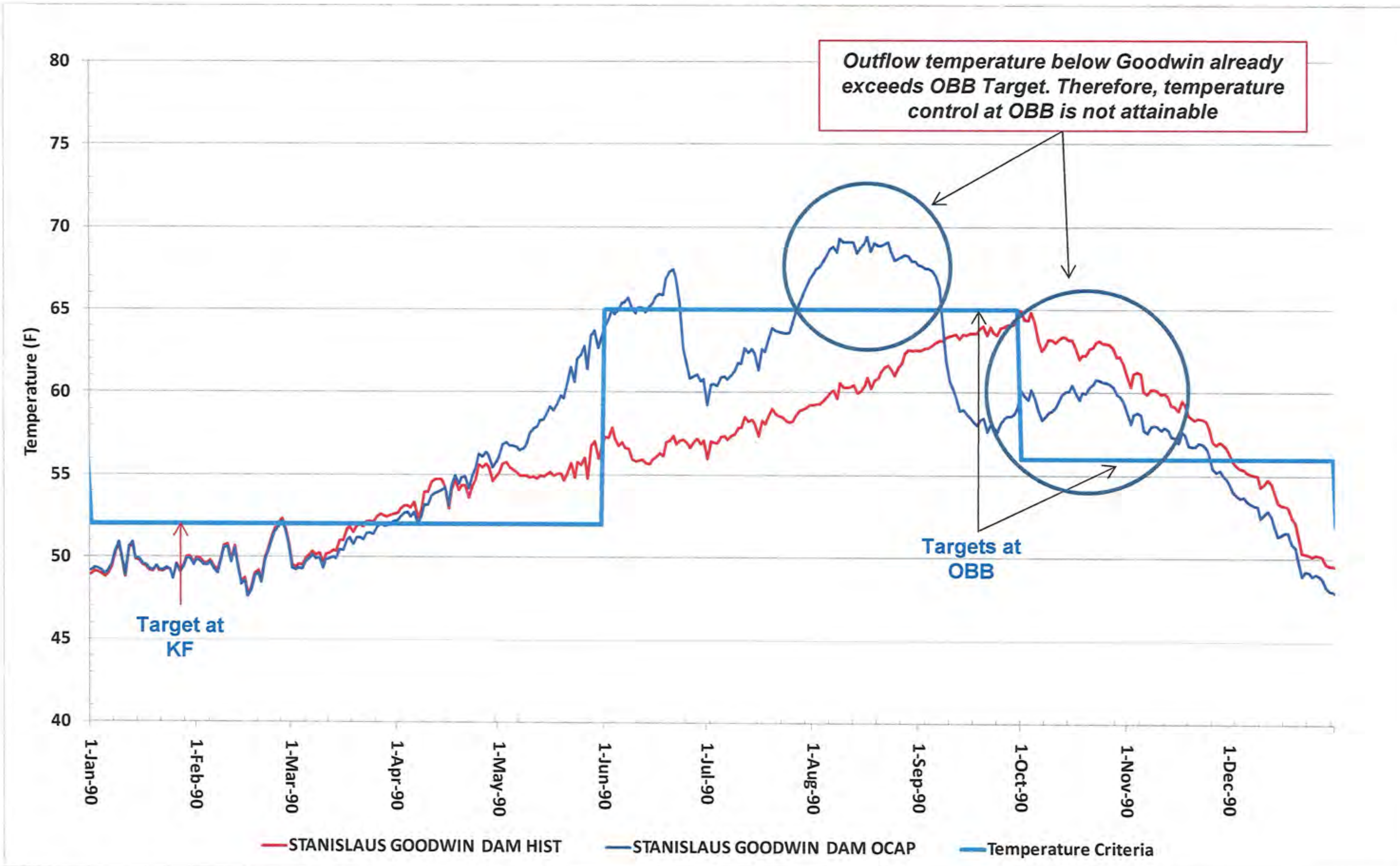
Temperature Below Goodwin Dam in Relation to Target Temperature at Knights Ferry (KF) and Orange Blossom Bridge (OBB)
Example: 1990



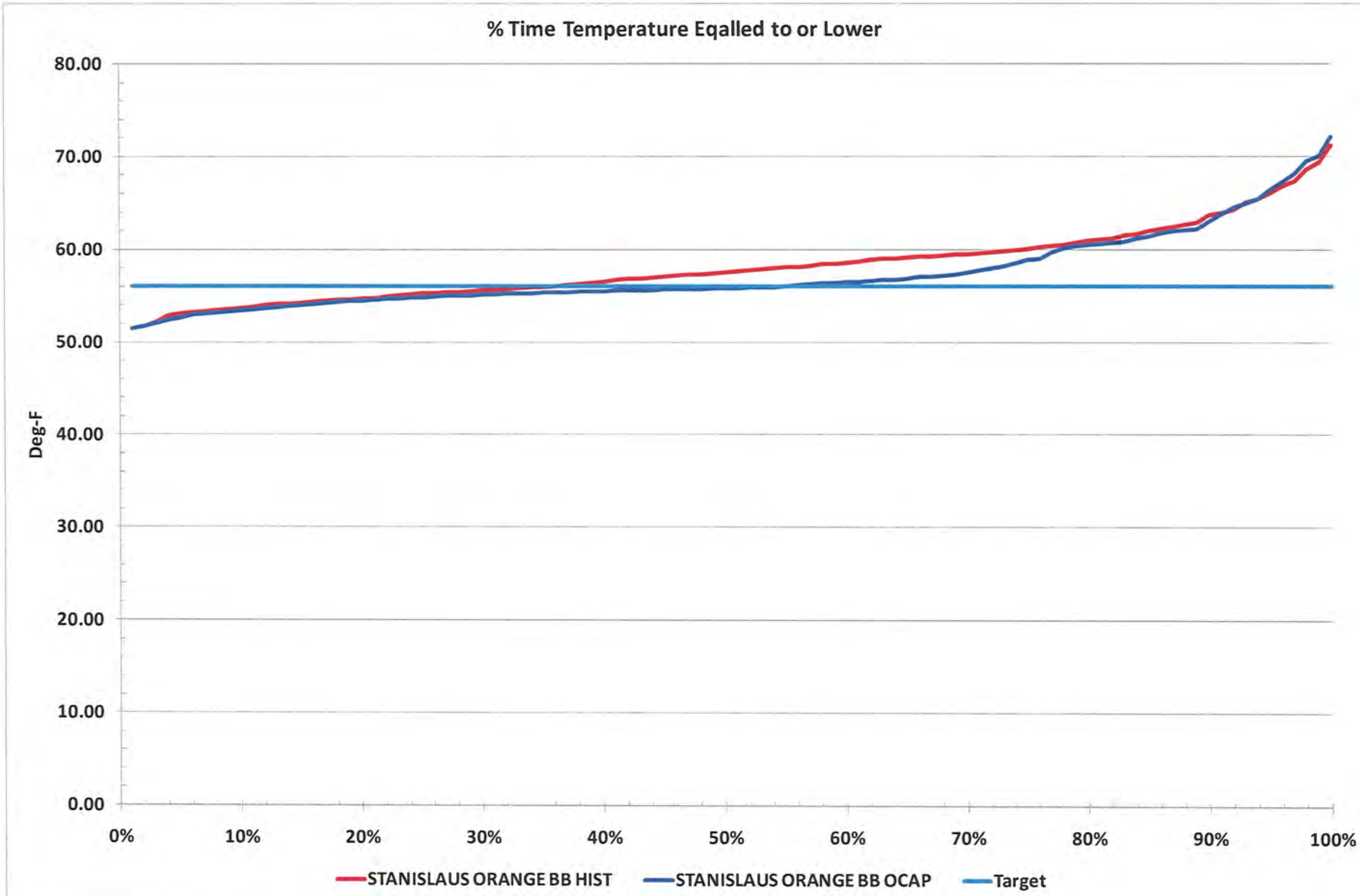
Temperature Below Goodwin Dam in Relation to Target Temperature at Knights Ferry (KF) and Orange Blossom Bridge (OBB)
Example: 1990



Temperature Below Goodwin Dam in Relation to Target Temperature at Knights Ferry (KF) and Orange Blossom Bridge (OBB)
Example: 1990



Target temperature at Orange Blossom Bridge can be met only about 50% of the time in the month of October even after flow augmentation (about 15% increase over Historical)



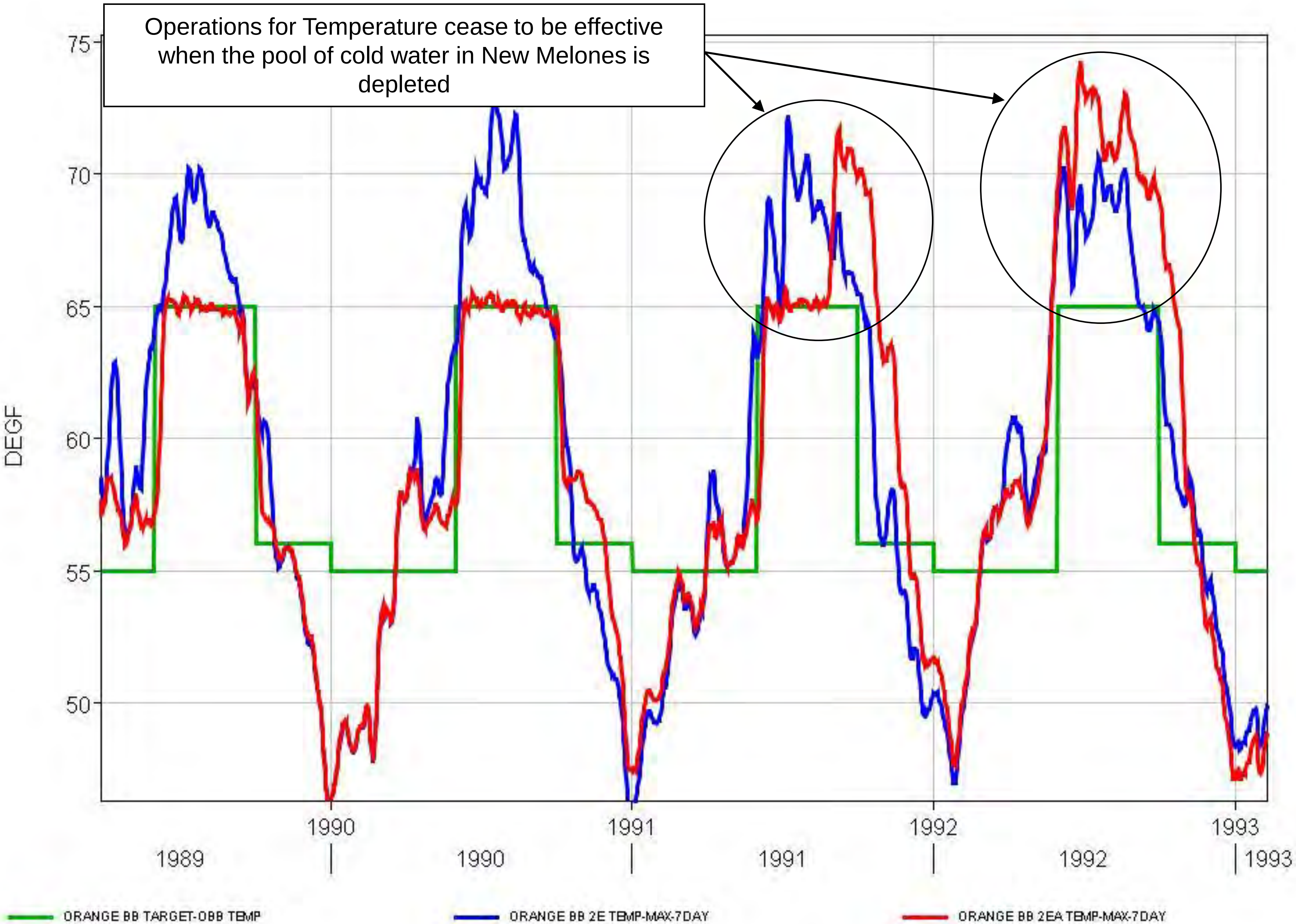
16%	47.5	46.3	49.1	47.3	50.9	49.5	51.8	48.8	53.3	50.7	55.2	54.5	60.7	60.6	60.4	61.2	58.0	58.7	54.4	57.8	52.3	53
18%	47.6	46.3	49.2	48.6	51.2	49.7	52.0	49.3	53.5	50.9	55.5	54.6	61.1	61.8	60.7	61.2	58.7	60.2	54.6	57.8	52.5	53
20%	47.7	46.3	49.3	48.6	51.3	49.7	52.2	49.3	53.6	50.9	55.7	54.6	61.5	61.8	61.0	61.2	59.0	60.2	54.7	58.1	52.6	55
22%	47.8	46.4	49.4	48.7	51.4	49.7	52.5	49.5	53.7	51.9	55.8	55.8	61.9	62.0	61.3	62.0	59.3	60.9	54.8	58.1	52.7	55
24%	47.9	46.4	49.6	48.7	51.6	49.7	52.7	49.5	54.1	51.9	56.1	55.8	62.2	62.0	61.5	62.0	59.5	60.9	55.0	58.1	53.0	55
26%	48.0	46.4	49.6	48.8	51.7	49.7	52.9	49.5	54.3	52.0	56.5	55.9	62.5	62.0	61.8	62.1	59.8	61.1	55.1	58.1	53.2	55
28%	48.1	47.1	49.7	48.8	51.9	50.1	53.1	49.7	54.4	53.0	56.8	56.3	62.6	62.3	61.9	62.8	60.1	62.2	55.2	58.7	53.4	55
30%	48.2	47.1	49.8	48.8	52.0	50.1	53.3	49.7	54.6	53.0	57.1	56.3	62.7	62.3	62.1	62.8	60.3	62.2	55.3	58.7	53.5	55
32%	48.3	47.5	49.9	48.9	52.2	50.4	53.4	50.1	54.8	53.1	57.3	57.1	62.9	62.6	62.2	63.2	60.4	62.4	55.4	58.9	53.7	55
34%	48.4	47.5	49.9	48.9	52.3	50.4	53.6	50.1	54.9	53.1	57.5	57.1	63.0	62.6	62.4	63.2	60.6	62.4	55.6	58.9	53.8	55
36%	48.5	47.8	50.0	49.2	52.4	50.8	53.7	50.5	55.1	53.7	57.6	57.9	63.2	62.6	62.5	63.2	60.8	62.8	55.7	58.9	53.9	55
38%	48.6	47.8	50.1	49.2	52.5	50.8	53.8	50.5	55.3	53.7	57.9	57.9	63.5	62.6	62.6	63.2	60.9	62.8	55.8	59.2	54.1	55
40%	48.6	48.1	50.2	49.6	52.6	51.0	54.0	50.6	55.4	54.2	58.0	58.6	63.8	62.8	62.8	63.2	61.0	62.9	56.0	59.2	54.2	55
42%	48.7	48.1	50.3	49.6	52.7	51.0	54.1	50.6	55.6	54.2	58.2	58.6	63.9	62.8	62.9	63.2	61.1	62.9	56.2	59.2	54.3	55
44%	48.8	48.1	50.5	49.8	52.8	51.4	54.2	51.6	55.7	55.5	58.4	58.7	64.1	63.1	63.1	63.3	61.2	63.0	56.3	59.2	54.5	55
46%	48.9	48.1	50.5	49.8	52.9	51.4	54.3	51.6	55.9	55.5	58.8	58.7	64.3	63.1	63.3	63.3	61.3	63.0	56.4	59.2	54.5	55
48%	49.0	48.1	50.6	50.1	53.0	51.5	54.5	51.9	56.0	55.5	59.6	61.5	64.4	63.2	63.4	63.3	61.5	63.3	56.6	59.2	54.6	55
50%	49.0	48.1	50.7	50.1	53.2	51.5	54.6	51.9	56.2	55.5	60.2	61.5	64.6	63.2	63.6	63.3	61.7	63.3	56.7	59.4	54.7	56
52%	49.1	48.1	50.8	50.2	53.3	51.5	54.8	51.9	56.3	55.5	60.9	61.5	64.7	63.2	63.7	63.3	61.7	63.3	56.8	59.5	54.8	56
54%	49.2	48.2	51.0	50.2	53.4	51.7	54.9	53.2	56.5	55.9	61.6	61.7	64.9	63.4	63.9	63.8	61.9	63.7	57.0	59.5	54.9	56
56%	49.3	48.2	51.1	50.2	53.5	51.7	55.0	53.2	56.6	55.9	62.1	61.7	65.0	63.4	63.9	63.8	62.1	63.7	57.2	59.6	54.9	56
58%	49.3	48.2	51.3	50.5	53.6	52.3	55.1	53.2	56.8	56.2	62.4	61.8	65.1	63.7	64.1	63.9	62.3	63.9	57.3	59.6	55.1	56
60%	49.4	48.2	51.3	50.5	53.8	52.3	55.2	53.2	56.9	56.2	62.8	61.8	65.1	63.7	64.2	63.9	62.4	63.9	57.5	59.7	55.2	56
62%	49.5	48.6	51.4	50.6	54.0	52.4	55.3	53.2	57.1	56.6	63.1	62.0	65.3	64.7	64.3	64.0	62.5	64.2	57.8	59.7	55.3	56
64%	49.6	48.6	51.6	50.6	54.1	52.4	55.5	53.2	57.3	56.6	63.4	62.0	65.4	64.7	64.5	64.0	62.7	64.2	57.9	59.7	55.4	56
66%	49.7	48.8	51.7	50.8	54.2	52.8	55.6	53.5	57.4	56.8	63.7	62.9	65.5	64.7	64.6	64.2	62.8	64.4	58.1	59.7	55.6	56
68%	49.8	48.8	51.8	50.8	54.4	52.8	55.8	53.5	57.6	56.8	64.0	62.9	65.6	64.7	64.7	64.2	63.0	64.4	58.3	59.7	55.8	56
70%	49.9	49.2	51.9	51.5	54.6	53.3	55.9	53.8	57.8	57.3	64.2	63.1	65.7	65.1	64.8	64.3	63.2	64.4	58.6	60.3	55.9	56
72%	50.0	49.2	52.0	51.5	54.7	53.3	56.1	53.8	58.0	57.3	64.4	63.1	65.9	65.1	64.9	64.3	63.4	64.4	59.0	60.3	56.1	56
74%	50.1	49.2	52.2	51.6	54.8	53.6	56.3	54.4	58.2	57.4	64.5	63.9	66.0	65.3	65.1	64.5	63.7	64.7	60.0	60.7	56.3	56
76%	50.2	49.4	52.3	51.6	55.0	53.6	56.5	54.5	58.4	57.4	64.7	64.0	66.2	65.3	65.1	64.5	64.1	64.7	60.3	60.7	56.4	56
78%	50.3	49.4	52.4	51.6	55.1	53.6	56.6	54.5	58.6	57.4	64.9	64.0	66.4	65.3	65.3	64.5	64.3	64.7	60.6	61.1	56.7	57
80%	50.5	49.7	52.5	51.7	55.4	54.1	56.8	54.6	58.8	57.5	65.1	64.0	66.5	65.6	65.5	64.8	64.8	64.7	60.9	61.1	56.9	57
82%	50.7	49.7	52.7	51.7	55.6	54.1	57.1	54.6	59.0	57.5	65.3	64.0	66.7	65.6	65.7	64.8	65.1	64.7	61.3	61.8	57.1	57
84%	50.8	49.8	53.0	51.9	55.9	54.2	57.3	54.8	59.3	57.6	65.5	64.1	66.9	65.8	66.0	65.3	65.6	65.0	61.8	61.8	57.4	57
86%	51.0	49.8	53.1	51.9	56.1	54.2	57.6	54.8	59.5	57.6	65.8	64.1	67.2	65.8	66.4	65.3	66.2	65.0	62.0	61.8	57.6	57
88%	51.2	50.3	53.3	51.9	56.3	54.4	57.8	55.8	59.7	58.6	66.0	64.3	67.5	66.0	67.1	65.3	68.2	65.5	63.0	62.1	58.0	57
90%	51.5	50.3	53.6	51.9	56.6	54.4	58.0	55.8	60.1	58.6	66.3	64.3	67.8	66.0	67.8	65.3	68.6	65.5	64.0	62.1	58.3	57
92%	51.7	50.9	54.0	53.1	57.0	54.7	58.3	56.2	60.5	58.8	66.6	65.5	68.3	66.1	69.1	66.0	68.9	66.6	65.2	64.5	58.6	58
94%	52.0	50.9	54.3	53.1	57.4	54.7	58.5	56.2	61.1	58.8	67.0	65.5	69.4	66.1	69.8	66.0	69.2	66.6	66.2	64.5	59.1	58
96%	52.4	52.1	54.8	54.0	58.2	56.6	58.9	57.5	63.4	61.6	67.4	65.8	70.1	68.3	70.7	66.2	69.5	68.3	66.8	65.9	60.2	59
98%	53.2	52.1	55.1	54.0	59.0	56.6	60.0	57.5	65.4	61.6	68.0	65.8	70.9	68.3	71.6	66.2	69.9	68.3	67.4	65.9	61.9	59
100%	53.9	52.1	58.4	54.0	60.8	56.6	63.9	57.5	67.6	61.6	69.6	65.8	74.0	68.3	73.1	66.2	71.0	68.3	69.7	65.9	63.3	59
Case	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NMFS	5Q	NM
Target	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	56.0	56.0	56.0	56

Above target   Below Target

Case 1:09-cv-01053-LJO-DLB Document 442-15 Filed 08/06/10 Page 1 of 1

Figure - 11

Augmentation for Temperature from 2E to 2EA

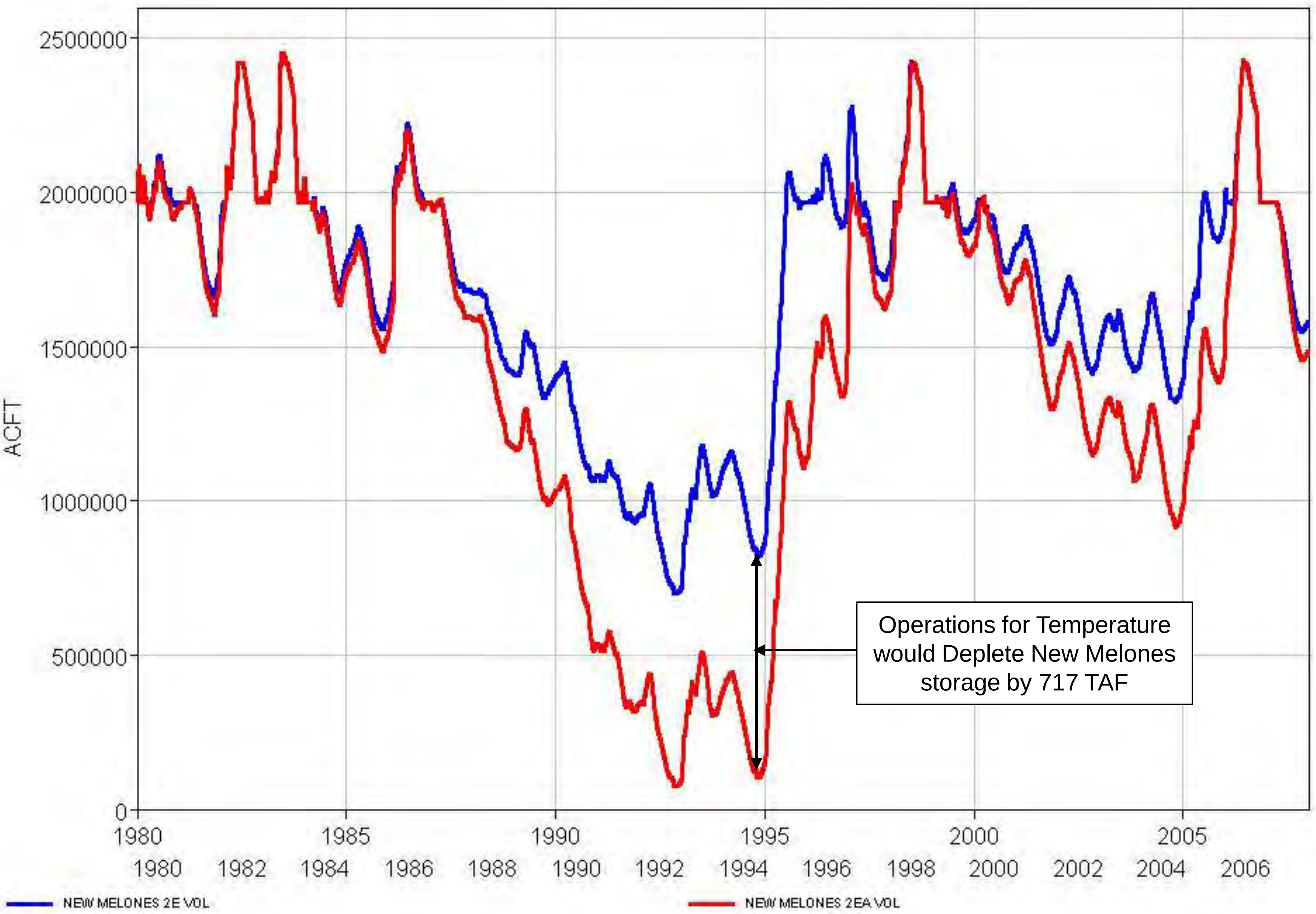


16%	47.6	47.5	49.2	49.1	50.8	50.5	52.5	52.2	54.3	54.1	55.7	55.6	60.8	60.3	60.9	60.9	58.8	58.9	54.0	53.7	51.8	
18%	47.8	47.7	49.4	49.2	51.0	50.7	52.7	52.4	54.5	54.3	56.0	55.8	61.0	60.6	61.1	61.0	59.0	59.0	54.1	54.0	51.9	52
20%	47.9	47.8	49.4	49.3	51.2	51.0	52.9	52.6	54.6	54.4	56.3	56.2	61.4	61.1	61.2	61.2	59.3	59.3	54.3	54.3	52.1	52
22%	48.1	47.9	49.5	49.4	51.4	51.1	53.2	52.7	54.8	54.6	56.6	56.4	61.6	61.4	61.4	61.4	59.4	59.4	54.4	54.5	52.2	52
24%	48.2	48.1	49.7	49.5	51.6	51.3	53.3	52.9	54.9	54.7	56.8	56.6	61.9	61.9	61.5	61.5	59.6	59.7	54.6	54.7	52.3	52
26%	48.3	48.2	49.8	49.5	51.7	51.5	53.4	53.1	55.0	54.8	57.0	56.7	62.2	62.2	61.7	61.8	59.7	59.9	54.8	54.9	52.5	52
28%	48.4	48.3	49.9	49.6	51.9	51.6	53.6	53.3	55.2	54.9	57.2	57.0	62.5	62.4	61.9	62.1	59.8	60.1	55.0	55.0	52.6	52
30%	48.5	48.4	50.0	49.8	52.1	51.8	53.8	53.5	55.4	55.1	57.4	57.2	62.7	62.7	62.1	62.3	60.0	60.3	55.2	55.2	52.8	52
32%	48.6	48.4	50.1	49.9	52.2	52.0	54.0	53.7	55.5	55.2	57.6	57.4	63.0	63.0	62.3	62.5	60.1	60.5	55.3	55.3	52.9	53
34%	48.6	48.5	50.1	50.0	52.3	52.1	54.1	53.8	55.6	55.3	57.8	57.6	63.2	63.2	62.4	62.7	60.3	60.7	55.5	55.4	53.1	53
36%	48.7	48.6	50.2	50.1	52.4	52.3	54.3	54.0	55.7	55.4	58.0	57.8	63.4	63.5	62.6	62.9	60.5	60.9	55.6	55.5	53.1	53
38%	48.8	48.7	50.3	50.2	52.5	52.4	54.4	54.2	55.8	55.5	58.2	58.0	63.7	63.7	62.9	63.2	60.7	61.0	55.8	55.6	53.3	53
40%	48.9	48.8	50.4	50.3	52.6	52.6	54.5	54.3	55.9	55.7	58.4	58.1	63.9	64.0	63.1	63.4	60.9	61.2	55.9	55.6	53.4	53
42%	48.9	48.8	50.5	50.4	52.8	52.7	54.7	54.4	56.0	55.8	58.6	58.3	64.2	64.2	63.4	63.7	61.0	61.4	56.0	55.7	53.5	53
44%	49.0	48.9	50.6	50.6	52.9	52.8	54.8	54.6	56.0	55.9	58.9	58.6	64.6	64.4	63.6	63.8	61.2	61.5	56.1	55.8	53.6	53
46%	49.0	49.0	50.7	50.7	53.0	53.0	55.0	54.8	56.2	56.0	59.6	58.9	65.0	64.6	63.8	64.0	61.4	61.6	56.2	55.9	53.7	53
48%	49.1	49.0	50.8	50.7	53.1	53.1	55.2	55.1	56.4	56.1	60.5	59.4	65.3	64.7	64.1	64.2	61.5	61.8	56.4	55.9	53.8	53
50%	49.1	49.1	50.9	50.8	53.3	53.3	55.3	55.2	56.5	56.2	61.5	60.0	65.9	64.7	64.3	64.3	61.6	61.9	56.5	56.0	53.9	54
52%	49.2	49.2	51.0	51.0	53.4	53.4	55.5	55.4	56.7	56.3	62.9	60.5	66.3	64.8	64.5	64.4	61.8	62.0	56.7	56.0	54.0	54
54%	49.3	49.3	51.1	51.1	53.5	53.5	55.6	55.5	56.8	56.4	63.9	61.0	66.5	64.8	64.6	64.5	61.9	62.2	56.9	56.1	54.1	54
56%	49.3	49.3	51.2	51.2	53.7	53.7	55.7	55.7	56.9	56.5	64.3	61.5	66.8	64.9	64.9	64.6	62.1	62.4	57.0	56.2	54.2	54
58%	49.4	49.4	51.3	51.3	53.8	53.9	55.9	55.8	57.1	56.6	64.6	62.6	67.1	64.9	65.1	64.6	62.2	62.5	57.1	56.3	54.3	54
60%	49.5	49.5	51.4	51.4	54.0	54.0	56.0	56.0	57.2	56.7	64.9	63.4	67.2	65.0	65.3	64.7	62.4	62.7	57.2	56.4	54.4	54
62%	49.5	49.6	51.4	51.5	54.2	54.2	56.2	56.0	57.5	56.8	65.2	64.0	67.4	65.0	65.5	64.7	62.6	62.9	57.3	56.6	54.4	54
64%	49.7	49.7	51.5	51.5	54.5	54.4	56.4	56.1	57.7	56.9	65.5	64.3	67.5	65.0	65.7	64.8	62.8	63.1	57.7	56.7	54.5	54
66%	49.7	49.8	51.6	51.7	54.7	54.7	56.5	56.3	57.8	56.9	65.8	64.6	67.7	65.1	66.0	64.8	62.9	63.2	57.8	56.8	54.5	55
68%	49.8	49.9	51.7	51.8	55.0	55.0	56.7	56.4	58.1	57.0	66.0	64.7	67.9	65.1	66.1	64.9	63.1	63.4	58.0	56.9	54.6	55
70%	49.9	50.0	51.9	51.9	55.3	55.2	56.8	56.6	58.3	57.1	66.2	64.8	68.1	65.1	66.3	64.9	63.3	63.7	58.2	57.1	54.7	55
72%	50.0	50.1	52.1	52.1	55.5	55.5	57.0	56.7	58.6	57.1	66.4	64.9	68.3	65.2	66.5	65.0	63.5	63.9	58.5	57.2	54.8	55
74%	50.2	50.2	52.2	52.2	55.9	55.9	57.2	56.8	58.8	57.2	66.7	65.0	68.5	65.2	66.7	65.0	63.7	64.1	58.7	57.4	54.8	55
76%	50.2	50.3	52.3	52.4	56.3	56.2	57.4	56.9	59.2	57.3	67.0	65.0	68.8	65.2	66.9	65.0	64.0	64.3	59.0	57.7	55.0	55
78%	50.3	50.4	52.5	52.6	56.6	56.5	57.6	57.0	59.6	57.4	67.2	65.1	69.0	65.3	67.1	65.1	64.2	64.5	59.2	57.9	55.1	55
80%	50.5	50.5	52.7	52.9	56.9	56.7	57.8	57.1	60.3	57.5	67.4	65.2	69.2	65.3	67.3	65.1	64.4	64.7	59.5	58.3	55.2	55
82%	50.6	50.6	52.8	53.1	57.2	56.9	58.1	57.4	61.3	57.6	67.7	65.3	69.4	65.4	67.6	65.1	64.6	64.9	59.6	58.7	55.5	55
84%	50.7	50.8	53.0	53.4	57.4	57.2	58.5	57.5	62.0	57.7	68.0	65.4	69.6	65.4	67.9	65.2	64.8	65.0	59.8	59.2	55.6	56
86%	50.9	50.9	53.2	53.5	57.7	57.4	58.9	57.8	62.5	57.8	68.1	65.5	69.8	65.5	68.1	65.3	65.0	65.8	60.1	61.4	55.8	56
88%	51.1	51.1	53.4	53.8	57.9	57.7	59.2	58.0	63.0	57.9	68.4	65.6	70.1	65.6	68.2	65.3	65.2	66.7	60.3	62.7	56.2	56
90%	51.2	51.3	53.6	53.9	58.2	57.8	59.6	58.3	63.4	58.0	68.8	65.7	70.4	65.7	68.4	65.5	65.5	68.1	60.5	63.5	56.5	57
92%	51.4	51.6	54.0	54.2	58.4	58.0	59.8	58.5	64.0	58.1	69.2	66.0	70.7	65.9	68.7	65.8	65.9	68.9	60.8	64.5	56.7	57
94%	51.6	51.8	54.3	54.5	58.8	58.3	60.3	58.8	64.4	58.4	69.5	68.3	71.1	71.2	69.0	69.5	66.2	69.6	61.2	65.4	56.9	57
96%	52.0	52.2	54.6	54.8	59.3	58.6	60.8	59.0	65.4	59.5	69.8	70.0	71.5	73.2	69.4	70.5	66.5	69.9	62.1	66.5	57.3	58
98%	52.5	52.9	55.0	55.2	60.0	59.0	61.6	59.3	67.1	66.2	70.3	71.9	72.0	74.6	70.1	71.8	68.0	70.6	63.7	68.3	57.8	61
100%	54.0	54.0	56.6	56.7	60.8	59.7	63.3	60.0	69.9	71.1	71.0	74.9	74.0	75.9	73.0	73.6	70.2	72.5	65.6	70.5	59.3	63
Case	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2EA	2E	2E
Target	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	56.0	56.0	56.0	56

Above target Below Target

Figure - 8

New Melones Storage: 2E vs. 2EA



Summary of Floodplain Modeling and Geomorphic Flows

cbec conducted modeling (SRH-2D) for a 5.7 mile reach extending from Orange Blossom Bridge (OBB; RM 46.9) to Lovers Leap (RM 52.6). This reach was selected because LiDAR and bathymetry data was available and the reach represents much of the primary juvenile salmon rearing habitat. The model was developed with the intent to (1) identify the presence, or lack thereof, of floodplain habitat along the Lower Stanislaus River that would be available for salmon rearing, and (2) understand the behavior of geomorphically significant flows in forming and maintaining the channel and transporting sediment.

Floodplain inundation modeling results indicate the following:

- Total floodplain inundation area in the modeled reach was essentially 0 acres at <3,000 cfs. A total of 35 acres was available at 5,000 cfs, and 82 acres at 8,000 cfs.
- It would take (1) at least a 2-year post-dam flow to begin to inundate some fraction of the 35 acres of near-channel floodplain; (2) at least a 5-year post-dam flow to inundate some fraction of an additional 47 acres of overflow channel floodplain; and (3) a post-dam 100-year base flood (approximately 8,000 cfs) to inundate the entire 82 acres of available floodplain. It would be expected that floodplain areas below and above 5,000 cfs would be inundated on average 19 days and 6 days, respectively, in a given year.
- Based on extrapolations, the total acreage for the entire primary rearing reach is estimated to be 85 acres at 5,000 cfs and 200 acres at 8,000 cfs. As such, the flow release schedule stated in the National Marine Fisheries Service (NMFS 2009) Biological Opinion would result in very little floodplain inundation, which will provide little benefit to salmonids, particularly in the case of steelhead since floodplain is probably "not important to steelhead… given that there is little evidence of their extensive use of floodplain habitat in California" (Moyle 2009), and their preference for mid-channel and margin habitat as observed in the Stanislaus River (FISHBIO, personal observations).
- Based on this study, much larger pulse flows (than 8,000 cfs) would be required and/or topographic manipulation (e.g., Honolulu Bar Floodplain Enhancement Project- see description below) to reconnect floodplains to the present day river.

Channel forming and maintenance flows results indicate the following:

- Based on assumption that channel maintenance flows refer to mobilization of d_{50}-sized particles and greater, flows in the 3,000-5000 cfs range may provide some limited mobilization since modeled depth-averaged shear stresses were sufficient to mobilize d50 in this range at 43% of sites (i.e., 3 of 7) analyzed.
- Based on the assumption that channel forming flows refer to mobilization of d_{84}-sized particles and greater (which is our best assumption for total mobility of the channel bed, although not necessarily indicative of channel forming flows), channel forming flows will not be achieved under existing flood control limitations (i.e., no flows greater than 8,000 cfs released). At no modeled flow (i.e., 3,000 to 8,000) was the depth-averaged shear stress above that required to mobilize d_{84}-sized material. Channel forming flows would realistically require a minimum of a 5-year pre-dam flow, and as determined by Kondolf et al. (2001), the 5-year pre-dam flow that was partially responsible for forming the river prior to gravel mining and flow regulation was 19,100 cfs.
- Mobilization of spawning gravels may actually be detrimental to existing and restored

gravel supplies within the river channel. For instance, flows in the 5,000 to 6,000 range have been observed to displace gravel from restored gravel augmentation sites below Goodwin Dam into deep, downstream pools (FISHBIO personal observations) where it is of no use to spawning and rearing fish. Due to the severe gravel deficit and existence of several deep pools in the canyon, restored gravels can be expected to be lost to these mined areas at flows greater than 5,000 cfs.

Honolulu Bar Floodplain Enhancement Project

The Honolulu Bar Floodplain Enhancement Project (RM 49 to RM 50.5) was recently completed (end of September 2012; Figure 1). It was designed to restore several aquatic and riparian habitat elements in the Stanislaus River including 2.4 acres of floodplain habitat on the inside edge of a mid-channel island, 0.7 acres of floodplain bench in the south side of the river upstream of the mid-channel island, 0.4 acres of spawning riffle in the river adjacent to the mid-channel island, 3.85+ acres of native vegetation, and increased frequency and duration of flow connectivity in one mile of side channel habitat (Figure 2). Objectives of the Project include (1) restoring seasonally inundated floodplain habitat, (2) restoring year-round rearing habitat, (3) addressing an existing adult stranding issue, (4) increasing usable spawning habitat area, (5) increasing hiding cover, velocity refugia, habitat complexity, and instream habitat types, and (6) restoring native vegetation.

Figure 1. Side channel and restored floodplain looking northeast. Approximately 4.5-6 feet of materials were removed to lower gradient to increase amount of juvenile salmon rearing habitat over a wider range of flows.

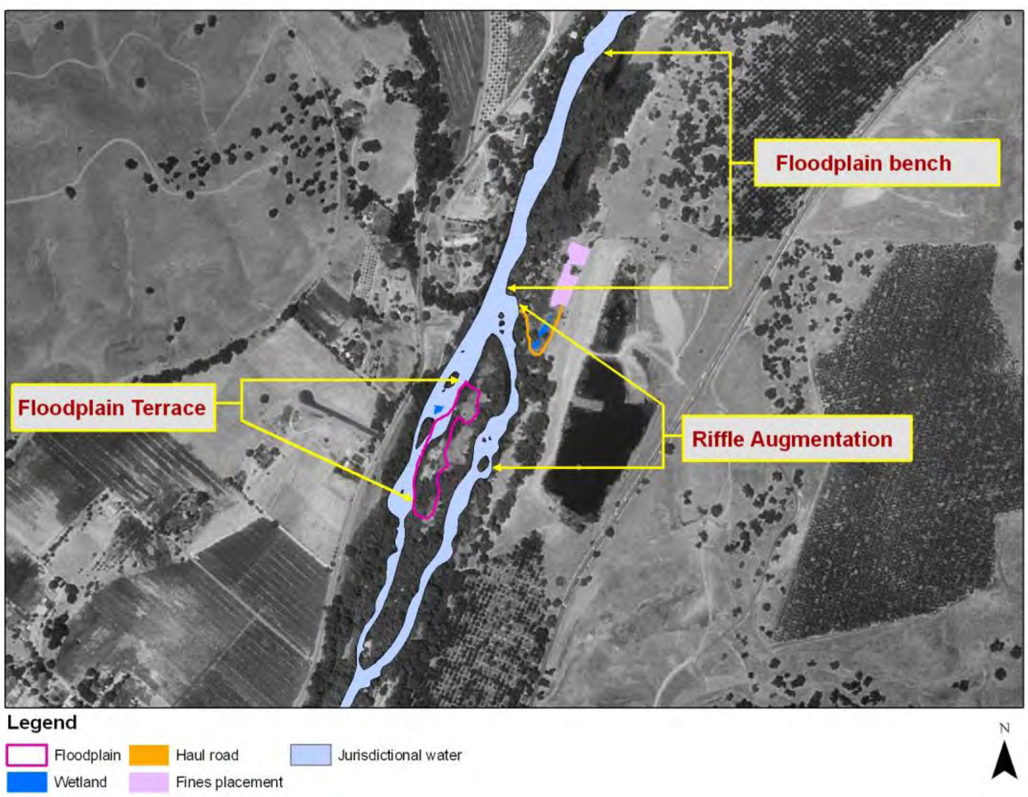


Figure 2. Honolulu Bar Floodplain Enhancement Project general footprints.

Summary of Key Findings from Stanislaus River Studies

Juvenile Migration Timing

- Juvenile Chinook migration can be temporarily stimulated by changes in flow, but the effect is short lived (few days) (Demko et al. 2001, 2000, 1996; Demko and Cramer 1995).
- Juvenile salmon migration typically begins in January and most juveniles migrate by May 15 (Table 1).
- Except in wet and above normal years, 0.7% or less of total juvenile salmon (i.e., fry, parr, and smolts), and 0.8% or less of salmon smolts outmigrate during June.
- Juvenile *O. mykiss* may be found migrating downstream throughout the year, but the majority of outmigration to the ocean occurs episodically between March and May. Based on Caswell RST catches, the majority of juvenile *O. mykiss* outmigrate by mid to late May (Table 2).

Juvenile Outmigrant Survival

- Over a decade of rotary screw trap monitoring in the Stanislaus River shows that
  - flow has a strong positive relationship with migration survival of Chinook fry (Pyper et al. 2006). Benefits to adult escapement of increased fry survival in the Stanislaus are uncertain (Baker and Morhardt 2001; SRFG 2004; SJRGA 2008; Pyper and Justice 2006).
  - abundance ratios for parr and smolts were only weakly correlated with flows (Pyper and Justice 2006).
- Smolt survival (CWT) studies conducted by CDFG at flows ranging from 600 cfs to 1,500 cfs and at 4,500 cfs have shown that smolt survival is highly variable and not improved by higher flows in the Stanislaus River (SRFG 2004; CDFG unpublished data), which is consistent with Pyper and Justice (2006) results above.

Adult upstream migration timing

- Operations at the Stanislaus River Weir (2003-2011) indicate that more than 97% of adult FRCS migrate after October 1 (Figure 1).
- Adult FRCS migration rate and timing are not dependent upon flows, water temperature or dissolved oxygen concentrations (Pyper and others 2006).
- Prolonged, high-volume fall pulse flows are not warranted, since equivalent stimulation of adult migration may be achieved through modest pulses (Pyper and others 2006). Relatively modest pulse-flow events (increase of ~200 cfs for 3 days) were found to stimulate migration for a short duration (2-3 day migration); while longer duration high-volume pulses did not substantially increase migration duration or magnitude (3-4 day migration).

Spawn timing and distribution

- The majority (98%) of Chinook salmon spawning occurs between October 15 and December 31.
- Historically, the spawning reach of the Stanislaus was described by G.H. Clark in the 1920s as extending from Knights Ferry to Oakdale, and this continues to be the reach where most spawning activity occurs. A small proportion of late-season spawning

(less than 5%) occurs down to Riverbank, and 95% of this activity occurs after November 30.

O. mykiss Abundance and Distribution

- Snorkel surveys conducted since 2002 have provided the most extensive data set on the distribution and between-year abundance of adult and juvenile *O. mykiss*. Surveys are performed bi-weekly at seven sample reaches between Goodwin Dam (RM 58.4) and Valley Oak (RM 41). Data indicate O. *mykiss* distribution is highest in the first four miles of river below Goodwin Dam–which consists primarily of high gradient canyon environment–with over 80% of the *O. mykiss* population inhabiting this reach of river.
- Summer population estimates calculated from intensive snorkel surveys between Goodwin Dam and Oakdale during 2009-2011 indicate that abundance is relatively stable across years, ranging from approximately 13,000-17,000 individuals.

Table 1. Stanislaus River juvenile Chinook salmon outmigration timing at Caswell (RM 8.6; 1998-2005).

		Wet (n=2)	Above Normal (n=2)	Below Normal (n=1)	Dry (n=3)	Critical (n=0)
Fry	Jan 1-15	0.7%	0.0%	0.0%	0.0%	-
	Jan 16-31	22.5%	12.4%	39.3%	0.1%	-
	Feb 1-15	22.6%	26.0%	3.3%	0.4%	-
	Feb 16-28	11.8%	27.4%	1.4%	14.4%	-
	Mar 1-15	8.8%	8.9%	2.9%	17.6%	-
	Mar 16-31	7.9%	7.7%	8.3%	5.3%	-
Smolt	Apr 1- 15	3.9%	4.5%	4.5%	16.3%	-
	Apr 16-30	3.9%	5.1%	26.5%	21.0%	-
	May 1-15	8.6%	3.5%	11.3%	17.8%	-
	May 16-31	7.0%	3.3%	2.5%	6.4%	-
	Jun 1- 15	2.1%	1.0%	0.1%	0.7%	-
	Jun 16-30	0.3%	0.2%	0.0%	0.0%	-

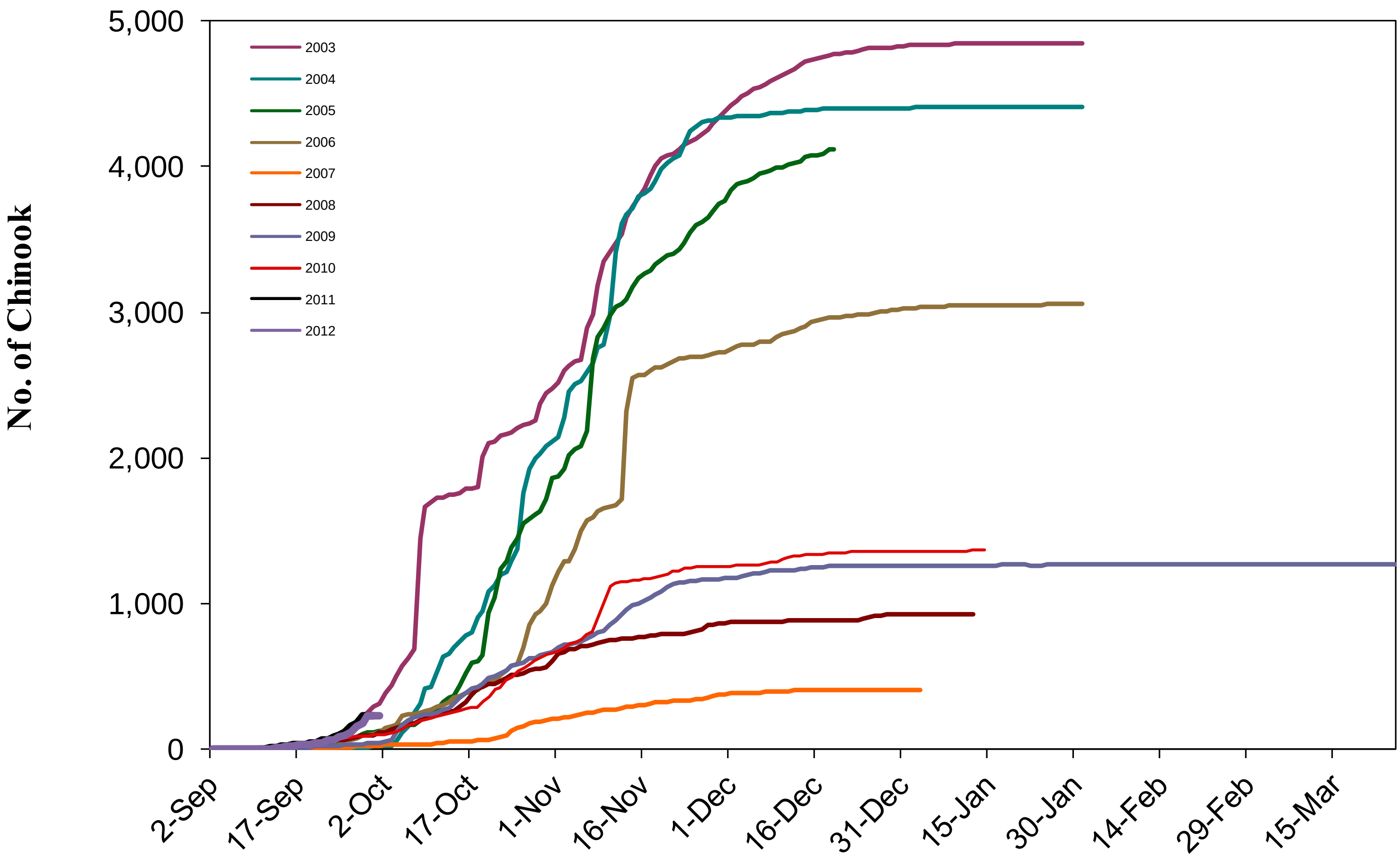
Table 2. Stanislaus River juvenile *O. mykiss* outmigration timing by water year type at Caswell (RM 8.6; 1995-2011).

	Wet (n=7)	Above Normal (n=3)	Below Normal (n=2)	Dry (n=3)	Critical (n=2)
J[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
J[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
F[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
F[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mar 1-15	2.6%	2.8%	37.7%	27.0%	0.0%
Mar 16-31	17.2%	5.0%	7.7%	9.2%	6.5%
Apr 1- 15	16.8%	8.3%	0.0%	5.3%	8.7%
Apr 16-30	15.8%	13.9%	23.1%	12.0%	4.3%
May 1-15	2.6%	38.3%	3.8%	16.1%	54.3%
May 16-31	10.0%	5.0%	0.0%	3.7%	8.7%
Jun 1- 15	17.9%	2.8%	0.0%	0.0%	6.5%
Jun 16-30	0.0%	5.0%	0.0%	0.0%	0.0%

Table 3. Geographic and temporal distribution of spawning in the Stanislaus, 2000-2005.

STANISLAUS RIVER					
		Distribution of Redds[2]			
Date	%Redds Observed[1]	Goodwin	Knights Ferry to Horseshoe	Horseshoe to Oakdale	Oakdale to Riverbank
Before Oct 1	0.1%	100.0%	0.0%	0.0%	0.0%
Oct 1-15	1.5%	32.1%	61.3%	4.8%	1.8%
Oct 16-31	10.5%	17.5%	55.0%	24.5%	3.0%
Nov 1-15	29.4%	15.1%	51.4%	31.1%	2.5%
Nov 16-30	29.4%	13.6%	49.5%	33.6%	3.3%
Dec 1-15	19.0%	19.7%	38.9%	33.2%	8.2%
Dec 16-31	9.0%	14.5%	44.6%	34.3%	6.6%
Jan 1-15	1.1%	0.0%	46.5%	43.9%	9.7%

Cumulative Chinook Passage at the Stanislaus River Weir



Three Settings:
- 1997 IOP – Current SJR
- Current River – RPA
- September 2012 District Proposal

General Assumptions:
- Upstream San Joaquin River (above Stanislaus River Confluence)
  - Existing FERC and other Tributary instream flow requirements
  - Pre-SJRRP Friant
  - No SJRA/VAMP
- “Add Water” incorporated when necessary to maintain New Melones Storage > 150 TAF during 1986-1992 drought sequence.

New Melones
- 1997 IOP – Current SJR
  - OID/SSJID: Formula Water, occasionally not fully used according to land use and commitments calculation.
  - Vernalis flow requirement (February-June, including pulse) per D1641, using forecasted 75% exceedence parameters.

New Melones Forecast and Allocations

Annual Volume in 1,000 acre-feet

New Melones Forecast Index equals end-of-February storage plus March through September inflow

New Melones Forecast Index	Current RPA Instream Fish	SEWD	CSJWCD	Vernalis Water Quality	Vernalis Flow Objective
0	1	2	3	4	5
0	0	0	0	0	0
1400	98	0	0	70	0
2000	125	0	0	80	0
2499.99	345	10	49	175	0
2500	345	10	80	175	1000
3000	467	10	80	250	1000
6000	467	10	80	250	1000
7000	467	10	80	250	1000
8000	467	10	80	250	1000
Form of lookup between indices:	Interpolate	Interpolate	Interpolate	Interpolate	Lookup
Threshold cutoff for interpolation:	NA	0	0	0	1400

Spreadsheet Canal

Upstream VAMP flo

Release for Vernalis

Release for Vernalis
Vernalis water qualit

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Initial Allocations

NM Index (Oct 192

New Melones Stor

Stanislaus Instream Fish Flow Requirement Monthly Distribution

Flow in CFS

Days	Lookup Period	Month	Lookup Reference	Breakpoints of Flow Distribution Schedules - 1,000 Acre-f and Period Schedules - CFS				
Days			0	0.0	98.4	243.3	253.8	310.3
15	10_1	Oct	1	0	110	200	250	250
16	10_2	Oct	2	0	110	200	250	250
15	11_1	Nov	3	0	200	250	275	300
15	11_2	Nov	4	0	200	250	275	300
15	12_1	Dec	5	0	200	250	275	300
16	12_2	Dec	6	0	200	250	275	300
15	1_1	Jan	7	0	125	250	275	300
16	1_2	Jan	8	0	125	250	275	300
15	2_1	Feb	9	0	125	250	275	300
13	2_2	Feb	10	0	125	250	275	300
15	3_1	Mar	11	0	125	250	275	300
16	3_2	Mar	12	0	125	250	275	300
14	4_1	Apr	13	0	250	300	300	900
16	4_2	Apr	14	0	500	1500	1500	1500
15	5_1	May	15	0	500	1500	1500	1500
16	5_2	May	16	0	250	800	300	900
15	6_1	Jun	17	0	0	200	200	250
15	6_2	Jun	18	0	0	200	200	250
15	7_1	Jul	19	0	0	200	200	250
16	7_2	Jul	20	0	0	200	200	250
15	8_1	Aug	21	0	0	200	200	250
16	8_2	Aug	22	0	0	200	200	250
15	9_1	Sep	23	0	0	200	200	250
15	9_2	Sep	24	0	0	200	200	250
Do not copy into this row	Equivalent Volume 1,000 Acre-feet:			0.0	98.9	245.7	256.2	311.5

New Melones Forecast and Allocations

Annual Volume in 1,000 acre-feet

- Current River – RPA
  - OID/SSJID: Formula Water, occasionally not fully used according to land use and commitments calculation.
  - Vernalis flow requirement (February-June, including pulse) per D1641, using forecasted 75% exceedence parameters.
  - Additional critical year RPA schedule (98.4 TAF) added for years when NMI < 1,400 TAF consistent with BO modeling. Such schedule is not included in Table 2E. Flow schedules do not include releases for BO temperature requirements.
  - Allocation for CVP Contractors is arbitrary but contributes to viable operation during all periods except during 1987-1992 drought.

