

1 Michael A. Brodsky
Law Offices of Michael A. Brodsky
2 201 Esplanade, Upper Suite
Capitola, CA 95010
3 Telephone: (831) 469-3514
4 Facsimile: (831) 471-9705
Email: michael@brodskylaw.net
5 SBN 219073

6 Attorney for Protestants Save the California Delta Alliance, et al.

7 **BEFORE THE CALIFORNIA STATE WATER RESOURCES CONTROL BOARD**

9 **IN RE CALIFORNIA WATERFIX**
10 **CALIFORNIA DEPARTMENT OF**
11 **BUREAU OF RECLAMATION**
12 **PETITION FOR CHANGES IN**
13 **WATER RIGHTS, POINTS OF**
14 **DIVERSION/RE-DIVERSION**

PROTESTANT SAVE THE CALIFORNIA
DELTA ALLIANCE, ET AL.'s REQUEST FOR
OFFICIAL NOTICE IN SUPPORT OF
OBJECTIONS TO EVIDENCE

15
16
17
18
19
20
21
22
23
24
25
26
27
28

1 **REQUEST FOR OFFICIAL NOTICE**

2 Protestants Save the California Delta Alliance et al. (“Delta Alliance”) respectfully requests
3 that the Board take judicial notice of the following documents, which are attached as Exhibits A–E.

4 Exhibit A is a true and correct copy of the Letter from Jared Blumenfeld, Regional Director
5 USEPA Region 9 to David Murilo, Regional Director Bureau of Reclamation Mid-Pacific Region,
6 October 30, 2015.

7
8 Exhibit B is a true and correct copy the August 26, 2014, letter from the Office of the
9 Regional Administrator, Region 9, of the United States Environmental Protection Agency regarding
10 the Draft Environmental Impact Statement for the Bay Delta Conservation Plan.

11 Exhibit C is a true and correct copy of the Review by the Delta Independent Science Board
12 of the Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental
13 Impact Report/Supplemental Draft Environmental Impact Statement, September 30, 2015.

14 Exhibit D is a true and correct copy of Saracino and Mount, et al., Panel Review of the Draft
15 Bay Delta Conservation Plan, September 2013.

16 Exhibit E is a true and correct copy of DWR’s Written Response to March 4 Requirement to
17 Address Information Requests from California Water Research and Sacramento Valley Water
18 Users, March 11, 2016.

19
20 **GROUNDS FOR GRANTING REQUEST**

21 “[A]gencies engaged in Tier 2 adjudication and local agencies can also take official notice,
22 at least of matters that could be judicially noticed by courts.” (California Practice Guide—
23 Administrative Law (Rutter 2015) § 9:163 [citing *Cantrell v. Board of Supervisors of Los Angeles*
24 *County (1948)* 87 Cal .App. 2d 471, 477–478].) “A court (and thus an agency) can take judicial
25 notice of the acts of the legislative, executive and judicial departments of any state.” (*Id.* at §9:168).
26 An agency can take official notice of letters sent from state officials and departments. (*San Mateo*
27 *county Coastal Landowners’ Ass’n v. County of San Mateo* (1995) 38 Cal. App. 4th 523, 552–553.)
28

1 An agency can take official notice of material in the record of an agency adjudication. (*Hogen v.*
2 *Valley Hosp.* (1983) 147 Cal. App. 3d 119, 125.) An agency can take official notice of “any
3 generally accepted technical or scientific matter within the agency’s” expertise. (Gov. Code §
4 11515). “Thus, the scope of official notice is considerably wider than the scope of judicial notice.”
5 (Administrative Law § 9:170)
6

7 Under Evidence Code section 452(c) it is appropriate for a court to take judicial notice of
8 “[o]fficial acts of the legislative, executive, and judicial departments of the United States or any state
9 of the United States.” Courts may properly take judicial notice of official letters sent by government
10 agencies. *People v. Castillo*, 49 Cal. 4th 145, 157 n. 14 (2010); *Landstar Global Logistics, Inc. v.*
11 *Robinson & Robinson, Inc.*, 216 Cal. App. 4th 378, 388 n.4 (2013) (letter from U.S. Department of
12 State).
13

14 Exhibits A and B are official act of the Environmental Protection Agency, an agency of the
15 executive branch of the United States government. They are therefore subject to judicial notice
16 pursuant to section 452(c). They are also technical and scientific matter within the Board’s
17 expertise, and are part of the Board’s administrative record as comments submitted on SWRCB-3
18 (Exhibit B is attached to Delta Alliance’s October 30, 2015 comments on the RDEIR/SDEIS as
19 Attachment 23). Exhibit A is available at [https://www.epa.gov/sites/production/files/2015-](https://www.epa.gov/sites/production/files/2015-10/documents/waterfix-ltr-murillo-103015.pdf)
20 [10/documents/waterfix-ltr-murillo-103015.pdf](https://www.epa.gov/sites/production/files/2015-10/documents/waterfix-ltr-murillo-103015.pdf). Exhibit B is available at
21 [https://www.epa.gov/sites/production/files/2014-11/documents/bay-delta-conservation-plan-](https://www.epa.gov/sites/production/files/2014-11/documents/bay-delta-conservation-plan-deis.pdf)
22 [deis.pdf](https://www.epa.gov/sites/production/files/2014-11/documents/bay-delta-conservation-plan-deis.pdf). Petitioners have sought to introduce as SWRCB-3 the 2015 RDEIR/SDEIS “and
23 comments.” They are also part of the Board’s administrative record as they were attached to Delta
24 Alliance’s Protest as Attachments two and six.
25

26 Exhibit C is an official act of the Delta Independent Science Board, an instrumentality of the
27 Delta Stewardship Council, a California state agency. Exhibit C is also technical and scientific
28 matter within the Board’s expertise, and part of the Board’s administrative adjudicative record as


1 comments submitted on SWRCB-3 (Exhibit C is attached to Delta Alliance's October 30, 2015
2 comments on the RDEIR/SDEIS as Attachment 21). Exhibit C is also a part of the Board's
3 administrative record as it was attached to Delta Alliance's Protest as Attachment 8. Exhibit C is
4 available at [http://www.deltacouncil.ca.gov/sites/default/files/2015/10/Item_15_Attach_3_2015-10-](http://www.deltacouncil.ca.gov/sites/default/files/2015/10/Item_15_Attach_3_2015-10-6-DISB-cover-letter-and-comments-RDEIR-SDEIS-final.pdf)
5 [6-DISB-cover-letter-and-comments-RDEIR-SDEIS-final.pdf](http://www.deltacouncil.ca.gov/sites/default/files/2015/10/Item_15_Attach_3_2015-10-6-DISB-cover-letter-and-comments-RDEIR-SDEIS-final.pdf).

7 Exhibit D is technical and scientific matter within the Board's expertise, and part of the
8 Board's administrative adjudicative record as comments submitted on SWRCB-3 (Exhibit D was
9 attached to Delta Alliance's July 29, 2014 comments on the EIR/S). Exhibit D is available at
10 <https://watershed.ucdavis.edu/files/biblio/FINAL-BDCP-REVIEW-for-TNC-and-AR-Sept-2013.pdf>

11 Exhibit E is technical and scientific matter within the Board's expertise, and part of the
12 Board's administrative adjudicative record submitted to the Board in these proceedings in response
13 to the Board's direction.
14

15
16 Dated July 12, 2016

17 Respectfully Submitted,

18
19 By: 

20 Michael A. Brodsky
21 Attorney for Protestant Save the California Delta Alliance
22
23
24
25
26
27
28

EXHIBIT A



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

**75 Hawthorne Street
San Francisco, CA 94105-3901**

OCT 30 2015

**OFFICE OF THE
REGIONAL ADMINISTRATOR**

David Murillo, Regional Director
Bureau of Reclamation, Mid-Pacific Region
2800 Cottage Way, MP-700
Sacramento, CA 95825

Subject: Supplemental Draft Environmental Impact Statement
Bay Delta Conservation Plan/California WaterFix CEQ# 20150196

Dear Mr. Murillo:

The U.S. Environmental Protection Agency has reviewed the Bay Delta Conservation Plan (BDCP)/California WaterFix Supplemental Draft EIS pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review responsibilities under Section 309 of the Clean Air Act. The San Francisco Bay/Sacramento-San Joaquin Delta is an important estuarine system, supporting over 750 species and supplying drinking water to 25 million people and irrigation water to 4 million acres of farmland.

Background

The WaterFix project evolved from the BDCP, which was proposed as a Habitat Conservation Plan (HCP) to support the issuance of a 50-year incidental take permit under Section 10 of the Endangered Species Act (ESA). A joint federal and state Draft Environmental Impact Statement/Draft Environmental Impact Report (DEIS/DEIR) for the BDCP was released on December 13, 2013, with the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and Bureau of Reclamation (Reclamation) as joint federal lead agencies for the DEIS, and the California Department of Water Resources (DWR) as the State lead agency for the DEIR. The BDCP included a major habitat restoration program, targeting over 150,000 acres, as well as a proposed new conveyance facility (tunnels) to transport water from the Sacramento River to existing pumps in the South Delta.

In August 2014, the federal and State lead agencies committed to supplement/recirculate the DEIS/DEIR in response to public comments received on that document, including those submitted by EPA on August 26, 2014. In a collaborative effort to resolve the issues that we had raised, EPA met frequently with DWR and the original federal lead agencies for several months after submitting our comments on the DEIS, and we appreciate the attention given to the analysis of the proposed project's impacts on specific water quality parameters.

In April 2015, Reclamation and DWR announced fundamental changes to the proposed project and changed its name from BDCP to the California WaterFix. The WaterFix project focuses on the construction and operation of proposed new water export intakes on the Sacramento River to divert water into a proposed 40 mile twin tunnel conveyance facility. Reclamation is now the sole lead federal agency. The proposed federal action has changed from implementing a Habitat Conservation Plan under

Section 10 of the ESA to modifying operations of the federal Central Valley Project (CVP) in order to accommodate new water conveyance infrastructure.

Project Benefits

The proposed project and alternatives would provide greater water supply reliability for the users of exported Delta water and would reduce certain adverse impacts of the CVP and State Water Project (SWP) on fish. The SDEIS shows that transporting water in tunnels would reduce the risks to CVP/SWP exports in several ways. The proposed tunnel project would provide greater protection against sudden degradation of exported freshwater caused by the catastrophic failure of the earthen levees in the Delta and the consequent intrusion of saltwater that could foul supplies of water for municipal, agricultural and industrial consumption. Given the potential for earthquakes and floods in the region and the numerous earthen levees encircling the Delta islands, water supply security is a significant concern. Transporting water via tunnels would substantially address longer term threats to export water quality caused by sea level rise, with its concomitant salt water intrusion. The proposed project would also enhance CVP/SWP project flexibility by adding a northern diversion point. The current system, which relies solely on the southerly intakes, provides limited operational flexibility and at times results in reverse flows in Old and Middle Rivers which are associated with decreased survival of endangered fishes. Added flexibility would enable better real-time management of the export operations in response to observed movement of special status fish populations. Furthermore, the SDEIS predicts that flexible use of the proposed new intake facilities, combined with the establishment of biological criteria for operation, the installation of state-of-the-art fish screens, and the reduction of reverse flows in Old and Middle Rivers, would reduce the entrapment of certain fish species into poor habitats and the entrainment of fish into the CVP/SWP system. By making these physical and operational changes in the Delta, the proposed project would address some of the many identified stressors to aquatic resources in the Delta. In addition, although not part of the WaterFix project, the State of California has launched a separate EcoRestore initiative to pursue the restoration and stewardship of 30,000 acres of floodplains, riparian forests, and wetlands within the Delta over the next four years. As this significant conservation effort was not part of the SDEIS, it was not reviewed or rated as part of our NEPA review.

Project Purpose and Need

As stated in the SDEIS, the purpose and need for the WaterFix project, as was the case for the BDCP, is to advance the co-equal goals set forth in the Delta Reform Act of 2009. Those are (1) to provide a more reliable water supply for California, and (2) to protect, restore, and enhance the Delta ecosystem. EPA recognizes the crucial public health, economic, and ecological importance of both goals. The proposed project and the alternatives evaluated in the SDEIS support the water reliability component, but largely defer actions necessary to protect water quality and aquatic life to the future.

As has been discussed throughout the development of this project, the most essential decision for achieving the desired balance between water reliability and restoration of the Bay Delta ecosystem is how freshwater flows through the Delta will be managed. This key decision is not described in the SDEIS and is, instead, deferred to future regulatory processes administered by the State of California in consultation with federal resource and regulatory agencies. The decision by the State of California and Reclamation to defer these decisions means that the impacts of the WaterFix project on the Delta ecosystem cannot be fully evaluated at this time, and that any attempt to describe the environmental impacts of the project is necessarily incomplete. Once those decisions, described below, are concluded, the evaluation of possible impacts and consideration of alternatives can be completed.

Aquatic Habitat and Water Quality

As noted above, the project has been significantly revised since the initial DEIS, yet the SDEIS relies on modeling results that are based on the BDCP alternatives. Information in the SDEIS indicates that the modeling completed for the BDCP alternatives is not necessarily representative of the environmental effects resulting from the WaterFix alternatives. NMFS and FWS concluded in 2008 and 2009, respectively, that continued operation of the CVP/SWP would jeopardize the existence of delta smelt, winter-run Chinook salmon, green sturgeon and several other fish species. Even with the predictive limitations of the modeling, the SDEIS predicts a loss of valuable aquatic habitat for many fish species in the Delta and upstream tributaries due to the combined effects of the WaterFix project, CVP/SWP exports, climate change, and increased water diversions upstream of the Delta in the Sacramento River Basin. These species have experienced sharp population declines in the last decade and showed record low abundance over the last five years. Information presented in the SDEIS shows that the WaterFix project could reduce habitat conditions for delta smelt, winter-run Chinook salmon, green and white sturgeon, striped bass, and American shad, and result in a decline of longfin smelt abundance. For example, according to the SDEIS, winter-run Chinook salmon and sturgeon may be negatively impacted when migrating past new intakes, because significant volumes of freshwater flows are diverted at the intakes resulting in less water that is also of lower quality downstream of the intakes. The SDEIS also predicts that selenium concentrations in sturgeon would increase by 12-19% as a result of the proposed project, and would exceed the FWS and NMFS benchmark for adverse impacts to sensitive species.

The modeling results presented in the SDEIS show predicted exceedances of a salinity standard at both Prisoner's Point and Emmaton. The water quality modeling predicts that the Western Delta and Suisun Marsh will become saltier over time, which is likely to cause increased exceedances of chloride criteria near municipal water supply intakes. Mitigation actions are identified in the SDEIS to prevent exceedances, and the compliance history shows that salinity standards have rarely been exceeded in non-drought years. Nevertheless, if the proposed project operations contribute to a general increase in salinity in the Delta, the flexibility that Reclamation and DWR have to operate the system to ensure that water quality criteria are met will be seriously diminished, and the two agencies will have little room for error in operating the system to protect beneficial uses and achieve the co-equal goals.

While the impacts stated above may be mitigated by appropriately timed increased flows and habitat restoration, the WaterFix project does not propose additional flows in the Delta, nor does it propose significant habitat restoration (See EcoRestore above). CVP/SWP operation scenarios that propose additional outflow, such as BDCP Alternatives 7 and 8 from the DEIS, could provide substantially more water for resident and migratory fish and provide benefits to aquatic life; however, these were not evaluated as alternatives in the SDEIS.

Pending Regulatory Actions

Several pending regulatory actions are important to understanding the full impacts of the project. First, the State Water Resources Control Board (State Water Board) will be acting on Reclamation's and DWR's recent request to add points of freshwater diversion from the South Delta to the Sacramento River in the North Delta (at the northern end of the new conveyance facility). This State regulatory action is likely to include terms and conditions, including flow requirements, that could modify proposed WaterFix operations sufficiently to produce environmental and water supply effects that have not been analyzed in the SDEIS. Additionally, the State Water Board is in the midst of comprehensively updating water quality standards through the Bay Delta Water Quality Control Plan (Bay Delta WQCP). The updated standards could result in freshwater flow management provisions and corresponding changes to water supply diversions throughout the watershed that have not been analyzed

in the SDEIS. The Delta is listed as impaired for several water quality parameters under Section 303(d) of the CWA. EPA is working closely with the State Water Board to ensure that the revised standards are sufficient to address impaired water quality conditions in the Delta and reverse the declines in the fish species. The updated standards could result in altered environmental and water supply impacts that have not been analyzed in the SDEIS.

Second, ESA Section 7 consultation with FWS and NMFS regarding the construction and operation of new conveyance facilities is underway. We understand that the FWS and NMFS are not relying solely on the SDEIS for the Section 7 consultation process and that additional information is being generated to identify criteria for operating the new WaterFix facilities, to be included in the Biological Opinions and Incidental Take Permits. This information and such operating criteria could result in environmental impacts that have not been analyzed in the SDEIS.

Third, construction of WaterFix's new water intake and conveyance infrastructure would require authorization under Clean Water Act Section 404, as well as a Rivers and Harbors Act Section 14 modification of levees permit, from the U.S. Army Corps of Engineers. Water quality and aquatic life analyses in the SDEIS show that the proposed project may cause or contribute to violations of state water quality standards and significant degradation of waters of the U.S.; therefore, additional avoidance and minimization of environmental impacts and/or compensatory mitigation may be necessary in order to comply with CWA Section 404. It is also likely that additional information and analysis not included in the SDEIS will be required to support those permit decisions and that information and analysis will better inform the overall evaluation.

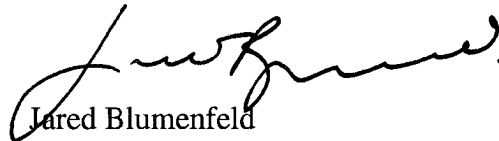
All of the above listed regulatory processes will develop new data and likely new compliance requirements beyond those provided in the SDEIS. EPA understands that these as yet incomplete regulatory requirements will be addressed through the pending actions by the State Water Resources Control Board, FWS, NMFS, and Corps of Engineers. These key decisions, and the analysis that will support them, are not yet done. Our statutory responsibility is to review the NEPA document that is in front of us at this time, however, the reality is that these future regulatory processes will have an important bearing on the project. Because these subsequent regulatory processes are likely to generate real world operational scenarios that are significantly different from the operations proposed in the SDEIS, the information is not yet available to reach definitive conclusions concerning the environmental impacts of the proposed project.

The tunnels that are discussed in detail in this draft NEPA document are an important improvement for water reliability, but the choices that will affect the operation of the tunnels, and thus the overall impacts of the project, will not be made until future regulatory actions are completed. These future decisions will supply the missing pieces necessary to determine the environmental impact of the entire project. The unusual circumstances of this project mean that the information is not yet available for a complete evaluation of environmental impacts – and for that reason a rating of “3” (*Inadequate*) for the SDEIS is required – but EPA expects that the project will continue to move forward, with those necessary additional pieces to be supplied as the later regulatory processes proceed. Under the unique circumstances of this case, the additional data, analysis and public input associated with these future regulatory processes are expected to provide the needed supplemental information to allow a full review of the environmental impacts without requiring another draft supplemental EIS. EPA will have the opportunity to support Reclamation, other federal agencies, and the State of California as they collectively continue to define an environmentally sound and effective project that would operate in a manner that simultaneously supports water supply reliability and enhances the Delta's ecosystem. EPA

believes that the upcoming actions by USFWS, NMFS, the State Water Board, and the Corps of Engineers will be critical next steps in the design and review of the project, and EPA looks forward to continuing to work with these agencies as the project moves forward.

If you have any questions, please contact me at 415-947-8702. Alternatively, your office may contact Kathleen Johnson, Enforcement Division Director. Ms. Johnson can be reached at 415-972-3873.

Sincerely,



Jared Blumenfeld

EXHIBIT B



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

OFFICE OF THE
REGIONAL ADMINISTRATOR

Aug 26, 2014

Will Stelle, Regional Administrator
West Coast Region National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

Subject: Draft Environmental Impact Statement for the Bay Delta Conservation Plan, San Francisco Bay Delta, California (CEQ# 20130365)

Dear Mr. Stelle:

The U.S. Environmental Protection Agency has reviewed the Bay Delta Conservation Plan (BDCP) Draft EIS pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review authority under Section 309 of the Clean Air Act. The Draft EIS explores options for a comprehensive conservation strategy to restore and protect the Sacramento–San Joaquin Delta’s ecosystem health, water supply, and water quality.

As you know, the San Francisco Bay/Sacramento-San Joaquin Delta Estuary is one of the largest and most important estuarine systems on the Pacific Coast of the United States, supporting over 750 species. It is the hub of California’s water distribution system, supplying drinking water to 25 million people and irrigation water to 4 million acres of farmland. The decline of aquatic resources in the Estuary, along with the corresponding impacts on urban and agricultural water districts that rely on water exported from it, present significant challenges. Recent circumstances have only underscored the importance of working together on these issues, as California is experiencing severe drought and water shortages. We believe the NEPA process is well-suited to bring all of these considerations together, including the consideration of the environmental impacts of reasonable alternatives to the BDCP as it is currently proposed. We appreciate the effort to prepare the Draft EIS, and we support your recent decision to prepare a Supplemental Draft EIS to take a closer look at these issues.

EPA fully supports the stated purpose of the BDCP effort: to produce a broad, long-term planning strategy that would meet the dual goals of water reliability and species recovery in this valuable ecosystem, and we recognize the potential benefits of a new conveyance facility. However, we are concerned that the actions proposed in the Draft EIS may result in violations of Clean Water Act water quality standards and further degrade the ecosystem.

Our comments are consistent with those we have made in conversations that have taken place over the last few years among the agencies involved in managing the Delta. Many of our comments have also been made by others, both formally and informally, throughout the process, and we believe that they reflect a developing consensus within the scientific and regulatory communities. We are committed to continuing to work with you and other stakeholders toward a project proposal that meets the dual goals

of water reliability and species recovery in the Bay Delta, and toward a well documented EIS that adequately informs decision-makers and the public, as required by NEPA.

Clean Water Act Water Quality Standards

The Draft EIS shows that operating any of the proposed conveyance facilities, which constitute Conservation Measure 1 (CM1), would contribute to increased and persistent violations of water quality standards in the Delta, set under the Clean Water Act, measured by electrical conductivity (EC) and chloride concentrations. We recommend that the Supplemental Draft EIS include one or more alternatives that would, instead, facilitate attainment of all water quality standards in the Delta. Specifically, we recommend that an alternative be developed that would, at minimum, not contribute to an increase in the magnitude or frequency of exceedance of water quality objectives, and that would address the need for water availability and greater freshwater flow through the Delta. Such an alternative should result in a decrease in the state and federal water projects' contributions to the exceedance of any water quality objectives in the Delta.

We also note that, while CM1 would improve the water quality for agricultural and municipal water agencies that receive water exported from the Delta, water quality could worsen for farmers and municipalities who divert water directly from the Delta. In that regard, we recommend that the Supplemental Draft EIS consider measures to ensure that the project would not increase concentrations of bromide around the intake for the North Bay Aqueduct at Barker Slough. In addition, we recommend consideration of whether additional measures, such as operational modifications both upstream and downstream, are needed to avoid increasing mercury and selenium concentrations and bioavailability in the Delta.

The Draft EIS indicates that CM1 would not protect beneficial uses for aquatic life, thereby violating the Clean Water Act. Total freshwater flows will likely diminish in the years ahead as a result of drought and climate change. Continued exports at today's prevailing levels would, therefore, result in even lower flows through the Delta in a likely future with less available water. We recommend that the Supplemental Draft EIS consider modified operational scenarios for CM1 alternatives that would have beneficial effects on covered fish populations during all life stages and attain water quality standards in the Bay Delta.

Habitat Restoration

The Draft EIS describes a general proposal to restore approximately 150,000 acres of wetlands, uplands, grasslands, and riparian areas in and around the Delta to offset the adverse impacts of the continued operations of the water projects. However, the Draft EIS does not indicate whether suitable acreage is available or whether restoration alone would be sufficient to recover fish populations. We are concerned over the sole reliance on habitat restoration for ecosystem recovery, recognizing that existing freshwater diversions and significantly diminished seaward flows have played a significant role in precluding the recovery of Bay Delta ecosystem processes and declining fish populations. We recommend that the Supplemental Draft EIS consider measures to ensure freshwater flow that can meet the needs of those populations and the ecosystem as a whole, and is supported by the best available science. We recommend that this analysis recognize the demonstrated significant correlations between freshwater flow and fish species abundance. We also recommend that the Supplemental Draft EIS include gradients of partial success for each habitat type to be restored, as supported by available science. The impacts

could be re-evaluated relative to each alternative (CMs2-11) in light of these gradients and the likely success rates for each habitat restoration type.

Alternatives

The Draft EIS defines the alternatives in terms of the design and capacity of the proposed conveyance structure. Each alternative is paired with a particular operational scenario. EPA agreed with this organizational construct early in the BDCP process, expecting that the Draft EIS would present a range of fully evaluated alternatives that clarifies the environmental and water supply tradeoffs being considered. The Draft EIS, however, focuses primarily on Alternative 4. It appears that the environmental impacts of certain other alternatives would be reduced if those alternatives were matched with more optimal operational criteria (for example, Alternative 5 with Operational Scenario F). Other reasonable alternatives could be developed by incorporating a suite of measures, including Integrated Water Management, water conservation, levee maintenance, and decreased reliance on the Delta.¹ Such alternatives would be consistent with the purpose and need for the project, as well as with the California Bay Delta Memorandum of Understanding among federal agencies² and the Delta Reform Act of 2009.

Project-level Analysis

The Draft EIS states that it includes a *project-level* analysis of environmental effects associated with CM1 (the conveyance facilities, which define the alternatives), and a *programmatic-level* analysis of 21 other Conservation Measures, including a suite of habitat restoration and aquatic stressors management initiatives. Programmatic-level inputs were used in some of the “project-level” analyses. We recommend that the Supplemental Draft EIS include project-level information and analyses for the conveyance tunnels, including the information necessary for permit decisions, to support the federal decision.

Upstream/Downstream Impacts

The federal and State water management systems in the Delta are highly interconnected, both functionally and physically. The Draft EIS does not address how changes in the Delta can affect resources in downstream waters, such as San Francisco Bay, and require changes in upstream operations, which may result in indirect environmental impacts that must also be evaluated. We recommend that the Supplemental Draft EIS include an analysis of upstream and downstream impacts.

NEPA Effects Determination

The Draft EIS presents *NEPA Effects Determinations*, but does not describe the decision rules that were used to make those determinations from the analytical information presented for each impact category. We recommend that the *NEPA Effects Determinations* and thresholds -- quantitative when possible -- be provided for each category so that it is clear why some estimated impacts result in one *NEPA Effects Determination* over another. We also recommend that the Supplemental Draft EIS explain whether all metrics are considered equal in the analysis or some are weighted. Please clarify whether negative impacts in one metric category translate into an adverse determination, regardless of the other metrics. Lastly, it would be helpful to include summary tables for each impact category so that the public and decision-makers can understand the metrics and their results and how they compare among alternatives.

¹ The “Portfolio Approach” developed by a diverse set of stakeholders is one attempt to place Delta water management into the larger context of facilities investments and integrated operations. http://www.sdcwa.org/sites/default/files/files/news-center/top-issues/portfolio-based-bay-delta-conceptual-alternative_1-16-13.pdf

² <http://www2.epa.gov/sites/production/files/documents/baydeltamousigned.pdf>

Adaptive Management

The Draft EIS explains that the adaptive management program is a work in progress. The specific approach for an adaptive management program and its effect on environmental consequences is fundamental to the success of the BDCP and should be addressed during the NEPA process. We recommend that a more detailed adaptive management program be provided in the Supplemental Draft EIS, since the goal of species recovery relies significantly on an effective adaptive management program. As you develop the plan, include detailed information on the plan's objectives, explicit thresholds, alternative hypotheses, responsive actions, and designated responsible parties.

Conclusion

EPA remains committed to working with the federal and state lead agencies to develop an environmentally sound, scientifically defensible, and effective plan for restoring the Bay Delta ecosystem and achieving greater water supply reliability. Please note that, because you are preparing a Supplemental Draft EIS, which we anticipate will address many of the issues raised about this Draft EIS, including the issues we have outlined here, EPA will defer our rating until the Supplemental Draft is circulated for public review and comment. We have also enclosed more detailed comments and recommendations for your consideration.

We are available to discuss our comments and recommendations. Please send one hard, and one electronic, copy of the Supplemental Draft EIS to this office at the same time it is officially filed with our Washington D.C. Office. If you have any questions, please contact me at 415-947-8702. Alternatively, your office may contact Kathleen Johnson, Enforcement Division Director. Ms. Johnson can be reached at 415-972-3873.

Sincerely,

/S/

Jared Blumenfeld

Enclosure

cc: Ren Lohofener, Regional Director, Pacific Southwest Region, U.S. Fish and Wildlife Service
David Murillo, Regional Director, Mid Pacific Region, U.S. Bureau of Reclamation

Table of Contents

- I. Water Quality Impacts..... 2
 - A. Adverse Impacts..... 2
 - B. Salinity (Electrical Conductivity, Chloride) and Bromide.....2
 - 1. Water Quality Standards Exceedances and Degradation..... 2
 - 2. Mitigation Effectiveness.....4
 - 3. Mitigation Relationship to Water Quality Standards.....4
 - 4. Impacts of Changes to the Salinity Gradient (X2).....5
 - C. Potential Increases in Methylmercury Formation and Transport.....6
 - D. Selenium..... 8
 - E. Additional Water Quality Impacts10
- II. Fish and Aquatic Resources.....10
 - A. Aquatic Resources Beneficial Uses.....10
 - 1. Longfin Smelt Abundance.....10
 - 2. Entrainment of Juvenile Delta Smelt.....11
 - 3. Impacts on Delta Smelt Rearing Conditions.....11
 - B. NEPA Effects Determinations.....12
- III. Analytical and Presentational Issues.....12
 - A. Defining the Project Proposal.....12
 - B. Alternatives Analysis.....13
 - C. Comparison of Alternatives.....14
 - D. Scope of the Impacts Analysis15
 - E. Integrated Water Management15
 - F. Habitat Restoration15
 - G. Aquatic Species Recovery16
 - H. Project-level Decision-making17
 - I. Energy Infrastructure18
 - J. No Action Alternative19
 - K. Impacts to Wetlands19
 - L. Air Quality Impacts20
- IV. Additional Issues.....21
 - A. Alternatives.....21
 - B. Water Supply.....25
 - C. Groundwater.....26
 - D. Water Quality.....26
 - E. Fish and Aquatic Resources.....28
 - F. Energy.....32
 - G. HCP Monitoring and Assessment.....35

I. Water Quality Impacts

A. Adverse Impacts

Chapter 8 indicates that all project alternatives would result in adverse, significant, unmitigated effects to water quality and one or more beneficial uses within the affected water bodies. For example:

- The proposed changes in water management would measurably exacerbate impairment of agricultural and aquatic life beneficial uses in the South Delta and Suisun Marsh (p. 8-439);
- Bromide, chloride, dissolved organic carbon, and electrical conductivity (EC) are expected to increase due to changes in hydrodynamics as a result of the implementation of the CM1 Alternative 4 (pp.8-420, -428, -454, and -439). In addition, the feasibility of mitigation actions for EC is uncertain (p. 8-441); therefore, the net effect to overall salinity levels is unclear;
- Mercury, pesticide, and selenium exposure levels may increase and be cumulatively significant (p. 8-446, -767, -768); and
- Water quality degradation resulting from the increased pumping of freshwater from the North Delta could cause increases in water treatment costs (p. 8-420).

All Bay Delta Estuary waters are impaired due to numerous contaminants, including pesticides, manufacturing compounds, metals (including selenium), pathogens, nutrients/low dissolved oxygen, invasive species, salinity, and toxicity from unknown sources. Without adequate mitigation, these impairments would be exacerbated by any of the alternatives evaluated in the Draft EIS. Poor water quality in the Bay Delta Estuary and its tributaries adversely affects terrestrial and aquatic ecosystems, drinking water, recreation, industry, agriculture, and the local, state, and interstate economy.

***Recommendation:** Discuss mitigation measures that would reduce the projected adverse impacts on water quality, and discuss whether the proposed actions would contribute to impairments of beneficial uses or further degrade water quality.*

B. Salinity (Electrical Conductivity, Chloride) and Bromide

1. Water Quality Standards Exceedances and Degradation

The Bay Delta Water Quality Control Plan (WQCP) contains EC objectives for the Delta to protect agricultural and fish and wildlife beneficial uses, and chloride objectives to protect municipal and industrial water supply beneficial uses. Bromide, a significant precursor to brominated disinfection byproducts, is subject to CALFED Drinking Water Program goals (p. 8-42). The Draft EIS estimates that EC, chloride and bromide concentrations would increase under CM1 Alternative 4, relative to the No Action Alternative and Existing Conditions for Delta locations. The document predicts increased exceedances of numeric water quality standards, which suggests that CM1 Alternative 4 would result in a loss of protection for municipal, agricultural, and aquatic life beneficial uses. Specifically, CM1 Alternative 4 would result in:

- A 17% increase in days out of compliance with the agricultural EC standard at Emmaton (p. 8-252 lines 6-7). The EC objective at Emmaton is intended to protect agricultural beneficial uses, but also has ancillary benefits to aquatic life. Increasing noncompliance days would further contribute to existing EC water quality impairments in the western Delta, and degrade beneficial use protection for agricultural and aquatic life beneficial uses.

- A 7% increase in days exceeding the municipal chloride standard (250 milligrams per liter (mg/L) mean daily maximum) at Contra Costa Canal Pumping Plant #1 (p. 8-243 line 26) and “substantial degradation during the months October through December when average concentrations would be near, or exceed, the objective” (p. 8-243 lines 33-34 and Appendix 8G, 27 Table CI-9).
- A doubling of the frequency of exceeding the lower municipal chloride standard at Antioch and Contra Costa Canal Pumping Plant #1: “All of the Alternative H1-H4 Scenarios would result in substantially increased chloride concentrations in the Delta such that frequency of exceeding the 150 mg/L Bay-Delta WQCP objective would approximately double” compared to Existing Conditions (p. 8-429) and the No Action Alternative (Appendix 8G Table CI-64).
- Increased EC levels in Suisun Marsh, exacerbation of the existing EC water quality impairment, and degradation of aquatic life beneficial use protection (p. 8-438 and Appendix 8H-27). “The most substantial EC increase would occur at Beldon Landing with long-term average EC levels increasing by 1.3-6.0 milliSiemens per centimeter (mS/cm), depending on the month and operations scenario, at least doubling during some months the long-term average EC relative to Existing Conditions” and the No Action Alternative (p. 8-438).
- Higher quality water to those receiving the exported water, but adverse impacts on those who rely on water directly from the Delta: “the operations and maintenance activities under Scenario H1-H4 of Alternative 4 would cause substantial degradation to water quality with respect to bromide at Barker Slough... and could necessitate changes in water treatment plant operations or require treatment plant upgrades” (p.8-420).

The EC and chloride analyses in the Draft EIS provide some confusing results. For example, the 16-year average EC concentration (mass balance) at Emmaton is 887 micromhos per centimeter ($\mu\text{mhos/cm}$) for CM7, and 935 $\mu\text{mhos/cm}$ for CM8, even though outflow (an indicator of freshwater flow to the estuary) is twice as high for CM8. Similarly, chloride concentrations predicted for CM7 (mass balance and EC-chloride relationship) at Antioch on the San Joaquin River are slightly lower than those for CM8.

The water quality chapter of the Draft EIS does not evaluate the alternatives against the full suite of Water Quality Objectives for Fish and Wildlife Beneficial Uses, which are found in Table 3 of the Bay Delta WQCP. The Delta outflow objective is discussed in Chapter 5 Water Supply, and a brief discussion of Delta outflow objective is in the HCP for only the CEQA Preferred Alternative 4.

Recommendations: Describe mitigation measures that would prevent the proposed project from resulting in increased exceedances of water quality objectives in the already-degraded Delta. These measures may include reducing exports to provide more outflow and mitigate salinity intrusion.

Explain the differences in the predictions among CM1 alternatives, including why twice as much outflow would result in higher salinity concentrations for Alternative 8 relative to Alternative 7. Disclose the confidence intervals for the mass-balance and EC-chloride relationship approaches for predicting future concentrations of EC and chloride.

Evaluate all CM1 alternatives with respect to all water quality standards listed in Tables 1-3 of the Bay-Delta WQCP, and indicate whether each standard would be met under each alternative.

2. Mitigation Effectiveness

Appendix 8H “Electrical Conductivity” states that, although the modeling results show exceedences of water quality D-1641 standards, the project proponents “intend” to operate the State Water Project and Central Valley Project facilities by fine tuning reservoir storage and exports in real time to meet the standards (p. 8H-1). The water quality objectives that would be met in this manner are not specified, nor is an estimate provided of the impact of this measure on water supply. Furthermore, the Draft EIS includes the caveat that “if sufficient operational flexibility to offset chloride increases is not feasible under Alternative 4 operations, achieving chloride reduction pursuant to this mitigation measure would not be feasible under this Alternative” (p.8-430). A similar caveat is stated regarding bromide (p. 8-422). These statements suggest that the water supply exports that define the Alternative 4 operational scenario would be given higher priority than meeting water quality standards, thus rendering that scenario potentially inconsistent with the protection of beneficial uses.

Recommendations: *Clearly identify the water quality objectives that the proponents intend to meet by fine-tuning reservoir storage and exports in real time, and clearly state this intention as an enforceable commitment. Reconcile the conflicting caveats regarding operational flexibility with this commitment.*

Provide an estimate of the amount of water that would be needed to meet water quality standards during periods when the modeling predicts exceedances, and describe how the use of water for this purpose would impact water diversions for upstream and downstream users. Include a comparison against drought years.

Provide historical data to illustrate how D-1641 standards have been met in the past, including the number of times that DWR has submitted Temporary Urgency Change Petitions with the State Water Board requesting modification of requirements of D-1641 because of drought conditions.

3. Mitigation Relationship to Water Quality Standards

EPA understands that the modeling for the water quality analysis was based on an assumption that the Emmaton EC water quality standard compliance point would be moved four miles upstream to Three Mile Slough, as DWR is anticipated to request. We also understand that DWR will request that the State Water Resources Control Board include this compliance point change as part of the Phase II update to the Bay Delta WQCP. The State Board will review this request, as will the EPA. We are concerned that the intended mitigation for the water quality violations at Emmaton relies on a change in the compliance point. We consider the movement of the compliance point to Three Mile Slough a relaxation of the EC standard because it would potentially permit four miles of additional salinity intrusion into the upper estuary, which could have negative impacts on multiple beneficial uses.

Recommendations: *Explain the technical, scientific, and policy reasons for using Three Mile Slough in DSM2 modeling for assessing EC compliance at Emmaton. Describe how EC was estimated at Emmaton under the No Action Alternative and for Existing Conditions if it was not directly estimated using DSM2; and interpret the comparison of EC at Three Mile Slough in CMI operational scenarios to EC at Emmaton.*

Identify all of the water quality standards, including EC at Emmaton, which the BDCP assumes will be modified. Disclose the process for obtaining a modification of a water quality standard.

4. Impacts of Changes to the Salinity Gradient (X2)

The salinity gradient, approximated by X2¹, has an inverse relationship with many diverse bay and estuarine fishes, including the threatened and endangered species that are the conservation targets of the BDCP. As X2 decreases (i.e., moves out to sea) habitat conditions for some species improve and relative abundance increases². Because the location of X2 is closely tied to freshwater flow through the Delta, the proposed project would have a strong influence on this parameter, yet the Draft EIS does not analyze each alternative's impacts on aquatic life in the context of this relationship.

Examination of the predicted changes in monthly average X2 for each CM1 operational scenario, A through G, would help determine how the quantity and quality of estuarine habitats and relative fish abundance would change under those scenarios for multiple fish species. It would also be useful to estimate the range of monthly average X2 values (and/or monthly Delta outflow) for each alternative and compare it to the pattern of freshwater flows and salinity gradients that characterized a reference time period when resident and migratory fish populations were in comparatively better condition. The operational scenarios that more closely mimic the reference period freshwater flow and salinity gradient pattern could be expected to produce aquatic conditions and habitats that benefit native and migratory fishes and support important food web processes at all ecosystem levels.

Freshwater flow may be one of the best tools available in the short term to improve fish populations and protect aquatic life beneficial uses prior to the completion of planned restoration projects, given its widely cited importance to ecosystem recovery. Relative fish abundance responses to freshwater flow can be estimated using regression equations provided in peer reviewed literature and government reports.³ The equations do not directly include the effects of tidal marsh and floodplain restoration on fish populations; therefore, in their current form, they would be most useful for evaluating the impacts of flow variations prior to the completion of restoration projects. We anticipate that the ability to measure the benefits of restoration projects will improve after the projects are started and measurements and monitoring data become available.

The Draft EIS does not evaluate potential downstream effects of CM1 alternatives on San Francisco Bay fish populations. The description of impacts to San Francisco Bay from Delta Outflow changes (p. 11-132) stops at Suisun Bay even though outflow affects relative abundance of San Francisco Bay fishes such as Bay shrimp, starry flounder, and Pacific Herring. Some of these populations may be negatively affected by reduced outflows associated with CM1 alternatives, and the effect of restoration CMs (2-12) on these fish populations may or may not be beneficial.

Recommendations: Describe the estuarine salinity gradient and how it defines important aquatic habitats, including marine, low salinity zones, and migratory corridors for target fishes. Describe its relevance to important aquatic life communities, including phytoplankton and zooplankton.