	New Melones Forecast Index	Instream Fish	SEWD	CSJWCD	Vernalis Water Quality	Vernalis Flow Objective
	0	1	2	3	4	5
New Melones Forecast Index	0	98.4	10	0	400	0
equals end-of-February	1000	98.4	10	0	400	0
storage plus March through	1000.1	98.4	10	0	400	0
September inflow	1399.9	98.4	10	0	400	0
	1400	185.3	10	49	400	99999
	1724.9	185.3	10	49	400	99999
	1725	234.1	10	49	400	99999
	2177.9	234.1	10	49	400	99999
	2178	346.7	75	80	400	99999
	2386.9	346.7	75	80	400	99999
	2387	461.7	75	80	400	99999
	2500	461.7	75	80	400	99999
	2761.9	461.7	75	80	400	99999
	2762	589	75	80	400	99999
	3000	589	75	80	400	99999
	6000	589	75	80	400	99999
Form of lookup between indices:		Interpolate	Interpolate	Interpolate	Interpolate	Lookup
Threshold cutoff for interpolation:		NA	0	0	0	1400

Spreadsheet Canal

Upstream VAMP flo

Release for Vernalis

Release for Vernalis
Vernalis water qualit

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Release for DO Req
Critical Year DO Re

Max Goodwin Releas

Initial Allocations
NM Index (Oct 192

New Melones Stor

Stanislaus Instream Fish Flow Requirement Monthly Distribution

Flow in CFS

Days	Lookup Period	Month	Lookup Reference	Breakpoints of Flow Distribution Schedules - 1,000 Acre-f and Period Schedules - CFS				
			0	0.0	98.9	185.3	234.2	346.7
15	10_1	Oct	1	0	110	577	636	774
16	10_2	Oct	2	0	110	577	636	774
15	11_1	Nov	3	0	200	200	200	200
15	11_2	Nov	4	0	200	200	200	200
15	12_1	Dec	5	0	200	200	200	200
16	12_2	Dec	6	0	200	200	200	200
15	1_1	Jan	7	0	125	213	219	226
16	1_2	Jan	8	0	125	213	219	226
15	2_1	Feb	9	0	125	214	221	229
13	2_2	Feb	10	0	125	214	221	229
15	3_1	Mar	11	0	125	200	200	200
16	3_2	Mar	12	0	125	200	200	200
14	4_1	Apr	13	0	250	200	500	1471
16	4_2	Apr	14	0	500	677	1000	1548
15	5_1	May	15	0	500	677	1000	1548
16	5_2	May	16	0	250	150	284	1031
15	6_1	Jun	17	0	0	150	200	363
15	6_2	Jun	18	0	0	150	200	363
15	7_1	Jul	19	0	0	150	200	250
16	7_2	Jul	20	0	0	150	200	250
15	8_1	Aug	21	0	0	150	200	250
16	8_2	Aug	22	0	0	150	200	250
15	9_1	Sep	23	0	0	150	200	250
15	9_2	Sep	24	0	0	150	200	250
Do not copy into this row	Equivalent Volume 1,000 Acre-feet:			0.0	98.9	185.3	234.2	346.7

- September 2012 District Proposal
  - OID/SSJID: Formula water, occasionally not fully used according to land use and commitments calculation.
  - No Vernalis flow requirement (assumed satisfied with tributary contributions)
  - Stanislaus River DO requirements modified – non-controlling.
  - Instream flow requirement:
    - Proposed schedule (monthly schedule providing the following annual total)

New Melones Storage Plus Inflow From	To	Fishery (TAF)
0	1,800	174
1,800	2,500	235
2,500	6,000	318

  - CVP Contractors annual allocation

New Melones Storage Plus Inflow From	To	Contractors (TAF)
0	1,400	10 (SEWD)
1,400	1,800	59 (10 SEWD)
1,800	6,000	155

New Melones Forecast and Allocations

Annual Volume in 1,000 acre-feet

Spreadsheet Canal

	New Melones Forecast Index	Instream Fish	SEWD	CSJWCD	Vernalis Water Quality	Vernalis Flow Objective
	0	1	2	3	4	5
New Melones Forecast Index	0	9999	10	0	100	0
equals end-of-February	1299.999	9999	10	0	100	0
storage plus March through	1400	9999	10	0	100	0
September inflow	1401	9999	10	49	100	0
	1800	9999	10	49	100	0
	1801	99999	75	80	100	0
	2500	99999	75	80	100	0
	2501	999999	75	80	100	0
	7000	999999	75	80	100	0
	8000	999999	75	80	100	0
Form of lookup between indices:		Interpolate	Interpolate	Interpolate	Interpolate	Lookup
Threshold cutoff for interpolation:		NA	0	0	0	0

Upstream VAMP flo

Release for Vernalis

Release for Vernalis
Vernalis water qualit

Stanislaus River Fis
Stanislaus fish patte
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Release for DO Req
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Initial Allocations
NM Index (Oct 192

New Melones Stor

Stanislaus Instream Fish Flow Requirement Monthly Distribution

Flow in CFS

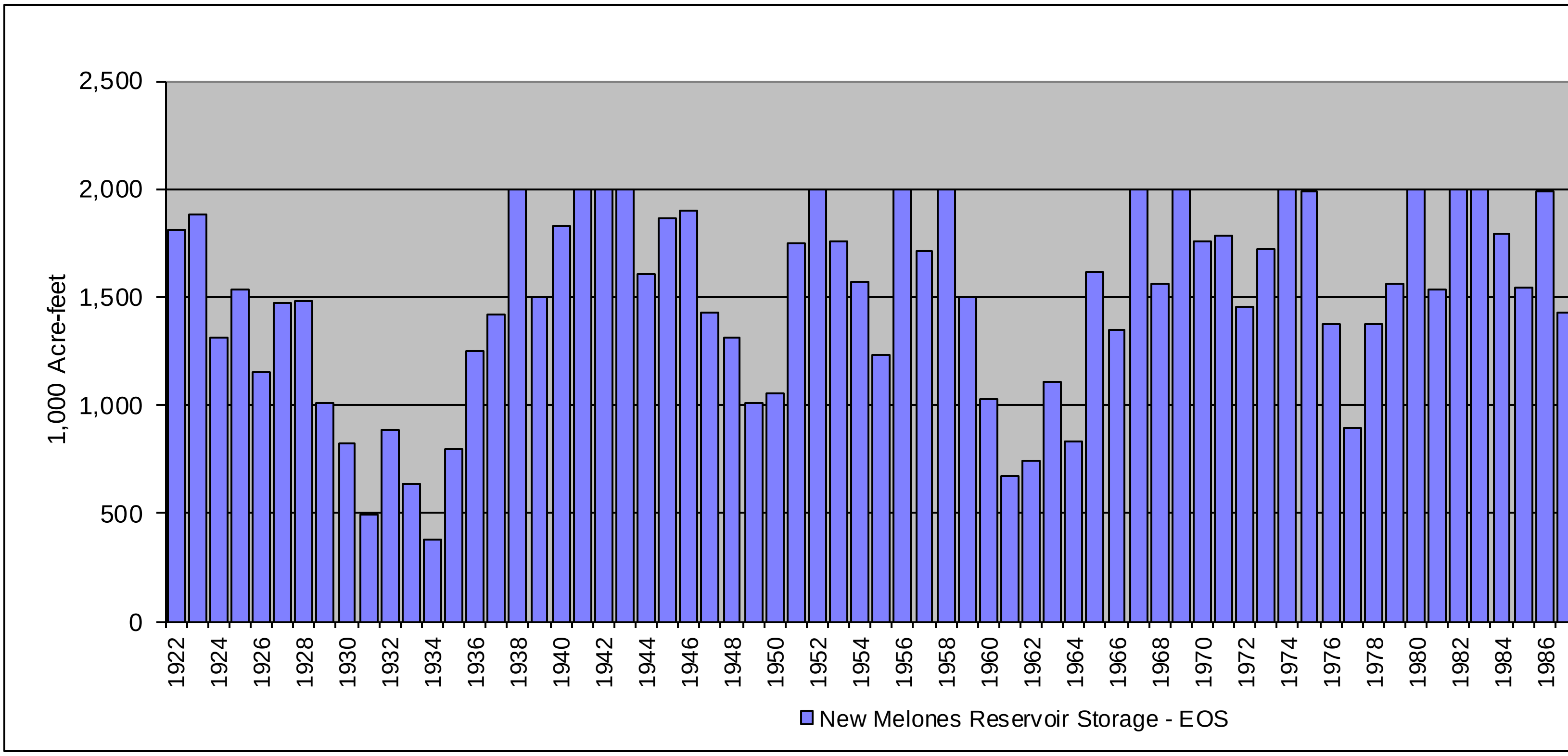
Breakpoints of Flow Distribution Schedules - 1,000 Acre-f and Period Schedules - CFS

Days	Lookup Period	Month	Lookup Reference	0.0	98.9	185.3	234.2	346.7
			0					
15	10_1	Oct	1	0	110	577	636	774
16	10_2	Oct	2	0	110	577	636	774
15	11_1	Nov	3	0	200	200	200	200
15	11_2	Nov	4	0	200	200	200	200
15	12_1	Dec	5	0	200	200	200	200
16	12_2	Dec	6	0	200	200	200	200
15	1_1	Jan	7	0	125	213	219	226
16	1_2	Jan	8	0	125	213	219	226
15	2_1	Feb	9	0	125	214	221	229
13	2_2	Feb	10	0	125	214	221	229
15	3_1	Mar	11	0	125	200	200	200
16	3_2	Mar	12	0	125	200	200	200
14	4_1	Apr	13	0	250	200	500	1471
16	4_2	Apr	14	0	500	677	1000	1548
15	5_1	May	15	0	500	677	1000	1548
16	5_2	May	16	0	250	150	284	1031
15	6_1	Jun	17	0	0	150	200	363
15	6_2	Jun	18	0	0	150	200	363
15	7_1	Jul	19	0	0	150	200	250
16	7_2	Jul	20	0	0	150	200	250
15	8_1	Aug	21	0	0	150	200	250
16	8_2	Aug	22	0	0	150	200	250
15	9_1	Sep	23	0	0	150	200	250
15	9_2	Sep	24	0	0	150	200	250
Do not copy into this row		Equivalent Volume 1,000 Acre-feet:		0.0	98.9	185.3	234.2	346.7

New Melones End-of-September Reservoir Storage

1997 IOP – Adapted to Current SJR

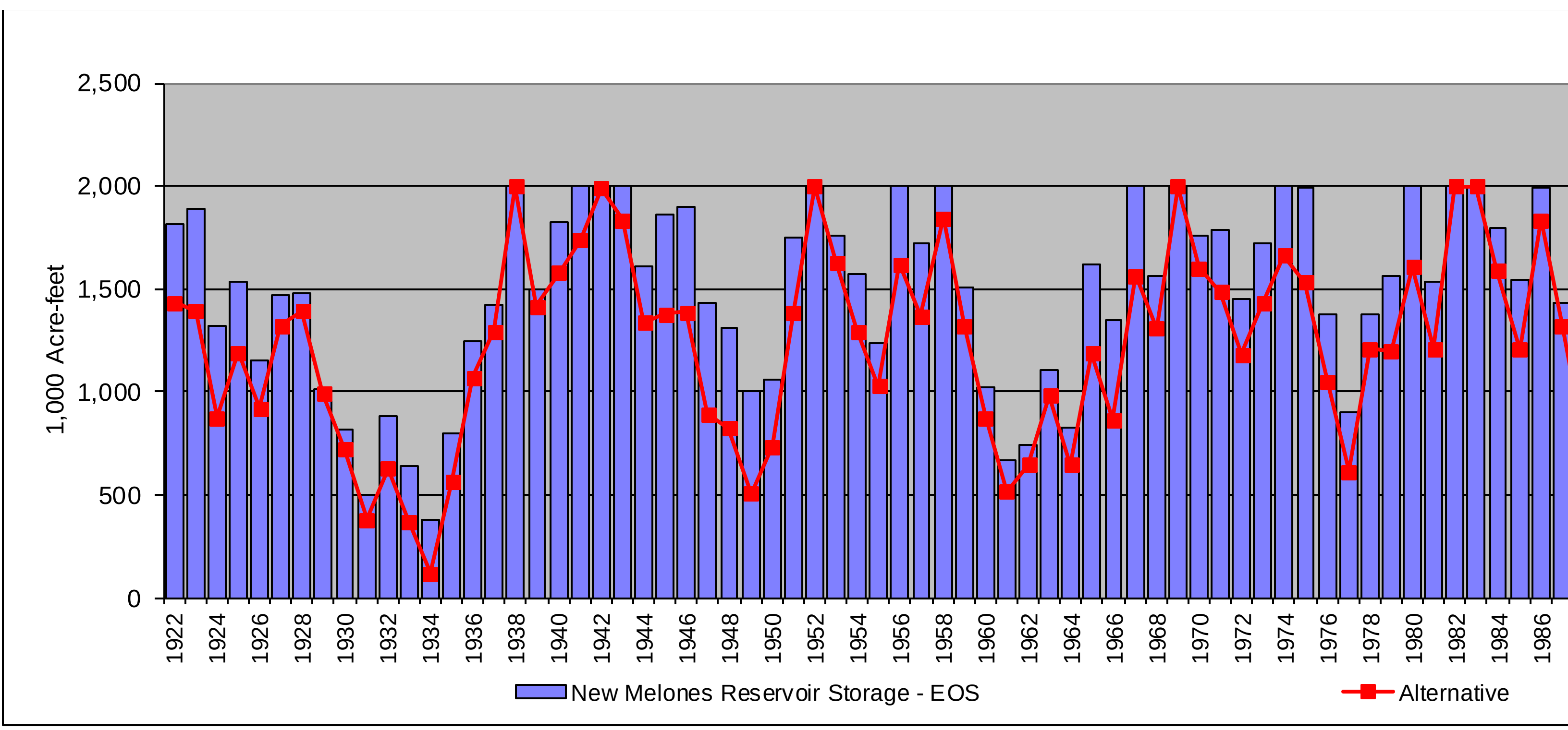
Current River – RPA



1997 IOP – Adapted to Current SJR (Blue Bar) v Current River RPA (Red Line)

1997 IOP – Adapted to Current SJR (Blue Bar) v September 2012 District Proposal (Red Line)

September 2012 District Proposal (Blue Bar) v Current River RPA (Red Line)

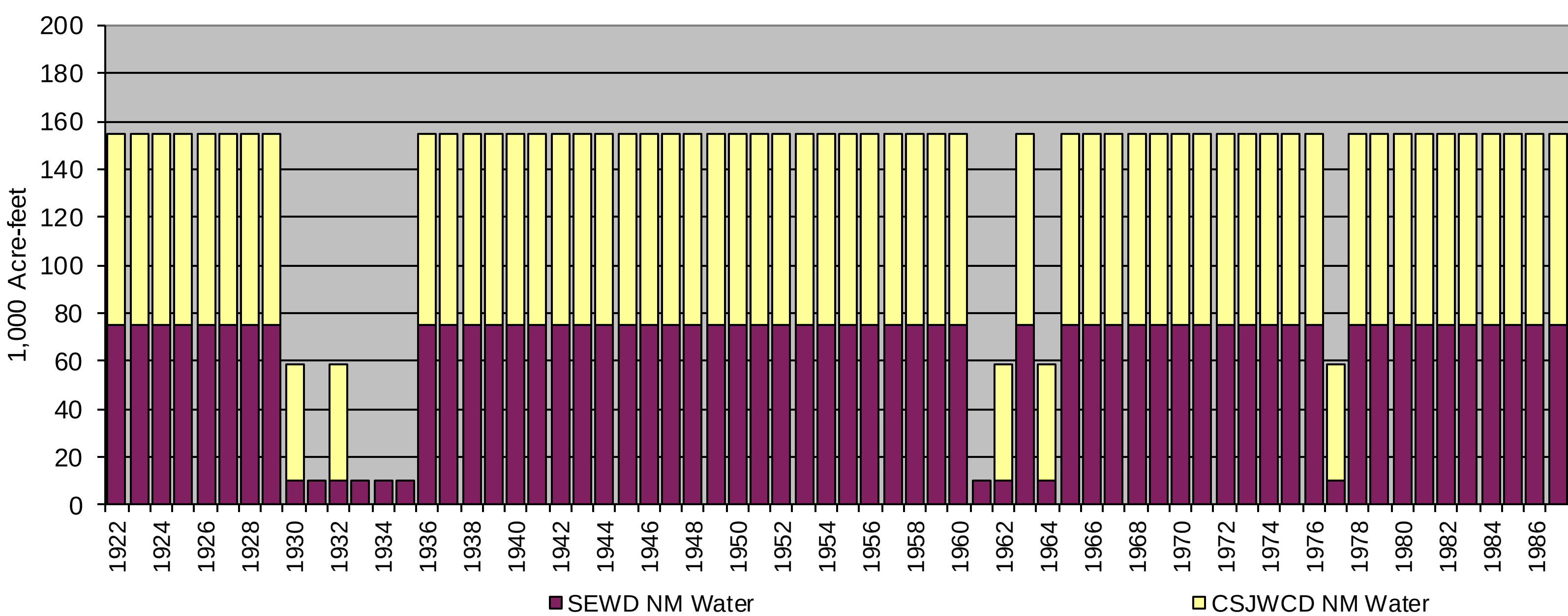


CVP Contractor Annual Allocations

1997 IOP – Adapted to Current SJR

Current River – RPA

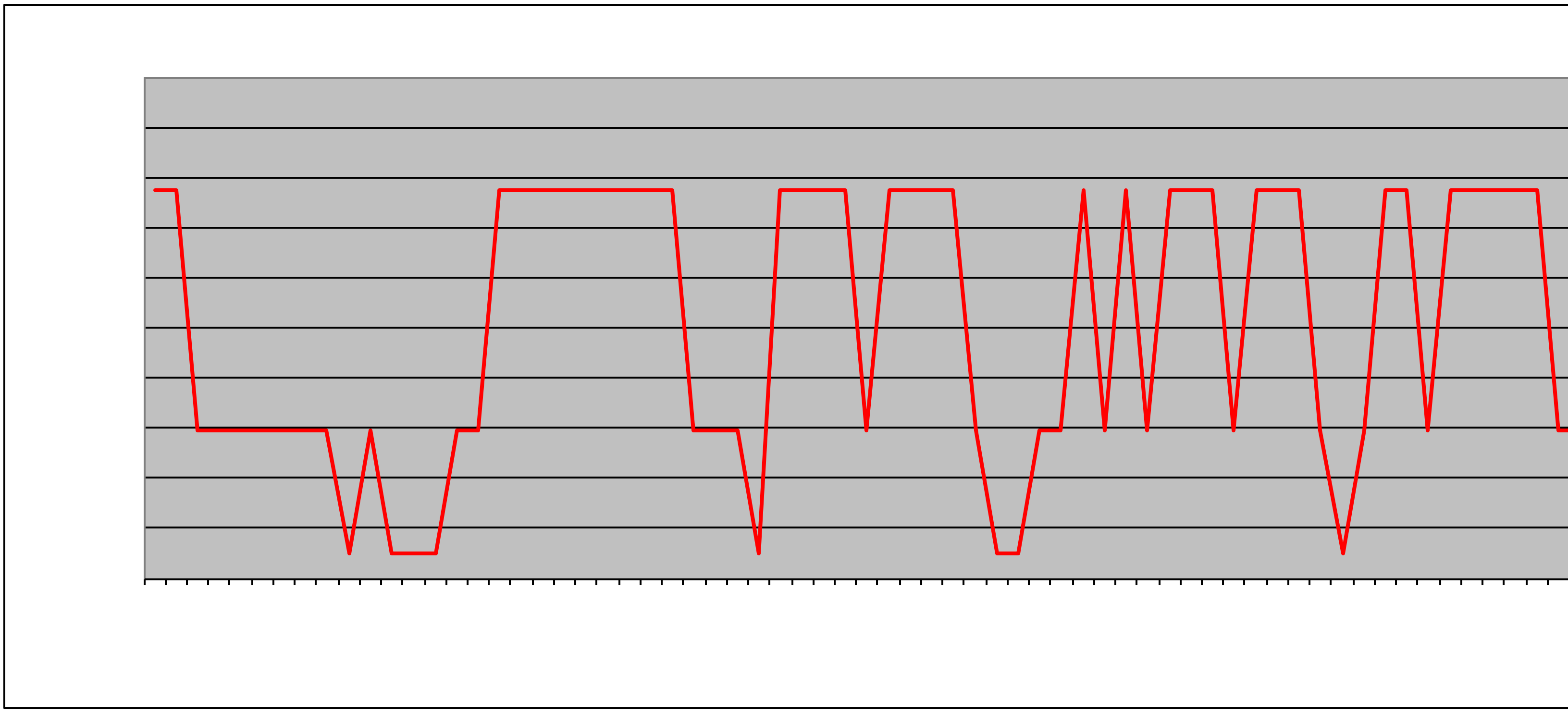
September 2012 District Proposal



1997 IOP – Adapted to Current SJR (Bars) v Current River RPA (Red Line)

1997 IOP – Adapted to Current SJR (Bars) v September 2012 District Proposal (Red Line)

September 2012 District Proposal (Bars) v Current River RPA (Red Line)

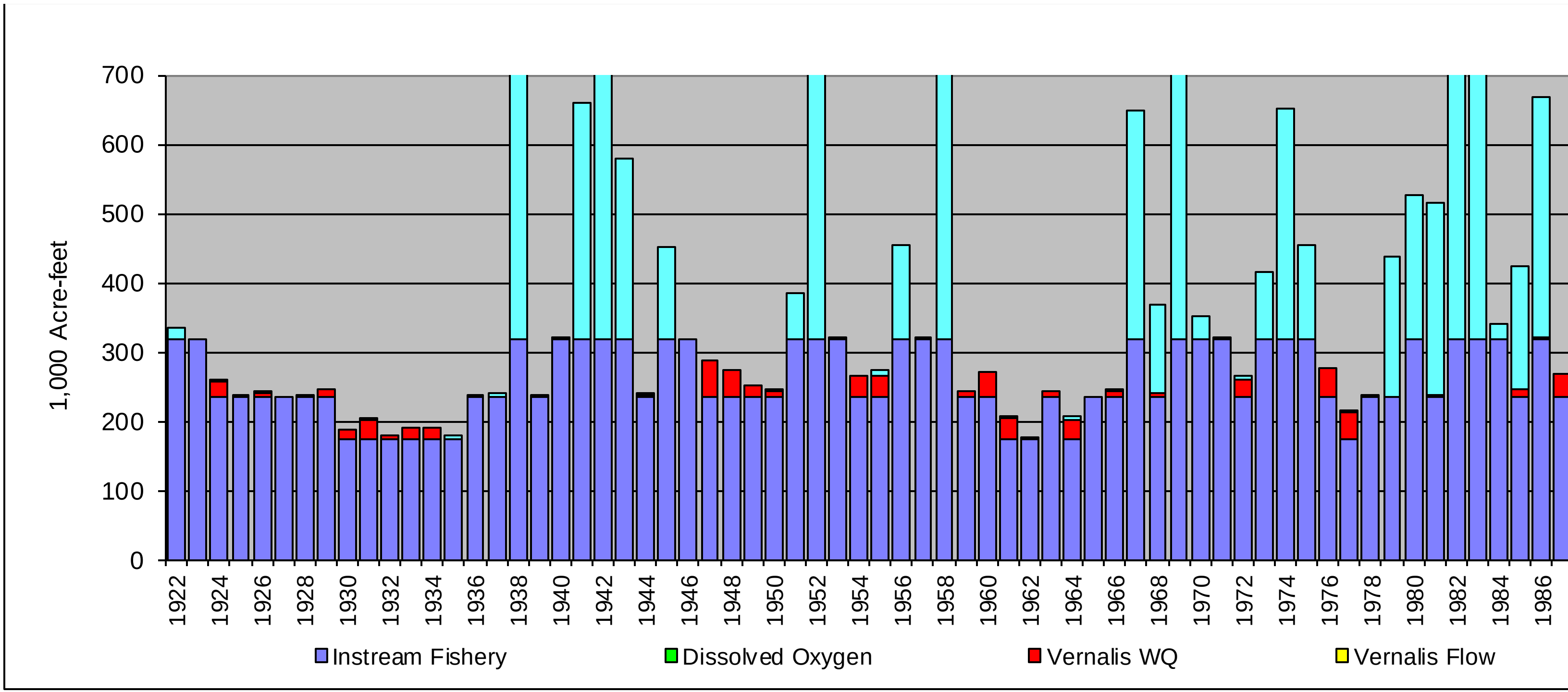


Goodwin Dam Annual Releases to Stanislaus River

1997 IOP – Adapted to Current SJR

Current River – RPA

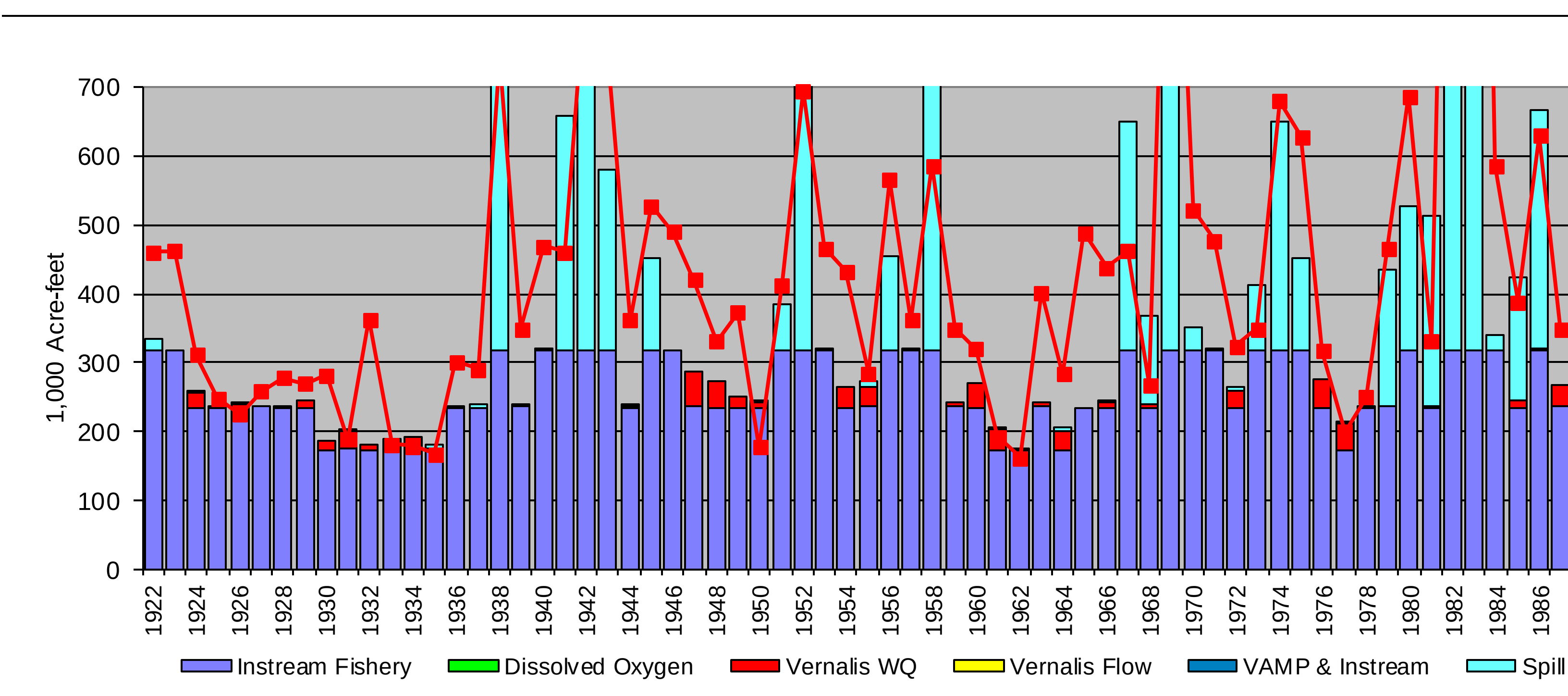
September 2012 District Proposal



1997 IOP – Adapted to Current SJR (Bars) v Current River RPA (Red Line)

1997 IOP – Adapted to Current SJR (Bars) v September 2012 District Proposal (Red Line)

September 2012 District Proposal (Bars) v Current River RPA (Red Line)



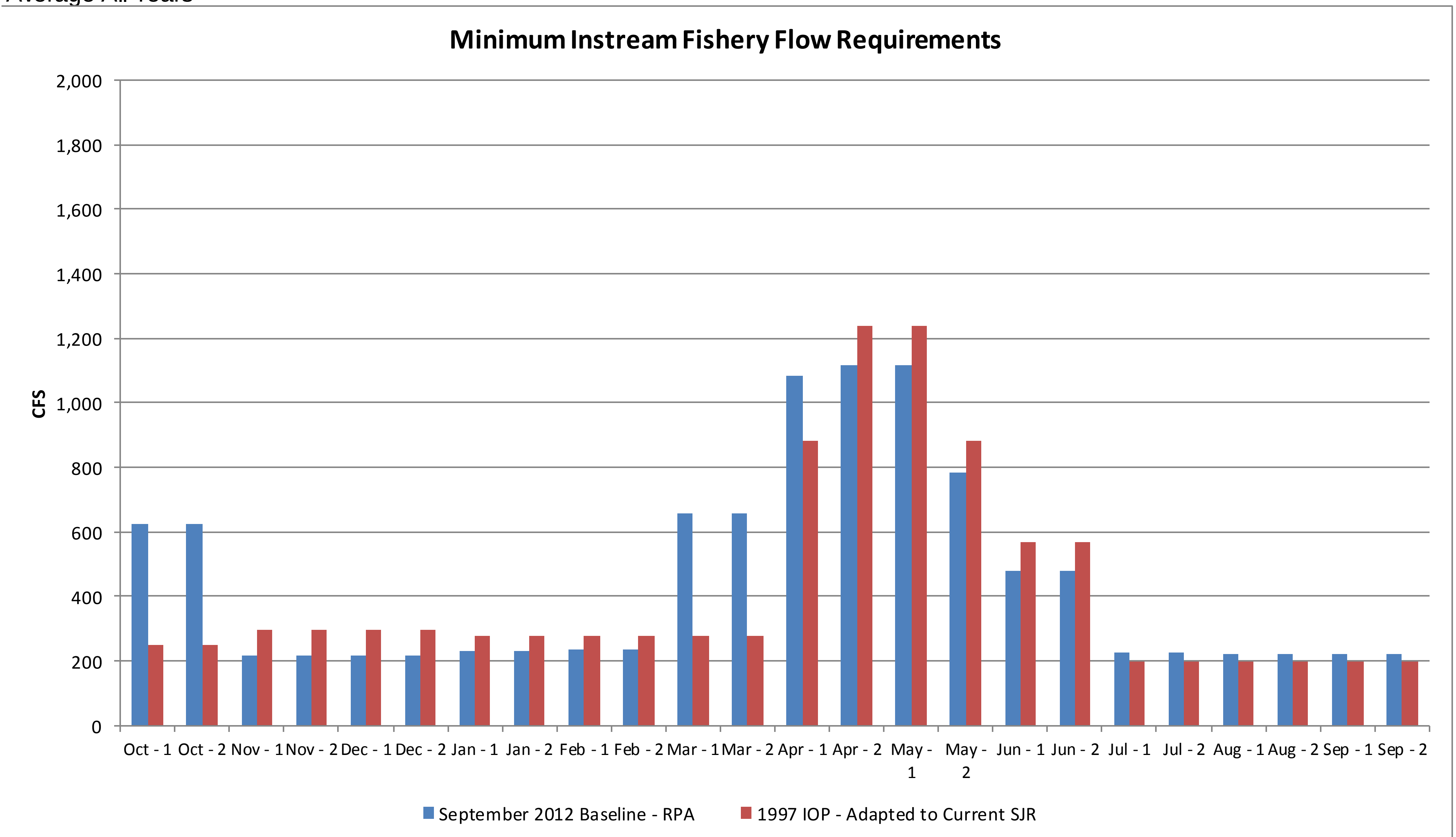
Difference (September 2012 Baseline - RPA minus 1997 IOP - Adapted to Current SJR)
Minimum Instream Fishery Requirement
Average Period CFS

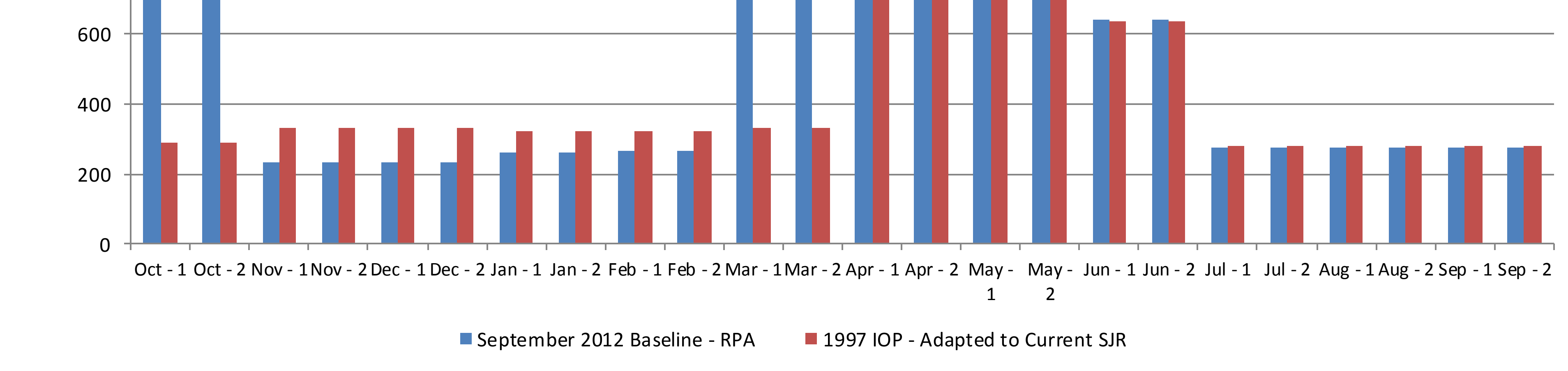
Work Product – Subject to Revision
DBS – September 30, 2012

Year Type	Oct - 1	Oct - 2	Nov - 1	Nov - 2	Dec - 1	Dec - 2	Jan - 1	Jan - 2	Feb - 1	Feb - 2	Mar - 1	Mar - 2
25% W Ave	449	449	-122	-122	-122	-122	-88	-88	-84	-84	1,138	1,138
25% AN Ave	417	417	-95	-95	-95	-95	-62	-62	-58	-58	461	461
25% BN Ave	398	398	-96	-96	-96	-96	-64	-64	-61	-61	-55	-55
25% D Ave	236	236	-11	-11	-11	-11	15	15	16	16	7	7
10% D Ave	163	163	11	11	11	11	29	29	30	30	7	7
All Avg	374	374	-80	-80	-80	-80	-49	-49	-46	-46	378	378

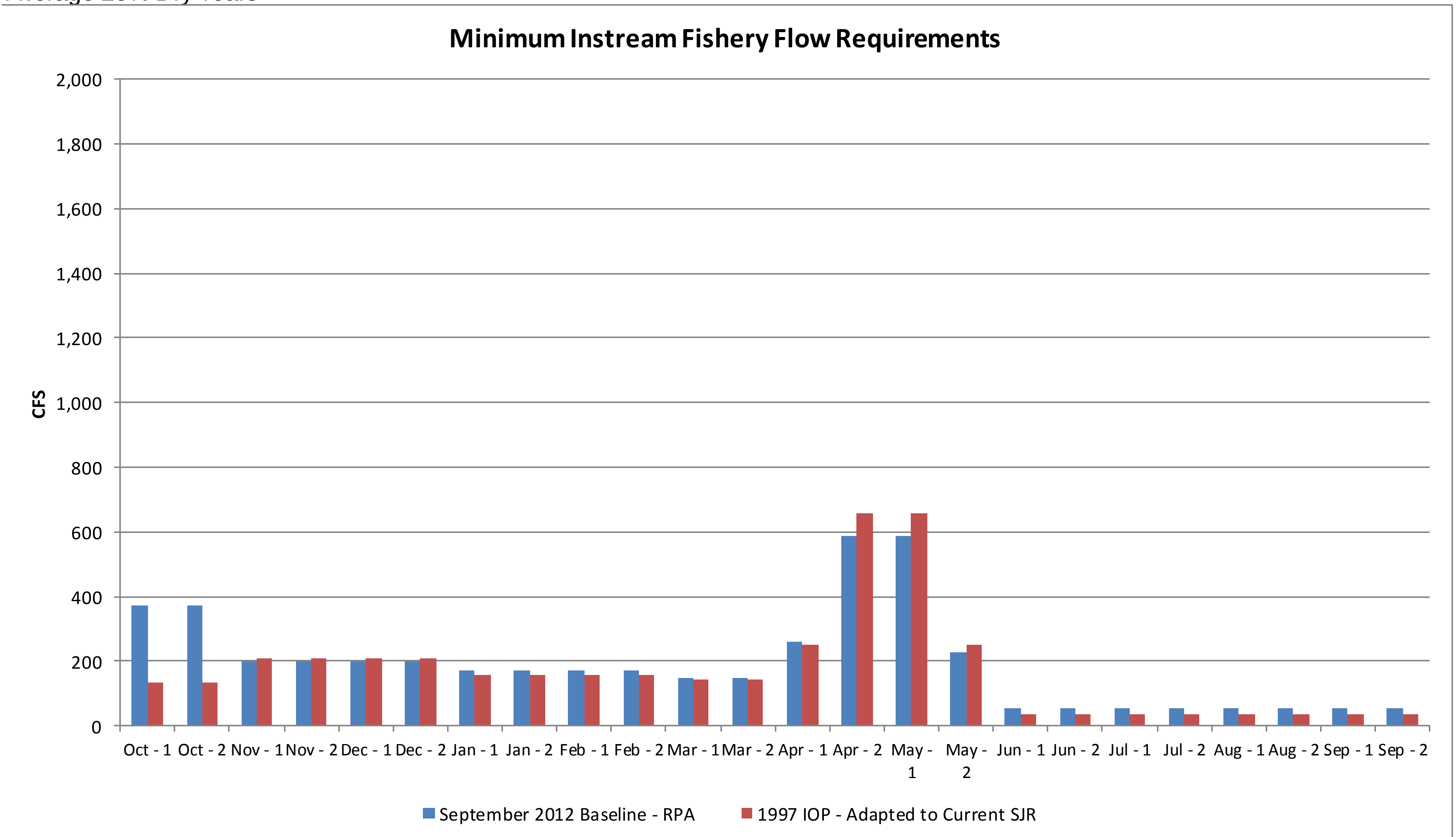
Minimum Instream Flow Req
1997 IOP – Adapted to Curre

Average All Years





Average 25% Dry Years



Work Product – Subject to Revision   DBS – September 30, 2012

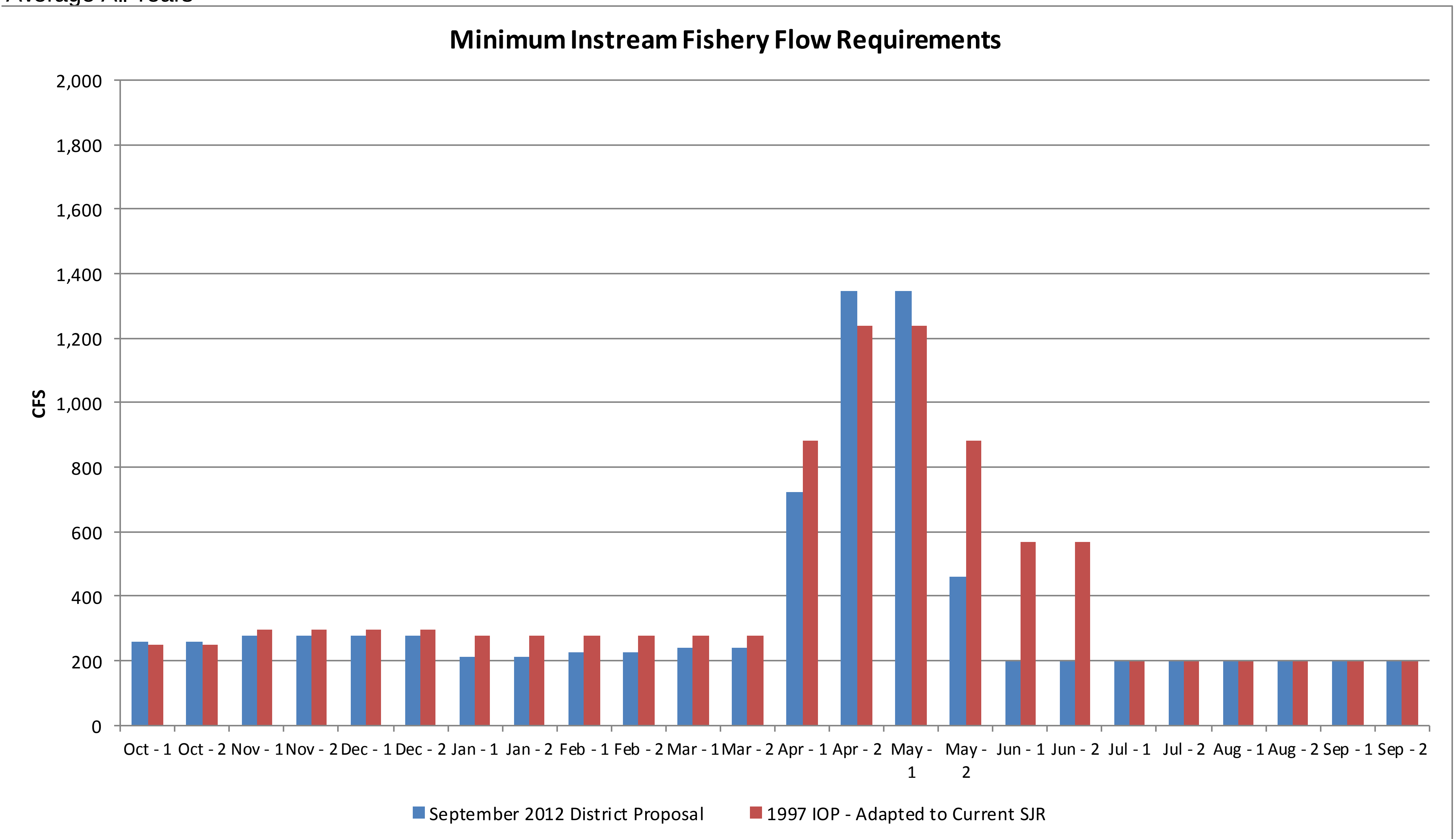
Difference (September 2012 District Proposal minus 1997 IOP - Adapted to Current SJR)

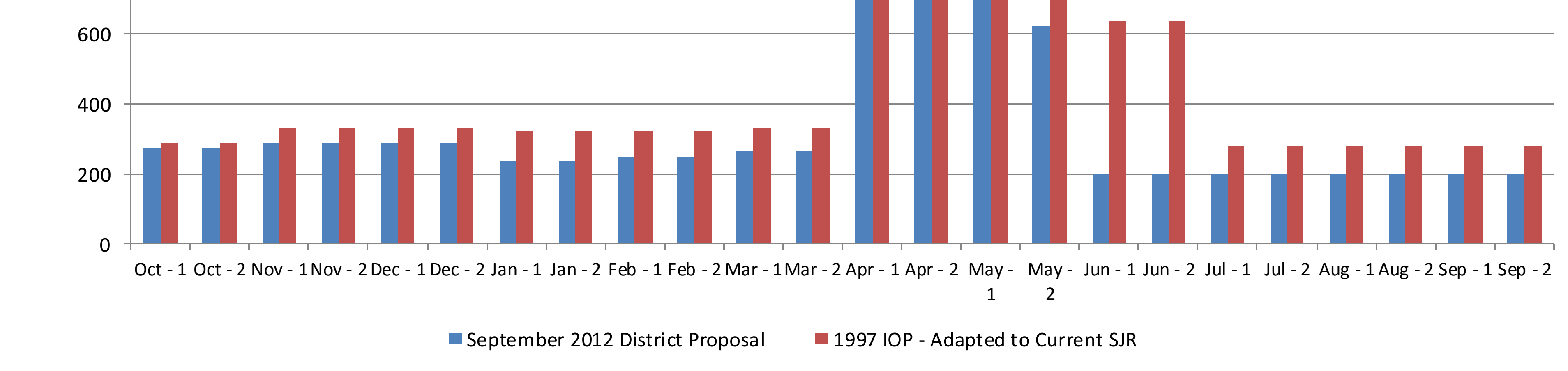
Minimum Instream Fishery Requirement

Average Period CFS

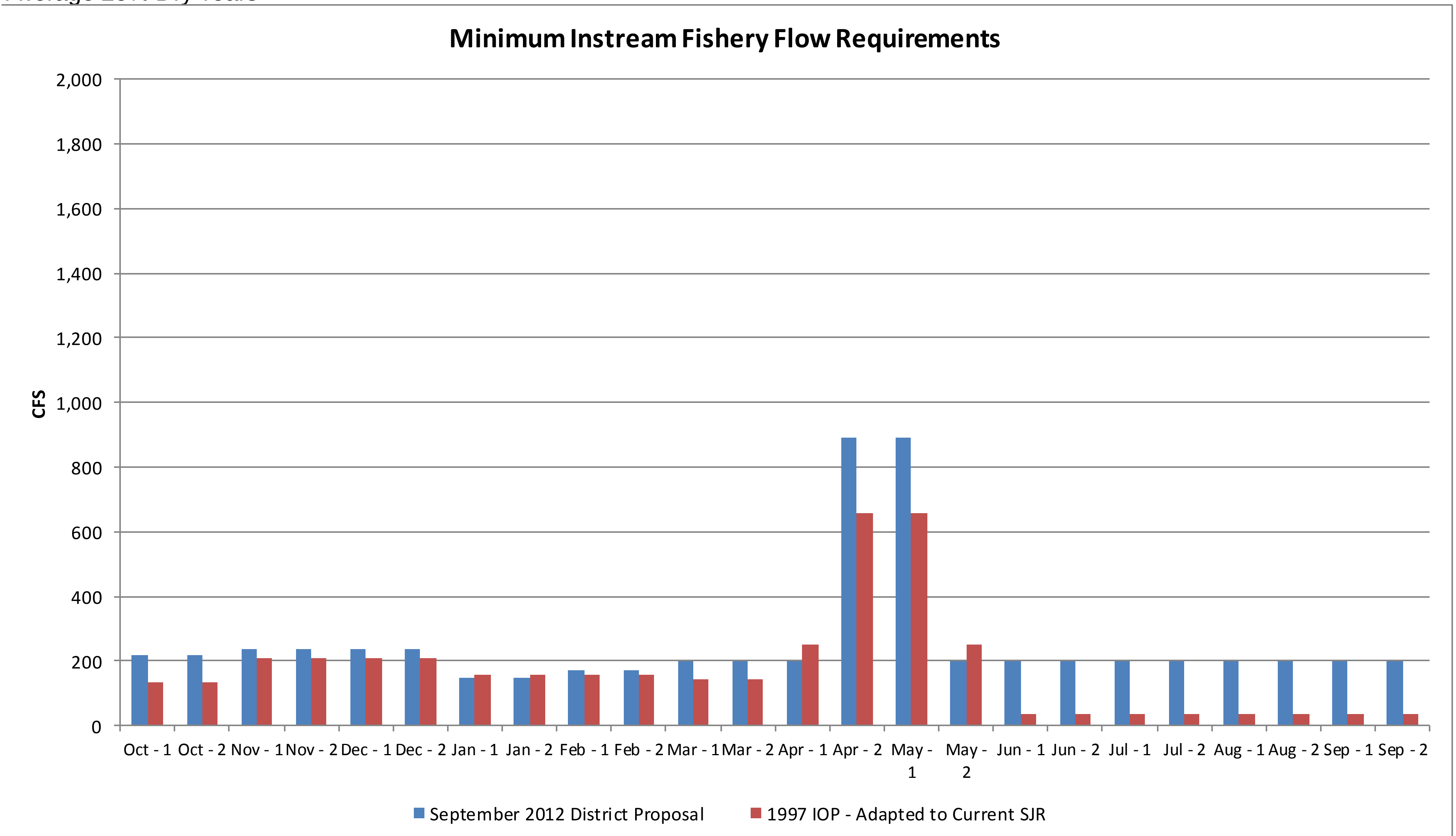
Year Type	Oct - 1	Oct - 2	Nov - 1	Nov - 2	Dec - 1	Dec - 2	Jan - 1	Jan - 2	Feb - 1	Feb - 2	Mar - 1	Mar - 2
25% W Ave	-28	-28	-42	-42	-42	-42	-93	-93	-85	-85	-93	-93
25% AN Ave	-14	-14	-40	-40	-40	-40	-84	-84	-75	-75	-68	-68
25% BN Ave	-6	-6	-24	-24	-24	-24	-97	-97	-82	-82	-55	-55
25% D Ave	85	85	28	28	28	28	-8	-8	15	15	58	58
10% D Ave	97	97	22	22	22	22	25	25	48	48	82	82
All Avg	10	10	-19	-19	-19	-19	-70	-70	-56	-56	-39	-39

Average All Years





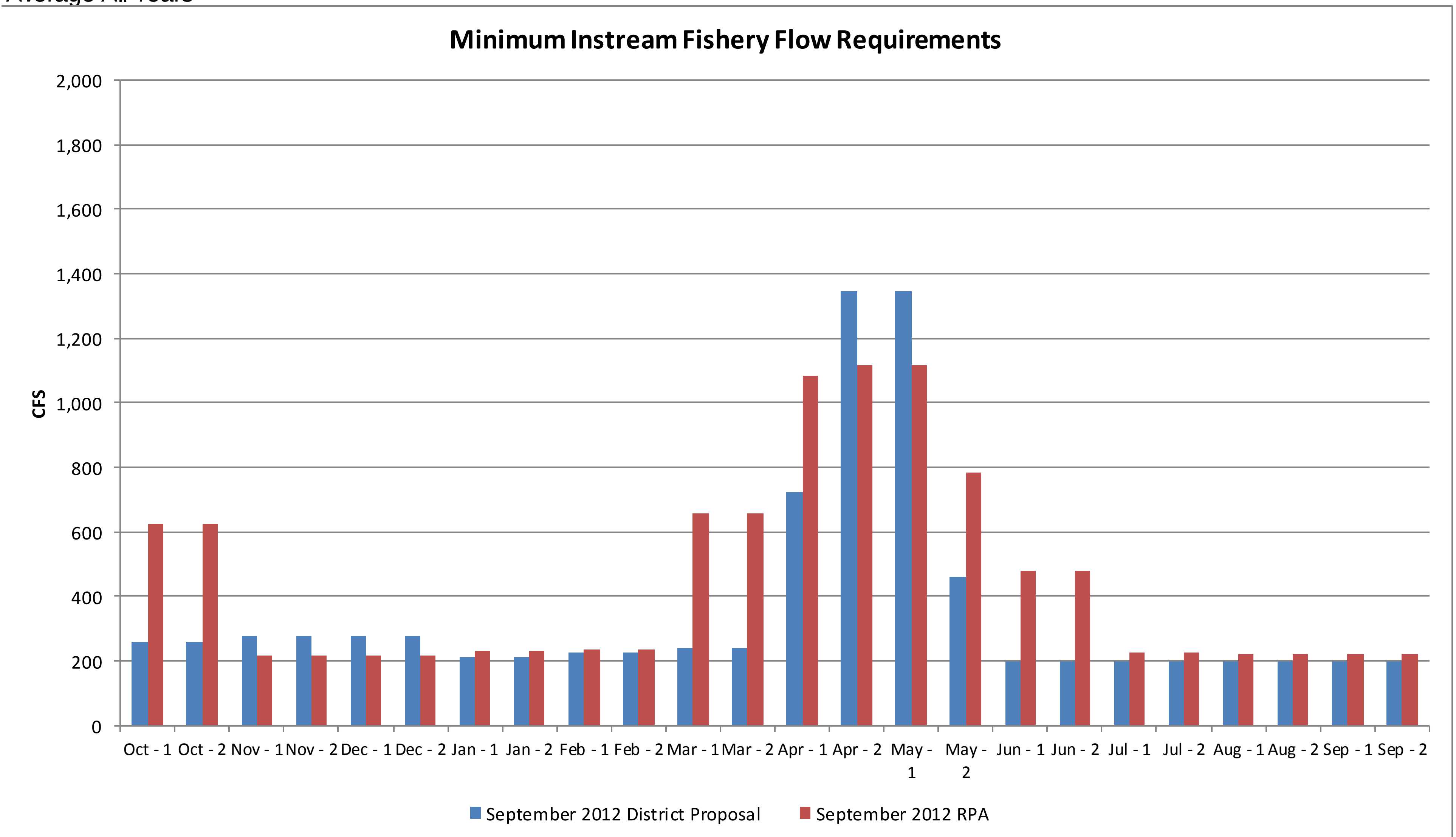
Average 25% Dry Years

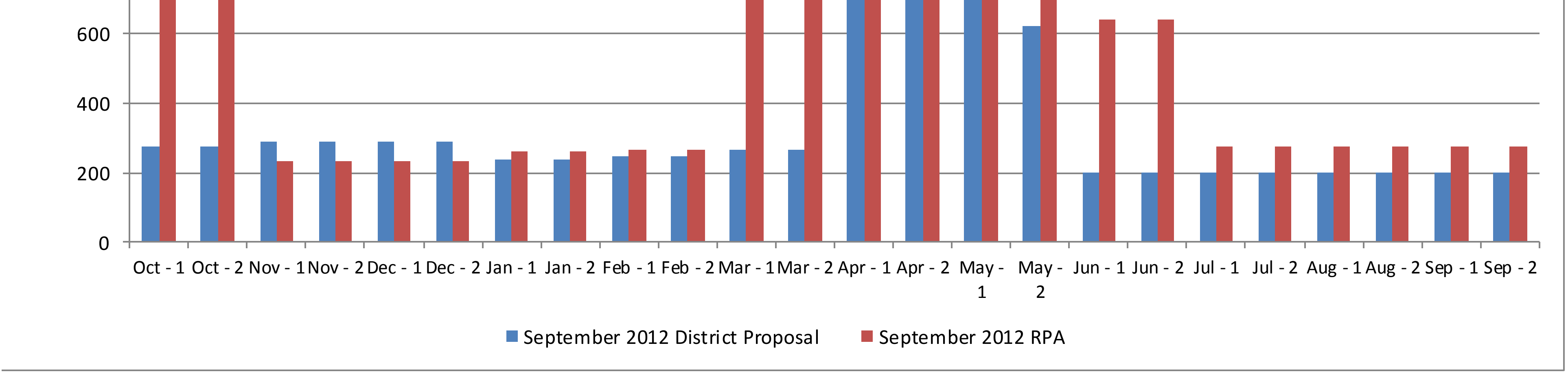


Difference (September 2012 District Proposal minus September 2012 RPA)
Minimum Instream Fishery Requirement
Average Period CFS

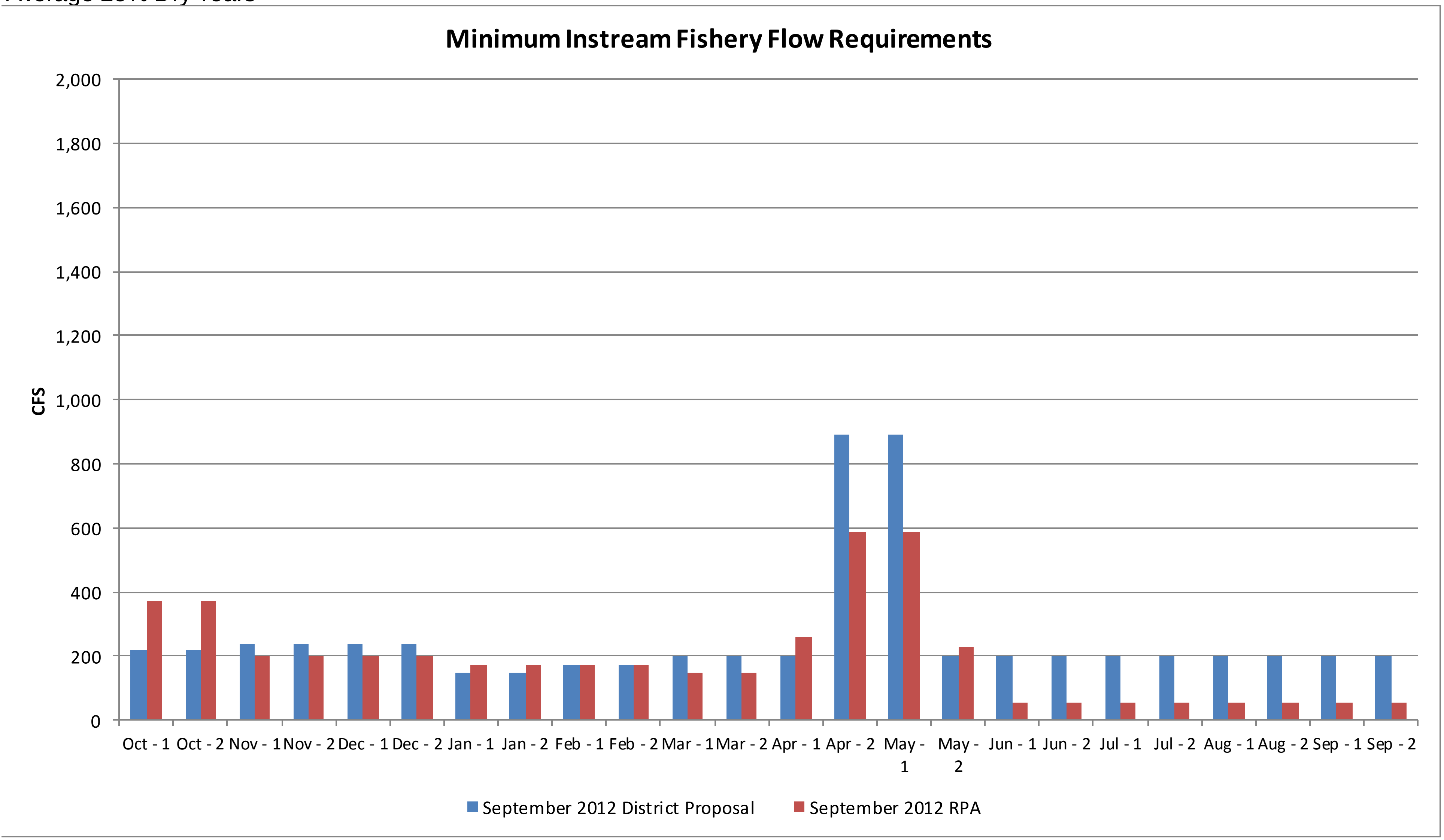
Year Type	Oct - 1	Oct - 2	Nov - 1	Nov - 2	Dec - 1	Dec - 2	Jan - 1	Jan - 2	Feb - 1	Feb - 2	Mar - 1	Mar - 2
25% W Ave	-477	-477	80	80	80	80	-5	-5	-1	-1	-1,231	-1,231
25% AN Ave	-431	-431	55	55	55	55	-22	-22	-16	-16	-529	-529
25% BN Ave	-404	-404	72	72	72	72	-32	-32	-21	-21	0	0
25% D Ave	-151	-151	39	39	39	39	-23	-23	-1	-1	50	50
10% D Ave	-66	-66	12	12	12	12	-5	-5	18	18	76	76
All Avg	-364	-364	61	61	61	61	-21	-21	-10	-10	-417	-417