¹ X2 refers to the distance from the Golden Gate up the axis of the estuary to the point where daily average salinity is 2 parts per thousand at 1 meter off the bottom (Jassby et. al. 1995).

² Jassby AD, Kimmerer WJ, Monismith SG, Armor C, Cloern JE, Powell TM, Schubel JR, Vendlinski TJ. 1995. Isohaline position as a habitat indicator for estuarine applications. *Ecological Applications* 5(1): 272-289;

Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: Physical effects or trophic linkages? *Marine Ecology Progress Series* 243:39-55; Kimmerer WJ, Gross ES, MacWilliams ML. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? *Estuaries and Coasts* 32: 375-389.

³ United States Fish and Wildlife Service, September 27, 2005, Recommended Streamflow Schedules To Meet the AFRP Doubling Goal in the San Joaquin River Basin (FWS 2005), pp. 27 available at:

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_sprinfo/afrp_2005.pdf;

Jassby AD, Kimmerer WJ, Monismith SG, Armor C, Cloern JE, Powell TM, Schubel JR, Vendlinski TJ. 1995. Isohaline position as a habitat indicator for estuarine applications. *Ecological Applications* 5(1): 272-289;

Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: Physical effects or trophic linkages? *Marine Ecology Progress Series* 243:39-55;

Kimmerer WJ, Gross ES, MacWilliams ML. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? *Estuaries and Coasts* 32: 375-389.

Describe the Delta outflow objective in the Water Quality Chapter, including a description of the “X2” concept, recognizing that the “X2” concept provides the foundation for the Delta outflow objective and is the basis for protecting springtime estuarine habitat for resident and migratory fishes, which are the targets of the BDCP.

Include a year-round salinity gradient and/or Delta outflow analysis for each CM1 alternative. This can be accomplished using information already generated for the BDCP EIS.⁴ Compare the results to a defined and supported reference period to determine how closely each scenario may mimic the salinity gradient and/or monthly outflow pattern. Alternatively, use three-dimensional modeling that maps the salinity gradient within the estuary on a monthly time step for all CM1 alternatives. This would make it possible to estimate the size and location of salinity zones, such as the low salinity zone, under different operational scenarios; however, it is not clear if this approach could be easily compared to a reference period using the same modeling tools.

Include at least one-dimensional salinity gradient and Delta outflow analyses for the fish species evaluated in Chapter 11. Define and support an agreed upon relative reference period for the analyses.

Use the referenced flow-abundance tools to predict a range of potential fish abundance changes under each operational scenario for CM1. The Kimmerer 2002 relationships should be used to evaluate potential downstream impacts to Bay fish populations. Provide the results of these analyses and explain that they do not include benefits of habitat restoration or entrainment reductions from minimizing use of south Delta pumping facilities when they cause the most harm for salmonids.⁵

C. Potential Increases in Methylmercury Formation and Transport

EPA agrees that restoring wetlands and floodplains in and near the Delta is an essential component of reviving the Estuary’s health; however, nearly all the locations targeted for habitat restoration in the Delta have been, or are at risk of being, contaminated with mercury from historical mining sources and ongoing air deposition from industry. Sport fish in the Delta are already burdened with higher concentrations of mercury than anywhere else in the State,⁶ and the presence of this powerful neurotoxin in the food web poses a threat to public health and the ecosystem as a whole. For this reason, health advisories have been issued for the Delta and several upstream rivers.

The BDCP relies heavily on proposed restoration in Yolo Bypass to mitigate for the adverse impacts of the CM1 alternatives on fish populations, noting that the Bypass is one of the places in the Delta that shows the most potential for providing floodplain benefits for fish, including salmon (BDCP p. 2-80). The Draft EIS, however, says that the Yolo Bypass may contribute up to 40% of the total methylmercury production in the entire Sacramento watershed (p. 25-63). The State Water Board has also observed that, when the Yolo Bypass is flooded, it becomes the dominant source of methylmercury to the Delta, and that restoration activities could exacerbate the existing mercury problem.⁷ While EPA strongly supports restoration of aquatic habitat in the Delta, caution must be exercised to ensure that it

⁴ Information needed to support salinity gradient and Delta outflow analyses appears to have been developed by completed modeling efforts for BDCP. The salinity gradient and low salinity zone are discussed in the HCP; X2 and Delta outflow are CALSIM outputs; a 3-dimensional model (UnTRIM) was used in Appendix 5A (Part D, Attachment 3 “Evaluation of Sea Level Rise Effects using UNTRIM San Francisco Bay-Delta Model”) to predict salinity gradient changes in climate change scenarios; and a spring Delta outflow comparison was provided for the longfin smelt analysis in the Draft EIS. The longfin smelt analysis in Chapter 11 includes a comparison of average monthly spring Delta outflow between CEQA and NEPA baselines and the H1 – H4 operational scenarios.

⁵ For more information, see EPA’s comments to the State Water Resources Control Board regarding the State’s effort to improve aquatic life beneficial use protection by modifying and/or adopting new water quality standards for flow in the Delta. See letter from US EPA to SWRCB, December 11, 2012, available at <http://www2.epa.gov/sites/production/files/documents/sfdelta-decpost-workshopltr-dec2012.pdf>; EPA presentation to SWRCB available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/wrkshp2/erinforenman.pdf

⁶ SWAMP- Surface Water Ambient Monitoring Program http://www.waterboards.ca.gov/water_issues/programs/swamp/rivers_study.shtml

⁷ P. 29 Periodic Review of the 2006 Water Quality Control Plan, State Water Resource Control Board http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/periodic_review/docs/periodicreview2009.pdf

does not result in unintended consequences that adversely affect water quality. Minimizing the formation and mobilization of methylmercury in wetlands is critical. Given the already high levels of mercury in the system, restoration in certain locations should be avoided if methylmercury production cannot otherwise be reduced or mitigated. For this reason, the BDCP's restoration acreage goals may not be attainable.

The DEIS underestimates the potential impacts of methylmercury on covered species and public health. Quantification of the methylmercury contributions from the proposed restoration were not provided in the document (this is acknowledged on p. 8-260), and the methylmercury NEPA Effects determinations rely on the success of unproven mitigation methods (CM12) that are currently under development to minimize formation and transport of methylmercury from Yolo Bypass, Cache Slough Complex, and the Cosumnes River Restoration Opportunity Areas (p.3-154). In the AQUA-8 "Effects of Contaminants Associated with Restoration Measures" evaluation of the impact of methylmercury, selenium, and other contaminants on delta smelt, the analysis of Alternative 1A concludes that methylmercury impacts to Delta smelt and winter-run Chinook salmon are "uncertain" (p. 11-277, 11-343). The analysis for Alternative 1A (and subsequent alternatives)⁸ states that restoration actions (CM2, CM4–CM7, and CM10) may increase production, mobilization, and bioavailability of methylmercury in the aquatic system, but that many effects are unknown at this time.

Research studies in the Yolo Bypass that were conducted by the US Geological Survey found methylmercury production values in Yolo Bypass managed wetlands and agricultural lands to be "among the highest ever recorded in wetlands."⁹ The Yolo Bypass mercury bioaccumulation study¹⁰ reported that all caged and wild fishes sampled had methylmercury fish tissue concentrations greater than the small fish tissue objective in the Delta Methylmercury TMDL (0.03 micrograms per kilogram ($\mu\text{g}/\text{kg}$) wet weight).¹¹ In addition, 59% of wild fishes and 82% of caged fishes had methylmercury concentrations greater than 0.20 $\mu\text{g}/\text{g}$ wet weight, which is a threshold above which fish health is impaired.¹² Finally, 52% of caged fish and 26% of wild fish had fish tissue concentrations greater than observed thresholds that reduce bird reproduction¹³ and greater than the large fish tissue objective (intended to protect human health and wildlife consumers). These results suggest that increasing production, transport, and bioavailability of methylmercury through restoration actions could result in adverse effects to human health and the environment.

The Environmental Justice Chapter of the Draft EIS provides conflicting information and conclusions regarding whether or not the BDCP alternatives would create conditions conducive to increased bioaccumulation of mercury in Delta fish species, and whether such bioaccumulation would be cumulatively significant for increasing the body burden (pp. 28-22, 25, 103) in fish. The USGS Yolo

⁸ Analyses for subsequent alternatives refer back to the analysis for Alternative 1A.

⁹ Alpers, C.N., Fleck, J.A., Marvin-DiPasquale, M., Stricker, C.A., Stephenson, M., and Taylor, H.E., Mercury cycling in agricultural and managed wetlands, Yolo Bypass, California: Spatial and seasonal variations in water quality: Science of The Total Environment, Volume 484, 15 June 2014, Pages 276–287 <http://dx.doi.org/10.1016/j.scitotenv.2013.10.096>.

¹⁰ Ackerman, J. "Agricultural Wetlands as Potential Hotspots for mercury bioaccumulation: experimental evidence using caged fish" Environmental Science and Technology 2010, 44, 1451-1457.

¹¹ The Delta Mercury and Methylmercury TMDL contains two fish tissue objectives that target specific beneficial uses. The average methylmercury concentrations shall not exceed 0.08 and 0.24 mg methylmercury/kg, wet weight, in muscle tissue of trophic level 3 and 4 fish, respectively (150-500 mm total length). These objectives are protective of (a) people eating 32 g/day (eight ounces, uncooked fish per week) of commonly eaten, legal size fish, and (b) all wildlife species that eat large fish. Small fish (less than 50 mm in length) – 0.03 mg methylmercury/ kg, wet weight, in muscle. The average methylmercury concentrations shall not exceed 0.03 mg methylmercury/kg, wet weight, in whole fish less than 50 mm in length. Large fish (150 – 500 mm total length) – 0.08 and 0.24 mg methylmercury/ kg, wet weight, in muscle. These objectives target protection of sensitive wildlife that eat fish. http://www.swrcb.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2010-0043_res.pdf.

¹² Frayer, W. E.; Peters, D. D.; Pywell, H. R. Wetlands of the California Central Valley status and Trends: 1939 to mid-1980's; U.S. Department of the Interior, Fish and Wildlife Service: Washington, DC, 1989.

¹³ Albers, P. H.; Koterba, M. T.; Rossmann, R.; Link, W. A.; French, J. B.; Bennett, R. S.; Bauer, W. C. Effects of methylmercury on reproduction in American kestrels. Environ. Toxicol.Chem.2007, 26, 1856–1866; Burgess, N. M.; Meyer, M. W. Methylmercury exposure associated with reduced productivity in common loons. Ecotoxicology 2008, 17, 83–91, as cited in Ackerman, J. "Agricultural Wetlands as Potential Hotspots for mercury bioaccumulation: experimental evidence using caged fish" Environmental Science and Technology 2010, 44, 1451-1457.

Bypass bioaccumulation study referenced above showed that the majority of wild and caged fishes had methylmercury tissue levels above the public health threshold for trophic level 3 fish and very close to the public health threshold for trophic level 4 (large) fish. Although the Delta is posted with fish advisories, people who rely on fishing for subsistence may consume more than the advisory recommends. Although the Draft EIS acknowledges that “restoration actions are likely to result in increased production, mobilization, and bioavailability of methylmercury in the aquatic system” (p. 25-64), it concludes that there would be no adverse effects on public health to any populations (p. 25-64, p. 28-22). This conclusion is inconsistent with the potential for increased methylmercury production, bioaccumulation, and effects to Environmental Justice communities, and the proposed mitigation actions described do not address the potential for significant negative effects to human health.

Recommendations: *Acknowledge that particular areas may not be suitable for restoration or that the acreages of proposed restoration may need to be reduced if such areas prove to be large contributors of methylmercury to the Delta ecosystem.*

Summarize recent research and current literature relevant to the potential for methylmercury impairment under existing conditions and future conditions; the potential impacts on covered fishes that use the Yolo Bypass; and the potential for bioaccumulation impacts to higher order species and human health.

Describe the existing methods that show potential for reducing formation and transport of methylmercury, and the CMs to which they could be applied. Further describe the range of potential reductions that could be expected from CM12 methods for minimizing methylmercury formation and transport.

Reconcile the Draft EIS’s conflicting conclusions regarding the likely impact of the BDCP alternatives on the conditions conducive to bioaccumulation of methylmercury, and provide the basis for these conclusions.

Describe and commit to water column and fish and invertebrate tissue monitoring for mercury and methylmercury to support adaptive management actions. Include a commitment to ensure that adequate warning signs are posted in appropriate languages regarding the risks of consuming fish caught in the Delta, and provide further outreach to minority populations about these risks. Such outreach should include meaningful involvement by the affected populations.

D. Selenium

Soils on the west side of the San Joaquin Valley are high in selenium. As a result, it is present in agricultural drainage and enters the Delta in the San Joaquin River at Vernalis. When mobilized in the environment and transformed to organic, bioavailable forms, selenium is highly bioaccumulative and can be toxic to organisms at very low levels of chronic exposure. The BDCP proposes to bring additional reliable water to the west side of the San Joaquin Valley. This would result in a greater volume of water and greater loads of selenium being discharged to the San Joaquin River. Although available data show that the maximum selenium concentration at Vernalis is not exceeding the current water quality objective of 5 micrograms per liter ($\mu\text{g/L}$)¹⁴ (p. 8-96), the operations of the proposed project would contribute significantly more selenium-laden San Joaquin River water to the Delta (p. 8-226). In addition, EPA is in the process of updating its national recommended chronic aquatic life criterion for selenium in freshwater to reflect the latest scientific information, which indicates that toxicity to aquatic life is driven by dietary exposures. As of this writing, a peer review draft of the

¹⁴ 4-day average for above normal and wet year types and a monthly mean for dry and below normal water year types.

updated criterion is undergoing public review, with comments due to EPA in July 2014. Following consideration of comments received, the draft criterion will be revised, as appropriate, and released as a draft criterion for public review.

EPA is concerned that the potential effects of selenium on covered species, especially green sturgeon, are underestimated in the Draft EIS. The analysis discusses increased residence time of selenium in Suisun Bay and concludes that the impacts of the proposed restoration measures on green sturgeon are “not adverse”; but does not discuss the south Delta, which would receive increased loads of selenium under all CM1 alternatives (p. 11-526). The increased loads, combined with increased residence time, could lead to greater selenium absorption in clam tissue, which is a primary food item of sturgeon (p. 11-257). Adverse effects of elevated selenium on early life stages of green sturgeon have been documented¹⁵.

Likewise, impacts of increased selenium loads to salmonids are not adequately addressed in the Draft EIS. Although salmonids do not eat clams, they are sensitive in all their life stages (figure 12 in Presser, Luoma 2010).¹⁶ One objective of the San Joaquin River Restoration Project (SJRRP) is to manage the river to restore salmon migration. The increased drainage of selenium-enriched water from the West side of the San Joaquin Valley that would likely result from the BDCP could compromise this effort.

Recommendations: *To mitigate for the project’s impacts to selenium levels in the estuary as a result of the BDCP operations, consider reviving and funding the Bureau of Reclamation’s Land Retirement Program¹⁷ to remove from cultivation and irrigation large areas of selenium laden lands on the West side of the San Joaquin Valley. This would save irrigation water, reduce discharges of selenium into the San Joaquin River basin, and advance attainment of selenium reduction targets¹⁸ set by EPA and the Central Valley Regional Water Quality Control Board. Evaluate the extent to which restoration of these “retired” lands to the native plant community could also contribute to the recovery of threatened and endangered plants and animals listed by FWS. Consider analyzing the cost/benefit of implementing treatment technologies vs. land retirement. Although cost/benefit analyses are not required under NEPA, such an analysis may be useful to decision makers and the public in this case.*

Reanalyze the proposal to develop wetlands as part of the conservation plan, taking into account the increased amount of agricultural drainage water from selenium-enriched lands that would enter these areas in the Delta as a result of BDCP operations, and the potential for selenium build-up and availability.

Discuss hydrodynamics and increased residence time of selenium in the San Joaquin River in the southern Delta and its potential impact on clam uptake of selenium, bioaccumulation in sturgeon, and the potential for population effects.

Reference and summarize the available literature regarding the impacts of selenium on sturgeon, especially with respect to early life stages, and consider such impacts in the analysis of increased selenium loading.

The evaluation of the Alternatives should consider the objectives of ongoing or proposed projects and programs that are intended to improve Bay Delta water quality and fish and aquatic resources. Disclose

¹⁵ Linares, J., Linville, R. Eenennaam, JV, Doroshov, S. 2004 Selenium effects on health and reproduction of white sturgeon in the Sacramento-San Joaquin estuary. Final Report for Project No. ERP-02-P35.

¹⁶ Presser TS and Luoma SN 2010 Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California USGS Administrative Report.

¹⁷ <http://www.usbr.gov/mp/cvpia/3408h/index.html>

¹⁸ <http://www.gpo.gov/fdsys/pkg/FR-2000-05-18/html/00-11106.htm>

potential conflicts with such projects or programs, as well as ways in which such conflicts could be avoided or minimized. In particular, the potential for competing management objectives between the BDCP and the SJRRP should be comprehensively analyzed and described.

E. Additional Water Quality Impacts

The conclusion that there would be no impact to dissolved oxygen concentrations in reservoirs (p. 8-192, lines 6-15) is unsupported given that three major reservoirs are predicted to experience a 10% increase in dead pool under the No Action Alternative.

Recommendation: Describe how predicted dead pool conditions in reservoirs may impact dissolved oxygen concentrations and other contaminant concentrations that may increase in these extreme conditions, and revise the impact conclusions, as appropriate.

It is not clear whether residence time was considered in the impact assessment of water quality contaminants such as pesticides and metals. It appears that southern Delta residence times would increase due to increased use of the north Delta pumps (and decreased use of south Delta pumps), limiting freshwater inputs to, and movement of water in, the south Delta. These conditions could increase residence time of water moving through the southern Delta, which would increase aquatic life exposure to contaminants such as pesticides and selenium.

Recommendation: Explicitly state whether or not residence time was included in assessments of contaminant impacts on aquatic life and other beneficial uses in the water quality analysis. If residence time was not considered, explain why it was not included and how increasing residence time could increase negative effects of contaminants as a result of CM1 operations.

II. Fish and Aquatic Resources

A. Aquatic Resources Beneficial Uses

Data and other information provided in the Draft EIS indicate that that all CM1 alternatives may contribute to declining populations of Delta smelt, Longfin smelt, green sturgeon, and winter-run, spring-run, fall-run and late-fall run Chinook salmon. Impact analyses in Chapter 11 show that entrainment, rearing, and migration conditions for these species are estimated, for many of the action alternatives, to be similar to, or worse than, existing conditions and sometimes worse than the future no action condition. Some of the NEPA effects that are described as “not determined” for some alternatives are very similar to effects that are described as “adverse” for other alternatives. Data regarding the impacts on fish is provided in various tables, and the summary statements made in the text do not always accurately reflect the information in those tables.

1. Longfin Smelt Abundance

Long-term and recent sharp declines in fish abundance have been cited by the lead federal agencies, their partners, and EPA as evidence of collapse in the Bay Delta ecosystem. Longfin smelt relative abundance is estimated to decline for all but one of the CM1 alternatives in most water year types (and in the average of all water year types) when compared to *Existing Conditions*.¹⁹ Alternative 8 is the only alternative that has a predicted relative abundance increase for Longfin smelt relative to *Existing Conditions*. In comparison to the *No Action* Alternative, four CM1 alternatives are predicted to result in declines in the Longfin smelt abundance index, while five CM1 alternatives are predicted to result in positive changes to that index. Despite these predictions, the Draft EIS concludes that the

¹⁹ Table 11-1A-8 page 11-297 “Estimated differences between scenarios for longfin smelt relative abundance in FMWT or Bay Otter Trawl,” Table 11-2A-7 page 11-764, Table 11-3-7 page 11-1097, Table 11-4-8 page 11-1308; Table 11-5-7 page 11-1742; Table 11-6-8 page 11-1951; Table 11-7-7 page 11-2227, Table 11-8-8 page 11-2492; Table 11-9-8 page 11-2768.

impact on Longfin smelt abundance would be “not determined” for all CM1 alternatives for the NEPA effects determination. This conclusion disregards the predicted differences among the alternatives in comparison to the *No Action Alternative*, and the predominantly negative impacts in comparison to *Existing Conditions*.

2. Entrainment of Juvenile Delta Smelt

The summary table on page 11-55 of the Draft EIS states that Alternative 4’s flow-related effects on fish would lead to “beneficial impacts” with respect to entrainment of Delta smelt. While the prediction for Alternative 4 shows somewhat less entrainment in comparison to the No Action Alternative, the predicted difference is much smaller for juveniles than for adults, and Alternatives 1, 2, 7, and 8 are predicted to result in substantially less entrainment at all life stages. Compared to Existing Conditions, Alternative 4 is predicted to result in *increased* entrainment of Delta smelt, especially juveniles. It is unclear how increases in juvenile entrainment would result in overall beneficial impacts. Entrainment estimates provided in the Draft EIS show reductions in adult entrainment, but increases in juvenile entrainment for all Alternatives except Alternatives 7 and 8, compared to Existing Conditions, and for Alternatives 3 and 5, compared to the No Action Alternative. The discussion in the text provides the caveat that “entrainment is expected to remain at or below the levels currently experienced by fish... there are very few instances where there would be increases, but these are substantially offset by decreases during other periods” (p.11-53). The analysis does not describe the relative importance of reducing entrainment of each life stage (adult and juvenile) to the overall population. No comparison among alternatives is provided, nor does the Draft EIS explain why some alternatives, such as Alternatives 7 and 8, show much larger reductions than other alternatives in both juvenile and adult entrainment.

3. Impacts on Delta Smelt Rearing Conditions

The Draft EIS forecasts changes to rearing conditions for Delta smelt by estimating the change in available fall abiotic habitat with and without estimated habitat restoration benefits relative to the two baselines: Existing Conditions and No Action Alternative. CM1 alternatives with “Fall X2” operational criteria are predicted to increase fall rearing habitat relative to the No Action Alternative. These include CM1 Alternatives 2, 4 H4, and 5-9. Alternatives 6 (isolated facility, eliminates south Delta exports) and 7 (enhanced flows) show the highest predicted increases in fall rearing habitat. The absolute values of fall rearing habitat or significance thresholds are not provided.

***Recommendations:** Modify operational scenarios for CM1 alternatives to develop at least one alternative that would have more certain and beneficial effects on covered fish populations during all life stages.*

Present the predicted impacts to each of the covered fish species and impact categories (entrainment, spawning, rearing, migration), for all the alternatives and baselines in comparative form, sharply defining the issues and providing a clear basis for choice among options by the decision-makers and the public (40 CFR 1502.14).

Provide absolute value estimates and proportional changes, in addition to relative changes from baselines, for predictions under each CM1 Alternative.

Describe the scientific basis of, and uncertainty associated with, any assumptions made in the analysis, including in the development of the No Action Alternative. This may include, for example, data regarding current entrainment levels of all covered fish species at all life stages in all water year types.

B. NEPA Effects Determinations

The NEPA Effects Determinations provided in the Draft EIS are not always consistent with the impacts described. We list a few examples below.

- **Alternative 1 AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt:** The description of impacts reports a 22% loss of rearing habitat (p. 11-265), which suggests that the impact should be considered adverse if proposed habitat restoration does not produce anticipated benefits. Instead, Table 11-1A-SUM2 (page 11-16) lists the NEPA Effects Determination as “Not Determined.” The NEPA Effects discussion on page 11-265 does not explicitly state that the NEPA Conclusion is “not determined.”
Alternative 1 AQUA-21 Effects of Water Operations on Entrainment of Longfin Smelt: The description of impacts shows that entrainment is estimated to increase for juvenile Longfin smelt in dry (14%), below normal (46%), and above normal (33%) water year types (Table 11-1A-6), and the *Summary* text on page 11-295 states, “It is concluded that these changes in Longfin smelt entrainment would be adverse under Alternative 1A.” The subsequent *NEPA Effects* statement comes to a different conclusion, “The overall effect of the Alternative 1A operations scenario would not be adverse to Longfin smelt.” Table 11-1A-SUM2 also lists the NEPA conclusion for entrainment of Longfin smelt as “not adverse.”
- **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.** The NEPA Effects discussion predicts reductions of 8 to 10 percent in relative abundance of Longfin smelt for Alternative 1A, suggesting an adverse impact on this species from Alternative 1A. No NEPA conclusion is explicitly stated in this section (p. 11-295); however, Table 11-1A- SUM2 (page 11-16) lists the NEPA conclusion as “not determined.”

Furthermore, throughout the document, different NEPA Effects Determinations are provided for similar impact descriptions. For example, in the discussion of “Effects of Water Operations on Migration Conditions for Winter-Run Chinook Salmon”, the Draft EIS concludes that Alternatives 1 and 8 would have "adverse" NEPA Effects and Alternatives 7 and 4 would have “not determined” NEPA Effects, even though the estimated NEPA effects are quantitatively similar for the multiple metrics evaluated. It is not apparent how the lead agencies decided that one impact was beneficial and another adverse.

***Recommendations:** Describe the decision making process and decision rules used to make NEPA Effects Determinations from the analytical information presented for each impact category. Define the NEPA Effects Determinations and provide thresholds -- quantitative when possible -- for each category so that it is clear why some estimated impacts result in one NEPA Effects Determination over another. Explain whether all metrics are considered equal in the analysis or some are weighted. If negative impacts in one metric category translate into an adverse conclusion, regardless of the other metrics, this should be disclosed. Include summary tables for each impact category so that the reader can see the metrics and their results and how they compare among alternatives.*

Compare the NEPA Effects Determinations with the narrative text describing the metrics and NEPA Effects among all alternatives for each impact category (e.g., AQUA-42 above) to ensure that decision rules and methods are used consistently.

III. Analytical and Presentational Issues

A. Defining the Project Proposal

The proposed project evaluated in the Draft EIS is not fully defined. EPA is aware that interagency discussions with the project proponents regarding key aspects of the proposed project are ongoing. Many of the undefined aspects of the BDCP are fundamental to the potential environmental impacts of

the proposal. For example, it is EPA's understanding that potential agreement, in advance, to a certain range of exports is under consideration in the HCP discussions. While an Implementation Agreement has been released for public comment, it is incomplete and is still being discussed by the involved parties. The Implementation Agreement's financing and decision making elements are important for public disclosure because they affect the likely implementation and success of mitigation and environmentally beneficial activities, yet these effects are not described for public review in the DEIS.

In addition, given the large scale nature of the construction activities associated with the BDCP, "minor" changes in proposed project design or operation can make a significant difference in the potential environmental impacts.

Recommendation: Fully describe the proposed project and reasonable alternatives, including information that is integral to decisions that are being made about the proposed project design and operations.

The Draft EIS explains that the adaptive management program is a work in progress (p. 3D-9, BDCP p. 3.4-32). The specific approach for an adaptive management program and its effect on environmental consequences is a fundamental issue that should be addressed during the NEPA process. Given that species recovery depends largely on the success of the adaptive management program, it is essential that a more fully formulated adaptive management program be described in the EIS.

Recommendation: Describe the adaptive management program in detail, including clear objectives, explicit thresholds, alternative hypotheses, and designated responsible parties. In addition, explain any limitations imposed on the adaptive management program by the Implementation Agreement, and explain how those limitations affect the integrity of the adaptive management program.

B. Alternatives Analysis

The Draft EIS states that alternatives in the document are "evaluated at an equal level of detail, as required by NEPA" (p. 3-5); however, the lead federal agencies' Progress Assessments indicate that the operational components of the alternatives were subjected to different levels of analysis. For example, iterative modeling runs were conducted for Operational Scenario H (solely associated with the CEQA Preferred Alternative 4) that were not run for other Operational Scenarios.

The Draft EIS defines the Alternatives in terms of the design and capacity of the proposed conveyance structure. Each alternative is then paired with a particular operational scenario. EPA agreed with this organizational construct early in the BDCP process, expecting to see a range of alternatives that could present the environmental and water supply tradeoffs being considered. Instead, the DEIS focuses primarily on Alternative 4. It appears that the environmental impacts of certain other alternatives would be reduced if those alternatives were matched with more optimal operational criteria (for example, Alternative 5 with Operational Scenario F); however, the DEIS does not attempt to optimize the other alternatives for environmental and water supply benefits. Other reasonable alternatives could be developed by incorporating a suite of measures, including water conservation, levee maintenance, and decreased reliance on the Delta.²⁰ Such alternatives would be consistent with the purpose and need for the project, as well as with the California Bay-Delta Memorandum of Understanding among federal agencies²¹ and the Delta Reform Act of 2009.

²⁰ The "Portfolio Approach" developed by a diverse set of stakeholders is one attempt to place Delta water management into the larger context of facilities investments and integrated operations.

²¹ <http://www2.epa.gov/sites/production/files/documents/baydeltamousigned.pdf>

Recommendations: *Work with State and federal partners to modify and further analyze the proposed Operational Scenarios to improve the precision and utility of the aquatic life analyses for all the operational alternatives.*

If differences in the level of analysis remain among the Alternatives, disclose, and explain the reason for those differences.

Evaluate the environmental impacts of pairing each Alternative with more optimal operational criteria.

C. Comparison of Alternatives

The Draft EIS does not clearly present the alternatives and their respective environmental impacts in a clear and comparative manner. Because technical results are not synthesized and displayed in a comparative format, it is difficult for the reader to compare the predicted effects of CMI alternatives.

Further compounding the difficulty is the fact that the Draft EIS uses two very different baselines (Existing Conditions and No Action), pursuant to CEQA and NEPA regulations, and neither baseline is clearly defined. The assumptions that inform the baseline descriptions are spread throughout the document (Chapter 4, Appendix 4D, Appendix 5A, and Appendix 3A). Although Chapter 4 attempts to summarize the baselines, the summary is confusing, and references appendices that are hundreds of pages long. The baseline assumptions form the basis for all impact assessments; therefore, their lack of clarity creates an underlying uncertainty in the document's analyses and conclusions.

The Draft EIS considers many other types of uncertainties, including those related to long-term climate change and human behavior, however, the treatment of uncertainty is confusing and exhibits a strong tendency to assume outcomes favorable to the proposed project. Uncertainties are expressed by “non-determined” NEPA conclusions, but they are not explicitly detailed in the body of the Draft EIS. EPA has repeatedly raised concerns about the treatment of uncertainty in the Draft EIS, and the Delta Independent Science Board and an independent panel commissioned by the Delta Science Program recently expressed similar critiques.²² Notably, the Panel concluded that the Effects Analysis of the BDCP (as incorporated by reference into the EIS) is “fragmented in its presentation, inconsistent with its technical appendices, and... inadequately conveys the fully integrated assessment that is needed to draw conclusions on the Plan due to incomplete information.”

Recommendations: *Include, in the body of the document, summary tables comparing the effects of all CMI alternatives and the No Action Alternative to the applicable water quality standards and other relevant environmental impact indicators, and compare and contrast the alternatives with respect to one another in the text. This discussion should inform potential mitigation strategies by identifying which alternatives would need more or less mitigation to comply with environmental objectives. Clearly explain the underlying assumptions inherent in the baselines. We suggest that this be presented in Chapter 4.*

Explicitly acknowledge uncertainties encountered in the analyses, explain what has been or could be done to eliminate or reduce those uncertainties, and disclose any assumptions made in the face of uncertainties that could not be eliminated.

²² Delta Independent Science Board Review: <http://deltacouncil.ca.gov/sites/default/files/documents/files/Cover-letter-v.4.pdf>
Independent Science Panel Review: http://deltacouncil.ca.gov/sites/default/files/documents/files/Delta-Science-Independent-Review-Panel-Report-PHASE-3-FINAL-SUBMISSION-03132014_0.pdf

D. Scope of Impact Analysis

The scope of analysis in the Draft EIS does not fully consider upstream and downstream impacts of the proposed actions in the Delta. As evidenced by the intergovernmental response to California's ongoing drought, the state and federal water projects are functionally and physically interconnected. For example, actions that Central Valley Project (CVP) operators take from the Trinity River have implications for South of Delta CVP and SWP deliveries, and operational changes in the Delta require upstream adjustments in project operations. Based on EPA's ongoing discussions with the federal lead agencies, we understand that the U.S. Bureau of Reclamation is continuing to evaluate its broad operational response to the proposed changes in the Delta, for both near term and longer term operations. Upstream operational changes caused by BDCP implementation could have significant environmental and water supply impacts in the upstream areas, and these impacts must be disclosed in the DEIS. Similarly, the BDCP activities are expected to have impacts on downstream aquatic resources in San Pablo and San Francisco Bay, primarily by changing the magnitude and timing of outflow and by altering the mix of contaminant inputs from upstream (see discussion of selenium, above.)

***Recommendation:** Explicitly recognize the integrated nature of the watershed and the water supply projects operating in the watershed, and analyze the upstream and downstream impacts, in particular to water supply and aquatic resources.*

E. Integrated Water Management

The BDCP effort has been ongoing since 2006. Initially, its broad goals were (a) the preparation of an HCP for continued operation of the state and federal water projects, and (b) a change in the mode of conveyance of export water through the Delta. As evidenced by the Alternatives Screening Criteria, as well as Water Supply Chapter 5 of the Draft EIS, there is now also a strong water supply *enhancement* component to the BDCP. That is, the project proponents appear to be anticipating that the CEQA Preferred Alternative 4 of the BDCP would result in the same or greater water exports (ranging from a decrease of 1% to an increase of 18%) than would be available in the absence of the BDCP (Table 5-9). Since the goals of a project drive the scope of the alternatives that must be evaluated in the NEPA process (as well as in the subsequent CWA Section 404 permitting process), EPA believes that a more robust discussion and evaluation of the water supply component of this project is warranted in the EIS.

California is moving quickly towards integrated water management, yet it is not clear how, as currently drafted, the BDCP conveyance component is consistent with this approach. Although the Draft EIS acknowledges California's progress in Demand Management in Appendix 1C, demand management is not incorporated into the project alternatives. Alternatives, such as the Portfolio Alternative, that proposed a more comprehensive and integrated approach to meeting the stated dual goals of the BDCP, were not evaluated.

***Recommendations:** Explain how the proposed changes in conveyance and exports fit within the larger integrated water management plan for California. Include a more comprehensive consideration of, and response to, suggested alternatives such as the "Portfolio Alternative" and discuss the demand scenario driving the Delta export facilities. Include a consideration of the significant water conservation efforts Statewide and in the export areas.*

F. Habitat Restoration

We are concerned that the analysis assumes a 100 percent success rate for habitat restoration, which is not consistent with our experience, or supported by restoration ecology and conservation biology academic literature and scientific investigation. The potential adverse impacts of CM1 operations would be greater than projected in the DEIS in the likely event that restoration of the Bay Delta ecosystem is not 100 percent successful.

Recommendations: Discuss restoration methods, performance metrics, and documented success rates for each habitat restoration type proposed.

Work with the federal and state wildlife agencies to develop analytical methods to evaluate gradients of partial success for each habitat type. Re-evaluate the impacts of each Alternative (CMs2-11) in light of these gradients and the likely success rates for each habitat restoration type. Incorporate the results into final conclusions about the impacts of BDCP alternatives.

G. Aquatic Species Recovery

Although not explicitly stated in the Draft EIS, the primary premise of the BDCP appears to be the hypothesis that endangered and threatened fish populations in the San Francisco Estuary can be protected from further degradation by habitat restoration without increasing freshwater flow to the Estuary. As noted in the Executive Summary, restoration of more than 150,000 acres of habitat is proposed under most BDCP alternatives. Only moderate changes in freshwater flows (Delta outflow) to the Estuary are proposed under any of the alternatives. In particular, all sub-alternatives for CEQA Preferred Alternative 4) would result in less Delta outflow compared to the No Action Alternative (DEIS Table 5-9).

The habitat restoration-only premise is inconsistent with broad scientific agreement, reflected in EPA's Delta Action Plan²³, that existing freshwater flow conditions in the San Francisco Estuary are insufficient to protect the aquatic ecosystem and multiple fish species, and that *both increased freshwater flows and aquatic habitat restoration* are needed to restore ecosystem processes in the Bay Delta and protect native and migratory fish populations.²⁴

The Draft EIS acknowledges the importance of freshwater flow to fish species abundance, but is inconsistent in describing its analyses of the benefits of habitat restoration versus increased freshwater flow. For example, page 11-202, lines 24 to 28 state that "although it is recognized that there are statistically significant correlations between freshwater flow and abundances of several fish species (e.g., Kimmerer 2002, FWS 2005), these correlations were not used in the EIR/EIS analysis to estimate fish population responses to alternatives because they do not directly include the effects of tidal marsh and floodplain restoration on fish populations." Elsewhere (e.g., p. 11-297), the document states that the Kimmerer 2002 model *was* used for the analysis. Correlations that do not include the effects of restoration were rejected for some analyses, but not for others.

Recommendation: *A consistent approach that recognizes the demonstrated significant correlations between freshwater flow and fish species abundance should be used to analyze all of the Alternatives. Describe the analytical approach and provide the rationale for, and implications of, any deviations from it.*

²³ <http://www2.epa.gov/sites/production/files/documents/actionplan.pdf>

²⁴ This broad scientific agreement is illustrated in the following reports: (a) Public Policy Institute of California (2013) Scientist and Stakeholder Views on the Delta Ecosystem "a strong majority of scientists prioritizes habitat and flow management actions that would restore more natural processes within and upstream of the delta" (p. 2). http://www.ppic.org/content/pubs/report/R_413EHR.pdf

(b) State Water Resources Control Board (2010) Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem Flows Report, p.7. "Both flow improvements and habitat restoration are essential to protecting public trust resources [defined as "native and valued resident and migratory species habitats and ecosystem processes" p. 10].

(c) National Academy of Sciences Natural Resource Council Committee on Sustainable Water Management in California's Bay-Delta (2012) Report: Sustainable Water and Environmental Management in California's Bay-Delta "...sufficient reductions in outflow due to diversions would tend to reduce the abundance of these organisms ["these organisms" = 8 Bay Delta aquatic species at various trophic levels]." Page 60 and "Thus, it appears that if the goal is to sustain an ecosystem that resembles the one that appeared to be functional up to the 1986-93 drought, exports of all types will necessarily need to be limited in dry years, to some fraction of unimpaired flows that remains to be determined." Page 105

(d) California Department of Fish and Wildlife (2010) Quantifiable Biological Objectives and Flow Criteria "...current Delta water flows for environmental resources are not adequate to maintain, recover, or restore the functions and processes that support native Delta fish." Page 1 in Executive Summary

H. Project-level Decision-making

The Draft EIS indicates that it provides a *project level* analysis of the proposed changes in conveyance (CM1) and a *programmatic* analysis of other BDCP elements. The level of engineering detail provided for the tunnels is not commensurate with the level of site-specific information typically provided in an EIS for a project that would require federal permits. For example, actions that would result in impacts to aquatic resources (e.g., grading, dredging, trench and fill, boring, spoils piling, levee work, excavation, etc.) are not detailed or quantified at a project-level of detail (e.g., limited information is provided regarding acres and/or linear feet of estimated impacts to waters of the US, the volume of sediment proposed for disposal sites, or the size and length of intakes, p. 3-92; 3C-3). Where reusable tunnel material sites are estimated for the pipelines and the forebays, they are estimated only for the preferred alternative and “may” be on the order of thousands of acres (p. 3-96). We do not believe the information provided in the Draft EIS is adequate to support a full assessment of the project-level impacts and mitigation opportunities, or to determine whether the project, as proposed, would satisfy requirements for requisite authorizations and permits. Given the lack of project-level information, EPA agrees with the Corps that supplemental NEPA review will be needed before a section 404 permit or CWA section 408 “Letters of Permission” could be issued.²⁵

The use of programmatic inputs to project-level analyses in the Draft EIS also substantially limited the predictive power of evaluations that were intended to provide project-level precision. For example, Section 8.4.1.7 “Constituent-Specific Considerations Used in the Assessment” states that the modeling to predict water quality effects (salinity) of CM1 operational scenarios relied on estimates of impacts from implementation of other conservation measures, specifically CM2 (Yolo Bypass Floodplain Restoration) and CM4 (tidal marsh restoration), which are evaluated in the Draft EIS at a programmatic level (p. 8-153). A representative estimate of the location and amount of tidal marsh restoration was used to predict water quality effects under each CM1 operational scenario. The programmatic nature of the CM4 input, which is based on an assumed 100 percent success rate, represents only one potential future configuration of tidal marsh restoration. The actual success rate and physical location(s) of tidal marsh restoration will have varying impacts on water quality elements such as salinity. The representative locations and amounts of CM4 and CM2 that were used for CM1 water supply modeling were not disclosed in the Draft EIS, nor has any feasibility analyses been cited that describes the availability of suitable sites in the restoration opportunity areas. The uncertainties introduced by the use of CM4 programmatic estimates raises concerns over the reliability of water quality modeling results, and whether the analysis presented in the Draft EIS is sufficient to support federal permit decisions.

Despite the substantial impact that the physical location of tidal marsh habitat restoration may have on water quality elements such as salinity, the Draft EIS does not describe how the locations for CM4 estimates were chosen or how likely it is that CM4 would result in the targeted amount of restoration (65,000 acres). A tidal marsh restoration success rate of less than 100 percent may yield very different results for predicted salinity values under each CM1 operational scenario. Typical success rates for wetland restoration have been reported to be substantially lower, e.g., on the order of 20-60 percent, and full restoration may require decades²⁶, yet this underlying uncertainty associated with the predicted salinity values is not characterized in the Draft EIS.