Average All Years





Average 25% Dry Years



Difference (September 2012 Baseline - RPA minus 1997 IOP - Adapted to Current SJR)
Minimum Instream Fishery Requirement
Average Period CFS

Work Product – Subject to Revision

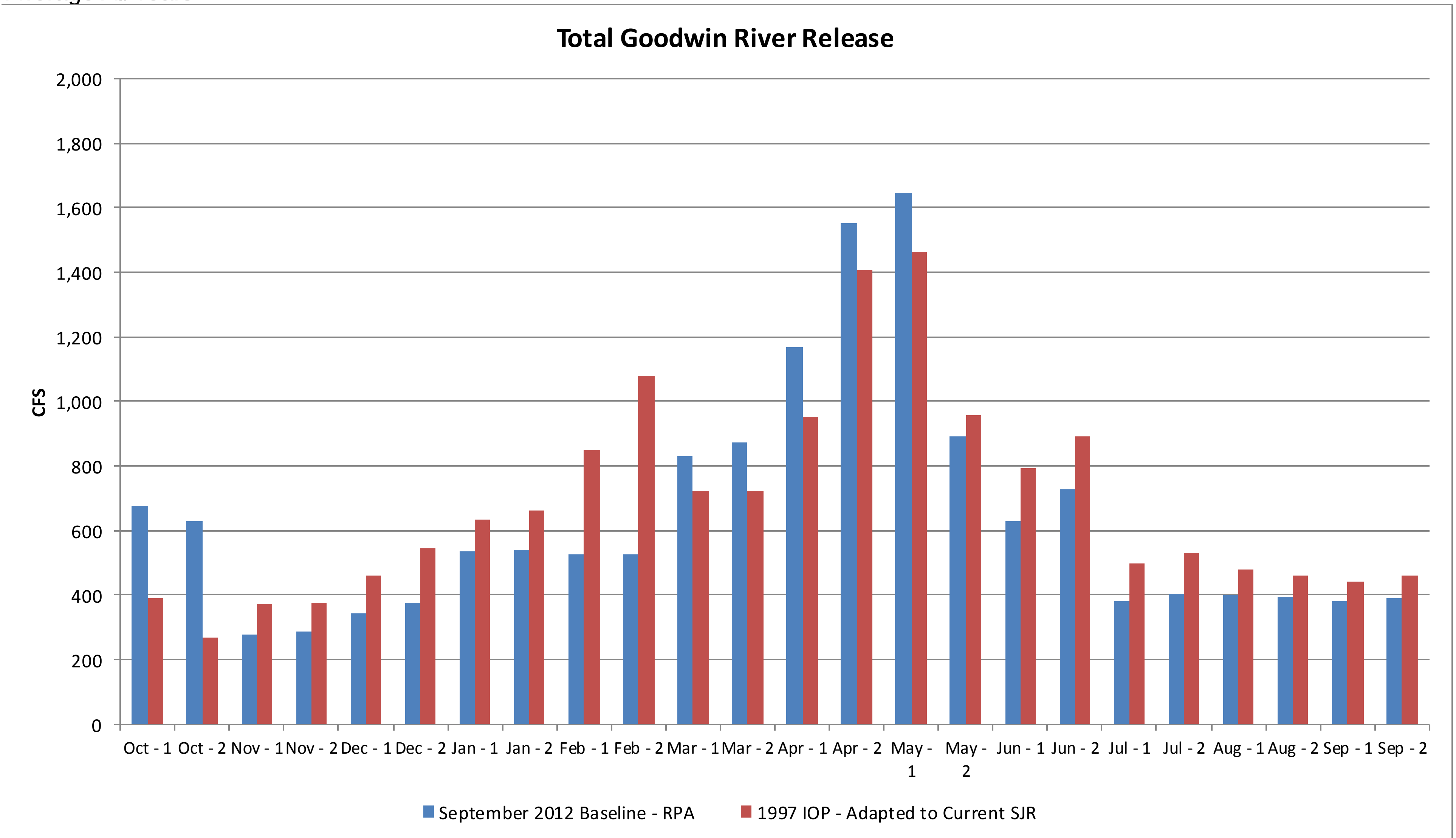
DBS – September 30, 2012

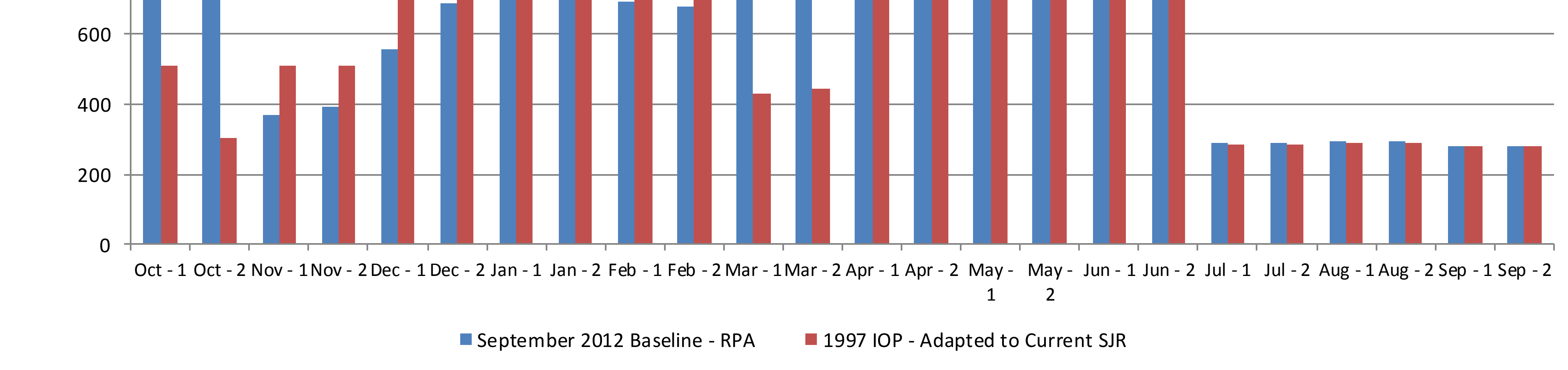
Total Goodwin River Release

1997 IOP – Adapted to Curre

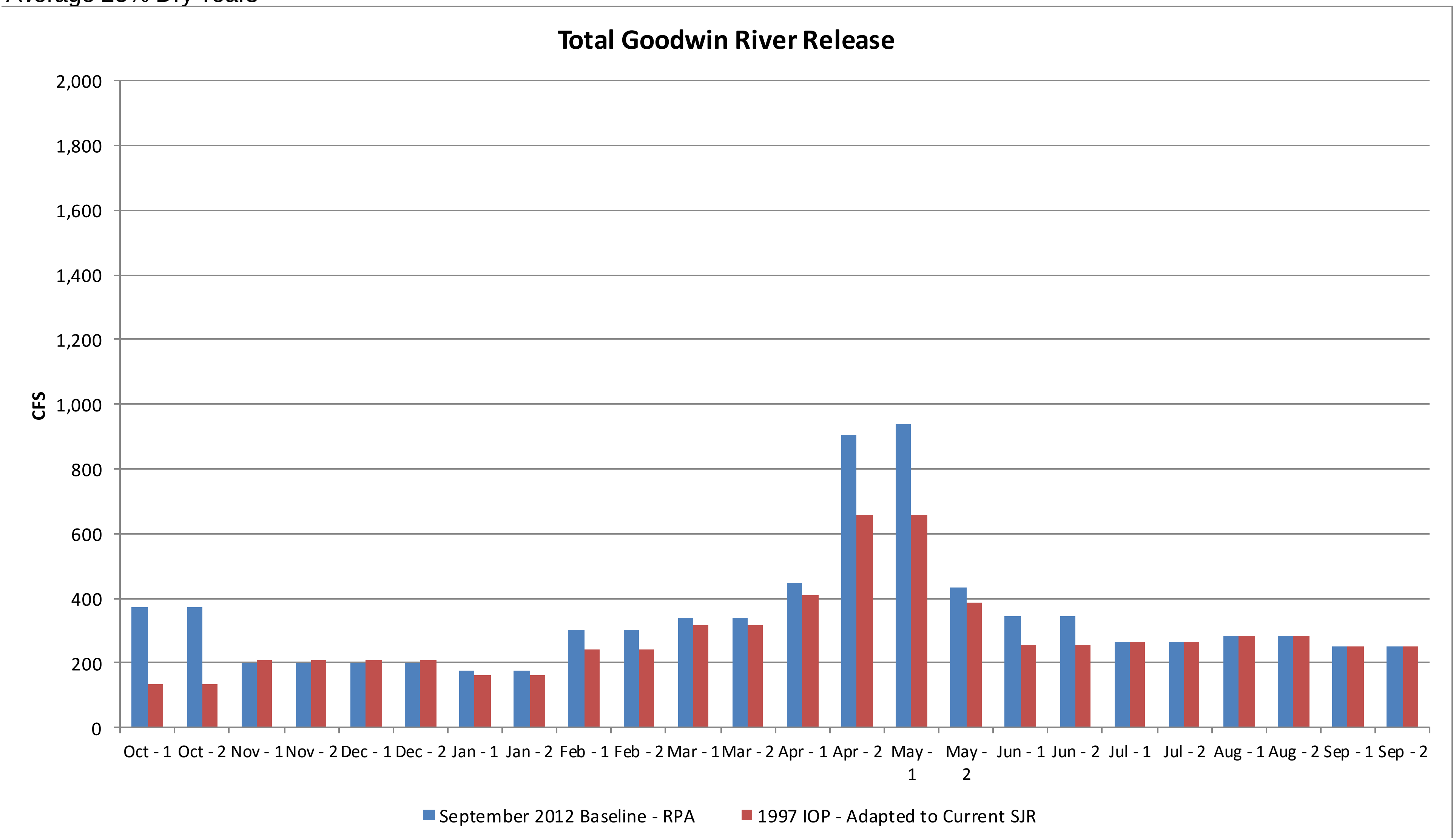
Year Type	Oct - 1	Oct - 2	Nov - 1	Nov - 2	Dec - 1	Dec - 2	Jan - 1	Jan - 2	Feb - 1	Feb - 2	Mar - 1	Mar - 2
25% W Ave	305	411	-124	-124	-158	-179	-193	-298	-1,128	-1,993	-9	191
25% AN Ave	259	403	-140	-119	-211	-398	-154	-156	-194	-292	418	401
25% BN Ave	346	398	-96	-96	-96	-96	-64	-64	-54	-61	-10	-11
25% D Ave	236	236	-11	-11	-11	-11	16	16	58	60	24	24
10% D Ave	163	163	11	11	11	11	31	31	49	49	3	3
All Avg	287	361	-92	-87	-117	-168	-97	-123	-322	-558	103	148

Average All Years





Average 25% Dry Years



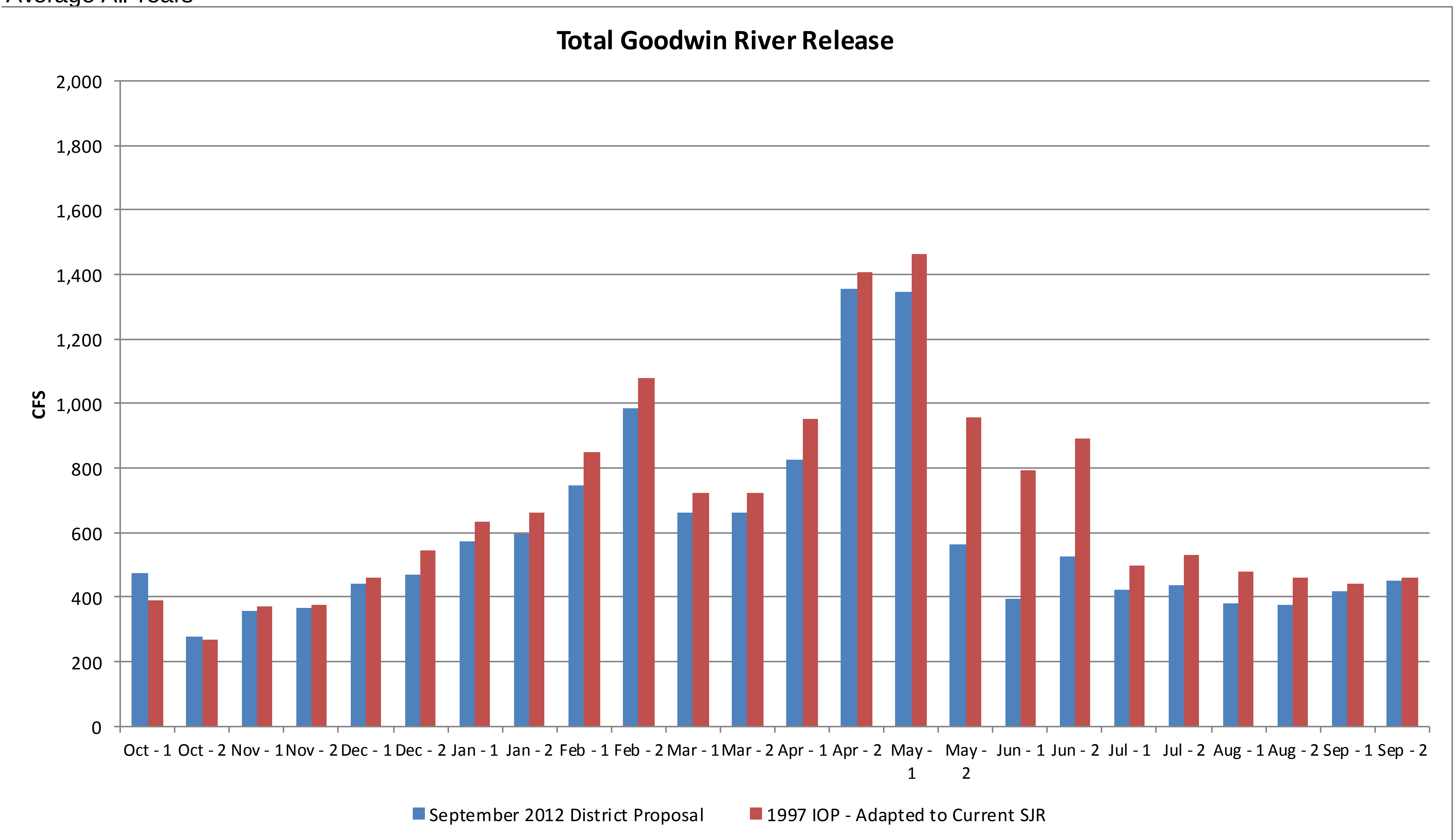
Difference (September 2012 District Proposal minus 1997 IOP - Adapted to Current SJR)
Minimum Instream Fishery Requirement
Average Period CFS

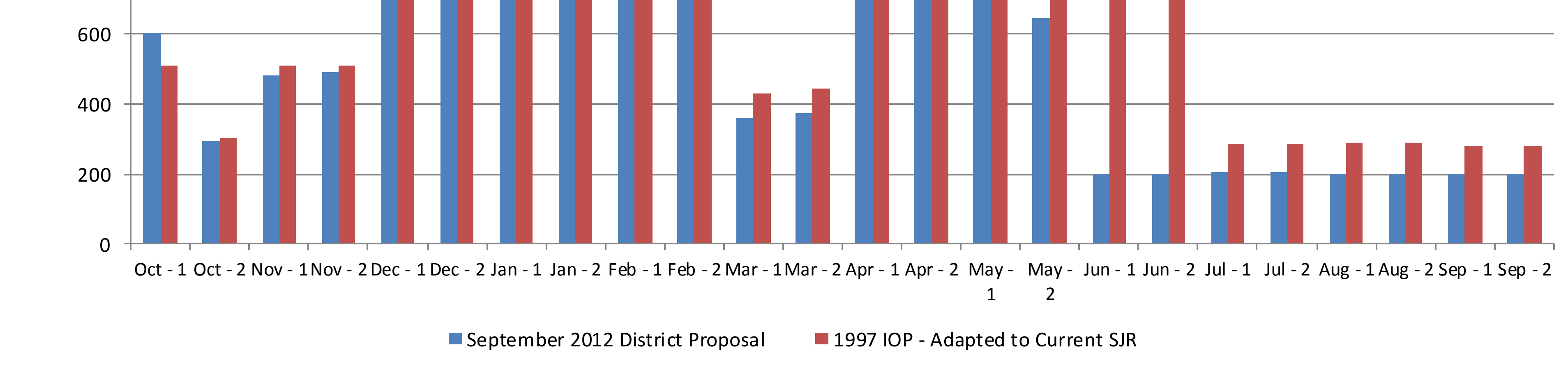
Work Product – Subject to Revision
DBS – September 30, 2012

Year Type	Oct - 1	Oct - 2	Nov - 1	Nov - 2	Dec - 1	Dec - 2	Jan - 1	Jan - 2	Feb - 1	Feb - 2	Mar - 1	Mar - 2
25% W Ave	26	-23	-29	-22	-56	-18	-43	-120	-405	-295	-156	-146
25% AN Ave	93	-9	-28	-20	-26	-313	-142	-125	-35	-110	-67	-70
25% BN Ave	128	-4	-17	-17	-10	1	-50	-18	-12	-30	-52	-53
25% D Ave	85	85	28	28	28	28	-9	-9	38	40	15	14
10% D Ave	97	97	22	22	22	22	22	22	60	60	20	19
All Avg	84	13	-11	-7	-15	-74	-60	-66	-101	-96	-64	-63

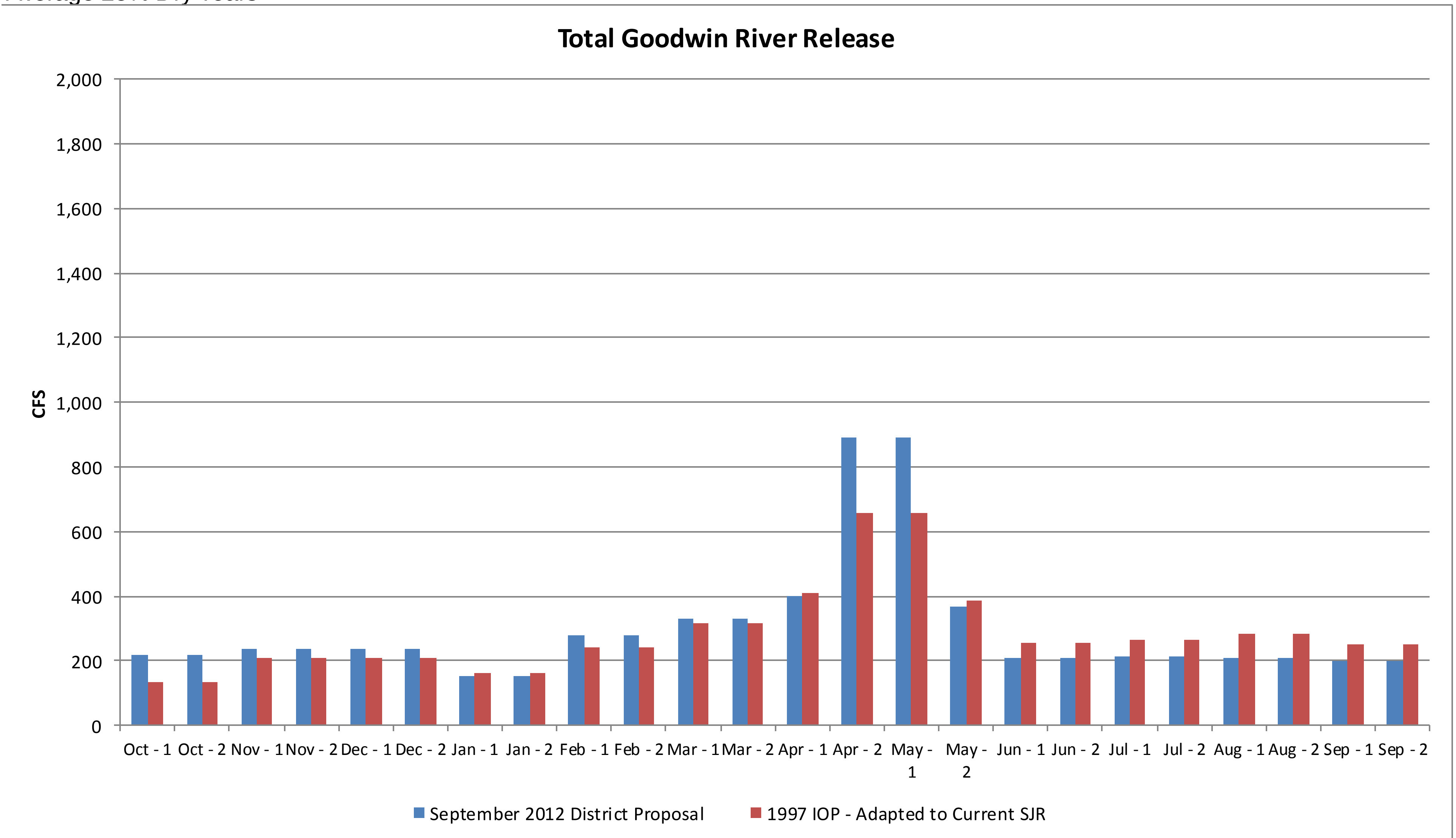
1997 IOP – Ada

Average All Years





Average 25% Dry Years



Difference (September 2012 District Proposal minus September 2012 Baseline - RPA)
Minimum Instream Fishery Requirement
Average Period CFS

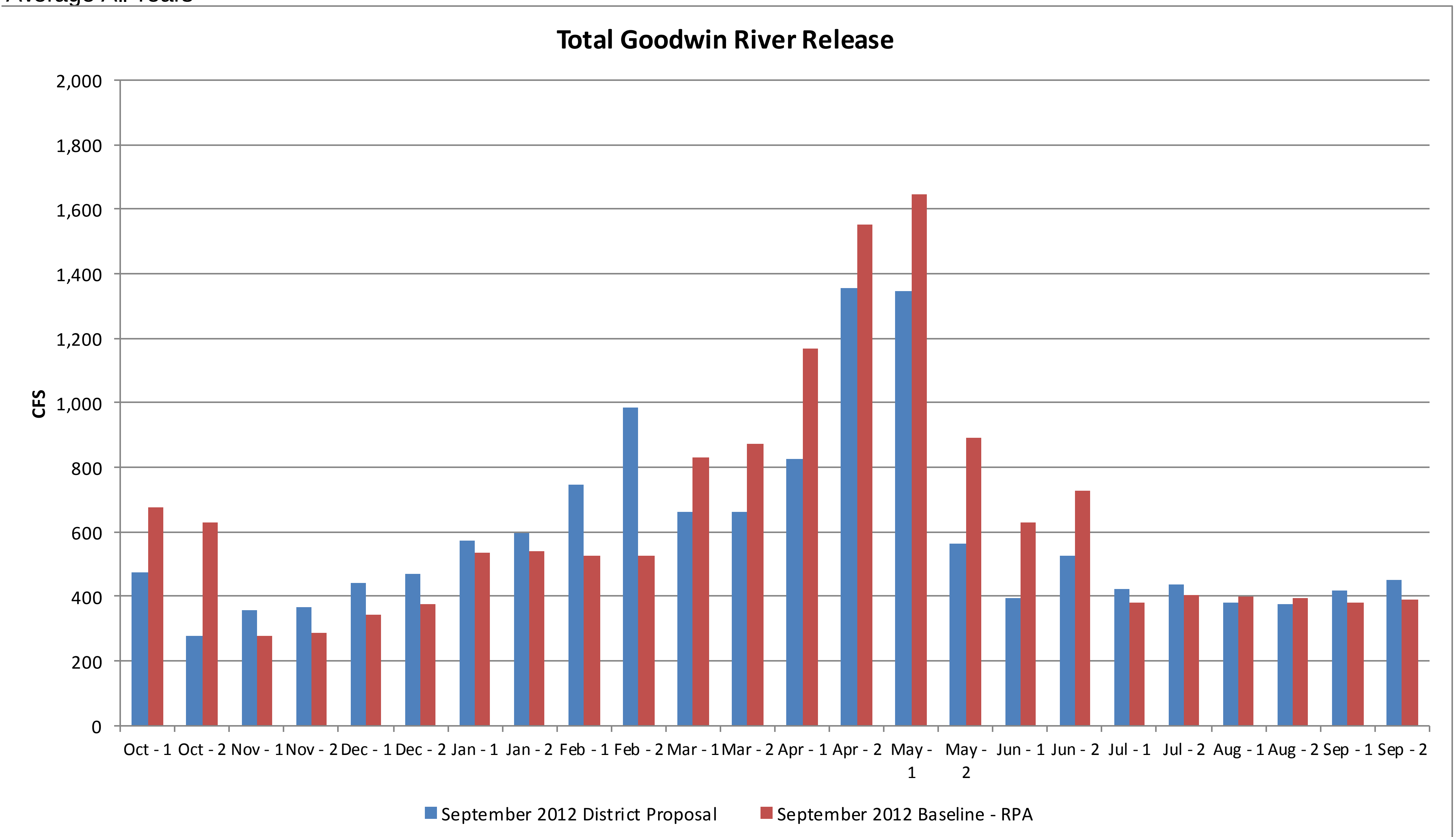
Work Product – Subject to Revision

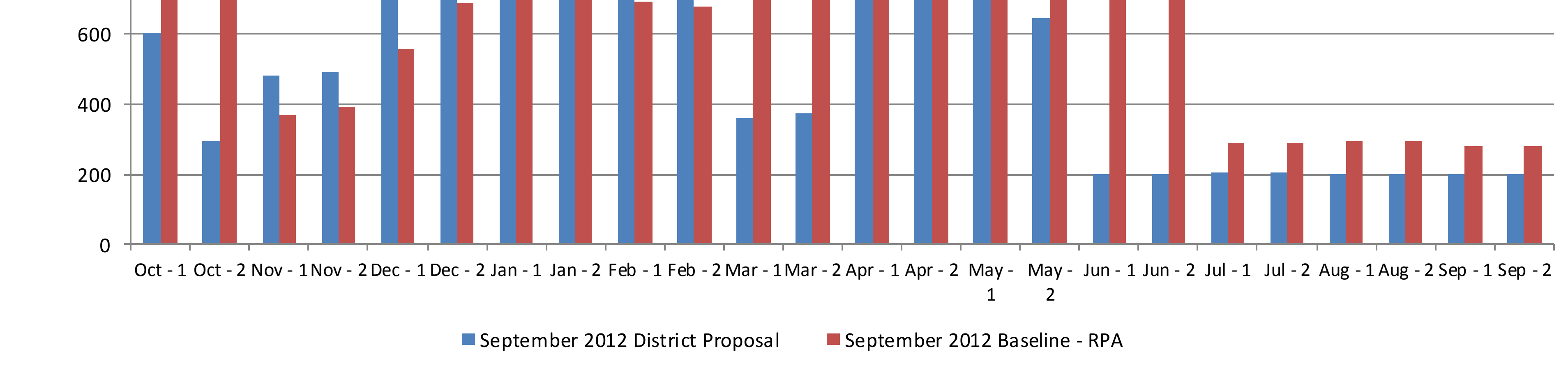
DBS – September 30, 2012

Se... osal v Current River RPA

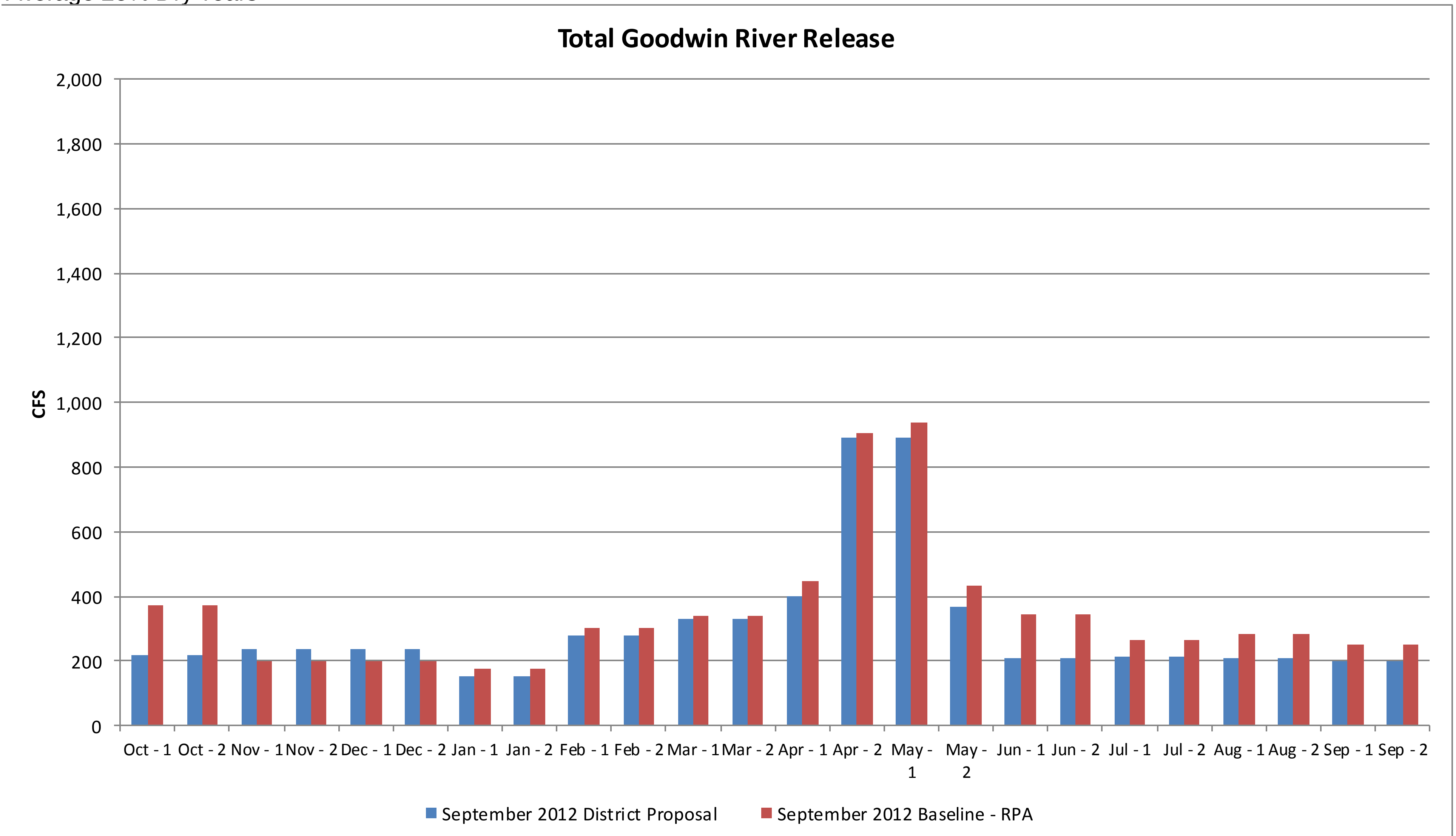
Year Type	Oct - 1	Oct - 2	Nov - 1	Nov - 2	Dec - 1	Dec - 2	Jan - 1	Jan - 2	Feb - 1	Feb - 2	Mar - 1	Mar - 2
25% W Ave	-279	-434	94	102	101	160	150	179	723	1,698	-147	-337
25% AN Ave	-166	-412	112	99	185	85	12	32	159	182	-485	-471
25% BN Ave	-218	-402	79	79	86	96	14	46	42	31	-43	-42
25% D Ave	-151	-151	39	39	39	39	-25	-25	-20	-20	-9	-10
10% D Ave	-66	-66	12	12	12	12	-9	-9	10	10	17	15
All Avg	-203	-348	80	79	102	94	37	57	221	461	-167	-210

Average All Years





Average 25% Dry Years



1943	1538	1930	0	484	10	80	468	0	0	51	713	194	3090
1944	649	1584	0	547	8	39	301	5	0	0	307	0	2397
1945	1228	1776	0	474	10	80	399	0	0	60	492	32	2722
1946	1175	1858	0	481	10	80	418	0	0	26	444	0	2801
1947	634	1460	0	600	7	33	274	11	22	0	308	0	2334
1948	853	1463	0	489	4	18	209	27	30	0	267	0	2186
1949	732	1328	0	583	1	6	155	39	18	0	211	0	2065
1950	1027	1494	0	549	5	25	239	18	4	0	674	413	2254
1951	1656	1733	0	505	10	80	394	0	0	30	486	63	2697
1952	1844	2000	0	496	10	80	467	0	0	0	1063	596	3430
1953	965	1763	0	546	10	80	393	0	0	0	393	0	2695
1954	882	1596	0	590	9	45	329	2	4	0	335	0	2462
1955	656	1395	0	516	2	12	180	25	35	0	322	82	2121
1956	1825	2000	0	527	10	80	467	0	0	95	631	70	3082
1957	878	1729	0	557	10	80	382	0	0	0	382	0	2649
1958	1599	2000	0	419	10	80	467	0	0	0	896	429	3200
1959	624	1560	0	556	7	37	292	8	0	0	299	0	2374
1960	574	1247	0	583	0	0	126	30	61	0	217	0	2001
1961	446	929	0	497	0	0	109	23	66	0	199	2	1623
1962	863	1050	0	540	0	0	113	44	15	0	172	0	1715
1963	1227	1526	0	481	4	19	214	26	4	0	244	0	2198
1964	632	1281	0	578	1	6	154	29	40	0	228	5	2062
1965	1666	1867	0	500	10	80	445	0	0	102	547	0	2910
1966	733	1582	0	552	9	43	319	2	0	0	322	0	2439
1967	1831	2000	0	486	10	80	468	0	0	0	939	471	3297
1968	670	1600	0	534	8	40	308	4	0	0	487	175	2413
1969	2118	2000	0	502	10	80	467	0	0	0	1465	999	3474
1970	1321	1695	0	528	10	80	399	0	0	67	496	30	2720
1971	1066	1716	0	528	10	80	377	0	1	13	391	0	2627
1972	764	1460	0	600	7	32	270	12	7	0	291	2	2325
1973	1237	1751	0	490	10	80	374	0	0	0	488	113	2618
1974	1500	1951	0	439	10	80	467	0	0	97	719	155	3045
1975	1210	1805	0	492	10	80	450	0	0	152	656	54	2927
1976	467	1381	0	511	2	10	173	26	48	0	247	0	2105
1977	271	982	0	381	0	0	105	23	72	0	203	3	1540
1978	1311	1574	0	454	5	22	227	21	0	0	249	1	2228
1979	1139	1630	0	529	10	80	375	0	0	100	722	247	2619
1980	1721	1920	0	481	10	80	467	0	0	104	607	36	3005
1981	634	1573	0	540	7	35	286	9	0	0	614	320	2361
1982	2229	2000	0	429	10	80	467	0	0	0	1880	1413	3419
1983	2900	2000	0	413	10	80	468	0	0	0	2320	1853	3965
1984	1621	1783	0	549	10	80	410	0	0	0	431	21	2765
1985	744	1577	0	510	8	39	302	4	1	0	514	206	2400
1986	1869	1932	0	475	10	80	467	0	0	0	777	310	3149
1987	497	1480	0	531	5	24	237	16	25	0	278	0	2248
1988	390	1099	0	460	0	0	115	23	76	0	214	0	1759
1989	648	950	0	548	0	0	110	36	70	0	216	0	1648
1990	491	658	0	527	0	0	95	32	68	0	195	0	1354
1991	502	437	0	526	0	0	75	29	53	0	159	1	1068
1992	459	198	0	506	0	0	58	63	41	0	166	4	830
1993	1275	827	0	477	0	0	100	63	33	0	197	1	1428
1994	501	546	0	529	0	0	88	47	62	0	201	4	1244
1995	2160	1869	0	452	10	80	383	0	0	0	589	206	2653
1996	1512	1968	0	517	10	80	467	0	0	0	1623	1157	3024
1997	1902	1653	0	556	10	80	406	0	0	97	559	56	2749
1998	1876	2000	0	444	10	80	467	0	0	0	1322	856	3374
1999	1326	1866	0	508	10	80	433	0	0	12	544	99	2860
2000	1062	1802	0	488	10	80	394	0	0	21	441	26	2702
2001	588	1549	0	469	6	28	253	12	19	0	284	0	2286
2002	710	1369	0	548	3	13	185	21	53	0	259	0	2132
2003	896	1405	0	530									2155

All units in 1,000 acre-feet unless otherwise noted.

Vernalis WQ Release from Goodwin (1)

DO Release from Goodwin

1943	1538	1835	0	484	75	80	588	0	0	50	757	120	3090
1944	649	1338	0	547	75	80	347	3	0	12	362	0	2289
1945	1228	1380	0	474	75	80	462	0	0	67	528	0	2455
1946	1175	1388	0	481	75	80	462	0	0	29	491	0	2441
1947	634	891	0	600	10	49	235	15	38	134	421	0	1872
1948	853	821	0	489	10	49	185	27	39	80	331	0	1607
1949	732	506	0	583	10	49	185	25	19	144	373	0	1400
1950	1027	733	0	549	10	0	98	51	22	0	178	6	1397
1951	1656	1386	0	505	75	80	347	3	0	60	414	3	2371
1952	1844	2000	0	496	75	80	587	0	0	0	697	110	3125
1953	965	1630	0	546	75	80	462	0	5	0	467	0	2695
1954	882	1294	0	590	75	80	347	3	12	72	433	0	2325
1955	656	1028	0	516	10	49	235	13	20	10	285	8	1791
1956	1825	1621	0	527	75	80	462	0	3	101	565	0	2759
1957	878	1369	0	557	75	80	347	3	8	4	362	0	2329
1958	1599	1844	0	419	75	80	587	0	0	0	587	0	2843
1959	624	1319	0	556	75	80	347	3	0	0	350	0	2267
1960	574	874	0	583	10	49	234	15	23	48	321	0	1737
1961	446	516	0	497	10	0	98	24	69	0	193	2	1206
1962	863	647	0	540	10	0	98	46	18	0	163	1	1305
1963	1227	982	0	481	10	49	235	15	4	148	402	0	1799
1964	632	647	0	578	10	49	185	22	33	38	284	5	1483
1965	1666	1188	0	500	75	80	347	3	0	140	490	0	2243
1966	733	863	0	552	10	49	234	14	2	189	439	0	1777
1967	1831	1564	0	486	75	80	462	0	0	0	462	0	2528
1968	670	1308	0	534	10	49	234	15	1	11	269	8	2070
1969	2118	2000	0	502	75	80	587	0	0	0	1273	686	3337
1970	1321	1601	0	528	75	80	462	0	0	62	523	0	2720
1971	1066	1484	0	528	75	80	462	0	7	9	478	0	2536
1972	764	1184	0	600	10	49	234	15	15	58	325	3	2087
1973	1237	1430	0	490	75	80	347	3	0	0	350	0	2329
1974	1500	1662	0	439	75	80	587	0	0	94	681	0	2839
1975	1210	1531	0	492	75	80	462	0	0	167	629	0	2699
1976	467	1048	0	511	10	49	234	14	29	40	317	0	1845
1977	271	615	0	381	10	0	98	22	77	0	200	3	1171
1978	1311	1211	0	454	10	49	234	15	0	0	250	1	1863
1979	1139	1197	0	529	75	80	347	3	0	113	466	3	2231
1980	1721	1606	0	481	75	80	587	0	0	101	688	0	2818
1981	634	1211	0	540	10	49	234	15	0	79	333	5	2034
1982	2229	2000	0	429	75	80	587	0	0	0	1761	1175	3362
1983	2900	2000	0	413	75	80	588	0	0	0	2256	1668	3965
1984	1621	1589	0	549	75	80	587	0	0	0	587	0	2765
1985	744	1204	0	510	75	80	347	2	1	33	388	5	2182
1986	1869	1835	0	475	75	80	587	0	0	0	630	44	2954
1987	497	1324	0	531	10	49	235	15	20	80	350	0	2139
1988	390	773	0	460	10	49	185	15	64	74	338	0	1551
1989	648	570	0	548	10	0	98	37	74	0	210	0	1265
1990	491	282	0	527	10	0	98	26	94	0	218	0	978
1991	502	150	116	526	10	0	99	23	57	0	180	1	673
1992	459	150	275	506	10	0	98	24	71	0	197	4	536
1993	1275	766	0	477	10	0	98	64	33	0	196	1	1381
1994	501	474	0	529	10	0	98	19	88	0	209	4	1183
1995	2160	1655	0	452	75	80	462	0	0	0	462	0	2577
1996	1512	1871	0	517	75	80	587	0	0	0	1548	961	3013
1997	1902	1545	0	556	75	80	462	0	0	102	569	5	2749
1998	1876	2000	0	444	75	80	587	0	0	0	1185	598	3295
1999	1326	1706	0	508	75	80	588	0	0	9	597	0	2860
2000	1062	1580	0	488	75	80	462	0	0	24	488	3	2587
2001	588	1292	0	469	10	49	234	12	18	64	328	0	2062
2002	710	874	0	548	10	49	234	11	35	203	483	0	1846
2003	896	712	0	530									1612

All units in 1,000 acre-feet unless otherwise noted. Vernalis WQ Release from Goodwin (1) DO Release from Goodwin

1943	1538	2000	0	484	75	80	318	0	0	0	580	261	3090
1944	649	1606	0	547	75	80	235	0	1	0	238	1	2464
1945	1228	1865	0	474	75	80	318	0	0	0	452	134	2748
1946	1175	1902	0	481	75	80	318	0	0	0	318	0	2801
1947	634	1431	0	600	75	80	236	0	51	0	287	0	2395
1948	853	1312	0	489	75	80	235	0	39	0	275	0	2152
1949	732	1006	0	583	75	80	235	0	15	0	251	0	1893
1950	1027	1056	0	549	75	80	235	0	7	0	243	0	1901
1951	1656	1747	0	505	75	80	318	0	0	0	385	67	2661
1952	1844	2000	0	496	75	80	318	0	0	0	998	680	3430
1953	965	1761	0	546	75	80	318	0	2	0	319	0	2695
1954	882	1569	0	590	75	80	235	0	30	0	266	0	2470
1955	656	1235	0	516	75	80	236	0	29	0	273	8	2098
1956	1825	2000	0	527	75	80	318	0	0	0	454	137	2979
1957	878	1717	0	557	75	80	318	0	2	0	320	0	2649
1958	1599	2000	0	419	75	80	318	0	0	0	828	510	3197
1959	624	1502	0	556	75	80	236	0	7	0	243	0	2374
1960	574	1025	0	583	75	80	235	0	35	0	271	0	1947
1961	446	668	0	497	10	0	174	0	31	0	207	2	1365
1962	863	746	0	540	10	49	174	0	0	0	174	0	1449
1963	1227	1104	0	481	75	80	236	0	7	0	243	0	1877
1964	632	829	0	578	10	49	174	0	26	0	206	5	1620
1965	1666	1617	0	500	75	80	235	0	0	0	235	0	2453
1966	733	1347	0	552	75	80	235	0	7	0	243	1	2232
1967	1831	2000	0	486	75	80	318	0	0	0	650	332	3071
1968	670	1559	0	534	75	80	235	0	5	0	368	128	2413
1969	2118	2000	0	502	75	80	318	0	0	0	1413	1096	3474
1970	1321	1761	0	528	75	80	318	0	0	0	350	33	2720
1971	1066	1782	0	528	75	80	318	0	3	0	321	0	2706
1972	764	1453	0	600	75	80	235	0	25	0	265	5	2407
1973	1237	1725	0	490	75	80	318	0	0	0	414	96	2603
1974	1500	2000	0	439	75	80	318	0	0	0	652	334	3045
1975	1210	1993	0	492	75	80	318	0	0	0	453	135	2927
1976	467	1372	0	511	75	80	235	0	41	0	276	0	2240
1977	271	896	0	381	10	49	174	0	38	0	214	2	1502
1978	1311	1373	0	454	75	80	235	0	0	0	236	1	2128
1979	1139	1562	0	529	75	80	236	0	0	0	436	201	2402
1980	1721	2000	0	481	75	80	318	0	0	0	526	209	3005
1981	634	1535	0	540	75	80	235	0	1	0	515	278	2381
1982	2229	2000	0	429	75	80	318	0	0	0	1823	1505	3419
1983	2900	2000	0	413	75	80	318	0	0	0	2255	1937	3965
1984	1621	1792	0	549	75	80	318	0	0	0	341	24	2765
1985	744	1548	0	510	75	80	235	0	11	0	424	178	2423
1986	1869	1991	0	475	75	80	318	0	2	0	667	347	3149
1987	497	1430	0	531	75	80	236	0	33	0	269	0	2297
1988	390	991	0	460	10	49	174	0	55	0	229	0	1692
1989	648	771	0	548	10	49	174	0	43	0	217	0	1508
1990	491	456	0	527	10	0	174	0	53	0	227	0	1159
1991	502	187	0	526	10	0	174	0	22	0	197	0	838
1992	459	150	257	506	10	0	174	0	33	0	211	4	563
1993	1275	757	0	477	10	0	174	0	32	0	206	0	1381
1994	501	452	0	529	10	0	174	0	50	0	228	4	1169
1995	2160	1752	0	452	75	80	318	0	0	0	418	100	2550
1996	1512	2000	0	517	75	80	318	0	0	0	1558	1240	3024
1997	1902	1755	0	556	75	80	318	0	0	0	489	171	2749
1998	1876	2000	0	444	75	80	318	0	0	0	1260	942	3374
1999	1326	1903	0	508	75	80	318	0	0	0	478	160	2860
2000	1062	1820	0	488	75	80	318	0	0	0	346	29	2702
2001	588	1486	0	469	75	80	235	0	30	0	266	0	2316
2002	710	1162	0	548	75	80	235	0	49	0	284	0	2060
2003	896	1047	0	530									1921

All units in 1,000 acre-feet unless otherwise noted.

Vernalis WQ Release from Goodwin (1) #N/A

1.C.2.3 Attachments to Comments of South Delta Water Agency

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Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, April 30, 2013

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	23 %
Vernalis Base Flow : Monthly average *	>= 1,140 or 710 cfs	2,193 cfs
7 Day average *	>=912 or 568 cfs	3,789 cfs
Habitat Protection, X2 / Flow	19 days at Chipps Island	21 days
	30 days at Collinsville	30 days
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	165 days	120 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	36 mg/l
14dm EC at Emmaton	<= 0.45 mS/cm	0.56 mS/cm
14dm EC at Jersey Point	<= 0.45 mS/cm	0.29 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	0.6 mS/cm
Brandt Bridge	<= 1.0 mS/cm	0.7 mS/cm
Old River Near Tracy	<=1.0 mS/cm	0.9 mS/cm
Old River Near Middle River	<=1.0 mS/cm	0.6 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, April 1, 2013)

Previous Month's Index (8RI for Mar.): 1.713 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%:6.0 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.8 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta cond. w/ no storage withdrawal
s = balanced Delta cond. w/ storage withdrawal
Excess Delta conditions with restrictions:
f = fish concerns
r = E/I ratio concerns

* NDOI, Rio Vista & Vernalis Flows:
- Monthly average is progressive daily mean.
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Ouflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
04/01/2013	6.10	3.98	15,753	20.40	10.76	10.71	5.58	5.04	3.81	2.51	1.50
04/02/2013	5.89	3.95	18,249	19.07	12.11	11.05	4.96	4.43	4.00	2.09	1.60
04/03/2013	5.68	3.94	19,557	17.99	10.63	11.27	4.13	3.61	4.12	1.55	1.67
04/04/2013	5.66	4.03	20,780	18.47	10.05	11.40	3.74	3.24	4.17	1.22	1.71
04/05/2013	5.47	3.85	21,744	17.08	8.69	11.37	3.04	2.57	4.17	0.89	1.70
04/06/2013	5.36	3.78	19,484	16.65	8.40	11.25	2.61	2.18	4.10	0.68	1.69
04/07/2013	5.33	3.85	17,737	16.82	8.42	11.09	2.49	2.07	4.00	0.50	1.64
04/08/2013	6.02	4.02	17,513	15.14	7.68	10.80	2.38	1.97	3.83	0.63	1.57
04/09/2013	5.43	3.58	18,388	13.97	5.75	10.37	1.44	1.13	3.60	0.53	1.48
04/10/2013	5.54	3.68	16,350	13.62	6.35	9.96	1.66	1.32	3.36	0.39	1.38
04/11/2013	5.87	3.92	15,537	14.70	6.97	9.60	1.88	1.51	3.18	0.41	1.30
04/12/2013	5.93	4.06	15,110	14.94	7.18	9.26	1.77	1.41	2.97	0.46	1.21
04/13/2013	6.00	4.13	13,928	15.54	7.48	8.84	1.91	1.54	2.69	0.47	1.06
04/14/2013	5.87	4.21	13,201	15.01	7.03	8.39	1.90	1.53	2.40	0.48	0.91
04/15/2013	6.05	4.36	13,006	16.10	7.53	8.16	2.00	1.62	2.15	0.58	0.78
04/16/2013	5.30	3.81	11,996	12.75	5.11	7.66	1.18	0.91	1.90	0.40	0.66
04/17/2013	4.62	3.44	11,692	10.87	3.83	7.18	0.91	0.68	1.69	0.35	0.57
04/18/2013	4.51	3.45	10,332	14.05	6.29	6.91	1.32	1.03	1.53	0.33	0.51
04/19/2013	4.84	3.53	9,139	16.43	8.65	6.90	2.74	2.30	1.51	0.55	0.48
04/20/2013	4.93	3.50	8,211	18.80	11.88	7.15	4.52	3.99	1.64	1.65	0.55
04/21/2013	5.12	3.57	7,471	21.29	13.71	7.53	6.22	5.68	1.90	2.35	0.68
04/22/2013	5.33	3.66	7,059	22.73	15.38	8.08	6.75	6.22	2.20	3.03	0.85
04/23/2013	5.73	3.88	6,849	24.39	15.82	8.80	7.88	7.37	2.65	4.18	1.12
04/24/2013	6.07	4.19	6,605	25.78	18.18	9.65	9.84	9.43	3.23	5.31	1.47
04/25/2013	6.47	4.25	7,038	26.40	18.77	10.49	10.63	10.27	3.86	6.13	1.88
04/26/2013	6.32	4.08	7,896	25.52	17.32	11.21	9.19	8.74	4.38	5.33	2.22
04/27/2013	6.31	4.02	9,030	24.92	16.30	11.84	8.76	8.29	4.86	4.95	2.54
04/28/2013	6.36	4.08	10,396	24.58	15.35	12.44	8.30	7.81	5.31	4.66	2.84
04/29/2013	6.40	4.24	10,578	24.44	14.82	12.96	8.21	7.72	5.75	4.38	3.11
04/30/2013	6.24	4.15	10,798	23.98	13.59	13.56	7.92	7.42	6.21	4.37	3.40

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
04/01/2013	1.20	0.79	0.38	0.32	0.33	0.25	0.63	9.74	8.00	7.90	7.75	3.11
04/02/2013	1.01	0.82	0.36	0.33	0.29	0.26	0.53	9.77	7.51	7.61	7.52	2.60
04/03/2013	0.84	0.84	0.33	0.33	0.27	0.26	0.52	9.61	7.35	7.46	7.60	2.15
04/04/2013	0.77	0.86	0.32	0.33	0.26	0.26	0.57	9.47	7.28	7.48	7.69	1.53
04/05/2013	0.66	0.87	0.30	0.33	0.22	0.27	0.65	9.37	6.87	7.44	7.30	1.30
04/06/2013	0.58	0.88	0.29	0.33	0.21	0.27	0.63	9.27	6.78	7.23	7.32	1.08
04/07/2013	0.55	0.87	0.28	0.33	0.21	0.27	0.62	9.06	6.94	7.19	7.26	0.63
04/08/2013	0.54	0.86	0.29	0.32	0.22	0.27	0.61	8.94	6.75	7.06	7.37	1.11
04/09/2013	0.44	0.83	0.26	0.32	0.19	0.26	0.55	9.05	6.48	6.78	6.94	0.58
04/10/2013	0.42	0.80	0.26	0.32	0.19	0.26	0.55	8.39	6.17	6.56	7.11	0.53
04/11/2013	0.44	0.77	0.26	0.31	0.20	0.25	0.54	7.59	5.89	6.56	6.86	0.48
04/12/2013	0.43	0.74	0.26	0.31	0.20	0.25	0.53	6.84	5.87	6.37	6.58	0.53
04/13/2013	0.41	0.68	0.25	0.30	0.20	0.24	0.50	6.51	6.19	6.08	6.29	0.56
04/14/2013	0.40	0.62	0.25	0.29	0.21	0.23	0.45	6.60	6.01	6.06	6.22	0.67
04/15/2013	0.44	0.57	0.26	0.28	0.22	0.22	0.43	6.39	5.85	5.98	6.20	0.72
04/16/2013	0.38	0.52	0.24	0.27	0.19	0.21	0.39	6.58	5.80	6.01	6.10	0.45
04/17/2013	0.33	0.48	0.24	0.27	0.18	0.21	0.38	6.63	5.74	6.00	6.08	0.42
04/18/2013	0.32	0.45	0.23	0.26	0.18	0.20	0.37	6.20	5.51	5.95	5.98	0.37
04/19/2013	0.33	0.43	0.23	0.26	0.19	0.20	0.39	6.00	5.23	5.71	5.70	1.21
04/20/2013	0.39	0.42	0.23	0.25	0.20	0.20	0.39	5.83	5.06	5.62	5.55	2.04
04/21/2013	0.61	0.42	0.24	0.25	0.22	0.20	0.40	5.92	5.40	6.19	5.60	3.56
04/22/2013	0.87	0.44	0.24	0.25	0.25	0.20	0.42	6.13	5.97	6.77	5.93	4.39
04/23/2013	1.16	0.49	0.25	0.25	0.29	0.21	0.42	6.94	7.31	8.39	7.40	5.37
04/24/2013	1.93	0.60	0.30	0.25	0.71	0.25	0.42	8.71	8.59	10.03	9.00	6.92
04/25/2013	2.36	0.74	0.36	0.26	1.28	0.32	0.43	9.73	8.79	10.32	9.24	7.42
04/26/2013	1.91	0.85	0.33	0.26	1.06	0.39	0.43	10.74	9.36	10.77	9.23	6.54
04/27/2013	1.87	0.95	0.34	0.27	1.00	0.44	0.42	11.60	9.71	11.16	9.59	5.86
04/28/2013	1.93	1.06	0.35	0.27	0.89	0.49	0.43	11.74	9.83	10.73	10.02	5.61
04/29/2013	2.04	1.17	0.36	0.28	0.75	0.53	0.45	11.84	10.00	11.33	10.34	5.73
04/30/2013	1.90	1.28	0.37	0.29	0.64	0.56	0.46	11.91	9.92	11.63	10.50	5.40

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
04/01/2013	0.29	0.33	0.28	0.27	0.29	0.42	0.49	313	33	30	r
04/02/2013	0.29	0.33	0.28	0.28	0.29	0.66	0.50	251	34	30	r
04/03/2013	0.30	0.33	0.28	0.28	0.29	0.72	0.48	199	35	29	b
04/04/2013	0.29	0.33	0.28	0.29	0.29	0.69	0.48	174	36	30	b
04/05/2013	0.30	0.34	0.28	0.29	0.29	0.72	0.48	140	37	30	b
04/06/2013	0.29	0.34	0.28	0.29	0.29	0.76	0.48	114	38	31	b
04/07/2013	0.29	0.34	0.28	0.30	0.29	0.77	0.48	105	39	31	b
04/08/2013	0.29	0.33	0.28	0.29	0.28	0.72	0.46	103	38	31	b
04/09/2013	0.28	0.32	0.27	0.29	0.28	0.75	0.48	69	38	31	b
04/10/2013	0.27	0.32	0.27	0.30	0.28	0.79	0.48	63	39	31	b
04/11/2013	0.27	0.31	0.27	0.29	0.28	0.70	0.48	70	38	31	b
04/12/2013	0.27	0.31	0.27	0.29	0.26	0.69	0.47	66	38	31	b
04/13/2013	0.26	0.31	0.27	0.29	0.27	0.69	0.47	61	37	34	b
04/14/2013	0.27	0.30	0.26	0.28	0.30	0.71	0.47	57	36	34	b
04/15/2013	0.27	0.28	0.26	0.28	0.31	0.57	0.76	69	35	36	b
04/16/2013	0.27	0.29	0.26	0.29	0.31	0.68	0.86	51	36	37	b
04/17/2013	0.26	0.29	0.26	0.28	0.33	0.68	0.88	36	35	35	f
04/18/2013	0.25	0.28	0.25	0.28	0.34	0.68	0.86	31	35	37	f
04/19/2013	0.25	0.28	0.26	0.28	0.34	0.61	0.81	34	34	38	f
04/20/2013	0.25	0.29	0.26	0.27	0.34	0.57	0.75	54	33	37	f
04/21/2013	0.25	0.29	0.25	0.27	0.32	0.51	0.68	124	32	38	f
04/22/2013	0.24	0.29	0.25	0.27	0.33	0.46	0.60	206	32	37	f
04/23/2013	0.24	0.29	0.25	0.27	0.33	0.43	0.50	298	31	37	f
04/24/2013	0.25	0.28	0.25	0.27	0.32	0.40	0.49	545	31	37	f
04/25/2013	0.26	0.27	0.25	0.26	0.32	0.38	0.42	683	31	36	f
04/26/2013	0.26	0.29	0.26	0.27	0.31	0.35	0.43	537	32	36	b
04/27/2013	0.25	0.29	0.26	0.28	0.32	0.32	0.40	524	34	36 e	b
04/28/2013	0.26	0.29	0.26	0.28	0.32	0.32	0.35	544	35	36 e	b
04/29/2013	0.26	0.30	0.26	0.28	0.29	0.31	0.32	581	35	36	b
04/30/2013	0.26	0.30	0.26	0.28	0.31	0.34	0.33	535	34	36	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta cond. w/ no storage withdrawal
- s = balanced Delta cond. w/ storage withdrawal
- Excess Delta conditions with restrictions:
  - f = fish concerns
  - r = E/I ratio concerns

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
04/01/2013	0.81	0.85	0.93	0.83	1.21	0.98	0.94	0.80
04/02/2013	0.78	0.85	0.94	0.84	1.21	0.99	0.89	0.80
04/03/2013	0.79	0.85	0.89	0.84	1.14	1.01	0.81	0.81
04/04/2013	0.85	0.86	0.84	0.85	1.11	1.02	0.82	0.81
04/05/2013	0.82	0.86	0.83	0.85	1.09	1.02	0.88	0.82
04/06/2013	0.83	0.87	0.87	0.86	1.05	1.03	0.89	0.82
04/07/2013	0.82	0.87	0.88	0.86	1.02	1.04	0.89	0.83
04/08/2013	0.82	0.87	0.88	0.87	1.04	1.05	0.90	0.84
04/09/2013	0.83	0.88	0.89	0.87	1.02	1.06	0.90	0.84
04/10/2013	0.83	0.88	0.90	0.88	1.06	1.06	0.93	0.85
04/11/2013	0.81	0.88	0.91	0.88	1.13	1.07	0.94	0.86
04/12/2013	0.76	0.88	0.93	0.89	1.16	1.08	0.95	0.87
04/13/2013	0.75	0.87	0.94	0.89	1.15	1.09	0.94	0.88
04/14/2013	0.73	0.87	0.94	0.90	1.16	1.09	0.88	0.89
04/15/2013	0.67	0.86	0.92	0.90	1.13	1.10	0.87	0.90
04/16/2013	0.62	0.85	0.88	0.90	1.07	1.10	0.79	0.90
04/17/2013	0.48	0.84	0.84	0.90	1.02	1.10	0.76	0.90
04/18/2013	0.43	0.83	0.76	0.90	1.02	1.11	0.63	0.90
04/19/2013	0.35	0.81	0.65	0.89	1.04	1.11	0.55	0.89
04/20/2013	0.39	0.79	0.52	0.88	0.90	1.10	0.40	0.87
04/21/2013	0.30	0.77	0.41	0.86	0.76	1.09	0.43	0.85
04/22/2013	0.30	0.75	0.42	0.84	0.64	1.08	0.33	0.84
04/23/2013	0.27	0.72	0.32	0.82	0.62	1.07	0.31	0.81
04/24/2013	0.25	0.70	0.30	0.80	0.47	1.05	0.26	0.79
04/25/2013	0.24	0.68	0.24	0.78	0.41	1.02	0.22	0.77
04/26/2013	0.24	0.65	0.22	0.76	0.34	1.00	0.21	0.74
04/27/2013	0.23	0.62	0.21	0.73	0.38	0.97	0.21	0.72
04/28/2013	0.23	0.60	0.21	0.71	0.38	0.94	0.21	0.69
04/29/2013	0.22	0.58	0.21	0.68	0.37	0.91	0.20	0.66
04/30/2013	0.22	0.56	0.20	0.66	0.35	0.88	0.20	0.64

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, June 04, 2013

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	14 %
Vernalis Base Flow : Monthly average *	>= 710 cfs	900 cfs
7 Day average *	>= 568 cfs	900 cfs
Habitat Protection, X2 / Flow		
	30 days at Collinsville	4 days
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	165 days	155 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	41 mg/l
14dm EC at Emmaton	<= 0.45 mS/cm	0.39 mS/cm
14dm EC at Jersey Point	<= 0.45 mS/cm	0.33 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.4 mS/cm
Brandt Bridge	<= 0.7 mS/cm	0.4 mS/cm
Old River Near Tracy	<=0.7 mS/cm	0.6 mS/cm
Old River Near Middle River	<=0.7 mS/cm	mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 1 Open / 0 Closed / 2 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2013)

Previous Month's Index (8RI for April.): 2.023 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%:5.8 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.6 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta cond. w/ no storage withdrawal
s = balanced Delta cond. w/ storage withdrawal
Excess Delta conditions with restrictions:
f = fish concerns
r = E/I ratio concerns

* NDOI, Rio Vista & Vernalis Flows:
- Monthly average is progressive daily mean.
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
05/06/2013	6.15	4.19	9,388	24.14	11.38	14.50	8.18	7.69	7.76	4.51	4.50
05/07/2013	6.06	4.10	9,350	23.80	11.10	14.17	8.04	7.54	7.77	4.44	4.52
05/08/2013	6.01	4.07	9,129	24.07	10.98	13.65	8.21	7.71	7.65	4.37	4.46
05/09/2013	6.05	4.08	9,695	23.57	9.40	12.98	7.95	7.45	7.45	4.07	4.31
05/10/2013	6.06	4.08	10,994	22.85	8.69	12.37	7.50	6.98	7.32	3.91	4.21
05/11/2013	6.04	4.03	11,743	21.76	7.75	11.76	6.63	6.09	7.17	3.39	4.10
05/12/2013	5.98	4.06	11,861	20.78	7.95	11.23	6.40	5.87	7.03	3.28	4.00
05/13/2013	5.94	4.12	11,402	21.10	7.48	10.70	6.19	5.65	6.88	3.12	3.91
05/14/2013	5.80	4.16	11,153	21.37	6.97	10.23	6.22	5.68	6.76	2.89	3.80
05/15/2013	5.72	4.15	10,114	21.13	5.60	9.82	6.14	5.60	6.72	2.74	3.71
05/16/2013	5.26	4.02	9,550	21.54	2.97	9.16	5.75	5.21	6.69	2.87	3.70
05/17/2013	5.18	3.95	8,987	21.04	2.33	8.46	5.39	4.85	6.60	1.99	3.63
05/18/2013	5.07	3.63	9,399	18.61	2.09	7.69	4.55	4.02	6.38	1.69	3.47
05/19/2013	5.27	3.48	9,727	18.03	1.99	6.91	4.14	3.62	6.00	1.52	3.20
05/20/2013	5.64	3.65	9,987	19.36	2.12	6.24	4.63	4.10	5.74	1.81	3.01
05/21/2013	5.76	3.94	9,870	23.02	2.39	5.62	6.82	6.29	5.65	2.74	2.88
05/22/2013	5.98	3.76	9,066	22.35	2.32	5.00	6.13	5.59	5.50	2.58	2.76
05/23/2013	5.96	3.77	9,551	22.31	2.36	4.50	6.24	5.70	5.37	2.49	2.64
05/24/2013	6.16	3.92	9,224	23.18	2.30	4.04	6.72	6.19	5.32	2.83	2.57
05/25/2013	6.46	4.10	9,069	24.10	2.27	3.65	7.40	6.88	5.37	3.17	2.55
05/26/2013	6.59	4.23	9,123	24.61	2.06	3.23	7.75	7.24	5.47	3.70	2.58
05/27/2013	6.52	4.13	8,997	24.24	1.75	2.82	7.48	6.97	5.57	3.35	2.60
05/28/2013	6.29	4.18	9,358	23.47	1.61	2.44	6.76	6.23	5.61	3.21	2.62
05/29/2013	6.04	4.17	9,502	23.58	1.59	2.15	6.82	6.29	5.65	3.23	2.66
05/30/2013	5.57	3.93	9,779	21.54	1.55	2.05	5.75	5.21	5.65	2.53	2.63
05/31/2013	5.38	3.71	10,488	19.57	1.48	1.99	4.64	4.11	5.60	1.95	2.63
06/01/2013	5.67	3.76	9,583	19.02	1.45	1.94	4.66	4.13	5.61	1.86	2.64
06/02/2013	6.13	4.02	9,053	20.43	1.52	1.91	5.41	4.87	5.70	2.22	2.69
06/03/2013	6.45	4.49	8,563	23.94	7.89	2.32	7.18	6.66	5.88	3.35	2.80
06/04/2013	6.55	4.57	7,386	25.19	16.19	3.31	8.01	7.52	5.97	3.96	2.89

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
05/06/2013	1.87	1.76	0.39	0.35	0.67	0.68	0.42	11.57	9.68	10.58	8.64	5.54
05/07/2013	1.71	1.80	0.37	0.36	0.62	0.71	0.43	11.61	9.25	9.83	7.57	5.72
05/08/2013	1.66	1.78	0.36	0.36	0.63	0.70	0.45	11.64	8.67	9.42	7.11	5.77
05/09/2013	1.63	1.73	0.36	0.36	0.61	0.65	0.48	11.79	8.13	9.21	6.63	5.27
05/10/2013	1.48	1.70	0.35	0.36	0.57	0.62	0.50	11.99	7.76	8.60	6.49	5.24
05/11/2013	1.32	1.66	0.34	0.36	0.46	0.58	0.48	12.11	7.49	8.22	6.05	4.24
05/12/2013	1.32	1.61	0.34	0.36	0.41	0.54	0.45	11.82	7.10	7.63	5.50	4.49
05/13/2013	1.18	1.55	0.34	0.36	0.37	0.52	0.45	11.36	6.59	7.07	4.94	3.93
05/14/2013	1.12	1.50	0.34	0.36	0.34	0.50	0.43	11.33	6.13	6.45	4.24	4.30
05/15/2013	1.11	1.48	0.33	0.35	0.37	0.50	0.42	11.16	5.72	5.97	3.88	3.56
05/16/2013	1.03	1.46	0.32	0.35	0.32	0.50	0.40	10.60	5.18	5.67	3.68	NR
05/17/2013	0.91	1.44	0.31	0.35	0.29	0.49	NR	10.25	5.10	5.62	3.53	3.14
05/18/2013	0.74	1.38	0.30	0.35	0.25	0.48	NR	10.12	5.04	5.56	3.31	2.43
05/19/2013	0.70	1.27	0.29	0.34	0.23	0.44	NR	9.95	4.98	5.51	2.97	2.33
05/20/2013	0.73	1.19	0.29	0.33	0.21	0.41	NR	9.41	5.03	5.33	2.87	2.79
05/21/2013	0.99	1.14	0.31	0.33	0.27	0.38	NR	8.64	4.43	4.88	2.50	4.05
05/22/2013	1.05	1.09	0.32	0.32	0.27	0.35	NR	8.81	4.36	4.77	2.25	3.64
05/23/2013	1.09	1.06	0.31	0.32	0.28	0.33	NR	9.16	4.31	4.59	2.60	3.57
05/24/2013	1.21	1.04	0.33	0.32	0.33	0.31	0.28	9.18	5.54	5.28	4.32	4.16
05/25/2013	1.43	1.04	0.34	0.32	0.43	0.31	0.26	9.15	6.83	6.34	5.06	3.98
05/26/2013	1.61	1.07	0.36	0.32	0.59	0.32	0.25	9.39	7.47	6.86	6.19	4.71
05/27/2013	1.53	1.09	0.34	0.32	0.54	0.34	0.26	10.04	7.64	7.48	6.47	4.41
05/28/2013	1.37	1.11	0.33	0.32	0.45	0.35	0.25	10.26	7.57	7.88	7.16	4.44
05/29/2013	1.40	1.13	0.34	0.32	0.47	0.35	0.26	10.43	7.18	7.32	7.19	4.02
05/30/2013	1.09	1.13	0.32	0.32	0.34	0.35	0.29	10.38	6.67	7.33	6.95	3.54
05/31/2013	0.90	1.13	0.30	0.32	0.26	0.35	0.39	10.26	6.56	7.79	6.68	2.87
06/01/2013	0.86	1.14	0.30	0.32	0.27	0.35	0.36	10.19	6.68	7.36	7.25	2.92
06/02/2013	0.98	1.16	0.31	0.32	0.28	0.36	0.37	10.03	6.83	7.29	7.20	3.58
06/03/2013	1.26	1.20	0.35	0.32	0.38	0.37	0.32	9.86	7.12	7.97	7.89	4.31
06/04/2013	1.61	1.24	0.40	0.33	0.57	0.39	0.30	10.18	7.10	8.90	7.64	5.07

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
05/06/2013	0.29	0.31	0.28	0.28	0.29	0.25	0.28	525	35	33	s
05/07/2013	0.29	0.32	0.28	0.29	0.29	0.24	NR	475	37	33	s
05/08/2013	0.30	0.33	0.29	0.29	0.28	0.24	NR	458	38	33	s
05/09/2013	0.30	0.33	0.29	0.30	0.30	0.25	NR	448	40	34	s
05/10/2013	0.31	0.34	0.30	0.30	0.30	0.26	NR	400	41	35	s
05/11/2013	0.31	0.33	0.30	0.31	0.29	0.28	NR	351	42	36	s
05/12/2013	0.31	0.34	0.30	0.31	0.31	0.29	NR	351	43	36	s
05/13/2013	0.31	0.33	0.31	0.32	0.32	0.31	NR	307	44	37	s
05/14/2013	0.31	0.33	0.31	0.32	0.32	0.30	NR	288	45	39	s
05/15/2013	0.31	0.34	0.31	0.32	0.32	0.32	NR	283	45	36	s
05/16/2013	0.31	0.34	0.31	0.32	NR	0.34	NR	257	45	40	s
05/17/2013	0.31	0.34	0.31	0.32	NR	0.35	NR	220	46	42	s
05/18/2013	0.31	0.34	0.31	0.33	NR	0.36	NR	166	47	38	s
05/19/2013	0.31	0.34	0.31	0.33	NR	0.39	NR	151	47	39	s
05/20/2013	0.31	0.34	0.30	0.33	NR	0.42	NR	164	47	40	s
05/21/2013	0.31	0.33	0.30	0.32	NR	0.44	NR	246	46	42	s
05/22/2013	0.31	0.33	0.30	0.32	NR	0.45	0.45	265	46	42	s
05/23/2013	0.30	0.33	0.30	0.32	NR	0.46	0.48	278	46	43	s
05/24/2013	0.30	0.33	0.30	0.32	NR	0.44	0.48	317	45	44	s
05/25/2013	0.30	0.33	0.30	0.31	NR	0.45	0.47	385	44	44 e	s
05/26/2013	0.30	0.32	0.30	0.31	NR	0.42	0.47	444	43	44 e	s
05/27/2013	0.30	0.32	0.30	0.31	NR	0.43	0.47	416	42	44 e	s
05/28/2013	0.30	0.32	0.30	0.31	NR	0.42	0.49	367	43	42	s
05/29/2013	0.30	0.32	0.29	0.31	NR	0.42	0.50	376	43	45	s
05/30/2013	0.30	0.32	0.29	0.31	0.38	0.43	0.50	277	43	45	s
05/31/2013	0.30	0.32	0.29	0.31	0.37	0.48	0.52	215	43	45 e	s
06/01/2013	0.30	0.33	0.29	0.31	0.36	0.46	0.52	204	42	45 e	s
06/02/2013	0.30	0.33	0.29	0.30	0.35	0.43	0.50	241	41	45 e	s
06/03/2013	0.30	0.33	0.28	0.30	0.34	0.41	0.48	330	39	44	s
06/04/2013	0.30	0.32	0.28	0.29	0.33	0.40	0.44	443	38	41	s

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta cond. w/ no storage withdrawal
- s = balanced Delta cond. w/ storage withdrawal
- Excess Delta conditions with restrictions:
  - f = fish concerns
  - r = E/I ratio concerns

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
05/06/2013	0.19	0.43	0.17	0.52	0.25	0.72	0.17	0.50
05/07/2013	0.20	0.41	0.18	0.50	0.28	0.69	0.18	0.48
05/08/2013	0.20	0.39	0.20	0.48	0.31	0.67	0.20	0.45
05/09/2013	0.22	0.37	0.20	0.45	0.30	0.64	0.21	0.43
05/10/2013	0.22	0.35	0.22	0.43	0.29	0.62	NR	NC
05/11/2013	0.21	0.33	0.23	0.41	0.29	0.59	NR	NC
05/12/2013	0.21	0.31	0.22	0.38	0.29	0.56	NR	NC
05/13/2013	0.22	0.29	0.22	0.36	0.30	0.53	0.23	NC
05/14/2013	0.26	0.28	0.24	0.34	0.30	0.50	0.25	NC
05/15/2013	0.33	0.27	0.27	0.32	0.31	0.48	0.29	NC
05/16/2013	0.38	0.26	0.32	0.30	0.36	0.45	0.37	NC
05/17/2013	0.40	0.26	0.37	0.28	0.43	0.43	0.44	NC
05/18/2013	0.44	0.26	0.44	0.27	0.47	0.42	0.47	NC
05/19/2013	0.48	0.26	0.47	0.27	0.54	0.40	0.51	NC
05/20/2013	0.48	0.26	0.50	0.26	0.60	0.39	0.55	NC
05/21/2013	0.50	0.27	0.52	0.27	0.67	0.39	0.57	NC
05/22/2013	0.52	0.28	0.54	0.27	0.68	0.39	0.58	NC
05/23/2013	0.53	0.29	0.56	0.28	0.66	0.39	0.59	NC
05/24/2013	0.54	0.30	0.56	0.29	0.70	0.40	0.62	NC
05/25/2013	0.53	0.31	0.57	0.30	0.74	0.41	0.63	NC
05/26/2013	0.51	0.32	0.57	0.31	0.77	0.42	0.56	NC
05/27/2013	0.52	0.32	0.59	0.32	0.77	0.43	0.54	NC
05/28/2013	0.56	0.34	0.61	0.34	0.78	0.45	0.58	NC
05/29/2013	0.54	0.35	0.62	0.35	0.81	0.46	0.55	NC
05/30/2013	0.53	0.36	0.62	0.37	0.81	0.48	0.62	NC
05/31/2013	0.57	0.37	0.62	0.38	0.82	0.50	0.59	NC
06/01/2013	0.56	0.38	0.62	0.39	0.84	0.51	0.63	NC
06/02/2013	0.56	0.39	0.63	0.41	0.89	0.53	0.62	NC
06/03/2013	0.55	0.41	0.62	0.42	0.92	0.55	0.69	NC
06/04/2013	0.59	0.42	0.61	0.44	0.93	0.57	0.68	NC

Electrical Conductivity (EC) units: milliSiemens per Centimeter
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Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, June 27, 2013

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	25 %
Vernalis Base Flow : Monthly average *	>= 710 cfs	763 cfs
Vernalis Base Flow : 7 Day average *	>= 568 cfs	672 cfs
Habitat Protection, X2 / Flow	30 days at Collinsville	27 days
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	165 days	178 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	40 mg/l
14dm EC at Emmaton	<= 0.45 mS/cm	0.44 mS/cm
14dm EC at Jersey Point	<= 0.45 mS/cm	0.37 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.6 mS/cm
Brandt Bridge	<= 0.7 mS/cm	0.6 mS/cm
Old River Near Tracy	<=0.7 mS/cm	0.9 mS/cm
Old River Near Middle River	<=0.7 mS/cm	0.6 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out
Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2013)

Previous Month's Index (8RI for April.): 2.023 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%:5.8 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.6 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta cond. w/ no storage withdrawal
s = balanced Delta cond. w/ storage withdrawal
Excess Delta conditions with restrictions:
f = fish concerns
r = E/I ratio concerns

* NDOI, Rio Vista & Vernalis Flows:
- Monthly average is progressive daily mean.
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
05/29/2013	6.04	4.17	9,502	23.58	1.59	2.15	6.82	6.29	5.65	3.23	2.66
05/30/2013	5.57	3.93	9,779	21.54	1.55	2.05	5.75	5.21	5.65	2.53	2.63
05/31/2013	5.38	3.71	10,488	19.57	1.48	1.99	4.64	4.11	5.60	1.95	2.63
06/01/2013	5.67	3.76	9,583	19.02	1.45	1.94	4.66	4.13	5.61	1.86	2.64
06/02/2013	6.13	4.02	9,053	20.43	1.52	1.91	5.41	4.87	5.70	2.22	2.69
06/03/2013	6.45	4.49	8,563	23.94	7.89	2.32	7.18	6.66	5.88	3.35	2.80
06/04/2013	6.55	4.57	7,386	25.19	16.19	3.31	8.01	7.52	5.97	3.96	2.89
06/05/2013	6.55	4.52	7,243	25.18	15.54	4.25	7.66	7.15	6.08	4.01	2.99
06/06/2013	6.61	4.54	7,307	24.66	15.14	5.17	7.40	6.88	6.17	2.76	3.01
06/07/2013	6.62	4.52	7,507	24.01	14.92	6.07	7.23	6.71	6.20	3.69	3.07
06/08/2013	6.60	4.75	7,527	23.41	16.14	7.06	7.70	7.19	6.22	4.16	3.14
06/09/2013	7.09	5.07	6,899	26.86	17.96	8.19	10.24	9.85	6.41	5.78	3.29
06/10/2013	6.74	4.67	7,371	25.20	15.39	9.17	8.01	7.51	6.45	4.40	3.36
06/11/2013	6.26	4.39	7,262	23.15	14.10	10.06	6.65	6.12	6.44	3.22	3.37
06/12/2013	6.11	4.28	7,472	22.24	14.23	10.96	6.60	6.07	6.43	3.16	3.36
06/13/2013	5.62	3.99	7,196	21.30	13.17	11.79	5.74	5.19	6.42	2.58	3.36
06/14/2013	5.16	3.80	7,413	19.46	11.64	12.52	4.71	4.18	6.43	2.21	3.38
06/15/2013	5.49	4.07	7,374	21.18	13.41	13.38	5.95	5.41	6.52	2.78	3.45
06/16/2013	5.52	3.90	6,959	20.98	13.47	14.23	6.12	5.58	6.57	2.64	3.48
06/17/2013	5.73	3.79	7,541	22.59	12.82	14.58	6.07	5.53	6.49	2.53	3.42
06/18/2013	6.15	3.99	7,458	23.41	13.86	14.42	6.49	5.95	6.38	2.78	3.33
06/19/2013	5.98	3.86	7,162	22.07	13.73	14.29	6.25	5.72	6.28	2.79	3.25
06/20/2013	6.14	3.87	7,222	22.49	13.91	14.20	6.40	5.86	6.20	2.66	3.24
06/21/2013	6.42	4.11	7,284	23.76	14.74	14.18	6.91	6.38	6.18	3.28	3.21
06/22/2013	6.61	4.23	7,950	24.47	15.64	14.15	7.60	7.08	6.17	3.79	3.19
06/23/2013	6.82	4.41	8,129	25.63	16.97	14.08	8.74	8.27	6.06	4.17	3.07
06/24/2013	6.82	4.33	7,283	25.37	15.53	14.09	7.90	7.40	6.05	3.94	3.04
06/25/2013	6.56	4.29	7,411	24.94	10.20	13.81	7.45	6.93	6.11	3.65	3.07
06/26/2013	6.28	4.23	7,529	23.80	9.40	13.46	7.17	6.65	6.15	3.66	3.10
06/27/2013	5.92	4.09	7,111	22.50	12.92	13.45	6.73	6.20	6.22	3.16	3.15

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
05/29/2013	1.40	1.13	0.34	0.32	0.47	0.35	0.26	10.43	7.18	7.32	7.19	4.02
05/30/2013	1.09	1.13	0.32	0.32	0.34	0.35	0.29	10.38	6.67	7.33	6.95	3.54
05/31/2013	0.90	1.13	0.30	0.32	0.26	0.35	0.39	10.26	6.56	7.79	6.68	2.87
06/01/2013	0.86	1.14	0.30	0.32	0.27	0.35	0.36	10.19	6.68	7.36	7.25	2.92
06/02/2013	0.98	1.16	0.31	0.32	0.28	0.36	0.37	10.03	6.83	7.29	7.20	3.58
06/03/2013	1.26	1.20	0.35	0.32	0.38	0.37	0.32	9.86	7.12	7.97	7.89	4.31
06/04/2013	1.61	1.24	0.40	0.33	0.57	0.39	0.30	10.18	7.10	8.90	7.64	5.07
06/05/2013	1.52	1.28	0.40	0.34	0.57	0.41	0.31	10.55	7.51	8.69	7.64	4.73
06/06/2013	1.53	1.31	0.40	0.34	0.48	0.43	0.31	11.79	7.81	8.97	7.64	
06/07/2013	1.58	1.33	0.42	0.35	0.52	0.44	0.34	12.76	7.99	9.95	8.09	4.84
06/08/2013	1.77	1.36	0.43	0.36	0.63	0.45	0.33	11.95	8.33	10.00	8.55	4.91
06/09/2013	2.43	1.42	0.60	0.37	1.25	0.50	0.29	11.59	8.76	9.99	9.63	7.18
06/10/2013	1.80	1.43	0.43	0.38	0.78	0.52	0.33	12.07	8.73	10.69	8.74	5.40
06/11/2013	1.50	1.44	0.38	0.38	0.47	0.52	0.39	12.42	8.73	9.91	8.63	4.17
06/12/2013	1.50	1.45	0.40	0.39	0.42	0.52	0.40	12.49	8.52	9.85	8.76	3.99
06/13/2013	1.27	1.46	0.38	0.39	0.33	0.51	0.37	12.53	8.15	9.37	8.29	3.61
06/14/2013	1.18	1.48	0.35	0.40	0.27	0.52	0.37	12.59	8.05	9.06	8.27	3.03
06/15/2013	1.21	1.51	0.36	0.40	0.33	0.52	0.36	12.58	8.20	8.95	8.74	4.09
06/16/2013	1.13	1.52	0.36	0.40	0.28	0.52	0.36	12.24	8.51	8.99	8.52	3.97
06/17/2013	1.08	1.51	0.34	0.40	0.29	0.51	0.38	12.82	8.43	9.73	8.20	3.55
06/18/2013	1.19	1.48	0.35	0.40	0.33	0.50	0.36	12.56	9.86	9.86	8.46	4.18
06/19/2013	1.27	1.46	0.35	0.40	0.36	0.48	0.37	12.33	9.59	9.62	8.45	3.44
06/20/2013	1.23	1.44	0.34	0.39	0.36	0.47	0.32	11.76	9.47	10.21	8.75	3.79
06/21/2013	1.47	1.43	0.37	0.39	0.49	0.47	0.28	11.58	9.60	10.00	9.35	4.15
06/22/2013	1.67	1.42	0.40	0.39	0.57	0.47	0.25	11.43	9.80	10.03	9.55	4.76
06/23/2013	2.03	1.40	0.42	0.37	0.74	0.43	0.28	11.38	10.01	10.00	10.25	5.61
06/24/2013	1.88	1.40	0.40	0.37	0.64	0.42	0.30	11.59	9.95	10.18	10.32	5.36
06/25/2013	1.75	1.42	0.39	0.37	0.54	0.42	0.27	11.76	9.77	9.90	10.69	5.41
06/26/2013	1.63	1.43	0.38	0.37	0.50	0.43	0.27	11.85	9.62	10.59	11.01	4.65
06/27/2013	1.47	1.44	0.37	0.37	0.40	0.44	0.28	12.06	9.45	11.06	10.77	3.87

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
05/29/2013	0.30	0.32	0.29	0.31	NR	0.42	0.50	376	43	45	s
05/30/2013	0.30	0.32	0.29	0.31	0.38	0.43	0.50	277	43	45	s
05/31/2013	0.30	0.32	0.29	0.31	0.37	0.48	0.52	215	43	45 e	s
06/01/2013	0.30	0.33	0.29	0.31	0.36	0.46	0.52	204	42	45 e	s
06/02/2013	0.30	0.33	0.29	0.30	0.35	0.43	0.50	241	41	45 e	s
06/03/2013	0.30	0.33	0.28	0.30	0.34	0.41	0.48	330	39	44	s
06/04/2013	0.30	0.32	0.28	0.29	0.33	0.40	0.44	443	38	41	s
06/05/2013	0.29	0.35	0.28	0.29	0.32	0.44	0.48	415	38	40	s
06/06/2013	0.29	0.35	0.28	0.29	0.31	0.43	0.46	417	38	43	s
06/07/2013	0.30	0.37	0.29	0.29	0.31	0.43	0.48	434	37	39	s
06/08/2013	0.30	0.37	0.29	0.29	0.31	0.43	0.49	492	37	39 e	s
06/09/2013	0.32	0.37	0.29	0.29	0.30	0.40	0.46	703	37	39 e	s
06/10/2013	0.32	0.39	0.29	0.29	0.30	0.46	0.44	503	38	39 e	s
06/11/2013	0.32	0.39	0.30	0.29	0.30	0.42	0.53	409	38	37	s
06/12/2013	0.31	0.40	0.31	0.30	0.30	0.46	0.49	409	39	37	s
06/13/2013	0.32	0.39	0.31	0.30	0.31	0.48	0.49	334	39	38	s
06/14/2013	0.32	0.38	0.30	0.30	0.31	0.42	0.50	305	40	39	s
06/15/2013	0.32	0.38	0.30	0.30	0.31	0.38	0.45	314	40	40	s
06/16/2013	0.32	0.37	0.30	0.30	0.32	0.38	0.45	291	40	41	s
06/17/2013	0.32	0.36	0.29	0.30	0.32	0.40	0.48	273	40	42	s
06/18/2013	0.32	0.35	0.29	0.30	0.31	0.39	0.47	308	39	42	s
06/19/2013	0.32	0.35	0.29	0.29	0.31	0.36	0.43	334	39	41	s
06/20/2013	0.32	0.36	0.29	0.29	0.31	0.34	0.42	322	38	42	s
06/21/2013	0.31	0.36	0.29	0.29	0.31	0.35	0.38	398	38	41	s
06/22/2013	0.31	0.36	0.29	0.29	0.31	0.35	0.36	463	38	41 e	s
06/23/2013	0.31	0.35	0.28	0.29	0.30	0.35	0.36	578	37	41 e	s
06/24/2013	0.31	0.35	0.28	0.29	0.30	0.35	0.36	528	37	39	s
06/25/2013	0.30	0.34	0.28	0.29	0.30	0.34	0.41	488	37	39	s
06/26/2013	0.30	0.34	0.28	0.29	0.30	0.33	0.38	450	36	41	s
06/27/2013	0.30	0.35	0.28	0.28	0.30	0.34	0.38	398	35	40	s

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta cond. w/ no storage withdrawal
- s = balanced Delta cond. w/ storage withdrawal
- Excess Delta conditions with restrictions:
  - f = fish concerns
  - r = E/I ratio concerns

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
05/29/2013	0.54	0.35	0.62	0.35	0.81	0.46	0.55	NC
05/30/2013	0.53	0.36	0.62	0.37	0.81	0.48	0.62	NC
05/31/2013	0.57	0.37	0.62	0.38	0.82	0.50	0.59	NC
06/01/2013	0.56	0.38	0.62	0.39	0.84	0.51	0.63	NC
06/02/2013	0.56	0.39	0.63	0.41	0.89	0.53	0.62	NC
06/03/2013	0.55	0.41	0.62	0.42	0.92	0.55	0.69	NC
06/04/2013	0.59	0.42	0.61	0.44	0.93	0.57	0.68	NC
06/05/2013	0.55	0.43	0.62	0.45	0.95	0.59	0.66	NC
06/06/2013	0.56	0.44	0.62	0.47	0.95	0.62	0.66	NC
06/07/2013	0.52	0.45	0.62	0.48	0.94	0.64	0.66	NC
06/08/2013	0.52	0.46	0.63	0.49	0.91	0.66	0.67	NC
06/09/2013	0.52	0.47	0.59	0.51	0.90	0.68	0.67	NC
06/10/2013	0.52	0.48	0.59	0.52	0.81	0.70	0.65	NC
06/11/2013	0.54	0.50	0.63	0.53	0.78	0.71	0.63	0.56
06/12/2013	0.53	0.51	0.63	0.55	0.78	0.73	0.63	0.57
06/13/2013	0.54	0.52	0.63	0.56	0.80	0.74	0.63	0.58
06/14/2013	0.55	0.52	0.64	0.57	0.81	0.76	0.69	0.60
06/15/2013	0.53	0.53	0.63	0.58	0.87	0.78	0.69	0.61
06/16/2013	0.56	0.53	0.62	0.59	0.90	0.79	0.70	0.62
06/17/2013	0.56	0.54	0.62	0.60	0.89	0.81	0.69	0.62
06/18/2013	0.58	0.54	0.63	0.60	0.88	0.82	0.67	0.63
06/19/2013	0.58	0.54	0.62	0.61	0.89	0.83	0.64	0.63
06/20/2013	0.58	0.55	0.64	0.61	0.94	0.84	0.67	0.64
06/21/2013	0.57	0.55	0.64	0.61	1.02	0.85	0.66	0.64
06/22/2013	0.56	0.55	0.64	0.62	1.11	0.86	0.68	0.64
06/23/2013	0.53	0.55	0.65	0.62	1.11	0.88	0.69	0.64
06/24/2013	0.58	0.55	0.67	0.62	1.13	0.89	0.66	0.65
06/25/2013	0.63	0.55	0.69	0.63	1.18	0.90	0.60	0.65
06/26/2013	0.64	0.56	0.69	0.63	1.20	0.92	0.46	0.64
06/27/2013	0.59	0.56	0.68	0.63	1.21	0.93	0.42	0.64

Electrical Conductivity (EC) units: milliSiemens per Centimeter
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Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, August 06, 2013

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	45 %
NDOI, monthly average *	>= 3,500 cfs	5,553 cfs
NDOI, 7 day average*	>= 2,500 cfs	5,553 cfs

Water Quality

Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	165 days	216 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	166 mg/l
14dm EC at Emmaton	<= 1.67 mS/cm	0.66 mS/cm
14dm EC at Jersey Point	<= 1.35 mS/cm	1.19 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.5 mS/cm
Brandt Bridge	<= 0.7 mS/cm	0.7 mS/cm
Old River Near Tracy	<=0.7 mS/cm	0.8 mS/cm
Old River Near Middle River	<=0.7 mS/cm	0.7 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out
Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2013)

Previous Month's Index (8RI for April.): 2.023 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%:5.8 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.6 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta cond. w/ no storage withdrawal
s = balanced Delta cond. w/ storage withdrawal
Excess Delta conditions with restrictions:
f = fish concerns
r = E/I ratio concerns

* NDOI, Rio Vista & Vernalis Flows:
- Monthly average is progressive daily mean.
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
07/08/2013	6.70	4.61	4,134	26.14	16.49	14.36	9.88	9.47	7.33	5.46	3.93
07/09/2013	6.39	4.35	5,204	24.47	15.62	14.74	8.90	8.44	7.44	4.67	4.00
07/10/2013	6.20	4.44	5,217	25.61	16.17	15.23	9.26	8.82	7.59	4.99	4.09
07/11/2013	6.12	4.43	5,226	26.21	16.10	15.45	9.30	8.85	7.78	5.18	4.24
07/12/2013	5.87	4.36	5,079	25.71	15.33	15.59	8.99	8.54	8.00	4.91	4.39
07/13/2013	5.56	4.24	5,014	24.84	14.42	15.66	8.31	7.82	8.16	4.48	4.52
07/14/2013	5.79	4.25	5,090	25.16	15.03	15.78	8.70	8.23	8.34	4.60	4.64
07/15/2013	6.11	4.33	4,884	26.04	15.65	15.99	9.18	8.74	8.55	4.94	4.80
07/16/2013	6.18	4.30	4,724	27.04	15.76	16.08	9.14	8.69	8.69	4.96	4.90
07/17/2013	6.28	4.13	5,300	25.12	14.96	16.10	8.23	7.74	8.70	4.34	4.92
07/18/2013	6.60	4.29	5,476	25.42	14.81	16.01	8.78	8.31	8.70	4.68	4.93
07/19/2013	6.77	4.47	5,365	25.83	16.76	15.92	9.47	9.03	8.69	5.29	4.97
07/20/2013	6.94	4.63	5,001	26.95	17.54	15.87	10.38	10.00	8.74	6.13	5.02
07/21/2013	7.21	4.83	4,974	28.62	17.39	15.86	11.37	11.05	8.84	7.02	5.12
07/22/2013	7.24	4.76	5,198	28.27	17.78	15.95	11.22	10.90	8.94	6.84	5.22
07/23/2013	6.89	4.47	5,352	27.81	17.11	16.06	10.44	10.07	9.06	6.09	5.32
07/24/2013	6.52	4.42	4,989	27.22	14.75	15.96	10.18	9.79	9.13	5.98	5.39
07/25/2013	6.32	4.50	5,130	27.04	14.18	15.82	10.46	10.08	9.21	6.08	5.45
07/26/2013	5.96	4.42	5,780	26.61	13.49	15.69	10.29	9.90	9.31	5.95	5.53
07/27/2013	6.01	4.37	6,288	26.62	14.11	15.66	9.95	9.54	9.43	5.81	5.62
07/28/2013	6.27	4.46	6,029	27.17	14.02	15.59	9.85	9.43	9.52	5.88	5.71
07/29/2013	6.34	4.52	4,962	27.56	13.56	15.44	10.05	9.65	9.59	5.95	5.79
07/30/2013	6.22	4.37	5,034	26.53	13.40	15.27	9.65	9.23	9.62	5.52	5.83
07/31/2013	6.28	4.43	5,510	26.43	12.77	15.12	9.64	9.22	9.73	5.60	5.92
08/01/2013	6.22	4.34	5,127	26.29	11.50	14.88	9.32	8.88	9.77	5.12	5.95
08/02/2013	6.16	4.27	5,669	25.38	10.11	14.41	8.81	8.34	9.72	4.70	5.90
08/03/2013	6.30	4.36	6,242	26.46	7.72	13.71	9.27	8.82	9.64	5.14	5.83
08/04/2013	6.41	4.40	6,130	26.94	6.32	12.91	9.85	9.44	9.52	5.40	5.72
08/05/2013	6.31	4.32	5,050	26.71	5.77	12.06	9.43	8.99	9.39	5.12	5.60
08/06/2013	6.23	4.30	5,101	26.82	10.46	11.58	9.46	9.02	9.31	5.17	5.53

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
07/08/2013	2.75	1.90	0.79	0.51	0.65	0.45	0.33	11.96	11.05	12.13	10.94	6.27
07/09/2013	2.61	1.96	0.76	0.54	0.54	0.45	0.33	12.16	10.58	11.34	10.73	5.71
07/10/2013	2.64	2.03	0.82	0.57	0.56	0.45	0.34	12.29	10.37	11.32	11.05	6.14
07/11/2013	2.64	2.11	0.86	0.60	0.55	0.46	0.39	12.38	10.21	11.74	10.90	6.15
07/12/2013	2.53	2.20	0.86	0.64	0.45	0.47	0.44	12.45	10.12	11.69	11.05	6.32
07/13/2013	2.40	2.28	0.86	0.68	0.40	0.48	0.43	12.57	10.01	11.54	10.70	5.42
07/14/2013	2.44	2.36	0.89	0.71	0.39	0.49	0.41	12.66	10.05	11.57	10.69	5.94
07/15/2013	2.52	2.44	0.93	0.75	0.45	0.50	0.41	12.74	10.10	11.81	10.79	6.58
07/16/2013	2.50	2.51	0.93	0.79	0.45	0.51	0.41	14.06	10.10	11.56	11.17	6.14
07/17/2013	2.40	2.55	0.90	0.81	0.44	0.52	0.43	15.17	9.99	11.52	11.08	5.75
07/18/2013	2.46	2.57	0.93	0.84	0.54	0.53	0.37	15.12	10.04	12.26	11.33	6.40
07/19/2013	2.79	2.58	1.02	0.86	0.72	0.54	0.32	14.77	10.22	12.45	11.91	6.26
07/20/2013	3.22	2.62	1.12	0.89	0.98	0.56	0.27	14.56	10.36	12.56	11.87	7.45
07/21/2013	3.61	2.68	1.24	0.92	1.22	0.60	0.25	14.93	10.52	12.48	11.91	8.34
07/22/2013	3.71	2.75	1.25	0.95	1.24	0.64	0.28	15.39	10.73	12.28	12.00	8.49
07/23/2013	3.34	2.80	1.08	0.98	0.91	0.66	0.33	15.27	10.91	12.11	12.22	7.61
07/24/2013	3.19	2.84	1.15	1.00	0.86	0.69	0.31	15.72	11.19	12.30	12.93	6.83
07/25/2013	3.21	2.88	1.19	1.02	0.89	0.71	0.32	15.46	11.68	13.44	13.27	7.43
07/26/2013	3.12	2.92	1.20	1.05	0.76	0.73	0.32	15.13	11.38	12.79	12.69	7.47
07/27/2013	2.99	2.96	1.18	1.07	0.65	0.75	0.36	15.06	11.17	12.49	12.64	6.90
07/28/2013	2.99	3.00	1.17	1.09	0.60	0.77	0.37	15.25	11.26	12.76	12.41	7.23
07/29/2013	3.11	3.05	1.20	1.11	0.59	0.78	0.45	15.49	11.45	12.49	12.25	7.22
07/30/2013	3.02	3.08	1.20	1.13	0.48	0.78	0.52	16.73	11.34	12.54	12.38	6.89
07/31/2013	2.99	3.12	1.21	1.15	0.53	0.78	0.52	17.93	11.12	12.45	12.86	6.48
08/01/2013	2.91	3.16	1.20	1.17	0.57	0.79	0.52	e	e	14.26	12.62	6.07
08/02/2013	2.81	3.16	1.18	1.18	0.57	0.78	0.51	17.62	10.77	13.75	12.82	5.65
08/03/2013	2.92	3.14	1.21	1.19	0.65	0.75	0.42	17.36	10.89	13.33	12.38	6.10
08/04/2013	2.98	3.09	1.23	1.19	0.72	0.72	0.39	16.97	10.95	12.78	12.42	6.75
08/05/2013	2.82	3.03	1.18	1.18	0.68	0.68	0.36	16.81	10.87	12.82	12.05	5.96
08/06/2013	2.88	2.99	1.18	1.19	0.68	0.66	0.33	16.77	10.81	12.48	11.81	6.24

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
07/08/2013	0.40	0.45	0.36	0.30	0.28	0.27	0.30	806	41	35	s
07/09/2013	0.42	0.47	0.39	0.33	0.28	0.27	0.31	763	48	36	s
07/10/2013	0.44	0.50	0.39	0.35	0.29	0.28	0.29	771	53	37	s
07/11/2013	0.46	0.54	0.41	0.36	0.30	0.29	0.29	770	55	39	s
07/12/2013	0.48	0.55	0.42	0.38	0.31	0.30	0.29	737	60	43	s
07/13/2013	0.50	0.57	0.44	0.40	0.34	0.31	0.30	695	65	49	s
07/14/2013	0.53	0.61	0.46	0.41	0.36	0.31	0.30	706	69	55	s
07/15/2013	0.55	0.64	0.48	0.42	0.38	0.32	0.30	733	72	60	s
07/16/2013	0.56	0.66	0.51	0.44	0.39	0.32	0.30	727	77	65	s
07/17/2013	0.59	0.66	0.53	0.47	0.40	0.32	0.31	696	84	69	s
07/18/2013	0.61	0.68	0.56	0.49	0.42	0.33	0.32	714	90	74	s
07/19/2013	0.64	0.72	0.57	0.51	0.43	0.36	0.32	818	95	76	s
07/20/2013	0.67	0.75	0.58	0.51	0.46	0.38	0.34	957	95	83	s
07/21/2013	0.72	0.78	0.60	0.52	0.48	0.38	0.34	1,080	97	89	s
07/22/2013	0.75	0.79	0.62	0.53	0.51	0.37	0.35	1,112	100	96	s
07/23/2013	0.76	0.81	0.64	0.55	0.53	0.39	0.37	992	106	100	s
07/24/2013	0.77	0.82	0.65	0.57	0.55	0.40	0.36	945	112	108	s
07/25/2013	0.79	0.83	0.66	0.59	0.56	0.41	0.37	952	115	116	s
07/26/2013	0.81	0.84	0.68	0.60	0.56	0.41	0.37	922	119	113	s
07/27/2013	0.82	0.84	0.69	0.62	0.58	0.41	0.39	882	123	116	s
07/28/2013	0.84	0.83	0.73	0.65	0.59	0.41	0.40	881	131	121	s
07/29/2013	0.85	0.82	0.75	0.68	0.59	0.42	0.42	922	139	120	s
07/30/2013	0.86	0.82	0.77	0.70	0.61	0.43	0.44	890	145	128	s
07/31/2013	0.87	0.82	0.78	0.71	0.62	0.46	0.44	882	148	132	s
08/01/2013	0.88	0.81	0.77	0.71	0.63	0.50	0.46	857	148	136	s
08/02/2013	0.88	0.79	0.75	0.70	0.65	0.49	0.46	826	145	139	s
08/03/2013	0.87	0.78	0.75	0.68	0.67	0.50	0.47	859	139	146	s
08/04/2013	0.89	0.80	0.75	0.66	0.70	0.49	0.46	879	135	152	s
08/05/2013	0.89	0.81	0.74	0.66	0.71	0.48	0.46	827	135	157	s
08/06/2013	0.89	0.80	0.76	0.67	0.74	0.48	0.44	848	138	166	s

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta cond. w/ no storage withdrawal
- s = balanced Delta cond. w/ storage withdrawal
- Excess Delta conditions with restrictions:
  - f = fish concerns
  - r = E/I ratio concerns

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
07/08/2013	0.50	0.55	0.71	0.65	0.82	0.95	0.66	0.63
07/09/2013	0.52	0.55	0.71	0.65	0.78	0.95	0.64	0.62
07/10/2013	0.48	0.54	0.69	0.65	0.78	0.95	0.60	0.62
07/11/2013	0.49	0.54	0.68	0.66	0.79	0.95	0.62	0.62
07/12/2013	0.55	0.54	0.71	0.66	0.79	0.95	0.67	0.62
07/13/2013	0.46	0.54	0.73	0.66	0.79	0.95	0.69	0.63
07/14/2013	0.48	0.54	0.74	0.66	0.80	0.95	0.70	0.63
07/15/2013	0.50	0.54	0.73	0.67	0.81	0.95	0.70	0.63
07/16/2013	0.53	0.54	0.72	0.67	0.81	0.94	0.68	0.63
07/17/2013	0.49	0.53	0.70	0.67	0.82	0.94	0.65	0.62
07/18/2013	0.51	0.53	0.68	0.68	0.85	0.94	0.68	0.62
07/19/2013	0.54	0.53	0.68	0.68	0.86	0.94	0.66	0.62
07/20/2013	0.52	0.53	0.75	0.68	0.86	0.94	0.69	0.63
07/21/2013	0.53	0.53	0.81	0.69	0.85	0.93	0.68	0.63
07/22/2013	0.51	0.52	0.82	0.69	0.88	0.92	0.69	0.63
07/23/2013	0.48	0.52	0.81	0.70	0.86	0.91	0.70	0.63
07/24/2013	0.49	0.52	0.79	0.70	0.86	0.91	0.69	0.63
07/25/2013	0.54	0.52	0.76	0.70	0.86	0.89	0.70	0.63
07/26/2013	0.49	0.51	0.73	0.70	0.86	0.88	0.72	0.64
07/27/2013	0.51	0.51	0.70	0.71	0.86	0.87	0.73	0.65
07/28/2013	0.49	0.51	0.67	0.71	0.87	0.86	0.74	0.66
07/29/2013	0.52	0.50	0.67	0.70	0.89	0.85	0.73	0.67
07/30/2013	0.53	0.50	0.66	0.70	0.89	0.85	0.72	0.67
07/31/2013	0.53	0.50	0.65	0.70	0.90	0.85	0.71	0.67
08/01/2013	0.45	0.50	0.65	0.70	0.91	0.85	0.69	0.68
08/02/2013	0.53	0.50	0.65	0.71	0.92	0.85	0.68	0.68
08/03/2013	0.47	0.50	0.66	0.71	0.92	0.85	0.69	0.68
08/04/2013	0.47	0.50	0.68	0.71	0.87	0.85	0.70	0.68
08/05/2013	0.51	0.50	0.70	0.71	0.85	0.85	0.70	0.68
08/06/2013	0.53	0.50	0.71	0.71	0.87	0.85	0.70	0.69

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
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Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, October 24, 2013

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	33 %
NDOI, monthly average *	>= 4,000 cfs	3,801 cfs
NDOI, 7 day average*	>= 3,000 cfs	3,574 cfs
Rio Vista flow, monthly average *	>= 4,000 cfs	3,939 cfs
Rio Vista flow, 7 day average*	>= 3,000 cfs	3,663 cfs

Water Quality

Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	165 days	216 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	115 mg/l

Maximum 30 day running average of mean daily EC at:

Vernalis	<=1.0 mS/cm	0.5 mS/cm
Brandt Bridge	<=1.0 mS/cm	0.6 mS/cm
Old River Near Tracy	<=1.0 mS/cm	0.8 mS/cm
Old River Near Middle River	<=1.0 mS/cm	0.6 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out
Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2013)

Previous Month's Index (8RI for May): 1.430 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%:5.8 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.6 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- Monthly average is progressive daily mean.
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
09/25/2013	5.94	4.30	4,585	24.18	16.69	16.72	9.31	8.87	8.62	5.15	4.97
09/26/2013	5.61	4.16	4,430	22.95	14.82	16.55	8.37	7.89	8.51	4.85	4.91
09/27/2013	5.32	3.91	4,202	22.69	15.22	16.41	7.77	7.26	8.37	4.23	4.82
09/28/2013	5.37	3.89	3,921	22.68	15.08	16.28	8.30	7.81	8.28	4.16	4.74
09/29/2013	5.46	3.96	4,304	24.79	16.71	16.26	9.24	8.79	8.26	4.73	4.70
09/30/2013	5.44	3.97	4,067	25.18	16.98	16.29	9.63	9.20	8.30	5.20	4.73
10/01/2013	5.56	3.99	4,302	25.62	17.85	16.33	10.13	9.74	8.40	5.42	4.78
10/02/2013	5.48	3.91	4,055	25.43	18.03	16.47	9.88	9.47	8.54	5.78	4.88
10/03/2013	5.38	3.82	4,312	25.67	17.63	16.57	9.64	9.21	8.65	5.94	4.99
10/04/2013	5.39	3.72	4,027	25.37	16.46	16.50	9.09	8.64	8.63	5.99	5.06
10/05/2013	5.58	3.72	3,970	26.43	18.29	16.61	10.48	10.10	8.71	5.44	5.09
10/06/2013	5.76	3.82	3,366	26.81	19.03	16.80	10.61	10.25	8.85	5.89	5.16
10/07/2013	6.13	4.10	3,522	27.82	20.04	17.11	11.63	11.34	9.09	6.97	5.33
10/08/2013	6.31	4.20	3,865	28.75	20.52	17.38	12.36	12.13	9.34	7.87	5.54
10/09/2013	6.47	4.43	4,189	29.86	22.19	17.77	13.47	13.34	9.65	8.27	5.77
10/10/2013	6.28	4.41	4,135	29.23	21.27	18.23	12.95	12.77	10.00	7.80	5.98
10/11/2013	5.98	4.22	3,949	28.16	21.10	18.65	12.72	12.52	10.38	7.40	6.20
10/12/2013	5.92	4.18	3,762	28.27	20.77	19.06	12.62	12.41	10.71	8.16	6.49
10/13/2013	5.58	4.02	3,618	27.76	19.67	19.27	12.17	11.93	10.93	7.57	6.69
10/14/2013	5.37	3.79	4,033	27.41	19.61	19.46	11.72	11.44	11.09	7.30	6.84
10/15/2013	5.50	3.88	3,671	28.01	19.89	19.61	11.95	11.68	11.23	7.35	6.98
10/16/2013	5.62	3.92	3,635	28.99	20.68	19.80	12.61	12.40	11.44	8.09	7.14
10/17/2013	5.90	4.01	3,786	29.17	21.26	20.06	13.16	13.00	11.71	8.59	7.33
10/18/2013	6.05	4.16	3,626	29.26	21.87	20.44	13.70	13.59	12.06	9.52	7.59
10/19/2013	6.10	4.15	3,731	29.21	20.86	20.62	13.73	13.62	12.31	9.41	7.87
10/20/2013	6.12	4.21	3,365	28.95	22.14	20.85	14.08	14.01	12.58	9.96	8.16
10/21/2013	6.12	4.27	3,163	29.25	22.18	21.00	14.66	14.65	12.82	10.20	8.39
10/22/2013	5.97	4.20	3,033	28.07	20.96	21.03	13.04	12.87	12.87	8.84	8.46
10/23/2013	6.06	4.34	4,176	29.73	22.41	21.05	14.78	14.77	12.97	10.33	8.61
10/24/2013	5.91	4.47	3,922	30.27	22.55	21.14	15.64	15.73	13.19	10.86	8.83

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
09/25/2013	2.90	2.80	0.97	1.08	NR	NC	0.53	15.49	e	13.86	15.28	6.04
09/26/2013	2.62	2.75	0.92	1.05	NR	NC	0.51	15.38	12.36	14.35	15.23	5.99
09/27/2013	2.37	2.70	0.85	1.02	0.56	NC	0.48	15.33	11.91	14.82	15.22	5.40
09/28/2013	2.49	2.67	0.86	0.99	0.59	NC	0.47	15.11	12.02	14.76	15.20	5.81
09/29/2013	2.62	2.65	0.85	0.97	0.66	NC	0.47	14.68	12.23	14.61	15.18	5.73
09/30/2013	2.76	2.63	0.85	0.95	0.72	NC	0.47	14.39	12.36	14.40	15.15	6.39
10/01/2013	2.89	2.65	0.86	0.93	0.78	NC	0.47	14.34	12.35	14.23	15.33	6.75
10/02/2013	2.79	2.67	0.81	0.92	0.74	NC	0.46	14.44	12.35	14.19	15.27	7.18
10/03/2013	2.66	2.68	0.82	0.91	0.63	NC	0.51	14.66	12.27	14.05	15.22	6.58
10/04/2013	2.26	2.65	0.81	0.89	0.50	NC	0.49	15.02	12.08	13.81	15.11	6.59
10/05/2013	2.74	2.64	0.83	0.88	0.94	NC	0.44	15.86	12.73	14.55	15.46	6.54
10/06/2013	3.18	2.68	0.86	0.87	1.15	NC	0.44	16.37	12.84	14.99	16.02	7.49
10/07/2013	3.66	2.76	0.91	0.87	1.48	NC	0.44	16.49	12.98	15.21	16.41	8.38
10/08/2013	4.19	2.87	0.98	0.87	1.67	NC	0.43	16.46	12.87	15.46	16.73	9.39
10/09/2013	4.84	3.00	1.13	0.88	1.95	NC	0.42	16.63	13.50	16.18	16.98	9.96
10/10/2013	4.83	3.16	1.20	0.90	1.85	1.02	0.41	16.85	13.98	16.84	17.29	9.76
10/11/2013	4.45	3.31	1.04	0.91	1.75	1.10	0.44	17.15	14.01	16.79	16.94	8.37
10/12/2013	4.27	3.44	1.04	0.93	1.72	1.18	0.44	17.35	14.14	16.95	17.47	9.31
10/13/2013	4.21	3.55	1.02	0.94	1.53	1.24	0.46	17.50	14.45	16.80	17.67	8.71
10/14/2013	3.84	3.63	0.97	0.95	1.47	1.30	0.49	17.64	14.48	16.97	17.75	8.42
10/15/2013	4.07	3.71	0.95	0.95	1.57	1.35	0.50	17.76	14.58	16.86	17.96	9.53
10/16/2013	4.52	3.84	1.03	0.97	2.03	1.45	0.53	17.79	14.75	16.96	18.05	9.45
10/17/2013	4.84	3.99	1.10	0.99	2.26	1.56	0.56	17.85	14.85	17.30	17.73	10.38
10/18/2013	5.45	4.22	1.33	1.03	2.40	1.70	0.56	17.94	15.00	17.72	17.65	10.97
10/19/2013	5.54	4.42	1.35	1.06	2.55	1.81	0.54	18.06	15.00	17.42	18.05	10.77
10/20/2013	5.68	4.60	1.41	1.10	2.82	1.93	0.52	18.25	15.08	17.49	18.18	10.77
10/21/2013	5.73	4.75	1.43	1.14	2.99	2.04	0.51	18.42	15.11	17.69	18.37	11.40
10/22/2013	4.82	4.79	1.18	1.16	2.25	2.08	0.54	18.55	15.09	17.59	18.50	10.70
10/23/2013	5.94	4.87	1.67	1.19	2.94	2.15	0.65	18.68	15.11	17.28	18.45	11.50
10/24/2013	5.98	4.95	1.73	1.23	3.22	2.25	0.70	18.78	15.13	17.78	18.43	12.17