The envisioned CM-1 tunnels would require one of the largest construction projects in the nation, which would occur in the upper portion of a sensitive estuary. The proposed structure includes elements (e.g.,

²⁵ See Corps comments on the Draft EIS July 16, 2014 and July 29, 2014

²⁶ J.L. Lockwood and S.L. Pimm (1999), When Does Restoration Succeed? (Chapter 13 in *Ecological Assembly Rule: Perspectives, Advances, and Retreats*; and Angel Borja & Daniel M. Dauer & Michael Elliott & Charles A. Simenstad (2010) *Medium- and Long-term Recovery of Estuarine and Coastal Ecosystems: Patterns, Rates and Restoration Effectiveness*, *Estuaries and Coasts* (2010) 33:1249-1260.

intake facilities and fish screens) that have never been constructed in the Sacramento River at this scale, yet the Draft EIS provides only a qualitative analysis of construction-related water quality impacts. This is inconsistent with the intent of the Draft EIS to support project-level decision making, which necessitates project-level analysis. Assessment of construction-related impacts is a basic element of project-level analysis, yet the Draft EIS provides no quantitative estimates of the amounts of soil, sediment, and contaminants that would be discharged to water bodies during CM1 construction, nor a rationale for not including such estimates. The qualitative description of best management practices does not provide an adequate basis for a lead federal agency to write permit conditions that would be effective in minimizing the water quality impacts of constructing CM1.

Additionally, on page 8-293, in lines 35 to 38, the Draft EIS states that “Alternative 1A would result in similar potential contaminant discharges to water bodies and associated water quality effects to those discussed above for the no action alternative.” It is not clear how the impacts on water quality from construction-related activities of building a 35-mile twin tunnel facility, with 5 screened on-bank intakes, would be the same as not building it.

Recommendations: *Provide quantitative information regarding project footprints and estimates of soil, sediment and contaminant discharges during construction, as well as the impacts of those discharges and measures that would mitigate those impacts.*

Provide the level of detailed information necessary to support project-level analyses and permit and authorization decision making, or specify and commit to the additional detailed work and appropriate supplemental NEPA analysis that will need to be done prior to project-level decision making.

Provide confidence intervals around predicted water quality effects of CM1 operational scenarios. Describe the methods used to identify tidal marsh habitat locations for estimating water supply effects of CM1 operational scenarios, and explain the reasons for choosing these locations. Disclose the tidal marsh habitat locations that were used to estimate water supply effects of CM1 operational scenarios. Evaluate water supply effects of CM1 scenarios using several configurations and success rates of CM4 and disclose methods and results.

Provide a summary of tidal marsh habitat success rates reported in academic literature and restoration industry reporting. Include a description of elements that drive restoration success, including location characteristics and restoration actions.

Describe the locations in Restoration Opportunity Areas that exhibit the location characteristics that optimize restoration success, would provide salinity gradient habitat benefits for pelagic native fishes and would protect municipal water supply intakes.

I. Energy Infrastructure

The Draft EIS indicates that DWR will conduct a five-to-seven year Systems Impact Study (SIS) to evaluate the electrical transmission and power needed for conveyance facilities (p. 21-22). This study is projected to be completed in time to procure the necessary power to support construction and operation of the facilities. Based on the Draft EIS, it is not clear whether the SIS could affect the conclusions summarized in the EIS, of the energy needed for the system (Table 21-11 p. 21-34) or to what extent it may influence the procurement and placement of future transmission and associated infrastructure.

Recommendations: *Provide additional details on the purpose of the SIS and how it may affect the assessment of the BDCP’s energy needs as well as the procurement and placement of future transmission and associated infrastructure.*

In the absence of the SIS, disclose the assumptions made regarding electrical transmission placement and energy needs for the proposed conveyance facilities and whether the SIS could affect the analysis of environmental impacts.

Clarify, particularly with respect to impacts on terrestrial species, the level of uncertainty involved with future placement, and associated impacts, of the transmission line and related infrastructure pending the completion of the SIS.

Discuss whether the SIS would provide an opportunity to focus procurement of a guaranteed source of 100% renewable energy (e.g., contractually binding agreement) for the BDCP.

J. No Action Alternative

The No Action Alternative assumes that no BDCP actions would be undertaken, and that climate change and sea level rise would occur and water demands and diversions north and south of the Delta would increase, resulting in reduced freshwater flows into the Delta (p. 5-57). Under the No Action Alternative described in the Draft EIS, no action would be taken in response to the impacts of climate change and sea level rise on the Delta.

EPA supports the Draft EIS's recognition that climate change and sea level rise would likely result in decreased freshwater flows into and through the Delta and increased salinity intrusion; however, the assumption that, in the face of diminished overall water supply due to climate change, diversions north of the Delta would be allowed to increase seems unrealistic. Similarly, maintaining existing reservoir operations and meeting existing water supply demands is unlikely with the predicted effects of sea level rise and climate change. Comparing the CM1 alternatives to a "No Action" Alternative that assumes that no actions would be taken by *any* party to address climate change-induced reductions in overall water availability has the potential effect of exaggerating the benefits of the CM1 alternatives to the project proponents.

The Draft EIS appears to contradict itself by stating that some of the water supply delivery differences between CM1 alternatives and the No Action Alternative in the year 2060 are "*solely* attributable to sea level rise and climate change, and not to the operational scenarios themselves (emphasis added, p. 5-47, lines 20-23)." This overlooks the significant impact of the CM1 project operational scenarios, which propose exporting volumes of water approximately equal to, or greater than, those exported under existing conditions, regardless of overall water availability. In a future affected by climate change and sea level rise, with less fresh water to allocate among all water users, exports of such magnitude would further reduce water availability for other uses and users.

Recommendations: *Consider and incorporate into the No Action Alternative predictable actions by other parties to address the anticipated effects of increased north of Delta demands, climate change, and sea level rise on water availability. This should include consideration of any measures that would likely be taken to reduce demands both north and south of the Delta.*

Clarify that the comparisons of CM1 alternatives to the No Action Alternative isolate the effects that would be attributable to CM1, and that such effects would occur in the context of increased north of Delta demands, sea level rise, and climate change, not "in the absence of" the effects of those stressors.

K. Impacts to Wetlands

At this time, no Clean Water Act (CWA) Section 404 permit application has been submitted for discharges of dredged or fill material into waters of the United States, including wetlands, associated

with projects described in the BDCP. EPA and the Corps encourage lead agencies to proactively integrate CWA Section 404 regulatory requirements into the NEPA process to streamline environmental review by using NEPA documents for multiple permitting processes. With this in mind, EPA and the Corps met with the lead and federal state agencies multiple times over the past several years in the interest of using the BDCP EIS/EIR to inform Corps' CWA 404 regulatory decisions. Although constructive and informative, those meetings did not result in an agreement to coordinate the NEPA and CWA 404 permit reviews.

Information provided in the Draft EIS and through meetings with the lead agencies illustrate that there are substantial challenges to finding that discharges associated with Alternative CM1 are consistent with the CWA Section 404(b)(1) Guidelines. In addition, the Draft EIS acknowledges that additional analyses for NEPA may be required to support Corps CWA Section 404 permit decisions for CM1 and that additional NEPA work will be done for other conservation measures (p.1-13). The Corps also submitted comments on the Draft EIS verifying that the Draft EIS does not provide the site-specific information necessary to form the basis for a permit decision, and we agree with that comment.²⁷

Recommendation: *Demonstrate that the proposed project would meet the requirements for a CWA section 404 permit.*

Wetland Extent and Jurisdiction (Section 12.3.4)

The accuracy of the CWA jurisdictional determination and estimates of impacts to jurisdictional waters need to be improved for project-level analysis. The Draft EIS is intended to provide project-level information for CM1. However, the BDCP applicants were not able to conduct field delineations of wetlands and waters of the U.S. Instead the extent of wetlands and other waters in the study area was determined primarily using aerial photography interpretation in a GIS with limited (26 sites) field delineations (p. 12-146). However, the Draft EIS does not provide an estimate of GIS-based mapping accuracy as compared to the on-the-ground mapping. The Draft EIS also states that the extent of impacts to jurisdictional wetlands and other waters is likely an overestimate because actual construction footprints will be smaller than presented in the document and because some mapped wetlands and waters could be non-jurisdictional (p. 12-147). However, in some areas, when compared for other projects (e.g., Delta Wetlands project EIS) the extent of potential wetlands and waters mapped for BDCP is substantially lower. While the extent of ground disturbance may be overestimated in the document, it is likely that the extent of wetlands and waters have been substantially underestimated.

Recommendations: *In Section 12.3.2.4, clearly describe how the GIS-based mapping compared to the field delineations and provide an estimate of GIS mapping accuracy. Use available approved wetland delineations from other projects to supplement the GIS mapping.*

Identify a schedule for improving delineation methods completing wetland delineations on sites where DWR has access or can reasonably obtain access. Estimate direct fill impacts and secondary effects to waters using engineering drawings and cross sections.

L. Air Quality Impacts

General Conformity

The Draft EIS discloses that this project would generate emissions within multiple air basins that are federally designated as nonattainment for ozone, PM_{2.5} (particulate matter smaller than 2.5 microns), and/or PM₁₀ (particulate matter smaller than 10 microns); as well as designated maintenance areas for

²⁷ See Corps comments on the Draft EIS July 16, 2014 and July 29, 2014

carbon monoxide (CO; p. 22-13, Table 22-4). The Draft EIS states that general conformity to the State Implementation Plan (SIP), with regard to all of these pollutants except CO, would be demonstrated through the use of a combination of mitigation measures and the purchase of offsets. For CO, conformity would need to be demonstrated through the use of local air quality modeling analyses (i.e., dispersion modeling).

The availability of sufficient offsets to demonstrate conformity for the BDCP may be limited. EPA is aware that other construction projects scheduled to take place in the BDCP project area during the BDCP's proposed construction time frame also include the purchase of offsets to demonstrate conformity. For example, two segments of the California High Speed Rail project scheduled to be constructed in the San Joaquin Valley Air District are currently pursuing a significant amount of offsets for several criteria pollutants.

The Draft EIS is not clear as to whether the federal lead agencies have made a general conformity determination. To the extent there is information regarding conformity, the Draft EIS also appears to rely on qualitative, not quantitative information. EPA interprets the general conformity rule as including all direct and indirect emissions from the federal action; therefore, the emissions from all conservation measures required as part of this federal action should be quantified and evaluated in the general conformity determination.

Recommendation: *Demonstrate that all direct and indirect emissions of the federal action, including all required conservation measures, would conform to the applicable SIPs and not cause or contribute to violations of the National Ambient Air Quality Standards (NAAQS).*

Continue to work closely with the local air districts to secure legally binding offset agreements and complete the general conformity determinations.

Include the Draft General Conformity Determination either as a detailed summary or as an appendix, and the previously referenced "Conformity Letters."

IV. Additional Issues

A. Alternatives

The reason for including maximum pumping capacity (10,600 cfs) for the State Water Project's Banks Pumping Plant in all CM1 alternatives that include north Delta intakes is not clear. The existing pumping restriction for Banks Pumping Plant for the gates of Clifton Court Forebay is intended to minimize erosive forces. Section 5.2.1.3 refers to the Corps of Engineers' Public Notice for the Bank Pumping Plant, which states that that additional permitting for the SWP's diversions would not be required so long as the SWP did not exceed a diversion of 13,250 acre feet (daily and 3-day running average). It is not clear that the Corps' goal of minimizing erosion would be met by full pumping capacity operation.

Recommendations: *Describe the Corps of Engineers' pumping restriction for the Banks Pumping Plant. Describe the circumstances under which the Banks pumping plant would be able to pump at maximum capacity, and why erosion would no longer be a significant effect from pumping.*

The description of CM2 (Yolo Bypass fisheries enhancement) in Section 3.6.2.1 (p. 3-122) does not contain information about the amount and location of planned restoration activities, disclosure of targeted flood frequency, or a description of how CM2 differs from what is already required of the Bureau of Reclamation by the 2009 NMFS Biological Opinion, Section I.6.1 (page 34 in the 2009

Biological Opinion with 2011 amendments). That Biological Opinion requires Reclamation to “provide significantly increased acreage of seasonal floodplain rearing habitat, with biologically appropriate durations and magnitudes, from December through April, in the lower Sacramento River basin, on a return rate of approximately one to three years, depending on water year type.” The Biological Opinion indicates that the amount of floodplain restoration should range between 17,000-20,000 acres (excluding tidally-influenced areas), with appropriate frequency and duration.

It is EPA's understanding that CM2 is evaluated programmatically and subsequent NEPA document(s) will further define aspects of this alternative. Indeed, the Bureau has already collected scoping comments for the development of an EIS specific to CM2. It is not clear how programmatic information from this Conservation Measure was used to inform project-level impact determinations for Chapter 5 through Chapter 11 in the current Draft EIS.

Recommendations: *Provide additional available information about the planning of CM2, including floodplain acreages, frequency and duration of estimated inundation, and maps of potential locations of restoration sites.*

Summarize the potential overlap between CM2 and Section I.6.1 of the 2009 Biological Opinion so that the reader is informed about the existing requirements under Section 7 of ESA and how actions taken or proposed pursuant to the Biological Opinion may be modified by the BDCP.

Indicate whether additional water would be needed to flood the Yolo Bypass and, if so, where the water would come from.

Explain how programmatic information drawn from this Conservation Measure was used to inform project-level impact conclusions for water supply and water quality.

Recent floodplain habitat loss over the last few decades is listed as one of the reasons for proposing CM2, however, floodplain habitat loss has been occurring for more than a few decades.

Recommendations: *Provide a broader description of long-term floodplain habitat loss over a 100 year timeframe and describe how it has affected fisheries populations, with appropriate citations.*

It does not appear that a feasibility analysis was conducted to determine the availability of lands for restoration within the Restoration Opportunity Areas for CMs 2, 4-11. We understand that much of this information is confidential; however, there are multiple other draft HCP efforts moving forward that overlap with the project area, creating the potential for restoration planning conflicts on the same parcel of land.

Recommendation: *Conduct an analysis of areas that support each type of proposed habitat restoration in each of the Restoration Opportunity Areas and develop criteria for prioritizing acquisition based on potential restoration success and availability. Consider the other draft HCP efforts that overlap or are immediately adjacent to the project area to identify potential conflicts on restoration areas.*

The Draft EIS does not include a comprehensive description of the CVP and SWP with and without new north Delta intake facilities or through-Delta operations. Such information is needed to assist the reader in understanding how the water delivery system operates under Existing Conditions and how it would change under CM1 alternatives.

Recommendation: *Include a description of existing CVP and SWP operations in the Chapter 3 discussion of the No Action alternative, including how operations would change or remain static under each proposed alternative.*

The North Delta Bypass rules are difficult to understand and should be more clearly explained, particularly in the context of how flows occur currently (p. 3-181-3-209). Listing the rules does not enable the reader to understand how the new facilities would operate within the CVP and SWP system and, subsequently, how the new rules could modify the Sacramento River where new intakes would be placed and operated.

Section 3.6.4.2 provides only an annual average of how often the north Delta intakes would be used versus the south Delta intakes. For the reader to understand how the system would work, information about the potential timing, frequency, and duration of operation of each of the pumps throughout the year would be more useful.

Recommendations: *Provide information and references that describe current CVP and SWP operations. Describe modifications to reservoir operations to avoid dead pool conditions for all alternatives.*

Clearly state that BDCP's North Delta Bypass rules are intended to protect flows from only one storm pulse or, potentially, two storm pulses if the first storm arrives before December 1st. Explain that subsequent storm pulses (that are important fish cues for migration) can be exported after BDCP's new operational rules have been met.

Provide information about the potential timing, frequency, and duration of operation of each of the pumps throughout the year, including when and the conditions under which each pump would be used alone or simultaneously with the other.

Provide information about Sacramento River flows to put the North Delta Bypass rules in context. For example, describe how often flows are at the levels used as thresholds in the bypass rules to help the reader to generally understand how much flow would remain in the river versus be diverted into the new intakes. Also provide exceedance curves of Sacramento River flows and the Post Pulse Water Operations for each CM1 alternative, and consider including a chart that summarizes information in Table 3-16 (p. 3-183) describing Post Pulse Water Operations, and include Sacramento River flows for comparison.

The Export/Import ratio (also known as Export Limits in Table 3 of the Water Quality Control Plan) does not necessarily solely apply to the south Delta or explicitly exclude new points of diversion. The description of how the export/import ratio from the 1995 Bay-Delta WQCP is included in operational requirements and impacts from the CM1 alternatives (p. 3-32) may not be consistent with the description of the E/I ratio as interpreted by NMFS.²⁸

Recommendation: *Describe how the E/I ratio was used in evaluations of each operational scenario for the alternatives. If the approach ultimately used in the analysis differs from the D-1641 approach, explain the reason(s) for, and implications of, using the different approach.*

²⁸ See NMFS Progress Assessment p. 10

http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/NMFS_Progress_Assessment_Regarding_the_BDCP_Administrative_Draft_4-11-13.sflb.ashx

State whether or not project proponents will request that the State Water Board modify the existing E/I water quality standard so it does not apply to the north Delta intakes and describe the process for having that modification approved.

Information that provides context for the Fremont Weir and Yolo Bypass Operational Criteria should be provided in the section that generally describes these operational criteria (p. 3-187). In the absence of context, it is unclear how the rules would change. For example, with no information about how often Sacramento River flows at Freeport are expected to be greater than 25,000 cfs, it is unclear how often the 17.5 and 11.5-foot elevation gates would be open and how often the Yolo Bypass floodplain restoration work would provide benefits to aquatic life using these resources.

Recommendations: *Provide cumulative distribution curves that show expected flows at Freeport under each CM1 alternative for each type of water year. Discuss the curves in the text and identify the median frequency at which Sacramento River flows at Freeport are expected to be greater than 25,000 cfs.*

Provide maps showing Yolo Bypass inundation of 3,000 to 6,000 cfs.

The Fremont Weir is described as a necessary component of CM1; however, the Draft EIS states that “CM2 is a programmatic element that will be further developed and analyzed in future technical and environmental reviews.” The impacts associated with this element are not estimated and disclosed in the Draft EIS. For example, although Fremont Weir gate operational rules were developed for the purposes of modeling, the impacts of the proposed operation of the Fremont Weir do not appear to have been analyzed. Without such analysis, the impacts of CM1 cannot be fully evaluated.

Recommendation: *Describe the updates to Fremont Weir that would take place under all of the Alternatives.*

The Rio Vista Minimum Instream Flow Criteria shown on p. 3-188 are substantially different from the Rio Vista flow criteria in the 2006 Bay-Delta WQCP, which are implemented through water right permit D-1641. It is not clear how the BDCP process would result in a change to the Bay-Delta WQCP water quality standards and the water right permit.

Recommendations: *Describe the Rio Vista flow criteria in the 2006 Bay-Delta WQCP and the D-1641 permit requirements. Describe the difference in flows proposed by the BDCP and explain how they would be attained.*

If it is anticipated that water quality standards would be modified subject to a request connected to the implementation of BDCP, describe the process by which the modification would be requested and processed by the State Water Board.

The discussion in Section 5.2.2.2 “The Revised Water Quality Control Plan (2006)” does not reflect substantial work the State Water Board has completed or undertaken relevant to the 2006 Bay Delta WQCP, including the 2009 Triennial Review and its conclusions, the 2010 Flow Criteria Report, and the Phase I and Phase II Updates to the 2006 Bay-Delta WQCP. These updates include potential modifications to San Joaquin River tributary and lower San Joaquin River flows, Delta outflow objectives, export/inflow objectives, Delta Cross Channel Gate closure objectives, Suisun Marsh objectives, potential new reverse flow objectives for Old and Middle Rivers and potential new floodplain habitat flow objectives. Under recent state legislation, the State Water Board will also be evaluating changes to outflow requirements for major Delta tributaries. Although the outcome of these

State Water Board regulatory processes is unknown at this time, it is reasonable to expect that all will have significant impacts on BDCP planning and implementation.

Recommendation: *Summarize the current status of the State Water Board's update to flow objectives, including export limits and minimum Delta outflows. Updated objectives should be considered in the impacts analyses, and the document should describe how any proposed or pending updates to flow standards may affect the analyses and the implementation of the BDCP. Describe the mechanisms that would be in place in the BDCP, the Implementation Agreement or other BDCP agreements to assure implementation of future SWRCB water quality and water rights actions.*

B. Water Supply

We are concerned that the “Overview of California Water Demand” discussion in Section 5.1.1.3 provides an incomplete summary of water demand in California. For example, population growth is discussed as a reason for increasing urban water demand (p. 5-4); however, there is no reference to the statewide mandate to increase water efficiency 20% by the year 2020 for urban water uses, which is discussed in appendices to other chapters. Details are not provided regarding the rate of urban water demand growth or estimated urban water demand and use, and no basis other than population growth is provided for the conclusion that water demands will increase. Similarly, the importance of water to the agricultural economy is discussed (p. 5-4); however, there is no discussion about the importance of water to other economic sectors.

Municipal and industrial (M & I) demand north of the Delta was estimated by assuming full build out of facilities associated with water rights and contracts north of the Delta, primarily to meet projections of increasing urban water demand (p. 5-57). It is not clear whether the 81% estimated increase under the No Action Alternative, compared to Existing Conditions, takes into consideration the required water efficiency efforts for municipal and industrial water use (see table 5-8). This is important because “increased system demands by water rights holders, especially in El Dorado, Placer, and Sacramento counties” is identified as a reason for projected decreases in reservoir storage and CVP and SWP deliveries under the No Action Alternative (p. 5-61 through 5-64). An overestimation of M & I demand would result in exaggerated projected decreases in water availability for those other uses.

Recommendations: *Modify Table 5-1 to include sectors of consumptive water use, average water use in each category, and estimated rates of growth in each category.*

Summarize the information in Table 5-1 in the text of Section 5.1.1.3.

Provide an overview of water demand in California that summarizes water use by sector (e.g., urban, agricultural, industrial), discloses the economic value generated by each sector, and estimate the rates of water demand growth in each sector.

Clarify whether or not the 2010 urban water efficiency mandate of a 20% reduction in M & I water use by 2020 is included in estimates of future water demand. If it is not included in water demand estimates, explain why it is excluded in the context of the potential impact of overestimating demand on BDCP estimates of water supply effects.

Evaluate water supply effects of CMI scenarios using several configurations and success rates of CM4, and disclose methods and results.

C. Groundwater

The Draft EIS describes beneficial impacts on groundwater resources for some alternatives as a result of CM1 (p. 7-54). It states that for all alternatives, increases in surface water supplies as a result of BDCP would result in diminished use of groundwater (p.7-84); however, no documentation is provided to support this assumption.

The Draft EIS states that groundwater use in the San Joaquin River area is estimated to be between 730,000 and 800,000 acre-feet per year, which exceeds the basin's estimated safe yield of 618,000 acre-feet per year and that each groundwater basin has experienced some overdraft (p.7-18). The Draft EIS also states that the estimated overdraft is between 1 and 2 million acre-feet annually, with many basins in Tulare Lake Basin in critical condition (p.5-4). The Draft EIS assumes that these overdrafts would stop after implementation of the BDCP. On the contrary, we believe it is reasonable to expect that provision of more water could result in more water being used, including as much groundwater as allowed, rather than in strict substitution of surface water for groundwater. Without management of groundwater resources, it is not clear that the pressure on groundwater resources would be diminished as a result of the BDCP.

***Recommendations:** Explain the basis for the assumption that increases in surface water supplies would result in diminished use of groundwater. The likelihood and potential impacts of increased use of surface water supplies for aquifer storage and recovery should be discussed.*

Consider development of a mitigation measure to address management of groundwater resources in the southern San Joaquin Valley.

D. Water Quality

Reporting methods for the chloride and EC analyses may partially obscure conclusions about the predicted range of salinity intrusion, chloride, and EC concentrations for existing conditions, the No Action Alternative, and CM1 alternatives. The chloride modeling analysis (Appendix 8G) provides a 16-year average of estimated chloride concentrations, a 5-year drought average chloride concentration, and a percent exceedence of the minimum health objective of 250 mg/L chloride. Combining 16 years of water quality data and reporting the average omits the predicted range of maximum mean daily chloride concentrations predicted for each of the compliance points under various alternatives compared to their baselines. Averages can mask the severity of chloride and EC concentrations by allowing wet years with lower salinity (chloride and EC) levels to balance dry years with higher salinity concentrations. The 5-year drought average provides some indication for time periods when increased salinity concentrations are expected; however, elevated EC and chloride concentrations at certain compliance points may also occur in above normal and below normal years following dry years.

The reason for, and consequences of, constraining the water quality analysis by using a 16-year hydrology modeling period is not described in the Draft EIS nor its appendices. The 16-year hydrology period extends from 1975 to 1991 and includes a drought period and the highest water year recorded in recent decades (1982). If this hydrology period is different than other periods that could have been chosen or the entire 82-year period available for modeling, results of the water quality analysis may be inaccurate.

***Recommendation:** Explain why the 16-year period was used and the 82-year period was not used, and describe the potential impacts on the precision of the water quality effects predicted by the modeling exercise reported in the Draft EIS Chapter 8 appendices and summarized in the text of the Draft EIS. Compare the 16-year hydrology period (1975-1991) to the entire hydrology period available, disclose*

that comparison to the public and decision-makers, and explain how the smaller time period may influence water quality predictions.

The assertion that water demand will go down in the Tulare basin, in the face of large increases in population, is not thoroughly supported (p. 30-31). This is stated to be the expected result of a decrease in agriculture (now using 82% of the water p. 30-32), but it is not a given that the acreage in agriculture would decrease when additional water resources become available as a result of BDCP. Rather, increases in both population and agriculture are plausible.

Recommendations: *Include a discussion of growth that considers the potential for increases in both urbanization and agricultural development in response to increased reliable water supplies, and that addresses the entire San Joaquin Valley. Include an explanation of why additional water resources are needed (p. 5-4) if projected urbanization would use less water (p. 30-11).*

Water Quality Impact Conclusion WQ-26 (effects on selenium concentrations resulting from restoration activities) lists impacts before mitigation, as “Less Than Significant.” After mitigation, conclusions are “Less Than Significant” and “Not Adverse.” Analysis of residence time for planned remediation efforts is not quantitative and, therefore, lacks sufficient resolution to substantiate impact conclusions.

Recommendation: *Re-analyze Impact WQ-26 based on quantitative measures of residence time and selenium bioaccumulation that: (1) include specificity of locations and species, and (2) reflects current science that assesses the Delta as one interconnected system physically and biologically.*

Consider making the environmental commitments for selenium in restored areas a high priority by addressing these impacts within the main water quality and aquatic resources part of the EIS. Clearly identify the potential impacts of using water supplies containing selenium for wetlands with high residence times and selenium risks to fish and wildlife.

Selenium bioaccumulation modeling for sturgeon is shown in Appendix 8M2, but an impact conclusion is not listed within the category of impacts to white and green sturgeon (e.g., AQUA-136). Other identified species considered of concern in terms of selenium effects, for which no conclusions are provided, are diving ducks (scoter and scaup), clapper rail, salmonids (Chinook salmon, steelhead) and splittail.

Recommendations: *Provide an impact analysis for these species, and add impact conclusions for these species to the category of Fish and Aquatic Resources impacts.*

Illustrate and conceptualize mixing of selenium sources. Document representativeness of sites to selenium modeling to enable coordination of site locations to modeling predictions.

Perform selenium bioaccumulation modeling to specifically address the potential for (1) less Sacramento River flow (i.e., less estuary dilution and increased residence times), and (2) more San Joaquin River flow (increased Se loads or concentrations) entering the Plan Area. Perform an analysis that is both species-specific and location-specific, and develop habitat-use and life-cycle diagrams to inform the selenium modeling. Identify the times and places of greatest ecosystem sensitivity to selenium as outcomes of the modeling and relate the outcome to the entire plan area. Add selenium bioaccumulation modeling of additional fish and bird species to identify the predators with the greatest selenium exposure within fish and bird communities. Development of a comprehensive set of enrichment factors to relate dissolved selenium concentrations to suspended particulate material selenium concentrations would address the uncertainty in this step of selenium modeling.

The data sets that were used to model selenium in sturgeon and derive impacts are not spatially and temporally matched. Locations in the western Delta are ecologically and hydrologically disconnected from the Bay, where effects to sturgeon are known to be greatest.²⁹

Recommendation: *Consider comprehensive sturgeon habitat and cumulative effects in selenium modeling and impact analysis.*

The multiple times that eutrophication is mentioned on page 8-70 (Section 8.2.3.1.0 Nitrate/Nitrite and Phosphorous) may suggest to some readers that the San Francisco Estuary is suffering from large-scale eutrophication. Currently, eutrophication is not one of the major stressors negatively affecting the open waters of the San Francisco Estuary.

Recommendations: *Clarify that monitoring shows that the open waters of the San Francisco Estuary do not show signs of large-scale eutrophication and that anoxic waters and sediment are not commonly reported in the Estuary. Identify the sites with demonstrated low dissolved oxygen problems and describe the extent to which nutrients, subsequent algal blooms, and microbial respiration contribute to low DO problems in the Estuary.*

Discuss the lack of diatom algal blooms as a stressor in the Estuary and the relationship between nutrients and the composition of the algal community and subsequent frequency of desired algal blooms. This can be a short summary in a few sentences and can refer to other locations in the document where nutrients and algal community composition is discussed in more detail. See <http://www.sfestuary.org/pea-soup/> for more information.

E. Fish and Aquatic Resources

The temperature analysis does not provide biologically meaningful temperature estimates for Chinook salmon and, potentially, other fishes. The majority of temperature estimates are calculated using models that predict monthly average temperatures which can obscure the occurrences of daily temperatures fluctuating above life stage impairment and lethal thresholds for Chinook salmon and other fishes. Daily temperatures are estimated for the mainstem of the upper Sacramento River in the segment downstream of Keswick dam because a model with a daily time unit of analysis is available for this exercise (Sacramento River Water Quality Model). Temperature models with a daily time unit are not yet available for the Feather, American, lower Sacramento, and Trinity Rivers, but we understand Bureau of Reclamation is developing daily temperature models as part of the OCAP Biological Opinion remand process. Completion of these models should be prioritized and used in any additional analyses to provide meaningful estimates of temperature impacts to fishes.

Recommendations: *Estimate potential temperature impacts when updated models become available. Identify temperature thresholds for specific life stages based on NMFS recommendations and other available guidance; for example, EPA temperature criteria. Identify mitigation measures that would minimize adverse temperature conditions.*

²⁹ (1) Linares, J., Linville, R. Eenennaam, JV, Doroshov, S. 2004 Selenium effects on health and reproduction of white sturgeon in the Sacramento-San Joaquin estuary. Final Report for Project No. ERP-02-P35.

(2) Linville RG 2006 Effect of excess selenium on the health and reproduction of white sturgeon (*Acipenser transmontanus*): Implications for San Francisco Bay-Delta. Ph.D. dissertation, University of California, Davis, CA 232 pp.

(3) Beckon, WN & Maurer, TC, 2008 Species at Risk from Selenium Exposure in the San Francisco Estuary. Final Report to the US EPA IAA No. DW14022048-01-0.

(4) Presser TS and Luoma SN 2010 Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California USGS Administrative Report.

EPA Region 10 developed EPA Guidance Criteria for Water Temperature³⁰ to assist States and Tribes in adopting water quality standards for the protection of coldwater salmonids. The guidance criteria provide an averaging period for temperature targets and would be an appropriate benchmark against which to evaluate estimated impacts from CM1 alternatives, in addition to the evaluated criteria summarized in Table 11-1A-11.

Recommendation: Compare impacts from CM1 and other CMs with the potential to impact water temperatures to EPA Guidance Criteria for Water Temperature to provide an additional metric for estimated impacts to Chinook salmon.

The Draft EIS assumes that state-of-the-art fish screens would function in a way that results in minimal to zero entrainment, but provides no evidence that these screens would completely or almost completely prevent entrainment of larval, juvenile, or adult covered fishes. No details are provided regarding the design or operation of the proposed fish screens.

Recommendation: Explain how the proposed fish screens would prevent entrainment of all life stages of covered fishes. Describe the entrainment thresholds that would trigger reduced pumping at the North Delta Diversion intakes, and mitigation strategies for minimizing entrainment if the fish screens do not function as anticipated.

The construction analysis relies on Best Management Practices for concluding that potential impacts to aquatic species would not be adverse. The construction is estimated to span ten years, coffer dams are expected to be constructed simultaneously, and potentially increasingly severe weather conditions during the ten-year construction period are likely to challenge the most effective Best Management Practices. Additionally, some of the equipment that would need to be constructed (including the dual 40 foot wide tunnel boring machines) would be some of the largest in the world and the Best Management Practices that have been designed for more conventional construction projects may not be applicable or effective as anticipated.

Recommendation: Describe options for minimizing construction impacts in the event that BMPs do not perform as anticipated or completely fail, given the size and scale of the construction.

NEPA effects determinations used in Chapter 11 include: beneficial, not adverse, adverse, and no determination. These terms are not defined nor are thresholds for selecting among them identified. The reader is not provided with an indication or description of the magnitude of estimated positive or negative impacts or uncertainty associated with each conclusion.

Recommendation: Define the NEPA conclusions and provide thresholds -- quantitative when possible -- for each category so that it is clear why some estimated impacts result in a NEPA conclusion.

Multiple indicators are used to evaluate impact and derive NEPA Effects determinations; however, the Draft EIS does not describe how each indicator was used to support the NEPA effects determination. For example, AQUA-42 Effects of Water Operations on Conditions for Chinook salmon (Winter-Run ESU) uses nine indicators to determine the overall effect of CM1 alternatives on adult and juvenile migration for winter run Chinook salmon. We have summarized key information from this section in the following table:

³⁰ http://www.epa.gov/region10/pdf/water/final_temperature_guidance_2003.pdf

AQUA-42 Effects of Water Operations on Conditions for Chinook salmon (Winter-Run ESU)

Migration Indicators	Alt 1	Alt 4	Alt 7	Alt 8
Upstream of Red Bluff flow during juvenile emigration period (Nov – August)	Similar to No Action Alternative (NAA) July & October + 36% Aug, Sept, & Nov -44%	Similar to NAA November 5-18% lower	Similar to NAA November -14%	Flows 26% lower than NAA
Monthly mean temperature between Keswick and Bend Bridge (Nov – Aug)	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA
Flow during adult migration (Dec – Aug)	Similar to NAA; August flows could be 19% lower.	Similar to NAA but May & June +12%	Similar to NAA or greater w/ few (unstated) exceptions.	Similar to NAA but up to 18% lower in July and August
Monthly mean T btw Keswick and Bend Bridge (Dec – Aug)	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA	Less than 5% difference in monthly mean T relative to NAA
Through-Delta Monthly mean flows downstream of NDD	10-31% lower than NAA	11-23% lower than NAA	25% lower than NAA	15% lower than NAA in November
Predation at intakes % of annual juvenile production (2 methods)	9%-3% 18.5%	0.02 – 0.30% 12%	0.02 – 0.30% 12%	0.02 – 0.30% 11.6%
	19,000 linear feet 22 acres of habitat	6360 linear feet 12.3 acres	6360 linear feet 12.3 acres	6360 linear feet 12.3 acres
DPM analysis of % survival through the Delta to Chipps	Wet – 45.5% Dry – 26% All – 33.3%	Wet – 45-46% Dry – 25-27% All – 33-35%	Wet – 45% Dry – 26% All – 33%	Wet – 44% Dry – 27% All – 33.5%
Adult migration -- % of Sacramento River-origin water at Collinsville	December – 63% January – 71% February – 67%	December – 66% January – 73% February – 68%	December – 65% January – 73% February – 67%	Results not provided for Alt 8 but a range of 58–71%
NEPA Effects Determination	Adverse	Not Determined	Not Determined	Adverse

It is not clear whether all nine indicators are considered equal when identifying the NEPA effect determination for migration overall. The monthly mean temperatures do not substantially vary among alternatives, so that indicator appears to be less useful than the others in differentiating between the alternatives. Some indicators show improved conditions relative to the No Action Alternative, while others show relatively worse conditions. For some indicators, the level of detail that is provided in the text differs from one alternative to another. The narrative descriptions of the multiple indicators in the NEPA Effects paragraphs often highlights different indicators when discussing the NEPA Effects determination, suggesting that some indicators are more important than others, depending on the alternative being evaluated. The reader sees only the summarized results of multiple indicators but cannot ascertain how the information was used to determine NEPA effects.

Recommendation: Explain how each metric was used, and how the metrics were used in combination, to derive the NEPA Effects determinations, including whether the metrics were weighted in any way. Thresholds that were used to determine the appropriate NEPA Effects conclusion should be disclosed.

The description of Clean Water Act programs in the Water Quality Regulatory Setting Section 8.3.1.1 (p. 8-112-114) contains a number of errors. For example, it appears to indicate that EPA has delegated its CWA oversight responsibility to the State of California. A useful description of CWA programs and how they operate in the San Francisco Bay Estuary can be found in the US EPA Advance Notice of Proposed Rule-making for Water Quality Challenges in the San Francisco Bay/Sacramento San Joaquin Delta, available at http://www2.epa.gov/sites/production/files/documents/baydeltaanpr_fr_unabridged.pdf pages 11-18.

Recommendation: Review the description of CWA programs in the San Francisco Bay Delta Estuary and California.

It appears from the Draft EIS that there could be significant impacts to vernal pools from implementation of CM1 and CM4. Impacts and mitigation for vernal pools are only presented as “vernal pool complex” and it is not clear from the document what percentage of this habitat is vernal pool wetlands (wetted surface area).

The Draft EIS states that implementation of CM4 may result in the loss of 372 acres of vernal pool complex habitat and CM1 could result in up to an additional 37 acres of loss (depending on alternative). With the information in the Draft EIS we cannot assess what proportion of these impacts are to wetlands. The document also states that AMM12 limits removal of “vernal pool crustacean habitat” to 10 wetted acres. However, it is not clear if all vernal pool wetlands are being considered “crustacean habitat.” According to the document, these 10 wetted acres of crustacean habitat equates to approximately 67 acres of “vernal pool complex” habitat. The 67 acres of impact allowed by AMM12 is significantly less than the 372 acres of potential loss identified for CM4.

Because the Draft EIS only presents theoretical footprints for tidal marsh restoration under CM4, it is unclear whether CM4 can be fully implemented while limiting vernal pool loss to 10 wetted acres as called for under AMM12. As the Draft EIS acknowledges, vernal pools are a highly sensitive community that has experienced significant loss in California. Yet, only 40 acres of restoration and 400 acres of protection are proposed in the near-term under the plan. Given the potential direct loss identified for CM1 and CM4, and the potential functional loss identified from implementation of CM2, the proposed vernal pool restoration may not be sufficient to meet mitigation needs under CWA Section 404. Mitigation needs cannot be fully assessed until project level information is available for all CMs.

Recommendations: Clearly state what percentage of the vernal pools complex habitat may be vernal pool wetlands (by wetted surface area). Clarify whether AMM12 applies to all vernal pool wetlands or only vernal pool wetlands occupied by special status crustaceans.

Clearly state how many acres of vernal pool wetlands may be lost from implementation of CM1 and CM4. Clarify whether it is feasible to fully implement CM4 while limiting vernal pool losses to 10 wetted acres and if there is a tradeoff, please disclose and discuss.

Quantify the potential functional loss to vernal pool habitat from changes in inundation and acknowledge that compensatory mitigation may be required for loss of function even if there is no net loss in area. Acknowledge and address that compensatory mitigation requirements under CWA Section 404 may be greater than the vernal pool complex restoration and protection proposed under the plan.

Appendix 3B details dredged material (DM) and reusable tunnel material (RTM) disposal and reuse commitments, among other environmental commitments. Neither Appendix 3B nor Chapter 3 details how much DM and RTM will be generated by each alternative; however, Chapter 12 identifies potentially significant impacts to wetlands and waters from disposal of this material. Impacts to jurisdictional wetlands and waters must be avoided and minimized to the maximum extent practicable consistent with the 404 Guidelines. Furthermore, the Draft EIS does not address the Delta Long Term Management Strategy (LTMS)³¹ goal to maximize beneficial reuse of DM by setting specific reuse targets for both DM and RTM. Appendix 3B states that material will be placed in multiple storage locations and reused in BDCP projects to the extent feasible, however, there are potentially many other construction and restoration projects in the Delta that could use the DM and RTM. If material will be placed in waters either temporarily or permanently, sediment testing will need to be coordinated with the Corps, EPA, and Regional Water Quality Control Boards.

Recommendations: Include the volume of DM and RTM in Chapter 3 and Appendix 3B. In Appendix 3B clearly state that placement of DM and RTM must comply with the CWA 404(b)(1) Guidelines, in addition to meeting to BDCP goals.

Discuss beneficial reuse goals for DM and RTM, including whether material will be made available for reuse in projects within and outside the BDCP.

Discuss whether placement of DM and RTM on peat soils, either temporarily or permanently, will further subsidence and undermine levee stability.

Clearly identify accessibility of placement sites and commit to promoting beneficial reuse of DM and RTM both within and outside BDCP projects.

For any material placed in waters, clarify that sediment testing must be coordinated with the USACE, EPA, and RWQCB.

F. Energy

The Draft EIS states that conveyance facility energy requirements are moderate and would not result in any substantial impacts (p. 21-25). The cumulative impacts analysis concludes that, while the cumulative energy demands of the BDCP, in combination with ongoing and reasonably foreseeable

³¹ The San Francisco Bay Long Term Management Strategy (LTMS) is a cooperative effort of EPA, the US Army Corps of Engineers, the San Francisco Regional Water Quality Control Board, the San Francisco Bay Conservation and Development Commission, and stakeholders in the region to develop a new approach to dredging and dredged material disposal in the San Francisco Bay area. The LTMS serves as the “Regional Dredging Team” for the San Francisco area, implementing the [National Dredging Policy](#) in cooperation with the [National Dredging Team](http://www.epa.gov/region9/water/dredging/ltms/index.html).<http://www.epa.gov/region9/water/dredging/ltms/index.html>

future projects, may affect regional resources, the increase attributable to any alternative is not cumulatively considerable, compared to statewide use (300,000 gigawatt-hours) (p. 21-61). A comparison only to statewide use does not provide sufficient context for decision makers and the public to understand the new energy demands associated with the BDCP alternatives and evaluate their potential effects on local and regional energy supplies.