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
09/25/2013	0.82	1.01	0.71	0.66	0.86	0.57	0.58	853	136	209	b
09/26/2013	0.82	0.99	0.70	0.66	0.93	0.58	0.57	763	135	212	b
09/27/2013	0.79	0.98	0.67	0.66	0.93	0.55	0.58	685	135	212	b
09/28/2013	0.75	0.96	0.63	0.65	0.93	0.55	0.58	723	132	202	b
09/29/2013	0.73	0.94	0.61	0.62	0.93	0.55	0.56	764	123	202	b
09/30/2013	0.72	0.92	0.60	0.59	0.92	0.54	0.52	809	117	202	b
10/01/2013	0.71	0.90	0.60	0.57	0.93	0.55	0.52	851	112	211	b
10/02/2013	0.71	0.89	0.59	0.56	0.90	0.53	0.51	819	109	204	b
10/03/2013	0.70	0.87	0.59	0.55	0.90	0.53	0.51	776	107	190	b
10/04/2013	0.69	0.85	0.57	0.56	0.89	0.52	0.50	649	108	182	b
10/05/2013	0.66	0.83	0.54	0.56	0.89	0.51	0.50	803	109	190	b
10/06/2013	0.65	0.82	0.53	0.54	0.85	0.52	0.50	943	104	182	b
10/07/2013	0.64	0.81	0.53	0.53	0.80	0.51	0.50	1,094	99	188	b
10/08/2013	0.64	0.80	0.53	0.51	0.77	0.50	0.50	1,264	95	165	b
10/09/2013	0.65	0.81	0.52	0.50	0.76	0.50	0.50	1,471	93	168	b
10/10/2013	0.65	0.81	0.50	0.50	0.73	0.50	0.50	1,469	92	168	b
10/11/2013	0.65	0.80	0.50	0.49	0.70	0.50	0.51	1,347	91	158	b
10/12/2013	0.65	0.80	0.50	0.49	0.69	0.51	0.51	1,290	90	153	b
10/13/2013	0.65	0.79	0.49	0.49	0.67	0.50	0.51	1,271	90	149	b
10/14/2013	0.65	0.78	0.49	0.49	0.64	0.49	0.51	1,152	90	147	b
10/15/2013	0.64	0.78	NR	0.49	0.64	0.50	0.51	1,225	89	137	b
10/16/2013	0.64	0.79	NR	0.49	0.63	0.49	0.51	1,369	89	131	b
10/17/2013	0.65	0.80	NR	0.48	0.62	0.48	0.52	1,471	88	129	b
10/18/2013	0.67	0.82	0.55	0.48	0.61	0.48	0.52	1,665	88	128	b
10/19/2013	0.68	0.83	0.55	0.48	0.59	0.45	0.53	1,694	88	128 e	b
10/20/2013	0.70	0.86	0.55	0.48	0.59	0.46	0.52	1,739	88	128 e	b
10/21/2013	0.71	0.87	0.56	0.49	0.59	0.46	0.52	1,754	89	121	b
10/22/2013	0.70	0.84	0.55	0.49	0.59	0.46	0.55	1,465	89	121	b
10/23/2013	0.74	0.93	0.58	0.49	0.58	0.46	0.52	1,821	90	118	b
10/24/2013	0.77	0.96	0.57	0.50	0.57	0.48	0.51	1,835	91	115	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
09/25/2013	0.31	0.55	0.54	0.67	0.85	0.84	0.45	0.63
09/26/2013	0.32	0.54	0.40	0.66	0.80	0.84	0.36	0.62
09/27/2013	0.31	0.53	0.36	0.65	0.71	0.84	0.35	0.61
09/28/2013	0.28	0.52	0.37	0.64	0.66	0.83	0.37	0.61
09/29/2013	0.30	0.51	0.36	0.63	0.65	0.83	0.36	0.60
09/30/2013	0.40	0.51	0.34	0.62	0.60	0.82	0.34	0.59
10/01/2013	0.50	0.50	0.35	0.60	0.63	0.82	0.36	0.58
10/02/2013	0.55	0.50	0.42	0.59	0.60	0.81	0.43	0.57
10/03/2013	0.58	0.50	0.50	0.58	0.60	0.80	0.52	0.56
10/04/2013	0.62	0.50	0.58	0.58	0.63	0.80	0.57	0.56
10/05/2013	0.58	0.50	0.64	0.58	0.64	0.79	0.63	0.56
10/06/2013	0.58	0.51	0.65	0.57	0.69	0.78	0.66	0.56
10/07/2013	0.61	0.51	0.68	0.57	0.74	0.78	0.67	0.56
10/08/2013	0.64	0.51	0.66	0.57	0.81	0.78	0.65	0.56
10/09/2013	0.58	0.51	0.66	0.57	0.86	0.78	0.66	0.56
10/10/2013	0.61	0.51	0.70	0.57	0.88	0.78	0.69	0.56
10/11/2013	0.66	0.52	0.71	0.57	0.90	0.79	0.69	0.56
10/12/2013	0.61	0.52	0.68	0.57	0.89	0.79	0.68	0.57
10/13/2013	0.65	0.53	0.70	0.58	0.86	0.79	0.71	0.57
10/14/2013	0.67	0.53	0.74	0.58	0.86	0.79	0.74	0.57
10/15/2013	0.62	0.53	0.71	0.58	0.86	0.79	0.71	0.58
10/16/2013	0.51	0.53	0.75	0.58	0.89	0.79	0.74	0.58
10/17/2013	0.52	0.53	0.75	0.59	0.91	0.79	0.72	0.59
10/18/2013	0.54	0.52	0.62	0.59	0.90	0.79	0.60	0.59
10/19/2013	0.63	0.53	0.59	0.59	0.90	0.79	0.58	0.59
10/20/2013	0.63	0.53	0.60	0.59	0.88	0.79	0.60	0.58
10/21/2013	0.58	0.52	0.68	0.59	0.83	0.79	0.68	0.58
10/22/2013	0.57	0.52	0.71	0.59	0.80	0.78	0.70	0.59
10/23/2013	0.55	0.53	0.67	0.59	0.80	0.78	0.67	0.59
10/24/2013	0.47	0.53	0.65	0.59	0.84	0.78	0.65	0.58

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
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Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, June 03, 2014

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	13 %
NDOI, 14 day average*	>= 4,000 cfs	
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	123 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	79 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	1.57 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	1.44 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.2 mS/cm
Brandt Bridge	<=0.7 mS/cm	0.3 mS/cm
Old River Near Tracy	<=0.7 mS/cm	1.0 mS/cm
Old River Near Middle River	<=0.7 mS/cm	0.3 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2014)

Previous Month's Index (8RI for Apr): 1.712 MAF
Water Year Type: Critical
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.1 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- Monthly average is progressive daily mean.
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
05/05/2014	5.45	4.17	4,476	23.19	16.64	9.49	10.00	9.60	8.18	6.13	4.91
05/06/2014	5.06	3.92	3,943	22.08	15.43	10.37	9.43	8.99	8.23	5.61	4.97
05/07/2014	5.11	3.74	4,277	22.48	15.71	11.36	9.19	8.74	8.34	5.24	5.06
05/08/2014	5.25	3.74	3,520	23.77	15.93	12.35	9.32	8.88	8.48	5.23	5.16
05/09/2014	5.33	3.70	3,013	23.42	16.51	13.39	9.79	9.37	8.61	5.68	5.28
05/10/2014	5.48	3.68	3,438	23.84	16.46	14.43	9.78	9.37	8.73	5.75	5.36
05/11/2014	5.36	3.55	4,515	23.09	14.23	15.31	9.01	8.55	8.80	5.74	5.47
05/12/2014	5.53	3.62	4,437	24.14	16.99	15.87	9.42	8.98	8.93	5.94	5.59
05/13/2014	5.72	3.68	4,313	25.00	17.61	16.13	10.17	9.77	9.14	6.28	5.74
05/14/2014	5.91	3.82	4,025	25.35	18.42	16.42	11.07	10.74	9.35	6.95	5.90
05/15/2014	6.22	4.08	3,746	26.55	18.80	16.64	12.35	12.12	9.60	8.19	6.11
05/16/2014	6.36	4.25	2,927	27.33	19.67	16.89	13.39	13.25	9.89	9.27	6.35
05/17/2014	6.47	4.31	3,476	28.58	21.44	17.20	14.33	14.28	10.20	9.61	6.58
05/18/2014	6.36	4.36	3,741	28.63	19.43	17.38	14.38	14.34	10.50	9.69	6.81
05/19/2014	6.16	4.31	3,389	28.32	20.85	17.68	14.16	14.10	10.82	9.64	7.06
05/20/2014	5.81	4.16	3,511	27.56	19.88	17.99	13.48	13.34	11.13	8.90	7.29
05/21/2014	5.61	4.03	4,150	25.70	19.91	18.29	12.67	12.47	11.40	8.43	7.52
05/22/2014	5.80	4.05	3,536	26.05	18.41	18.47	12.98	12.80	11.68	8.36	7.74
05/23/2014	6.01	4.15	3,340	26.48	19.83	18.71	13.65	13.54	11.97	9.39	8.01
05/24/2014	6.07	4.15	3,223	27.41	16.55	18.71	13.97	13.88	12.30	9.71	8.29
05/25/2014	6.20	4.18	3,393	27.90	20.36	19.15	13.90	13.81	12.67	9.96	8.60
05/26/2014	6.28	4.20	3,665	27.98	20.24	19.38	14.17	14.10	13.04	10.05	8.89
05/27/2014	6.27	4.19	3,615	28.16	21.26	19.65	14.58	14.55	13.38	10.40	9.18
05/28/2014	6.26	4.04	3,611	27.61	19.33	19.71	14.08	14.01	13.61	9.80	9.39
05/29/2014	6.13	4.13	4,288	27.91	20.56	19.84	13.96	13.88	13.74	9.14	9.45
05/30/2014	6.27	4.31	3,924	28.60	21.25	19.95	14.76	14.76	13.85	10.48	9.54
05/31/2014	6.19	4.25	3,948	28.32	20.55	19.89	14.73	14.72	13.88	10.47	9.60
06/01/2014	6.06	4.34	4,232	27.92	19.37	19.88	14.57	14.54	13.89	10.43	9.65
06/02/2014	6.09	4.52	3,978	29.39	21.13	19.90	15.70	15.80	14.01	10.99	9.75
06/03/2014	5.66	4.29	3,407	28.79	19.74	19.89	14.47	14.43	14.09	9.93	9.82

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
05/05/2014	3.03	2.32	0.67	0.55	0.63	NC	0.40	8.95	6.18	6.25	6.11	7.91
05/06/2014	2.65	2.35	0.62	0.56	0.57	NC	0.39	9.08	-0.01 m	6.50	6.57	6.70
05/07/2014	2.35	2.39	0.56	0.57	0.52	NC	0.40	9.29	6.77	6.83	6.81	6.35
05/08/2014	2.50	2.45	0.56	0.57	0.54	NC	0.43	9.46	6.74	3.65	6.64	6.60
05/09/2014	2.65	2.50	0.57	0.58	0.57	NC	0.52	9.64	6.81	6.59	6.16	7.24
05/10/2014	2.72	2.56	0.58	0.58	0.63	NC	0.56	9.83	6.75	6.91	5.86	7.36
05/11/2014	2.35	2.59	0.55	0.59	0.54	0.57	0.52	10.00	6.60	6.98	6.05	6.55
05/12/2014	2.63	2.64	0.58	0.59	0.59	0.58	0.52	10.17	7.23	7.45	6.30	7.26
05/13/2014	2.97	2.72	0.61	0.60	0.72 e	0.60	0.52	10.29	7.30	7.19	6.39	8.42
05/14/2014	3.46	2.81	0.70	0.61	0.84	0.63	0.44	10.25	7.82	7.35	6.59	8.85
05/15/2014	4.23	2.92	0.83	0.63	1.04	0.66	0.40	10.34	8.19	7.77	6.87	10.64
05/16/2014	4.77	3.06	1.00	0.66	1.30	0.71	0.42	10.55	8.44	7.87	6.70	11.14
05/17/2014	5.19	3.21	1.12	0.69	1.54	0.77	0.41	11.09	8.33	7.61	7.31	11.19
05/18/2014	5.64	3.37	1.24	0.73	1.62	0.83	0.42	11.67	8.58	7.09	8.01	11.56
05/19/2014	5.43	3.54	1.21	0.77	1.53	0.90	0.52	11.97	8.86	7.93	8.70	11.71
05/20/2014	5.03	3.71	1.12	0.80	1.32	0.95	0.50	12.25	9.31	8.57	9.47	10.94
05/21/2014	4.40	3.85	1.01	0.83	1.12	0.99	0.54	12.32	10.27	8.59	9.72	10.52
05/22/2014	4.53	4.00	1.05	0.87	1.16	1.04	0.50	12.38	10.21	9.62	9.55	10.80
05/23/2014	4.85	4.16	1.15	0.91	1.35	1.09	0.51	12.60	10.75	10.10	9.05	11.40
05/24/2014	5.13	4.33	1.22	0.96	1.49	1.15	0.46	12.81	10.47	10.10	9.08	11.53
05/25/2014	5.20	4.53	1.25	1.01	1.58	1.23	0.41	12.98	10.48	9.95	9.10	11.44
05/26/2014	5.40	4.73	1.35	1.06	1.66	1.30	0.39	13.18	10.32	10.14	9.55	11.68
05/27/2014	5.60	4.92	1.37	1.12	1.74	1.38	0.36	13.27	10.23	10.33	9.96	12.18
05/28/2014	5.62	5.07	1.40	1.17	1.66	1.44	0.33	13.44	9.71	10.21	10.12	11.48
05/29/2014	5.60	5.17	1.31	1.20	1.58	1.47	0.34	13.40	9.79	10.50	10.62	11.82
05/30/2014	6.25	5.28	1.66	1.25	1.80	1.51	0.33	13.38	10.32	10.36	10.33	12.31
05/31/2014	6.13	5.34	1.76	1.29	1.80	1.53	0.34	13.49	9.41	9.92	10.12	12.01
06/01/2014	6.17	5.38	1.82	1.33	1.69	1.53	0.41	13.59	9.85	10.12	10.24	12.19
06/02/2014	6.68	5.47	2.11	1.40	1.87	1.56	0.43	13.60	9.69	9.64	10.57	12.99
06/03/2014	6.01	5.54	1.74	1.44	1.55	1.57	0.44	13.67	9.95	10.27	10.99	11.86

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
05/05/2014	1.52	0.43	0.53	0.42	0.41	0.42	0.47	0.44	896	69	61	b
05/06/2014	1.25	0.44	0.54	0.43	0.41	0.42	0.46	0.44	773	70	61	b
05/07/2014	1.15	0.44	0.54	0.43	0.42	0.42	0.46	0.43	679	71	61	b
05/08/2014	1.21	0.44	0.54	0.44	0.42	0.42	0.46	0.43	726	72	61	b
05/09/2014	1.25	0.45	0.55	0.44	0.42	0.43	0.45	0.45	774	72	65	b
05/10/2014	1.25	0.46	0.55	0.44	0.43	0.43	0.47	0.46	796	73	62	b
05/11/2014	1.01	0.46	0.54	0.44	0.43	0.43	0.48	0.47	678	73	62	b
05/12/2014	1.30	0.45	0.55	0.44	0.43	0.43	0.48	0.46	766	74	63	b
05/13/2014	1.59	0.45	0.55	0.44	0.43	0.44	0.48	0.46	877	75	63	b
05/14/2014	1.89	0.46	0.55	0.44	0.43	0.47	0.48	0.46	1,033	75	64	b
05/15/2014	2.34	0.46	0.56	0.44	0.43	0.49	0.48	0.47	1,279	75	68	b
05/16/2014	2.93	0.48	0.57	0.45	0.43	0.51	0.48	0.47	1,449	75	70	b
05/17/2014	3.40	0.49	0.58	0.45	0.43	0.52	0.48	0.47	1,583	74	73	b
05/18/2014	3.56	0.51	0.63	0.46	0.43	0.53	0.47	0.47	1,726	75	74	b
05/19/2014	3.40	0.52	0.65	0.47	0.43	0.54	0.47	0.46	1,658	75	75	b
05/20/2014	2.78	0.53	0.67	0.48	0.44	0.55	0.47	0.46	1,533	75	75	b
05/21/2014	2.37	0.55	0.65	0.49	0.44	0.56	0.46	0.45	1,331	76	76	b
05/22/2014	2.51	0.56	0.67	0.50	0.45	0.56	0.48	0.46	1,372	78	76	b
05/23/2014	2.81	0.59	0.71	0.52	0.46	0.55	0.49	0.47	1,475	81	75	b
05/24/2014	3.10	0.60	0.73	0.54	0.46	0.55	0.49	0.48	1,565	83	75 e	b
05/25/2014	3.37	0.63	0.75	0.56	0.48	0.55	0.49	0.48	1,588	86	75 e	b
05/26/2014	3.43	0.65	0.79	0.58	0.48	0.55	0.48	0.48	1,648	88	75 e	b
05/27/2014	3.62	0.67	0.81	0.59	0.49	0.55	0.48	0.48	1,712	91	75	b
05/28/2014	3.33	0.69	0.84	0.62	0.50	0.55	0.48	0.48	1,718	93	78	b
05/29/2014	3.16	0.71	0.85	0.63	0.52	0.56	0.48	0.48	1,713	97	77	b
05/30/2014	3.64	0.74	0.89	0.65	0.54	0.57	0.48	0.48	1,922	103	78	b
05/31/2014	3.63	0.77	0.88	0.65	0.56	0.57	0.49	0.33	1,884	108	78 e	b
06/01/2014	3.59	0.79	0.91	0.65	0.57	0.57	0.49	0.03	1,897	110	78 e	b
06/02/2014	3.83	0.84	0.97	0.67	0.58	0.57	0.49	0.39	2,057	113	79	b
06/03/2014	3.13	0.81	0.97	0.68	0.58	0.57	0.50	0.50	1,845	112	79	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
05/05/2014	0.18	0.44	0.19	0.45	1.09	1.17	0.19	0.50
05/06/2014	0.18	0.41	0.20	0.43	1.10	1.17	0.20	0.48
05/07/2014	0.18	0.38	0.20	0.41	1.12	1.17	0.21	0.45
05/08/2014	0.15	0.34	0.21	0.40	1.13	1.17	0.21	0.42
05/09/2014	0.15	0.31	0.19	0.37	1.14	1.17	0.21	0.39
05/10/2014	0.14	0.28	0.18	0.35	1.16	1.16	0.19	0.35
05/11/2014	0.13	0.25	0.17	0.32	1.15	1.16	0.19	0.32
05/12/2014	0.13	0.23	0.16	0.28	1.14	1.16	0.18	0.29
05/13/2014	0.12	0.21	0.16	0.25	1.16	1.15	0.17	0.26
05/14/2014	0.13	0.19	0.15	0.22	1.16	1.15	0.17	0.24
05/15/2014	0.11	0.17	0.15	0.20	1.14	1.15	0.16	0.22
05/16/2014	0.12	0.16	0.15	0.19	1.13	1.14	0.16	0.20
05/17/2014	0.16	0.16	0.14	0.17	1.09	1.13	0.14	0.18
05/18/2014	0.21	0.15	0.17	0.17	1.07	1.13	0.15	0.18
05/19/2014	0.24	0.16	0.20	0.17	1.03	1.12	0.19	0.17
05/20/2014	0.23	0.16	0.24	0.17	1.02	1.11	0.23	0.18
05/21/2014	0.21	0.16	0.29	0.18	0.99	1.10	0.28	0.18
05/22/2014	0.24	0.16	0.32	0.18	0.95	1.09	0.33	0.19
05/23/2014	0.25	0.17	0.34	0.19	0.93	1.08	0.34	0.19
05/24/2014	0.26	0.17	0.34	0.19	0.89	1.07	0.35	0.20
05/25/2014	0.27	0.18	0.35	0.20	0.89	1.07	0.35	0.21
05/26/2014	0.24	0.18	0.36	0.21	0.84	1.06	0.37	0.21
05/27/2014	0.26	0.19	0.38	0.22	0.85	1.05	0.38	0.22
05/28/2014	0.30	0.19	0.39	0.23	0.81	1.04	0.39	0.23
05/29/2014	0.32	0.19	0.39	0.23	0.80	1.04	0.39	0.24
05/30/2014	0.28	0.20	0.40	0.24	0.81	1.03	0.40	0.24
05/31/2014	0.28	0.20	0.40	0.25	0.80	1.02	0.39	0.25
06/01/2014	0.30	0.20	0.40	0.25	0.81	1.01	0.41	0.26
06/02/2014	0.32	0.21	0.41	0.26	0.85	1.00	0.43	0.27
06/03/2014	0.31	0.21	0.42	0.27	0.87	1.00	0.47	0.27

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Wednesday, July 02, 2014

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	16 %
NDOI, monthly average *	>= 3,000 cfs	3,772 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	152 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	99 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	1.33 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	1.35 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.4 mS/cm
Brandt Bridge	<=0.7 mS/cm	0.5 mS/cm
Old River Near Tracy	<=0.7 mS/cm	1.0 mS/cm
Old River Near Middle River	<=0.7 mS/cm	0.6 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out
Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2014)

Previous Month's Index (8RI for Apr): 1.712 MAF
Water Year Type: Critical
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.1 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 14 day average is progressive daily mean for the first thirteen days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
06/03/2014	5.66	4.29	3,407	28.79	19.74	19.89	14.47	14.43	14.09	9.93	9.82
06/04/2014	5.35	4.16	4,591	27.20	19.00	19.83	13.36	13.21	14.14	8.99	9.86
06/05/2014	5.66	4.22	4,248	27.47	18.32	19.82	13.60	13.48	14.19	9.26	9.93
06/06/2014	5.90	4.28	4,086	29.29	18.61	19.73	13.88	13.79	14.21	9.68	9.95
06/07/2014	6.01	4.25	4,565	28.65	17.46	19.80	13.82	13.72	14.20	9.62	9.94
06/08/2014	6.05	4.13	4,796	27.88	17.81	19.62	12.86	12.67	14.12	8.58	9.84
06/09/2014	6.28	4.23	4,840	28.48	18.70	19.51	13.16	13.00	14.04	8.80	9.76
06/10/2014	6.56	4.62	4,202	30.47	21.02	19.49	15.39	15.45	14.10	10.77	9.78
06/11/2014	7.07	4.88	3,628	31.62	21.73	19.66	16.60	16.80	14.30	11.90	9.93
06/12/2014	6.99	4.64	3,762	31.77	20.29	19.64	15.93	16.05	14.46	11.03	10.07
06/13/2014	6.81	4.38	4,203	30.00 e	17.00 e	19.34	14.50 e	14.47 e	14.44	9.00 e	9.96
06/14/2014	6.60	4.30	4,138	29.99	15.12	18.95	14.12	14.05	14.39	8.44	9.82
06/15/2014	6.61	4.42	4,254	30.81	20.28	19.02	14.98	15.00	14.42	9.81	9.77
06/16/2014	6.50	4.43	4,503	30.40	19.95	18.93	15.20	15.24	14.38	9.54	9.67
06/17/2014	6.07	4.22	4,853	29.07	17.98	18.81	13.49	13.36	14.31	9.14	9.61
06/18/2014	5.58	3.99	5,638	27.67	18.04	18.74	12.43	12.21	14.23	8.34	9.57
06/19/2014	5.77	4.05	5,389	27.51	16.66	18.62	12.61	12.40	14.16	8.33	9.50
06/20/2014	6.00	4.05	5,290	27.49	18.80	18.63	12.72	12.52	14.07	8.42	9.41
06/21/2014	6.29	4.21	5,001	28.90	20.46	18.85	13.20	13.05	14.02	8.49	9.33
06/22/2014	6.29	4.25	4,979	28.45	20.96	19.07	13.26	13.11	14.05	8.73	9.34
06/23/2014	6.37	4.30	5,050	29.00	21.25	19.25	13.32	13.17	14.06	9.02	9.35
06/24/2014	6.44	4.43	5,336	29.69	21.72	19.30	13.89	13.80	13.94	9.16	9.24
06/25/2014	6.58	4.48	5,321	29.83	21.90	19.32	12.83	12.64	13.65	9.21	9.05
06/26/2014	6.55	4.44	5,610	29.81	21.38	19.39	13.54	13.42	13.46 e	8.91	8.89
06/27/2014	6.45	4.40	6,093	29.41	21.05	19.68	13.29	13.14	13.36	8.71	8.87
06/28/2014	6.39	4.37	6,055	29.23	19.48	19.99	12.80	12.61	13.26	8.39	8.87
06/29/2014	6.23	4.33	5,407	28.31	19.82	19.96	12.22	11.98	13.05	7.76	8.72
06/30/2014	6.19	4.52	5,195	28.34	20.32	19.99	12.44	12.22	12.83	7.89	8.61
07/01/2014	6.36	4.89	4,042	31.17	21.23	20.22	14.14	14.07	12.88	9.47	8.63
07/02/2014	5.97	4.64	3,503	30.09	19.77	20.34	13.13	12.97	12.93	8.89	8.67

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
06/03/2014	6.01	5.54	1.74	1.44	1.55	1.57	0.44	13.67	9.95	10.27	10.99	11.86
06/04/2014	5.59	5.63	1.68	1.49	1.22	1.58	0.41	13.76	10.39	11.27	11.82	10.62
06/05/2014	5.69	5.71	1.70	1.54	1.20	1.58	0.45	13.90	10.59	11.89	12.61	11.05
06/06/2014	5.83	5.78	1.84	1.59	1.30	1.58	0.43	14.18	11.00	12.41	13.11	11.70
06/07/2014	5.67	5.82	1.81	1.63	1.31	1.57	0.41	14.54	11.43	14.12	13.08	10.97
06/08/2014	5.43	5.83	1.65	1.66	1.29	1.55	0.38	15.02	12.07	14.99	13.65	9.52
06/09/2014	5.61	5.85	1.55	1.67	1.43	1.53	0.37	15.57	12.88	14.76	14.56	10.16
06/10/2014	6.60	5.92	2.17	1.73	1.94	1.54	0.33	16.05	13.50	14.65	15.45	11.16
06/11/2014	7.27	6.04	2.69	1.82	2.63	1.61	0.33	16.68	14.00	14.91	15.85	13.21
06/12/2014	6.93	6.13	2.24	1.89	2.29	1.66	0.33	17.74	14.97	15.48	16.10	12.48
06/13/2014	6.00 e	6.12	2.00 e	1.91	1.96	1.68	0.33 e	18.34	14.71	15.81	16.48	12.00 e
06/14/2014	5.96	6.10	1.58	1.90	1.70	1.67	0.33	18.31	14.70	15.64	16.50	12.00 e
06/15/2014	6.24	6.11	1.92	1.90	1.98	1.69	0.32	18.26	15.32	15.51	17.09	11.40
06/16/2014	6.14	6.07	1.83	1.88	2.05	1.70	0.45	18.25	15.80	15.12	17.21	11.12
06/17/2014	5.42	6.03	1.56	1.87	1.70	1.71	0.51	18.27	15.50	15.34	17.40	10.62
06/18/2014	4.83	5.97	1.37	1.85	1.38	1.72	0.48	18.25	15.11	15.05	17.34	10.07
06/19/2014	4.68	5.90	1.38	1.83	1.35	1.74	0.51	18.26	15.04	15.64	17.17	10.30
06/20/2014	4.66	5.82	1.31	1.79	1.32	1.74	0.47	18.18	15.59	16.75	16.92	9.74
06/21/2014	5.01	5.77	1.31	1.75	1.40	1.74	0.45	17.88	15.84	16.63	17.05	10.21
06/22/2014	5.15	5.75	1.29	1.73	1.49	1.76	0.52	17.77	15.98	16.37	17.19	9.36
06/23/2014	5.17	5.72	1.30	1.71	1.45	1.76	0.57	17.74	15.99	16.57	17.01	10.36
06/24/2014	5.44	5.64	1.52	1.66	1.49	1.73	0.53	17.69	16.09	16.20	17.19	9.90
06/25/2014	5.56	5.51	1.56	1.58	1.59	1.65	0.45	17.71	15.91	16.42	17.60	10.11
06/26/2014	5.39	5.40	1.52	1.53	1.46	1.59	0.41	17.90	16.16	16.00	17.69	10.21
06/27/2014	5.04	5.34	1.40	1.49	1.32	1.55	0.35	18.03	16.17	16.30	17.48	9.75
06/28/2014	4.70	5.25	1.30	1.47	1.18	1.51	0.32	18.02	16.35	16.02	17.61	9.36
06/29/2014	4.32	5.11	1.17	1.42	1.07	1.45	0.38	18.02	16.36	16.06	17.66	8.80
06/30/2014	4.53	4.99	1.23	1.37	1.07	1.38	0.44	17.97	16.44	15.77	17.67	9.48
07/01/2014	5.21	4.98	1.44	1.36	1.28	1.35	0.39	17.84	16.57	15.77	17.64	11.05
07/02/2014	4.69	4.97	1.19	1.35	1.10	1.33	0.36	18.65	16.45	15.49	17.57	10.33

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
06/03/2014	3.13	0.81	0.97	0.68	0.58	0.57	0.50	0.50	1,845	112	79	b
06/04/2014	2.58	0.85	0.98	0.70	0.58	0.58	0.50	0.51	1,711	114	79	b
06/05/2014	2.51	0.88	1.03	0.74	0.60	0.58	0.51	0.51	1,742	120	80	b
06/06/2014	2.58	0.92	1.13	0.77	0.63	0.59	0.52	0.52	1,786	127	80	b
06/07/2014	2.61	0.94	1.19	0.81	0.65	0.59	0.53	0.53	1,736	133	82	b
06/08/2014	2.51	0.98	1.21	0.84	0.67	0.59	0.54	0.53	1,661	136	83	b
06/09/2014	2.82	0.99	1.23	0.85	0.69	0.61	0.54	0.53	1,718	141	82	b
06/10/2014	3.73	1.02	1.39	0.89	0.73	0.61	0.56	0.54	2,033	153	85	b
06/11/2014	4.76	1.08	1.49	0.91	0.75	0.60	0.58	0.53	2,246	159	82	b
06/12/2014	4.45	1.12	1.51	0.92	0.75	0.64	0.58	0.54	2,136	158	80	b
06/13/2014	3.00 e	1.12 e	1.30 e	0.90 e	0.80 e	0.65 e	0.60 e	0.54 e	1,841 e	171 e	88	b
06/14/2014	2.66	1.12	1.30	0.93	0.78	0.65	0.60	0.54	1,829	165	85	b
06/15/2014	3.97	1.11	1.39	0.96	0.80	0.64	0.61	0.54	1,917	172	82	b
06/16/2014	4.11	1.12	1.38	0.95	0.81	0.64	0.61	0.54	1,886	174	82	b
06/17/2014	3.39	1.10	1.32	0.94	0.81	0.63	0.62	0.54	1,657	175	88	b
06/18/2014	2.76	1.07	1.27	0.94	0.82	0.63	0.63	0.54	1,468	175	88	b
06/19/2014	2.70	1.04	1.26	0.93	0.81	0.62	0.64	0.54	1,421	175	88	b
06/20/2014	2.61	1.04	1.25	0.92	0.82	0.62	0.65	0.54	1,415	176	88	b
06/21/2014	2.88	1.04	1.25	0.93	0.83	0.61	0.66	0.54	1,526	178	85	b
06/22/2014	2.85	1.03	1.24	0.91	0.82	0.61	0.67	0.54	1,570	178	85	b
06/23/2014	2.80	1.02	1.24	0.91	0.82	0.62	0.67	0.54	1,576	177	85	b
06/24/2014	2.70	1.00	1.22	0.90	0.82	0.66	0.69	0.54	1,663	176	92	b
06/25/2014	3.03	0.98	1.24	0.89	0.81	0.63	0.69	0.54	1,702	175	95	b
06/26/2014	2.87	0.97	1.24	0.87	0.80	0.64	0.70	0.54	1,647	172	91	b
06/27/2014	2.72	0.95	1.22	0.87	0.79	0.64	0.71	0.54	1,535	169	92	b
06/28/2014	2.52	0.93	1.19	0.86	0.79	0.65	0.73	0.57	1,426	168	95	b
06/29/2014	2.19	0.91	1.17	0.85	0.78	0.67	0.74	0.73	1,307	166	97	b
06/30/2014	2.30	0.86	1.14	0.85	0.77	0.69	0.72	0.72	1,372	165	97	b
07/01/2014	2.93	0.81	1.16	0.85	0.77	0.70	0.71	0.70	1,590	162	93	b
07/02/2014	2.24	0.86	1.14	0.83	0.76	0.71	0.70	0.69	1,425	161	99	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
06/03/2014	0.31	0.21	0.42	0.27	0.87	1.00	0.47	0.27
06/04/2014	0.30	0.22	0.44	0.28	1.02	0.99	0.49	0.28
06/05/2014	0.30	0.22	0.45	0.28	1.10	0.99	0.51	0.29
06/06/2014	0.36	0.23	0.46	0.29	1.20	1.00	0.51	0.30
06/07/2014	0.38	0.23	0.46	0.30	1.22	1.00	0.51	0.31
06/08/2014	0.37	0.24	0.47	0.31	1.24	1.00	0.51	0.33
06/09/2014	0.37	0.25	0.48	0.32	1.25	1.01	0.52	0.34
06/10/2014	0.43	0.26	0.46	0.33	1.01	1.00	0.51	0.35
06/11/2014	0.43	0.27	0.44	0.34	0.90	0.99	0.54	0.36
06/12/2014	0.44	0.28	0.46	0.35	0.84	0.98	0.55	0.37
06/13/2014	0.40 e	0.29	0.48 e	0.36	0.80 e	0.97	0.55 e	0.38
06/14/2014	0.40	0.30	0.50	0.37	0.79	0.96	0.58	0.40
06/15/2014	0.38	0.31	0.50	0.38	0.80	0.95	0.59	0.41
06/16/2014	0.37	0.31	0.52	0.40	0.85	0.94	0.60	0.43
06/17/2014	0.37	0.32	0.54	0.41	0.91	0.94	0.60	0.44
06/18/2014	0.36	0.32	0.56	0.42	0.94	0.93	0.62	0.46
06/19/2014	0.35	0.33	0.57	0.43	0.94	0.93	0.62	0.47
06/20/2014	0.45	0.34	0.57	0.44	1.00	0.93	0.63	0.48
06/21/2014	0.42	0.34	0.56	0.45	0.95	0.93	0.63	0.49
06/22/2014	0.39	0.35	0.55	0.46	0.94	0.93	0.63	0.50
06/23/2014	0.45	0.35	0.56	0.46	0.91	0.93	0.64	0.51
06/24/2014	0.43	0.36	0.57	0.47	0.87	0.93	0.64	0.52
06/25/2014	0.46	0.37	0.58	0.48	0.85	0.93	0.64	0.53
06/26/2014	0.45	0.37	0.59	0.49	0.86	0.93	0.69	0.54
06/27/2014	0.44	0.38	0.60	0.49	0.89	0.93	0.79	0.55
06/28/2014	0.45	0.38	0.61	0.50	0.96	0.94	0.88	0.57
06/29/2014	0.42	0.39	0.63	0.51	0.99	0.95	0.91	0.59
06/30/2014	0.38	0.39	0.63	0.52	1.08	0.95	0.90	0.60
07/01/2014	0.40	0.39	0.63	0.52	1.05	0.96	0.86	0.62
07/02/2014	0.35	0.39	0.63	0.53	1.00	0.97	0.86	0.63

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, August 04, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	8 %
NDOI, monthly average *	>= 3,000 cfs	3,774 cfs
NDOI, 7 day average*	>= 2,000 cfs	3,774 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	124 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	167 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	2.54 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	1.84 mS/cm
14dm EC at San Andreas Landing	<= 0.87 mS/cm	0.61 mS/cm
14dm EC at Terminous	<= 0.54 mS/cm	0.14 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.7 mS/cm
Brandt Bridge	<=0.7 mS/cm	1.1 mS/cm
Old River Near Tracy	<=0.7 mS/cm	1.0 mS/cm
Old River Near Middle River	<=0.7 mS/cm	1.1 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out   Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2015)

Previous Month's Index (8RI for Apr): 766 TAF
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.7 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
NR - No Record
NC - Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows and Suisun Marsh mhtEC:
- 7 day average is progressive daily mean for the first six days of the month.
- Monthly average is progressive daily mean from the beginning of the month

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
07/06/2015	6.36	4.60	2,702	31.87	21.78	21.21	16.59	16.79	15.78	12.22	11.17
07/07/2015	6.14	4.42	3,311	30.36	20.13	21.29	15.97	16.09	16.01	11.26	11.35
07/08/2015	6.41	4.47	3,072	30.48	19.10	21.28	16.17	16.32	16.23 e	11.35	11.52
07/09/2015	6.44	4.42	2,854	30.48	21.09	21.38	15.75	15.85	16.39	11.09	11.66
07/10/2015	6.57	4.34	3,498	29.91	19.86	21.29	15.26	15.31	16.43	10.68	11.68
07/11/2015	6.72	4.48	3,851	30.15	21.75	21.26	15.84	15.96	16.41	11.25	11.65
07/12/2015	6.75	4.53	3,723	30.82	21.81	21.33	16.12	16.26	16.43	11.55	11.66
07/13/2015	6.81	4.59	4,018	30.83	21.95	21.34	15.86	15.98	16.45	11.54	11.70
07/14/2015	6.89	4.61	4,169	31.16	22.52	21.57	16.38	16.55	16.55	11.48	11.75
07/15/2015	6.84	4.64	3,911	30.77	20.98	21.52	16.10	16.24	16.56	11.57	11.77
07/16/2015	6.91	4.78	3,881	32.00	22.88	21.60	16.70	16.92	16.56	12.34	11.79
07/17/2015	6.80	4.80	3,682	31.39	22.42	21.59	16.81	17.04	16.53	12.23	11.76
07/18/2015	6.77	4.82	4,139	31.15	20.09	21.38	16.79	17.02	16.47	12.26	11.72
07/19/2015	6.26	4.42	4,202	30.09	16.68	20.93	14.99	15.01	16.24	10.44	11.52
07/20/2015	5.89	4.38	4,388	29.15	19.50	20.77	14.28	14.23	16.05	9.82	11.35
07/21/2015	6.02	4.52	3,359	29.86	20.47	20.79	14.95	14.96	15.97	10.30	11.28
07/22/2015	6.21	4.60	3,358	30.86	18.77	20.77	15.42	15.49	15.91	10.46	11.21
07/23/2015	6.09	4.44	3,149	29.69	18.79	20.60	14.50	14.46	15.81	9.65	11.11
07/24/2015	6.09	4.25	3,079	28.36	20.39	20.64	13.73	13.62	15.69	9.03	10.99
07/25/2015	6.36	4.34	3,024	29.19	20.13	20.53	14.21	14.15	15.57	9.73	10.89
07/26/2015	6.70	4.63	3,183	30.95	19.09	20.33	15.28	15.33	15.50	10.65	10.82
07/27/2015	6.72	4.61	2,775	29.83	17.19	19.99	15.06	15.09	15.43	9.64	10.69
07/28/2015	6.78	4.61	3,510	30.25	19.25	19.76	15.17	15.21	15.34	10.54	10.62
07/29/2015	6.87	4.71	3,365	30.72	21.93	19.83	16.01	16.14	15.33	11.36	10.60
07/30/2015	7.14	4.86	3,357	31.63	23.39	19.86	17.39	17.68	15.39	12.76	10.63
07/31/2015	7.14	4.80	3,521	31.40	22.71	19.88	17.22	17.49	15.42	12.70	10.67
08/01/2015	7.03	4.74	3,908	31.08	21.44	19.98	17.07	17.33	15.44	12.48	10.68
08/02/2015	6.79	4.67	3,823	31.04	18.14	20.08	16.87	17.10	15.59	12.16	10.81
08/03/2015	6.45	4.61	3,638	30.09	18.88	20.04	16.59	16.79	15.77	11.57	10.93
08/04/2015	6.11	4.41	3,725	30.46	17.23	19.81	15.68	15.77	15.83	10.89	10.97

Antioch Tides measured in feet relative to the NAVD88 Datum
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised March 2000.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Three Mile Slough		San Andreas Landing		Terminous	
	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm
07/06/2015	7.29	6.65	2.42	2.12	5.77	4.62	3.61	2.77	0.62	0.65	0.14	0.16
07/07/2015	6.76	6.78	2.16	2.17	5.10	4.74	3.11	2.85	0.57	0.65	0.15	0.15
07/08/2015	6.90	6.91	2.10	2.20	5.18	4.89	3.21	2.94	0.55	0.65	0.15	0.15
07/09/2015	6.84	7.00	2.09	2.23	5.02	5.03	3.11	3.03	0.54	0.65	0.14	0.15
07/10/2015	6.66	7.02	1.98	2.24	4.66	5.10	2.77	3.09	0.54	0.64	0.14	0.15
07/11/2015	7.17	7.03	2.08	2.23	4.83	5.15	2.88	3.11	0.57	0.63	0.14	0.15
07/12/2015	7.37	7.08	2.30	2.24	5.20	5.21	3.00	3.15	0.61	0.63	0.14	0.15
07/13/2015	6.71	7.10	2.01	2.23	4.81	5.23	2.93	3.17	0.59	0.62	0.14	0.15
07/14/2015	6.99	7.15	1.97	2.23	5.01	5.27	2.94	3.20	0.58	0.62	0.14	0.15
07/15/2015	7.01	7.16	2.06	2.22	4.84	5.27	2.99	3.21	0.60	0.62	0.14	0.14
07/16/2015	7.15	7.13	2.18	2.21	5.21	5.27	3.10	3.20	0.63	0.61	0.14	0.14
07/17/2015	7.07	7.11	2.28	2.20	5.32	5.24	3.06	3.17	0.62	0.61	0.14	0.14
07/18/2015	7.06	7.06	2.28	2.18	5.34	5.20	3.03	3.13	0.62	0.60	0.14	0.14
07/19/2015	6.06	6.93	1.90	2.13	4.11	5.03	2.38	3.01	0.52	0.58	0.14	0.14
07/20/2015	5.73	6.82	1.59	2.07	3.75	4.88	2.14	2.90	0.50	0.57	0.14	0.14
07/21/2015	6.08	6.77	1.70	2.04	3.73	4.79	2.11	2.83	0.57	0.57	0.15	0.14
07/22/2015	6.38	6.73	1.62	2.00	3.54	4.67	2.13	2.75	0.61	0.58	0.14	0.14
07/23/2015	6.08	6.68	1.64	1.97	3.14	4.53	1.77	2.66	0.59	0.58	0.15	0.14
07/24/2015	5.84	6.62	1.57	1.94	2.68	4.39	1.50	2.57	0.58	0.58	0.15	0.14
07/25/2015	6.09	6.54	1.59	1.91	3.03	4.26	1.59	2.48	0.59	0.59	0.14	0.14
07/26/2015	6.45	6.48	1.66	1.86	3.76	4.16	2.01	2.41	0.63	0.59	0.14	0.14
07/27/2015	6.40	6.46	1.82	1.85	3.86	4.09	2.36	2.36	0.63	0.59	0.14	0.14
07/28/2015	6.57	6.43	1.74	1.83	4.11	4.03	2.51	2.33	0.63	0.59	0.14	0.14
07/29/2015	6.86	6.42	1.77	1.81	4.68	4.02	2.74	2.32	0.64	0.60	0.14	0.14
07/30/2015	7.52	6.44	2.26	1.82	5.39	4.03	3.24	2.33	0.67	0.60	0.14	0.14
07/31/2015	7.26	6.46	2.14	1.81	5.56	4.05	3.21	2.34	0.65	0.60	0.14	0.14
08/01/2015	7.13	6.46	2.13	1.79	5.69	4.07	3.30	2.36	0.62	0.60	0.14	0.14
08/02/2015	6.99	6.53	2.06	1.81	5.67	4.18	3.28	2.42	0.59	0.61	0.14	0.14
08/03/2015	6.96	6.61	1.97	1.83	5.51	4.31	3.17	2.49	0.56	0.61	0.14	0.14
08/04/2015	6.56	6.65	1.80	1.84	4.81	4.39	2.73	2.54	0.51	0.61	0.14	0.14

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
07/06/2015	0.99	1.81	0.74	0.75	0.80	0.72	0.78	2,252	159	170	b
07/07/2015	0.97	1.81	0.72	0.75	0.80	0.72	0.77	2,082	158	169	b
07/08/2015	0.94	1.84	0.72	0.74	0.80	0.72	0.77	2,127	156	170	b
07/09/2015	0.95	1.80	0.70	0.74	0.80	0.71	0.77	2,110	155	171	b
07/10/2015	0.94	1.78	0.71	0.73	0.79	0.73	0.76	2,050	153	170	b
07/11/2015	0.95	1.82	0.72	0.73	0.79	0.73	0.77	2,213	152	170 e	b
07/12/2015	0.98	1.89	0.75	0.72	0.78	0.73	0.77	2,278	151	170 e	b
07/13/2015	0.98	1.85	0.75	0.73	0.79	0.73	0.77	2,066	152	172	b
07/14/2015	0.96	1.75	0.76	0.73	0.78	0.73	0.77	2,156	153	170	b
07/15/2015	0.95	1.76	0.77	0.73	0.78	0.73	0.76	2,162	153	169	b
07/16/2015	0.97	1.80	0.81	0.73	0.78	0.73	0.77	2,206	153	168	b
07/17/2015	1.02	1.75	0.79	0.73	0.78	0.73	0.77	2,181	154	169	b
07/18/2015	1.02	1.76	0.78	0.74	0.77	0.73	0.77	2,180	155	169 e	b
07/19/2015	0.99	1.68	0.75	0.74	0.77	0.73	0.76	1,861	155	169 e	b
07/20/2015	0.94	1.59	0.76	0.72	0.76	0.73	0.76	1,755	150	170	b
07/21/2015	0.93	1.59	0.77	0.74	0.77	0.73	0.76	1,865	155	167	b
07/22/2015	0.94	1.59	0.77	0.73	0.77	0.73	0.76	1,962	154	168	b
07/23/2015	0.93	1.56	0.75	0.73	0.77	0.73	0.76	1,865	153	168	b
07/24/2015	0.92	1.52	0.74	0.73	0.77	0.75	0.76	1,791	153	170	b
07/25/2015	0.91	1.54	0.74	0.72	0.77	0.77	0.76	1,869	151	170 e	b
07/26/2015	0.91	1.59	0.75	0.72	0.77	0.76	0.76	1,985	149	170 e	b
07/27/2015	0.92	1.59	0.76	0.71	0.77	0.76	0.76	1,969	148	172	b
07/28/2015	0.93	1.60	0.77	0.71	0.77	0.76	0.76	2,022	148	171	b
07/29/2015	0.92	1.63	0.77	0.71	0.77	0.76	0.76	2,116	147	178	b
07/30/2015	0.97	1.73	0.76	0.71	0.77	0.76	0.76	2,326	147	172	b
07/31/2015	0.97	1.79	0.77	0.71	0.77	0.75	0.76	2,242	147	171	b
08/01/2015	0.96	1.79	0.75	0.71	0.77	0.74	0.76	2,201	147	171 e	b
08/02/2015	0.95	1.77	0.73	0.71	0.76	0.73	0.76	2,156	147	171 e	b
08/03/2015	0.94	1.72	0.72	0.71	0.75	0.72	0.75	2,148	147	169	b
08/04/2015	0.93	1.66	0.71	0.70	0.75	0.72	0.75	2,019	146	167	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta conditions
- r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	mdEC	30dm	mdEC	30dm	mdEC	30dm	mdEC	30dm
07/06/2015	0.74	0.69	1.16	1.05	0.96	1.04	1.17	1.05
07/07/2015	0.87	0.70	1.14	1.05	0.96	1.04	1.17	1.06
07/08/2015	0.98	0.71	1.13	1.06	0.96	1.04	1.15	1.07
07/09/2015	0.66	0.71	1.13	1.07	0.95	1.03	1.12	1.09
07/10/2015	0.59	0.70	1.12	1.08	0.96	1.03	1.11	1.10
07/11/2015	0.57	0.70	1.12	1.08	0.95	1.03	1.11	1.11
07/12/2015	0.57	0.69	1.11	1.09	0.93	1.03	1.11	1.12
07/13/2015	0.56	0.69	1.10	1.09	0.92	1.02	1.11	1.13
07/14/2015	0.53	0.69	1.09	1.10	0.93	1.02	1.11	1.14
07/15/2015	0.52	0.68	1.08	1.10	0.95	1.02	1.12	1.15
07/16/2015	0.66	0.68	1.08	1.10	0.99	1.01	1.12	1.16
07/17/2015	0.78	0.68	1.08	1.10	0.99	1.01	1.11	1.16
07/18/2015	0.78	0.68	1.09	1.10	0.98	1.01	1.11	1.17
07/19/2015	0.75	0.68	1.08	1.10	0.96	1.01	1.11	1.17
07/20/2015	0.61	0.68	1.07	1.10	0.95	1.01	1.11	1.17
07/21/2015	0.83	0.69	1.07	1.10	0.95	1.01	1.11	1.16
07/22/2015	0.75	0.69	1.08	1.10	0.95	1.00	1.10	1.16
07/23/2015	0.55	0.68	1.08	1.10	0.98	1.00	1.11	1.15
07/24/2015	0.41	0.67	1.06	1.11	1.01	1.00	1.11	1.15
07/25/2015	0.54	0.67	1.06	1.11	1.06	0.99	1.12	1.14
07/26/2015	0.74	0.67	1.07	1.11	1.04	0.99	1.12	1.14
07/27/2015	0.80	0.67	1.07	1.11	1.01	0.99	1.11	1.13
07/28/2015	0.94	0.68	1.07	1.11	1.01	0.99	1.12	1.13
07/29/2015	0.87	0.69	1.08	1.10	0.97	0.99	1.09	1.13
07/30/2015	0.93	0.70	1.09	1.10	0.95	0.98	1.11	1.12
07/31/2015	0.71	0.71	1.10	1.10	0.93	0.98	1.11	1.12
08/01/2015	0.51	0.70	1.10	1.10	0.94	0.98	1.10	1.12
08/02/2015	0.36	0.68	1.10	1.10	0.94	0.97	1.09	1.12
08/03/2015	0.45	0.67	1.09	1.10	0.96	0.97	1.09	1.12
08/04/2015	0.54	0.67	1.08	1.09	0.98	0.97	1.09	1.11

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
30dm : thirty day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Suisun Marsh Stations

Date	Collinvsille mhtEC	National Steel mhtEC	Beldon Landing mhtEC	Sunrise Club mhtEC	Volanti Slough mhtEC	Goodyear Slough mhtEC
07/06/2015	12.99	14.39	19.31	18.29	15.86	21.77
07/07/2015	12.38	14.26	19.12	18.46	15.92	21.97
07/08/2015	12.80	14.67	18.96	18.64	16.18	22.09
07/09/2015	12.49	14.71	18.96	18.84	16.56	22.16
07/10/2015	11.91	14.67	19.26	18.82	16.76	22.09
07/11/2015	12.00	14.63	19.44	19.00	17.05	21.94
07/12/2015	12.67	14.90	19.47	19.25	17.15	21.90
07/13/2015	12.06	14.79	19.87	19.36	17.60	21.69
07/14/2015	12.37	14.77	19.77	19.55	18.11	21.61
07/15/2015	12.58	15.16	20.14	18.74	18.23	21.59
07/16/2015	13.14	15.75	20.37	18.11	19.02	21.34
07/17/2015	13.01	15.78	20.27	20.12	19.67	21.33
07/18/2015	13.34	15.42	20.23	20.32	19.62	21.29
07/19/2015	11.27	15.56	19.83	20.17	19.01	21.39
07/20/2015	11.06	15.59	19.76	21.02	18.84	21.44
07/21/2015	12.02	15.79	19.95	22.67	18.98	21.28
07/22/2015	11.81	16.12	20.02	21.55	19.15	21.18
07/23/2015	10.37	16.13	20.01	20.92	18.81	21.21
07/24/2015	10.00	15.77	19.83	20.63	18.57	21.39
07/25/2015	10.88	15.30	19.75	20.29	18.53	21.46
07/26/2015	12.05	14.95	19.99	19.99	19.04	21.22
07/27/2015	10.81	14.55	20.02	19.85	19.08	21.08
07/28/2015	11.89	14.61	19.94	19.64	19.04	21.05
07/29/2015	11.73	15.18	20.10	19.58	18.96	20.94
07/30/2015	13.36	15.42	20.08	19.43	19.31	20.73
07/31/2015	13.71	15.47	20.10	20.25	19.23	20.90
08/01/2015	13.60	15.73	20.14	21.31	19.31	21.04
08/02/2015	13.09	16.37	20.22	21.19	19.53	21.26
08/03/2015	12.77	16.59	20.11	21.00	19.58	21.45
08/04/2015	12.03	16.18	20.32	20.76	19.33	21.51

Electrical Conductivity (EC) units: milliSiemens per Centimeter
mht : mean high tides
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, September 11, 2014

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	30 %
NDOI, monthly average *	>= 3,000 cfs	3,405 cfs
NDOI, 7 day average*	>= 2,000 cfs	3,649 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	223 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	141 mg/l
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	0.4 mS/cm
Brandt Bridge	<=1.0 mS/cm	0.7 mS/cm
Old River Near Tracy	<=1.0 mS/cm	1.1 mS/cm
Old River Near Middle River	<=1.0 mS/cm	0.6 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2014)

Previous Month's Index (8RI for Apr): 1.712 MAF
Water Year Type: Critical
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.1 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 14 day average is progressive daily mean for the first thirteen days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
08/13/2014	6.09	4.39	2,509	29.95	20.99	19.91	13.40	13.26	12.78	7.15	6.20
08/14/2014	6.01	4.27	1,907	29.08	20.17	20.08	12.97	12.79	12.81	6.89	6.35
08/15/2014	6.10	4.28	3,475	28.37	20.41	20.11	12.92	12.74	12.86	6.93	6.48
08/16/2014	6.18	4.31	2,464	-- NR	19.66	20.12	12.81	12.62	12.89	6.96	6.59
08/17/2014	6.31	4.40	1,818	-- NR	20.45	20.21	13.22	13.07	12.94	7.23	6.70
08/18/2014	6.44	4.54	2,794	-- NR	21.36	20.32	13.78	13.67	13.10	7.62	6.83
08/19/2014	6.47	4.57	2,840	-- NR	21.50	20.45	13.98	13.89	13.25	7.88	6.99
08/20/2014	6.34	4.57	2,449	-- NR	21.07	20.61	14.02	13.94	13.40	7.90	7.15
08/21/2014	6.38	4.47	3,343	-- NR	18.20	20.38	13.21	13.05	13.36	7.44	7.22
08/22/2014	6.36	4.56	3,300	-- NR	21.03	20.43	13.81	13.71	13.38	7.81	7.29
08/23/2014	6.39	4.53	2,636	-- NR	19.61	20.28	13.74	13.63	13.36	7.74	7.34
08/24/2014	6.39	4.61	4,311	-- NR	19.71	20.32	14.05	13.98	13.41	8.09	7.43
08/25/2014	6.34	4.58	3,508	-- NR	21.91	20.58	14.08	14.01	13.45	8.02	7.50
08/26/2014	6.12	4.40	3,081	-- NR	20.66	20.48	13.10	12.94	13.38	7.68	7.52
08/27/2014	5.83	4.24	3,393	-- NR	20.44	20.44	12.54	12.32	13.31	7.42	7.54
08/28/2014	5.65	4.27	3,105	-- NR	19.97	20.43	12.47	12.24	13.27	7.52	7.59
08/29/2014	5.78	4.34	2,788	-- NR	19.50	20.36	12.40	12.17	13.23	7.74	7.64
08/30/2014	5.92	4.27	3,417	-- NR	19.47	20.35	12.34	12.10	13.19	7.42	7.68
08/31/2014	5.96	4.27	2,807	-- NR	19.58	20.29	12.21	11.96	13.12	7.41	7.69
09/01/2014	6.11	4.29	3,183	-- NR	19.66	20.16	11.79	11.51	12.96	7.04	7.65
09/02/2014	6.43	4.57	3,268	31.28	21.42	20.16	13.35	13.21	12.91	8.05	7.66
09/03/2014	6.61	4.68	2,410	30.51	21.46	20.19	13.73	13.63	12.89	8.45	7.70
09/04/2014	6.82	4.87	3,055	30.61	22.29	20.48	14.43	14.39	12.99	8.77	7.80
09/05/2014	6.63	4.76	3,975	30.65	22.18	20.56	14.62	14.60	13.05	8.97	7.88
09/06/2014	6.72	4.61	3,018	29.77	20.90	20.65	14.15	14.09	13.08	8.69	7.95
09/07/2014	6.63	4.58	2,782	29.84	18.71	20.58	14.24	14.18	13.10	8.72	7.99
09/08/2014	6.55	4.62	4,957	30.28	21.40	20.54	14.57	14.54	13.13	9.01	8.06
09/09/2014	6.37	4.45	4,140	29.44	16.65	20.26	13.82	13.72	13.19	8.42	8.12
09/10/2014	6.14	4.42	2,798	29.27	20.13	20.24	13.44	13.30	13.26	8.02	8.16
09/11/2014	6.35	4.55	3,870	29.18	18.27	20.11	13.77	13.66	13.36	8.40	8.22

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
08/13/2014	4.97	NC	1.39	1.26	1.17	1.14	0.40	18.53	16.32	17.38	17.93	8.22
08/14/2014	4.74	NC	1.32	1.27	1.16	1.16	0.46	18.56	16.36	17.84	17.73	7.52
08/15/2014	4.80	NC	1.33	1.28	1.17	1.17	0.51	18.72	16.40	17.93	17.64	7.72
08/16/2014	4.75	NC	1.31	1.29	1.18	1.19	0.49	18.65	16.43	17.82	17.61	8.09
08/17/2014	4.98	NC	1.37	1.30	1.23	1.21	0.47	18.58	16.43	17.80	17.78	8.29
08/18/2014	5.15	NC	1.50	1.33	1.31	1.24	0.44	18.56	16.48	17.83	17.81	8.45
08/19/2014	5.32	NC	1.52	1.35	1.44	1.27	0.42	18.61	16.55	17.48	17.91	8.72
08/20/2014	5.47	NC	1.60	1.39	1.51	1.31	0.47	18.58	16.59	17.47	17.84	8.55
08/21/2014	5.14	NC	1.46	1.40	1.40	1.31	0.55	18.72	16.58	17.83	17.81	8.52
08/22/2014	5.26	NC	1.44	1.41	1.37	1.31	0.57	18.71	16.60	17.67	18.01	8.15
08/23/2014	5.17	NC	1.45	1.41	1.40	1.31	0.55	18.73	16.67	17.58	17.90	8.34
08/24/2014	5.43	5.05	1.49	1.42	1.47	1.31	0.49	18.71	16.80	17.54	18.01	8.79
08/25/2014	5.29	5.13	1.43	1.43	1.43	1.32	0.50	18.68	16.99	17.51	18.13	8.82
08/26/2014	4.81	5.09	1.27	1.42	1.19	1.32	0.49	18.83	16.99	17.13	18.10	8.29
08/27/2014	4.41	5.05	1.18	1.41	1.05	1.31	0.46	18.98	16.98	17.03	18.09	8.53
08/28/2014	4.41	5.03	1.15	1.39	0.99	1.30	0.46	19.06	17.01	17.78	17.86	8.23
08/29/2014	4.46	5.00	1.20	1.38	0.96	1.28	0.47	18.99	18.13	18.43	18.12	8.80
08/30/2014	4.41	4.98	1.19	1.38	0.92	1.26	0.48	18.96	18.78	18.42	18.17	8.36
08/31/2014	4.37	4.93	1.13	1.36	0.89	1.24	0.44	18.92	18.30	18.31	18.15	8.56
09/01/2014	4.47	4.89	1.17	1.33	0.88	1.21	0.45	18.79	17.99	18.16	18.09	8.18
09/02/2014	5.03	4.87	1.33	1.32	1.03	1.18	0.46	18.49	17.77	17.90	18.15	9.32
09/03/2014	5.18	4.85	1.44	1.31	1.14	1.15	0.48	18.27	17.55	18.02	18.07	10.01
09/04/2014	5.59	4.88	1.57	1.32	1.25	1.14	0.47	17.98	17.33	18.07	18.13	10.12
09/05/2014	5.67	4.91	1.63	1.33	1.47	1.15	0.50	17.88	17.18	17.94	17.70	9.97
09/06/2014	5.35	4.92	1.53	1.34	1.32	1.14	0.50	17.89	16.99	17.49	17.30	10.66
09/07/2014	5.34	4.91	1.49	1.34	1.25	1.13	0.46	17.95	16.59	17.24	16.36	10.22
09/08/2014	5.55	4.93	1.53	1.34	1.30	1.12	0.45	17.96	16.19	16.63	15.34	10.73
09/09/2014	5.00	4.95	1.35	1.35	1.19	1.12	0.45	18.13	15.36	15.29	13.63	10.13
09/10/2014	5.01	4.99	1.35	1.36	1.17	1.13	0.44	17.83	14.48	14.25	12.68	9.86
09/11/2014	5.33	5.05	1.41	1.38	1.29	1.15	0.45	16.98	13.80	14.07	12.03	10.77

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
08/13/2014	2.68	0.73	0.81	0.66	0.61	0.88	0.56	0.58	1,513	123	124	b
08/14/2014	2.42	0.74	0.79	0.66	0.62	0.88	0.56	0.57	1,438	123	126	b
08/15/2014	2.40	0.78	0.78	0.67	0.62	0.88	0.56	0.56	1,458	124	127	b
08/16/2014	2.32	0.76	0.81	0.67	0.62	0.88	0.56	0.58	1,444	125	127	b
08/17/2014	2.43	0.81	0.84	0.68	0.63	0.89	0.56	0.57	1,516	126	128	b
08/18/2014	2.72	0.78	0.82	0.67	0.63	0.90	0.55	0.55	1,569	126	128	b
08/19/2014	3.03	0.82	0.81	0.66	0.63	0.86	0.56	0.56	1,623	126	128	b
08/20/2014	3.15	0.79	0.77	0.68	0.63	0.90	0.57	0.57	1,672	125	130	b
08/21/2014	2.78	0.83	0.75	0.68	0.63	0.90	0.57	0.58	1,566	126	130	b
08/22/2014	2.83	0.79	0.75	0.70	0.63	0.90	0.57	0.58	1,606	127	131	b
08/23/2014	2.93	0.82	0.70	0.62	0.64	0.90	0.57	0.58	1,578	129	131	b
08/24/2014	3.03	0.83	0.67	0.70	0.64	0.91	0.56	0.60	1,659	130	132	b
08/25/2014	3.11	0.80	0.66	0.70	0.64	0.91	0.57	0.59	1,615	130	133	b
08/26/2014	2.64	0.83	0.66	0.70	0.65	0.91	0.57	0.58	1,463	131	132	b
08/27/2014	2.14	0.82	0.66	0.69	0.65	0.91	0.57	0.61	1,335	133	134	b
08/28/2014	2.16	0.70	0.68	0.68	0.66	0.91	0.57	0.59	1,335	133	134	b
08/29/2014	2.09	0.80	0.67	0.65	0.66	0.91	0.57	0.57	1,350	135	135	b
08/30/2014	1.98	0.80	0.63	0.65	0.67	0.91	0.56	0.55	1,335	136	139	b
08/31/2014	1.77	0.79	0.59	0.63	0.66	0.91	0.55	0.57	1,321	136	140	b
09/01/2014	1.65	0.76	0.62	0.63	0.66	0.91	0.56	0.57	1,355	135	139	b
09/02/2014	2.16	0.78	0.69	0.65	0.65	0.91	0.57	0.56	1,531	133	139	b
09/03/2014	2.39	0.79	0.76	0.59	0.65	0.90	0.57	0.57	1,580	131	137	b
09/04/2014	2.65	0.76	0.94	0.62	0.64	0.90	0.57	0.57	1,710	130	138	b
09/05/2014	2.76	0.81	1.03	0.67	0.64	0.91	0.57	0.56	1,736	129	139	b
09/06/2014	2.52	0.82	1.04	0.68	0.64	0.92	0.56	0.56	1,633	128	139 e	b
09/07/2014	2.65	0.81	1.05	0.69	0.64	0.92	NR	0.57	1,632	128	139 e	b
09/08/2014	2.88	0.82	1.07	0.69	0.64	0.92	NR	0.60	1,698	129	140	b
09/09/2014	2.62	0.79	1.03	0.69	0.64	0.91	NR	0.58	1,521	129	142	b
09/10/2014	2.48	0.80	1.01	0.69	0.64	0.90	0.56	0.58	1,524	130	141	b
09/11/2014	2.72	0.77	1.01	0.70	0.65	0.91	NR	0.57	1,626	132	141	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
08/13/2014	0.36	0.32	0.68	0.70	1.16	1.16	0.56	0.78
08/14/2014	0.40	0.33	0.68	0.70	1.19	1.16	0.54	0.77
08/15/2014	0.40	0.33	0.69	0.70	1.22	1.17	0.54	0.75
08/16/2014	0.40	0.33	0.70	0.70	1.19	1.18	0.55	0.74
08/17/2014	0.38	0.34	0.71	0.69	1.22	1.19	0.55	0.73
08/18/2014	0.40	0.34	0.73	0.69	1.26	1.20	0.56	0.72
08/19/2014	0.42	0.34	0.74	0.69	1.26	1.21	0.56	0.71
08/20/2014	0.44	0.35	0.75	0.69	1.27	1.22	0.55	0.70
08/21/2014	0.44	0.35	0.74	0.70	1.23	1.23	0.55	0.69
08/22/2014	0.47	0.36	0.74	0.70	1.16	1.24	0.56	0.68
08/23/2014	0.45	0.36	0.74	0.70	1.09	1.24	0.57	0.67
08/24/2014	0.44	0.37	0.74	0.70	1.08	1.24	0.58	0.66
08/25/2014	0.44	0.37	0.73	0.70	1.01	1.23	0.59	0.66
08/26/2014	0.42	0.37	0.71	0.70	0.96	1.23	0.59	0.65
08/27/2014	0.43	0.38	0.68	0.70	0.95	1.22	0.59	0.64
08/28/2014	0.45	0.38	0.66	0.70	0.94	1.20	0.58	0.64
08/29/2014	0.42	0.39	0.65	0.70	0.94	1.19	0.59	0.63
08/30/2014	0.48	0.39	0.65	0.70	0.94	1.18	0.62	0.63
08/31/2014	0.48	0.40	0.64	0.69	0.94	1.16	0.64	0.63
09/01/2014	0.46	0.40	0.64	0.69	0.99	1.15	0.63	0.63
09/02/2014	0.55	0.41	0.65	0.69	1.06	1.14	0.62	0.62
09/03/2014	0.56	0.42	0.65	0.69	1.04	1.13	0.63	0.62
09/04/2014	0.50	0.42	0.66	0.69	1.03	1.12	0.63	0.61
09/05/2014	0.45	0.43	0.70	0.69	1.00	1.11	0.64	0.61
09/06/2014	0.42	0.43	0.70	0.69	0.96	1.09	0.64	0.61
09/07/2014	0.38	0.43	0.70	0.69	0.96	1.08	0.64	0.60
09/08/2014	0.40	0.43	0.69	0.69	0.95	1.08	0.65	0.60
09/09/2014	0.48	0.43	0.68	0.69	0.91	1.07	0.65	0.59
09/10/2014	0.46	0.44	0.66	0.69	0.94	1.07	0.66	0.59
09/11/2014	0.58	0.44	0.67	0.69	1.08	1.06	0.64	0.60

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, December 11, 2014

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	51 %
NDOI, monthly average *	>= 4,500 cfs	16,956 cfs
NDOI, 7 day average*	>= 3,500 cfs	20,811 cfs
Rio Vista flow, monthly average *	>= 4,500 cfs	16,058 cfs
Rio Vista flow, 7 day average*	>= 3,500 cfs	20,424 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	310 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	150 mg/l
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	0.6 mS/cm
Brandt Bridge	<=1.0 mS/cm	0.6 mS/cm
Old River Near Tracy	<=1.0 mS/cm	0.7 mS/cm
Old River Near Middle River	<=1.0 mS/cm	mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, December 1, 2014)

Previous Month's Index (8RI for Nov): 0.46 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%: 5.6 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.4 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
11/12/2014	5.62	4.26	5,109	27.60	14.18	16.60	13.01	12.84	13.56	8.67	9.20
11/13/2014	5.30	3.75	4,812	26.52	14.37	16.15	11.89	11.62	13.36	7.84	9.07
11/14/2014	5.30	3.97	5,733	26.31	13.89	15.70	12.86	12.67	13.19	8.02	8.90
11/15/2014	5.33	3.79	5,818	26.16	12.32	15.03	12.50	12.28	12.99	7.85	8.72
11/16/2014	5.21	3.54	5,573	25.76	11.40	14.42	11.43	11.13	12.82	7.25	8.56
11/17/2014	5.26	3.51	5,480	26.61	11.80	14.10	11.85	11.57	12.73	7.43	8.46
11/18/2014	5.51	3.68	4,870	27.83	11.69	13.84	12.88	12.69	12.74	8.27	8.44
11/19/2014	5.97	3.97	3,357	29.37	12.58	13.61	14.09	14.02	12.85	9.45	8.52
11/20/2014	6.07	4.05	4,423	29.80	13.02	13.49	14.98	14.99	12.99	9.92	8.60
11/21/2014	6.17	4.09	4,271	29.93	13.39	13.40	15.09	15.12	13.12	10.33	8.70
11/22/2014	6.47	4.25	4,450	30.26	14.62	13.46	15.83	15.94	13.33	10.60	8.84
11/23/2014	6.12	3.92	5,015	29.01	13.53	13.47	14.75	14.74	13.44	10.25	8.95
11/24/2014	5.97	3.81	5,361	28.74	13.74	13.34	13.98	13.90	13.44	9.52	8.95
11/25/2014	5.71	3.69	4,553	28.09	17.38	13.42	13.59	13.47	13.36	9.04	8.89
11/26/2014	5.74	3.76	4,714	28.50	20.97	13.91	13.77	13.66	13.42	8.95	8.91
11/27/2014	5.66	3.90	3,825	28.93	21.40	14.41	14.45	14.41	13.61	9.33	9.02
11/28/2014	5.59	4.03	3,016	28.38	22.26	15.01	15.00	15.02	13.78	9.97	9.15
11/29/2014	5.81	4.18	2,892	28.29	22.16	15.71	15.39	15.46	14.01	10.29	9.33
11/30/2014	5.91	4.06	3,297	28.42	21.90	16.46	15.04	15.06	14.29	10.13	9.53
12/01/2014	5.87	3.92	5,770	28.18	21.44	17.15	14.48	14.45	14.49	9.98	9.72
12/02/2014	6.27	4.22	5,410	28.46	21.96	17.88	15.17	15.21	14.67	10.28	9.86
12/03/2014	7.13	4.89	11,695	29.64	19.93	18.41	16.92	17.16	14.90	10.97	9.97
12/04/2014	7.05	4.86	17,961	29.14	22.34	19.07	15.41	15.48	14.93	9.95	9.97
12/05/2014	6.90	4.73	22,572	27.88	20.73	19.60	13.84	13.74	14.84	8.58	9.85
12/06/2014	6.80	4.71	26,063	26.61	19.25	19.93	12.11	11.86	14.54	7.25	9.61
12/07/2014	6.65	4.50	32,406	24.73	17.01	20.18	9.68	9.26	14.15	5.16	9.24
12/08/2014	6.52	4.51	23,448	23.85	14.88	20.26	8.55	8.07	13.74	4.13	8.86
12/09/2014	6.25	4.43	16,919	22.51	10.68	19.78	7.21	6.68	13.25	3.37	8.45
12/10/2014	6.13	4.42	14,101	22.13	9.36	18.95	6.95	6.42	12.73	2.94	8.02
12/11/2014	6.74	5.23	10,167	24.82	13.55	18.39	8.57	8.09	12.28	3.27	7.59

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
11/12/2014	5.25	5.74	1.50	1.59	1.71	1.81	0.78	18.27	15.33	16.35	16.40	9.45
11/13/2014	4.65	5.62	1.37	1.56	1.63	1.76	0.78	19.06	15.32	15.77	15.85	8.43
11/14/2014	4.96	5.49	1.23	1.52	1.36	1.69	0.79	19.97	15.30	15.81	16.34	8.87
11/15/2014	4.72	5.35	1.17	1.47	1.19	1.61	0.80	20.31	15.11	15.89	16.16	9.50
11/16/2014	4.27	5.26	1.08	1.45	1.07	1.56	0.80	20.65	15.39	15.83	15.85	8.81
11/17/2014	4.43	5.20	1.09	1.42	1.11	1.52	0.79	20.64	15.34	15.85	15.96	9.09
11/18/2014	5.00	5.18	1.18	1.41	1.27	1.51	0.78	20.16	15.31	15.91	16.46	9.19
11/19/2014	6.02	5.24	1.44	1.41	1.65	1.52	0.75	19.26	15.37	15.89	16.66	10.45
11/20/2014	6.46	5.31	1.58	1.41	1.94	1.55	0.76	18.77	15.38	16.94	16.85	11.49
11/21/2014	6.52	5.38	1.67	1.42	2.17	1.60	0.75	18.41	15.39	17.86	16.81	12.35
11/22/2014	7.35	5.51	2.00	1.45	2.61	1.67	0.74	18.57	15.51	17.59	17.06	11.74
11/23/2014	6.50	5.58	1.67	1.46	2.01	1.69	0.82	18.75	15.43	17.34	16.86	11.74
11/24/2014	6.10	5.59	1.63	1.45	1.96	1.69	0.75	19.23	15.50	17.07	16.97	10.97
11/25/2014	5.93	5.58	1.60	1.44	1.83	1.68	0.66	19.50	15.32	16.79	17.03	10.24
11/26/2014	6.03	5.64	1.70	1.46	1.91	1.69	0.62	19.64	15.12	16.75	17.07	10.19
11/27/2014	6.37	5.76	1.83	1.49	2.06	1.72	0.64	19.45	15.21	16.72	17.08	10.80
11/28/2014	6.78	5.89	2.07	1.55	2.31	1.79	0.69	19.11	15.32	16.60	17.20	11.77
11/29/2014	7.21	6.07	2.21	1.63	2.56	1.89	0.73	18.31	15.38	16.77	17.34	12.24
11/30/2014	7.13	6.27	2.15	1.70	2.49	1.99	0.81	18.27	15.25	16.45	17.24	11.96
12/01/2014	6.87	6.45	2.00	1.77	2.32	2.08	0.74	18.45	NR	16.27	17.26	11.78
12/02/2014	7.22	6.61	2.21	1.84	2.44	2.16	0.62	17.94	14.88	16.30	17.29	12.33
12/03/2014	8.87	6.81	3.15	1.96	3.29	2.28	0.35	16.70	13.72	15.59	17.21	12.83
12/04/2014	8.51	6.96	3.11	2.07	2.76	2.34	0.36	16.58	12.67	16.53	17.16	12.68
12/05/2014	7.48	7.03	2.74	2.15	1.66	2.30	0.44	16.32	11.36	17.14	16.71	10.90
12/06/2014	6.36	6.95	2.52	2.19	1.05	2.19	0.48	16.19	12.47	16.58	16.35	9.06
12/07/2014	4.96	6.84	2.12	2.22	0.81	2.10	0.54	16.04	11.74	15.63	15.82	6.69
12/08/2014	4.09	6.70	1.94	2.24	0.72	2.01	0.59	16.76	11.76	14.81	16.16	5.54
12/09/2014	3.40	6.52	1.77	2.25	0.66	1.93	0.61	16.62	11.91	14.09	16.44	4.04
12/10/2014	2.96	6.30	1.75	2.26	0.58	1.84	0.64	16.75	11.80	13.59	16.21	3.86
12/11/2014	3.53	6.10	2.11	2.28	0.57	1.73	0.54	15.16	11.81	13.34	15.09	3.97

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
11/12/2014	3.32	0.94	1.06	0.77	0.77	0.86	0.61	0.59	1,602	164	150 e	b
11/13/2014	3.21	0.92	1.04	0.76	0.77	0.84	0.60	0.57	1,410	163	150 e	b
11/14/2014	2.93	0.91	1.02	0.75	0.77	0.85	0.65	0.57	1,509	162	150 e	b
11/15/2014	2.41	0.90	1.01	0.75	0.76	0.85	0.68	0.57	1,434	161	150 e	b
11/16/2014	1.93	0.90	0.99	0.76	0.76	0.85	0.68	0.58	1,290	161	150 e	b
11/17/2014	2.16	0.87	0.99	0.75	0.76	0.84	0.69	0.59	1,341	161	150 e	b
11/18/2014	2.46	0.81	0.99	0.74	0.76	0.84	0.71	0.65	1,522	160	150 e	b
11/19/2014	3.43	0.76	1.00	0.73	0.75	0.84	0.72	0.62	1,847	158	150 e	b
11/20/2014	3.92	0.83	0.99	0.72	0.74	0.83	0.71	0.65	1,988	156	150 e	b
11/21/2014	4.33	0.83	0.99	0.71	0.73	0.83	0.69	0.65	2,005	153	150 e	b
11/22/2014	4.85	0.81	1.00	0.69	0.72	0.79	0.69	0.65	2,272	150	150 e	b
11/23/2014	4.01	0.84	0.98	0.69	0.71	0.82	0.68	0.65	1,999	147	150 e	b
11/24/2014	3.81	0.84	0.97	0.68	0.70	0.81	0.68	0.62	1,874	144	150 e	b
11/25/2014	3.58	0.84	0.96	0.68	0.68	0.81	0.66	0.65	1,820	140	150 e	b
11/26/2014	3.60	0.85	0.97	0.68	0.67	0.80	0.66	0.65	1,851	138	150 e	b
11/27/2014	3.92	0.86	0.98	0.68	0.66	0.81	0.65	0.64	1,960	135	150 e	b
11/28/2014	4.29	0.88	1.00	0.68	0.66	0.80	0.64	0.63	2,088	134	150 e	b
11/29/2014	4.47	0.94	1.02	0.67	0.66	0.80	0.63	0.62	2,226	133	150 e	b
11/30/2014	4.56	0.97	1.01	0.67	0.65	0.79	0.62	0.63	2,202	133	150 e	b
12/01/2014	4.02	1.00	1.00	0.67	0.65	0.79	0.62	0.63	2,117	132	150 e	b
12/02/2014	4.29	1.06	1.03	0.68	0.65	0.75	0.60	0.63	2,230	132	150 e	b
12/03/2014	5.54	1.18	1.13	0.69	0.65	0.70	0.60	0.64	2,756	132	150 e	b
12/04/2014	4.29	1.23	1.17	0.71	0.65	0.67	0.61	0.63	2,640	133	150 e	b
12/05/2014	3.15	1.30	1.19	0.75	0.66	0.67	0.59	0.63	2,312	136	150 e	b
12/06/2014	1.27	1.37	1.22	0.78	0.69	0.65	0.58	0.62	1,957	141	150 e	b
12/07/2014	0.79	1.38	1.22	0.82	0.71	0.64	0.59	0.61	1,510	147	150 e	b
12/08/2014	0.68	1.36	1.25	0.86	0.74	0.64	0.59	0.60	1,231	156	150 e	b
12/09/2014	0.55	1.32	1.26	0.91	0.77	0.64	0.58	0.58	1,013	165	150 e	b
12/10/2014	0.55	1.27	1.28	0.90	0.81	0.63	0.60	0.58	874	174	150 e	b
12/11/2014	0.88	1.25	1.35	0.89	0.82	0.63	0.62	0.58	1,055	175	150 e	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
11/12/2014	0.52	0.36	0.42	0.40	0.52	0.85	0.46	0.42
11/13/2014	0.54	0.36	0.44	0.40	0.55	0.84	0.50	0.42
11/14/2014	0.54	0.36	0.45	0.39	0.62	0.83	0.54	0.41
11/15/2014	0.53	0.36	0.47	0.39	0.67	0.83	0.57	0.41
11/16/2014	0.53	0.36	0.49	0.39	0.68	0.82	0.57	0.41
11/17/2014	0.53	0.37	0.50	0.39	0.72	0.82	0.56	0.41
11/18/2014	0.52	0.37	0.51	0.38	0.74	0.81	0.57	0.41
11/19/2014	0.52	0.37	0.51	0.38	0.77	0.81	0.57	0.42
11/20/2014	0.53	0.37	0.51	0.38	0.76	0.81	0.56	0.42
11/21/2014	0.54	0.38	0.52	0.38	0.73	0.80	0.55	0.42
11/22/2014	0.56	0.39	0.54	0.38	0.71	0.80	0.55	0.42
11/23/2014	0.59	0.40	0.53	0.38	0.72	0.79	0.56	0.41
11/24/2014	0.61	0.41	0.54	0.37	0.70	0.78	0.57	0.41
11/25/2014	0.62	0.42	0.54	0.37	0.72	0.77	0.59	0.42
11/26/2014	0.62	0.43	0.55	0.38	0.74	0.77	0.62	0.42
11/27/2014	0.64	0.44	0.56	0.39	0.76	0.76	0.62	0.43
11/28/2014	0.66	0.45	0.58	0.40	0.75	0.75	NR	NC
11/29/2014	0.68	0.47	0.59	0.41	0.75	0.74	NR	NC
11/30/2014	0.68	0.48	0.59	0.42	0.75	0.73	NR	NC
12/01/2014	0.63	0.50	0.58	0.43	0.76	0.72	0.67	NC
12/02/2014	0.61	0.51	0.57	0.44	0.80	0.71	0.67	NC
12/03/2014	0.58	0.52	0.58	0.46	0.85	0.70	0.62	NC
12/04/2014	0.51	0.53	0.59	0.47	0.82	0.70	0.61	NC
12/05/2014	0.56	0.54	0.59	0.48	0.73	0.69	0.59	NC
12/06/2014	0.61	0.55	0.61	0.50	0.69	0.69	0.52	NC
12/07/2014	0.64	0.56	0.61	0.51	0.68	0.69	0.55	NC
12/08/2014	0.72	0.57	0.63	0.52	0.66	0.70	0.60	NC
12/09/2014	0.88	0.59	0.65	0.53	0.65	0.70	0.63	NC
12/10/2014	0.91	0.60	0.71	0.54	0.69	0.71	0.67	NC
12/11/2014	0.81	0.61	0.84	0.56	0.79	0.72	0.80	NC

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Monday, January 05, 2015

Criteria	Standard		Status	
Flow/Operational				
% of inflow diverted	65	%	18	%
NDOI, monthly average *	>= 4,500	cfs	11,148	cfs
NDOI, 7 day average*	>= 3,500	cfs	11,148	cfs
Water Quality				
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155	days		days
Export Areas for SWP, CVP, CCWD, et al	<= 250	mg/l Cl		mg/l
14dm EC at Jersey Point	<= 2.20	mS/cm	0.33	mS/cm
Maximum 30 day running average of mean daily EC at:				
Vernalis	<=1.0	mS/cm	0.9	mS/cm
Brandt Bridge	<=1.0	mS/cm	0.9	mS/cm
Old River Near Tracy	<=1.0	mS/cm	1.1	mS/cm
Old River Near Middle River	<=1.0	mS/cm	0.9	mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, December 1, 2014)

Previous Month's Index (8RI for Nov): 0.46 MAF
Water Year Type: Dry
Sacramento valley water year type index (40/30/30) @ 50%: 5.6 MAF (Dry)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.4 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
12/07/2014	6.65	4.50	32,406	24.73	17.01	20.18	9.68	9.26	14.15	5.16	9.24
12/08/2014	6.52	4.51	23,448	23.85	14.88	20.26	8.55	8.07	13.74	4.13	8.86
12/09/2014	6.25	4.43	16,919	22.51	10.68	19.78	7.21	6.68	13.25	3.37	8.45
12/10/2014	6.13	4.42	14,101	22.13	9.36	18.95	6.95	6.42	12.73	2.94	8.02
12/11/2014	6.74	5.23	10,167	24.82	13.55	18.39	8.57	8.09	12.28	3.27	7.59
12/12/2014	6.33	4.93	25,695	19.25	13.35	17.75	6.86	6.33	11.66	2.87	7.08
12/13/2014	5.96	4.32	33,149	16.73	9.77	16.87	4.11	3.59	10.81	1.17	6.43
12/14/2014	5.81	4.16	45,427	14.83	7.00	15.80	2.48	2.06	9.89	0.63	5.75
12/15/2014	6.01	4.48	49,468	14.07	6.95	14.77	1.90	1.53	8.96	0.29	5.06
12/16/2014	6.67	4.88	60,179	13.76	6.14	13.64	1.77	1.42	7.98	0.26	4.34
12/17/2014	6.79	4.82	56,774	13.49	5.25	12.59	1.24	0.95	6.82	0.21	3.58
12/18/2014	6.90	4.80	51,404	10.83	3.01	11.21	0.85	0.63	5.76	0.22	2.88
12/19/2014	7.15	4.91	49,639	9.23	2.51	9.91	0.71	0.52	4.81	0.27	2.29
12/20/2014	7.15	4.93	50,919	7.10	1.62	8.65	0.61	0.44	4.00	0.25	1.79
12/21/2014	7.21	4.91	50,884	5.23	1.29	7.52	0.58	0.41	3.37	0.25	1.44
12/22/2014	6.91	4.67	47,468	3.74	0.83	6.52	0.53	0.38	2.82	0.23	1.16
12/23/2014	6.85	4.68	46,826	3.31	0.69	5.81	0.51	0.36	2.37	0.22	0.93
12/24/2014	7.13	4.93	45,175	3.45	0.73	5.19	0.48	0.34	1.93	0.22	0.74
12/25/2014	6.35	4.53	41,454	2.05	0.54	4.26	0.41	0.28	1.37	0.21	0.52
12/26/2014	5.77	4.27	36,676	2.48	0.46	3.34	0.38	0.26	0.94	0.22	0.33
12/27/2014	5.80	4.06	30,711	3.74	0.46	2.68	0.38	0.26	0.70	0.22	0.26
12/28/2014	5.83	3.93	26,911	5.42	0.60	2.22	0.36	0.24	0.57	0.23	0.23
12/29/2014	6.01	3.95	22,778	7.09	1.27	1.81	0.35	0.24	0.48	0.24	0.23
12/30/2014	6.29	3.76	19,102	7.63	1.57	1.49	0.38	0.26	0.40	0.25	0.23
12/31/2014	5.91	3.77	16,496	8.33	1.97	1.25	0.37	0.25	0.35	0.25	0.23
01/01/2015	6.34	4.07	14,652	11.50	3.41	1.28	0.74	0.54	0.34	0.28	0.24
01/02/2015	6.47	4.23	12,327	13.23	5.05	1.46	1.18	0.91	0.37	0.30	0.24
01/03/2015	6.37	4.24	10,567	-- NR	5.54	1.74	NR	-- NR		0.35	0.25
01/04/2015	6.22	4.05	9,481	-- NR	5.75	2.06	NR	-- NR		0.36	0.25
01/05/2015	6.02	3.94	8,715	13.82	5.84	2.42	1.82	1.46		0.43	0.27

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
12/07/2014	4.96	6.84	2.12	2.22	0.81	2.10	0.54	16.04	11.74	15.63	15.82	6.69
12/08/2014	4.09	6.70	1.94	2.24	0.72	2.01	0.59	16.76	11.76	14.81	16.16	5.54
12/09/2014	3.40	6.52	1.77	2.25	0.66	1.93	0.61	16.62	11.91	14.09	16.44	4.04
12/10/2014	2.96	6.30	1.75	2.26	0.58	1.84	0.64	16.75	11.80	13.59	16.21	3.86
12/11/2014	3.53	6.10	2.11	2.28	0.57	1.73	0.54	15.16	11.81	13.34	15.09	3.97
12/12/2014	2.73	5.81	1.64	2.25	0.68	1.61	0.28	13.44	2.63	8.67	14.94	3.84
12/13/2014	2.12	5.45	1.33	2.18	0.63	1.48	0.36	12.98	4.15	7.47	14.06	1.58
12/14/2014	1.70	5.06	1.17	2.11	0.50	1.33	0.45	13.18	5.16	7.99	13.71	0.84
12/15/2014	1.48	4.67	1.07	2.05	0.40	1.20	0.45	13.00	4.35	7.64	13.28	0.28
12/16/2014	1.31	4.25	1.00	1.96	0.30	1.04	0.34	11.33	3.20	6.69	12.25	0.28
12/17/2014	1.21	3.70	0.86	1.80	0.37	0.83	0.35	9.68	2.80	6.17	10.70	0.17
12/18/2014	1.06	3.17	0.74	1.63	0.38	0.66	0.46	9.23	4.82	7.47	9.79	0.24
12/19/2014	0.89	2.70	0.64	1.48	0.35	0.57	0.48	8.22	7.35	6.88	7.21	0.30
12/20/2014	0.78	2.30	0.56	1.34	0.33	0.52	0.37	7.90	5.65	6.02	7.04	0.25
12/21/2014	0.68	2.00	0.50	1.22	0.30	0.48	0.48	7.19	5.93	5.77	6.55	0.26
12/22/2014	0.60	1.75	0.43	1.11	0.28	0.45	0.58	7.25	5.95	5.22	5.97	0.23
12/23/2014	0.54	1.54	0.40	1.01	0.25	0.42	0.66	6.51	5.96	4.73	5.51	0.21
12/24/2014	0.50	1.37	0.39	0.92	0.24	0.40	0.70	5.48	5.68	4.41	4.79	0.21
12/25/2014	0.46	1.15	0.35	0.79	0.23	0.38	0.76	7.17	5.79	4.50	5.80	0.22
12/26/2014	0.41	0.98	0.33	0.70	0.23	0.34	0.77	7.90	6.12	4.68	5.68	0.21
12/27/2014	0.40	0.86	0.32	0.63	0.24	0.32	0.79	7.67	6.33	4.60	5.51	0.21
12/28/2014	0.38	0.76	0.32	0.56	0.25	0.30	0.84	7.81	6.47	4.45	5.18	0.23
12/29/2014	0.37	0.68	0.31	0.51	0.25	0.29	0.88	7.13	6.73	4.11	4.50	0.24
12/30/2014	0.37	0.62	0.31	0.46	0.27	0.28	0.87	8.88	5.93	4.40	4.37	0.24
12/31/2014	0.36	0.56	0.31	0.42	0.28	0.28	0.87	7.09	5.80	4.50	4.52	0.25
01/01/2015	0.36	0.51	0.32	0.39	0.28	0.27	0.86	5.91	5.51	4.17	4.25	0.31
01/02/2015	0.36	0.47	0.32	0.37	0.30	0.27	NR	4.73	5.40	4.25	4.35	0.33
01/03/2015	- - NR	NC	0.32	0.35	0.30	0.26	NR	4.65	5.45	e	e	0.36
01/04/2015	- - NR	NC	0.32	0.34	0.30	0.26	NR	5.56	5.34	4.17	e	0.35
01/05/2015	0.44	NC	0.32	0.33	0.31	0.27	NR	5.96	5.16	4.03	e	0.55

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
12/07/2014	0.79	1.38	1.22	0.82	0.71	0.64	0.59	0.61	1,510	147	150 e	b
12/08/2014	0.68	1.36	1.25	0.86	0.74	0.64	0.59	0.60	1,231	156	150 e	b
12/09/2014	0.55	1.32	1.26	0.91	0.77	0.64	0.58	0.58	1,013	165	150 e	c
12/10/2014	0.55	1.27	1.28	0.90	0.81	0.63	0.60	0.58	874	174	150 e	c
12/11/2014	0.88	1.25	1.35	0.89	0.82	0.63	0.62	0.58	1,055	175	150 e	c
12/12/2014	0.41	1.23	1.20	0.86	0.81	0.60	0.62	0.60	799	174	150 e	c
12/13/2014	0.34	1.21	1.17	0.85	0.81	0.57	0.65	0.62	606	175	150 e	c
12/14/2014	0.30	1.16	1.15	0.84	0.82	0.55	0.64	0.67	472	176	150 e	c
12/15/2014	0.21	1.09	1.13	0.80	0.80	0.54	0.62	0.68	403	172	150 e	r
12/16/2014	0.18	1.02	1.13	0.76	0.78	0.53	0.64	0.65	346	166	150 e	r
12/17/2014	0.24	1.01	1.10	0.73	0.76	0.52	0.62	0.64	314	160	150 e	r
12/18/2014	0.29	0.94	1.06	0.70	0.73	0.52	0.63	0.66	266	154	150 e	r
12/19/2014	0.28	0.82	1.03	0.68	0.71	0.54	0.67	0.69	215	149	150 e	r
12/20/2014	0.27	0.73	1.00	0.65	0.69	0.64	0.72	0.71	177	143	150 e	r
12/21/2014	0.26	0.65	0.96	0.59	0.67	0.65	0.74	0.74	148	137	150 e	r
12/22/2014	0.26	0.59	0.92	0.59	0.65	0.65	0.77	0.75	121	132	150 e	r
12/23/2014	0.23	0.51	NR	0.54	0.63	0.67	0.77	0.76	103	126	150 e	r
12/24/2014	0.22	0.46	NR	0.51	0.59	0.67	0.78	0.76	90	117	150 e	r
12/25/2014	0.21	0.50	NR	0.43	0.55	0.68	0.75	0.76	77	107	150 e	r
12/26/2014	0.20	0.41	NR	0.43	0.53	0.69	0.78	0.77	61	101	150 e	r
12/27/2014	0.20	0.36	NR	0.43	0.51	0.68	0.77	0.78	56	95	150 e	r
12/28/2014	0.21	0.34	NR	0.42	0.47	0.67	0.71	0.80	50	86	150 e	r
12/29/2014	0.22	0.33	NR	0.41	0.45	0.66	0.64	0.79	49	80	150 e	r
12/30/2014	0.23	0.33	0.61	0.33	0.43	0.67	0.61	0.80	48	74	NR	r
12/31/2014	0.25	0.32	0.57	0.35	0.41	0.68	0.59	0.78	46	69	NR	r
01/01/2015	0.26	0.31	0.56	0.35	0.39	0.67	0.54	0.79	43	63	NR	r
01/02/2015	0.26	0.31	0.53	0.35	0.38	0.69	0.53	0.80	45	60	NR	r
01/03/2015	0.28	0.31	0.51	0.35	0.38	0.68	0.52	0.79		60	NR	r
01/04/2015	0.28	0.31	0.50	0.35	0.37	0.67	0.53	0.70		59	NR	r
01/05/2015	0.29	0.32	0.50	0.35	0.37	0.71	0.51	0.66	71	58	NR	r

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
12/07/2014	0.64	0.56	0.61	0.51	0.68	0.69	0.55	NC
12/08/2014	0.72	0.57	0.63	0.52	0.66	0.70	0.60	NC
12/09/2014	0.88	0.59	0.65	0.53	0.65	0.70	0.63	NC
12/10/2014	0.91	0.60	0.71	0.54	0.69	0.71	0.67	NC
12/11/2014	0.81	0.61	0.84	0.56	0.79	0.72	0.80	NC
12/12/2014	0.64	0.62	0.90	0.58	0.83	0.73	0.78	NC
12/13/2014	0.45	0.61	0.89	0.59	0.83	0.73	0.74	NC
12/14/2014	0.47	0.61	0.85	0.60	1.01	0.75	0.49	NC
12/15/2014	0.59	0.61	0.81	0.62	0.93	0.76	0.43	NC
12/16/2014	0.70	0.62	0.79	0.63	0.93	0.76	0.52	NC
12/17/2014	0.82	0.63	0.67	0.63	0.84	0.77	0.61	NC
12/18/2014	0.85	0.64	0.59	0.63	0.77	0.77	0.71	NC
12/19/2014	0.91	0.65	0.68	0.64	0.84	0.77	0.81	NC
12/20/2014	1.00	0.67	0.79	0.65	0.97	0.78	0.82	NC
12/21/2014	1.01	0.69	0.80	0.66	1.01	0.79	0.91	NC
12/22/2014	1.09	0.70	0.85	0.67	1.04	0.80	0.96	NC
12/23/2014	1.17	0.72	0.92	0.68	1.12	0.81	0.99	NC
12/24/2014	1.18	0.74	0.94	0.69	1.19	0.83	1.07	NC
12/25/2014	1.17	0.76	0.97	0.71	1.21	0.85	1.12	NC
12/26/2014	1.17	0.78	1.05	0.72	1.30	0.86	1.13	NC
12/27/2014	1.18	0.80	1.11	0.74	1.50	0.89	1.13	NC
12/28/2014	1.18	0.81	1.12	0.76	1.55	0.92	1.14	NC
12/29/2014	1.18	0.83	1.13	0.78	1.58	0.94	1.16	NC
12/30/2014	1.17	0.85	1.14	0.80	1.53	0.97	1.15	0.79
12/31/2014	1.15	0.86	1.15	0.82	1.47	0.99	1.16	0.80
01/01/2015	1.13	0.88	1.15	0.84	1.55	1.02	1.15	0.82
01/02/2015	1.12	0.90	1.15	0.85	1.37	1.03	1.13	0.84
01/03/2015	1.07	0.92	1.15	0.87	1.32	1.05	1.13	0.85
01/04/2015	1.06	0.93	1.16	0.89	1.32	1.07	1.12	0.87
01/05/2015	1.08	0.95	1.16	0.91	1.33	1.09	1.09	0.89

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, February 03, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	45 %	33 %
NDOI, monthly average *	>= 4,000 cfs	6,057 cfs
NDOI, 7 day average*	>= 3,000 cfs	6,057 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	175 days	34 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	50 mg/l
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	1.0 mS/cm
Brandt Bridge	<=1.0 mS/cm	1.1 mS/cm
Old River Near Tracy	<=1.0 mS/cm	1.3 mS/cm
Old River Near Middle River	<=1.0 mS/cm	1.0 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, January 1, 2015)

Previous Month's Index (8RI for Dec): 2.91 MAF
Water Year Type: Below Normal
Sacramento valley water year type index (40/30/30) @ 50%: 6.7 MAF (Below Normal)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.4 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value s - substituted value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
01/05/2015	6.02	3.94	8,715	13.82	5.84	2.42	1.82	1.46	0.56	0.43	0.27
01/06/2015	5.96	4.00	8,622	14.43	6.47	2.83	1.97	1.59	0.65	0.51	0.29
01/07/2015	5.92	4.08	7,105	15.06	7.24	3.30	2.50	2.07	0.77	0.61	0.32
01/08/2015	5.77	4.12	6,622	15.93	8.07	3.84	3.04	2.57	0.93	0.82	0.36
01/09/2015	5.60	4.20	6,130	15.68	8.59	4.42	3.55	3.06	1.13	1.02	0.42
01/10/2015	5.47	4.14	6,049	15.68	9.29	5.05	3.89	3.39	1.36	1.20	0.49
01/11/2015	5.54	4.01	5,788	15.81	9.62	5.69	4.10	3.59	1.60	1.29	0.56
01/12/2015	5.43	3.75	5,675	15.83	9.74	6.30	3.94	3.43	1.82	1.45	0.65
01/13/2015	5.49	3.66	5,565	16.55	10.05	6.90	4.30	3.78	2.08	1.61	0.75
01/14/2015	5.59	3.70	5,051	18.26	11.35	7.57	5.24	4.70	2.39	2.06	0.88
01/15/2015	5.77	3.78	4,606	20.91	13.23	8.27	6.47	5.93	2.78	2.57	1.04
01/16/2015	6.10	3.92	5,029	22.92	15.27	9.00	7.81	7.30	3.24	3.55	1.27
01/17/2015	6.22	3.96	5,041	23.62	15.98	9.75	8.83	8.37	3.76	4.39	1.56
01/18/2015	6.30	3.98	5,031	23.68	16.25	10.50	9.31	8.87	4.29	4.84	1.88
01/19/2015	6.27	3.93	4,996	23.76	16.42	11.25	9.51	9.08	4.84	5.17	2.22
01/20/2015	6.37	4.04	4,983	24.19	16.80	11.99	10.16	9.76	5.42	5.84	2.60
01/21/2015	6.19	3.97	4,980	23.65	16.61	12.66	10.15	9.76	5.97	5.92	2.98
01/22/2015	5.71	3.70	5,040	23.00	15.71	13.21	9.45	9.01	6.43	5.38	3.31
01/23/2015	5.49	3.68	4,977	22.28	15.55	13.70	9.43	8.99	6.85	5.15	3.60
01/24/2015	5.27	3.69	4,857	22.59	15.33	14.14	9.27	8.82	7.24	5.11	3.88
01/25/2015	5.39	3.64	4,848	22.38	15.35	14.54	9.15	8.70	7.61	5.10	4.15
01/26/2015	5.70	3.80	4,784	22.67	15.99	14.99	9.46	9.03	8.01	5.68	4.46
01/27/2015	6.03	3.87	4,878	23.33	16.16	15.43	10.08	9.68	8.43	6.01	4.77
01/28/2015	5.95	3.82	4,953	23.31	16.36	15.79	9.99	9.59	8.78	5.84	5.04
01/29/2015	6.05	3.96	4,838	23.82	16.92	16.05	10.25	9.87	9.06	5.96	5.28
01/30/2015	6.22	4.13	4,675	24.03	17.92	16.24	10.99	10.66	9.30	6.86	5.52
01/31/2015	6.25	4.20	4,772	24.79	17.76	16.37	10.86	10.51	9.45	7.45	5.74
02/01/2015	6.09	4.05	6,071	24.10	17.12	16.43	10.93	10.59	9.57	6.62	5.86
02/02/2015	5.93	3.92	5,926	23.69	16.93	16.46	10.56	10.20	9.65	6.43	5.95
02/03/2015	5.84	3.91	6,173	23.51	16.65	16.45	10.17	9.78	9.66	6.20	5.98

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value s - substituted value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
01/05/2015	0.44	0.41	0.32	0.33	0.31	0.27	NR	5.96	5.16	4.03	e	0.55
01/06/2015	0.48	0.41	0.32	0.33	0.31	0.27	NR	5.82	4.53	3.61	2.30	0.50
01/07/2015	0.53	0.41	0.32	0.32	0.31	0.27	NR	5.88	4.23	3.17	2.01	0.67
01/08/2015	0.60	0.42	0.33	0.32	0.31	0.28	NR	5.47	3.91	3.05	1.83	0.84
01/09/2015	0.66	0.44	0.33	0.32	0.32	0.29	NR	5.49	3.65	2.76	1.60	1.42
01/10/2015	0.71	0.46	0.34	0.32	0.32	0.29	NR	5.51	3.55	2.64	1.54	1.48
01/11/2015	0.73	0.48	0.34	0.32	0.32	0.30	NR	5.57	3.60	2.69	1.62	1.62
01/12/2015	0.71	0.51	0.34	0.32	0.32	0.30	NR	6.18	4.15	3.01	1.74	1.86
01/13/2015	0.80	0.54	0.34	0.33	0.33	0.31	NR	7.18	4.48	3.30	1.93	2.55
01/14/2015	1.02	0.59	0.36	0.33	0.32	0.31	NR	7.96	5.44	3.83	2.22	3.47
01/15/2015	1.61	0.68	0.38	0.33	0.33	0.31	NR	8.24	6.25	5.07	3.21	3.20
01/16/2015	1.93	0.79	0.42	0.34	0.37	0.32	NR	8.01	7.86	6.50	3.73	5.62
01/17/2015	2.35	0.93	0.46	0.35	0.42	0.33	NR	8.79	8.36	6.58	3.37	6.62
01/18/2015	2.66	1.09	0.51	0.36	0.49	0.34	NR	9.33	8.28	6.62	3.46	7.65
01/19/2015	2.79	1.26	0.54	0.38	0.54	0.36	NR	9.66	8.31	6.57	4.08	7.74
01/20/2015	3.22	1.45	0.62	0.40	0.63	0.38	NR	10.20	7.99	5.64	5.09	7.52
01/21/2015	3.25	1.65	0.64	0.42	0.63	0.40	NR	10.38	7.68	5.91	5.35	7.23
01/22/2015	2.92	1.81	0.60	0.44	0.55	0.42	NR	10.10	7.68	6.11	5.80	6.62
01/23/2015	2.91	1.97	0.63	0.46	0.53	0.44	NR	9.91	7.58	6.09	5.93	6.68
01/24/2015	3.01	2.14	0.67	0.49	0.54	0.45	NR	9.89	7.66	6.15	6.04	6.59
01/25/2015	3.04	2.30	0.70	0.51	0.56	0.47	NR	9.87	7.68	6.01	5.76	6.10
01/26/2015	3.16	2.48	0.79	0.55	0.65	0.49	NR	9.89	7.44	6.19	5.61	6.87
01/27/2015	3.61	2.68	0.88	0.59	0.80	0.53	NR	10.29	8.02	6.70	5.74	7.63
01/28/2015	3.63	2.86	0.89	0.62	0.80	0.56	NR	10.85	7.83	7.23	5.97	8.12
01/29/2015	3.92	3.03	0.99	0.67	0.83	0.60	NR	10.79	8.05	7.47	6.33	8.03
01/30/2015	4.30	3.20	1.10	0.72	0.84	0.63	NR	10.94	9.00	7.81	6.66	8.89
01/31/2015	4.25	3.33	1.14	0.76	0.87	0.66	NR	11.08	8.74	7.93	6.77	9.50
02/01/2015	4.20	3.44	1.14	0.81	0.97	0.70	NR	11.35	9.71	7.41	6.80	7.68
02/02/2015	3.93	3.53	1.04	0.85	0.87	0.72	NR	11.65	8.68	7.39	7.32	7.92
02/03/2015	3.83	3.57	1.03	0.88	0.84	0.73	NR	11.97	9.65	7.45	7.68	8.19

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
01/05/2015	0.29	0.32	0.50	0.35	0.37	0.71	0.51	0.66	71	58	89 s	r
01/06/2015	0.29	0.30	0.50	0.35	0.37	0.77	0.53	0.68	81	58	80 s	r
01/07/2015	0.31	0.32	0.49	0.35	0.37	0.75	0.57	0.71	98	57	79 s	r
01/08/2015	0.32	0.32	0.49	0.35	0.36	0.65	0.56	0.68	120	56	70 s	r
01/09/2015	0.33	0.32	0.49	0.35	0.36	NR	0.54	0.76	140	55	65 s	r
01/10/2015	0.34	0.32	0.49	0.35	0.36	NR	0.57	0.74	155	55	66 s	r
01/11/2015	0.34	0.33	0.49	0.34	0.36	NR	0.57	0.76	164	54	67 s	r
01/12/2015	0.33	0.33	0.49	0.35	0.36	0.71	0.60	0.78	155	55	69 s	r
01/13/2015	0.32	0.33	0.49	0.34	0.36	0.69	0.54	0.82	185	54	82 s	r
01/14/2015	0.32	0.33	0.48	0.34	0.35	0.69	0.53	0.75	256	54	61 s	r
01/15/2015	0.41	0.34	0.48	0.35	0.35	0.64	0.50	0.73	443	54	70 s	b
01/16/2015	0.62	0.34	0.47	0.35	0.35	0.55	0.44	0.71	544	53	60 s	b
01/17/2015	0.76	0.34	0.47	0.35	0.35	0.56	0.45	0.66	680	54	59 s	b
01/18/2015	1.00	0.35	0.47	0.35	0.35	0.57	0.47	0.66	776	54	58 s	b
01/19/2015	1.11	0.35	0.46	0.35	0.36	0.51	0.48	0.68	820	55	57 s	b
01/20/2015	1.36	0.36	0.47	0.36	0.36	0.53	0.48	0.67	957	55	55 s	b
01/21/2015	1.33	0.37	0.47	0.36	0.36	0.52	0.48	0.70	965	56	52 s	b
01/22/2015	1.10	0.38	0.48	0.36	0.36	0.58	0.50	0.67	859	57	53 s	b
01/23/2015	1.04	0.39	0.49	0.37	0.37	0.64	0.51	0.69	858	58	51 s	b
01/24/2015	1.11	0.39	0.49	0.37	0.37	0.55	0.47	0.67	890	58	53 s	b
01/25/2015	1.10	0.42	0.50	0.38	0.37	0.43	0.46	0.64	899	59	50 s	b
01/26/2015	1.22	0.44	0.51	0.38	0.38	0.42	0.45	0.65	936	60	52 s	b
01/27/2015	1.39	0.46	0.53	0.39	0.38	0.51	0.47	0.65	1,081	62	52 s	b
01/28/2015	1.31	0.46	0.53	0.40	0.39	0.51	0.47	0.65	1,086	63	49 s	b
01/29/2015	1.41	0.52	0.56	0.41	0.39	0.43	0.41	0.65	1,179	65	53 s	b
01/30/2015	1.50	0.53	0.60	0.42	0.40	0.43	0.44	0.62	1,298	67	51 s	b
01/31/2015	1.59	0.55	0.63	0.45	0.42	0.46	0.45	0.62	1,283	70	52 s	b
02/01/2015	1.78	0.61	0.65	0.45	0.43	0.47	0.46	0.64	1,269	74	52 s	b
02/02/2015	1.57	0.64	0.66	0.47	0.44	0.49	0.50	0.63	1,183	77	52 s	b
02/03/2015	1.60	0.65	0.68	0.49	0.45	0.42	0.57	0.64	1,150	79	50 e	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
01/05/2015	1.08	0.95	1.16	0.91	1.33	1.09	1.09	0.89
01/06/2015	1.07	0.96	1.16	0.93	1.39	1.12	1.08	0.91
01/07/2015	1.05	0.98	1.16	0.95	1.37	1.14	1.09	0.92
01/08/2015	1.04	0.98	1.15	0.96	1.37	1.16	1.08	0.94
01/09/2015	1.02	0.98	1.15	0.98	1.41	1.19	1.07	0.95
01/10/2015	0.98	0.99	1.15	0.99	1.35	1.21	1.06	0.96
01/11/2015	0.97	1.00	1.14	1.00	1.38	1.22	1.03	0.97
01/12/2015	0.97	1.02	1.12	1.00	1.43	1.24	0.99	0.98
01/13/2015	0.97	1.03	1.10	1.01	1.49	1.26	0.98	0.99
01/14/2015	0.96	1.05	1.09	1.02	1.62	1.28	0.98	1.01
01/15/2015	0.91	1.05	1.08	1.03	1.64	1.31	0.98	1.03
01/16/2015	0.85	1.05	1.07	1.04	1.53	1.33	0.97	1.04
01/17/2015	0.87	1.06	1.07	1.06	1.47	1.35	0.90	1.05
01/18/2015	0.86	1.05	1.05	1.07	1.37	1.37	0.87	1.05
01/19/2015	0.86	1.05	1.04	1.08	1.26	1.38	0.88	1.05
01/20/2015	0.87	1.04	1.03	1.09	1.22	1.39	0.87	1.05
01/21/2015	0.85	1.04	1.02	1.09	1.18	1.39	0.87	1.04
01/22/2015	0.83	1.03	1.00	1.10	1.20	1.40	0.88	1.04
01/23/2015	0.83	1.01	1.00	1.10	1.23	1.40	0.87	1.03
01/24/2015	0.87	1.00	1.00	1.10	1.31	1.40	0.86	1.03
01/25/2015	0.91	0.99	1.00	1.10	1.35	1.40	0.85	1.02
01/26/2015	0.95	0.99	1.01	1.10	1.35	1.40	0.88	1.01
01/27/2015	1.01	0.98	1.02	1.09	1.30	1.39	0.91	1.00
01/28/2015	1.01	0.98	1.02	1.09	1.27	1.38	0.94	0.99
01/29/2015	0.98	0.97	1.02	1.08	1.26	1.37	0.99	0.99
01/30/2015	1.04	0.97	1.04	1.08	1.33	1.36	1.00	0.98
01/31/2015	1.00	0.96	1.05	1.08	1.31	1.36	0.98	0.98
02/01/2015	1.02	0.96	1.04	1.07	1.26	1.35	0.97	0.97
02/02/2015	1.18	0.96	1.03	1.07	1.24	1.35	0.97	0.97
02/03/2015	1.32	0.97	1.02	1.07	1.26	1.35	0.98	0.96

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value   s : substituted value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, March 05, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	35 %
NDOI, monthly average *	>= 4,000 cfs	5,578 cfs
NDOI, 7 day average*	>= 3,000 cfs	5,578 cfs
Vernalis Base Flow : Monthly average *	>= 500 cfs	704 cfs
7 Day average *	>= 400 cfs	704 cfs
Habitat Protection, X2 / Flow	31 day at Chipps Island	5 days
* 20 Chipps days as carryover from Febru	31 days at Collinsville	5 days
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	59 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	158 mg/l
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	1.0 mS/cm
Brandt Bridge	<=1.0 mS/cm	1.0 mS/cm
Old River Near Tracy	<=1.0 mS/cm	1.2 mS/cm
Old River Near Middle River	<=1.0 mS/cm	1.0 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, February 1, 2015)

Previous Month's Index (8RI for Jan): 0.805 MAF
Water Year Type: Critical
Sacramento valley water year type index (40/30/30) @ 50%: 5.1 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 1.1 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
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Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
02/04/2015	5.88	4.04	7,194	23.53	16.88	16.47	10.41	10.03	9.67	6.52	6.02
02/05/2015	6.05	4.28	7,002	24.58	17.39	16.59	11.28	10.96	9.81	6.77	6.12
02/06/2015	6.46	4.81	7,197	25.87	19.30	16.86	12.18	11.93	10.02	6.85	6.24
02/07/2015	6.27	4.56	9,392	24.45	17.67	17.03	11.12	10.79	10.16	6.75	6.36
02/08/2015	5.84	4.62	18,244	22.82	16.41	17.10	10.14	9.75	10.24	5.23	6.37
02/09/2015	6.34	4.42	24,498	21.23	14.14	16.97	8.05	7.55	10.13	3.90	6.24
02/10/2015	5.64	3.92	39,822	17.40	9.72	16.51	4.24	3.72	9.71	1.46	5.92
02/11/2015	5.68	3.82	39,879	15.03	7.08	15.85	2.53	2.11	9.17	0.76	5.55
02/12/2015	5.62	3.86	36,707	14.51	5.58	15.04	1.65	1.31	8.56	0.51	5.16
02/13/2015	5.92	4.04	33,818	15.28	5.35	14.14	1.38	1.07	7.88	0.43	4.71
02/14/2015	6.14	4.16	29,486	16.03	6.45	13.33	1.52	1.20	7.21	0.40	4.20
02/15/2015	6.28	4.21	24,399	16.65	7.15	12.62	1.70	1.35	6.55	0.39	3.76
02/16/2015	6.36	4.24	20,307	15.93	7.34	11.94	1.93	1.56	5.94	0.43	3.33
02/17/2015	6.42	4.30	17,399	16.52	7.92	11.31	2.24	1.83	5.37	0.53	2.92
02/18/2015	6.21	4.15	14,977	15.01	7.04	10.61	1.89	1.52	4.76	0.50	2.49
02/19/2015	6.05	4.08	13,243	14.73	6.68	9.84	1.87	1.50	4.09	0.52	2.05
02/20/2015	5.86	4.04	11,698	14.77	6.70	8.94	1.98	1.60	3.35	0.55	1.60
02/21/2015	5.80	4.17	10,260	15.48	7.23	8.20	2.36	1.94	2.72	0.57	1.16
02/22/2015	6.09	4.22	10,228	14.85	7.14	7.54	2.40	1.98	2.16	0.84	0.84
02/23/2015	5.99	3.99	10,638	14.45	6.17	6.97	1.99	1.61	1.74	0.88	0.63
02/24/2015	5.84	3.80	9,866	14.50	7.09	6.78	2.14	1.75	1.60	0.71	0.57
02/25/2015	5.78	3.85	8,971	14.36	7.12	6.78	2.18	1.79	1.57	0.72	0.57
02/26/2015	5.81	3.95	7,562	14.77	8.05	6.96	2.56	2.13	1.63	0.79	0.59
02/27/2015	5.87	4.20	6,633	16.51	9.52	7.26	3.39	2.90	1.76	1.08	0.64
02/28/2015	5.97	4.18	5,805	17.11	9.13	7.45	3.42	2.94	1.89	1.25	0.70
03/01/2015	5.80	4.03	5,927	16.87	8.98	7.58	3.35	2.87	2.00	1.37	0.77
03/02/2015	6.04	4.17	5,924	18.05	11.04	7.84	4.38	3.85	2.16	1.65	0.85
03/03/2015	5.70	3.97	5,230	17.74	10.51	8.03	4.27	3.75	2.30	1.57	0.93
03/04/2015	5.54	3.90	5,412	18.04	10.60	8.28	4.27	3.75	2.45	1.68	1.01
03/05/2015	5.20	3.61	5,395	17.60	10.18	8.53	4.13	3.61	2.61	1.51	1.08