Recommendations: *Include a table showing the current overall energy usage by the CVP and SWP to supply water to the end users, compared to the projected overall energy demand by the CVP and SWP to do the same under the No Action and each of the BDCP build alternatives. Separately, for additional context, compare these projections to recent and reasonably foreseeable development projects, including the High Speed Rail project. Include an evaluation of the effects of each alternative on peak and base period demands, as well as effects on local and regional energy supplies, as recommended by the State CEQA Energy Conservation Guidelines (Appendix F).*

EPA supports the use of gravity-fed tunnels to transport water to minimize net energy use for conveyance to the greatest extent possible. Alternative 4 is designed to take greater advantage of gravity than the other alternatives. According to the Draft EIS, the Department of Energy has estimated that construction of two 40-foot tunnels (Alternative 4) would require about 78% more electrical energy than would be needed for alternatives requiring two 33-foot tunnels (p. 21-31 and Table 21-9); however, since Alternative 4 would eliminate the need for an intermediate low-head pumping plant for flows of more than 9,000 cfs (p. 21-31), Alternative 4 would be able to ‘recover’ the extra energy used during construction in 25 years. It is not clear why the 33-foot tunnel alternatives do not include gravity-fed designs.

Recommendations: *Discuss the practicability of increasing the energy head (difference in water elevation) between the intermediate Forebay at the north of the Delta and the Clifton Court and Byron Forebays to allow for greater gravity-fed flow through the 33-foot tunnel alternatives. Discuss whether 9,000 cfs could be achieved without the need for intermediate low-head pumping through 33-foot tunnels.*

Consider alternate locations for the intakes, including upstream of the Sacramento Regional Wastewater Treatment Plant, and evaluate whether an increase in the energy head between the alternative north end intake locations and the south end of the proposed conveyance system could decrease net energy use for each alternative.

Include a table that demonstrates, for each alternative, the time that would be needed to ‘recover’ the energy used during construction. Incorporate into the table any additional alternatives that would minimize net energy use, and the time to ‘recover’ energy used during their construction. As part of the same table, include the overall energy for construction and operation of the BDCP for the total expected life of the project.

EPA strongly supports the goal, stated in the Draft EIS, to power the BDCP’s average 270 megawatt (MW) construction load and 57 MW permanent load with 100% renewable energy (p. 21-33). This would avoid emissions of greenhouse gases and other pollutants associated with the generation of energy from fossil fuels. We find, however, that the Draft EIS defers much of the necessary analysis of renewable energy benefits, challenges, and opportunities to the future development of other documents, and lacks clear commitments regarding procurement of renewable energy. For example, regarding construction, Mitigation Measure AQ-15 in Chapter 22 includes a suite of greenhouse gas emission reduction strategies that would be utilized to develop a future GHG Mitigation Program to reduce construction related GHG emissions to net zero (p. 22-75). At this time, it is unclear which strategies

would comprise the program and whether a commitment would be made to enter into a purchase agreement for 100% renewables (Strategy 1) or temporarily increase renewable energy purchases to offset BDCP construction emissions (Strategy 12).

Regarding operations, Chapter 21 of the Draft EIS explains that the energy needed for pumping water would be provided from a mix of hydro, power purchase contracts, power exchanges and power markets (p. 21-22). The Draft EIS notes that 60% of the State Water Project's (SWP) 2010 load was met by hydro resources, while the remainder of the load was met by a mix of coal power and real-time purchases from the California Independent System Operator's (CAISO) energy market (p. 21-7). According to Chapter 21, the potential for new or expanded electrical power generation facilities is not discussed in the Draft EIS because it will be addressed through SWP power purchase programs (p. 21-33). Similarly, new energy sources to support the potential increased load from the Central Valley Project (CVP) are not discussed in the Draft EIS. It is unknown what type of power source (e.g., renewable, natural gas) would be substituted for the CVP-generated electricity that would be consumed by the project, itself, or to what extent some of additional energy required would be made up with higher efficiency (p. 22-198).

The Draft EIS references DWR's Climate Action Plan, which established near-term (by 2020) and long-term (by 2050) goals of reducing emissions of greenhouse gases throughout DWR's operations -- including those of the SWP -- in part, by increasing the use of renewable energy sources. Similarly, the President's June 2013 Climate Action Plan established a goal for the federal government of consuming 20 percent of its electricity from renewable energy sources by 2020.

Recommendations:

Identify opportunities to power the BDCP conveyance system with renewable energy for the life of the project to demonstrate how the stated goal of powering the anticipated construction and operations energy loads with 100% renewable energy could be met. Consider committing to power construction and/or the conveyance system operations with 100% renewable energy, similar to the CA High Speed Rail (HSR) Authority's commitment to use 100% renewable energy for operation of the HSR. At minimum, commit to ensure that construction and operation of the BDCP facilities are powered by renewable energy sources to the greatest extent feasible.

Discuss whether DWR's Renewable Energy Procurement Plan (REPP) would provide a mechanism to secure 100% renewable sources for construction and operations of the BDCP prior to project approval. Consider adopting an approach similar to the California High Speed Rail Authority's partnership with the National Renewable Energy Laboratory to create and implement a strategic energy plan for the BDCP. Outline the steps that would need to occur, the barriers that would need to be overcome and the potential for partnerships with entities in the vicinity of the Delta that are aiming to achieve similar goals.

Quantify how securing new, 100% renewable energy sources for construction and operations of the BDCP would assist DWR in achieving its Climate Action Plan (CAP) goals. Discuss the extent to which hydropower resources will be used to meet the 2020 and 2050 goals in the CAP, and whether larger hydropower generators would qualify.

Discuss the extent to which the CVP is currently being used to meet California's renewable energy goals. To reduce potential indirect effects from substitute electricity for any new CVP energy usage, consider a commitment to ensure that new, renewable sources are secured to compensate for any use of CVP electricity for the BDCP.

Under the “NEPA Effects” section for each alternative in Chapter 21.3.3, the Draft EIS indicates that the use of Best Management Practices will ensure that only high-efficiency equipment is utilized during construction and that all feasible control measures to improve equipment efficiency and energy use are included. Similarly, it is noted that operation of the water conveyance facilities would be managed to maximize efficient energy use, including off-peak pumping and the use of gravity and, therefore, would not result in a wasteful or inefficient energy use. These conclusions are identical for every tunnel conveyance alternative.

Recommendations: Explain how all of the energy efficiency mitigation measures and Best Management Practices referenced in Chapter 21 would be made an enforceable part of the project's implementation schedule. We recommend implementation of applicable mitigation measures prior to or, at a minimum, concurrently with, commencement of construction of the project.

With regard to solicitations for future contracts for project construction and operations, consider including the following as energy efficiency requirements:

- *The use of energy- and fuel-efficient fleets;*
- *For construction, the utilization of grid-based electricity and/or onsite renewable electricity generation, to the extent possible, rather than diesel and/or gasoline powered generators;*
- *Using lighting systems that are energy efficient, such as LED technology;*
- *Recycling construction debris to maximum extent feasible;*
- *Planting shade trees in or near construction projects where feasible;*
- *Giving preference to construction bids that use Best Available Control Technology, particularly those seeking to deploy zero emission technologies;*
- *Employing the use of alternative fueled vehicles;*
- *Using the minimum feasible amount of GHG-emitting construction materials that is feasible;*
- *Use of cement blended with the maximum feasible amount of flash or other materials that reduce GHG emissions from cement production; and,*
- *Use of lighter-colored pavement where feasible.*

G. HCP Monitoring and Assessment

The BDCP is a project of such significance, with a reliance on extensive monitoring and technical information, that its development and approval represents an opportunity to advance aquatic resource monitoring for the entire state of California. For several years, EPA and partner state and federal agencies have been advancing a comprehensive monitoring program that supports integration of federal and state aquatic resource permitting for Habitat Conservation Plans (HCPs) and Natural Community Conservation Plans (NCCPs). When implemented as a monitoring program, the framework that has been established will generate information to evaluate site specific and regional outcomes of habitat conservation and aquatic resource mitigation activity. This framework has been created in consideration of the Clean Water Act (CWA) Mitigation Rule (33 CFR Parts 325 and 332; 40 CFR Part 230), the “Five Point Policy” (Addendum to the HCP Handbook), Tenets of a State Wetland and Riparian Monitoring Plan (CA Water Quality Monitoring Council 2010)³², and Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans³³.

³² Tenets of a State Wetland and Riparian Monitoring Program. 2010. California Water Quality Monitoring Council (CA Wetland Monitoring Workgroup). (http://www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf).

³³ Atkinson, A. J., P. C. Trenham, R. N. Fisher, S. A. Hathaway, B. S. Johnson, S. G. Torres and Y. C. Moore. 2004. Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans. U.S. Geological Survey Technical Report. USGS Western Ecological Research Center, Sacramento, CA. 69 pages. (<http://www.dfg.ca.gov/habcon/nccp/publications.html>).

At the state level, the 2007 MOU signed by the Secretaries of the California Environmental Protection Agency (Cal/EPA) and the California Natural Resources Agency (Resources Agency) establishes the Water Quality Monitoring Council. The Council now requires the boards, departments and offices within Cal/EPA and the Resources Agency to integrate and coordinate their water quality and related ecosystem monitoring, assessment, and reporting. The Monitoring Council is further aligning state aquatic resource monitoring programs with their federal counterparts in order to develop an integrated monitoring program that addresses the needs of the HCP/NCCPs while providing CWA monitoring data and information that will satisfy the Corps of Engineers, EPA, and the Water Boards.

The primary goal of such a program is to develop a fully integrated monitoring framework (covering ESA, CESA, CWA, and the Porter-Cologne Act) that provides the best available information on the extent of impacts from permitted activities and progress toward achieving conservation targets using common databases to facilitate the sharing of this information across eco-regions and among local, regional, state and federal programs.

The monitoring design for this comprehensive federal/State monitoring program is based on the EPA tiered monitoring approach (http://water.epa.gov/type/wetlands/outreach/upload/techfram_pr.pdf), which has also been adopted by the State, is increasingly used by programs across the country, and is consistent with the tiered approach described by Atkinson et al. (2004)³⁴. The Delta Science Plan (dated 12/30/2013 and found at <http://deltacouncil.ca.gov/science-program/delta-science-plan>) describes a process by which this monitoring approach could be developed and implemented, including sections on adaptive management, data management, modeling, and communication. EPA strongly supports the recommendations in the Delta Science Plan.

Recommendation: Discuss how the BDCP mitigation monitoring and reporting program will be consistent with the federal and State efforts discussed above.

³⁴Ibid

8/27/2014 1:33pm

BDCP DEIS: Corrections and Additional Editorial Recommendations

To: 'will.stelle@noaa.gov'

Cc: 'ren_lohofener@fws.gov'; 'dmurillo@usbr.gov'; 'Ryan Wulff - NOAA Federal' <ryan.wulff@noaa.gov>; Johnson, Kathleen <Johnson.Kathleen@epa.gov>; Hanf, Lisa <Hanf.Lisa@epa.gov>; Skophammer, Stephanie SKOPHAMMER.STEPHANIE@EPA.GOV

Will, Ryan –

Yesterday, I sent you EPA's major comments on the BDCP DEIS. During our review of the DEIS, we also identified a number of corrections that are needed, as well as some missing information that would improve the document's usefulness. These are listed below. In our role as a Cooperating Agency, we request that you also address the following in the Supplemental Draft EIS:

- Potential funding sources shown on page 8-105 of the BDCP are not valid. The table in the BDCP shows EPA's 2011 budget being spent on conservation measures under the BDCP. The text states that "Funding for this program [California Bay-Delta Restoration appropriations] is assumed to continue and to support natural community restoration under BDCP" (p.8-106 of the BDCP). EPA has not committed any funding towards the construction and implementation of the BDCP and any future funds that are available for projects in the San Francisco Bay Delta are subject to EPA's future budget, legislative mandates, and agency discretion. Please remove the section of the BDCP that indicates that EPA funding is assumed to continue and support restoration components of the BDCP for 50 years.
- There are errors in the Draft EIS describing multiple Clean Water Act programs including the CWA 404 Regulatory Program. In addition, the CWA Section 404 Program is described differently in different chapters. Please make the following corrections:
 - Correct language on page 8-114 that states that CWA Section 404 is implemented "via the issuance of National Pollutant Discharge Elimination System permits." The NPDES program comes from Section 402 of the CWA. The words "NPDES" permits should be replaced with "Section 404 permits." The following sentence in the Draft EIS accurately states that the "USACE is authorized to issue Section 404 permits."
 - Correct language on page 8-113 (lines 4-6) that states California "administers the CWA through the Porter-Cologne Act." Section 303 of the CWA gives the states the authority to establish water quality standards, subject to EPA approval, and the NPDES Program is delegated to the State of California under CWA Section. California administers these CWA programs **and** the Porter-Cologne Act.
 - The following sentence in the Draft EIS on page 8-114 is not correct and should be removed: "If a federal agency is a partner in the implementation of a project, the proposed action/project must be recognized as the LEDPA." A proposed action is not the LEDPA simply because a federal agency is a partner and chooses that proposed action as its preferred alternative. Federal agencies are required to comply with the 404(b)(1) Guidelines and their preferred alternative must meet the restrictions to discharge outlined at 40 CFR 230.10.
- Table 3-3 (p.3-19) "Summary of Proposed BDCP Conservation Measures of All Action Alternatives" is the only complete Conservation Measure (CM) summary table provided in the entire Draft EIS. While it is helpful to the extent that it lists all of the CMs in one place, it lacks key information such as acreage

targets.

- CM2 is not included in the list of Conservation components for Alternative 1A on p. 3-49. The Draft EIS states that CM2 is included in all of the Alternatives considered.
- CM2 is not included in the description of CM3 Natural Communities Protection and Restoration (page 3-129).
- Table 8-1 Designated Beneficial Uses for Water Bodies in the Study Area identified Estuarine Habitat as an “Additional Beneficial Use of the Delta” suggesting the Delta is the only group of water bodies with the Estuarine Habitat beneficial use. The San Francisco Bay and its component water bodies, including Suisun Bay and Marsh also have the Estuarine Habitat beneficial use and they are part of the BDCP “Plan Area.”
- The 2012 Pulse of the Delta was finalized in October 2012. Delete the word “draft” in reference to the *2012 Pulse of the Delta* on Page 8-48, line 39.
- Figure 8-7 shows the compliance locations commonly discussed in Chapter 8 with so many labeled locations that the reader cannot see their location precisely.
- It is very helpful to readers to provide citations when “available evidence” is referred to in the Draft EIS. For example, page 8-457, line 7, states “available evidence suggests that restorations activities establishing new tidal and non-tidal wetlands, new riparian and new seasonal floodplain habitat could potentially lead to new substantial sources of localize DOC loading within the Delta.”
- Existing Conditions and No Action Alternative values are slightly different in Tables 11-1A-5 (p. 293) and 11-4-4 (page 1302). The tables rely on the same entrainment analysis at south Delta pumps, but one is for Alternative 1A and the other is for Alternative 4. The Existing Conditions and No Action Alternative numbers are very similar, but should be identical, and it is not clear why they are different. This occurs again for the North Bay Aqueduct Analysis (p. 11-295 Table 11-1A-7 v. page 11-4-6 page 11-1304).
- The list of local habitat conservation plans and natural community conservation plans in the Delta includes plans that are adjacent to the Delta is missing the south Sacramento HCP (page 11-176).
- Page 11-160: There is very little description of Section 10 and Section 7 of ESA. The Revised or Supplemental Draft EIS should include a description of basic regulatory requirements and targets that are applicable to the BDCP such as “contribute to recovery” for Section 10 and “avoid jeopardy” for Section 7.
- Page 11-166: CWA Section 303(c) Water Quality Standards and protection of beneficial uses should be discussed in this section.
- Page 11-175: The need for a change in point of diversion to D1641 should be discussed in this section.
- Page 11-183: Table 11-3, please discuss options for soft stabilization along river banks near the intake structures.

- Table ES-11 and its associated text describe changes in average Delta outflow, total exports, and south Delta pumping for the BDCP alternatives in the late long term (2060); however, the baseline for this comparison should be specified.
- The change in total exports from the No Action Alternative to Alternative 1 is listed in Table ES-11 as 1,025 thousand acre feet however, subtracting the value of No Action Alternative total exports (4441 TAF) from that of Alternative 1 total exports (5459 TAF) yields a difference of 1018 TAF. Similar small potential errors are present in the rest of the Total Exports Change column.
- The average Delta outflow and export values in Table ES-11 do not match average Delta outflow and export values in Table 5-4 Water Supply Summary Tables. Many of the values are very close to one another, but are not the same. The true values are important for determining compliance with Delta outflow water quality standards.
- Selenium effects and thresholds vary between the EIS and the appendices (see p. 8-167 (table 8-55) and page 8M-9 (table 8M-3)).
- Language used to describe Total Maximum Daily Loads in the Plan Area and Study area for Chapter 8 could be misinterpreted. Table 8-4 and the text in lines 13-15 on page 8-24 state that a number of TMDLs are “complete”, which could be read as suggesting that TMDL water quality targets have been achieved, which is not accurate for most TMDLs. Many of these TMDLs are *adopted* and water quality is improving as a result, but is not yet meeting the TMDL quantitative targets. Replace the word “complete” with “adopted” in reference to TMDLs in this section.
- Table 22-5 should be updated to identify the annual PM2.5 NAAQS as 12 micrograms per meter cubed ($\mu\text{g}/\text{m}^3$).
- Table 22-3 provides ambient air quality monitoring data, in terms of standards exceedances, for the relevant air basins from 2008 to 2010. This table should be updated to provide monitoring data from 2010 to 2012.
- The data used to describe organophosphate pesticides on page 8-85, Tables 8-23 and 8-24 do not characterize existing conditions. More recent data show that diazinon is rarely detected in Delta waters in recent years and chlorpyrifos detections and exceedances have substantially declined. Update the pesticide discussion using more recent data. These data are available at <http://www.ceden.org>.
- In Table 30-2, it is unclear how much of the environmental water is also used by agriculture and urban users. Separate tables by water year type would be more informative.

Thank you for your consideration of these recommendations. If you have any questions, please contact me.

-Kathy

Kathleen Martyn Goforth, Manager
 Environmental Review Section
 EPA Region 9 (ENF-4-2)
 75 Hawthorne Street
 San Francisco, CA 94105
 415-972-3521

EXHIBIT C



980 NINTH STREET, SUITE 1500
SACRAMENTO, CALIFORNIA 95814
HTTP://DELTACOUNCIL.CA.GOV
(916) 445-5511

Delta Independent Science Board

Chair

Jay Lund, Ph.D.

Chair Elect

Stephen Brandt, Ph.D.

Past Chair

Tracy Collier, Ph.D.

Members

Brian Atwater, Ph.D.
Elizabeth Canuel, Ph.D.
Harindra Fernando, Ph.D.
Richard Norgaard, Ph.D.
Vincent Resh, Ph.D.
John Wiens, Ph.D.
Joy Zedler, Ph.D.

September 30, 2015

To: Randy Fiorini, Chair, Delta Stewardship Council
Charlton Bonham, Director, California Department
of Fish and Wildlife

From: Delta Independent Science Board

Subject: Review of environmental documents for California WaterFix

We have reviewed the partially Recirculated Draft Environmental Impact Report/ Supplemental Draft Environmental Impact Statement for the Bay Delta Conservation Plan/California WaterFix (herein, "the Current Draft"). We focused on how fully and effectively it considers and communicates the scientific foundations for assessing the environmental impacts of water conveyance alternatives. The review is attached and is summarized below.

The Current Draft contains a wealth of information but lacks completeness and clarity in applying science to far-reaching policy decisions. It defers essential material to the Final EIR/EIS and retains a number of deficiencies from the Bay Delta Conservation Plan Draft EIR/EIS. The missing content includes:

1. Details about the adaptive-management process, collaborative science, monitoring, and the resources that these efforts will require;
2. Due regard for several aspects of habitat restoration: landscape scale, timing, long-term monitoring, and the strategy of avoiding damage to existing wetlands;
3. Analyses of how levee failures would affect water operations and how the implemented project would affect the economics of levee maintenance;
4. Sufficient attention to linkages among species, landscapes, and management actions; effects of climate change on water resources; effects of the proposed project on San Joaquin Valley agriculture; and uncertainties and their consequences;
5. Informative summaries, in words, tables, and graphs, that compare the proposed alternatives and their principal environmental and economic impacts.

The effects of California WaterFix extend beyond water conveyance to habitat restoration and levee maintenance. These interdependent issues of statewide importance warrant an environmental impact assessment that is more complete, comprehensive, and comprehensible than the Current Draft.

**Review by the Delta Independent Science Board of the
Bay Delta Conservation Plan/California WaterFix
Partially Recirculated Draft Environmental Impact Report/
Supplemental Draft Environmental Impact Statement**

September 30, 2015

Contents

Expectations for impact assessment of California WaterFix	1
Background of this review	1
Differences between the BDCP and California WaterFix	2
Improvements on the Previous Draft	3
Current concerns	4
Missing content	4
Adaptive management	5
Restoration as mitigation	6
Levees	7
Long-term effects	8
Informative summaries and comparisons	9
Prior concerns and their relevance to the Current Draft	10
Effectiveness of conservation actions	10
Uncertainty	10
Effects of climate change and sea-level rise on the proposed actions	11
Interactions among species, landscapes, and the proposed actions	12
Effects on San Francisco Bay, levees, and south-of-Delta environments	12
Implementing adaptive management	13
Reducing and managing risk	13
Comparing BDCP alternatives	13
Comments on individual sections and chapters	14
Alternatives 4A, 2D, and 5A (Section 4)	14
Water quality (Chapter 8)	16
Fish and aquatic resources (Chapter 11)	17
Terrestrial biological resources (Chapter 12)	18
Land use (Chapter 13)	19

EXPECTATIONS FOR IMPACT ASSESSMENT OF CALIFORNIA WATERFIX

The Sacramento – San Joaquin Delta presents interconnected issues of water, biological resources, habitat, and levees. Dealing with any one of these problem areas is most usefully considered in light of how it may affect and be affected by the others. The effects of any actions further interact with climate change, sea-level rise, and a host of social, political, and economic factors. The consequences are of statewide importance.

These circumstances demand that the California WaterFix EIR/EIS go beyond legal compliance. This EIR/EIS is more than just one of many required reports. Its paramount importance is illustrated by the legal mandate that singles it out as the BDCP document we must review.

It follows that the WaterFix EIR/EIS requires extraordinary completeness and clarity. This EIR/EIS must be uncommonly complete in assessing important environmental impacts, even if that means going beyond what is legally required or considering what some may deem speculative (below, p. 4). Further, the WaterFix EIR/EIS must be exceptionally clear about the scientific and comparative aspects of both environmental impacts and project performance (p. 9).

These reasonable expectations go largely unmet in the Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement Draft (herein, “the Current Draft”). We do not attempt to determine whether this report fulfills the letter of the law. But we find the Current Draft sufficiently incomplete and opaque to deter its evaluation and use by decision-makers, resource managers, scientists, and the broader public.

BACKGROUND OF THIS REVIEW

The Delta Reform Act of 2009, in §85320(c), directs the Delta Independent Science Board (Delta ISB) to review the environmental impact report of the Bay Delta Conservation Plan (BDCP) and to provide the review to the Delta Stewardship Council and the California Department of Fish and Wildlife. On May 14, 2014, we submitted our review of the BDCP’s Draft Environmental Impact Report/Draft Environmental Impact Statement (herein, the “Previous Draft”), which had been posted for review on December 9, 2013. This review¹ contained three main parts: an extended summary, detailed responses to charge questions from the Delta Stewardship Council, and reviews of individual chapters. Although the Previous Draft considered vast amounts of scientific information and analyses to assess the myriad potential environmental impacts of the many proposed BDCP actions, we concluded that the science in the Previous Draft had significant gaps, given the scope and importance of the BDCP.

The proposed BDCP actions have now been partitioned into two separate efforts: water conveyance under California WaterFix² and habitat restoration under California EcoRestore³. Environmental documents in support of California WaterFix (the Current Draft) were made available for a 120-day comment period that began July 10, 2015. The Current Draft focuses on three new alternatives for conveying Sacramento River water through the Sacramento – San

¹ <http://deltacouncil.ca.gov/sites/default/files/documents/files/Attachment-1-Final-BDCP-comments.pdf>

² <http://www.californiawaterfix.com/>

³ <http://resources.ca.gov/ecorestore/>

Joaquin Delta. One of them, Alternative 4A, is the preferred alternative, identified as California WaterFix.

The Delta Stewardship Council asked us to review the Current Draft and to provide our comments by the end of September 2015. We are doing so through this report and its summary, which can be found in the cover letter.

The review began in July 2015 with a preliminary briefing from Laura King-Moon of California Department of Water Resources (three Delta ISB members present). The Delta ISB next considered the Current Draft in a public meeting on August 13–14 (nine of the ten members present)⁴. The meeting included a briefing on California EcoRestore by David Okita of California Natural Resources Agency and a discussion of the Current Draft and California WaterFix with Cassandra Enos-Nobriga of California Department of Water Resources (DWR) and Steve Centerwall of ICF International.

The initial public draft of this review was based on our study of Sections 1-4 of the Current Draft and on checks of most resource chapters in its Appendix A. This public draft was the subject of a September 16 meeting that included further discussions with Cassandra Enos-Nobriga⁵ and comments from Dan Ray of the Delta Stewardship Council staff. Additional comments on that initial draft were provided by DWR in a September 21 letter to the Delta ISB chair⁶. These discussions and comments helped clarify several issues, particularly on expectations of a WaterFix EIR/EIS.

This final version of the review begins with a summary in the cover letter. The body of the report continues first with a section on our understanding of major differences between the BDCP and California WaterFix. Next, after noting examples of improvement in the Current Draft, we describe our main concerns about the current impact assessments. These overlap with main concerns about the Previous Draft, which we revisit to consider how they are addressed in the Current Draft. Finally, we offer specific comments on several major Sections and Chapters.

DIFFERENCES BETWEEN THE BDCP AND CALIFORNIA WATERFIX

The project proposed in the Current Draft differs in significant respects from what was proposed as the BDCP in December 2013. Here we briefly state our understanding of some main differences and comment on their roles on this review:

- The time period for permitting incidental take under Section 7 of the federal Endangered Species Act (ESA) and Section 2081(b) of the California Endangered Species Act (CESA) is substantially less than the 50 years envisioned as part of a Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) in BDCP. As a result, the science associated with many impacts of climate change and sea-level rise may seem less relevant. The permitting period for the project proposed in the Current Draft remains in place unless environmental baseline conditions change substantially or other permit requirements are not met. Consequently, long-term effects of the proposed project remain important in terms of operations and expected benefits (p. 8).

⁴ <http://deltacouncil.ca.gov/docs/delta-isb-meeting-notice-meeting-notice-delta-isb/delta-independent-science-board-isb-august-13>

⁵ Written version at https://s3.amazonaws.com/californiawater/pdfs/63qnf_Delta_ISB_draft_statement_-_Enos_-_FINAL.pdf

⁶ <http://deltacouncil.ca.gov/docs/response-letter-dwr>

- In this shortened time frame, responsibility for assessing WaterFix’s effects on fish and wildlife would fall to resource agencies (National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife). Other impacts would be regulated by a variety of federal and state agencies (Current Draft Section 1).
- The proposed habitat restorations have been scaled back. The Current Draft incorporates elements of 11 Conservation Measures from BDCP to mitigate impacts of construction and operations. Most habitat restoration included in the Previous Draft has been shifted to California EcoRestore. Our review of the Previous Draft contained many comments on the timing of restoration, species interactions, ecological linkages of conservation areas, locations of restoration areas and the science supporting the efficiency and uncertainty of effective restoration. Some of these comments apply less to the Current Draft because of its narrower focus on water conveyance.
- There remains an expected reliance on cooperative science and adaptive management during and after construction.
- It is our understanding that the Current Draft was prepared under rules that disallow scientific methods beyond those used in the Previous Draft. The rules do allow new analyses, however. For example, we noticed evidence of further analyses of contaminants, application of existing methods (e.g. particle tracking) to additional species (e.g., some of the non-covered species), and occasional selection of one model in place of the combined results of two models (e.g., fish life cycle models SALMOD and SacEFT).

IMPROVEMENTS ON THE PREVIOUS DRAFT

A proposed revamping of water conveyance through the Sacramento-San Joaquin Delta involves a multitude of diverse impacts within and outside of the Delta. Unavoidably, the EIR/EIS for such a project will be complex and voluminous, and preparing it becomes a daunting task in its own right. The inherent challenges include highlighting, in a revised EIR/EIS, the most important of the changes.

The new Sections 1 through 4 go a long way toward meeting some of these challenges. Section 1 spells out the regulatory context by discussing laws and agencies that establish the context for the Current Draft. Section 2 summarizes how the Previous Draft was revised in response to project changes and public input. Section 3 describes how the preferred alternative in the Previous Draft (Alternative 4) has been changed. Section 4 presents an impressive amount of detailed information in assessing the sources of habitat loss for various species and discussing how restoration and protection can mitigate those losses. Generally comprehensive lists of “Resource Restoration and Performance Principles” are given for the biological resources that might be affected by construction or operations. For example, page 4.3.8-140 clearly describes a series of measures to be undertaken to minimize the take of sandhill cranes by transmission lines (although the effectiveness of these measures is yet to be determined).

Section 4 also contains improvements on collaborative science (4.1.2.4, mostly reiterated in ES.4.2). This part of the Current Draft draws on recent progress toward collaborative efforts in monitoring and synthesis in support of adaptive management in the Delta. The text identifies the main entities to be involved in an expected memorandum of agreement on a monitoring and adaptive-management program in support of the proposed project.

Appendix A describes revisions to the resource chapters of the Previous Draft. Track-changed versions of the chapters simplify the review process, although this was not done for the

key chapter on aquatic resources (p. 17). We noticed enhanced analyses of contaminants and application of methods such as particle tracking to additional species, including some of the non-covered taxa; a detailed treatment of *Microcystis* blooms and toxicity; more information about disinfection byproducts; improved discussion of vector control arising from construction and operational activities; and revised depiction of surficial geology. Potential exposure of biota to selenium and methylmercury is now considered in greater detail. Evaluations will be conducted for restoration sites on a site-specific basis; if high levels of contaminants cannot otherwise be addressed, alternative restoration sites will be considered (page 4.3.8-118). Incidentally, this is a good example of adaptive management, although it is not highlighted as such. Explanations were provided for why the nitrogen-to-phosphorus ratio was not specifically evaluated, why dissolved vs. total phosphorus was used in the assessment, and how upgrades to the Sacramento Regional Wastewater Treatment Plant would eventually affect phosphorus concentrations.

CURRENT CONCERNS

These and other strengths of the Current Draft are outweighed by several overarching weaknesses: overall incompleteness through deferral of content to the Final EIR/EIS (herein, "the Final Report"); specific incompleteness in treatment of adaptive management, habitat restoration, levees, and long-term effects; and inadequacies in presentation. Some of these concerns overlap with ones we raised in reviewing the Previous Draft (revisited below, beginning on p. 10).

Missing content

The Current Draft lacks key information, analyses, summaries, and comparisons. The missing content is needed for evaluation of the science that underpins the proposed project. Accordingly, the Current Draft fails to adequately inform weighty decisions about public policy. The missing content includes:

1. Details on adaptive management and collaborative science (below, p. 5).
2. Modeling how levee failures would affect operation of dual-conveyance systems (below, p. 7). Steve Centerwall told us on August 14 that modeling of the effects of levee failure would be presented in the Final Report.
3. Analysis of whether operation of the proposed conveyance would alter the economics of levee maintenance (below, p. 7).
4. Analyses of the effects of climate change on expected water exports from the Delta. “[A]n explanation and analysis describing potential scenarios for future SWP/CVP system operations and uncertainties [related to climate change] will be provided in the Final Report” (p. 1-35 of the Current Draft).
5. Potential impacts of climate change on system operations, even during the shortened time period emphasized in the Current Draft (below, p. 8 and 11).
6. Potential effects of changes in operations of the State Water Project (SWP) and Central Valley Project (CVP), or other changes in water availability, on agricultural practices in the San Joaquin Valley (p. 12).
7. Concise summaries integrated with informative graphics (below, p. 9 and 13). The Current Draft states that comparisons of alternatives will be summarized in the Final Report (p. 1-35).

While some of the missing content has been deferred to the Final Report (examples 2, 4, and 7), other gaps have been rationalized by deeming impacts “too speculative” for assessment.

CEQA guidance directs agencies to avoid speculation in preparing an EIR/EIS⁷. To speculate, however, is to have so little knowledge that a finding must be based on conjecture or guesswork. Ignorance to this degree does not apply to potential impacts of WaterFix on levee maintenance (example 3; see p. 7) or on San Joaquin Valley agriculture (example 6; p. 12).

Even if content now lacking would go beyond what is legally required for an EIR/EIS, providing such content could assist scientists, decision-makers, and the public in evaluating California WaterFix and Delta problems of statewide importance (above, p. 1).

Adaptive management

The guidelines for an EIR/EIS do not specifically call for an adaptive-management plan (or even for adaptive management). However, if the project is to be consistent with the Delta Plan (as legally mandated), adaptive management should be part of the design.

The Current Draft relies on adaptive management to address uncertainties in the proposed project, especially in relation to water operations. The development of the Current Draft from the Previous Draft is itself an exercise in adaptive management, using new information to revise a project during the planning stage. Yet adaptive management continues to be considered largely in terms of how it is to be organized (i.e., coordinated with other existing or proposed adaptive-management collaborations) rather than how it is to be done (i.e., the process of adaptive management). Adaptive management should be integral with planned actions and management—the Plan A rather than a Plan B to be added later if conditions warrant. The lack of a substantive treatment of adaptive management in the Current Draft indicates that it is not considered a high priority or the proposers have been unable to develop a substantive idea of how adaptive management would work for the project.

There is a very general and brief mention of the steps in the adaptive management process in Section 4 (p. 4.1-6 to 4.1-7), but nothing more about the process. We were not looking here for a primer on adaptive management. Rather, we expected to find serious consideration of barriers and constraints that have impeded implementation of adaptive management in the Delta and elsewhere (which are detailed in the Delta Plan), along with lessons learned on how adaptive management can be conducted overcome these problems.

The Current Draft contains general statements on how collaborative science and adaptive management under California WaterFix would be linked with the Delta Collaborative Science and Adaptive Management Program (CSAMP) and the Collaborative Adaptive Management Team (CAMT). These efforts, however, have taken place in the context of regulations and permits, such as biological opinions and biological assessments required under the Endangered Species Act. We did not find examples of how adaptive management would be applied to assessing—and finding ways to reduce—the environmental impacts of project construction and operations.

Project construction, mitigation, and operations provide many opportunities for adaptive management, both for the benefit of the project as well as for other Delta habitat and ecosystem initiatives, such as EcoRestore. To be effective in addressing unexpected outcomes and the need for mid-course corrections, an adaptive-management management team should evaluate a broad range of actions and their consequences from the beginning, as plans are being developed, to facilitate the early implementation and effectiveness of mitigation activities.

⁷ https://s3.amazonaws.com/californiawater/pdfs/bo0lx_Delta_ISB_Draft_Statement_&_Response_Letter_-_Enos_-_FINAL.pdf

The Current Draft defers details on how adaptive management will be made to work: “An adaptive management and monitoring program will be implemented to develop additional scientific information during the course of project construction and operations to inform and improve conveyance facility operational limits and criteria” (p. ES-17). This is too late. If adaptive management and monitoring are central to California WaterFix, then details of how they will be done and resourced should be developed at the outset (now) so they can be better reviewed, improved, and integrated into related Delta activities. The details could include setting species-specific thresholds and timelines for action, creating a Delta Adaptive Management Team, and capitalizing on unplanned experiments such as the current drought⁸. Illustrative examples could use specific scenarios with target thresholds, decision points, and alternatives. The missing details also include commitments and funding needed for science-based adaptive management and restoration to be developed and, more importantly, to be effective.

The protracted development of the BDCP and its successors has provided ample time for an adaptive-management plan to be fleshed out. The Current Draft does little more than promise that collaborations will occur and that adaptive management will be implemented. This level of assurance contrasts with the central role of adaptive management in the Delta Plan and with the need to manage adaptively as climate continues to change and new contingencies arise.

Restoration as mitigation

Restoration projects should not be planned and implemented as single, stand-alone projects but must be considered in a broader, landscape context. We highlighted the landscape scale in our review of the Previous Draft and also in an earlier review of habitat restoration in the Delta⁹. A landscape approach applies not just to projects that are part of EcoRestore, but also to projects envisioned as mitigation in the Current Draft, even though the amount of habitat restoration included (as mitigation) in the Current Draft has been greatly reduced. On August 13 and 14, representatives of WaterFix and EcoRestore acknowledged the importance of the landscape scale, but the Current Draft gives it little attention. Simply because the CEQA and NEPA guidelines do not specifically call for landscape-level analyses is not a sufficient reason to ignore them.

Wetland restoration is presented as a key element of mitigation of significant impacts (example below in comments on Chapter 12, which begin on p. 18). We noticed little attention to the sequence required for assessing potential impacts to wetlands: first, avoid wetland loss; second, if wetland loss cannot be avoided, minimize losses; and third, if avoidance or minimization of wetland loss is not feasible, compensate. Much of the emphasis in the Current Draft is on the third element. Sequencing apparently will be addressed as part of the permitting process with the US Army Corps of Engineers (USACE) for mitigation related to the discharge of dredged or fill material.¹⁰ However, it is difficult to evaluate the impacts on wetlands in advance of a clarification of sequencing and criteria for feasibility.

Mitigation ratios

Restoring a former wetland or a highly degraded wetland is preferable to creating wetlands from uplands¹¹. When an existing wetland is restored, however, there is no net gain of

⁸ <http://deltacouncil.ca.gov/docs/adaptive-management-report-v-8>

⁹ <http://deltacouncil.ca.gov/sites/default/files/documents/files/HABITAT%20RESTORATION%20REVIEW%20FINAL.pdf>

¹⁰ Letter from Cassandra Enos-Nobriga, DWR, September 21, 2015.

¹¹ <http://www.nap.edu/openbook.php?isbn=0309074320>

area, so it is unclear whether credits for improving existing wetlands would be considered equivalent to creating wetlands where they did not recently exist.

In view of inevitable shortcomings and time delays in wetland restorations, mitigation ratios should exceed 1:1 for enhancement of existing wetlands. The ratios should be presented, rather than making vague commitments such as “restore or create 37 acres of tidal wetland...” The Final Draft also needs to clarify how much of the wetland restoration is out-of-kind and how much is in-kind replacement of losses. It should examine whether enough tidal area exists of similar tidal amplitude for in-kind replacement of tidal wetlands, and whether such areas will exist with future sea-level rise. We agree that out-of-kind mitigation can be preferable to in-kind when the trade-offs are known and quantified and mitigation is conducted within a watershed context, as described in USACE’s 2010 guidance for compensatory wetland mitigation.¹² Since then, many science-based approaches have been developed to aid decision-making at watershed scales, including the 2014 Watershed Approach Handbook produced by the Environmental Law Institute and The Nature Conservancy¹³.

Restoration timing and funding

To reduce uncertainty about outcomes, allow for beneficial and economical adaptive management, and allow investigators to clarify benefits before the full impacts occur, mitigation actions should be initiated as early as possible. Mitigation banks are mentioned, but are any operational or planned for operation soon? The potential for landowners to develop mitigation banks could be encouraged so restoration could begin immediately, engendering better use of local knowledge, financial profit, and local support for the project. We are told that the timing of mitigation will be coordinated with other review processes that are currently ongoing.⁶

Levees

A comprehensive assessment of environmental impacts should relate California WaterFix to levee failure by examining the consequences each may have for the other. The interplay between conveyance and levees is receiving additional attention through the Delta Levee Investment Strategy.

On the one hand, the Current Draft fails to consider how levee failures would affect the short-term and long-term water operations spelled out in Table 4.1-2. A rough estimate was proposed under the Delta Risk Management Study¹⁴ and another is part of a cost-benefit analysis for the BDCP¹⁵. The Final Report should provide analyses that incorporate these estimates.

On the other hand, the Current Draft also fails to consider how implementing the project would affect the basis for setting the State’s priorities in supporting Delta levee maintenance. This potential impact is illustrated by a recent scoring system of levee-project proposals that awards points for expected benefits to “export water supply reliability”¹⁶. Further efforts to quantify these benefits have been recommended as part of a comprehensive risk assessment that

¹² [http://www.sac.usace.army.mil/Portals/43/docs/regulatory/Guidelines for Preparing a Compensatory Mitigation Planf.pdf](http://www.sac.usace.army.mil/Portals/43/docs/regulatory/Guidelines%20for%20Preparing%20a%20Compensatory%20Mitigation%20Planf.pdf)

¹³ https://www.eli.org/sites/default/files/eli-pubs/watershed-approach-handbook-improving-outcomes-and-increasing-benefits-associated-wetland-and-stream_0.pdf

¹⁴ http://www.water.ca.gov/floodmgmt/dsmo/sab/drmisp/docs/Delta_Seismic_Risk_Report.pdf

¹⁵ http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Draft_BDCP_Statewide_Economic_Impact_Report_8513.sflb.ashx

¹⁶ http://www.water.ca.gov/floodsafe/fessro/docs/special_PSP14_final.pdf

would guide the Delta Levees Investment Strategy¹⁷. Public safety, a focus of the Delta Flood Emergency Management Plan,¹⁸ is just one asset that levees protect. The Current Draft does not evaluate how the proposed project may affect estimates of the assets that the levees protect.