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value s - substituted value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
02/04/2015	3.83	3.61	1.01	0.90	0.82	0.75	NR	12.13	8.45	7.24	7.24	7.45
02/05/2015	4.14	3.70	1.09	0.94	0.86	0.77	NR	11.53	8.51	7.19	6.97	8.76
02/06/2015	4.88	3.84	1.23	0.98	0.99	0.80	NR	11.42	9.56	7.73	6.79	8.69
02/07/2015	4.72	3.96	1.12	1.01	0.91	0.83	NR	11.31	9.21 e	7.22	6.75	8.08
02/08/2015	3.73	4.01	0.98	1.03	0.59	0.83	NR	11.33	8.50	7.38	7.15	6.45
02/09/2015	3.28	4.02	0.94	1.04	0.50	0.82	NR	11.37	4.64	6.73	7.53	4.74
02/10/2015	1.65	3.88	0.70	1.03	0.46	0.79	NR	12.33	5.94	6.32	6.99	1.82
02/11/2015	1.19	3.70	0.60	1.01	0.38	0.77	NR	12.55	6.63	6.37	7.13	1.11
02/12/2015	0.98	3.49	0.54	0.98	0.33	0.73	NR	12.07	6.80	6.77	7.15	0.60
02/13/2015	0.84	3.25	0.52	0.93	0.31	0.69	NR	11.46	6.92	6.80	6.76	0.50
02/14/2015	0.74	3.00	0.50	0.89	0.29	0.65	NR	10.56	7.01	6.94	6.56	0.46
02/15/2015	0.68	2.74	0.47	0.84	0.28	0.60	NR	9.98	7.43	6.34	5.96	0.54
02/16/2015	0.66	2.51	0.45	0.80	0.29	0.56	NR	9.42	7.31	5.99	6.00	0.59
02/17/2015	0.64	2.28	0.44	0.76	0.29	0.52	NR	8.75	6.92	5.84	5.22	0.50
02/18/2015	0.62	2.05	0.42	0.71	0.31	0.48	NR	8.25	6.09	5.31	3.78	0.48
02/19/2015	0.60	1.80	0.41	0.66	0.31	0.45	NR	8.13	5.17	4.27	2.46	0.57
02/20/2015	0.60	1.50	0.40	0.61	0.32	0.40	NR	8.18	4.34	3.45	1.71	0.52
02/21/2015	0.61	1.20	0.39	0.55	0.32	0.36	NR	7.65	3.66	3.09	1.45	0.61
02/22/2015	0.62	0.98	0.40	0.51	0.33	0.34	NR	7.26	3.64	2.93	1.37	1.09
02/23/2015	0.58	0.79	0.40	0.47	0.34	0.33	NR	8.87	3.73	2.75	1.28	0.90
02/24/2015	0.57	0.71	0.38	0.45	0.34	0.32	NR	8.97	3.79	3.03	1.28	0.75
02/25/2015	0.58	0.67	0.38	0.44	0.34	0.32	NR	8.65	4.17	2.90	1.34	0.84
02/26/2015	0.61	0.64	0.39	0.42	0.35	0.32	NR	7.57	4.43	2.77	1.36	1.08
02/27/2015	0.69	0.63	0.40	0.42	0.34	0.32	NR	6.62	4.09	2.53	1.36	1.41
02/28/2015	0.74	0.63	0.40	0.41	0.35	0.32	NR	6.42	3.85	3.05	1.43	1.67
03/01/2015	0.74	0.63	0.40	0.40	0.35	0.33	NR	6.92	4.08	2.91	1.58	1.39
03/02/2015	0.85	0.65	0.41	0.40	0.35	0.33	NR	6.52	3.65	2.82	1.65	2.13
03/03/2015	0.87	0.66	0.40	0.40	0.35	0.34	NR	6.66	3.57	2.47	1.83	2.11
03/04/2015	0.90	0.68	0.41	0.40	0.35	0.34	NR	6.77	3.54	2.69	1.87	1.86
03/05/2015	0.87	0.70	0.40	0.40	0.35	0.34	NR	8.10	3.67	2.41	2.09	1.71

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
02/04/2015	1.65	0.67	0.70	0.49	0.46	0.34	0.50	0.61	1,149	81	56 s	b
02/05/2015	1.81	0.68	0.73	0.51	0.47	0.38	0.51	0.60	1,249	84	58 s	b
02/06/2015	2.35	0.72	0.76	0.50	0.48	0.37	0.48	0.60	1,483	88	59 s	b
02/07/2015	1.57	0.72	0.77	0.48	0.49	0.38	0.62	0.59	1,432	90	58 s	r
02/08/2015	0.99	0.72	0.76	0.50	0.49	0.40	0.59	0.68	1,116	91	59 s	r
02/09/2015	0.54	0.66	0.78	0.50	0.50	0.40	0.60	0.61	976	93	63 s	r
02/10/2015	0.34	0.71	0.74	0.53	0.51	0.40	0.61	0.73	456	94	70 s	r
02/11/2015	0.30	0.63	0.73	0.52	0.51	0.40	0.64	0.67	309	95	71 s	r
02/12/2015	0.28	0.66	0.74	0.54	0.51	0.42	0.61	0.66	242	96	74 s	r
02/13/2015	0.25	0.57	0.74	0.53	0.51	0.42	0.58	0.30	198	96	77 s	r
02/14/2015	0.23	0.53	0.74	0.50	0.51	0.39	0.51	0.56	165	94	91 s	r
02/15/2015	0.23	0.49	0.71	0.49	0.45	0.37	0.54	0.45	147	80	112 s	r
02/16/2015	0.23	0.46	0.69	0.48	0.49	0.36	0.57	0.21	141	89	119 s	r
02/17/2015	0.25	0.43	0.66	0.46	0.47	0.41	0.56	0.20	134	86	109 s	r
02/18/2015	0.26	0.41	0.63	0.43	0.46	0.41	0.56	0.59	128	83	111 s	r
02/19/2015	0.27	0.42	0.60	0.43	0.46	0.38	0.58	0.77	122	81	107 s	r
02/20/2015	0.28	0.41	0.58	0.42	0.44	0.40	0.67	0.71	119	78	102 s	r
02/21/2015	0.28	0.37	0.56	0.41	0.43	0.41	0.71	0.70	124	74	116 s	r
02/22/2015	0.31	0.38	0.54	0.40	0.42	0.41	0.57	0.61	127	71	91 s	r
02/23/2015	0.30	0.38	0.52	0.39	0.41	0.40	0.55	0.74	114	70	89 s	r
02/24/2015	0.30	0.34	0.51	0.39	0.41	0.43	0.55	0.77	111	69	128 s	r
02/25/2015	0.30	0.37	0.50	0.38	0.40	0.46	0.49	0.72	115	67	108 s	r
02/26/2015	0.31	0.36	0.50	0.38	0.40	0.40	0.50	0.74	126	66	108 s	r
02/27/2015	0.33	0.34	0.48	0.38	0.39	0.33	0.47	0.72	149	63	151 s	r
02/28/2015	0.34	0.38	0.46	0.37	0.38	0.35	0.45	0.67	166	62	118 s	r
03/01/2015	0.33	0.38	0.47	0.38	0.38	0.38	0.46	0.73	167	62	160 s	r
03/02/2015	0.37	0.37	0.47	0.38	0.38	0.38	0.46	0.60	201	61	150 s	r
03/03/2015	0.35	0.37	0.47	0.37	0.38	0.41	0.45	0.58	208	61	155 s	r
03/04/2015	0.35	0.36	0.47	0.37	0.38	0.46	0.43	0.59	215	60	158 e	r
03/05/2015	0.34	0.36	0.47	0.38	0.38	0.45	0.46	0.62	206	60	158 e	r

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
02/04/2015	1.27	0.98	1.01	1.06	1.33	1.35	1.11	0.96
02/05/2015	1.14	0.98	1.01	1.06	1.32	1.35	1.23	0.97
02/06/2015	1.09	0.98	1.01	1.05	1.30	1.34	1.22	0.97
02/07/2015	1.05	0.98	1.03	1.05	1.33	1.34	1.12	0.97
02/08/2015	1.01	0.98	1.07	1.04	1.35	1.34	1.02	0.97
02/09/2015	0.97	0.98	1.05	1.04	1.38	1.34	1.02	0.97
02/10/2015	0.89	0.98	1.09	1.04	1.24	1.34	0.95	0.97
02/11/2015	0.97	0.98	1.07	1.04	1.26	1.33	0.90	0.97
02/12/2015	0.97	0.98	1.05	1.04	1.28	1.32	0.84	0.96
02/13/2015	1.08	0.98	1.02	1.03	1.26	1.31	0.93	0.96
02/14/2015	1.10	0.99	0.97	1.03	1.21	1.30	0.94	0.96
02/15/2015	1.05	0.99	0.93	1.03	1.14	1.28	1.04	0.96
02/16/2015	1.01	1.00	0.88	1.02	1.14	1.27	1.07	0.97
02/17/2015	0.98	1.00	0.85	1.01	1.14	1.27	1.05	0.97
02/18/2015	0.92	1.01	0.84	1.01	1.16	1.26	1.02	0.98
02/19/2015	0.87	1.01	0.86	1.00	1.17	1.26	1.00	0.98
02/20/2015	0.83	1.00	0.87	0.99	1.19	1.26	0.92	0.98
02/21/2015	0.87	1.01	0.88	0.99	1.21	1.26	0.86	0.98
02/22/2015	0.87	1.01	0.88	0.99	1.21	1.26	0.81	0.98
02/23/2015	0.90	1.01	0.90	0.98	1.20	1.26	0.88	0.98
02/24/2015	0.84	1.01	0.90	0.98	1.11	1.25	0.87	0.98
02/25/2015	0.81	1.00	0.90	0.98	1.13	1.24	0.89	0.98
02/26/2015	0.82	0.99	0.90	0.97	1.19	1.24	0.86	0.98
02/27/2015	0.84	0.99	0.92	0.97	1.20	1.24	0.84	0.98
02/28/2015	0.87	0.99	0.96	0.97	1.16	1.23	0.86	0.97
03/01/2015	0.99	0.98	1.00	0.97	1.10	1.23	0.87	0.97
03/02/2015	1.07	0.99	1.06	0.97	1.10	1.22	0.88	0.96
03/03/2015	1.07	0.99	1.10	0.97	1.12	1.21	0.95	0.96
03/04/2015	0.98	0.98	1.14	0.97	1.11	1.21	1.02	0.96
03/05/2015	0.85	0.97	1.18	0.98	1.10	1.20	1.08	0.97

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, April 02, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	19 %
NDOI, monthly average *	>= 4,000 cfs	4,092 cfs
NDOI, 7 day average*	>= 3,000 cfs	4,092 cfs
Vernalis Base Flow : Monthly average *	>= 500 cfs	822 cfs
Vernalis Base Flow : 7 Day average *	>= 400 cfs	822 cfs
Habitat Protection, X2 / Flow	31 days at Collinsville	0
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	84 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	68 mg/l
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	0.6 mS/cm
Brandt Bridge	<=1.0 mS/cm	1.1 mS/cm
Old River Near Tracy	<=1.0 mS/cm	1.2 mS/cm
Old River Near Middle River	<=1.0 mS/cm	0.8 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In
Boat Lock Status : Open

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, March 1, 2015)

Previous Month's Index (8RI for Feb): 2.23 MAF
Water Year Type: Critical
Sacramento valley water year type index (40/30/30) @ 50%: 4.7 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.9 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value s - substituted value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
03/04/2015	5.54	3.90	5,412	18.04	10.60	8.28	4.27	3.75	2.45	1.68	1.01
03/05/2015	5.20	3.61	5,395	17.60	10.18	8.53	4.13	3.61	2.61	1.51	1.08
03/06/2015	5.16	3.62	5,359	18.10	10.65	8.81	4.50	3.97	2.77	1.71	1.17
03/07/2015	5.19	3.78	4,611	19.15	11.37	9.11	4.98	4.44	2.95	2.03	1.27
03/08/2015	5.37	3.86	4,679	18.84	12.01	9.46	5.68	5.14	3.18	2.46	1.39
03/09/2015	5.50	3.91	4,305	19.76	12.45	9.91	5.88	5.34	3.44	2.88	1.53
03/10/2015	5.61	3.93	4,184	20.06	12.71	10.31	6.15	5.61	3.72	3.04	1.70
03/11/2015	5.73	3.94	4,513	20.64	12.85	10.72	6.29	5.75	4.00	3.31	1.88
03/12/2015	5.48	3.74	5,485	20.14	12.48	11.03	5.98	5.43	4.24	3.00	2.04
03/13/2015	5.58	3.86	5,825	20.71	13.08	11.29	6.38	5.84	4.45	3.21	2.19
03/14/2015	5.60	3.95	5,104	20.94	14.08	11.64	6.88	6.35	4.69	3.38	2.34
03/15/2015	5.96	4.09	4,697	22.64	15.24	12.09	8.07	7.58	5.03	4.49	2.56
03/16/2015	5.86	4.00	5,625	23.02	15.84	12.43	8.21	7.72	5.31	4.75	2.79
03/17/2015	5.95	4.07	5,582	22.93	16.24	12.84	9.23	8.78	5.66	5.42	3.06
03/18/2015	5.75	3.93	5,562	20.16	15.73	13.21	8.86	8.40	6.00	5.19	3.31
03/19/2015	5.68	3.90	5,556	19.77	15.65	13.60	8.70	8.23	6.33	5.24	3.58
03/20/2015	5.67	4.02	5,344	20.41	15.86	13.97	9.30	8.85	6.68	5.60	3.86
03/21/2015	5.79	3.99	4,900	20.22	15.81	14.29	9.31	8.87	6.99	5.66	4.12
03/22/2015	5.89	4.02	4,897	20.22	16.17	14.58	9.61	9.18	7.28	5.67	4.35
03/23/2015	5.96	3.97	4,441	19.97	15.81	14.82	9.50	9.07	7.55	5.64	4.54
03/24/2015	5.85	3.86	4,668	20.85	15.55	15.03	9.45	9.01	7.79	5.67	4.73
03/25/2015	5.69	3.77	4,545	21.27	15.42	15.21	8.83	8.37	7.98	5.51	4.89
03/26/2015	5.57	3.79	4,525	21.33	15.11	15.40	8.65	8.18	8.17	5.22	5.05
03/27/2015	5.49	3.96	4,536	20.97	15.49	15.57	9.12	8.67	8.37	5.60	5.22
03/28/2015	5.23	3.77	4,351	22.06	15.42	15.67	8.94	8.48	8.53	5.45	5.36
03/29/2015	5.33	3.83	4,864	21.96	15.75	15.70	9.06	8.60	8.60	5.71	5.45
03/30/2015	5.48	4.01	4,240	22.59	16.61	15.76	9.68	9.26	8.71	6.14	5.55
03/31/2015	5.38	3.99	4,109	24.03	17.02	15.81	10.46	10.08	8.80	6.41	5.62
04/01/2015	5.04	3.56	4,101	22.30	15.91	15.83	9.07	8.61	8.82	5.49	5.64
04/02/2015	5.03	3.49	4,083	22.00	15.24	15.80	8.71	8.24	8.82	5.55	5.67

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value s - substituted value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
03/04/2015	0.90	0.68	0.41	0.40	0.35	0.34	NR	6.77	3.54	2.69	1.87	1.86
03/05/2015	0.87	0.70	0.40	0.40	0.35	0.34	NR	8.10	3.67	2.41	2.09	1.71
03/06/2015	0.93	0.73	0.41	0.40	0.35	0.34	NR	8.08	3.85	2.70	2.07	2.20
03/07/2015	1.04	0.76	0.42	0.40	0.34	0.34	NR	7.82	3.63	2.72	2.18	2.26
03/08/2015	1.20	0.80	0.44	0.40	0.36	0.35	NR	6.74	3.79	3.08	2.08	3.10
03/09/2015	1.27	0.85	0.46	0.41	0.37	0.35	NR	6.60	4.01	3.41	2.13	3.46
03/10/2015	1.40	0.91	0.47	0.41	0.38	0.35	NR	6.60	4.07	3.62	2.23	4.01
03/11/2015	1.51	0.97	0.50	0.42	0.39	0.35	NR	6.74	4.21	3.88	2.65	4.01
03/12/2015	1.43	1.03	0.49	0.43	0.39	0.36	NR	7.30	4.37	3.97	3.13	3.81
03/13/2015	1.64	1.10	0.52	0.44	0.39	0.36	NR	7.74	4.77	4.06	3.33	4.42
03/14/2015	1.87	1.18	0.55	0.45	0.40	0.36	NR	8.02	5.03	3.85	3.58	4.26
03/15/2015	2.27	1.29	0.60	0.46	0.47	0.37	NR	8.40	5.62	3.72	3.69	6.01
03/16/2015	2.15	1.38	0.59	0.48	0.47	0.38	NR	8.98	5.64	3.78	3.79	5.73
03/17/2015	2.40	1.49	0.62	0.49	0.50	0.39	NR	8.82	5.72	3.98	3.98	6.45
03/18/2015	2.28	1.59	0.60	0.50	0.49	0.40	NR	9.18	5.55	4.08	4.71	6.25
03/19/2015	2.31	1.69	0.62	0.52	0.50	0.41	NR	9.31	6.00	4.09	5.05	5.85
03/20/2015	2.53	1.81	0.65	0.54	0.54	0.43	NR	9.43	6.10	4.46	5.32	6.56
03/21/2015	2.58	1.92	0.67	0.56	0.56	0.44	NR	9.64	6.11	4.51	5.18	6.95
03/22/2015	2.74	2.03	0.71	0.57	0.61	0.46	NR	9.90	6.22	4.56	5.08	6.57
03/23/2015	2.77	2.13	0.72	0.59	0.63	0.48	NR	10.31	6.06	4.66	5.24	6.94
03/24/2015	2.71	2.23	0.71	0.61	0.64	0.50	NR	10.48	6.16	4.74	5.43	7.09
03/25/2015	2.52	2.30	0.69	0.62	0.62	0.51	NR	10.61	6.40	4.92	5.63	6.03
03/26/2015	2.57	2.38	0.70	0.64	0.64	0.53	NR	10.34	6.74	5.61	5.65	6.20
03/27/2015	2.82	2.47	0.73	0.65	0.68	0.55	NR	10.14	7.06	6.45	5.62	6.95
03/28/2015	2.74	2.53	0.70	0.66	0.62	0.57	NR	10.11	7.54	6.08	5.47	6.14
03/29/2015	2.71	2.56	0.72	0.67	0.60	0.58	NR	10.23	7.80	6.33	4.28	7.08
03/30/2015	2.96	2.62	0.75	0.68	0.69	0.59	NR	10.13	7.94	6.62	5.53	7.32
03/31/2015	3.17	2.67	0.78	0.70	0.74	0.61	NR	10.49	8.24	6.34	5.59	7.65
04/01/2015	2.49	2.69	0.66	0.70	0.62	0.62	NR	11.25	7.85	6.17	5.62	6.91
04/02/2015	2.21	2.68	0.67	0.70	0.57	0.62	NR	12.34	7.78	6.29	5.93	6.11

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
03/04/2015	0.35	0.36	0.47	0.37	0.38	0.46	0.43	0.59	215	60	158 s	r
03/05/2015	0.34	0.36	0.47	0.38	0.38	0.45	0.46	0.62	206	60	172 s	r
03/06/2015	0.35	0.38	0.47	0.38	0.38	0.44	0.46	0.57	227	60	125 s	r
03/07/2015	0.38	0.36	0.47	0.38	0.38	0.44	0.42	0.57	262	60	114 s	r
03/08/2015	0.41	0.38	0.47	0.38	0.37	0.43	0.42	0.55	311	59	95 s	r
03/09/2015	0.43	0.38	0.47	0.38	0.38	0.44	0.42	0.56	335	60	100 s	r
03/10/2015	0.48	0.39	0.48	0.38	0.38	0.47	0.41	0.55	376	60	95 s	r
03/11/2015	0.48	0.39	0.48	0.39	0.38	0.61	0.41	0.53	410	60	89 s	r
03/12/2015	0.42	0.40	0.48	0.39	0.38	0.63	0.42	0.52	386	61	84 s	r
03/13/2015	0.50	0.40	0.49	0.38	0.38	0.57	0.41	0.51	453	62	78 s	r
03/14/2015	0.59	0.41	0.49	0.37	0.38	0.67	0.42	0.48	527	62	87 s	r
03/15/2015	0.79	0.42	0.50	0.37	0.39	0.68	0.42	0.49	652	62	95 s	r
03/16/2015	0.78	0.39	0.50	0.37	0.39	0.74	0.44	0.57	614	63	103 s	b
03/17/2015	0.95	0.41	0.51	0.39	0.39	0.79	0.49	0.57	694	63	103 s	b
03/18/2015	0.91	0.44	0.52	0.40	0.39	0.80	0.46	0.60	657	65	84 s	b
03/19/2015	0.96	0.45	0.52	0.42	0.40	1.04	0.51	0.61	665	66	97 s	b
03/20/2015	1.14	0.44	0.53	0.43	0.40	1.52	0.52	0.62	735	67	103 s	b
03/21/2015	1.21	0.46	0.54	0.44	0.41	1.83	0.50	0.62	752	69	66 s	b
03/22/2015	1.36	0.47	0.55	0.44	0.41	1.90	0.50	0.65	803	70	64 s	b
03/23/2015	1.31	0.46	0.56	0.45	0.42	1.79	0.48	0.65	813	71	63 s	b
03/24/2015	1.30	0.47	0.58	0.46	0.42	1.58	0.50	0.66	793	72	69 s	b
03/25/2015	1.16	0.46	0.59	0.46	0.43	1.23	0.50	0.63	731	73	48 s	b
03/26/2015	1.18	0.48	0.59	0.47	0.43	1.06	0.50	0.62	749	75	62 s	b
03/27/2015	1.30	0.46	0.59	0.48	0.45	0.96	0.51	0.66	827	79	60 s	b
03/28/2015	1.11	0.48	0.59	0.47	0.44	0.84	0.59	0.66	802	77	61 s	b
03/29/2015	1.23	0.50	0.60	0.47	0.45	0.73	0.65	0.68	792	78	60 s	b
03/30/2015	1.48	0.49	0.60	0.48	0.45	0.64	0.64	0.71	872	79	62 s	b
03/31/2015	1.59	0.52	0.62	0.48	0.45	0.58	0.64	0.66	938	79	62 s	b
04/01/2015	1.11	0.50	0.62	0.48	0.45	0.53	0.58	0.66	722	79	74	b
04/02/2015	0.79	0.52	0.63	0.50	0.45	0.49	0.51	0.58	633	80	68	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
03/04/2015	0.98	0.98	1.14	0.97	1.11	1.21	1.02	0.96
03/05/2015	0.85	0.97	1.18	0.98	1.10	1.20	1.08	0.97
03/06/2015	0.67	0.95	1.21	0.98	1.13	1.20	1.10	0.97
03/07/2015	0.62	0.93	1.23	0.99	1.16	1.19	1.07	0.96
03/08/2015	0.70	0.91	1.24	1.00	1.21	1.19	1.02	0.96
03/09/2015	0.87	0.91	1.24	1.01	1.23	1.19	0.94	0.95
03/10/2015	0.88	0.90	1.25	1.01	1.22	1.18	0.89	0.95
03/11/2015	0.73	0.90	1.25	1.02	1.23	1.18	0.88	0.94
03/12/2015	0.68	0.89	1.26	1.02	1.24	1.18	0.95	0.94
03/13/2015	0.67	0.88	1.25	1.03	1.22	1.18	0.98	0.94
03/14/2015	0.62	0.87	1.25	1.04	1.23	1.17	1.03	0.95
03/15/2015	0.73	0.86	1.24	1.04	1.25	1.17	1.04	0.95
03/16/2015	0.77	0.85	1.23	1.05	1.26	1.18	0.99	0.95
03/17/2015	0.79	0.84	1.24	1.06	1.28	1.18	0.93	0.95
03/18/2015	0.69	0.83	1.25	1.07	1.29	1.18	0.86	0.94
03/19/2015	0.63	0.81	1.24	1.09	1.29	1.19	0.85	0.94
03/20/2015	0.72	0.81	1.23	1.10	1.30	1.19	0.86	0.93
03/21/2015	0.74	0.80	1.24	1.11	1.32	1.20	0.88	0.93
03/22/2015	0.70	0.80	1.23	1.13	1.33	1.20	0.88	0.93
03/23/2015	0.73	0.79	1.21	1.14	1.31	1.21	0.86	0.93
03/24/2015	0.77	0.79	1.20	1.15	1.28	1.21	0.83	0.93
03/25/2015	0.72	0.79	1.18	1.16	1.25	1.21	0.82	0.93
03/26/2015	0.34	0.77	1.15	1.17	1.23	1.22	0.80	0.92
03/27/2015	0.20	0.75	1.11	1.17	1.20	1.22	0.79	0.92
03/28/2015	0.20	0.73	1.01	1.18	1.18	1.22	0.62	0.91
03/29/2015	0.25	0.71	0.79	1.17	1.08	1.21	0.24	0.89
03/30/2015	0.38	0.69	0.45	1.15	0.96	1.21	0.20	0.87
03/31/2015	0.41	0.67	0.26	1.13	0.85	1.20	0.23	0.85
04/01/2015	0.36	0.65	0.22	1.10	0.62	1.18	0.31	0.83
04/02/2015	0.30	0.62	0.26	1.07	0.54	1.16	0.36	0.81

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
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Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Thursday, May 07, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	8 %
NDOI, monthly average *	>= 4,000 cfs	4,425 cfs
NDOI, 7 day average*	>= 3,000 cfs	4,425 cfs
Vernalis Base Flow : Monthly average *	>= 300 cfs	402 cfs
7 Day average *	>= 240 cfs	402 cfs
Habitat Protection, X2 / Flow	31 days at Collinsville	0 days
	0 day (s) at Chipps Island	0 days
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	119 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	143 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	1.75 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	1.66 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.3 mS/cm
Brandt Bridge	<=0.7 mS/cm	0.3 mS/cm
Old River Near Tracy	<=0.7 mS/cm	0.7 mS/cm
Old River Near Middle River	<=0.7 mS/cm	0.3 mS/cm
SUISUN MARSH:		
Suisun Marsh Salinity Control Gates :	0 Open / 0 Closed / 3 Full Tide Open	
Flashboard Status : In		
Boat Lock Status : Open		

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, April 1, 2015)

Previous Month's Index (8RI for Mar): 840 TAF
Water Year Type: Critical
Sacramento valley water year type index (40/30/30) @ 50%: 4.1 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.7 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
28 dm - twenty-eight day running mean
NR - No Record
NC - Average not computed due to insufficient data.
BR : Below Rating
e - estimated value s - substituted value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows:
- 7 day average is progressive daily mean for the first six days of the month.

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
04/08/2015	5.78	3.82	9,749	23.61	16.70	16.43	10.16	9.76	9.30	6.56	6.03
04/09/2015	5.59	3.80	10,786	22.68	16.81	16.56	9.88	9.47	9.40	6.22	6.10
04/10/2015	5.70	3.95	9,558	23.15	17.43	16.69	10.42	10.04	9.49	6.70	6.18
04/11/2015	5.54	3.98	8,994	23.57	17.50	16.84	10.50	10.13	9.61	6.81	6.28
04/12/2015	5.33	3.84	8,867	23.14	17.04	16.93	9.91	9.50	9.68	6.37	6.33
04/13/2015	5.08	3.76	4,740	22.93	17.21	16.98	10.05	9.65	9.70	6.83	6.38
04/14/2015	5.19	3.63	4,221	23.36	16.07	16.91	9.71	9.29	9.65	6.35	6.37
04/15/2015	4.94	3.35	5,263	22.79	16.27	16.93	9.26	8.82	9.66	5.96	6.40
04/16/2015	5.17	3.52	4,960	23.59	16.64	17.03	9.72	9.30	9.74	6.37	6.46
04/17/2015	5.59	3.76	3,879	24.47	17.81	17.17	10.94	10.59	9.87	7.20	6.58
04/18/2015	5.96	4.00	3,798	24.80	18.99	17.32	12.13	11.88	10.02	8.25	6.72
04/19/2015	6.34	4.31	3,450	25.65	19.93	17.50	13.35	13.20	10.23	9.49	6.93
04/20/2015	6.45	4.41	3,318	26.97	20.58	17.71	14.02	13.94	10.50	10.04	7.18
04/21/2015	6.53	4.46	3,890	27.49	21.25	17.87	14.40	14.36	10.71	10.47	7.40
04/22/2015	6.25	4.26	3,644	26.25	20.37	18.13	13.17	13.01	10.94	9.42	7.61
04/23/2015	6.11	4.28	3,751	26.65	18.97	18.29	13.51	13.38	11.22	9.69	7.85
04/24/2015	5.92	4.30	2,822	27.11	20.86	18.53	14.06	13.99	11.50	9.82	8.08
04/25/2015	5.62	4.24	2,895	26.70	19.88	18.70	13.32	13.17	11.72	9.30	8.25
04/26/2015	4.98	3.77	6,427	24.57	18.74	18.83	12.13	11.88	11.89	8.26	8.39
04/27/2015	5.14	3.66	7,292	24.22	18.19	18.90	11.34	11.03	11.99	7.69	8.45
04/28/2015	5.26	3.76	6,737	25.43	18.93	19.10	12.26	12.02	12.18	8.45	8.60
04/29/2015	5.30	3.77	6,058	25.35	19.48	19.33	12.30	12.06	12.42	8.59	8.79
04/30/2015	5.46	3.81	6,433	23.28	19.04	19.50	12.26	12.02	12.61	8.63	8.95
05/01/2015	5.61	4.04	4,241	22.83	20.70	19.71	13.46	13.32	12.80	9.68	9.13
05/02/2015	6.09	4.34	3,649	23.79	21.95	19.92	15.35	15.41	13.06	11.32	9.35
05/03/2015	6.26	4.09 e	4,093	24.00	22.65	20.11	15.99	16.12	13.26	12.08	9.53
05/04/2015	6.37	4.41	3,961	24.06	22.77	20.27	15.95 e	15.65	13.39	11.98	9.67
05/05/2015	6.25 e	4.14 e	4,919	27.06	22.99	20.39	15.35	15.40	13.46	11.00	9.71
05/06/2015	6.19	4.39 e	4,866	28.81	23.10	20.59	15.14	15.18	13.62	10.88	9.81
05/07/2015	6.21	4.20	5,246	28.76	22.74	20.86	14.87	14.88	13.75	10.63	9.88

Antioch Tides measured in feet above mean sea level.
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised June 1995.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e - estimated value   s - substituted value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Threemile Slough		Cache Slough	Good Year Slough	Sunrise Club	Volanti Slough	Beldon Landing	Collinsville
	mdEC	14mdEC	mdEC	14mdEC	mdEC	14mdEC	mdEC	mhtEC	mhtEC	mhtEC	mhtEC	mhtEC
04/08/2015	3.39	2.95	0.87	0.77	0.84	0.69	NR	12.36	8.06	5.59	6.12	7.55
04/09/2015	3.26	3.00	0.83	0.78	0.75	0.69	NR	12.39	8.70	6.42	5.70	7.01
04/10/2015	3.44	3.04	0.89	0.79	0.79	0.70	NR	12.07	8.94	7.94	6.86	8.35
04/11/2015	3.45	3.09	0.90	0.81	0.75	0.71	NR	11.94	9.28	8.08	7.16	8.37
04/12/2015	3.16	3.12	0.84	0.81	0.68	0.72	NR	11.82	9.45	8.42	4.64	7.56
04/13/2015	3.19	3.14	0.86	0.82	0.76	0.72	NR	12.19	8.82	7.84	7.24	6.28
04/14/2015	3.10	3.14	0.80	0.82	0.73	0.72	NR	11.63	8.85	8.05	5.60	7.92
04/15/2015	2.51	3.14	0.73	0.83	0.59	0.72	NR	12.07	8.71	7.92	7.37	7.17
04/16/2015	2.82	3.18	0.79	0.84	0.66	0.73	NR	12.09	8.55	7.83	7.37	6.94
04/17/2015	3.42	3.25	0.88	0.85	0.93	0.75	NR	12.20	8.75	7.30	7.02	8.48
04/18/2015	4.02	3.33	1.03	0.87	1.18	0.79	NR	11.86	8.52	7.40	6.56	9.34
04/19/2015	4.72	3.44	1.22	0.90	1.52	0.85	NR	11.80	8.80	7.75	6.51	10.83
04/20/2015	5.13	3.56	1.43	0.94	1.76	0.93	NR	12.20	9.04	7.55	7.02	11.79
04/21/2015	5.32	3.64	1.57	0.97	2.14	1.01	NR	13.52	9.28	8.09	7.97	11.56
04/22/2015	4.85	3.74	1.43	1.01	1.71	1.07	NR	13.78	9.23	8.42	8.86	10.94
04/23/2015	5.04	3.87	1.48	1.06	1.77	1.14	NR	13.67	9.59	9.37	9.68	11.34
04/24/2015	5.52	4.02	1.59	1.11	1.87	1.22	NR	13.62	9.77	9.51	9.89	11.41
04/25/2015	5.17	4.14	1.51	1.15	1.64	1.28	NR	13.47	9.59	9.65	9.63	10.79
04/26/2015	4.47	4.23	1.27	1.18	1.24	1.32	NR	13.38	9.74	9.70	9.62	9.60
04/27/2015	4.06	4.30	1.17	1.21	0.99	1.34	NR	13.31	9.92	10.17	9.76	8.83
04/28/2015	4.46	4.39	1.23	1.24	1.27	1.38	NR	13.44	9.70	9.74	9.39	10.05
04/29/2015	4.53	4.54	1.27	1.28	1.26	1.42	NR	13.43	9.90	9.95	9.07	9.55
04/30/2015	4.71	4.67	1.33	1.31	1.22	1.46	NR	13.44	9.89	10.12	8.49	10.24
05/01/2015	5.32	4.81	1.53	1.36	1.60	1.51	NR	13.47	10.55	10.32	8.82	10.76
05/02/2015	6.11	4.96	1.91	1.42	2.03	1.57	NR	13.75	10.48	10.27	8.79	13.31
05/03/2015	6.66	5.10	2.19	1.49	2.32	1.63	NR	13.95 e	10.43 e	10.10	8.80	11.84 e
05/04/2015	6.49	5.19	2.20	1.55	2.45	1.68	NR	14.26	10.29	9.53	10.30	13.50
05/05/2015	6.61	5.29	2.06	1.58	2.16	1.68	NR	15.04	11.41	10.45	10.58	12.48
05/06/2015	6.40	5.40	2.03	1.63	2.21	1.72	NR	15.17	12.18	10.84	11.60	13.01
05/07/2015	6.41	5.50	2.02	1.66	2.28	1.75	NR	15.16	12.15	11.13	11.69	12.46

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
mht : mean high tides
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value

Delta Water Quality Conditions

Date	Emmaton mdEC	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
04/08/2015	1.45	0.53	0.65	0.50	0.48	0.48	0.48	0.48	1,010	86	66	b
04/09/2015	1.45	0.56	0.65	0.51	0.48	0.48	0.50	0.49	968	86	68	b
04/10/2015	1.65	0.57	0.67	0.52	0.48	0.49	0.50	0.51	1,024	87	70	b
04/11/2015	1.61	0.56	0.68	0.52	0.48	0.50	0.51	0.53	1,027	88	71	b
04/12/2015	1.32	0.54	0.68	0.53	0.49	0.50	0.51	0.52	937	89	73	b
04/13/2015	1.67	0.56	0.69	0.54	0.49	0.51	0.50	0.52	946	90	74	b
04/14/2015	1.24	0.58	0.70	0.54	0.50	0.51	0.51	0.55	919	92	75	b
04/15/2015	0.98	0.55	0.70	0.55	0.50	0.51	0.53	0.58	728	93	76	b
04/16/2015	1.32	0.54	0.70	0.54	0.51	0.51	0.52	0.57	828	96	76	b
04/17/2015	1.91	0.55	0.70	0.53	0.52	0.51	0.51	0.57	1,018	98	77	b
04/18/2015	2.39	0.54	0.72	0.54	0.52	0.52	0.51	0.58	1,209	97	79	b
04/19/2015	2.95	0.59	0.75	0.55	0.52	0.53	0.51	0.57	1,434	97	81	b
04/20/2015	3.41	0.61	0.80	0.57	0.50	0.53	0.51	0.57	1,565	92	83	b
04/21/2015	3.87	0.68	0.87	0.60	0.52	0.54	0.52	0.59	1,624	99	86	b
04/22/2015	3.02	0.70	0.87	0.60	0.53	0.55	0.51	0.61	1,476	101	87	b
04/23/2015	3.22	0.73	0.90	0.65	0.55	0.53	0.52	0.63	1,537	106	89	b
04/24/2015	3.54	0.78	0.97	0.66	0.58	0.55	0.53	0.62	1,689	113	90	b
04/25/2015	3.05	0.80	1.01	0.67	0.60	0.55	0.53	0.59	1,576	118	91	b
04/26/2015	2.23	0.81	1.02	0.64	0.60	0.56	0.53	0.55	1,352	119	92	b
04/27/2015	1.84	0.82	1.02	0.67	0.61	0.57	0.53	0.53	1,224	121	93	b
04/28/2015	2.40	0.82	1.06	0.70	0.64	0.58	0.54	0.52	1,350	129	95	b
04/29/2015	2.37	0.83	1.06	0.72	0.66	0.59	0.55	0.52	1,374	135	98	b
04/30/2015	2.16	0.84	1.05	0.75	0.69	0.61	0.55	0.53	1,430	142	102	b
05/01/2015	2.87	0.85	1.06	0.77	0.71	0.63	0.55	0.52	1,625	147	107	b
05/02/2015	3.69	0.85	1.13	0.78	0.72	0.65	0.58	0.53	1,877	150	112	b
05/03/2015	4.38	0.90	1.28	0.81	0.73	0.67	0.59	0.54	2,052	153	118	b
05/04/2015	4.53	0.95 e	1.38	0.85	0.73	0.69	0.60	0.54	1,998	154	126	b
05/05/2015	3.93 e	1.05 e	1.38	0.85	0.75	0.71	0.61	0.55	2,034	157	133	b
05/06/2015	3.90	1.08	1.41	0.88	0.77	0.72	0.62	0.57	1,969	162	138	b
05/07/2015	3.73	1.10 e	1.42	0.89	0.79	0.73	0.62	0.60	1,973	170	143	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value s : substituted value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
(Note: below label begins on October 1, 2013)
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
04/08/2015	0.13	0.51	0.38	0.90	0.78	1.07	0.43	0.68
04/09/2015	0.15	0.49	0.21	0.87	0.78	1.05	0.26	0.66
04/10/2015	0.16	0.47	0.15	0.83	0.82	1.04	0.15	0.63
04/11/2015	0.16	0.45	0.16	0.80	0.78	1.02	0.17	0.61
04/12/2015	0.17	0.44	0.21	0.76	0.74	1.01	0.21	0.58
04/13/2015	0.12	0.42	0.23	0.73	0.71	0.99	0.23	0.56
04/14/2015	0.11	0.40	0.23	0.69	0.71	0.97	0.23	0.53
04/15/2015	0.14	0.38	0.14	0.66	0.68	0.95	0.19	0.50
04/16/2015	0.14	0.36	0.13	0.62	0.69	0.93	0.13	0.48
04/17/2015	0.15	0.34	0.15	0.58	0.72	0.91	0.16	0.45
04/18/2015	0.18	0.32	0.15	0.55	0.76	0.90	0.17	0.43
04/19/2015	0.20	0.31	0.16	0.51	0.79	0.88	0.17	0.41
04/20/2015	0.22	0.29	0.17	0.48	0.79	0.86	0.18	0.38
04/21/2015	0.25	0.27	0.19	0.44	0.78	0.84	0.19	0.36
04/22/2015	0.29	0.26	0.21	0.41	0.75	0.82	0.21	0.34
04/23/2015	0.35	0.25	0.22	0.38	0.73	0.81	0.23	0.32
04/24/2015	0.41	0.24	0.24	0.34	0.73	0.79	0.25	0.30
04/25/2015	0.42	0.24	0.25	0.31	0.72	0.77	0.28	0.28
04/26/2015	0.44	0.25	0.28	0.29	0.71	0.75	0.31	0.27
04/27/2015	0.45	0.25	0.30	0.26	0.71	0.74	0.35	0.26
04/28/2015	0.46	0.26	0.32	0.25	0.73	0.73	0.39	0.26
04/29/2015	0.44	0.26	0.33	0.24	0.72	0.72	0.43	0.27
04/30/2015	0.48	0.27	0.34	0.25	0.72	0.72	0.47	0.28
05/01/2015	0.51	0.27	0.35	0.25	0.71	0.72	0.50	0.28
05/02/2015	0.45	0.28	0.37	0.25	0.74	0.72	0.53	0.29
05/03/2015	0.44	0.28	0.40	0.26	0.75	0.73	0.55	0.30
05/04/2015	0.43	0.28	0.42	0.26	0.74	0.74	0.57	0.30
05/05/2015	0.46	0.29	0.43	0.26	0.72	0.74	0.61	0.31
05/06/2015	0.50	0.30	0.45	0.26	0.73	0.74	0.61	0.32
05/07/2015	0.45	0.31	0.47	0.27	0.74	0.74	0.60	0.32

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
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BR : Below Rating
e : estimated value s : substituted value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, June 02, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	35 %	9 %
NDOI, monthly average *	>= 4,000 cfs	3,852 cfs
NDOI, 7 day average*	>= 3,000 cfs	3,852 cfs
Vernalis Base Flow : Monthly average *	>= 200 cfs	320 cfs
7 Day average *	>= 160 cfs	320 cfs
Habitat Protection, X2 / Flow	30 days at Collinsville	0 days
	0 day (s) at Chipps Island	0 days
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	124 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	207 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	1.67 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	1.59 mS/cm
14dm EC at San Andreas Landing	<= 0.87 mS/cm	0.52 mS/cm
14dm EC at Terminous	<= 0.54 mS/cm	0.16 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.5 mS/cm
Brandt Bridge	<=0.7 mS/cm	0.6 mS/cm
Old River Near Tracy	<=0.7 mS/cm	0.9 mS/cm
Old River Near Middle River	<=0.7 mS/cm	0.7 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out   Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2015)

Previous Month's Index (8RI for Apr): 766 TAF
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.7 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
NR - No Record
NC - Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows and Suisun Marsh mhtEC:
- 7 day average is progressive daily mean for the first six days of the month.
- Monthly average is progressive daily mean from the beginning of the month

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
05/04/2015	6.37	4.41	3,961	24.06	22.77	20.27	15.95 e	15.65	13.39	11.98	9.67
05/05/2015	6.25 e	4.14 e	4,919	27.06	22.99	20.39	15.35	15.40	13.46	11.00	9.71
05/06/2015	6.19	4.39 e	4,866	28.81	23.10	20.59	15.14	15.18	13.62	10.88	9.81
05/07/2015	6.21	4.20	5,246	28.76	22.74	20.86	14.87	14.88	13.75	10.63	9.88
05/08/2015	6.11	4.26	5,401	30.33	21.96	20.94	14.48	14.45	13.79	10.30	9.91
05/09/2015	5.86	4.17	5,799	30.00 e	21.76	21.07	15.01	15.03	13.92	11.01	10.04
05/10/2015	5.66	4.15	5,387	30.00 e	21.54	21.27	14.77	14.76	14.13	10.67	10.21
05/11/2015	5.42	4.10	5,319	26.95	21.92	21.54	14.62	14.60	14.38	10.12	10.38
05/12/2015	5.57	4.04	4,858	29.18	21.16	21.70	14.55	14.53	14.56	9.96	10.49
05/13/2015	5.68	3.97	5,620	27.57	21.10	21.81	14.31	14.25	14.72	9.70	10.57
05/14/2015	5.80	3.98	4,993	27.63	21.04	21.96	14.12	14.05	14.86	9.83	10.65
05/15/2015	6.02	4.07	5,964	28.59	21.65	22.02	14.85	14.85	14.97	10.29	10.70
05/16/2015	6.27	4.12	5,447	28.00 e	22.21	22.04	14.89	14.90	14.93	10.23	10.62
05/17/2015	6.36	4.19	6,090	28.00 e	22.14	22.01	14.93	14.94	14.85 e	10.70	10.52
05/18/2015	6.39	4.25	5,476	28.77	22.30	21.97	15.45	15.52	14.81	10.82	10.44
05/19/2015	6.45	4.26	5,865	28.90	22.17	21.91	15.16	15.20	14.80	10.69	10.42
05/20/2015	6.44	4.37	6,193	29.46	22.47	21.87	15.34	15.39	14.81	10.73	10.40
05/21/2015	6.35	4.38	6,150	28.33	22.18	21.83	15.25	15.30	14.84	10.61	10.40
05/22/2015	6.05	4.25	6,422	25.88	21.48	21.79	14.52	14.49	14.84	9.83	10.37
05/23/2015	5.74	4.14	6,055	25.00 e	21.27	21.76	13.68	13.57	14.74	9.09	10.23
05/24/2015	5.41	4.10	6,057	25.00 e	20.78	21.71	13.24	13.09	14.62	8.87	10.10
05/25/2015	5.62	4.11	5,656	25.00 e	19.94	21.56	13.64	13.52	14.54	8.73	10.00
05/26/2015	5.74	4.12	5,160	26.25	20.12	21.49	13.72	13.61	14.48	9.05	9.94
05/27/2015	5.88	4.12	4,711	26.47	19.67	21.39	13.40	13.27	14.41	8.80	9.88
05/28/2015	5.86	4.07	4,278	25.66	19.80	21.30	13.11	12.94	14.33	8.74	9.80
05/29/2015	6.02	4.15	4,461	25.45	20.22	21.20	13.37	13.23	14.21	8.91	9.70
05/30/2015	6.12	4.22	3,858	25.38	20.64	21.08	13.89	13.79	14.13	9.22	9.63
05/31/2015	6.38	4.39	3,904	27.27	21.59	21.04	14.90	14.91	14.13	9.82	9.56
06/01/2015	6.51	4.37	3,265	26.98	21.58	20.99	14.63	14.61	14.07	9.93	9.50
06/02/2015	6.47	4.34	4,439	26.57	21.86	20.97	14.30	14.25	14.00	9.79	9.44

Antioch Tides measured in feet relative to the NAVD88 Datum
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised March 2000.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Three Mile Slough		San Andreas Landing		Terminous	
	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm
05/04/2015	6.49	5.19	2.20	1.55	4.53	3.08	2.45	1.68	0.53	0.45	0.19	0.22
05/05/2015	6.61	5.29	2.06	1.58	3.93 e	3.09	2.16	1.68	0.52	0.45	0.20	0.22
05/06/2015	6.40	5.40	2.03	1.63	3.90	3.15	2.21	1.72	0.52	0.46	0.20	0.22
05/07/2015	6.41	5.50	2.02	1.66	3.73	3.19	2.28	1.75	0.55	0.47	0.20	0.21
05/08/2015	6.38	5.56	2.05	1.70	3.66	3.20	2.32	1.78	0.54	0.48	0.20	0.21
05/09/2015	6.21	5.63	2.00	1.73	3.81	3.25	2.18	1.82	0.54	0.49	0.20	0.21
05/10/2015	6.20	5.75	1.93	1.78	3.62	3.35	2.03	1.88	0.54	0.50	0.19	0.21
05/11/2015	5.96	5.89	1.83	1.83	3.47	3.47	1.95	1.95	0.53	0.51	0.19	0.21
05/12/2015	6.06	6.00	1.81	1.87	3.23	3.53	1.86	1.99	0.53	0.51	0.18	0.20
05/13/2015	5.84	6.10	1.76	1.90	3.01	3.57	1.67	2.02	0.52	0.52	0.18	0.20
05/14/2015	5.90	6.18	1.78	1.94	2.99	3.63	1.63	2.05	0.49	0.52	0.18	0.20
05/15/2015	6.11	6.24	1.90	1.96	3.53	3.68	1.90	2.07	0.47	0.52	0.16	0.19
05/16/2015	6.05	6.23	1.82	1.96	3.62	3.67	2.02	2.07	0.48	0.52	0.17	0.19
05/17/2015	6.19	6.20	1.79	1.93	4.01	3.65	2.16	2.06	0.47	0.52	0.19	0.19
05/18/2015	6.28	6.18	1.84	1.90	3.91	3.60	2.30	2.05	0.46	0.51	0.18	0.19
05/19/2015	6.31	6.16	1.89	1.89	3.58	3.58	2.19	2.05	0.50	0.51	0.17	0.19
05/20/2015	6.53	6.17	1.94	1.88	3.68	3.56	2.24	2.05	0.55	0.51	0.17	0.18
05/21/2015	6.57	6.18	2.06	1.89	3.28	3.53	2.08	2.04	0.55	0.51	0.16	0.18
05/22/2015	5.98	6.15	1.79	1.87	2.55	3.45	1.70	1.99	0.52	0.51	0.16	0.18
05/23/2015	5.14	6.08	1.65	1.84	2.20	3.33	1.50	1.94	0.46	0.51	0.16	0.17
05/24/2015	4.79	5.98	1.45	1.81	2.54	3.26	1.40	1.90	0.46	0.50	0.16	0.17
05/25/2015	4.69	5.89	1.37	1.78	2.63	3.20	1.42	1.86	0.45	0.49	0.16	0.17
05/26/2015	4.75	5.79	1.34	1.74	2.63	3.15	1.54	1.84	0.47	0.49	0.16	0.17
05/27/2015	4.87	5.72	1.37	1.71	2.27	3.10	1.44	1.82	0.48	0.49	0.17	0.17
05/28/2015	4.83	5.65	1.35	1.68	2.13	3.04	1.34	1.80	0.52	0.49	0.17	0.17
05/29/2015	5.00	5.57	1.41	1.65	2.38	2.96	1.41	1.77	0.54	0.49	0.17	0.17
05/30/2015	5.07	5.50	1.47	1.62	2.86	2.90	1.51	1.73	0.55	0.50	0.16	0.17
05/31/2015	5.35	5.44	1.68	1.61	3.32	2.85	1.84	1.71	0.59	0.51	0.17	0.16
06/01/2015	5.45	5.38	1.70	1.60	3.49	2.82	2.02	1.69	0.60	0.52	0.17	0.16
06/02/2015	5.76	5.34	1.65	1.59	3.46	2.81	1.93	1.67	0.60	0.52	0.17	0.16

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
05/04/2015	0.95 e	1.38	0.85	0.73	0.69	0.60	0.54	1,998	154	126	b
05/05/2015	1.05 e	1.38	0.85	0.75	0.71	0.61	0.55	2,034	157	133	b
05/06/2015	1.08	1.41	0.88	0.77	0.72	0.62	0.57	1,969	162	138	b
05/07/2015	1.10 e	1.42	0.89	0.79	0.73	0.62	0.60	1,973	170	143	b
05/08/2015	1.13	1.37	0.87	0.81	0.74	0.64	0.61	1,963	174	145	b
05/09/2015	1.14	1.38	0.90	0.82	0.74	0.66	0.60	1,907	175	145 e	b
05/10/2015	1.13	1.37	0.89	0.82	0.75	0.68	0.59	1,905	178	145 e	b
05/11/2015	1.14	1.36	0.88	0.83	0.76	0.68	0.59	1,827	178	149	b
05/12/2015	1.14	1.37	0.84	0.85	0.77	0.69	0.60	1,861	183	150	b
05/13/2015	1.15	1.37	0.89	0.86	0.78	0.71	0.60	1,789	187	156	b
05/14/2015	1.15	1.41	0.93	0.87	0.79	0.72	0.62	1,809	189	159	b
05/15/2015	1.06	1.41	0.95	0.89	0.80	0.72	0.63	1,876	194	163	b
05/16/2015	1.17	1.40	0.93	0.89	0.82	0.74	0.62	1,856	196	163 e	b
05/17/2015	1.17	1.42	0.94	0.90	0.83	0.77	0.65	1,900	197	163 e	b
05/18/2015	1.17	1.40	0.93	0.91	0.82	0.78	0.70	1,930	200	175	b
05/19/2015	1.17	1.37	0.89	0.92	0.88	0.78	0.78	1,940	204	177	b
05/20/2015	1.16	1.38	0.92	0.92	0.89	0.78	0.79	2,010	204	180	b
05/21/2015	1.17	1.38	0.91	0.93	0.91	0.80	0.79	2,021	206	183	b
05/22/2015	1.16	1.37	0.95	0.92	0.92	0.81	0.79	1,833	204	188	b
05/23/2015	1.16	1.35	0.93	0.92	0.93	0.81	0.79	1,568	203	185 e	b
05/24/2015	1.16	1.33	0.94	0.92	0.94	0.82	0.78	1,455	203	185 e	b
05/25/2015	1.15	1.34	0.92	0.92	0.95	0.82	0.79	1,425	203	185 e	b
05/26/2015	1.14	1.32	0.96	0.92	0.96	0.83	0.79	1,443	203	201	b
05/27/2015	1.09	1.32	0.95	0.93	0.97	0.84	0.80	1,480	205	203	b
05/28/2015	1.08	1.31	0.95	0.92	0.97	0.83	0.84	1,469	204	204	b
05/29/2015	1.08	1.33	0.93	0.92	0.97	0.82	0.84	1,523	203	204	b
05/30/2015	1.07	1.36	0.92	0.91	0.98	0.81	0.85	1,543	201	204 e	b
05/31/2015	1.07	1.41	0.90	0.90	0.98	0.80	0.86	1,633	197	204 e	b
06/01/2015	1.03	1.43	0.87	0.88	0.98	0.81	0.85	1,667	192	206	b
06/02/2015	0.99	1.43	0.87	0.87	0.98	0.81	0.89	1,765	189	207	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta conditions
- r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	mdEC	30dm	mdEC	30dm	mdEC	30dm	mdEC	30dm
05/04/2015	0.43	0.28	0.42	0.26	0.74	0.74	0.57	0.30
05/05/2015	0.46	0.29	0.43	0.26	0.72	0.74	0.61	0.31
05/06/2015	0.50	0.30	0.45	0.26	0.73	0.74	0.61	0.32
05/07/2015	0.45	0.31	0.47	0.27	0.74	0.74	0.60	0.32
05/08/2015	0.48	0.32	0.49	0.27	0.75	0.74	0.62	0.33
05/09/2015	0.43	0.33	0.52	0.28	0.78	0.74	0.64	0.34
05/10/2015	0.41	0.34	0.55	0.30	0.77	0.74	0.67	0.36
05/11/2015	0.41	0.35	0.60	0.31	0.81	0.74	0.71	0.38
05/12/2015	0.46	0.36	0.63	0.32	0.82	0.74	0.72	0.39
05/13/2015	0.50	0.37	0.64	0.34	0.86	0.75	0.71	0.41
05/14/2015	0.50	0.38	0.65	0.35	0.87	0.75	0.71	0.43
05/15/2015	0.53	0.39	0.65	0.37	0.87	0.76	0.71	0.44
05/16/2015	0.50	0.41	0.66	0.39	0.84	0.76	0.71	0.46
05/17/2015	0.44	0.42	0.66	0.40	0.83	0.77	0.71	0.48
05/18/2015	0.44	0.42	0.67	0.42	0.85	0.77	0.71	0.50
05/19/2015	0.51	0.43	0.68	0.44	0.85	0.77	0.70	0.52
05/20/2015	0.54	0.45	0.68	0.45	0.87	0.77	0.69	0.54
05/21/2015	0.57	0.46	0.70	0.47	0.89	0.78	0.68	0.55
05/22/2015	0.63	0.47	0.70	0.49	0.89	0.78	0.65	0.57
05/23/2015	0.62	0.48	0.70	0.50	0.89	0.79	0.68	0.58
05/24/2015	0.60	0.48	0.70	0.52	0.91	0.79	0.68	0.60
05/25/2015	0.54	0.49	0.71	0.53	0.92	0.80	0.68	0.61
05/26/2015	0.58	0.49	0.71	0.55	0.93	0.81	0.68	0.62
05/27/2015	0.69	0.50	0.70	0.56	0.95	0.82	0.68	0.63
05/28/2015	0.78	0.51	0.71	0.57	0.98	0.82	0.69	0.64
05/29/2015	0.65	0.52	0.73	0.59	1.00	0.83	0.68	0.65
05/30/2015	0.58	0.52	0.75	0.60	1.00	0.84	0.68	0.66
05/31/2015	0.50	0.52	0.78	0.62	1.00	0.85	0.71	0.66
06/01/2015	0.51	0.52	0.80	0.63	1.02	0.86	0.71	0.67
06/02/2015	0.58	0.53	0.81	0.64	1.01	0.87	0.72	0.68

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
30dm : thirty day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Suisun Marsh Stations