The Current Draft cites levee fragility mainly as a reason to build isolated conveyance for Sacramento River water (examples, p. 1-1, 1-7, 1-9). In a similar vein, the California WaterFix website states, “Aging dirt levees are all that protect most of California’s water supplies from the affects [*sic*] of climate change. Rising sea levels, intense storms, and floods could all cause these levees to fail, which would contaminate our fresh water with salt, and disrupt water service to 25 million Californians”¹⁹. Neither the Previous Draft nor the Current Draft, however, provides a resource chapter about Delta levees. Such a chapter would be an excellent place to examine interacting impacts of conveyance and levees.

Long-term effects

With the shortened time period, several potential long-term impacts of or on the proposed project no longer receive attention. While these effects may not become problematic during the initial permit period, many are likely to affect project operations and their capacity to deliver benefits over the long operational life of the proposed conveyance facilities. In our view, consideration of these long-term effects should be part of the evaluation of the science foundation of the proposed project.

The No-Action alternative establishes the baseline for evaluating impacts and benefits of the proposed alternative(s). It is therefore important to consider carefully how the baseline is established, as this can determine whether particular consequences of the alternatives have costs or benefits. Climate change, for example, is considered under the No-Action alternative in the Current Draft, as is sea-level rise. Climate change is expected to reduce water availability for the proposed northern intakes, and both climate change and sea-level rise are expected to influence tidal energy and salinity intrusion within the Delta²⁰. Changes in water temperature may influence the condition of fishes that are highly temperature-dependent in the current analyses. These environmental effects, in turn, are likely to influence environmental management and regulation; from the standpoint of water quality they may even yield environmental benefits if agricultural acreage decreases and agricultural impacts are reduced.

Rather than consider such effects, however, the Current Draft focuses on how the proposed project would affect “the Delta’s resiliency and adaptability to expected climate change” (Current Draft section 4.3.25). Quite apart from the fact that “resiliency” and “adaptability” are scarcely operational terms, the failure to consider how climate change and sea-level rise could affect the outcomes of the proposed project is a concern that carries over from our 2014 review and is accentuated by the current drought (below, p. 11).

The Current Draft states that “Groundwater resources are not anticipated to be substantially affected in the Delta Region under the No Action Alternative (ELT) because surface water inflows to this area are sufficient to satisfy most of the agricultural, industrial, and municipal water supply needs” (p. 4.2-16). This conclusion is built on questionable assumptions; the current drought illustrates how agriculture turns to groundwater when surface-water availability diminishes. Groundwater regulation under the recently enacted Sustainable

¹⁷ <http://deltacouncil.ca.gov/docs/delta-levee-investment-strategy/dlis-peer-review-technical-memorandum-31>

¹⁸ <http://www.water.ca.gov/floodmgmt/hafoo/fob/dreppr/InterdepartmentalDraftDFEMP-2014.pdf>.

¹⁹ <http://www.californiawaterfix.com/problem>

²⁰ <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0024465>

Groundwater Management Act (SGMA) can also be expected to have long-term effects on the proposed project—effects that the Current Draft does not assess. Ending of more than a million acre-feet of overdraft in the southern Central Valley under the SGMA is likely to increase demand for water exports from the Delta in the coming decades. The Current Draft discusses the potential effects of the project on groundwater (for example, in Sections 4.3.3 and 5.2.2.3), but we found only two brief, descriptive mentions of SGMA in the 235 pages of Section 5. The implications of prolonged droughts (e.g., on levee integrity) and of the consequences of SGMA receive too little attention in the Current Draft.

The Current Draft suggests that unnamed “other programs” that are “separate from the proposed project” will use elements of the Previous Draft to implement long-term conservation efforts that are not part of California WaterFix (Current Draft, p. 1-3). The Final Report should provide assurances that such other programs will step in, and could go further in considering their long-term prospects.

Informative summaries and comparisons

According to guidance for project proponents, “Environmental impact statements shall be written in plain language and may use appropriate graphics so that decision-makers and the public can readily understand them” (Code of Federal Regulations, 40 CFR 1502.8). Far-reaching decisions should not hinge on environmental documents that few can grasp.

This guidance applies all the more to an EIR/EIS of the scope, complexity, and importance of the Current Draft. It demands excellent comparative descriptions of alternatives that are supported by readable tables and high-quality graphics, enumeration of major points, well-organized appendices, and integration of main figures with the text. For policy deliberations, the presentation of alternatives should include explicit comparisons of water supply deliveries and reliabilities as well as economic performance. For decision-makers, scientists, and the public, summaries of impacts should state underlying assumptions clearly and highlight major uncertainties. The Current Draft is inadequate in these regards.

The Previous Draft provided text-only summaries for just the two longest of its resource chapters (Chapters 11 and 12). A fragmentary comparison of alternatives was buried in a chapter on “Other CEQA/NEPA required sections” (part 3 of Chapter 31) but fell far short of what was needed. Both the Previous and Current Drafts have been accompanied by a variety of outreach products for broad audiences (e.g., the descriptive overview of the BDCP Draft EIR/EIS²¹). These products do little to compensate for the overall paucity of readable summaries and comparisons in the Previous and Current Drafts.

For over three years, the Delta ISB has been specifically requesting summaries and comparisons: first in June 2012²², then in June 2013²³, and again in a review of the Previous Draft in May 2014 (footnote 1, p. 1). Appallingly, such summaries and comparisons remain absent in the Current Draft. The generally clear writing in Sections 1 through 4 shows that the preparers are capable of providing the requested summaries and comparisons. Prescriptions in CEQA and NEPA in no way exclude cogent summaries, clear comparisons, or informative graphics. And three years is more than enough time to have developed them.

²¹ Highlights+of+the+Draft+EIS-EIR+12-9-13.pdf

²² http://deltacouncil.ca.gov/sites/default/files/documents/files/DISB_Letter_to_JMeral_and_DHoffman-Floerke_061212.pdf

²³ http://deltacouncil.ca.gov/sites/default/files/documents/files/DISB%20Comments%20on%20Draft%20BDCP%20Document.doc_.pdf

On August 14, 2015, representatives of California WaterFix assured us that this kind of content would eventually appear, but only in the Final Report. That will be far too late in the EIR/EIS process for content so critical to comprehending what is being proposed and its potential impacts.

PRIOR CONCERNS AND THEIR RELEVANCE TO THE CURRENT DRAFT

The Delta ISB review of May 14, 2014 emphasized eight broad areas of concern about the scientific basis for the Previous Draft. Each is summarized below, followed by a brief appraisal of how (or whether) the concern has been dealt with in the Current Draft. While the reduced scope of the proposed project has reduced the relevance of some issues, particularly habitat restoration and other conservation measures, other concerns persist.

Our persistent concerns include the treatment of uncertainty, the implementation of adaptive management, and the use of risk analysis. These topics receive little or no further attention in the Current Draft. We also found few revisions in response to points we raised previously about linkages among species, ecosystem components, or landscapes; the potential effects of climate change and sea-level rise; and the potential effects of changes in water availability on agricultural practices and the consequent effects on the Delta. Our previous comments about presentation also pertain.

Effectiveness of conservation actions

Our 2014 review found that many of the impact assessments hinged on optimistic expectations about the feasibility, effectiveness, or timing of the proposed conservation actions, especially habitat restoration.

This is arguably less of a concern now, given the substantially shorter time frame of the revised project and narrower range of conservation actions designed for compensatory restoration. Nonetheless, the Current Draft retains unwarranted optimism, as on page 4.3.25-10: “By reducing stressors on the Delta ecosystem through predator control at the north Delta intakes and Clifton Court Forebay and installation of a nonphysical fish barrier at Georgiana Slough, Alternative 4A will contribute to the health of the ecosystem and of individual species populations making them stronger and more resilient to the potential variability and extremes caused by climate change.” A scientific basis for this statement is lacking, and an adaptive or risk-based management framework is not offered for the likely event that such optimism is unfulfilled.

Is it feasible for even the reduced amounts of mitigation and restoration to be completed within the time period proposed? Perhaps yes. Is it feasible that these actions will mitigate impacts over the long term? This is more problematic. To be effective, mitigation actions should deal with both the immediate and long-term consequences of the project. The proposed permitting should allow for monitoring long enough to assess the effectiveness of habitat restoration measures, which will need to extend beyond the initial permitting period.

Uncertainty

The 2014 review found the BDCP encumbered by uncertainties that were considered inconsistently and incompletely. We commented previously that modeling was not used effectively enough in bracketing uncertainties or exploring how they may propagate or be addressed.

In the Current Draft, uncertainties and their consequences remain inadequately addressed, improvements notwithstanding. Uncertainties will now be dealt with by establishing “a robust program of collaborative science, monitoring, and adaptive management” (ES 4.2). No details about this program are provided, so there is no way to assess how (or whether) uncertainties will be dealt with effectively. Although sensitivity modeling was used to address the effects of changes in the footprint and other minor changes of the revised project, full model runs were not carried out to assess the overall effects of the specific changes. Consequently, modeling that would help to bracket ranges of uncertainties or (more importantly) assess propagation of uncertainties is still inadequate.

Many of our prior concerns about uncertainties pertained to impacts on fish. If those uncertainties have now been addressed in Chapter 11, they are difficult to evaluate because changes to that chapter have not been tracked in the public draft (below, p. 17).

There are also uncertainties with the data generated from model outputs, although values are often presented with no accompanying error estimates. This situation could be improved by presenting results from an ensemble of models and comparing the outputs.

Effects of climate change and sea-level rise on the proposed actions

Our 2014 review stated concerns that the Previous Draft underestimated effects of climate change and sea-level rise across the 50-year timeline of the BDCP. With the nominal duration shortened substantially, most of the projected impacts of climate change and sea-level rise may occur later. But climate-related issues remain.

First, the Current Draft is probably outdated in its information on climate change and sea-level rise. It relies on information used in modeling climate change and sea-level rise in the Previous Draft, in which the modeling was conducted several years before December 2013. The absence of the climate-change chapter (Chapter 29) in the Previous Draft from Appendix A in the Current Draft indicates that no changes were made. In fact, the approaches and assumptions in the Current Draft remained unchanged from the Previous Draft in order to ensure consistency and comparability across all the Alternatives, even though newer scientific information had become available.⁶ Yet climatic extremes, in particular, are a topic of intense scientific study, illustrated by computer simulations of ecological futures²⁴ and findings about unprecedented drought²⁵. The Current Draft does not demonstrate consideration of recently available climate science, and it defers to the Final Report analysis of future system operations under potential climate and sea-level conditions. In fact, the Current Draft generally neglects recent literature, suggesting a loose interpretation of “best available science.”

Second, climate change and sea-level rise are now included in the No-Action Alternative, as they will transpire whether or not WaterFix moves forward. A changed future thus becomes the baseline against which Alternative 4A (and the others) are compared. Changes in outflow from the Delta due to seasonal effects of climate change and the need to meet fall X2 requirements are considered in Section 4.3.1. The difference in outcomes then depends on assumptions about the facility and operations of Alternative 4A and the other Alternatives. Sensitivity analyses indicate that the impacts of the different Alternatives are generally similar in comparison to the No Action Alternative under the range of climate projections considered.⁶ Thus, “Delta exports would either remain similar or increase in wetter years and remain similar

²⁴ <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0024465>

²⁵ Cook, B.I., Ault, T.R., and Smerdon, J.E., 2015, Unprecedented 21st century drought risk in the American Southwest and Central Plains: *Science Advances*, v. 1, doi:10.1126/sciadv.1400082.

or decrease in the drier years under Alternative 4A as compared to the conditions without the project.” (p. 4.3.1-4). Such an inconclusive conclusion reinforces the need to be able to adapt to different outcomes. Simply because the Alternatives are expected to relate similarly to a No Action Alternative that includes climate change does not mean that the Alternatives will be unaffected by climate change.

Interactions among species, landscapes, and the proposed actions

The Previous Draft acknowledged the complexities produced by webs of interactions, but it focused on individual species, particular places, or specific actions that were considered in isolation from other species, places, or actions. Potential predator-prey interactions and competition among covered and non-covered fish species were not fully recognized. Confounding interactions that may enhance or undermine the effectiveness of proposed actions were overlooked. In our 2014 review we recommended describing and evaluating the potential consequences of such interactions, particularly in Chapters 11 (Fish and aquatic resources) and 12 (Terrestrial resources).

The Current Draft recognizes that mitigation measures for one species or community type may have negative impacts on other species or communities, and mitigation plans may be adjusted accordingly. But the trade-offs do not seem to be analyzed or synthesized. This emphasizes the need for a broader landscape or ecosystem approach that comprehensively integrates these conflicting effects.

Effects on San Francisco Bay, levees, and south-of-Delta environments

In 2014 we pointed to three kinds of impacts that the Previous Draft overlooked: (1) effects on San Pablo Bay and San Francisco Bay in relation to Delta tides, salinity, and migratory fish; (2) effects of levee failures on the proposed BDCP actions and effects of isolated conveyance on incentives for levee investments; and (3) effects of increased water reliability on crops planted, fertilizers and pesticides used, and the quality of agricultural runoff. The Current Draft responds in part to point 1 (in 11.3.2.7) while neglecting point 2 (above, p. 7) and point 3.

On point 3: Although the Current Draft considers how the project might affect groundwater levels south of the Delta (7.14 to 7.18), it continues to neglect the environmental effects of water use south of (or within) the Delta. Section 4.3.26.4 describes how increased water-supply reliability could lead to increased agricultural production, especially during dry years. Elsewhere, a benefit-cost analysis performed by ICF and the Battle Group²⁶ calculated the economic benefits of increased water deliveries to agriculture in the Delta. The Current Draft does not fully consider the consequences of these assumptions, or of the projections that the project may enhance water-supply reliability but may or may not increase water deliveries to agriculture (depending on a host of factors). We have been told that to consider such possibilities would be “too speculative” and that such speculations are explicitly discouraged in an EIR/EIS. Yet such consequences bear directly on the feasibility and effectiveness of the project, and sufficient information is available to bracket a range of potential effects. Our previous concerns are undiminished.

The impacts of water deliveries south of the Delta extend to the question of how each intake capacity (3,000, 9,000, or 15,000 cfs) may affect population growth in Southern

²⁶ Hecht, J., and Sunding, D., Draft Bay Delta Conservation Plan statewide economic impact report, August 2013.

California. Section 4.4.1-9 treats the growth-enabling effects of alternative 2D lightly, saying that additional EIS review would be needed for future developments.

Implementing adaptive management

In the Previous Draft, details about adaptive management were to be left to a future management team. In our 2014 review we asked about situations where adaptive management may be inappropriate or impossible to use, contingency plans in case things do not work as planned, and specific thresholds for action.

Although most ecological restoration actions have been shifted to California EcoRestore (p. 5), we retain these and other concerns about adaptive management under California WaterFix. If the mitigation measures for terrestrial resources are implemented as described, for example, they should compensate for habitat losses and disturbance effects of the project. The test will be whether the measures will be undertaken as planned, be as effective as hoped, and continue long enough to fully mitigate effects. This is where adaptive management and having contingency plans in place becomes critically important. It is not apparent that the mitigation plans include these components.

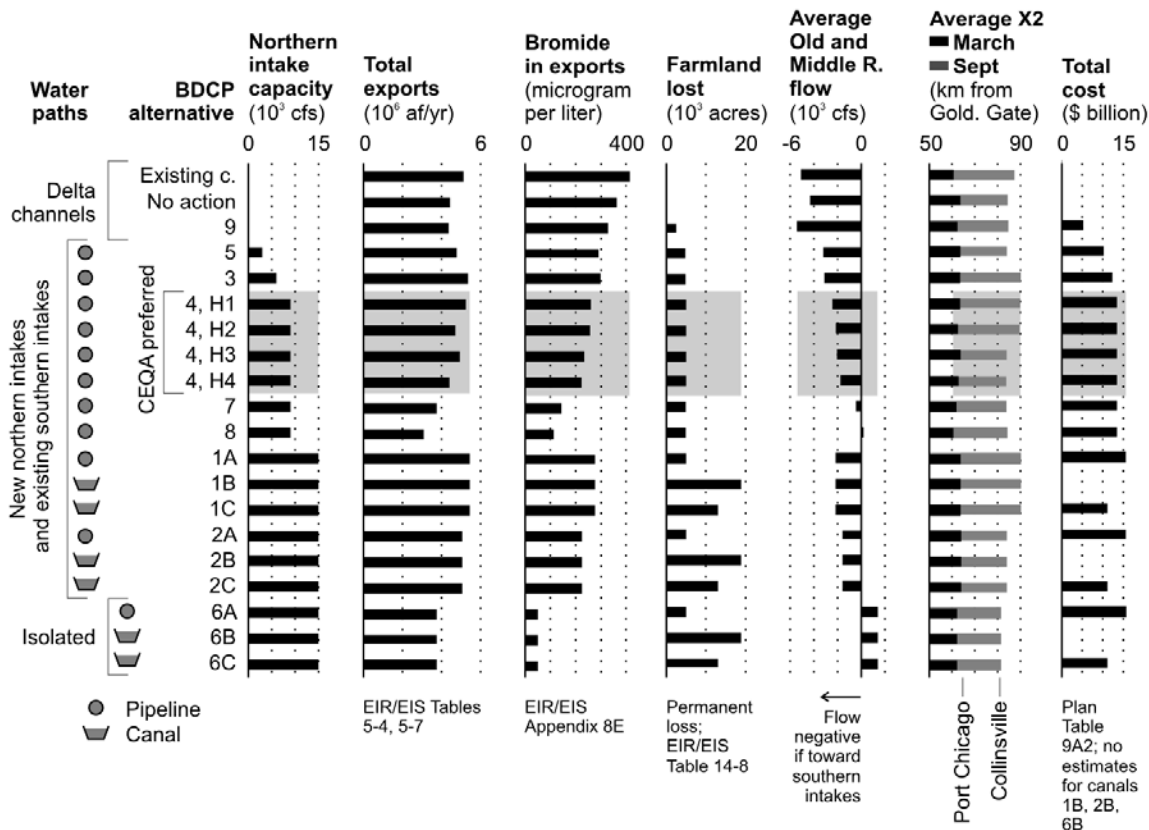
Reducing and managing risk

Our 2014 review advised using risk assessment and decision theory in evaluating the proposed BDCP actions and in preparing contingency plans. We noticed little improvement on this issue, just a mention that it might be considered later. This is not how the process should be used.

Comparing BDCP alternatives

The Previous Draft contained few examples of concise text and supporting graphics that compare alternatives and evaluate critical underlying assumptions. Rudimentary comparisons of alternatives were almost entirely absent. The Current Draft retains this fundamental inadequacy (p. 9).

Our 2014 review urged development and integration of graphics that offer informative summaries at a glance. We offered the example reproduced below. If the Current Draft contains such graphics, they would need to be ferreted out from long lists of individual pdf files. Because they are not integrated into the text where they are referenced in the Current Draft, the figures cannot readily illustrate key points.



COMMENTS ON INDIVIDUAL SECTIONS AND CHAPTERS

This final section of the review contains minimally edited comments on specific points or concerns. These comments are organized by Section or Chapter in the Current Draft. Many are indexed to pages in the section or chapter named in the heading.

Alternatives 4A, 2D, and 5A (Section 4)

It is good that the proposed alternatives are seen as flexible proposals, as it is difficult to imagine that any proposal for such a complex and evolving system could be implemented precisely as proposed. Some initial and ongoing modifications seem desirable, and unavoidable.

The operating guidance for the new alternatives seems isolated from the many other water management and environmental activities in and upstream of the Delta likely to be important for managing environmental and water supply resources related to Delta diversions. While it is difficult to specify detailed operations for such a complex system, more details on the governance of operations (such as the Real Time Operations process) would be useful. The operational details offered seem to have unrealistic and inflexible specificity. Presentations of delivery-reliability for different alternatives remain absent. Environmental regulations on Delta diversions have tended to change significantly and abruptly in recent decades, and seem likely to change in the future. How sensitive are project water supply and environmental performance to changes in operating criteria?

The collaborative science ideas seem philosophically attractive, but are not given much substance. Monitoring is mentioned, but details of organization, intent, and resources seem

lacking. Adequate funding to support monitoring, collaborative science, and adaptive management is a chronic problem. Section ES.4.2 states that “Proponents of the collaborative science and monitoring program will agree to provide or seek additional funding when existing resources are insufficient.” This suggests that these activities are lower in priority than they should be.

The three new alternatives, 4A, 2D, and 5A, seem to have modest changes over some previous alternatives, with the exception of not being accompanied by a more comprehensive environmental program. In terms of diversion capacities, they cover a wide range, 3,000 cfs (5A), 9,000 cfs (4A), and 15,000 cfs (2D). The tables comparing descriptions of the new alternatives to previous Alternative 4 are useful, but should be supplemented by a direct comparison of the three new alternatives.

The new Sustainable Groundwater Management Act (SGMA) seems likely to increase demands for water diversions from the Delta to the south to partially compensate for the roughly 1.5-2 maf/year that is currently supplied by groundwater overdraft.

The State seems embarked on a long-term reduction in urban water use, particularly outdoor irrigation. Such a reduction in urban water use is likely to have some modest effects on many of the water-demand and scarcity impacts discussed.

The climate change analysis of changes in Delta inflows and outflows is useful, but isolating the graphs in a separate document disembodies the discussion. The fragmentation of the document by removing each Section 4 figure into a separate file is inconvenient for all, and makes integrated reading practically impossible for many.

The details of the alternative analyses seem mostly relevant and potentially useful. Much can be learned about the system and the general magnitude of likely future outcomes from patient and prolonged reading of this text. An important idea that emerges from a reading of the No Action Alternative is that the Delta, and California water management, is likely to change in many ways with or without the proposed project. The No Action and other alternatives also illustrate the significant inter-connectedness of California’s water system. The range of impacts considered is impressive, but poorly organized and summarized.

The discussion of disinfection by-product precursor effects in Delta waters is improved significantly, but could be made more quantitative in terms of economic and public-health impacts.

The discussion on electromagnetic fields is suitably brief, while the tsunami discussion could be condensed.

The effects of the likely listing of additional native fish species as threatened or endangered seems likely to have major effects on project and alternative performance. These seem prudent to discuss, and perhaps analyze.

Is Alternative 2D, with 15,000 cfs capacity, a serious alternative? Does it deserve any space at all?

Table 4.1-8 implies that tidal brackish/*Schoenoplectus* marsh. Should some of this be considered tidal freshwater marsh?

The dynamics of the Delta are largely determined by water flows. The Current Draft acknowledges that water flows and salinity will change in complex ways. There are statements about how inflows, outflows, and exports will change in Alternative 4A in relation to baseline (No-Action) conditions (p. 4.3.8-13). What is the scientific basis on which these changes will be managed? Will models be used? What confidence should we have in current projections? Have the effects of droughts or deluges been considered?

4.3.7-10, line 13: Text on disturbing sediments and releasing contaminants needs to add nitrogen and phosphorus to the concerns.

Water quality (Chapter 8)

8-3, line 13: *Microcystis* is singled out as a cyanobacterium that can (but doesn't always) produce the toxin, microcystin; however, there are other cyanobacteria that sometimes produce other toxins. Different genera can differ in the nutrient that limits their blooms (see 2014 letter by Hans Paerl in *Science* 346(6406): 175-176). For example, *Microcystis* blooms can be triggered by N additions because this species lacks heterocysts, while toxin-producing *Anabaena* blooms can be triggered by P additions, because *Anabaena* has heterocysts and can fix N. The frequently repeated discussion of cyanobacteria blooms needs to be updated. Also cite Paerl on page 8-45 line 8. Ditto on page 8-103 and 8-106 line 34.

8-8. In our earlier comments, we recommended that carbon be separated into its dissolved and particulate forms for consideration of water quality impacts because dissolved organic carbon (DOC) is the form most likely to react with chloride and bromide and result in formation of disinfection by-products. The section on bromide focuses on interactions with total organic carbon (TOC), rather than DOC. Carbon is primarily considered with respect to formation of disinfection by-products but carbon plays a central role in the dynamics of the Delta, affecting processes such as metabolism, acidity, nutrient uptake, and bioavailability of toxic compounds. Carbon cycling determines ecosystem structure and function in aquatic systems. It also modifies the influence and consequences of other chemicals and processes in aquatic systems. Dissolved organic carbon (DOC), for example, influences light and temperature regimes by absorbing solar radiation, affects transport and bioavailability of metals, and controls pH in some freshwater systems. Respiration of organic carbon influences dissolved oxygen concentrations and pH.

8-18, line 12 says that salt disposal sites were to be added in 2014; were they?

8-19 and 8-20: "CECs" is not defined and seems to be used incorrectly. Change "CECs" to "EDCs" on page 8-19 and to "PPCPs" on page 8-20.

8-21, line 18-19: Such a statement should be qualified. The conclusion that marine waters are N-limited and inland waters are P-limited is outdated. Recent papers, including the above, find more complex patterns.

8-22, lines 18 and 30: Choose either "cyanobacteria" or "blue-green algae;" using both will confuse readers who may perceive them as different.

8-23, lines 15-16: Say how the N:P ratio changed composition, not just that it did change composition.

8-23 through 8-25: Uncertainties (e.g., standard deviation or standard error of the mean) associated with the mean concentrations of DOC should be presented. It is impossible to interpret differences between the values that are presented without knowledge of the variation around the mean values (e.g., without knowledge of variation around the mean, it is difficult to evaluate whether DOC concentrations at south vs. north-of-Delta stations and Banks headworks differ from one another; 3.9 to 4.2 mg/L vs. 4.3 mg/L).

8-65, line 12: Specify if DO is for daytime or night, and for surface, bottom or mid-water column.

8-75, line 6: The failure to consider dissolved P (DP) should be addressed; there is much greater uncertainty. The adherence of some P to sediment does not prevent considerable

discharge of P as DP. Also on page 8-95 line 40, qualify predictions due to lack of consideration of DP.

8-82, line 4-5: It seems unlikely that current levels of *Microcystis* growth in the Delta are dependent on the exclusive uptake of ammonia. Temperature is one of the primary factors driving *Microcystis* blooms and global warming could promote bloom occurrence. Consider revising this section to, “Because it seems unlikely that current levels of *Microcystis* growth in the Delta are dependent on the exclusive uptake of ammonia, the frequency, magnitude and geographic extent of *Microcystis* under future scenarios is difficult to predict.”

8-105, line 8: Would total nitrogen be dominated by nitrate just by increasing ammonia removal? Depending on redox and microbiota, why wouldn't nitrate be converted to ammonium?

A lot of attention is given to factors controlling *Microcystis* blooms in this chapter but little attention is given to its toxicity. Just as factors controlling blooms are not fully understood, the regulating factors of cellular toxin contents remain poorly understood. As a result, the impact of blooms on the environment can vary (e.g., large blooms of non-toxic or low toxin organisms may have impacts on environmental variables such as nutrient uptake and dissolved oxygen consumption while small blooms of highly toxic organisms could impact food webs) [see: Ma et al. (2015) Toxic and non-toxic strains of *Microcystis aeruginosa* induce temperature dependent allelopathy toward growth and photosynthesis of *Chlorella vulgaris*. Harmful Algae 48: 21–29].

Fish and aquatic resources (Chapter 11)

We found individual conclusions or new analyses difficult to identify in this key chapter because changes to it were not tracked in the public version of the Current Draft and there was no table of contents that could have assisted in side-by-side comparison with the Previous Draft.

Effects of temperature

We noticed more emphasis on temperature concerning the fish ‘downstream’ impacts (but without tracked changes this becomes difficult to document).

The main temperature variable used expresses the percentage of time when monthly mean temperatures exceed a certain rate or fall within a certain boundary. The biological impact, however, is difficult to assess with these numbers. If all of the change occurred just during operations or just during one day, the biological impact could be much different than a small change every day (provided by using means). Graphs of changes and listing of extreme highs and lows during a model run would have more biological meaning. Also, comparisons were made using current baseline conditions and did not consider climate change effects on temperatures.

Fish screens

It is unclear how (and how well) the fish screens would work. The description of fish screens indicates that fish >20 mm are excluded, but what about fish and larvae that are <20 mm, as well as eggs? Table 11-21 seems out of date, because some fish screens appear to have been installed, but data on their effects are not given. Despite the lack of specific data on how well screens function, the conclusion that there will be no significant impact is stated as certain (e.g., page 1-100 line 38).

Here, as in many other places, measures are assumed to function as planned, with no evidence to support the assumptions. The level of certainty seems optimistic, and it is unclear whether there are any contingency plans in case things don't work out as planned. This problem persists from the Previous Draft.

Invasive plants

Cleaning equipment is mentioned, but it is not specifically stated that large machinery must be cleaned before entering the Delta. Section 4.3.8-358 says equipment would be cleaned if being moved within the Delta. Cleaning is essential to reduce transfer of invasive species; a mitigating measure is to wash equipment, but it must also be enforced.

Weed control (fire, grazing) is suggested, but over what time frame? It may be needed in perpetuity. That has been our experience at what is considered the world's oldest restored prairie (the 80-yr-old Curtis Prairie, in Madison, WI).

Weed invasions can occur after construction is completed; how long will the project be responsible for weed control? 3-5 years won't suffice.

4.3.8-347. Herbicides are prescribed to keep shorebird nesting habitat free of vegetation, but toxic effects of herbicides on amphibians etc. are not considered.

4.3.8-354. Impacts of invasive plants seem underestimated. Impact analysis implies that the project disturbance area is the only concern, when dispersal into all areas will also be exacerbated. At the Arboretum, a 1200-ac area dedicated to restoration of pre-settlement vegetation, invasive plants are the main constraint. A judgment of no significant impact over just the disturbance area is overly optimistic.

4.3.8-356. Does not mention need to clean equipment to minimize import of seeds on construction equipment.

Cryptic acronym and missing unit

Figure 2: SLR x year: y axis lacks units; reader has to continue on to table 11-20 to find that it is cm.

Terrestrial biological resources (Chapter 12)

Effects on wetlands and waters of the United States (WOTUS)

Page 12-1, line 18-19 says: "Under Alternatives 2D, 4, 4A, and 5A, larger areas of non-wetland waters of the United States would be filled due to work in Clifton Court Forebay; however, the Forebay would ultimately expand by 450 acres and thus largely offset any losses there." Is the assumption that, acre for acre, all jurisdictional waters are interchangeable, whether of different type or existing vs. created? The literature does not support this assumption.

The text argues that the wetlands would be at risk with levee deterioration, sea-level rise, seismic activity, etc. But the solution is for "other programs" to increase wetlands and riparian communities. What if this project causes the problem, e.g. via vibration?

CM1 alternative 4A would fill 775 acres of WOTUS (491 wetland acres); Alt 2D would fill 827 (527 wetland) + 1,931 ac temporary fill at Clifton Court Forebay; Alt 5A would fill 750 (470 wetland). That's a lot of area. The timing and details of mitigation measures are not provided. References to the larger Delta Plan suggest that compensations would come at unknown times. Piecemeal losses such as indicated here: "Only 1% of the habitat in the study area would be filled or converted" (Chapter 12, line 29, page 12-22) is how the US has lost its historical wetlands. What are the overall cumulative impacts of wetland losses in the Delta? What is the tipping point beyond which further wetland losses must be avoided? The proposed project is one part of the broader array of management actions in the Delta and should be considered in that broader context.

Habitat descriptions

How will mudflats be sustained for shorebirds? Exposed mud above half-tide can become vegetated rapidly. In the Delta, the bulrush *Schoenoplectus californicus* tolerates nearly continuous tidal submergence.

Are soils clayey enough for the proposed restoration of up to 34 acres of vernal pool and alkali seasonal wetland near Byron? These areas will need to pond water, not just provide depressions.

12-243, line 18: How would adding lighting to electrical wires eliminate any potential impact to black rails? This mitigation is overstated.

Several of the species accounts (e.g., bank swallow) indicate that there is uncertainty about how construction or operations will impact the species. In most cases, monitoring is proposed to assess what is happening. But to be effective, the monitoring results need to be evaluated and fed into decision-making, as visualized in the adaptive-management process. There is little explicit indication of how this will be done or funded.

Land use (Chapter 13)

Alternative 4A would allow water diversion from the northern Delta, with fish screens, multiple intakes, and diversions limited to flows that exceed certain minima, e.g., 7000 cfs. This would reduce flood-pulse amplitudes and, presumably, downstream flooding. How does this alter opportunities for riparian restoration? Which downstream river reaches are leveed and not planned to support riparian restoration? Where would riparian floodplains still be restorable?

Over what surface area does the pipeline transition to the tunnel? At some point along the pipeline-tunnel transition, wouldn't groundwater flow be affected?

Up to 14 years of construction activities were predicted for some areas (e.g., San Joaquin Co.); this would have cumulative impacts (e.g., dewatering would affect soil compaction, soil carbon, microbial functions, wildlife populations, and invasive species). What about impacts of noise on birds; e.g., how large an area would still be usable by greater sandhill cranes?

State how jurisdictional wetlands have been mapped and how the overall project net gain or net loss of wetland area has been estimated. If mitigation consists only of restoration actions in areas that are currently jurisdictional wetlands, then there would be an overall net loss of wetland area due to the project. A mitigation ratio >1:1 would be warranted to compensate for reduced wetland area. This was also a concern for Chapter 12.

Up to 277 ac of tidal wetlands are indicated as restorable; text should indicate if these are tidal freshwater or tidal brackish wetlands (or saline, as is the typical use of "tidal wetlands").

13-19. On the need to store removed aquatic vegetation until it can be disposed: there are digesters for this purpose, and they might be efficient means of mitigation if management of harvested aquatic plants will be long-term. A waste product could be turned into a resource (methane fuel).

13-19, line 12: Text says that "predator hiding spots" will be removed. What are these?

13-19, line 20: What are the E16 nonphysical fish barriers? An electrical barrier?

13-20, line 19: Boat-washing stations are mentioned; would these discharge pollutants (soap, organic debris?)

EXHIBIT D



September 19, 2013

Re: Independent Panel Review of the Bay Delta Conservation Plan

Dear Interested Stakeholder:

The attached report was prepared by an independent panel of experts convened by Dr. Jeff Mount for American Rivers and The Nature Conservancy to assist in our deliberations regarding the Bay Delta Conservation Plan. Dr. Mount assembled a balanced, interdisciplinary, and objective group of experts with long experience in the San Francisco Bay-Delta estuary to conduct this review of the March 2013 BDCP Administrative Draft and associated documents released during the Spring of 2013. This report will now join a growing library of independent reviews of efforts to resolve the Delta crisis.

The opinions, analyses, and recommendations provided in the report are solely those of the authors. Our organizations will use the information in the report along with our own analysis of BDCP to develop a proposal for increasing the probability that BDCP will substantially improve environmental conditions in the Delta. This report does not represent the position of American Rivers or the Nature Conservancy.

American Rivers and The Nature Conservancy have been active participants in the BDCP planning process for the last seven years. Our organizations have not taken a formal position in support of the proposed project described in the administrative draft of the BDCP, but we are fully committed to continue our work in good faith to develop a conservation plan for the Delta ecosystem that advances the co-equal goals of ecosystem restoration and water supply reliability. The status quo condition in the Delta is unacceptable, and without action, will result in the inexorable decline of the Delta ecosystem and the species it supports.

Please direct questions regarding the report to Leo Winternitz or John Cain at lwinternitz@TNC.ORG and jcain@americanrivers.org. Thank you for your consideration.

Sincerely:

Leo Winternitz
Senior Advisor - Water Program
The Nature Conservancy

John Cain
Conservation Director
American Rivers

PANEL REVIEW OF THE DRAFT BAY DELTA CONSERVATION PLAN: PREPARED FOR THE NATURE CONSERVANCY AND AMERICAN RIVERS

Jeffrey Mount, Ph.D. (Chair)
William Fleenor, Ph.D.
Brian Gray, J.D.
Bruce Herbold, Ph.D.
Wim Kimmerer, Ph.D.

Financial support provided by the S.D. Bechtel, Jr. Foundation

Technical support provided by NewFields, Inc.

September 2013

Saracino & Mount, LLC

Preface

The Bay-Delta Conservation Plan is more than 15,000 pages long and covers a wide range of issues ranging from water supply, new facility construction, aquatic and terrestrial ecosystem management, governance and costs. Few outside of the handful of people deeply involved in BDCP actually know what is in the document due to its imposing size. This is particularly true for the various stakeholder groups who lack either the staff or the technical capacity to review the document and to evaluate the complex analyses that underpin it.

Saracino & Mount, LLC, was asked to assemble a panel of independent experts to review portions of the Plan to help guide decision-making by two non-governmental organizations: The Nature Conservancy and American Rivers. Guided by a narrow set of questions about how the Plan would impact water supply and endangered fishes, the panel reviewed the Plan documents and conducted analyses of data provided by the project consultants. The following document is a summary of our results.

It is important that this analysis not be over-interpreted. We do not endorse or reject the Plan. We only assess effectiveness of various conservation measures, guided by narrowly targeted questions. In addition, we make a handful of modest proposals to improve the performance of the Plan, particularly for issues of concern to the two non-governmental organizations. Thus, the scope of this review is quite limited.

The authors wish to thank the S.D. Bechtel, Jr. Foundation for its generous support. The staff of The Nature Conservancy and American Rivers provided abundant time and energy as we scoped this review. Jennifer Pierre, Armin Munevar, Chandra Chillmakuri, and Laura King-Moon provided voluminous data, answered our many questions and addressed our concerns. Spreck Rosecrans and Drs. Peter Moyle and Jay Lund provided comment on portions of the manuscript, although their comments do not constitute formal peer review. All errors of omission or commission are our own.

Jeff Mount, Panel Chair

Table of Contents

Executive Summary	1
Chapter 1: The Bay Delta Conservation Plan and Charge to Panel	
• Introduction	6
• Guiding Questions	6
• Basis of Comparison	8
• A Note About Hydrologic Modeling Tools and Uncertainties	11
• Organization of this Report	12
• Conclusion	13
Chapter 2: An Overview of the Law Governing the BDCP	14
• Introduction	14
• Habitat Conservation Planning and Natural Community Conservation Planning	14
• Conservation and Recovery Requirements Under Federal and State Law	15
• Conclusion	19
Chapter 3: Water Supply Operations	
• Introduction	21
• Proposed Facilities and Operations	21
• Export Reliability	24
• Export Timing	26
• Drought Performance	27
• Conclusions	30
Chapter 4: Environmental Flow Performance: Upstream and Inflows	
• Introduction	32
• Impaired Flow in an Impaired System	32
• Main Rivers of the Sacramento Valley	34
• Yolo Bypass Flows	38
• North Delta Facility Impacts and Mitigation	42
• Conclusion	46
Chapter 5: In-Delta Flow Performance	
• Introduction	47
• Concerns over Modeling	47
• Analysis of Flows	51
• Conclusion	58

Chapter 6: Estimated Effects of BDCP Flows on Smelt	
• Introduction	60
• Direct Losses of Delta Smelt	60
• Outflow Effects	64
• Conclusions	68
Chapter 7: Likely Response of Listed Fishes to Physical Habitat Restoration	70
• Introduction	70
• Summary of Assessment	71
• Marsh Restoration	80
• Floodplain	82
• Conclusion	
Chapter 8: Regulatory Oversight and Assurances	82
• Introduction	82
• Regulatory Oversight	88
• Regulatory Assurances and the “No Surprises” Policy	98
• Conclusion	
Chapter 9: Science and Adaptive Management in BDCP	99
• Introduction	99
• Adaptive Management Program	102
• Decision Tree	104
• Conclusion	
Chapter 10: Summary and Recommendations	
• Introduction	105
• Question 1: Operations	105
• Question 2: Impacts of North Delta Facility	106
• Question 3: In-Delta Conditions	107
• Question 4: Benefits of Habitat Restoration	109
• Question 5: Governance	110
• Question 6: Science and Adaptive Management	111
Appendices	
• Appendix A: Operational rules for the North Delta Facility	114
• Appendix B: Impaired Flows into an Impaired Estuary	117
• Appendix C: Effects of changes in flow on delta smelt	124
• Appendix D: Evidence for food limitation of the smelt species	126
• Appendix E: Model of plankton subsidy from marsh to estuary	129
• Appendix F: Effects of floodplain inundation	133
• Appendix G: Can incidental take permits be issued to water contractors?	135
References	138

Executive Summary

Two non-governmental organizations, The Nature Conservancy (TNC) and American Rivers (AR), are evaluating their options for engagement with the Bay Delta Conservation Plan (BDCP). If approved, the Plan would become a Habitat Conservation Plan (HCP) under the federal Endangered Species Act and a Natural Communities Conservation Plan (NCCP) under California law. The purpose of the Plan is to allow for construction of new water diversion facilities in the Sacramento-San Joaquin Delta while also protecting aquatic and terrestrial species that may be adversely affected by the project and accompanying changes in the State Water Project (SWP) and Central Valley Project (CVP) operations. The Plan also includes habitat restoration and a commitment to assist in the conservation and recovery of species that are listed for protection under the federal and state Endangered Species Acts.

With financial support from the S.D. Bechtel, Jr. Foundation, Saracino and Mount, LLC, convened an independent panel of experts, with technical support from NewFields, Inc., to evaluate portions of the Plan. The panel, working jointly with TNC and AR, developed a series of technical and legal questions about the Plan. This report provides answers to these questions, along with limited recommendations on how to improve BDCP.

To simplify analysis, this review focuses on conditions for federally listed fishes during the Early Long Term (ELT), a decade after a permit would be issued (approximately year 2025). These are described in detail in the BDCP Effects Analysis and accompanying Environmental Impact Statement/Environmental Impact Report. We compared the performance of three different scenarios: a No Action Alternative (NAA) where no new North Delta diversion facility is constructed, a High Outflow Scenario (HOS) where the facilities are operated in a way that allows for occasional high spring and fall outflows, and a Low Outflow Scenario (LOS) with lower spring and fall outflows. The review also emphasizes in-Delta and Sacramento River watershed conditions during the ELT, with less attention to San Joaquin River conditions and fishes.

Although multiple data sources were used in this analysis, most hydrologic data came from CALSIM simulations conducted by BDCP consultants. The Panel strongly cautions about the conclusions drawn from these simulations. Flow simulations have three compounding uncertainties that can lead to significant error: (1) uncertainty in system understanding and future conditions, (2) model uncertainties (particularly the relationships between 1-, 2-, and 3-dimensional models), and (3) behavioral/regulatory uncertainty where the models cannot capture the scope of human behavior in operating the projects under various conditions. These uncertainties, which are not described in BDCP documents well, makes all of our conclusions contingent on the projects *actually being operated as simulated*.

Do Operations Shift Delta Exports from Dry to Wet Years?

The BDCP calls for increasing exports in wet years and reducing them in dry years, taking advantage of the increased operational flexibility provided by two points of diversion. This

would reduce stress on Delta ecosystems during drier periods. Our analysis of simulation data suggests that while there is some increase in flexibility, export operations are highly constrained by upstream consumptive uses, regulations that cover reservoir operations, and flow and water quality standards. This greatly limits the anticipated benefit associated with operation of the dual facilities. Despite these limitations, as modeled, there is an increase in exports in wet years. In most dry years there are no substantial changes over NAA conditions. However, significant improvements in outflow and Old and Middle River (OMR) conditions occur in some dry years. We were unable to identify the regulatory or operational requirements that would lead to this.

Are Impacts of the North Delta Facility Fully Assessed and Mitigated?

The Plan identifies multiple near- and far-field effects of the new North Delta facility. Based on our review of the Effects Analysis, the Plan appears to have properly identified the most significant effects and uses standard models to assess them. Outmigrating juvenile winter-run and spring-run Chinook salmon will be most heavily affected, leading, in the absence of mitigation, to significant losses. The Plan identifies multiple mitigation strategies, including pulse flow management, predator control, entrainment reduction, non-physical barriers, real-time operations and development of alternative migration pathways (Yolo Bypass). With the exception of benefits from diverting juveniles onto the Yolo Bypass, all of these mitigation approaches have high uncertainties. Done well and successfully, however, they appear to offset the losses associated with operation of the North Delta facility. The HOS appears most protective of conditions upstream of the Delta and adjacent to the new facility. However, mitigation actions are unlikely to contribute significantly to recovery of these species. Additionally, successful mitigation is likely to occur only if there is a robust adaptive management and real-time operations program. The Plan provides neither.

Are In-Delta Conditions Significantly Improved for Smelt?

We evaluated the modeling results in the Plan and conducted our own modeling to evaluate how changes in conditions would affect delta and longfin smelt. As noted, we are concerned that anomalously positive (or less negative) OMR flows and high Delta outflows that are modeled during some drier years would not actually occur in real operations. However, if these changes were to occur we find modest to significant improvement in in-Delta conditions for smelt, particularly delta smelt. Improvements in OMR flows under HOS and LOS result in substantial decreases in entrainment, leading to significant increases in long-term survival percentages for delta smelt. However, increases in spring and fall outflow under HOS lead to small increases in longfin smelt abundance and modest improvements in delta smelt recruitment.

Will Pelagic Fishes Benefit from Floodplain and Tidal Marsh Restoration?

The Plan properly identifies food limitation as a significant stressor on smelt populations in the Delta. The Plan proposes to address this issue by restoring physical habitat to help subsidize pelagic food webs. Based on simple modeling and comparison with other systems,

we find that restored floodplains and tidal marshes are unlikely to make a significant contribution to smelt rearing habitat conditions. Tidal marshes can be sinks or sources of food, with most appearing to be sinks for zooplankton. The Plan appears to be too optimistic about the benefits of tidal marsh and floodplain restoration. However, there is likely to be benefit where fishes have direct access to productivity, such as in Cache Slough. In addition, although benefits for listed pelagic fishes are low, there are broad benefits of restoration for many aquatic and terrestrial species covered by the Plan.

Does the Plan Provide an Effective Governance Structure?

We reviewed the proposed BDCP governance structure to evaluate its likely effectiveness in meeting the Plan’s goals and objectives. Implementation of BDCP would be overseen by an Authorized Entity Group (AEG) comprising the California Department of Water Resources (DWR), the U.S. Bureau of Reclamation (USBR), and the state and federal water contractors if they are issued incidental take permits pursuant to the BDCP. A Permit Oversight Group (POG), consisting of the U.S. Fish and Wildlife Service (USFS), the National Marine Fisheries Service (NMFS), and the California Department of Fish and Wildlife (CDFW), would monitor implementation of the Plan and compliance with the biological objectives and conservation requirements. The draft BDCP includes a 50-year “no surprises” guarantee, as well as other regulatory assurances. We found that, when examined in detail, the draft BDCP blurs the lines between implementation and regulation and grants the permittees unusual decision authority. Additionally, the regulatory assurances in the Plan, especially the “no-surprises” policy, place undue financial responsibilities on the state and federal governments if certain modifications to the Plan become necessary during its 50-year term. Given the complexity of the Delta ecosystem, predicted changes in hydrology, anticipated changes in the Delta not included in the Plan, and significant scientific uncertainties, Plan modifications are likely to be needed in the future.

Is There a Robust Science and Adaptive Management Plan for BDCP?

The Plan is committed to adaptive management in order to address the high uncertainties. Most of the unresolved issues in the Plan are to be resolved at a future date through adaptive management. A “decision tree” approach is proposed to resolve conflicts over starting operations. We found that the governance structure, whereby the AEG may exercise veto authority over changes to the biological objectives and conservation measures, is likely to create disincentives for adaptive management. In addition, a proposed consensus-based Adaptive Management Team made up of POG, AEG, and scientific community members creates conflicting relationships between decision-makers and providers of key information. The limited information available about the science program suggests that BDCP proposes to develop a wholly new science program that is not integrated, but should be, with existing programs. Finally, our review of the “decision tree” process indicates that it is unlikely to achieve the goal of significantly reducing uncertainties before the North Delta facility is constructed and ready for operation.

Recommendations

Based on answers to these six questions, the Panel formulated a list of nine recommendations for improving BDCP.

- All parties need to recognize the model uncertainties in BDCP and factor that into decision-making. It is unlikely that actual operations will follow simulated operations.
- Given the high uncertainty over mitigation for the North Delta facility, all mitigation efforts should be in-place and tested *before* the facility is completed. This includes completion of the Fremont Weir modifications on the Yolo Bypass as well as large scale, significant experiments in real-time flow management, predator control and non-physical barriers.
- The improvements in long-term survival percentages for delta smelt in response to changes in OMR need to be more rigorously evaluated, particularly in light of uncertainties over operations. If further examination supports these findings, operational rules should be developed that insure that the anomalous, significantly improved drier-period OMR and outflow conditions occur.
- The limited benefit derived from changes in outflow under HOS requires a second look at options for significant increases in outflow, including finding sources of water outside the direct control of BDCP.
- Although we find that marsh and floodplain restoration is unlikely to create the benefits for pelagic fishes described in the Plan, this can only be resolved through experimental restoration projects. These projects need to be designed and implemented rapidly to resolve this issue.
- Substantial revision of BDCP's governance structure is needed. This includes giving full regulatory authority to the POG, while limiting their involvement in implementation.
- To address high uncertainties about project performance and future conditions, instead of a 50-year permit, there should be renewable "no surprises" guarantees issued every ten years based on conditions at the time and prior performance.
- An adaptive management program needs to be developed that has the capacity and authority to conduct adaptive management experiments and effectively use outcomes to revise and improve future actions..
- A well-funded BDCP science program needs to be developed that is integrated with existing Delta science programs. The best opportunity for integration lies with the current efforts to update the Delta Science Program.

Chapter 1: The Bay Delta Conservation Plan and Charge to the Panel

Introduction

The Bay Delta Conservation Plan (BDCP) is being developed to meet endangered species act permit requirements for operations of the Federal Central Valley Project (CVP) and the State Water Project (SWP) within the Sacramento-San Joaquin Delta. The Plan includes proposals for new points of diversion in the North Delta, new operations criteria, extensive floodplain and tidal marsh restoration, and new governance, oversight and adaptive management programs. The Plan applicants are seeking Habitat Conservation Plan (HCP)/Natural Communities Conservation Plan (NCCP) permits that will guide water exports and habitat management for 50 years.

The Bay Delta Conservation Plan is the most complex HCP/NCCP permit application ever attempted. Development of the Plan has been funded principally by state and federal water contractors and has been on-going for more than 5 years. In Spring 2013, select chapters of the Administrative Draft of BDCP were serially released for public review¹. An Administrative Draft of the EIS/EIR for the Plan was released in May of 2013².

At the request of The Nature Conservancy California and American Rivers—two non-governmental organizations engaged in the BDCP process—an independent panel of five experts (Text Box 1.1) was assembled to assist in technical review of BDCP documents. The panel was asked to answer a suite of questions about the Plan to help inform decisionmaking by American Rivers and The Nature Conservancy. The panel was assembled and managed by Saracino & Mount, LLC, under contract from the S.D. Bechtel, Jr. Foundation Water Program. NewFields, Inc. provided support for the panel, including data retrieval, analysis and presentation. This report summarizes the conclusions of the work of this panel.

Guiding Questions

Two planning meetings were held between Saracino & Mount, LLC and staff of American Rivers and The Nature Conservancy. An initial list of more than 40 questions were developed that were germane to decisions that the organizations

¹ This report assumes that the reader is familiar with the Sacramento-San Joaquin Delta and on-going efforts to manage water supply and ecosystems to meet the co-equal goals prescribed in the 2009 Delta Reform Act. A summary of conditions in the Delta and other issues can be found at:

<http://baydeltaconservationplan.com/Home.aspx>

²<http://baydeltaconservationplan.com/Library/DocumentsLandingPage/EIREISDocuments.aspx>

needed to make about future engagement with BDCP. These questions were distilled into the following six:

- *Q.1 Do operations of the dual facilities meet the broader goal of taking advantage of wet and above average years for exports while reducing pressure on below average, dry and critically dry years? What substantive changes in operations (and responses, see below) are there both seasonally and interannually?*
- *Q.2 Based on operations criteria, does the Plan properly identify ecological impacts likely to occur adjacent to and in the bypass reach downstream of the new North Delta diversion facilities? If there will be direct and indirect harm to listed species by the facilities, does the Plan prescribe sufficient mitigation measures?*
- *Q.3 Are changes in operations and points of diversion prescribed in the Plan sufficient to significantly improve in-Delta conditions for covered species? The focus is on listed species, including delta and longfin smelt, steelhead, winter and spring run Chinook, and green sturgeon.*
 - *Q.4 Are covered pelagic fish like longfin smelt and delta smelt likely to benefit from restoration of floodplain and tidal marsh habitat at the scale proposed by the Plan? Given the current state of knowledge, and assuming that all Plan commitments are met, are these efforts likely to result in relaxed X2 and spring outflow standards?*
 - *Q.5 Does the Plan provide achievable, clear and measureable goals and objectives, as well as governance that is transparent and resilient to political and special interest influence?*
- *Q.6 Is there a robust science and adaptive management plan for BDCP? As described, is the proposed “decision tree” likely to resolve major issues regarding Fall X2 and Spring Outflow prior to initial operations?*

Text Box 1.1: Members of the Review Panel.

Jeffrey Mount, Ph.D. (chair), geomorphologist, Professor Emeritus UC Davis, former Chair of the Delta Independent Science Board, and Partner, Saracino & Mount, LLC

William Fleenor, Ph.D. hydrologist and water quality specialist, Research Scientist, UC Davis Center for Watershed Sciences

Brian Gray, J.D. Professor, environmental law, UC Hastings.

Bruce Herbold, Ph.D. retired US Environmental Protection Agency, former Coordinator for the Interagency Ecological Program

Wim Kimmerer, Ph.D. food web ecologist, Researcher, San Francisco State University, Tiburon Center.

Using these questions as guide, the panel reviewed selected chapters within the Plan. The focus of the review was on the biological goals and objectives for species of fish listed as threatened or endangered (BDCP Chapters 1, 2), the conservation measures proposed to meet the biological objectives (BDCP Chapter 3 and appendixes, see Text Box 1.2), and the analysis of the effects of the project on Delta fish species and communities (BDCP Chapter 5 and appendixes). The panel also examined governance, adaptive management and science programs proposed in the

Plan, including the “decision tree” intended to resolve technical disagreements about initial operations (BDCP Chapters 3, 5, 6, 7, 8, 9, 10).

In addition to reviewing BDCP documents and literature, the panel held two meetings with the consultants who prepared the Plan for the project applicants. The consultants answered questions about analyses contained within the Plan and provided or directed panel members to pertinent sources of modeling data.

Text Box 1.2: Conservation Measures Considered by the Panel

There are 22 different conservation measures in BDCP. Since the questions asked were narrowly defined, the Panel focused only on five of the measures. These include:

Conservation Measure 1: Operations and Facilities. This covers the design, implementation and operation of a new North Delta point of diversion and the operation of all SWP and CVP facilities to improve conditions for listed species.

Conservation Measure 2: Yolo Bypass Fisheries Enhancement. The Plan proposes to increase winter flooding in the Yolo Bypass to improve rearing habitat for salmon as well as improve Delta food webs.

Conservation Measure 4: Tidal Natural Communities Restoration. This measure seeks to restore 55,000 acres of tidal freshwater and brackish marsh, with an additional 10,000 acres of transitional habitat. This will improve rearing habitat for several listed species and improve food webs for pelagic fishes.

Conservation Measure 5: Seasonally Inundated Floodplain Restoration. The Plan seeks to restore 10,000 acres of seasonal floodplain outside of the Yolo Bypass. This supports juvenile salmonids and overall food web productivity of the Delta.

Conservation Measure 6: Channel Margin Enhancement. The goal of the Plan is to improve conditions for rearing salmonids along channels of the Delta with close levees. This measure will improve 20 linear miles of channel by creating mudflat, riparian and wetland habitat through levee setbacks.

Basis of Comparison

The Bay Delta Conservation Plan seeks a permit for operation of the SWP and CVP at a future date when new facilities will be constructed. As written, the preferred alternative is to construct a new point of diversion in the North Delta on the Sacramento River near Freeport, with the goal of completion in 2025. This

diversion is to have three screened intakes that will divert water into forebays and a pair of tunnels capable of transmitting a maximum of 9000 cfs by gravity feed. These tunnels will link to existing SWP and CVP export facilities located in the South Delta. Permit authority for the construction and combined operations of these facilities—typically referred to as dual facilities—are the foundation of the plan. Construction and operations are paired with extensive conservation measures (see below) to mitigate for impacts of the project and to conserve and recover listed species and their biological communities.

One of the many controversies surrounding the Plan is the establishment of an environmental baseline for comparison of alternatives and analysis of the effects of the project on listed species. The requirements of the Biological Opinions (BiOps) issued by the U.S. Fish and Wildlife Service (USFWS) in 2008 and the National Marine Fisheries Service (NMFS) in 2009 constitute the baseline for the Plan. There is considerable debate between the fish agencies (NMFS and USFWS principally) and the permittees over the provisions of these BiOps, particularly in regard to requirements for high Delta outflows to support longfin smelt in the spring and high outflows to achieve Fall X2 (low salinity zone) provisions to support delta smelt. For this reason, there are two Existing Biological Conditions (EBC) considered by the Plan (Table 1.1): EBC1 includes high spring outflow provisions and EBC2, includes both high spring outflow and the new Fall X2 provisions.

A central requirement of the Plan, and the source of much of its complexity, is to analyze conditions over the 50-year life of the project. The Plan divides future conditions into two classes: Early Long Term (ELT), which captures the initial operating conditions of the project once a new diversion facility has been constructed (approximately 2025), and Late Long Term (LLT) which accounts for full completion of all conservation measures, including restoration of more than 55,000 acres of tidal marsh and floodplain (approximately 2060). Climate change, particularly changes in runoff and sea level, and changes in water demand are incorporated in these projections.

The controversy over spring and fall outflow needs for conservation and recovery of listed species propagates into the assessments of future conditions. Without-project EBC1 and EBC2 are considered for both ELT and LLT. Evaluated starting operations (ESO) of the preferred project and alternatives are presented for ELT and LLT conditions. Two additional future scenarios are evaluated that purport to provide bookends to project operations that dictate future water exports. The first is a High Outflow Scenario (HOS), which is similar to the outflow standards in EBC2 (high spring and fall outflow). The second is a Low Outflow Scenario (LOS), which has reduced outflow standards for both spring and fall. Both the LOS and HOS are considered in the ELT and LLT, with the latter including completion of habitat restoration. The Plan proposes a “decision tree process” be undertaken during construction of the facility that will reduce uncertainties and guide initial project operations, presumably within the bounds of the HOS and LOS (reviewed in Chapter 9).

For the purposes of this review, we simplified our comparison of operations and restoration scenarios to just three. Using simulation data provided by BDCP consultants we examined the HOS and LOS scenarios for ELT. We then used a no-project alternative, NAA ELT, that commonly appears throughout BDCP documentation, particularly in the EIR/EIS. NAA prescribes a high fall outflow to maintain X2 standards for smelt and D-1641 salinity and flow standards required by the State Water Resources Control Board for the remainder of the year.

Table 1.1. Definitions of existing baseline conditions and project conditions simulated in BDCP.

Conditions		Description
Existing Biological Conditions	EBC1	Current operations based on BiOps, excluding management of outflows to the Fall X2 provisions of USFWS 2008 BiOp.
	EBC2	Current operations based on BiOps, including management of outflows to meet USFWS Fall X2 provisions from 2008 BiOp.
Projected Future Conditions without the BDCP	EBC2_ELТ	EBC2 projected into year 15 (2025) accounting for climate change expected at that time.
	EBC2_LLТ	EBC2 projected into year 50 (2060) accounting for climate change expected at that time.
Projected Future Conditions with the BDCP	ESO_ELТ	Evaluated starting operations in year 15 assuming new intake facility operational and restoration not fully implemented
	ESO_LLТ	Evaluated starting operations in year 50 assuming new intake facility operational and restoration fully implemented.
	HOS_ELТ	High-outflow operations during spring and fall in year 15 assuming new intake facility operational and restoration not fully implemented.
	HOS_LLТ	High-outflow operations during spring and fall in year 50 assuming new intake facility operational and restoration fully implemented.
	LOS_ELТ	Low-outflow operations during spring and fall in year 15 assuming new intake facility operational and restoration not fully implemented.
	LOS_LLТ	Low-outflow operations during spring and fall in year 50 assuming new intake facility operational and restoration fully implemented.

It should be noted that the Panel chose not to review LLТ scenarios and conditions beyond the question of whether restoration of marsh is likely to benefit listed fishes.

Although it is necessary and useful to consider how the project might operate over the long-term, especially under climate change, the Panel felt that exceptionally high uncertainties made it difficult to offer precise answers within the LLT framework. These uncertainties are associated with our understanding of the Delta, with the models used to simulate future conditions, and with the array of events (biological invasions, floods, droughts, earthquakes, policy changes, lawsuits, etc.) that are likely to occur.

A Note About Hydrologic Modeling Tools and Uncertainties

The basis for the BDCP analysis is hydrologic simulation modeling that provides flow, water elevations, temperature and salinity at various locations throughout the Delta and its upstream areas. Much of the Effects Analysis for aquatic species and all of the export projections are based on outputs from these hydrologic models. BDCP is one of the most complex modeling efforts of its kind and certainly the most complex ever attempted in the Delta. This is a heroic modeling effort.

There are three general categories of uncertainty in the hydrologic model results:

Model uncertainties. This includes how the model simulates hydrology and the hydrologic results of operations, including salinity, temperatures and other water quality parameters. The currently available modeling tools are less than ideal to simulate such a long-term record with dramatic changes in conditions such as sea level rise and introduced sub-tidal and inter-tidal land. The principal issues are summarized in Text Box 1.3.

Future condition uncertainties. There is extensive effort in BDCP to estimate future conditions in the Delta, including sea level rise and changes in temperature and runoff. This is the most comprehensive approach to date. These are described well in Appendix 5A of the Plan and highlight high levels of uncertainty.

Regulatory and behavioral uncertainty. BDCP models assume that flow and water quality standards will remain static during the life of the project. In addition, the models assume uniform behavior of system operators, ignoring real-time operations and adaptations. All of these are highly unlikely to occur.

The hydrologic model results of BDCP are presented as if they are a unique solution. Given the compounding uncertainties, BDCP model results should be considered as scenarios rather than specific outcomes. This issue is often lost in the public debates over BDCP. As discussed later in this report, the model uncertainties significantly impact our confidence in some of our results, particularly our analysis of the response of pelagic fishes to changes in South Delta operations.

Text Box 1.3: Hydrologic Model Uncertainty.

To adapt existing tools to model future conditions under BDCP consultants developed dispersion coefficients with the 3-dimensional UnTRIM model developed by Michael MacWilliams for sea level rise. A similar process was then followed with a 2-dimensional model developed by Research Management Associates to estimate the additional dispersion for the proposed new open tidal areas. Parameters developed from the multi-dimensional efforts were then incorporated into the 1-dimensional DSM2 planning model developed by DWR to simulate a part of the long-term record incorporating sea level rise and tidally restored acreage. The boundary conditions for the DSM2 model, which operates at time steps as short as 15 minutes, was provided by CALSIM, the 1-dimensional system-wide water operations optimization model. CALSIM output occurs on monthly time steps and had to be disaggregated to provide boundary conditions for DSM2. All the results, including the DSM2 results and artificial neural network salinity results, were then used to train the CALSIM model. The CALSIM model was then used to simulate the entire 82-year record that formed the basis for the Effects Analysis. All of these model exchanges, particularly between 1-, 2-, and 3-dimensional models, create error or model bias. To date, there is no assessment of these model biases and how they impact BDCP results.

Organization of This Report

This report is organized into nine chapters followed by a summary of answers to the guiding questions. Chapters 2-9 include:

- *Chapter 2, Overview of the Law Governing BDCP.* Although not specifically requested by TNC and AR, we found it helpful to review key provisions of the HCP/NCCP laws that set standards for recovery of populations of covered fishes.
- *Chapter 3, Water Supply Operations.* This chapter examines how BDCP performs in meeting the goal of increasing water supply reliability. This includes assessment of changes in export volumes, both seasonally and within different year types.
- *Chapter 4, Environmental Flow Performance: Upstream and Inflows.* The new facilities and their operation are supposed to improve flow conditions impacted by the SWP and CVP. This chapter describes flows regulated by project dams, flows past and through the new North Delta facilities, and the overall inflow regime of the estuary.
- *Chapter 5, In-Delta Effects on Pelagic Fishes.* The changes in flow conditions outlined in the previous chapter translate to changes in ecological conditions for listed fish species. This chapter evaluates the likely response of delta smelt and longfin smelt to these changes

- *Chapter 6, Estimated Effects of BDCP Flows on Smelt.* This chapter examines the magnitude of changes in outflow and the likely response of delta and longfin smelt.
- *Chapter 7, Likely Response of Listed Fishes to Habitat Restoration.* A fundamental hypothesis of BDCP is that restoration of physical habitat, particularly tidal marsh, will improve food web conditions for pelagic fishes, aiding their recovery. This chapter evaluates this hypothesis.
- *Chapter 8, Governance and Terms of BDCP.* The 50-year permit for the project, coupled with governance and oversight, are examined in this chapter.
- *Chapter 9, Science and Adaptive Management.* The Plan makes extensive mention of the use of adaptive management supported by robust science to address major uncertainties. The Plan's objectives in this regard are reviewed.
- *Chapter 10, Summary and Conclusions.* This chapter provides a summary of answers to the six questions presented to the panel by American Rivers and The Nature Conservancy. In addition, where appropriate, recommendations are offered for ways to improve the performance of BDCP.

Conclusion

This report is, by design, narrowly focused on a limited set of issues of concern to The Nature Conservancy and American Rivers. It is not intended to serve as a broad review of BDCP, nor is it directed toward a wide audience. In addition, the panel specifically steered away from endorsing or rejecting BDCP, and makes no recommendation on the critical question of whether American Rivers and The Nature Conservancy should support BDCP, support it with modifications, or reject/oppose it. Rather, the observations, analyses and recommendations are solely intended to inform this decision.

Chapter 2: An Overview of the Law Governing the BDCP

Introduction

This chapter provides a brief overview of the law that governs the creation and implementation of the Bay Delta Conservation Plan. It also addresses an important question that has arisen during the BDCP negotiations: May the California Department of Fish and Wildlife (CDFW) approve the BDCP as a natural community conservation plan if the BDCP does not provide for full recovery of the endangered and threatened species covered by the Plan?

Habitat Conservation Planning and Natural Community Conservation Planning Under Federal and California Law

The BDCP is a Habitat Conservation Plan (HCP) authorized by section 10(a) of the federal Endangered Species Act (ESA), 16 U.S.C. § 1539(a), and a Natural Community Conservation Plan (NCCP) authorized by the California Natural Community Conservation Planning Act (NCCPA), California Fish and Game Code §§ 2800-2835. Section 10(a) of the federal ESA allows the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) to issue permits that authorize the taking of endangered or threatened species “if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity” and the proposed activity is governed by an approved HCP. *Id.* § 1539(a)(1)(B) & (2). Similarly, under the NCCPA the California Department of Fish and Wildlife (CDFW) may “authorize by permit the taking of any covered species . . . whose conservation and management is provided for in a natural community conservation plan approved by the department.” California Fish & Game Code § 2835.¹

If approved by the three fish and wildlife agencies, the BDCP will be a legally binding document that defines the terms and conditions under which the U.S. Bureau of Reclamation (USBR) and the California Department of Water Resources (DWR) may construct and operate the proposed new water diversion and transport facilities described in the draft Plan.² The BDCP also will serve as “a comprehensive

¹ The NCCPA defines “covered species” to include species that are listed for protection under the California Endangered Species Act, California Fish & Game Code §§ 2050-2115.5, and nonlisted species that are “conserved and managed under [another] approved natural community conservation plan and that may be authorized for take.” *Id.* § 2805(e).

² The complete statutory requirements governing the contents and approval of the BDCP as an HCP and NCCP are set forth respectively in section 10(a)(2)(A) & (B) of the federal Endangered Species Act, 16 U.S.C. § 1539(a)(2)(A) & (B), and sections 2810 and 2820 of the California Fish and Game Code.

conservation strategy for the Sacramento–San Joaquin River Delta (Delta) designed to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework” (BDCP 1-1)³.

The BDCP will include “regulatory assurances” that protect the permittees from the financial cost of changes to the BDCP or other regulatory changes needed to protect the species or their habitat⁴. As authorized by federal and state law, these regulatory assurances provide that, if changed circumstances arise that are either unforeseen or not provided for in the Plan, then the fish and wildlife agencies will not require the permittees to devote additional land, water, or financial resources beyond the levels set forth in the BDCP without the consent of the plan participants. Nor will the federal and state regulators impose additional restrictions on project operations without compensating the permittees for the lost water or additional costs.⁵

Both statutes also authorize the fish and wildlife agencies to suspend or revoke the incidental take permits for noncompliance with the terms and conditions of the BDCP or where implementation of the Plan will place the covered species in jeopardy of extinction.⁶

We consider the regulatory assurances, revocation authority, and other aspects of BDCP governance in Chapter 8.

³ In addition, the BDCP will be the basis for a biological assessment that USBR will submit to the USFWS and NMFS prior to consultation under section 7 of the Endangered Species Act. BDCP 1-6. The BDCP thus will help to inform the federal fish and wildlife agencies’ analysis of the new facilities and changes in coordinated CVP/SWP operations proposed in the draft Plan. The agencies then will decide whether the BDCP “is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [the species’ critical habitat].” 16 U.S.C. § 1536(a)(2). If the agencies determine that the BDCP *is* likely to jeopardize a listed species or adversely affect critical habitat, the biological opinion that they issue to the Bureau will include “reasonable and prudent alternatives” designed to avoid these consequences, as well as incidental take authorization governing CVP operations. *Id.* § 1536(b)(3) & (4).

⁴ The regulatory assurances will apply to all entities that are issued incidental take permits under the BDCP, including DWR and the CVP and SWP contractors if the contractors become permittees. The “no surprises” assurance will not apply, however, to the Bureau of Reclamation. BDCP 6-29.

⁵ The USFWS and NMFS adopted the federal “no surprises” policy by rulemaking in 1998. The substantive requirements of these rules may be found at 50 C.F.R. § 17.22(b)(5) & (6) and 50 C.F.R. § 222.307(g), respectively. The state “no surprises” guarantees are set forth in the NCCPA itself. California Fish & Game Code § 2820(f).

⁶ The federal suspension and revocation rules are set forth in the Endangered Species Act, 16 U.S.C. § 1539(a)(2)(C), and in the ESA regulations, 50 C.F.R. § 17.22(b)(8). The state law counterparts may be found in California Fish & Game Code § 2820(b)(3).

Conservation and Recovery Requirements Under Federal and State Law

The federal Endangered Species Act and the California Natural Communities Conservation Planning Act differ in their respective conservation and recovery standards. The federal statute provides that the fish and wildlife agencies may not approve the BDCP unless they determine that the incidental take authorized by the permit and HCP “will not appreciably reduce the likelihood of the survival and recovery of the species in the wild.” 16 U.S.C. § 1539(a)(2)(B)(iv).

In contrast, the NCCPA states that Department of Fish and Wildlife may approve the BDCP only if it finds *inter alia* that the Plan

provides for the protection of habitat, natural communities, and species diversity on a landscape or ecosystem level through the creation and long-term management of habitat reserves or other measures that provide equivalent *conservation* of covered species appropriate for land, aquatic, and marine habitats within the plan area.

California Fish & Game Code § 2820(a)(3) (emphasis added). The Act defines “conservation” as “the use of methods and procedures within the plan area that are necessary to bring any covered species to the point at which the measures provided pursuant to [the California Endangered Species Act] are not necessary.” *Id.* § 2805(d) (emphasis added).

In other words, the federal Endangered Species Act requires only that habitat conservation plans ensure that the permitted activities do no significant harm to the listed species or to their critical habitats. The California Natural Communities Conservation Planning Act, by comparison, regards proposed projects such as the BDCP as opportunities for more coordinated and cohesive planning to improve the condition of covered species and their habitat, rather than simply being a means to authorize the permitted activities while maintaining the *status quo ante*.

The draft BDCP describes its biological goals and objectives in two different ways. At the “landscape level,” the goals include restoration or creation of “ecological processes and conditions that sustain and reestablish natural communities and native species” (BDCP 3.3-5). At the “species level,” however, the biological goals refer to *progress toward* the landscape level goal of reestablished and sustainable natural communities and native species.

Thus, the primary biological goals for the Delta Smelt and Longfin Smelt are “increased end of year fecundity and improved survival of adult and juvenile . . . smelt to support increase abundance and long-term population viability” (BDCP 3.3-13 & 3.3-16). Similarly, the principal biological goal for Sacramento Winter-Run Chinook Salmon is “improved survival (to contribute to increased abundance) of immigrating and emigrating . . . salmon through the Plan Area,” (BDCP 3.3-16), and

for other species of salmon and steelhead the goal is “increased . . . abundance” (BDCP 3.3-17 to 3.3-19).

The draft BDCP explains that the process of developing these species level biological goals “did not assume that the BDCP would be solely responsible for recovery of these species, and so the designated biological goals and objectives did not necessarily match the recovery goals, but instead represented the BDCP’s potential to *contribute to recovery* within the Plan Area (BDCP 3.A-14: emphasis added). This decision has become a focal point of debate over the essential purposes and mandates of the NCCPA.

In a July 10, 2013, letter to the Director of CDFW, three environmental organizations challenged the BDCP’s proposed adoption of biological goals that do not provide for full recovery of the species, arguing that this “contribution to recovery” standard violates California law:

Under the plain text of the NCCPA, conservation means recovery, and a Plan is required to contain measures that are sufficient to achieve recovery within the plan area.

The Natural Community Conservation Planning Act is the Foundation for a Successful Bay Delta Conservation Plan, Letter to Charlton H. Bonham, Director of the California Department of Fish and Wildlife, from the Defenders of Wildlife, Natural Resources Defense Council, and the Bay Institute, July 10, 2013, at 5 (citing Fish & Game Code § 2805(c)).

As described in detail in the chapters that follow, the limitations on project operations and other conservation measures set forth in the draft BDCP would not meet the conservation standard proposed by the July 10th letter—*viz.* full recovery of the listed species—though they are likely to contribute to species recovery. The letter thus raises a critical legal question that will have to be resolved by the Director of CDFW, in consultation with the Department’s General Counsel and the Attorney General, before the Department decides whether to approve the BDCP.

The answer to this question is not free from doubt, as the Legislature defined the purposes of the NCCPA in terms that stand in some tension to one another. For example, section 2801(i) declares that the “purpose of natural community conservation planning is to *sustain and restore* those species and their habitat . . . that are necessary to maintain the continued viability of those biological communities impacted by human changes to the landscape.” California Fish and Game Code § 2801(i) (emphasis added). In contrast, section 2801(g) states that “[n]atural community conservation planning is a mechanism that can provide an early planning framework for proposed development projects . . . in order to avoid, minimize, and compensate *for project impacts to wildlife.*” *Id.* § 2801(g) (emphasis added).

A careful and integrated reading of the text of the substantive provisions of the statute, however, should lead to the conclusion that the Act authorizes the CDFW to approve the BDCP if it concludes that the Plan would protect listed species from the adverse effects of the projects authorized by the Plan (including full mitigation of those effects) *and* would promote the recovery of listed species. Stated differently, we do not believe that the Legislature intended to prohibit the Department from approving the BDCP unless it concludes that the Plan—in isolation both from other existing sources of the species’ decline and from other state and federal actions to protect listed species—will achieve full recovery of the species. We reach this conclusion for several reasons.

First, the interpretation of the statute proposed in the July 10th letter is based entirely on the section of the Act that defines the term “conservation.” If the Legislature actually intended to require the CDFW to determine that an NCCP would be likely to achieve full recovery of listed species, it would have included this requirement in Section 2820, which governs the Department’s approval of proposed NCCPs.

Section 2820(a) lists ten separate findings that are prerequisite to CDFW approval, and section 2820(b) contains nine terms that must be included in the implementation agreements that accompany the NCCPs. None of these mandatory findings and terms includes the requirement proposed in the July 10th letter. We do not believe that the Legislature somehow intended to add a twentieth requirement to these lists—that the NCCP and implementation plan must provide for full species recovery—by implication from the definitions section of the Act.

Second, there are two provisions in section 2820 that expressly link the required conservation measures to the effects of the project authorized by an NCCP. Section 2820(a) states that the CDFW may approve an NCCP only if it finds that the plan

contains specific conservation measures that meet the biological needs of covered species and that are based upon the best available scientific information regarding the status of covered species and the impacts of permitted activities on those species. [Id. § 2820(a)(6) (emphasis added).]

Section 2820(b) stipulates that implementation agreements must include provisions

to ensure that implementation of mitigation and conservation measures on a plan basis is roughly proportional in time and extent to the impact on habitat or covered species authorized under the plan. These provisions shall identify the conservation measures . . . that will be maintained or carried out in rough proportion to the impact on habitat or covered species. [Id. § 2820(b)(9) emphasis added].]

This pairing of conservation and recovery with references to the “impacts of permitted activities,” together with the “rough proportionality” limitation on

conservation measures, suggests that the Legislature intended to authorize NCCPs as a means of contributing to other state and federal efforts to recover species, but not significantly in excess of the burdens that the project covered by the plan would impose on the species.⁷

Third, there is nothing in the text or legislative history of the NCCPA to indicate that the Legislature intended to force the state to bear programmatic and financial responsibility for full species recovery each time the CDFW approves an NCCP.⁸ Conservation measures required to achieve full recovery may extend far beyond the scope of an individual NCCP. Indeed, a requirement of full recovery would be particularly problematic for plans such as the BDCP that involve multiple species (some of which only partly inhabit the program area), multiple sources of stress, and diverse land and water management and regulatory agencies that each have independent obligations to contribute to species conservation and recovery. We do not believe that the Legislature would have assigned such a Herculean obligation to the Department, or imposed such a potentially large financial burden on state taxpayers, without saying so explicitly in the text of the statute.

Finally, an interpretation of the statute that would require the CDFW to make a determination that all proposed NCCPs provide for full recovery of listed species would likely have the unintended and pernicious consequence of deterring the Department from approving future plans. The CDFW might conclude that the scope of the necessary species recovery effort extends beyond the scope of the proposed project and hence beyond the capabilities of the project restrictions and conservation measures that would be included in the individual NCCP. Or it might be reluctant to approve an NCCP in situations where the costs of full recovery of the listed species covered by the plan—which the state would have to bear—significantly exceed the project mitigation costs that may be placed on the project proponents.

Again, these factors are especially pronounced in contexts such as the Delta ecosystem where there are multiple species (some of whose habitat is only partly

⁷ The July 10th letter acknowledges that the NCCPA contains this “rough proportionality” limitation, but argues that “the concept of ‘rough proportionality’ is applied only to mitigation measures and not to a plan’s conservation measures.” Letter to Director Bonham at 7. The text of the Act belies this interpretation, however, as four of the five statutory references expressly apply the “rough proportionality” limitation to the conservation requirements. See California Fish & Game Code §§ 2805(g)(3)(C), 2820(b)(3)(B), § 2820(b)(9) & § 2820(c).

⁸ The July 10th letter recognizes that the entities that receive incidental take permits under the BDCP may not be required to bear all of the costs of recovery of the various listed species: “[W]hen dividing up the costs of the plan’s conservation strategy, the individual developers are only responsible for paying for ‘mitigation’ and the ‘conservation’ increment above mitigation is the responsibility of the state.” Letter to Director Bonham at 7. Thus, if the costs of recovery exceed the mitigation costs that lawfully may be assigned to the permitted entities, the state must make up the difference: “The BDCP cannot limit its conservation measures to address only those impacts from the covered activities and avoid providing conservation measures sufficient to recover covered species.” *Id.* at 8.

within the project area), multiple stressors (many of which are not plan participants), overlapping and sometimes conflicting habitat requirements, and tremendous uncertainty both about the needs of the species and the likelihood of success of recovery strategies. The interpretation of the NCCPA set forth in the July 10th letter therefore poses a significant policy risk of deterring otherwise salutary applications of natural resources conservation planning.

Conclusion

We conclude that the draft BDCP's establishment of biological goals and conservation measures that are based on the Plan's "potential to contribute to recovery" of the covered species complies with the Natural Communities Conservation Planning Act. We also believe that the CDFW may approve the Plan if it determines that the BDCP will ensure the survival of the listed species, fully mitigate the adverse effects of the project on all covered species and their habitat, and further the more general state and federal efforts to recover the species and to restore the favorable conditions of their habitat.

Chapter 3: Water Supply Operations

Introduction

The construction of a new North Delta diversion facility, and the coordinated operation of the North and South Delta facilities constitute the first and most prominent conservation measure (CM#1) of the BDCP. While ostensibly a conservation measure, the new facilities are principally an effort to improve the reliability of exports from the Delta. Their operations, in conjunction with all other conservation measures, are intended to mitigate for impacts of the CVP and SWP, avoid jeopardy and/or to contribute to the recovery of covered species (Chapter 2).

A basic premise of BDCP is that the construction of the new North Delta diversion facility will simultaneously improve water supply reliability while reducing ecosystem impacts. This stems from the increased operational flexibility associated with two points of diversion located in different portions of the Delta. A presumed benefit of this flexibility is the capacity to take advantage of periods of high inflow for exports, allowing for reductions in exports during dry periods when impacts on the ecosystem may be largest. This is consistent with the co-equal goals expressed in the 2009 Delta Reform Act.

This chapter examines the water supply operations proposed under BDCP to evaluate 1) if there are significant changes in supply reliability associated with the project and 2) how these changes apportion exports in wet vs. dry periods. This description is foundational for the assessment of ecological and species-specific consequences of BDCP as described in subsequent chapters.

Proposed Facilities and Operations

There are lengthy descriptions of the design and operation of new and existing water export facilities in the Administrative Drafts of the EIR/EIS and BDCP. The reader is referred to these documents for information. The centerpiece of the plan is the 9000 cfs capacity diversion in the North Delta that conveys water to the SWP and CVP export facilities in the South Delta through two tunnels.

Regulatory Constraints

The operational criteria for the export facilities are both complex and highly constrained (Appendix A). As outlined below, these constraints *significantly reduce the operational flexibility of the facilities*. The current regulatory constraints include but are not limited to:

- SWRCB water rights decision D-1641: this includes standards for minimum monthly Delta outflow, salinity objectives at multiple Delta locations, location of X2 (the position of the 2 ppt salinity near the channel bottom), a maximum

export/import ratio objective¹, closures of the Delta Cross Channel (DCC), placement of a barrier at the head of Old River, and flow standards for the San Joaquin River below Vernalis. These standards vary depending upon months of the year and water year type.