Date	Collinvsille mhtEC	National Steel mhtEC	Beldon Landing mhtEC	Sunrise Club mhtEC	Volanti Slough mhtEC	Goodyear Slough mhtEC
05/04/2015	13.50	12.06	10.30	10.29	9.53	14.26
05/05/2015	12.48	10.83	10.58	11.41	10.45	15.04
05/06/2015	13.01	10.51	11.60	12.18	10.84	15.17
05/07/2015	12.46	10.58	11.69	12.15	11.13	15.16
05/08/2015	12.95	9.05	11.43	12.73	12.40	15.11
05/09/2015	13.61	9.98	11.03	12.51	11.61	15.06
05/10/2015	12.89	9.98	10.76	12.22	11.35	15.06
05/11/2015	11.79	9.81	10.71	11.84	10.98	15.14
05/12/2015	11.73	9.09	10.98	11.61	10.98	15.18
05/13/2015	11.30	8.62	10.73	11.43	10.77	15.37
05/14/2015	11.99	8.91	10.46	11.47	10.78	15.49
05/15/2015	12.11	9.48	10.33	11.62	11.04	15.60
05/16/2015	12.25	10.06	10.07	11.39	11.01	15.56
05/17/2015	12.51	10.12	10.12	11.63	10.97	15.54
05/18/2015	12.03	10.16	10.26	11.72	11.05	15.49
05/19/2015	12.24	10.04	10.45	11.31	10.66	15.46
05/20/2015	12.62	10.01	10.84	11.53	10.74	15.60
05/21/2015	12.27	10.19	10.81	11.44	11.09	15.82
05/22/2015	11.75	9.76	10.83	11.10	11.41	15.67
05/23/2015	11.25	9.20	10.89	11.08	10.11	15.41
05/24/2015	11.00	9.02	10.68	10.92	8.74	15.26
05/25/2015	10.78	8.92	10.30	10.90	9.19	15.08
05/26/2015	10.90	8.99	9.70	10.76	9.79	15.11
05/27/2015	10.17	8.88	9.78	11.16	10.40	15.22
05/28/2015	10.63	8.82	9.93	11.47	10.16	15.15
05/29/2015	10.37	9.19	9.97	11.53	10.43	15.18
05/30/2015	9.95	9.57	9.96	11.67	10.70	15.21
05/31/2015	10.88	9.92	9.95	11.32	10.62	15.44
06/01/2015	11.02	10.94	9.96	11.66	11.24	15.94
06/02/2015	11.10	9.64	10.12	11.44	11.02	16.26

Electrical Conductivity (EC) units: milliSiemens per Centimeter
mht : mean high tides
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Monday, July 13, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	7 %
NDOI, monthly average *	>= 3,000 cfs	3,256 cfs
NDOI, 7 day average*	>= 2,000 cfs	3,475 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	124 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	172 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	3.17 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	2.23 mS/cm
14dm EC at San Andreas Landing	<= 0.87 mS/cm	0.62 mS/cm
14dm EC at Terminous	<= 0.54 mS/cm	0.15 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.7 mS/cm
Brandt Bridge	<=0.7 mS/cm	1.1 mS/cm
Old River Near Tracy	<=0.7 mS/cm	1.0 mS/cm
Old River Near Middle River	<=0.7 mS/cm	1.1 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out — Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2015)

Previous Month's Index (8RI for Apr): 766 TAF
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.7 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
NR - No Record
NC - Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows and Suisun Marsh mhtEC:
- 7 day average is progressive daily mean for the first six days of the month.
- Monthly average is progressive daily mean from the beginning of the month

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
06/14/2015	7.14	4.85	4,356	32.38	22.30	20.88	15.84	15.95	14.25	11.46	9.92
06/15/2015	7.09	4.70	3,971	31.57	20.59	20.81	15.58	15.66	14.32	10.87	9.99
06/16/2015	6.88	4.53	3,732	30.90	18.98	20.60	14.57	14.55	14.34	10.46	10.04
06/17/2015	6.72	4.49	3,370	30.59	19.74	20.37	14.49	14.46	14.34	10.39	10.09
06/18/2015	6.60	4.47	3,697	30.65	21.19	20.33	14.76	14.76	14.40	10.37	10.14
06/19/2015	6.37	4.34	3,481	30.25	20.53	20.25	14.32	14.27	14.36	10.06	10.10
06/20/2015	6.12	4.39	3,792	29.48	20.25	20.15	13.81	13.71	14.25	9.78	10.01
06/21/2015	5.87	4.32	3,595	30.19	19.97	20.09	14.18	14.12	14.23	9.91	9.99
06/22/2015	5.50	4.13	3,458	29.29	18.17	19.97	13.31	13.16	14.23	9.23	9.99
06/23/2015	5.68	4.04	3,846	28.21	19.00	19.95	13.03	12.86	14.15	8.83	9.93
06/24/2015	5.88	4.09	3,472	28.31	19.31	19.94	13.33	13.18	14.17	8.86	9.93
06/25/2015	6.07	4.15	3,281	29.04	19.67	19.95	13.76 e	13.65 e	14.25	9.14	9.97
06/26/2015	6.45	4.36	3,271	30.09	21.02	20.00	14.74	14.73	14.32	10.46	10.05
06/27/2015	6.41	4.51	3,126	30.92	22.23	20.21	16.09	16.23	14.38	11.58	10.10
06/28/2015	6.48	4.44	2,962	30.82	20.80	20.10	15.90	16.02	14.38	11.42	10.10
06/29/2015	6.58	4.44	3,113	31.16	21.78	20.19	15.63	15.71	14.39	11.09	10.11
06/30/2015	6.63	4.38	3,484	30.01	19.35	20.22	15.09	15.12	14.43	10.77	10.14
07/01/2015	6.76	4.48	3,511	30.63	21.60	20.35	16.00	16.13	14.55	11.26	10.20
07/02/2015	6.88	4.65	3,153	31.32	21.87	20.40	16.72	16.93	14.70	12.08	10.32
07/03/2015	6.97	4.68	2,809	32.23	22.48	20.54	17.12	17.39	14.92	12.58	10.50
07/04/2015	6.91	4.80	2,929	32.61	23.06	20.74	17.55	17.86	15.22	12.89	10.72
07/05/2015	6.83	4.89	2,900	33.16	22.98	20.95	17.93	18.30	15.52	13.21	10.96
07/06/2015	6.36	4.60	2,702	31.87	21.78	21.21	16.59	16.79	15.78	12.22	11.17
07/07/2015	6.14	4.42	3,311	30.36	20.13	21.29	15.97	16.09	16.01	11.26	11.35
07/08/2015	6.41	4.47	3,072	30.48	19.10	21.28	16.17	16.32	16.23 e	11.35	11.52
07/09/2015	6.44	4.42	2,854	30.48	21.09	21.38	15.75	15.85	16.39	11.09	11.66
07/10/2015	6.57	4.34	3,498	29.91	19.86	21.29	15.26	15.31	16.43	10.68	11.68
07/11/2015	6.72	4.48	3,851	30.15	21.75	21.26	15.84	15.96	16.41	11.25	11.65
07/12/2015	6.75	4.53	3,723	30.82	21.81	21.33	16.12	16.26	16.43	11.55	11.66
07/13/2015	6.81	4.59	4,018	30.83	21.95	21.34	15.86	15.98	16.45	11.54	11.70

Antioch Tides measured in feet relative to the NAVD88 Datum
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised March 2000.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
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e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Three Mile Slough		San Andreas Landing		Terminous	
	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm
06/14/2015	6.73	5.81	2.22	1.76	4.85	3.66	2.91	2.16	0.71	0.63	0.17	0.17
06/15/2015	6.33	5.87	2.08	1.79	4.85	3.76	2.83	2.22	0.70	0.64	0.18	0.18
06/16/2015	6.10	5.90	1.94	1.81	4.48	3.83	2.68	2.27	0.68	0.64	0.18	0.18
06/17/2015	5.99	5.91	1.93	1.83	4.36	3.89	2.55	2.30	0.66	0.65	0.16	0.18
06/18/2015	6.10	5.96	1.78	1.83	4.47	3.97	2.67	2.35	0.62	0.65	0.16	0.17
06/19/2015	5.85	5.93	1.85	1.83	4.28	3.99	2.51	2.37	0.61	0.64	0.16	0.17
06/20/2015	5.71	5.89	1.77	1.82	4.05	3.97	2.45	2.37	0.60	0.63	0.17	0.17
06/21/2015	5.76	5.90	1.78	1.81	4.30	4.00	2.53	2.40	0.58	0.63	0.17	0.17
06/22/2015	5.06	5.88	1.62	1.81	3.60	4.01	2.18	2.41	0.51	0.63	0.17	0.17
06/23/2015	4.94	5.82	1.53	1.80	3.30	3.99	1.95	2.39	0.52	0.62	0.17	0.17
06/24/2015	5.18	5.81	1.55	1.80	3.17	4.00	1.93	2.39	0.57	0.62	0.17	0.17
06/25/2015	5.60	5.84	1.67	1.81	3.06	4.01	1.86	2.40	0.60	0.62	0.17	0.17
06/26/2015	6.35	5.88	1.89	1.83	3.70	4.04	2.04	2.40	0.68	0.62	0.17	0.17
06/27/2015	6.93	5.90	2.21	1.84	4.14	4.04	2.55	2.40	0.69	0.62	0.16	0.17
06/28/2015	6.67	5.90	2.17	1.84	4.31	4.00	2.47	2.37	0.67	0.62	0.15	0.17
06/29/2015	6.43	5.90	2.16	1.85	4.50	3.98	2.57	2.35	0.63	0.62	0.15	0.16
06/30/2015	6.31	5.92	1.99	1.85	4.43	3.98	2.58	2.34	0.60	0.61	0.15	0.16
07/01/2015	6.98	5.99	2.16	1.87	4.81	4.01	2.87	2.37	0.65	0.61	0.15	0.16
07/02/2015	7.44	6.09	2.35	1.91	5.22	4.06	3.19	2.41	0.68	0.61	0.15	0.16
07/03/2015	7.47	6.20	2.42	1.95	5.74	4.17	3.45	2.47	0.72	0.62	0.15	0.16
07/04/2015	7.63	6.34	2.55	2.00	5.98	4.30	3.63	2.56	0.75	0.63	0.15	0.16
07/05/2015	7.95	6.49	2.62	2.06	6.48	4.46	4.10	2.67	0.72	0.64	0.15	0.16
07/06/2015	7.29	6.65	2.42	2.12	5.77	4.62	3.61	2.77	0.62	0.65	0.14	0.16
07/07/2015	6.76	6.78	2.16	2.17	5.10	4.74	3.11	2.85	0.57	0.65	0.15	0.15
07/08/2015	6.90	6.91	2.10	2.20	5.18	4.89	3.21	2.94	0.55	0.65	0.15	0.15
07/09/2015	6.84	7.00	2.09	2.23	5.02	5.03	3.11	3.03	0.54	0.65	0.14	0.15
07/10/2015	6.66	7.02	1.98	2.24	4.66	5.10	2.77	3.09	0.54	0.64	0.14	0.15
07/11/2015	7.17	7.03	2.08	2.23	4.83	5.15	2.88	3.11	0.57	0.63	0.14	0.15
07/12/2015	7.37	7.08	2.30	2.24	5.20	5.21	3.00	3.15	0.61	0.63	0.14	0.15
07/13/2015	6.71	7.10	2.01	2.23	4.81	5.23	2.93	3.17	0.59	0.62	0.14	0.15

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
06/14/2015	0.95	1.54	0.81	0.76	0.87	0.81	0.90	2,073	161	184	b
06/15/2015	0.90	1.53	0.79	0.76	0.86	0.80	0.87	1,945	162	184	b
06/16/2015	0.85	1.52	0.79	0.76	0.85	0.80	0.91	1,872	161	182	b
06/17/2015	0.86	1.55	0.80	0.74	0.84	0.80	0.88	1,837	156	178	b
06/18/2015	0.87	1.56	0.79	0.75	0.84	0.79	0.88	1,874	159	178	b
06/19/2015	0.87	1.53	0.79	0.74	0.84	0.78	0.86	1,792	156	178	b
06/20/2015	0.87	1.48	0.78	0.75	0.83	0.78	0.84	1,749	157	177	b
06/21/2015	0.89	1.48	0.78	0.75	0.82	0.77	0.84	1,765	158	175	b
06/22/2015	0.89	1.44	0.75	0.71	0.83	0.77	0.83	1,542	146	174	b
06/23/2015	0.86	1.42	0.75	0.73	0.82	0.76	0.82	1,504	153	175	b
06/24/2015	0.86	1.43	0.75	0.72	0.82	0.77	0.82	1,580	149	175	b
06/25/2015	0.86	1.44	0.76	0.74	0.80	0.77	0.82	1,713	156	174	b
06/26/2015	0.88	1.51	0.78	0.74	0.82	0.77	0.82	1,951	155	173	b
06/27/2015	0.96	1.57	0.77	0.74	0.82	0.76	0.82	2,137	154	174	b
06/28/2015	0.95	1.66	0.77	0.74	0.81	0.76	0.81	2,056	155	172	b
06/29/2015	0.96	1.74	0.77	0.74	0.80	0.75	0.80	1,978	155	174	b
06/30/2015	0.91	1.71	0.77	0.74	0.79	0.76	0.80	1,939	155	173	b
07/01/2015	0.89	1.76	0.78	0.74	0.79	0.76	0.80	2,152	156	172	b
07/02/2015	0.92	1.81	0.77	0.74	0.79	0.75	0.80	2,300	156	171	b
07/03/2015	0.95	1.84	0.81	0.71	0.79	0.74	0.81	2,308	148	171 e	b
07/04/2015	0.98	1.88	0.81	0.75	0.79	0.73	0.81	2,362	159	171 e	b
07/05/2015	1.02	1.91	0.76	0.75	0.79	0.73	0.80	2,461	159	171 e	b
07/06/2015	0.99	1.81	0.74	0.75	0.80	0.72	0.78	2,252	159	170	b
07/07/2015	0.97	1.81	0.72	0.75	0.80	0.72	0.77	2,082	158	169	b
07/08/2015	0.94	1.84	0.72	0.74	0.80	0.72	0.77	2,127	156	170	b
07/09/2015	0.95	1.80	0.70	0.74	0.80	0.71	0.77	2,110	155	171	b
07/10/2015	0.94	1.78	0.71	0.73	0.79	0.73	0.76	2,050	153	170	b
07/11/2015	0.95	1.82	0.72	0.73	0.79	0.73	0.77	2,213	152	170 e	b
07/12/2015	0.98	1.89	0.75	0.72	0.78	0.73	0.77	2,278	151	170 e	b
07/13/2015	0.98	1.85	0.75	0.73	0.79	0.73	0.77	2,066	152	172	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta conditions
- r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	mdEC	30dm	mdEC	30dm	mdEC	30dm	mdEC	30dm
06/14/2015	0.68	0.62	0.98	0.79	1.04	0.96	0.82	0.72
06/15/2015	0.69	0.62	1.02	0.80	1.06	0.97	0.85	0.73
06/16/2015	0.81	0.63	1.04	0.81	1.03	0.98	0.86	0.73
06/17/2015	0.77	0.64	1.06	0.83	1.02	0.98	0.89	0.74
06/18/2015	0.67	0.65	1.09	0.84	1.00	0.99	0.93	0.75
06/19/2015	0.63	0.65	1.08	0.85	1.01	0.99	1.11	0.76
06/20/2015	0.72	0.66	1.07	0.87	1.01	1.00	1.23	0.78
06/21/2015	0.67	0.66	1.07	0.88	1.00	1.00	1.25	0.80
06/22/2015	0.68	0.66	1.04	0.89	1.02	1.01	1.24	0.82
06/23/2015	0.75	0.67	1.01	0.90	1.04	1.01	1.25	0.84
06/24/2015	0.75	0.67	1.01	0.91	1.11	1.02	1.25	0.86
06/25/2015	0.58	0.67	1.03	0.92	1.29	1.03	1.25	0.88
06/26/2015	0.61	0.67	1.05	0.93	1.12	1.03	1.26	0.90
06/27/2015	0.73	0.67	1.08	0.95	1.07	1.04	1.24	0.91
06/28/2015	0.69	0.67	1.12	0.96	1.01	1.04	1.22	0.93
06/29/2015	0.65	0.67	1.13	0.97	1.01	1.04	1.21	0.95
06/30/2015	0.54	0.67	1.12	0.98	1.02	1.04	1.19	0.97
07/01/2015	0.58	0.68	1.13	0.99	1.02	1.04	1.17	0.98
07/02/2015	0.70	0.68	1.15	1.00	1.06	1.04	1.17	1.00
07/03/2015	0.87	0.69	1.16	1.02	1.06	1.04	1.16	1.01
07/04/2015	0.77	0.70	1.17	1.03	1.06 e	1.04	1.14	1.02
07/05/2015	0.68	0.69	1.18	1.04	1.06 e	1.04	1.15	1.04
07/06/2015	0.74	0.69	1.16	1.05	0.96	1.04	1.17	1.05
07/07/2015	0.87	0.70	1.14	1.05	0.96	1.04	1.17	1.06
07/08/2015	0.98	0.71	1.13	1.06	0.96	1.04	1.15	1.07
07/09/2015	0.66	0.71	1.13	1.07	0.95	1.03	1.12	1.09
07/10/2015	0.59	0.70	1.12	1.08	0.96	1.03	1.11	1.10
07/11/2015	0.57	0.70	1.12	1.08	0.95	1.03	1.11	1.11
07/12/2015	0.57	0.69	1.11	1.09	0.93	1.03	1.11	1.12
07/13/2015	0.56	0.69	1.10	1.09	0.92	1.02	1.11	1.13

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
30dm : thirty day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Suisun Marsh Stations

Date	Collinvsille mhtEC	National Steel mhtEC	Beldon Landing mhtEC	Sunrise Club mhtEC	Volanti Slough mhtEC	Goodyear Slough mhtEC
06/14/2015	12.64	11.23	15.74	15.45	15.26	19.64
06/15/2015	11.80	11.39	15.88	15.45	15.25	20.66
06/16/2015	11.11	11.70	16.10	16.21	16.12	20.49
06/17/2015	11.42	11.96	16.79	17.81	16.83	20.19
06/18/2015	11.24	12.10	17.19	17.14	16.15	19.85
06/19/2015	10.64	12.35	17.08	15.83	16.35	19.93
06/20/2015	10.99	12.40	17.14	15.63	16.47	19.89
06/21/2015	11.18	12.48	17.19	15.55	16.96	19.78
06/22/2015	10.58	12.52	16.73	15.21	16.84	19.81
06/23/2015	9.83	12.61	16.66	15.16	16.66	19.95
06/24/2015	10.12	12.65	17.01	15.56	16.57	20.07
06/25/2015	10.23	12.73	17.09	15.57	16.43	19.97
06/26/2015	11.89	12.77	17.10	15.61	16.02	19.88
06/27/2015	11.84	12.77	17.07	15.61	16.45	19.92
06/28/2015	12.59	13.23	16.86	15.58	16.10	20.11
06/29/2015	11.98	13.47	17.05	15.86	16.63	20.20
06/30/2015	11.89	13.56	17.13	16.48	17.09	20.44
07/01/2015	12.50	13.63	17.92	16.02	17.25	20.39
07/02/2015	13.79	13.66	18.57	16.40	17.27	20.62
07/03/2015	13.43	13.82	18.46	17.09	16.63	21.18
07/04/2015	14.10	14.16	19.08	17.99	16.13	21.30
07/05/2015	14.59	14.27	19.41	18.37	15.70	21.42
07/06/2015	12.99	14.39	19.31	18.29	15.86	21.77
07/07/2015	12.38	14.26	19.12	18.46	15.92	21.97
07/08/2015	12.80	14.67	18.96	18.64	16.18	22.09
07/09/2015	12.49	14.71	18.96	18.84	16.56	22.16
07/10/2015	11.91	14.67	19.26	18.82	16.76	22.09
07/11/2015	12.00	14.63	19.44	19.00	17.05	21.94
07/12/2015	12.67	14.90	19.47	19.25	17.15	21.90
07/13/2015	12.06	14.79	19.87	19.36	17.60	21.69

Electrical Conductivity (EC) units: milliSiemens per Centimeter
mht : mean high tides
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Sunday, August 09, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	9 %
NDOI, monthly average *	>= 3,000 cfs	3,799 cfs
NDOI, 7 day average*	>= 2,000 cfs	3,780 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	124 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	167 mg/l
14dm EC at Threemile Slough at Sac	<= 2.78 mS/cm	2.73 mS/cm
14dm EC at Jersey Point	<= 2.20 mS/cm	1.90 mS/cm
14dm EC at San Andreas Landing	<= 0.87 mS/cm	0.61 mS/cm
14dm EC at Terminous	<= 0.54 mS/cm	0.14 mS/cm
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=0.7 mS/cm	0.6 mS/cm
Brandt Bridge	<=0.7 mS/cm	1.1 mS/cm
Old River Near Tracy	<=0.7 mS/cm	1.0 mS/cm
Old River Near Middle River	<=0.7 mS/cm	1.1 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 3 Open / 0 Closed / 0 Full Tide Open
Flashboard Status : Out   Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2015)

Previous Month's Index (8RI for Apr): 766 TAF
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.7 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
NR - No Record
NC - Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows and Suisun Marsh mhtEC:
- 7 day average is progressive daily mean for the first six days of the month.
- Monthly average is progressive daily mean from the beginning of the month

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
07/11/2015	6.72	4.48	3,851	30.15	21.75	21.26	15.84	15.96	16.41	11.25	11.65
07/12/2015	6.75	4.53	3,723	30.82	21.81	21.33	16.12	16.26	16.43	11.55	11.66
07/13/2015	6.81	4.59	4,018	30.83	21.95	21.34	15.86	15.98	16.45	11.54	11.70
07/14/2015	6.89	4.61	4,169	31.16	22.52	21.57	16.38	16.55	16.55	11.48	11.75
07/15/2015	6.84	4.64	3,911	30.77	20.98	21.52	16.10	16.24	16.56	11.57	11.77
07/16/2015	6.91	4.78	3,881	32.00	22.88	21.60	16.70	16.92	16.56	12.34	11.79
07/17/2015	6.80	4.80	3,682	31.39	22.42	21.59	16.81	17.04	16.53	12.23	11.76
07/18/2015	6.77	4.82	4,139	31.15	20.09	21.38	16.79	17.02	16.47	12.26	11.72
07/19/2015	6.26	4.42	4,202	30.09	16.68	20.93	14.99	15.01	16.24	10.44	11.52
07/20/2015	5.89	4.38	4,388	29.15	19.50	20.77	14.28	14.23	16.05	9.82	11.35
07/21/2015	6.02	4.52	3,359	29.86	20.47	20.79	14.95	14.96	15.97	10.30	11.28
07/22/2015	6.21	4.60	3,358	30.86	18.77	20.77	15.42	15.49	15.91	10.46	11.21
07/23/2015	6.09	4.44	3,149	29.69	18.79	20.60	14.50	14.46	15.81	9.65	11.11
07/24/2015	6.09	4.25	3,079	28.36	20.39	20.64	13.73	13.62	15.69	9.03	10.99
07/25/2015	6.36	4.34	3,024	29.19	20.13	20.53	14.21	14.15	15.57	9.73	10.89
07/26/2015	6.70	4.63	3,183	30.95	19.09	20.33	15.28	15.33	15.50	10.65	10.82
07/27/2015	6.72	4.61	2,775	29.83	17.19	19.99	15.06	15.09	15.43	9.64	10.69
07/28/2015	6.78	4.61	3,510	30.25	19.25	19.76	15.17	15.21	15.34	10.54	10.62
07/29/2015	6.87	4.71	3,365	30.72	21.93	19.83	16.01	16.14	15.33	11.36	10.60
07/30/2015	7.14	4.86	3,357	31.63	23.39	19.86	17.39	17.68	15.39	12.76	10.63
07/31/2015	7.14	4.80	3,521	31.40	22.71	19.88	17.22	17.49	15.42	12.70	10.67
08/01/2015	7.03	4.74	3,908	31.08	21.44	19.98	17.07	17.33	15.44	12.48	10.68
08/02/2015	6.79	4.67	3,823	31.04	18.14	20.08	16.87	17.10	15.59	12.16	10.81
08/03/2015	6.45	4.61	3,638	30.09	18.88	20.04	16.59	16.79	15.77	11.57	10.93
08/04/2015	6.11	4.41	3,725	30.46	17.23	19.81	15.68	15.77	15.83	10.89	10.97
08/05/2015	6.17	4.20	3,653	29.30	16.44	19.64	14.60	14.57	15.77	9.98	10.94
08/06/2015	6.39	4.30	3,947	28.88	16.66	19.49	14.35	14.30	15.76	9.80	10.95
08/07/2015	6.58	4.51	3,790	30.04	19.55	19.43	15.66	15.75	15.91	10.92	11.08
08/08/2015	6.57	4.50	3,888	30.34	16.79	19.19	15.59	15.67	16.02	11.08	11.18
08/09/2015	6.65	4.50	3,821	29.92	17.01	19.04	15.04	15.06	16.00	10.66	11.18

Antioch Tides measured in feet relative to the NAVD88 Datum
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised March 2000.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
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e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Three Mile Slough		San Andreas Landing		Terminous	
	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm
07/11/2015	7.17	7.03	2.08	2.23	4.83	5.15	2.88	3.11	0.57	0.63	0.14	0.15
07/12/2015	7.37	7.08	2.30	2.24	5.20	5.21	3.00	3.15	0.61	0.63	0.14	0.15
07/13/2015	6.71	7.10	2.01	2.23	4.81	5.23	2.93	3.17	0.59	0.62	0.14	0.15
07/14/2015	6.99	7.15	1.97	2.23	5.01	5.27	2.94	3.20	0.58	0.62	0.14	0.15
07/15/2015	7.01	7.16	2.06	2.22	4.84	5.27	2.99	3.21	0.60	0.62	0.14	0.14
07/16/2015	7.15	7.13	2.18	2.21	5.21	5.27	3.10	3.20	0.63	0.61	0.14	0.14
07/17/2015	7.07	7.11	2.28	2.20	5.32	5.24	3.06	3.17	0.62	0.61	0.14	0.14
07/18/2015	7.06	7.06	2.28	2.18	5.34	5.20	3.03	3.13	0.62	0.60	0.14	0.14
07/19/2015	6.06	6.93	1.90	2.13	4.11	5.03	2.38	3.01	0.52	0.58	0.14	0.14
07/20/2015	5.73	6.82	1.59	2.07	3.75	4.88	2.14	2.90	0.50	0.57	0.14	0.14
07/21/2015	6.08	6.77	1.70	2.04	3.73	4.79	2.11	2.83	0.57	0.57	0.15	0.14
07/22/2015	6.38	6.73	1.62	2.00	3.54	4.67	2.13	2.75	0.61	0.58	0.14	0.14
07/23/2015	6.08	6.68	1.64	1.97	3.14	4.53	1.77	2.66	0.59	0.58	0.15	0.14
07/24/2015	5.84	6.62	1.57	1.94	2.68	4.39	1.50	2.57	0.58	0.58	0.15	0.14
07/25/2015	6.09	6.54	1.59	1.91	3.03	4.26	1.59	2.48	0.59	0.59	0.14	0.14
07/26/2015	6.45	6.48	1.66	1.86	3.76	4.16	2.01	2.41	0.63	0.59	0.14	0.14
07/27/2015	6.40	6.46	1.82	1.85	3.86	4.09	2.36	2.36	0.63	0.59	0.14	0.14
07/28/2015	6.57	6.43	1.74	1.83	4.11	4.03	2.51	2.33	0.63	0.59	0.14	0.14
07/29/2015	6.86	6.42	1.77	1.81	4.68	4.02	2.74	2.32	0.64	0.60	0.14	0.14
07/30/2015	7.52	6.44	2.26	1.82	5.39	4.03	3.24	2.33	0.67	0.60	0.14	0.14
07/31/2015	7.26	6.46	2.14	1.81	5.56	4.05	3.21	2.34	0.65	0.60	0.14	0.14
08/01/2015	7.13	6.46	2.13	1.79	5.69	4.07	3.30	2.36	0.62	0.60	0.14	0.14
08/02/2015	6.99	6.53	2.06	1.81	5.67	4.18	3.28	2.42	0.59	0.61	0.14	0.14
08/03/2015	6.96	6.61	1.97	1.83	5.51	4.31	3.17	2.49	0.56	0.61	0.14	0.14
08/04/2015	6.56	6.65	1.80	1.84	4.81	4.39	2.73	2.54	0.51	0.61	0.14	0.14
08/05/2015	6.06	6.63	1.60	1.84	3.83	4.41	2.27	2.55	0.53	0.60	0.15	0.14
08/06/2015	6.18	6.63	1.64	1.84	3.57	4.44	2.25	2.58	0.59	0.60	0.15	0.14
08/07/2015	7.01	6.72	1.96	1.87	4.05	4.54	2.42	2.65	0.66	0.61	0.15	0.14
08/08/2015	6.93	6.78	1.97	1.89	4.24	4.62	2.47	2.71	0.63	0.61	0.15	0.14
08/09/2015	6.47	6.78	1.75	1.90	3.99	4.64	2.32	2.73	0.60	0.61	0.15	0.14

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
14dm : fourteen day running mean
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
07/11/2015	0.95	1.82	0.72	0.73	0.79	0.73	0.77	2,213	152	170 e	b
07/12/2015	0.98	1.89	0.75	0.72	0.78	0.73	0.77	2,278	151	170 e	b
07/13/2015	0.98	1.85	0.75	0.73	0.79	0.73	0.77	2,066	152	172	b
07/14/2015	0.96	1.75	0.76	0.73	0.78	0.73	0.77	2,156	153	170	b
07/15/2015	0.95	1.76	0.77	0.73	0.78	0.73	0.76	2,162	153	169	b
07/16/2015	0.97	1.80	0.81	0.73	0.78	0.73	0.77	2,206	153	168	b
07/17/2015	1.02	1.75	0.79	0.73	0.78	0.73	0.77	2,181	154	169	b
07/18/2015	1.02	1.76	0.78	0.74	0.77	0.73	0.77	2,180	155	169 e	b
07/19/2015	0.99	1.68	0.75	0.74	0.77	0.73	0.76	1,861	155	169 e	b
07/20/2015	0.94	1.59	0.76	0.72	0.76	0.73	0.76	1,755	150	170	b
07/21/2015	0.93	1.59	0.77	0.74	0.77	0.73	0.76	1,865	155	167	b
07/22/2015	0.94	1.59	0.77	0.73	0.77	0.73	0.76	1,962	154	168	b
07/23/2015	0.93	1.56	0.75	0.73	0.77	0.73	0.76	1,865	153	168	b
07/24/2015	0.92	1.52	0.74	0.73	0.77	0.75	0.76	1,791	153	170	b
07/25/2015	0.91	1.54	0.74	0.72	0.77	0.77	0.76	1,869	151	170 e	b
07/26/2015	0.91	1.59	0.75	0.72	0.77	0.76	0.76	1,985	149	170 e	b
07/27/2015	0.92	1.59	0.76	0.71	0.77	0.76	0.76	1,969	148	172	b
07/28/2015	0.93	1.60	0.77	0.71	0.77	0.76	0.76	2,022	148	171	b
07/29/2015	0.92	1.63	0.77	0.71	0.77	0.76	0.76	2,116	147	178	b
07/30/2015	0.97	1.73	0.76	0.71	0.77	0.76	0.76	2,326	147	172	b
07/31/2015	0.97	1.79	0.77	0.71	0.77	0.75	0.76	2,242	147	171	b
08/01/2015	0.96	1.79	0.75	0.71	0.77	0.74	0.76	2,201	147	171 e	b
08/02/2015	0.95	1.77	0.73	0.71	0.76	0.73	0.76	2,156	147	171 e	b
08/03/2015	0.94	1.72	0.72	0.71	0.75	0.72	0.75	2,148	147	169	b
08/04/2015	0.93	1.66	0.71	0.70	0.75	0.72	0.75	2,019	146	167	b
08/05/2015	0.93	1.60	0.71	0.70	0.74	0.72	0.75	1,861	145	166	b
08/06/2015	0.91	1.59	0.72	0.70	0.74	0.72	0.75	1,900	144	166	b
08/07/2015	0.91	1.68	0.73	0.69	0.74	0.72	0.75	2,164	143	167	b
08/08/2015	1.01	1.72	0.73	0.69	0.74	0.71	0.74	2,138	143	167 e	b
08/09/2015	0.97	1.70	0.73	0.69	0.74	0.71	0.74	1,990	143	167 e	b

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value
Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta conditions
- r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	mdEC	30dm	mdEC	30dm	mdEC	30dm	mdEC	30dm
07/11/2015	0.57	0.70	1.12	1.08	0.95	1.03	1.11	1.11
07/12/2015	0.57	0.69	1.11	1.09	0.93	1.03	1.11	1.12
07/13/2015	0.56	0.69	1.10	1.09	0.92	1.02	1.11	1.13
07/14/2015	0.53	0.69	1.09	1.10	0.93	1.02	1.11	1.14
07/15/2015	0.52	0.68	1.08	1.10	0.95	1.02	1.12	1.15
07/16/2015	0.66	0.68	1.08	1.10	0.99	1.01	1.12	1.16
07/17/2015	0.78	0.68	1.08	1.10	0.99	1.01	1.11	1.16
07/18/2015	0.78	0.68	1.09	1.10	0.98	1.01	1.11	1.17
07/19/2015	0.75	0.68	1.08	1.10	0.96	1.01	1.11	1.17
07/20/2015	0.61	0.68	1.07	1.10	0.95	1.01	1.11	1.17
07/21/2015	0.83	0.69	1.07	1.10	0.95	1.01	1.11	1.16
07/22/2015	0.75	0.69	1.08	1.10	0.95	1.00	1.10	1.16
07/23/2015	0.55	0.68	1.08	1.10	0.98	1.00	1.11	1.15
07/24/2015	0.41	0.67	1.06	1.11	1.01	1.00	1.11	1.15
07/25/2015	0.54	0.67	1.06	1.11	1.06	0.99	1.12	1.14
07/26/2015	0.74	0.67	1.07	1.11	1.04	0.99	1.12	1.14
07/27/2015	0.80	0.67	1.07	1.11	1.01	0.99	1.11	1.13
07/28/2015	0.94	0.68	1.07	1.11	1.01	0.99	1.12	1.13
07/29/2015	0.87	0.69	1.08	1.10	0.97	0.99	1.09	1.13
07/30/2015	0.93	0.70	1.09	1.10	0.95	0.98	1.11	1.12
07/31/2015	0.71	0.71	1.10	1.10	0.93	0.98	1.11	1.12
08/01/2015	0.51	0.70	1.10	1.10	0.94	0.98	1.10	1.12
08/02/2015	0.36	0.68	1.10	1.10	0.94	0.97	1.09	1.12
08/03/2015	0.45	0.67	1.09	1.10	0.96	0.97	1.09	1.12
08/04/2015	0.54	0.67	1.08	1.09	0.98	0.97	1.09	1.11
08/05/2015	0.55	0.66	1.07	1.09	1.00	0.97	1.08	1.11
08/06/2015	0.66	0.66	1.06	1.09	1.09	0.97	1.08	1.11
08/07/2015	0.69	0.65	1.07	1.08	1.16	0.98	1.08	1.11
08/08/2015	0.68	0.65	1.07	1.08	1.13	0.98	1.08	1.10
08/09/2015	0.61	0.65	1.05	1.08	1.06	0.99	1.08	1.10

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
30dm : thirty day running mean
NR : No Record
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Delta Water Quality Conditions

Suisun Marsh Stations

Date	Collinvsille mhtEC	National Steel mhtEC	Beldon Landing mhtEC	Sunrise Club mhtEC	Volanti Slough mhtEC	Goodyear Slough mhtEC
07/11/2015	12.00	14.63	19.44	19.00	17.05	21.94
07/12/2015	12.67	14.90	19.47	19.25	17.15	21.90
07/13/2015	12.06	14.79	19.87	19.36	17.60	21.69
07/14/2015	12.37	14.77	19.77	19.55	18.11	21.61
07/15/2015	12.58	15.16	20.14	18.74	18.23	21.59
07/16/2015	13.14	15.75	20.37	18.11	19.02	21.34
07/17/2015	13.01	15.78	20.27	20.12	19.67	21.33
07/18/2015	13.34	15.42	20.23	20.32	19.62	21.29
07/19/2015	11.27	15.56	19.83	20.17	19.01	21.39
07/20/2015	11.06	15.59	19.76	21.02	18.84	21.44
07/21/2015	12.02	15.79	19.95	22.67	18.98	21.28
07/22/2015	11.81	16.12	20.02	21.55	19.15	21.18
07/23/2015	10.37	16.13	20.01	20.92	18.81	21.21
07/24/2015	10.00	15.77	19.83	20.63	18.57	21.39
07/25/2015	10.88	15.30	19.75	20.29	18.53	21.46
07/26/2015	12.05	14.95	19.99	19.99	19.04	21.22
07/27/2015	10.81	14.55	20.02	19.85	19.08	21.08
07/28/2015	11.89	14.61	19.94	19.64	19.04	21.05
07/29/2015	11.73	15.18	20.10	19.58	18.96	20.94
07/30/2015	13.36	15.42	20.08	19.43	19.31	20.73
07/31/2015	13.71	15.47	20.10	20.25	19.23	20.90
08/01/2015	13.60	15.73	20.14	21.31	19.31	21.04
08/02/2015	13.09	16.37	20.22	21.19	19.53	21.26
08/03/2015	12.77	16.59	20.11	21.00	19.58	21.45
08/04/2015	12.03	16.18	20.32	20.76	19.33	21.51
08/05/2015	11.64	16.21	20.48	20.47	19.18	21.50
08/06/2015	11.40	16.45	20.65	20.25	19.11	21.38
08/07/2015	12.03	16.78	20.62	20.17	19.73	21.21
08/08/2015	12.02	16.34	20.60	19.90	19.63	21.07
08/09/2015	11.41	16.23	20.53	19.72	19.72	21.12

Electrical Conductivity (EC) units: milliSiemens per Centimeter
mht : mean high tides
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value

Compliance Standards

for the Sacramento - San Joaquin Delta and Suisun Marsh
Tuesday, September 01, 2015

Criteria	Standard	Status
Flow/Operational		
% of inflow diverted	65 %	50 %
NDOI, monthly average *	>= 3,000 cfs	2,592 cfs
NDOI, 7 day average*	>= 2,000 cfs	2,592 cfs
Rio Vista flow, monthly average *	>=2,500	3,269 cfs
Rio Vista flow, 7 day average*	>= 2,000	3,269 cfs
Water Quality		
Days @ CCWD PP#1 w/ chlorides <= 150 mg/l	155 days	124 days
Export Areas for SWP, CVP, CCWD, et al	<= 250 mg/l Cl	161 mg/l
Maximum 30 day running average of mean daily EC at:		
Vernalis	<=1.0 mS/cm	0.6 mS/cm
Brandt Bridge	<=1.0 mS/cm	1.0 mS/cm
Old River Near Tracy	<=1.0 mS/cm	1.0 mS/cm
Old River Near Middle River	<=1.0 mS/cm	1.1 mS/cm

SUISUN MARSH:

Suisun Marsh Salinity Control Gates : 0 Open / 0 Closed / 3 Full Tide Open
Flashboard Status : In   Boat Lock Status : Closed

California Hydrologic Conditions: (California Cooperative Snow Surveys Forecast, May 1, 2015)

Previous Month's Index (8RI for Apr): 766 TAF
Sacramento valley water year type index (40/30/30) @ 50%: 4.0 MAF (Critical)
San Joaquin valley water year type index (60/20/20) @ 75%: 0.7 MAF (Critical)

Electrical Conductivity (EC) in milliSiemens per Centimeter.
Chlorides (Cl) in milligrams per liter
mht - mean high tides
md - mean daily
14 dm - fourteen day running mean
NR - No Record
NC - Not Computed due to insufficient data
BR : Below Rating
e - estimated value

Montezuma Slough Gate Operation:
Number of gates operating at either Open, Closed, or Full Tide Open
Flashboard Status : In, Out, or Modified In
Boat Lock Status : Open or Closed

Coordinated Operation Agreement Delta Status:
c = excess Delta conditions
b = balanced Delta conditions
r = excess Delta conditions with restrictions:

* NDOI, Rio Vista & Vernalis Flows and Suisun Marsh mhtEC:
- 7 day average is progressive daily mean for the first six days of the month.
- Monthly average is progressive daily mean from the beginning of the month

Delta Water Quality Conditions

Date	Antioch Tides		Net Delta Outflow Index	Martinez	Port Chicago		Mallard	Chipps Island		Collinsville	
	High	Half	cfs	mdEC	mdEC	14dm	mdEC	mdEC	14dm	mdEC	14dm
08/03/2015	6.45	4.61	3,638	30.09	18.88	20.04	16.59	16.79	15.77	11.57	10.93
08/04/2015	6.11	4.41	3,725	30.46	17.23	19.81	15.68	15.77	15.83	10.89	10.97
08/05/2015	6.17	4.20	3,653	29.30	16.44	19.64	14.60	14.57	15.77	9.98	10.94
08/06/2015	6.39	4.30	3,947	28.88	16.66	19.49	14.35	14.30	15.76	9.80	10.95
08/07/2015	6.58	4.51	3,790	30.04	19.55	19.43	15.66	15.75	15.91	10.92	11.08
08/08/2015	6.57	4.50	3,888	30.34	16.79	19.19	15.59	15.67	16.02	11.08	11.18
08/09/2015	6.65	4.50	3,821	29.92	17.01	19.04	15.04	15.06	16.00	10.66	11.18
08/10/2015	6.54	4.51	3,877	30.74	22.23	19.40	15.63	15.71	16.04	10.93	11.27
08/11/2015	6.66	4.51	3,605	30.32	18.75	19.37	15.32	15.38	16.05	10.77	11.29
08/12/2015	6.53	4.34	3,551	29.93	19.80	19.22	14.65	14.63	15.95	10.23	11.21
08/13/2015	6.37	4.37	3,804	30.04	17.92	18.82	14.77	14.76	15.74	10.23	11.03
08/14/2015	6.32	4.25	3,745	29.53	17.02	18.42	14.44	14.40	15.52	9.68	10.81
08/15/2015	6.06	4.08	3,714	29.05	15.81	18.01	13.56	13.44	15.24	9.12	10.57
08/16/2015	5.89	4.11	3,505	28.80	18.40	18.03	13.75	13.64	14.99	8.91	10.34
08/17/2015	5.91	4.34	2,964	29.18	16.82	17.89	14.54	14.51	14.83	9.92	10.22
08/18/2015	6.00	4.63	2,529	30.55	16.67	17.85	15.94	16.06	14.85	11.23	10.25
08/19/2015	5.95	4.51	1,700	30.51	19.30	18.05	15.93	16.05	14.96	11.31	10.34
08/20/2015	6.05	4.45	1,966	30.63	18.03	18.15	15.31	15.36	15.03	10.94	10.42
08/21/2015	6.14	4.48	2,133	30.40	20.20	18.20	15.03	15.06	14.98	10.66	10.40
08/22/2015	6.24	4.47	1,887	29.80	19.08	18.36	14.85	14.85	14.92	10.34	10.35
08/23/2015	6.25	4.48	2,313	94.36	18.61	18.47	14.71	14.70	14.90	10.24	10.32
08/24/2015	6.34	4.45	2,584	30.65	16.25	18.05	14.36	14.31	14.80	10.16	10.27
08/25/2015	6.49	4.46	2,754	30.75	18.17	18.01	14.19	14.13	14.71	9.84	10.20
08/26/2015	6.34	4.39	3,196	30.79	18.73	17.93	14.12	14.04	14.67	9.87	10.17
08/27/2015	6.49	4.32	3,231	29.86	16.41	17.82	14.04	13.96	14.61	9.55	10.13
08/28/2015	6.55	4.36	1,613	29.94	17.07	17.82	14.52	14.49	14.62	9.89	10.14
08/29/2015	6.62	4.38	1,731	30.25	19.65	18.10	14.92	14.93	14.72	10.50	10.24
08/30/2015	6.38	4.31	1,693	29.75	17.16	18.01	15.30	15.35	14.84	10.60	10.36
08/31/2015	6.14	4.28	1,645	29.97	15.01	17.88	15.44	15.51	14.92	10.59	10.41
09/01/2015	6.27	4.44	2,592	30.46	18.32	18.00	16.01	16.14	14.92	11.18	10.40

Antioch Tides measured in feet relative to the NAVD88 Datum
Net Delta Ouflow Index calculated from equation as specified in D-1641, revised March 2000.
Chipps Island EC calculated from measurements recorded at Mallard Slough.
Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
14dm : fourteen day running mean
NR : No Record
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e - estimated value

Delta Water Quality Conditions

Date	Antioch		Jersey Point		Emmaton		Three Mile Slough		San Andreas Landing		Terminous	
	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm	mdEC	14dm
08/03/2015	6.96	6.61	1.97	1.83	5.51	4.31	3.17	2.49	0.56	0.61	0.14	0.14
08/04/2015	6.56	6.65	1.80	1.84	4.81	4.39	2.73	2.54	0.51	0.61	0.14	0.14
08/05/2015	6.06	6.63	1.60	1.84	3.83	4.41	2.27	2.55	0.53	0.60	0.15	0.14
08/06/2015	6.18	6.63	1.64	1.84	3.57	4.44	2.25	2.58	0.59	0.60	0.15	0.14
08/07/2015	7.01	6.72	1.96	1.87	4.05	4.54	2.42	2.65	0.66	0.61	0.15	0.14
08/08/2015	6.93	6.78	1.97	1.89	4.24	4.62	2.47	2.71	0.63	0.61	0.15	0.14
08/09/2015	6.47	6.78	1.75	1.90	3.99	4.64	2.32	2.73	0.60	0.61	0.15	0.14
08/10/2015	6.76	6.81	1.83	1.90	4.47	4.68	2.63	2.75	0.59	0.60	0.15	0.14
08/11/2015	6.56	6.81	1.76	1.90	4.43	4.71	2.60	2.76	0.59	0.60	0.14	0.14
08/12/2015	6.27	6.76	1.70	1.90	3.95	4.65	2.23	2.72	0.59	0.60	0.15	0.15
08/13/2015	6.31	6.68	1.80	1.86	3.65	4.53	2.11	2.64	0.61	0.59	0.15	0.15
08/14/2015	6.08	6.59	1.74	1.83	3.54	4.38	1.95	2.55	0.61	0.59	0.15	0.15
08/15/2015	5.56	6.48	1.60	1.80	2.96	4.19	1.77	2.44	0.56	0.59	0.15	0.15
08/16/2015	5.62	6.38	1.50	1.76	3.21	4.01	1.97	2.35	0.54	0.58	0.15	0.15
08/17/2015	6.03	6.32	1.55	1.73	3.58	3.88	2.19	2.28	0.56	0.58	0.15	0.15
08/18/2015	6.65	6.32	1.76	1.72	4.43	3.85	2.60	2.27	0.61	0.59	0.15	0.15
08/19/2015	6.44	6.35	1.74	1.73	4.39	3.89	2.62	2.29	0.57	0.59	0.16	0.15
08/20/2015	6.04	6.34	1.67	1.74	4.10	3.93	2.43	2.31	0.54	0.59	0.16	0.15
08/21/2015	6.04	6.27	1.64	1.71	4.01	3.92	2.29	2.30	0.54	0.58	0.17	0.15
08/22/2015	5.99	6.20	1.66	1.69	3.85	3.90	2.13	2.27	0.53	0.57	0.16	0.15
08/23/2015	6.17	6.18	1.60	1.68	3.70	3.88	2.07	2.25	0.53	0.57	0.16	0.15
08/24/2015	5.93	6.12	1.56	1.66	3.43	3.80	1.93	2.20	0.51	0.56	0.17	0.16
08/25/2015	5.59	6.05	1.49	1.64	3.19	3.71	1.79	2.15	0.49	0.56	0.17	0.16
08/26/2015	5.54	6.00	1.53	1.63	3.18	3.66	1.80	2.12	0.49	0.55	0.17	0.16
08/27/2015	5.37	5.93	1.48	1.61	3.22	3.63	1.78	2.09	0.48	0.54	0.17	0.16
08/28/2015	5.61	5.90	1.48	1.59	3.37	3.62	1.89	2.09	0.49	0.53	0.17	0.16
08/29/2015	6.16	5.94	1.62	1.59	3.58	3.66	2.13	2.11	0.50	0.53	0.16	0.16
08/30/2015	6.14	5.98	1.57	1.60	3.47	3.68	2.02	2.12	0.50	0.52	0.17	0.16
08/31/2015	6.15	5.99	1.55	1.60	3.39	3.66	1.92	2.10	0.50	0.52	0.19	0.17
09/01/2015	6.62	5.98	1.73	1.59	3.57	3.60	2.14	2.07	0.54	0.51	0.20	0.17

Electrical Conductivity (EC) units: milliSiemens per Centimeter
Chloride (Cl) units: milligrams per liter
md : mean daily
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Delta Water Quality Conditions

Date	Bethel Island mdEC	Farrar Park mdEC	Holland Tract mdEC	Bacon Island mdEC	Contra Costa mdEC	Clifton Court mdEC	Tracy Pumping Plant mdEC	Antioch mdCl	Bacon Island mdCl	Contra Costa mdCl	Delta Status
08/03/2015	0.94	1.72	0.72	0.71	0.75	0.72	0.75	2,148	147	169	b
08/04/2015	0.93	1.66	0.71	0.70	0.75	0.72	0.75	2,019	146	167	b
08/05/2015	0.93	1.60	0.71	0.70	0.74	0.72	0.75	1,861	145	166	b
08/06/2015	0.91	1.59	0.72	0.70	0.74	0.72	0.75	1,900	144	166	b
08/07/2015	0.91	1.68	0.73	0.69	0.74	0.72	0.75	2,164	143	167	b
08/08/2015	1.01	1.72	0.73	0.69	0.74	0.71	0.74	2,138	143	164	b
08/09/2015	0.97	1.70	0.73	0.69	0.74	0.71	0.74	1,990	143	163	b
08/10/2015	0.95	1.69	0.73	0.69	0.74	0.71	0.74	2,084	143	165	b
08/11/2015	0.94	1.66	0.72	0.69	0.73	0.70	0.74	2,021	143	161	b
08/12/2015	0.94	1.64	0.74	0.69	0.73	0.70	0.73	1,928	143	161	b
08/13/2015	0.95	1.65	0.73	0.69	0.73	0.71	0.73	1,940	143	169	b
08/14/2015	0.96	1.64	0.73	0.69	0.72	0.72	0.73	1,868	143	162	b
08/15/2015	0.95	1.57	0.73	0.69	0.72	0.73	0.74	1,700	143	156	b
08/16/2015	0.94	1.52	0.73	0.69	0.72	0.73	0.74	1,720	143	160	b
08/17/2015	0.93	1.51	0.72	0.69	0.72	0.73	0.74	1,851	144	162	b
08/18/2015	0.94	1.56	0.72	0.69	0.72	0.73	0.74	2,047	143	159	b
08/19/2015	1.02	1.59	0.71	0.69	0.72	0.72	0.74	1,983	143	157	b
08/20/2015	0.98	1.56	0.70	0.69	0.72	0.72	0.74	1,854	142	157	b
08/21/2015	0.93	1.57	0.69	0.69	0.72	0.72	0.74	1,852	142	160	b
08/22/2015	0.95	1.59	0.69	0.69	0.72	0.72	0.72	1,836	141	161	b
08/23/2015	0.98	1.60	0.68	0.68	0.72	0.71	0.72	1,894	141	161	b
08/24/2015	0.99	1.60	0.68	0.68	0.71	0.75	0.72	1,818	140	161	b
08/25/2015	0.97	1.57	0.69	0.68	0.71	0.72	0.72	1,711	140	163	b
08/26/2015	0.96	1.53	0.68	0.68	0.71	0.71	0.71	1,693	140	160	b
08/27/2015	0.96	1.50	0.69	0.68	0.71	0.71	0.71	1,639	139	162	b
08/28/2015	0.95	1.46	0.69	0.68	0.71	0.70	0.70	1,716	139	165	b
08/29/2015	0.95	1.48	0.71	0.66	0.71	0.69	0.69	1,891	135	165 e	b
08/30/2015	0.95	1.50	0.70	0.66	0.71	0.68	0.69	1,886	134	165 e	b
08/31/2015	0.96	1.50	0.67	0.65	0.71	0.67	0.68	1,890	132	162	b
09/01/2015	0.95	1.54	0.69	0.64	0.70	0.67	0.68	2,038	130	161	b

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Antioch and Bacon Island mdCl are calculated from the respective mdEC values.

Coordinated Operation Agreement Delta Status:
- c = excess Delta conditions
- b = balanced Delta conditions
- r = excess Delta conditions with restrictions:

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	mdEC	30dm	mdEC	30dm	mdEC	30dm	mdEC	30dm
08/03/2015	0.45	0.67	1.09	1.10	0.96	0.97	1.09	1.12
08/04/2015	0.54	0.67	1.08	1.09	0.98	0.97	1.09	1.11
08/05/2015	0.55	0.66	1.07	1.09	1.00	0.97	1.08	1.11
08/06/2015	0.66	0.66	1.06	1.09	1.09	0.97	1.08	1.11
08/07/2015	0.69	0.65	1.07	1.08	1.16	0.98	1.08	1.11
08/08/2015	0.68	0.65	1.07	1.08	1.13	0.98	1.08	1.10
08/09/2015	0.61	0.65	1.05	1.08	1.06	0.99	1.08	1.10
08/10/2015	0.61	0.65	1.05	1.08	0.98	0.99	1.09	1.10
08/11/2015	0.68	0.65	1.04	1.08	0.97	0.99	1.09	1.10
08/12/2015	0.49	0.65	1.03	1.07	0.97	0.99	1.10	1.10
08/13/2015	0.49	0.65	1.01	1.07	0.99	0.99	1.11	1.10
08/14/2015	0.50	0.65	0.99	1.07	1.02	1.00	1.12	1.10
08/15/2015	0.52	0.64	0.95	1.06	1.00	1.00	1.12	1.10
08/16/2015	0.53	0.64	0.92	1.06	1.01	1.00	1.12	1.10
08/17/2015	0.58	0.63	0.91	1.05	1.01	1.00	1.13	1.10
08/18/2015	0.65	0.63	0.92	1.05	0.99	1.00	1.13	1.10
08/19/2015	0.63	0.63	0.92	1.04	0.97	1.00	1.13	1.10
08/20/2015	0.74	0.62	0.91	1.04	0.94	1.00	1.14	1.11
08/21/2015	0.58	0.62	0.91	1.03	0.91	1.00	1.14	1.11
08/22/2015	0.45	0.61	0.91	1.03	0.91	1.00	1.14	1.11
08/23/2015	0.42	0.61	0.91	1.02	0.92	0.99	1.14	1.11
08/24/2015	0.36	0.61	0.90	1.01	0.94	0.99	1.14	1.11
08/25/2015	0.42	0.60	0.89	1.01	0.96	0.99	1.15	1.11
08/26/2015	0.46	0.59	0.89	1.00	0.96	0.98	1.15	1.11
08/27/2015	0.53	0.57	0.88	1.00	0.96	0.98	1.15	1.11
08/28/2015	0.75	0.57	0.88	0.99	0.96	0.98	1.13	1.11
08/29/2015	0.75	0.56	0.88	0.98	0.98	0.98	1.05	1.11
08/30/2015	0.80	0.57	0.89	0.98	0.99	0.99	0.96	1.11
08/31/2015	0.60	0.57	0.89	0.97	1.00	0.99	0.92	1.10
09/01/2015	0.56	0.58	0.89	0.96	0.99	0.99	0.91	1.09

Electrical Conductivity (EC) units: milliSiemens per Centimeter
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Delta Water Quality Conditions

Suisun Marsh Stations

Date	Collinvsille mhtEC	National Steel mhtEC	Beldon Landing mhtEC	Sunrise Club mhtEC	Volanti Slough mhtEC	Goodyear Slough mhtEC
08/03/2015	12.77	16.59	20.11	21.00	19.58	21.45
08/04/2015	12.03	16.18	20.32	20.76	19.33	21.51
08/05/2015	11.64	16.21	20.48	20.47	19.18	21.50
08/06/2015	11.40	16.45	20.65	20.25	19.11	21.38
08/07/2015	12.03	16.78	20.62	20.17	19.73	21.21
08/08/2015	12.02	16.34	20.60	19.90	19.63	21.07
08/09/2015	11.41	16.23	20.53	19.72	19.72	21.12
08/10/2015	12.04	16.04	20.45	19.60	19.72	21.09
08/11/2015	11.66	16.58	20.59	19.48	19.70	21.07
08/12/2015	11.57	16.63	20.68	19.24	19.56	21.17
08/13/2015	11.21	16.67	20.78	19.03	19.59	21.13
08/14/2015	10.70	16.46	20.72	18.81	19.62	20.95
08/15/2015	9.71	16.85	20.60	18.69	19.53	20.93
08/16/2015	9.45	16.79	20.65	18.60	19.43	20.65
08/17/2015	10.27	17.45	20.56	18.47	19.54	20.27
08/18/2015	12.41	17.53	20.45	18.48	19.49	19.50
08/19/2015	12.04	16.50	20.53	18.40	19.49	19.39
08/20/2015	11.78	16.05	20.75	18.48	19.89	19.49
08/21/2015	11.58	15.09	20.59	18.52	19.98	19.70
08/22/2015	10.83	14.24	20.42	18.51	19.81	20.01
08/23/2015	10.82	13.85	20.35	18.70	19.50	20.23
08/24/2015	10.80	13.31	20.24	18.63	18.78	20.50
08/25/2015	10.73	13.47	20.13	18.75	18.58	20.66
08/26/2015	11.23	13.09	20.81	18.65	18.42	20.68
08/27/2015	10.65	13.60	20.81	18.64	18.38	20.71
08/28/2015	11.42	12.87	20.79	18.67	18.35	20.58
08/29/2015	12.20	8.98	20.18	18.55	18.80	20.45
08/30/2015	12.73	8.80	18.38	18.07	18.73	20.31
08/31/2015	13.08	8.83	15.74	17.22	17.28	20.25
09/01/2015	13.11	8.99	13.57	16.10	15.24	19.95

Electrical Conductivity (EC) units: milliSiemens per Centimeter
mht : mean high tides
NR : No Record
NC : Not Computed due to insufficient data
BR : Below Rating
e : estimated value