- Remanded 2008 USFWS Biological Opinion (BiOp): prescribes restrictions for magnitude and timing of reverse flows in Old and Middle River (OMR) in the South Delta, to protect delta smelt. These vary depending upon time of year, water temperature, flows on the San Joaquin River, and proximity of smelt. This BiOp also calls for higher spring and fall outflows that exceed D-1641 standards. These outflow standards vary on water year type.
- Remanded 2009 NMFS BiOp: has different restrictions on OMR flows than the USFWS BiOp. Reductions in reverse OMR flows are scheduled to protect outmigrating salmonids. These vary depending on temperature and inflow. This BiOp increased San Joaquin River flows and set export/San Joaquin River flow ratios that are more restrictive than D-1641.

There are other regulatory constraints beyond D-1641 and the two remanded BiOps; however, compliance with these regulations appears to dominate water supply export modeling. Additional constraints are based on proposed operating rules for both the North and South Delta facilities. The most significant include:

- Maintenance of minimum flows downstream of the North Delta facility (called “Bypass Flows”)
- Restrictions aimed to reduce reverse flows at the confluence between the Sacramento River and Georgiana Slough
- A tiered, three-level pumping regime for December through June that seeks to protect the initial winter flood pulse and spring pulses that affect juvenile salmon outmigration
- Flows with sufficient velocity to reduce impingement of salmonids at diversion screens
- Increased restrictions for reverse Old and Middle River (OMR) flows associated with South Delta exports.

Infrastructure and Inflow Constraints

Infrastructure design and capacity forms another array of constraints. For the purposes of BDCP simulation modeling, south of Delta storage was limited to space within San Luis Reservoir. Operations during wet and above average conditions are often constrained by available space to store water in this facility. Expanding potential storage, particularly groundwater storage, would have created considerably more flexibility in exports, particularly during wet years.

¹ BDCP treats the export/import ratio in two ways: 1) counting as “import” all inflows from the San Joaquin and Sacramento Rivers and Delta’s tributaries or 2) counting inflows as above, but counting flows below the North Delta facility as inflow. The latter approach seeks to exclude North Delta exports from D-1641 export/import restrictions. From an ecosystem perspective, this makes no sense since the North Delta exports are, in effect, exports from the legal Delta.

The size of the North Delta facility is also a constraint, principally during periods of sustained high flow on the Sacramento River in wet years. The preferred project has shifted from an initial facility size of 15,000 cfs to 9,000 cfs in the current plan. The export, economic and environmental performance of the 9,000 cfs facility is compared to 14 alternatives in Chapter 3 and 5 of the Draft EIS/EIR. These alternatives vary facility size, location and operations in the comparison. A narrative is presented in the EIS/EIR that describes the rationale for rejecting the 14 alternatives and selecting the preferred project².

Exports are also naturally constrained by the timing and volume of inflows, with strong seasonal and interannual variation. One of the larger export challenges faced by BDCP is its location at the bottom of the system where flows enter the Delta. Upstream water management and consumptive use dominate inflows to the Delta over most years (Figure 3.1). These abstractions, which consume roughly ¼ of water that would naturally flow to the Delta, are beyond the control of BDCP, yet are the greatest operational influence on Delta inflows. Under BDCP, exports would be roughly equivalent to upstream consumptive use.

In addition, there are important restrictions on reservoir operations that constrain exports. The USACE has congressionally authorized rule curves that dictate Fall, Winter and Spring operations to maintain flood reserves. More importantly, there are BiOps that dictate flow and temperature requirements to meet the life history needs of covered salmon, steelhead and sturgeon below the dams. Meeting these standards, particularly in drier years and under a warming climate, limits the amount and timing of inflows to the Delta. Oroville Reservoir, which has fewer restrictions on flows, becomes the most important for supporting Delta inflows as a result, particularly during drought conditions (see below).

Consequences of Constraints

The above discussion is intended to highlight a conundrum that is not discussed much outside of the BDCP community of experts and is not examined in the Plan: export operations and operations to support conservation are *highly* constrained. These regulatory, operational and infrastructure constraints limit the ability of BDCP to adaptively manage operations to support co-equal export *and* ecosystem objectives. For this reason, the anticipated management associated with the new diversion facility is not fully realized.

² It is beyond the scope of this review to examine facility size in detail. In general, the analyses offered in the EIR/EIS conclude that the 9000 cfs facility provides the optimal balance of cost and flexibility. The additional capacity of the 15,000 cfs facility is rarely used in the operations that they modeled, leading to a very modest increase (<250 taf) in overall exports. The EIS/EIR did examine smaller facilities with capacities of 6000 and 3000 cfs. However, the operating criteria used to evaluate these two alternatives are not comparable to those of the preferred alternative, making the comparison moot.

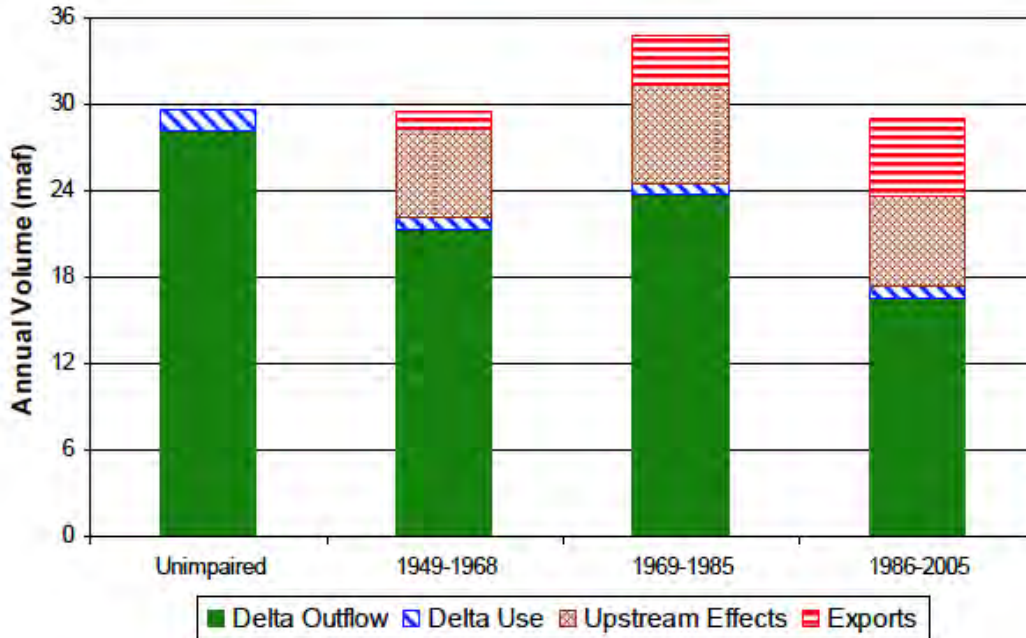


Figure 3.1 Proportional Delta water use. Exports constitute roughly 18% of the total unimpaired flow of the Delta in the 1986-2005 hydrology, with upstream consumptive use approximately 24%. From Fleenor et al. (2010).

This also highlights how flow management in BDCP was developed using system models. As described in Appendix 5C of the Plan, the models sought to meet the requirements of D-1641, the remanded BiOps, reservoir and diversion facility constraints, and south of Delta storage. The objective function was then to maximize Delta exports within those constraints. Although this seems logical, it highlights how CM1 is not a conservation measure, per se. Rather than doing a bottom-up assessment of ecosystem flow needs, as is typically done when setting environmental flows, the modeling sought to meet current regulatory requirements and flow constraints sought by fish agencies. This illustrates one of the key points made by Lund et al. (2010) and Moyle et al. (2012) that multi-objective management of the Delta is likely to require a comprehensive re-evaluation of flow and water quality standards.

Export Reliability

A goal of the BDCP project and the current Delta Plan is to improve reliability of water derived from the Delta for consumptive uses³. Using model simulations provided by BDCP consultants, we have evaluated how well BDCP meets the goal of improving export reliability. The most commonly discussed aspect of BDCP—

³ In actuality, the most reliable system would provide a given amount of water each year with the smallest deviation from that amount. Instead, BDCP attempts to produce the most water in any given year under the given regulatory and operational constraints. This produces a more *resilient* water supply systems, whereby the greatest volume is made available, even under the event of catastrophic salinity intrusion into the Delta. The terms resilient and reliable are used interchangeably in BDCP and other documents.

average annual export—is summarized in Figure 3.2, and compares the no-project alternative, NAA with the high outflow scenario, HOS and low outflow scenario, LOS (defined in Chapter 1). This modeling suggests that the HOS and NAA would provide roughly equal average exports, with the LOS providing approximately 700 taf more. However, these figures are an average over an 82-year simulation period and offer little information about reliability.

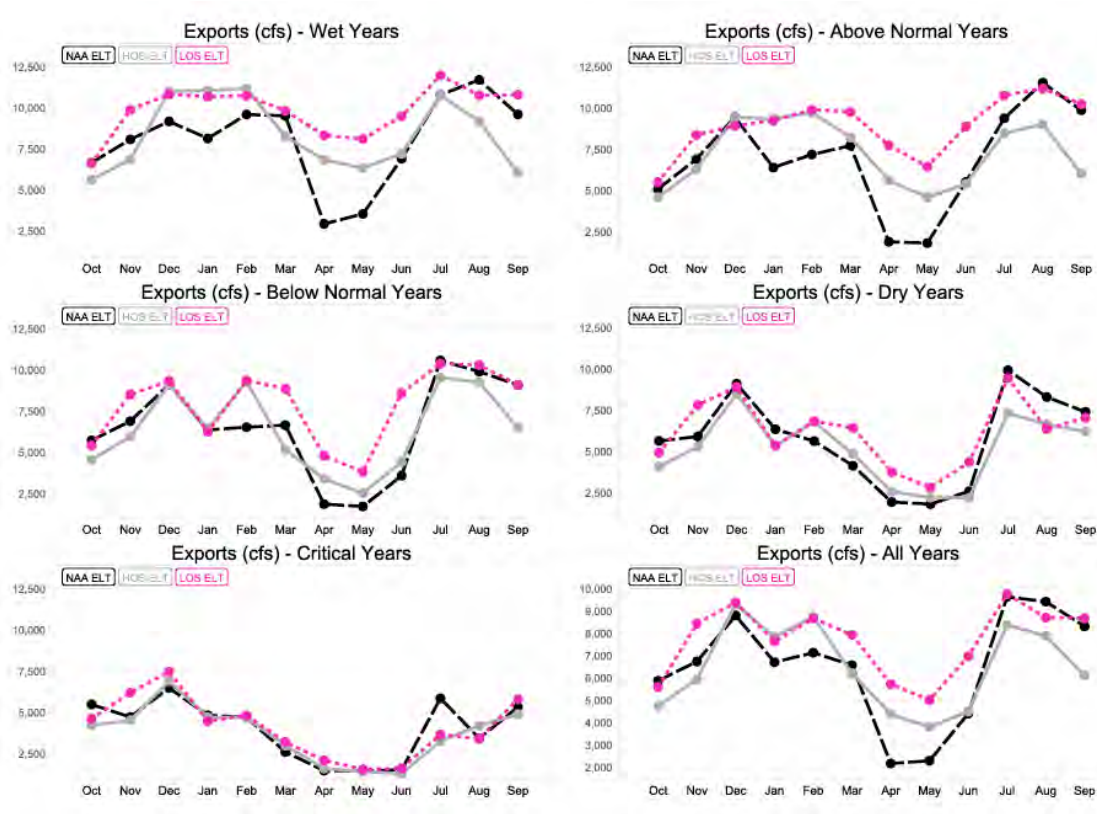


Figure 3.2: Monthly averaged exports for NAA, LOS and HOS under ELT conditions. Based on BDCP CALSIM data.

Exceedance curves (Figure 3.3) give a better indication of reliability. This approach provides the probability that a given export volume will be equaled or exceeded in any given year. For example, for the 50% exceedance probability (meaning one out of every two years), the NAA performs slightly better than the HOS, but much worse than the LOS. Overall, the LOS performs significantly better than NAA in six out of ten years and better than the HOS in eight out of ten. The HOS is outperformed by the NAA in five out of ten years (drier) and appears to only provide significant water supply benefits over the NAA in one out of ten years (wettest). The conclusion is that export reliability for the HOS and NAA are not substantially different, while reliability for the LOS is markedly higher.

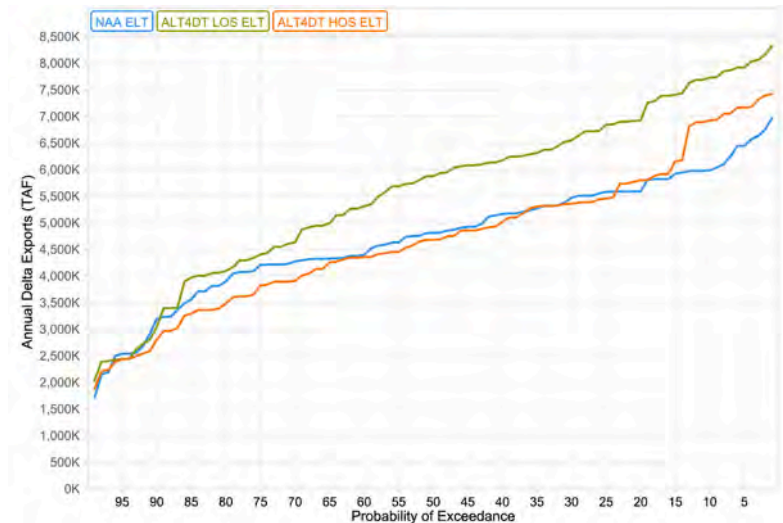


Figure 3.3: Exceedance probabilities for NAA, LOS and HOS exports under ELT conditions. Note that LOS produces higher exports for all probabilities, suggesting that it is the most reliable/resilient of the scenarios.

Water supply reliability curves for SWP and CVP customers are presented in Chapter 5 of the Draft EIS/EIR. These curves indicate that south-of-Delta municipal and farm users would realize considerable increases in overall reliability of supply under the LOS, compared to the NAA and HOS, particularly in above average and wet years. North-of-Delta users of CVP water would likely see a decrease in reliability over the long term, principally due to climate change.

Export Timing

A goal of BDCP and the Delta Plan is to shift exports to wetter years and to reduce pressure on drier years. A comparison of the average exports of NAA, LOS and HOS for all five year-types is presented in Figure 3.2. Based on the modeling data provided, there appears to be a significant increase in LOS exports in above average and wet years as compared to the NAA, with HOS intermediate between the two. This increase is accomplished through increased use of the North Delta facility during winter and spring periods when OMR restrictions most strongly impact South Delta operations.

Below average, dry and critical dry year performance of BDCP is mixed (Figure 3.2). For LOS, overall exports during the drier years are higher than the NAA, while HOS exports are roughly the same as NAA. Exports, on average, for both the LOS and HOS tend to be higher than the NAA in the winter and early spring, and lower during the summer. This minimal change in exports during dry years stems, in comparison to wet years, from the constraints on North Delta facility operations. As is illustrated below, during dry periods the North Delta facility is used very little, creating pressure on South Delta facilities.

In sum, although there are many regulatory and infrastructure constraints, BDCP does make use of the dual points of diversion to create modest increases in wet year exports and, depending on which export scenario is evaluated, equal to or greater exports in drier years. *BDCP therefore does not achieve the broader goal of reducing pressure on the Delta during dry years by shifting exports to wet years.*

Drought Performance

In the draft Plan and EIR/EIS, export performance of BDCP is summarized by presenting averages, typically linked to water year-types based on the Sacramento 40-30-30 index. Averaging fails to fully reflect how the system might be operated, however, because the complex rules governing operation can create significant year-to-year variability in exports (although see concerns over model uncertainties described in Chapter 1). This issue is particularly acute during multi-year droughts, when carryover storage in reservoirs is greatly reduced and demand increases significantly. To better illustrate how this system might perform we examined time series of model outputs during drought periods.

There were two six-year droughts during the 20th Century that fall within the time period used for hydrologic simulations: water years 1929-34 and 1987-92. We focused on the 1987-92 period of record for evaluation because it has historical export data for comparison and facilities that are comparable to today. As shown in Figure 3.4, overall export timing and magnitude during the six-year drought were roughly the same for the NAA, LOS and HOS, with LOS performing marginally better for exports throughout the drought⁴. The significant exception to this pattern is in the one year in that sequence, 1989, where modest inflows to the Delta occurred in the winter. Once bypass flow criteria were met, the flexibility created by the North Delta facility was able to take advantage of these inflows during a period of high restrictions on South Delta pumping to protect smelt.

⁴ Figure 3.4 highlights one of the issues not discussed in BDCP documentation. The environmental baseline for the BDCP assessment was determined to be the remanded BiOps, with provisions of one of the BiOps (high fall X2 flows in above normal and wet years) yet to be enacted. By choosing this as a baseline, the plan does not provide a comparison with how the project was actually operated under historic conditions. This administrative decision to only compare proposed operations with the remanded BiOps masks the striking differences between historic export operations and those proposed under BDCP.

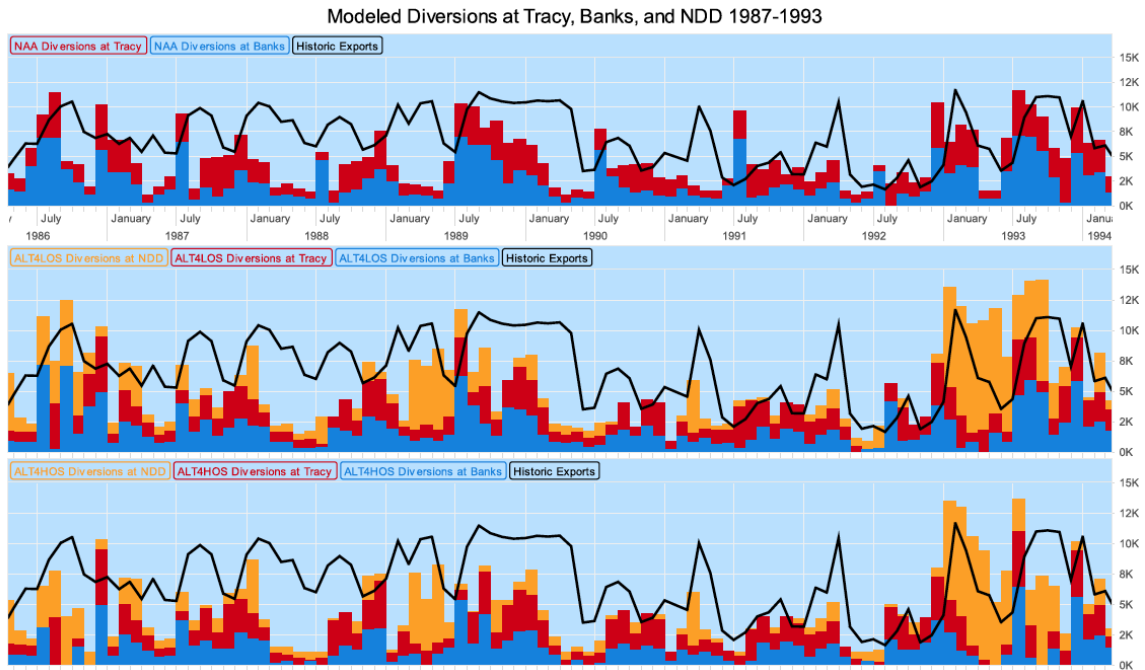


Figure 3.4: Exports for NAA, LOS and HOS under ELT conditions simulated for the 1987-92 drought, with historical exports are plotted for comparison. Important to note that ELT conditions take into account minor changes in climate and sea level rise by 2025 and cannot be compared specifically with historic conditions. In addition, historic conditions reflect human behavior; simulated conditions are guided by algorithms that do not account for human behavior.

Role of Reservoirs in Drought Management

Reservoir storage and operations play a critical role in drought management in California and greatly influence the timing and magnitude of Delta exports. The CALSIM modeling conducted for BDCP manages reservoirs within operational constraints described above and in detail in Chapter 3 of the Plan. The Plan makes it clear that the plan area does not include these reservoirs. Existing and future BiOps will govern their operations, not the terms of the HCP/NCCP permit. Despite this, the plan does envision significant changes to the operations of Oroville Reservoir under BDCP.

The 1987-92 simulated operations of the three most important reservoirs—Shasta, Oroville and Folsom—are shown in Figure 3.5. These simulations have important biological implications that are covered in later chapters. For water supply reliability, there are several important observations:

- As noted by the BDCP documentation, the NAA puts a great deal of pressure on upstream reservoirs to meet flow requirements, with Oroville providing most of the operational flexibility. In comparison to historic operations, the NAA significantly reduces storage, and thus carryover, in Shasta and

Oroville, but has limited impact on Folsom, with the exception of the last two years of drought.

- Under NAA all three reservoirs are at or near dead pool for the last two years of the drought cycle. Had water-year 1989 been closer in runoff to the other drought years, dead pool conditions would have occurred for the last three years of the six-year drought. Although a statement of the obvious, dead pool limits flexibility in managing water supply and ecosystem needs, both immediately downstream and in the Delta. This is likely to be of greatest concern for managing flow and temperature needs of winter- and spring-run Chinook salmon, particularly under warming climate conditions. Changes in flow releases to meet the needs of listed salmon are highly likely to impact export operations during dry periods. BDCP recognizes this as a concern but does not analyze the likely effects.
- A surprising result of the simulations is that HOS drought operating procedures are more protective of reservoir storage than either NAA or LOS. In an extended drought, storage is more aggressively allocated to either outflow (NAA) or exports (LOS), with both increasing the risk of creating dead pool conditions. This suggests that HOS operating criteria designed to protect smelt, may also do a better job of protecting upstream conditions for salmonids and sturgeon by increasing carryover storage. This, in turn may inadvertently improve water supply resiliency during drought.

It is important to note that a time series analysis of one extended drought within a single simulation record does not give guidance on how the system is likely to perform in all future droughts. Each drought is different, with different storage (reservoir and groundwater) conditions at the start, different precipitation and temperature patterns, and different regulatory or operational responses. To test the above observations more thoroughly, a range of six-year drought scenarios, should be simulated and analyzed. Given that most climate models prescribe an increase in frequency and duration of drought, this anecdotal assessment highlights an issue that is likely to occur during the life of the project and have significant impacts on supply as well as ecosystem management.

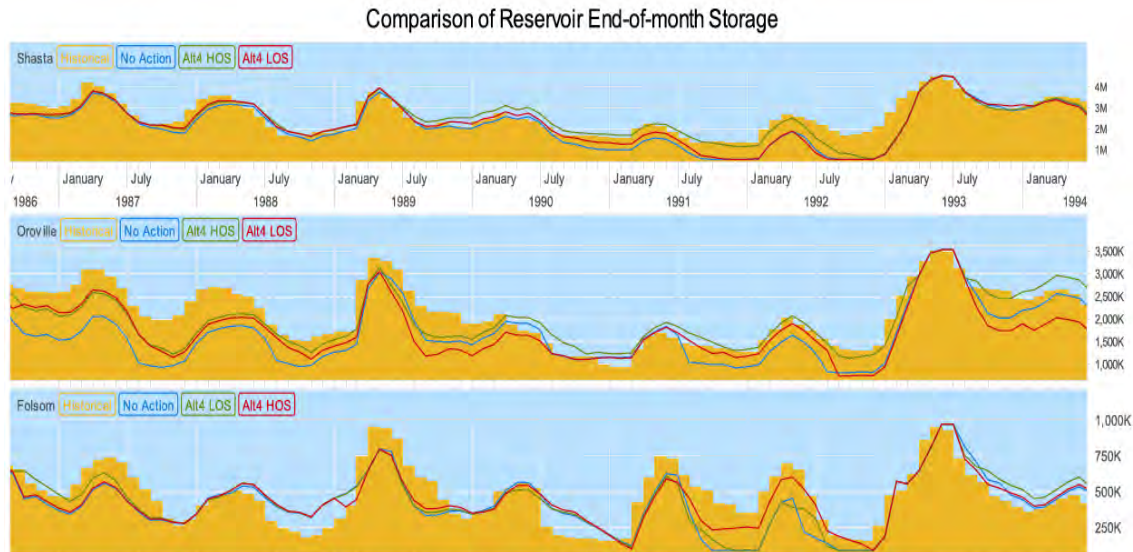


Figure 3.5: End of month storage for HOS, LOS and NAA under ELT conditions simulated for the 1987-92 drought. Historical storage (yellow histogram bars) is plotted for comparison. During the latter stages of the drought, dead pool conditions occur on all three reservoirs. Note that ELT conditions take into account minor changes in climate and sea level rise by 2025 and cannot be compared directly with historical conditions.

Conclusions

The project described in the Draft BDCP and the accompanying Draft EIR/EIR seeks to improve water supply reliability for water exported from the Delta while improving conditions for covered species. An underlying premise for the effort is that adding a second point of diversion, the North Delta facility, operated in conjunction with existing South Delta facilities will allow for more flexible export operations that better support environmental goals and objectives. In concept, this approach appears reasonable and should provide significant flexibility. In practice, however, regulatory and infrastructure constraints, coupled with high upstream consumptive uses of water, severely limits flexibility in operations. These highly constrained operations limit the effectiveness of BDCP in improving water supply reliability.

One of the objectives of BDCP that is in line with those of the Delta Plan is to increase exports during wet periods and decrease them during dry periods when impacts on the ecosystem are greatest. In comparison to the no project alternative, the new facility appears to achieve the former to a modest degree, but it does not significantly reduce pressure on the Delta during drier periods.

The proposed system is particularly vulnerable to extended drought periods (3-6 years). The NAA and LOS lead to dead pool conditions in upstream reservoirs after 3-4 years of drought. This decreases water supply reliability during dry periods and,

as discussed in later chapters, places at risk species dependent upon reservoir releases, particularly cold water pool releases. This problem is likely to be particularly acute as climate changes. The surprising result from the model outputs is that the high outflow scenario, principally designed to improve conditions for smelt in the Delta, leads to improved carryover in upstream reservoirs that, in turn, improves year to year water supply reliability and allows for greater flexibility to manage reservoir-dependent species.

The hydrologic modeling effort for BDCP is unprecedented and heroic. However, the tools available for this modeling do not match the information demands. In addition, the plan documents do not do an adequate job of quantifying model uncertainties, particularly those caused by exchanges between 1-, 2- and 3-dimensional models, uncertainties over future conditions, and regulatory behavioral uncertainties . New tools will be needed going forward.

Chapter 4: Environmental Flow Performance: Upstream and Inflows

Introduction

The focus of the BDCP is principally on the legal Delta and adjacent Suisun Bay and Marsh, where export operations have the most direct impact on covered species. As discussed in Chapter 3, upstream management, including reservoir operations, consumptive uses of water, and flood management, play a critical role in inflow timing and volume. In this chapter, we examine how conservation measures #1 (water operations) and #2 (Yolo Bypass fisheries) meet conservation objectives that impact listed aquatic species.

The focus of this chapter is on the environmental performance of proposed flow changes in the Sacramento watershed, including the Sacramento, Feather and American Rivers, and inflows to the Delta through the Yolo Bypass and the Sacramento River. Although inflow from the San Joaquin River is important and a determinant of conditions in the South Delta, BDCP does not envision significant changes in flows. For this reason, our analysis is focused only on the Sacramento watershed.

Performance, as used here, is how well actions proposed by BDCP are likely to meet the goals and objectives of the plan. Although there are many issues discussed in the Plan for the Sacramento system and covered species, there are three central flow performance concerns: changes in reservoir release timing and magnitude and its impact on anadromous fishes; modifications to Fremont Weir and its benefits for floodplain habitat for outmigrating salmonids; and near- and far-field effects of North Delta diversion operations.

Impaired Flow in an Impaired System

One of the objectives of BDCP and the Delta Plan—and a concern of many NGOs—is to produce a flow regime with attributes that better support the life history stages of covered aquatic and riparian species. This objective is supported by a large body of national and international literature that has demonstrated how creating more natural flow regimes in highly regulated systems improves conditions for native species (see recent summary by Arthington, 2012). This issue has been at the forefront of controversial efforts by the SWRCB to develop a basin plan that addresses flows (Fleenor et al., 2010).

A flow regime that mimics natural seasonal variation is also considered by the scientific community in the Delta to be fundamental to better species management (Hanak et al., 2013). Restoring appropriate seasonal and intra-annual variability

involves re-establishing flow timing, magnitude, duration, frequency and rates of change that drive key ecosystem attributes that, in turn, support native species (Figure 4.1).

Although restoring elements of the natural flow regime is a worthwhile goal, it should be made clear that in the Delta and its tributaries there is little that remains natural (Bay Institute, 1998; Whipple et al., 2012). Added to these physical changes are profound shifts in biological conditions, including a Delta ecosystem dominated by non-native plants and animals (Lund et al., 2008; Baxter et al., 2010). For this reason, restoring a more naturally variable flow regime in an altered Delta and its watershed, while necessary for improving conditions for covered species, is unlikely to lead, by itself, to their recovery (Mount et al., 2012).

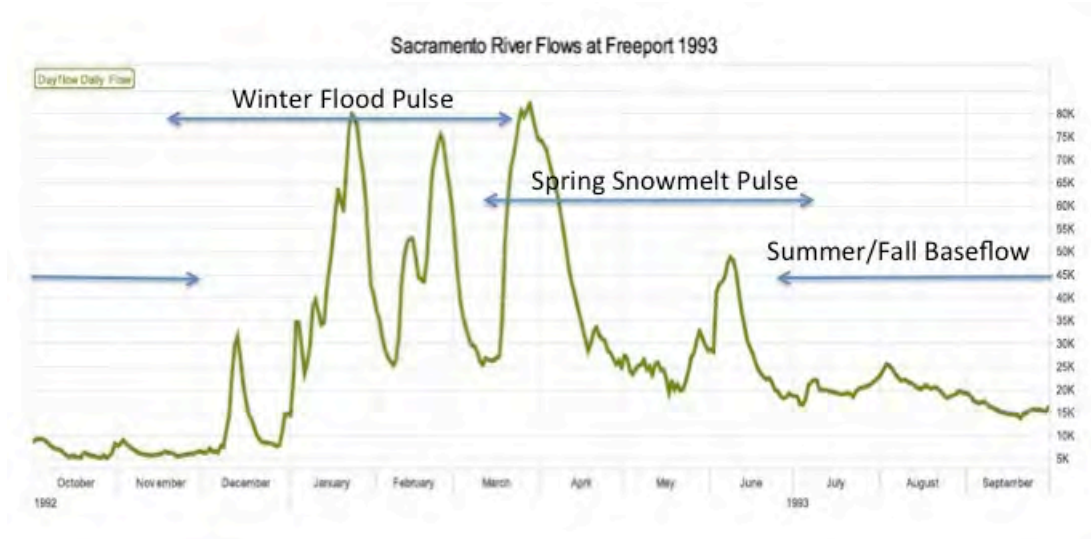


Figure 4.1: Unimpaired Sacramento River flow at Freeport for WY 1992-3 based on DAYFLOW data (DWR). This illustrates the range of natural seasonal variability in flow. Reproduction or migration of aquatic and riparian species are tied to timing, magnitude, frequency, duration and rate of change of flows. Flows, particularly winter and spring flood pulses, are necessary for geomorphic processes that support various life history stages. Flow regulation and land reclamation have significantly altered flow regime (see text for discussion).

In this chapter we sought to evaluate BDCP’s potential impact on flow regimes upstream and into the Delta. It is infeasible—if not inappropriate—to reconstruct natural flow in the Central Valley given the significant changes in the landscape. Instead, we use *unimpaired flow* (DWR 2007) as a proxy for a more naturally distributed flow regime¹. Unimpaired flow is the volume of water that would flow by a given point if no upstream impoundments or diversions were in place. Estimating

¹ We focus here principally on the rivers that feed into the Delta rather than the Delta per se. An assessment of changes in outflow that occurs in response to changes in operations is contained in Appendix B.

unimpaired flow is complicated and imprecise, yet is important in setting flow and water quality targets, particularly by the SWRCB. It involves aggregating unimpaired and unregulated runoff from multiple basins that flow to the Delta. Unimpaired flow ignores surface water-groundwater interactions and storage or conveyance of flow in channels, floodplains and wetlands. For this reason, it is not a useful proxy for flow regime on daily time steps, but can be used as an imperfect proxy for annual and monthly flows. We follow that convention in this analysis.

This simplified approach should not be over-interpreted. It is used to assess whether BDCP meets the overall goal of improving ecological conditions by creating a more natural seasonally variable flow regime. It does not address all issues of concern for listed fishes, such as winter- and spring-run Chinook salmon whose primary limitation is due to loss of upstream spawning and rearing habitat and high temperatures in existing channel habitat (Williams, 2006, 2009).

Main Rivers of the Sacramento Valley

Multiple biological goals and objectives of BDCP are associated with flow conditions on the Sacramento River and its two main tributaries, the Feather and American Rivers. All anadromous fishes covered by BDCP rely directly on these river systems for spawning, rearing and migration. As noted in Chapter 1, we focus here principally on winter- and spring-run Chinook since the BiOps that cover their life history needs have the greatest impact on water operations.

With the exception of proposed changes to the Fremont Weir and the Yolo Bypass (CM#2), BDCP does not envision making significant investments in improving physical habitat upstream of the Delta, or addressing other stressors such as hatcheries, contaminants or harvest procedures (see summary in Williams, 2006, 2009). For this reason, most of the impact of BDCP on the Sacramento River and its tributaries upstream of the North Delta facilities will be associated with changes in flow releases from the three major reservoirs: Shasta, Oroville and Folsom.

Simulated average flow conditions affected by changes in reservoir operations under BDCP are summarized in Figure 4.2A-C, including Sacramento River at Red Bluff, Feather River below Oroville Reservoir, and American River below Folsom. These flows, along with all other tributaries, aggregate to form the Freeport flow (Figure 4.2D) and the Yolo Bypass. These results include NAA, LOS and HOS flow scenarios and unimpaired flow under the five year-types based on the Sacramento River wetness index.

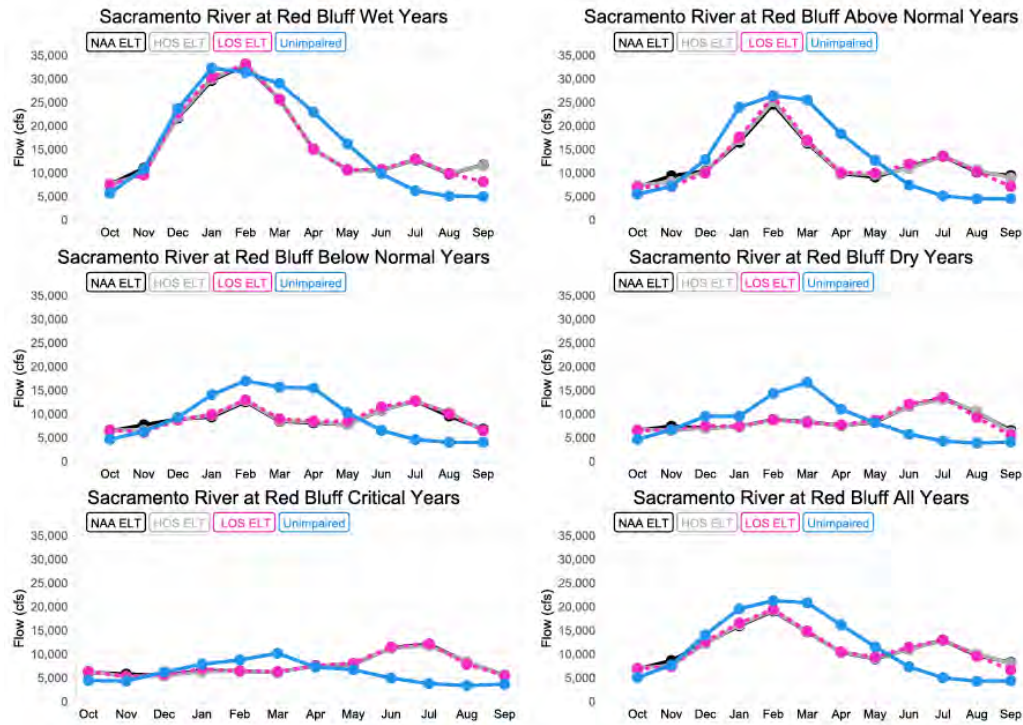


Figure 4.2A: Sacramento River at Red Bluff.

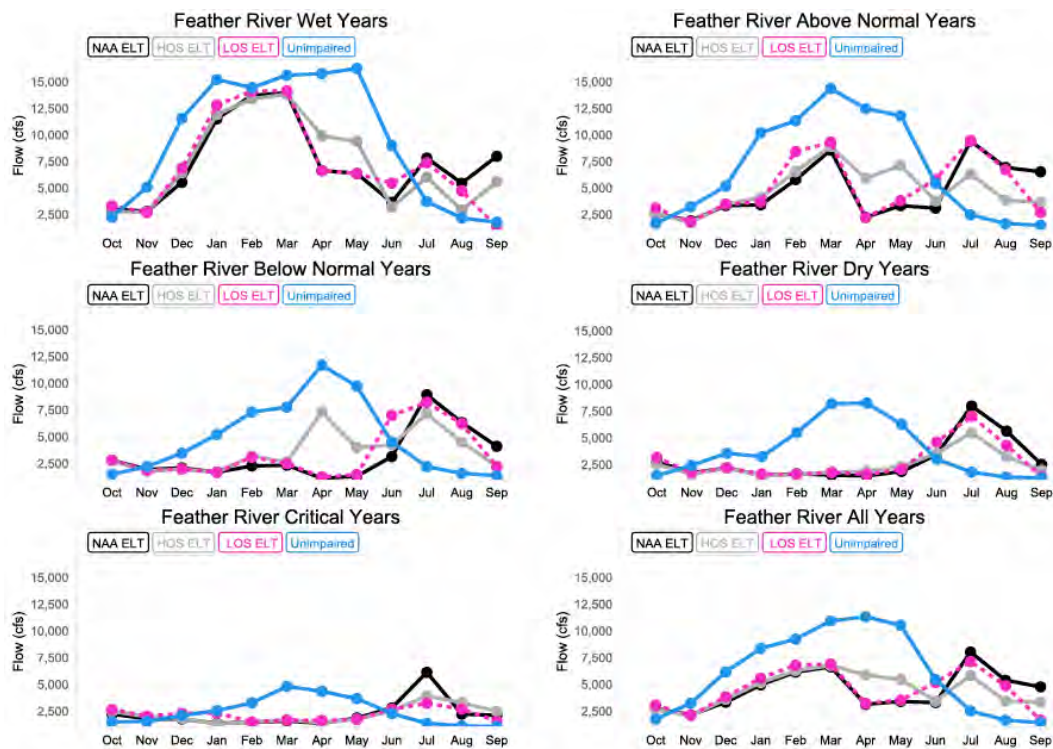


Figure 4.2B: Feather River.

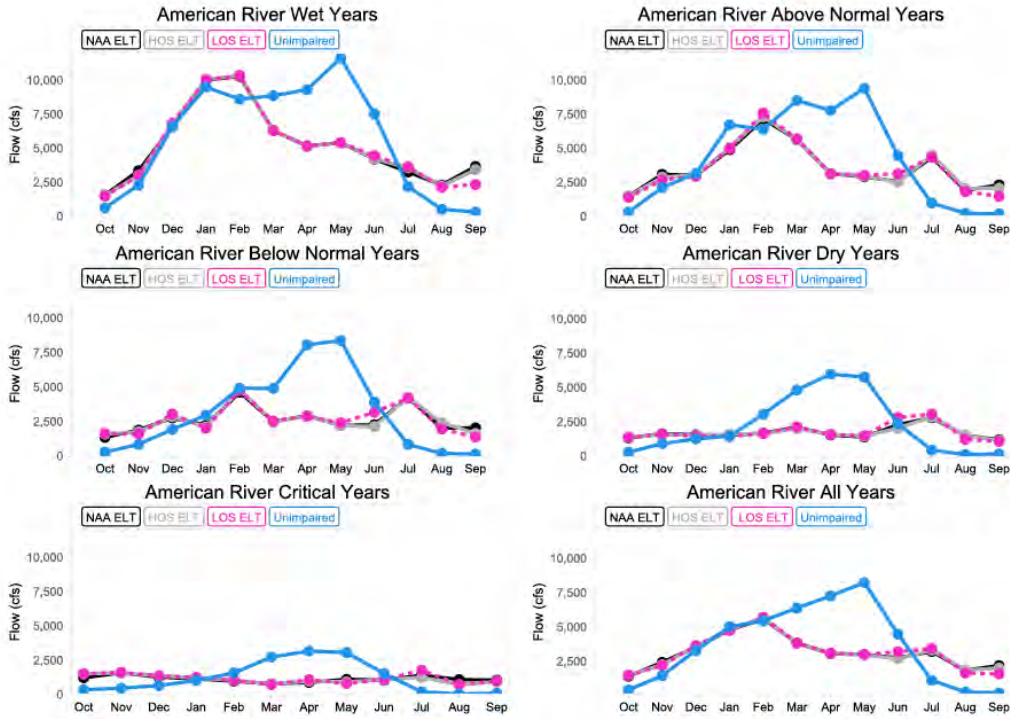


Figure 4.2C: American River.

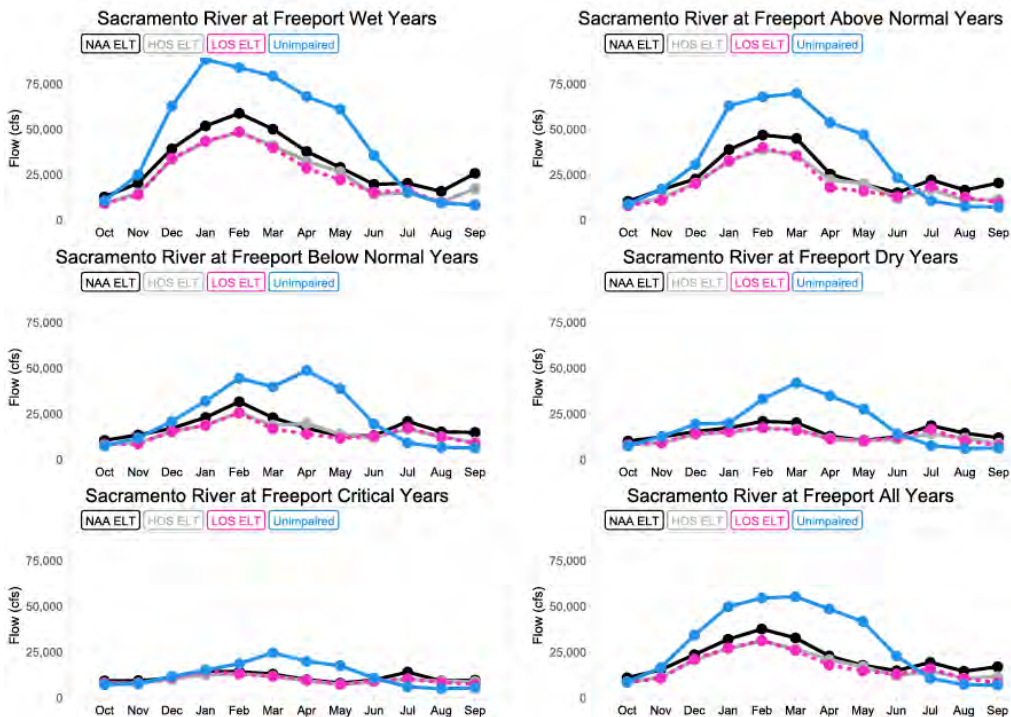


Figure 4.2D: Flow at Freeport. Figures 4.2A-D. Monthly averages sorted by water year types for HOS, LOS, NAA and unimpaired flow. Unimpaired flow is based on current conditions and HOS, LOS and NAA are ELT conditions. See text for discussion. Data from BDCP CALSIM simulations.

As noted in Chapter 3, the constraints on reservoir operations are significant due to temperature and downstream flow requirements, based mostly on the 2009 BiOp. For this reason, the differences between scenarios are not large. However, a comparison of the impaired and unimpaired flow data allows for several general conclusions about the impact of BDCP on key attributes of Sacramento Valley flow regimes:

Winter Flood Pulse. With the exception of the American River, the winter flood pulse is significantly reduced over unimpaired conditions in the Sacramento Valley. The magnitude of this reduction reflects the size and operations of upstream impoundments relative to the total runoff of the watershed. The most dramatic impairment of winter flood pulses occurs on the Feather River where the pulse is virtually eliminated in most years. There are no substantive differences between LOS, HOS and NAA operations for winter flood pulses. The winter flood pulse is marginally higher under NAA at Freeport, but this reflects more frequent flows down the Yolo Bypass.

Spring Snowmelt Pulse. The rise and gradual recession of flow in the spring is, next to low baseflow conditions in the late summer, the most predictable element of the Sacramento Valley flow regime and is of high biological significance. As shown in Figures 4.2A-D, the spring snowmelt pulse is highly impaired due to impoundments and flow diversions. With the exception of the Feather River, there are no substantive differences between HOS, LOS and NAA impacts on the spring snowmelt pulse in the Sacramento Valley. On the Feather, HOS flow operations designed to improve spring outflow in the Delta, lead to significant improvement in spring conditions in all but dry and critical year types.

Summer/Fall Baseflow. The timing and magnitude of reservoir releases dominates the summer/fall flow regime of the basin (Figure 4.2A-D). These releases are to meet the complex array of temperature and flow requirements downstream of the dams, irrigation demands upstream of the Delta, inflows to meet export demands, and outflows to meet water quality and habitat standards. Summer/fall baseflow flow regimes are highly altered with flows three to five times higher than unimpaired flows. With the exception of the Feather River, BDCP does not change summer/fall baseflow conditions. Under HOS and LOS simulations, the summer flows on the Feather are reduced, creating marginal improvement in flow regime.

Main Rivers Summary. The plan area for BDCP is, by design, limited in scope. The same applies to its conservation measures. The project Plan documents make it clear that operations of the CVP and SWP reservoirs are governed by BiOps or FERC licenses, and not BDCP. In addition, they note limited flexibility in reservoir operation due to cold water pool management, particularly on Shasta and Folsom Reservoirs. In this way, the reservoirs are in effect another constraint on BDCP (Chapter 3), rather than an asset for management.

Yet operations of these reservoirs greatly impact winter- and spring-run Chinook habitat downstream. As shown above, these operations contribute to the significant

impairment of flows of the Sacramento River and its major tributaries and are a challenge when trying to meet the biological objectives of BDCP. Additionally, these dams block access to holding, spawning and rearing habitat that has far-reaching effects on winter- and spring-run Chinook salmon populations (Williams, 2006, 2009). These dams also support mitigation hatcheries whose operations may be contributing to harm of native salmon (Moyle et al., 2011).

It is unclear to us how to disentangle the relationship between the impacts of BDCP—a project designed to meet CVP and SWP water supply needs and an array of associated biological goals and objectives—and operations of SWP and CVP reservoirs. It seems logical to include these reservoirs in BDCP and operate them, along with the new facilities, under a single HCP/NCCP. The modest improvement in Feather River flows notwithstanding, the result of this administrative separation is, in effect, to maintain the status quo for the highly impaired flows of the Sacramento system.

Yolo Bypass Flows

One of the more prominent conservation measures (CM#2) of BDCP is the modification of the Fremont Weir to promote increases in the frequency of winter and early spring inundation of the Yolo Bypass. A well-established and growing body of evidence, involving monitoring data, field experimentation and, to a lesser extent, life cycle models indicate high benefit of floodplain habitat to foraging juvenile salmon (see BDPC documentation for a full summary). This stems from the use of high value, off-channel habitat by juveniles, who, under optimal bioenergetic conditions and low predation pressures grow at high rates, increasing their survivorship through the Delta. Fish that either forage on the Yolo Bypass and/or use it as a migration corridor will not be impacted by near-field effects of the proposed North Delta diversion facilities. Fish using the Bypass are also less likely to enter the interior of the Delta where predation pressures are high. Finally, juveniles that use the Bypass leave the Delta later in the season, increasing the likelihood of arriving at the ocean during higher upwelling periods with better food availability.

Currently flow onto the Yolo Bypass from the Sacramento River only occurs when the Verona gauge exceeds 55,000 cfs. Modifications to the Fremont Weir would allow 1,000 cfs to flow onto the floodplain when flow at Verona exceeds 25,000 cfs. Flow through the Weir would climb to 6000 cfs when the river approaches 55,000 cfs. Above 55,000 cfs flow into the Bypass would be similar to NAA conditions. In addition to allowing flood flows, the weir would be modified to allow 100 cfs attraction flows to a fish ladder to improve upstream passage of adult salmon, steelhead and sturgeon (passage issues not evaluated here).

The average annual flow of the Yolo Bypass is approximately 1.5 maf. Under NAA, HOS and LOS, this amount would not differ significantly since the majority of flow volume on the Bypass occurs when the Sacramento overtops Fremont Weir and the

Sacramento Weir (Figure 4.3). However, the timing, frequency, and duration of floodplain inundation—key elements of the natural flow regime--would change substantially with the proposed modification of Fremont Weir.

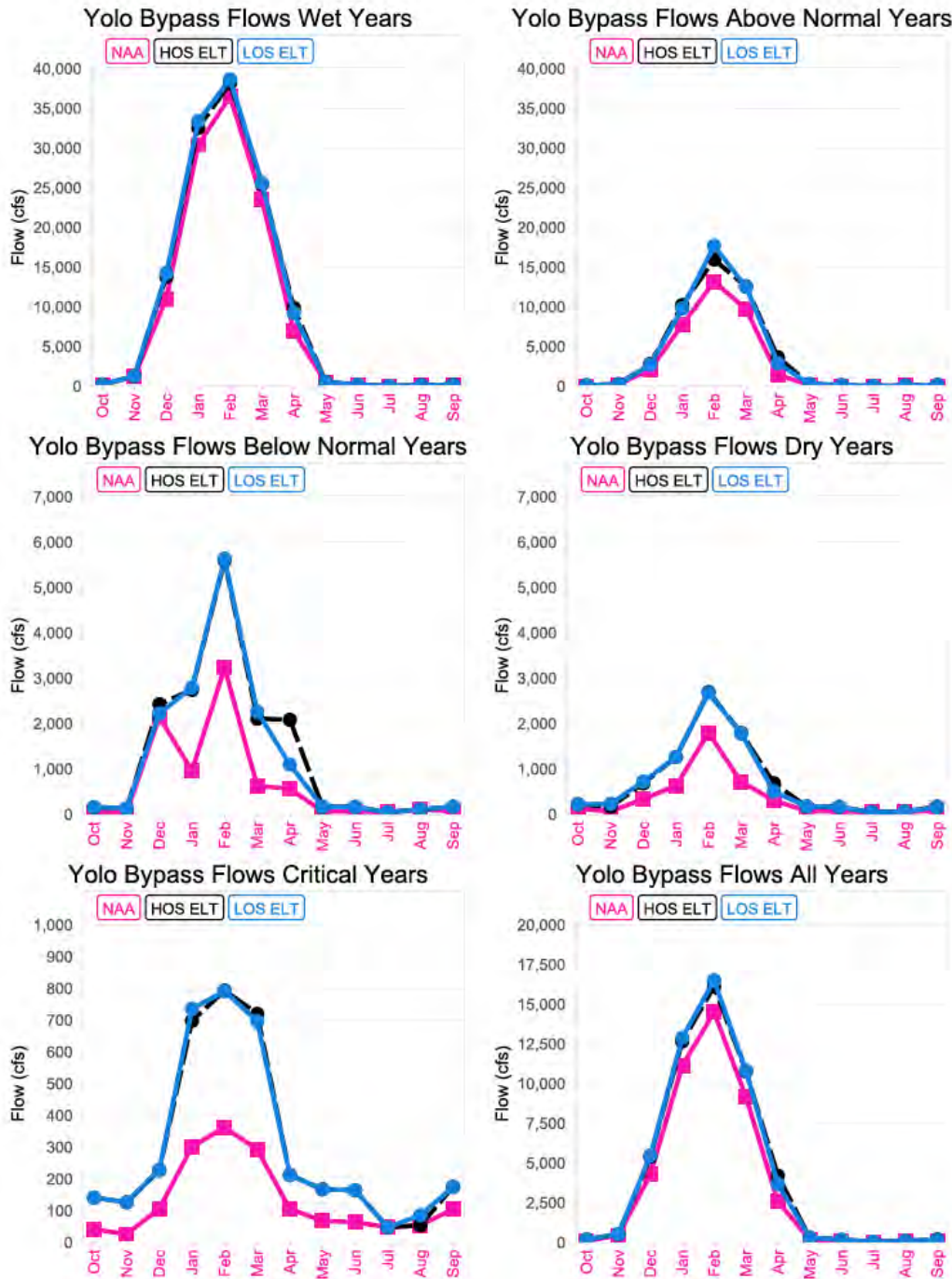


Figure 4.3: Average monthly flows for the Yolo Bypass under HOS, LOS and NAA under ELT conditions for different year types. Note changes in scale.

Flood Frequency. The frequency of inundation of the Bypass increases significantly under BDCP. Under current conditions there is a roughly 40% annual probability of flooding on the Yolo Bypass. Under BDCP this increases to more than 70% annual probability (BDCP statistics). The largest change occurs in drier years (Figure 4.3).

Flood Duration. Multiple studies have shown that flood duration, which allows for nutrient cycling and primary production, is essential for supporting juvenile salmonid foraging (Sommer et al., 2001; Williams, 2006, 2009). Modifications to Fremont Weir increase flood durations with high habitat benefits. Under current operations, flood durations aggregate to an average of 25 days per year. This would not change under NAA in the ELT. Under both HOS and LOS ELT this would increase more than three-fold to an average of 81 days per year.

Flood Timing. In addition to more frequent, longer-lasting flooding conditions, modifications to the Fremont Weir would expand the flood season, particularly in drier years (Figure 4.3). This expansion helps divert early migrants, such as winter-run Chinook salmon and later migrants, such as spring-run and fall-run Chinook, onto the floodplain. For example, based on BDCP data, we estimate that days of flooding above 1000 cfs on the Bypass will more than double in January and triple in April.

Yolo Bypass performance for listed salmon

Although CM#2 achieves the broader objective of improving the amount and quality of floodplain habitat, principally by restoring a more natural flow regime, it's effectiveness in supporting federally listed species of salmon (the focus of this review) is somewhat limited. The BDCP consultants modeled the overall benefits of the Yolo Bypass flows to out-migrating and foraging juveniles. For winter-run Chinook salmon, the benefits were modest with an estimate 1-8% increase in escapement. The limited benefit of the Yolo Bypass is, according to the BDCP model results, due to the small percentage of juveniles likely to be diverted onto the floodplain. This stems from the fact that most migration begins in December and January coincident with the first pulse flows of the season and does not coincide with peak inundation periods of the Bypass.

Greater benefit, albeit still limited, occurs for spring-run Chinook salmon. The bulk of juvenile out-migration takes place during the optimal months for floodplain inundation: February through March. However, two factors reduce the effectiveness of Yolo Bypass for spring-run according to BDCP documents. The majority of spring-run Chinook salmon come from hatcheries in the Feather River. Juveniles leaving the Feather are only diverted onto the Yolo Bypass during rare high flow events, leaving the Sacramento River as their principal migration route to the Delta. Naturally spawned fish in Butte Creek use the Sutter Bypass as their principal migration route. Like Feather River fish, they too only move access the Yolo Bypass during rare high flow events. Naturally spawned spring-run in Battle, Clear, Mill and Deer Creek pass Fremont Weir on their out-migration paths and will benefit most from likely access to the Bypass.

Second, according to BDCP models, most spring-run juveniles reach the Delta, and presumably the Yolo Bypass, as yearling smolts. In this stage, they are presumed by BDCP consultants to not take full advantage of the high quality foraging conditions of the Bypass, but use it principally as a migration corridor. BDCP consultants estimate that 90% of spring-run Chinook in the Yolo Bypass are migrants, rather than foraging fish. The BDCP consultants readily note that this proportion reflects the split between migrants and foraging characteristics in hatchery fish and may not be indicative of proportions of wild fish. Our consultation with several salmon biologists suggests that the distinction between foragers and migrants is arbitrary and likely does not reflect actual behavior of juveniles on the Bypass. In addition, there is emerging evidence that a high percentage of naturally spawned fish move out as fry and migrate during high winter flows (*pers. comm.*, P.B. Moyle, 2013).

The BDCP consultants used several approaches to model the effect of the Yolo Bypass on survivorship. They acknowledge that current modeling tools are not well-suited to this kind of analysis. They developed a simple bioenergetic model for floodplain rearing, but told the panel that they felt it did not fully capture the benefits of the Bypass, and that their estimates of survivorship were conservatively low. Despite these limitations the BDCP models along with a growing body of literature suggest that spring-run juveniles as well as winter-run juveniles that access the Bypass are likely to have significantly higher survival rates to Chippis Island and presumably higher adult escapement².

Yolo Bypass Summary

CM#2 has high potential to benefit a range of covered species. Its benefit for winter- and spring-run Chinook is muted due to outmigration timing (winter-run) or the structural difficulty in diverting Feather River and Butte Creek fish (spring-run) onto the Bypass. Yet even with these concerns, there are likely to be improvements in survivorship associated with an alternative migration corridor with high value foraging habitat. There is an adaptive management program being developed for the Yolo Bypass that will be incorporated into BDCP. This effort would benefit BDCP objectives by conducting experiments and modeling that test ways to improve access of listed salmon onto the Bypass. This can include modifications to the Fremont Weir or pulse flow releases that improve winter-run diversion. Along with modification of Fremont Weir, this program may also want to consider the potential for using the Sacramento Weir to divert Feather River and Butte Creek fish. Regardless, as outlined below, a more aggressive approach to developing an alternative migration corridor for winter- and spring-run Chinook is likely to be necessary to mitigate the effects of the new North Delta facility.

² The focus of this chapter is on spring- and winter-run Chinook. There is very significant benefit to other covered species, particularly fall-run Chinook and Sacramento splittail that can take advantage of Yolo Bypass flooding more readily.

North Delta Facility Impacts and Mitigation

The new point of diversion along the Sacramento River is likely to impact all covered fish that either use the main channel of the Sacramento for migration or rearing, or are indirectly affected by downstream changes in flow volume and timing. These impacts are some of the most difficult to assess due to uncertainties about design and operation of the facilities (no comparable facility exists to calibrate models) and the relationship between downstream actions, such as tidal marsh restoration, and flows. This section assesses BDCP's evaluation of near-field (adjacent to the facility) and far-field (downstream from the facility) effects.

Near Field Effects

The preferred project involves the construction of three screened intakes along the left bank of the Sacramento River in the vicinity of the town of Hood. Each screen will be capable of withdrawing up to 3000 cfs. In our view, the BDCP consultants have properly identified the two main sources of near field effects of the facility on out-migrating salmonids: losses due to impingement on the intake screens and losses due to predation near the diversion. However, we are uncertain about the effectiveness of proposed mitigation for these effects.

To mitigate for impingement potential, the consultants propose real-time management of pumping regimes relative to channel flow in order to maintain approach and sweeping velocities that reduce contact with intake screens. This real-time management would be informed by upstream monitoring of outmigrants. This issue remains a high uncertainty for operations of the facility ("low certainty" in the parlance of BDCP). Conceptually, a good adaptive management and research program coupled with real-time management could reduce impacts. However, as of this writing, the specifics of this program are not provided by BDCP (see discussion in Chapters 8, 9 this report) and we are unable to evaluate how effective it might be.

A greater near field effect of the facility is the high likelihood of concentration of predators near the facility, with resulting losses of migrants and foragers due to predation. Predators take advantage of concentrated prey and velocity refugia at physical structures throughout the Delta (Vogel, 2008) and will presumably do the same at the North Delta intake facilities. The BDCP consultants use various modeling approaches to estimate potential predation losses, including comparison with estimates of losses at known structures such as diversion screens of the Glenn-Colusa Irrigation District. Estimated predation losses for juvenile winter run Chinook that pass the facility vary from as low as 1% to as high as 12% (we did not find statistics for spring-run Chinook salmon losses). The higher predation loss values would have significant population-level impacts on winter-run Chinook and would fail to meet objectives of BDCP. The consultants acknowledge high levels of uncertainty about predation effects at the facility. The solution, as with most issues with high uncertainty in BDCP, is to defer this to adaptive management of the project, including unspecified predator control programs and real time management

of flows. Based on our experience in the Delta, we consider this to be a significant, unresolved management issue.

Far Field Effects

The North Delta facility is expected to provide an average of roughly half of the exports from the Delta. As outlined in Chapter 3, operations of the facility are highly constrained by flow and water quality regulations, upstream water use, reservoir operations and hydrology. The simulated operations of the North Delta facility are summarized in Figure 4.4, including a measure of the proportion of channel flow that is diverted.

There are significant seasonal and interannual variations in operation of the North Delta facility that will drive far field effects³. During wet and above average water years, pumping regimes are most aggressive, particularly during the summer and early fall when 25% to as much as 39% of channel flow is diverted. Diversions, as a percentage of channel flow, decline dramatically in below normal, dry and critical years. In addition, pumping regimes are highly protective of channel flow in December, reflecting the restrictions on exports to protect initial pulse flows for winter-run Chinook. As expected, the HOS scenario, designed to improve Delta outflow, results in the most protective pumping regime for bypass flows at the North Delta facility.

BDCP documents acknowledge that the reductions in bypass flow create multiple far field effects that impact listed salmon. These include reduced attraction flows for migrating adult salmon, increased losses of juvenile salmon migrants and foragers due to longer transit times to the Delta, and diversion into the interior Delta where predation and/or entrainment losses are high. These operations also affect total Delta outflow⁴.

The BDCP consultants use multiple modeling approaches to address the far field effects of the North Delta facility. The main model used is the Delta Passage Model (DPM) that tracks smolt survival through the Delta. This model and others summarized in Appendix 5C of the Effects Analysis all draw the same conclusion: there is an increase in losses of winter- and spring-run Chinook salmon migrants associated with reduced flows in the bypass reach from Hood to Rio Vista. The magnitude of this impact varies depending upon year type (wetter years have reduced losses) and magnitude of flow reduction associated with pumping (up to 35% decreases in flows during some migration periods). These results are not surprising since there is a long-established relationship between transit time and

³ We did not evaluate the effects of size of the facility and its level of use. However, it is worth noting in Figure 4.4 how often average monthly exports approach facility capacity. Using a monthly average greater than 8000 cfs as an indicator of periodic use of full capacity, this only occurs in February and March in wet years and March of above average years. This is roughly 5% of the total months, suggesting that operational and regulatory constraints, rather than facility size, determine export volumes.

⁴ Appendix B presents a summary of Delta outflow and the magnitude of impairment of flows from the Sacramento Valley. The latter uses a simplified impairment index.

survivorship for smolts leaving the Sacramento River (Newman, 2003; Perry et al., 2010).



Figure 4.4. Average monthly export flows of North Delta diversion facility under HOS and LOS ELT for different year types, and percentage of total bypass channel flow exported.

BDCP proposes to mitigate the increase in losses of smolts associated with far-field effects through six strategies:

- Tiered pumping regimes to reduce withdrawals during the initial winter flood pulse (described in Chapter 3)

- Real-time operational changes that reduce export pumping when monitoring indicates that large numbers of migrants have entered the reach upstream of the facility
- Flow management that reduces tidal reversals at Georgiana Slough, decreasing the likelihood of smolts diverting into the interior of the Delta
- Non-physical barriers at Georgiana Slough
- Reductions in entrainment at the South Delta facility due to reduced export pumping
- Increased diversion of foragers and migrants onto the Yolo Bypass
- Improved channel margin, floodplain and tidal marsh habitat to support foraging juveniles

The benefits of the last of these strategies—habitat restoration—are not captured in the survivorship modeling that was completed by BDCP consultants (see chapter 7 for a discussion). In addition, the models do not incorporate real-time operations adjustments since the scope and terms of these operations have yet to be determined. The remaining strategies are incorporated into models used to assess smolt survivorship. Closely examined, BDCP model results indicate that these measures, in combination, roughly offset the losses created by reductions in flows and increases in predation in the bypass reach, meeting the standard of mitigation. There is no indication that these actions would result in substantial improvement in conditions for listed salmon. This includes the Yolo Bypass, which provides significant benefits for other covered species.

North Delta Facility Summary

We have not had sufficient time or resources to conduct a detailed review of the models used to assess survivorship in the bypass reach and the effectiveness of mitigation efforts. Overall, most of the models used for near and far field impacts are standard Delta models. Model results seem reasonable and fall within the boundaries of current understanding. This suggests that they provide an acceptable first-order approximation useful enough as a basis for further analysis and adaptive management experiments.

We view the efforts to model the effectiveness of predator management and non-physical barriers as having high uncertainty. In addition, as noted, there is insufficient detail on real-time management to assess its likelihood for success. The flow modeling that was done on the bypass reach makes assumptions about tidal marsh restoration in the Cache Slough area. This restoration plays an important role in tidal energy and efforts to manage flow reversals at Georgiana Slough. We are uncertain about both the impact of this tidal marsh restoration and, if modeled correctly, whether the assumed restoration would be completed in the ELT. This same issue applies to the Yolo Bypass. Scheduling contained in BDCP suggests that the Yolo Bypass project would not be complete until after the North Delta facility. This lag in completion hampers efforts to mitigate for the project. At minimum, given the large uncertainties, it seems prudent to have all mitigation efforts in place and tested prior to initiating operation of the diversion facilities.

Conclusion

To meet its biological goals and objectives, BDCP has developed 22 conservation measures. Two of these measures—CM#1, Water Operations, and CM#2, Yolo Bypass—are intended to create significant improvement in conditions for covered fishes by creating more natural flow conditions, improving fish passage and, in the case of the Yolo Bypass, improving floodplain spawning and rearing habitat. We focused our assessment on how CM#1 and CM#2 performed for winter and spring-run Chinook in this regard.

In general, we found that CM#1 does not significantly change the highly impaired flow regime upstream of the Yolo Bypass and Freeport, with the exception of an increase in spring flows on the Feather River under the HOS flow scenario (nor does it change outflows much as shown in Appendix B). BDCP proponents have made the strategic decision to focus principally on the Delta, rather than including CVP and SWP reservoirs that regulate flow into the Delta. This limits BDCP's effectiveness in its conservation measures since it does not address the major risk factors for listed salmon.

We found the increased frequency of flows into the Yolo Bypass to be an important step in restoring floodplain habitat. However, timing of outmigration and current design of CM#2 modifications limit the impact of this effort for listed salmon. The current adaptive management program underway for the Yolo Bypass needs to address this issue, including considering changing reservoir operations and alternative ways to divert fish into the Bypass.

Near field and far field effects of the North Delta facility have the potential to significantly reduce survivorship if not fully mitigated. Uncertainties over mitigation are high and will require a robust adaptive management plan. In our view, the Yolo Bypass program should be viewed as mitigation for the impacts of the North Delta facility on listed salmon. CM#2, along with all other mitigation efforts, need to be in place prior to operation of the facility.

Chapter 5: In-Delta Flow Performance

Introduction

BDCP Conservation Measure #1 (CM#1) aims to restore more natural net flows (i.e. net seaward) within the Delta by adding a point of diversion upstream of the Delta:

Conservation Measure #1: “Construction and operation of the new north Delta intakes are designed to substantially reduce the incidence of reverse flow (Section 3.4.1.4.3, *Flow Criteria*) and restore a predominantly east-west flow pattern in the San Joaquin River. (Page 3.4-7, emphasis added).

This statement implies two classes of presumed effects that south Delta diversions induce through altered flows: direct effects whereby reversed flows in the south Delta contribute to entrainment of fish at the Delta export facilities, and indirect effects whereby changes in flow in the lower San Joaquin River are believed to alter the survival or migratory success of fish in the affected channels. Both of these presumed effects refer to net flows, which are determined by averaging out the substantial tidal flows that reverse direction twice daily. Although these net flows are small compared to tidal flows in much of the Delta, there is evidence that they can have substantial effects on some fish species.

In this chapter we evaluate changes in net flows in the Delta associated with changes in operations and the construction of the new facility. As in Chapters 3 and 4, we evaluate the differences between HOS and LOS scenarios and compare them to NAA, the no-action alternative. All of these analyses are in the Early Long-Term (ELT) shortly after the beginning of operations of the North Delta facility.

Concerns over modeling

As noted in Chapter 1 of this review, we have concerns over the use and over-interpretation of the modeling data provided to us. In conducting our analysis for this chapter and the following chapter on impacts of outflows on smelt, we have relied on output from CALSIM under various scenarios. Our analysis revealed several apparent anomalies in model output. Although we received clear explanations of the origin of these anomalies from the BDCP consultants, we remain concerned that the model output is unrealistic for projecting actual project operations and the resultant flows. In particular, certain modeled conditions arise through artifact that provide substantial improvements in conditions for delta smelt. Thus, conclusions drawn on the basis of these models rest on an unreliable foundation. These concerns are focused on Delta outflow during fall and southward flow in the southern Delta during winter. These flows have been linked to habitat and survival of delta smelt.

October

The USFWS Biological Opinion for delta smelt includes a fall X2 standard that applies following wet springs. Flows are usually low during this season so small variations in flow can have substantial effects on the location and area of the low salinity zone, and hence potentially on habitat conditions for smelt.

For various reasons X2 calculated by CALSIM differs substantially from that determined from outflow as in Jassby et al. (1995). We therefore focused on outflow as determined by CALSIM, rather than X2 as provided by BDCP modelers.

For this analysis we sorted flow data into a ranked series from lowest to highest values of Delta inflow under NAA. In Octobers of most years in the drier half of the series, outflow under HOS and LOS is up to twice that under NAA (Figure 5.1; median 77% higher for these 41 years). By contrast, during years of high inflow (right-hand half of Figure 5.1), HOS and NAA outflows roughly track each other, while LOS is much lower because the fall X2 requirement does not apply to that scenario. The anomaly occurring under dry conditions is not balanced by flows in other fall months. A few anomalies like those found in October crop up in November, but otherwise in those months either all three outflows track each other or LOS is lower.

To our knowledge there is no regulatory or operational requirement for reduced outflow under NAA or increased outflow under HOS or LOS in dry Octobers. Furthermore, there would be no reason to focus such a requirement in only one month if it were meant to benefit delta smelt, since they are present in the low-salinity zone from summer through fall. Outflow in fall can affect delta smelt recruitment so the modeled outflows can result in considerable differences in predicted recruitment under the three modeled scenarios (Chapter 6). We do not find these differences compelling because of a lack of a regulatory or other basis for the high outflows under HOS and LOS in dry Octobers.

January

January has been the month of greatest adult delta smelt entrainment historically, so the modeled conditions in January can have large impacts on forecasts of adult survival. The CALSIM modeling included a requirement that OMR flows during January be zero in wet years, no more negative than -3500 in above-normal and below-normal years, and no more negative than -5000 in dry and critical years. However, no estimates of current year type are possible in January, and rather than presume perfect foresight or use information available up to that point the modelers chose to operate the simulated system for January using the requirements that applied to the previous year type. Because dry Januaries can follow wet years, this resulted in an anomalous condition in which requirements for wet years applied during dry Januaries.

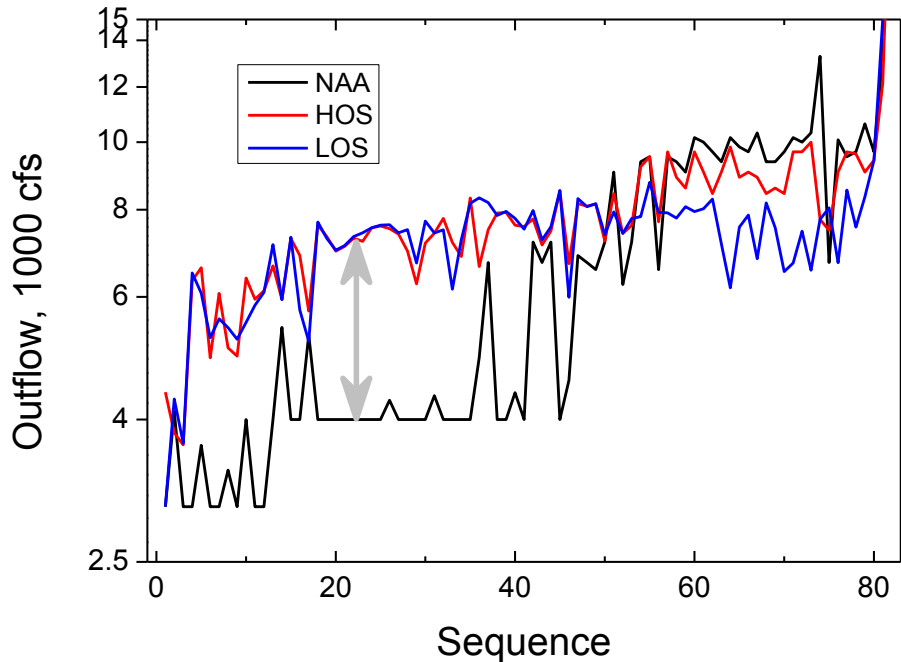


Figure 5.1. Net Delta outflow in October under the three scenarios sorted by inflow as determined by CALSIM under NAA; i.e., sequence 1 is the lowest inflow and 82 the highest. The gray arrow points out the region of interest where outflow under HOS and LOS is as much as double that under NAA. Outflow is plotted on a log scale to show proportional differences among scenarios especially at low flows, and because X2 can be modeled as a function of the log of outflow. The highest two outflows have been cut off to focus the figure on the lower values.

As a result of this anomaly, the modeled scenarios (LOS and HOS) called for reductions in export flows in Januaries following wet years, which substantially increased OMR during many Januaries at the dry end of the historical range for that month (Figure 5.2). This is unrealistic for several reasons. First, the actual values don't conform to the model requirements of 0, -3500 or -5000 cfs, depending on previous year type; instead they are quite variable and achieve zero rarely. Thus, there is no clear regulatory basis for these flows.

Second, the reduction in export flows was sometimes accomplished through increased outflow rather than reduced reservoir releases or increased exports from the North Delta (Figure 5.2). Thus, many January outflows during dry periods were much greater than the corresponding flows of the NAA alternative.

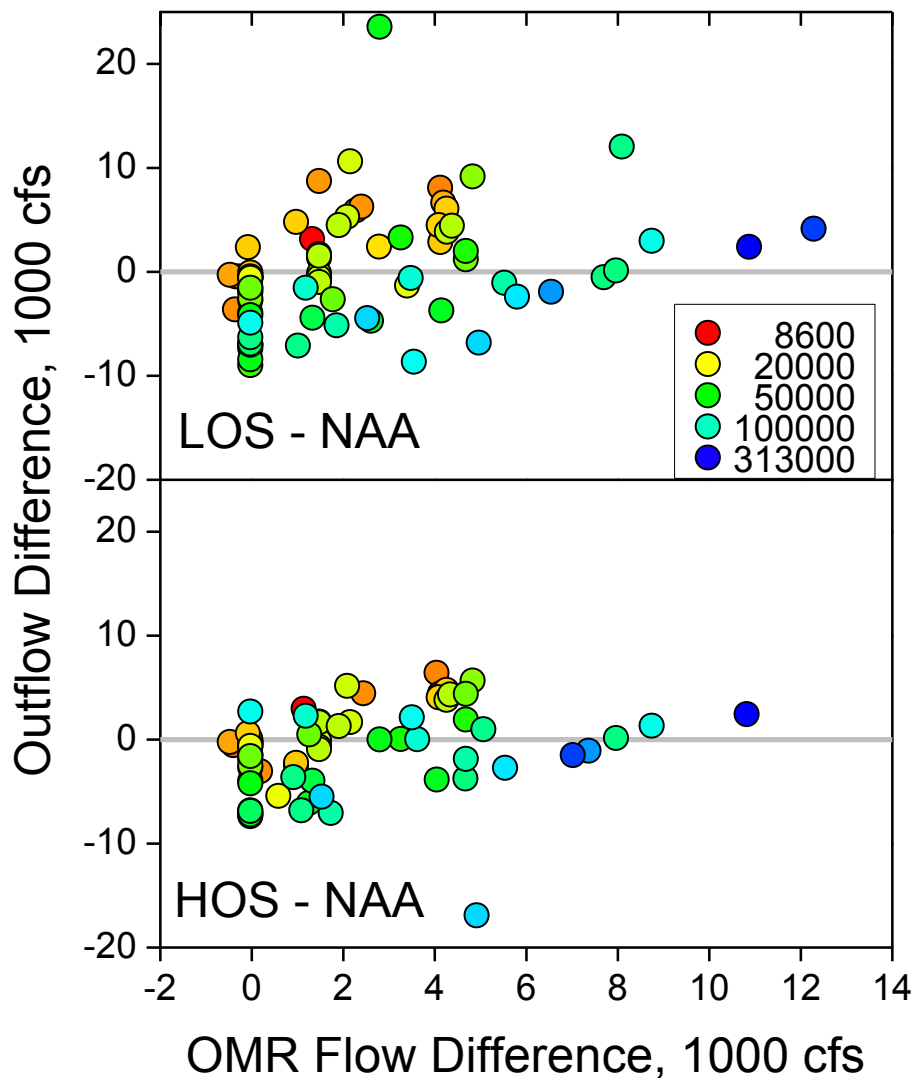


Figure 5.2. January flow conditions compared between the two modeled scenarios (LOS, top; HOS, bottom) as the differences from the flows under NAA. The colors show the range of NAA inflow. Under the LOS there were many Januaries when inflow was low but the outflow and OMR flow were increased by about the same amount over NAA.

Consequences

The anomalies discussed above seem to arise through the application of rules and constraints designed in some cases for real-time operations, using a model with a monthly time step. We understand and appreciate the difficulty in modeling such a complex system and the problems that would arise in attempting to mimic variation on a daily time scale. Furthermore, we trust that the modeling team has made every effort to produce output

that conforms to the constraints and the modeled hydrology. Nevertheless, the specific model outputs we focus on above seem unrealistic, particularly since these anomalies are largely confined to October and January. We do not think the system is likely to be operated in real time to achieve the flows shown in model output.

Thus, discussions in this and the next chapter should be accompanied with this caveat: *these apply only if the system were actually to be operated to achieve the flows indicated by the models.* If rules are not in place to ensure these flows are achieved, the benefits to delta smelt (and presumably other species) will not be realized.

Analysis of flows

Construction of a new export facility will not by itself achieve the goals of restoring more natural flow patterns in the Delta; the effects of such a facility are entirely dependent upon its operational rules. We assessed how much the modeled operational scenarios (HOS and LOS) achieve the goals of restoring net natural flow directions within the Delta. In recent years, the Biological Opinions for delta smelt and salmonids have directed attention to net flows in OMR, which are the main channels carrying Sacramento water to the export facilities in the south Delta. OMR flows show relationships with salvage of some fish species at the fish facilities and are presumed to reflect entrainment risk to fish in the Delta, i.e. the direct effects of the projects. In earlier years, focus was on net flows in the lower San Joaquin River (QWEST) as a more general measure of the impacts of water management on net flows in the Delta, which were believed to cause indirect effects on fish populations.

OMR and QWEST flows are two measures for the effectiveness of CM#1 in restoring more seaward flows in the Delta (see Chapter 6 for an estimate of effects of the modeled flows on delta smelt entrainment). Here we examine both the changes in seaward flows and the degree of negative flows as predicted from CALSIM models.

A north Delta diversion will increase the frequency of positive net OMR and QWEST flows and reduce negative values to the extent that exports from the north Delta reduce exports from the south Delta. However, BDCP calls for continued use of south Delta diversion facilities and greatly restricts the operation of the north Delta diversion, particularly in dry periods and early winter. Thus, restoration of seaward flows in the Delta must be viewed in the context of the timing and conditions when the north Delta diversion can be used.

We describe how LOS and HOS alter the incidence and degree of reverse flows during the seasons of sensitivity for the covered fish. For each season of sensitivity, we group results by quartiles of outflow to assess how changes in flows occur under drier vs. wetter conditions. Low flows in the winter and spring are when concern over reverse flows is greatest for most species.

Direct effects

Direct effects are entrainment, or the number of fish diverted into the facilities. This number is not known for any species because substantial numbers of fish are lost in the waterways leading to the fish facilities and through the louvers at the fish facilities. Salvage

is therefore a poor measure of entrainment effects, but there are no other direct measures. Estimates of entrainment as a proportion of total population of delta smelt are presented in Chapter 6. Such an analysis has not been developed for any other species of concern. Therefore, to broaden the analysis to all species we examined changes in modeled flow in OMR. This measure has been used in both Biological Opinions. OMR flow is both calculated by models and measured in the field; it is roughly equal to San Joaquin River inflow minus total exports. Because San Joaquin inflows are less than total exports under all but flood conditions, OMR flows are usually negative. We assume OMR is the primary focus of CM #1's goal to "reduce the incidence of reverse flow". To broaden the question we also assess the degree to which flows are made less negative by the alternatives.

Incidence of reverse flow

Because 'incidence' is a measure of frequency, the "Incidence of reverse flows" is the frequency with which OMR is changed from negative under NAA to zero or positive (northward) under the proposed alternatives; because model output is available by month, we examined frequency on a monthly basis (Table 1). The distribution across months of the change in net OMR direction implies that effects on each species will depend on its season of sensitivity.

The results below are consistent with the goal of CM#1 of achieving a greater frequency of positive net flows in Delta channels by shifting exports to the north Delta diversion site. This is true more for HOS than LOS operations.

LOS effects. The LOS reduced the incidence of negative flows by 5% overall (50 months out of the 984 months modeled; Table 1). Under NAA 110 months had positive (northward) OMR flows while 160 months had positive flows under LOS. Positive or zero OMR flows under LOS coincided with negative flows under NAA in all months save August, but most frequently in January – March. There were 21 months when OMR flows were positive under NAA but negative under LOS in April and May (Table 1).

The shift to positive OMR flows under LOS was sometimes quite large (about 6000 cfs) and occurred almost solely under higher river inflows during December through June. The occasions when NAA alone produced positive OMR flow occurred only in April and May and the change in OMR flows between NAA and LOS were small (<1000 cfs).

HOS effects. The HOS had a more substantial effect on the incidence of negative flows than LOS (Table 1). There were only 13 instances when positive OMR flows under NAA were negative under the HOS, and the differences were very small in those cases. As with LOS, the changed OMR status happened in all months save August. The most noticeable difference between HOS and the other two alternatives was in September and November when HOS was northward about a third of the time while NAA was always southward and LOS northward only a few times. The low frequency of northward flows under HOS in October may be related to the anomalies in outflow identified above, but the reasons for the otherwise high frequency of positive OMR flows in fall under HOS are obscure, as they are not called for by regulations and no fishes of concern are vulnerable to export entrainment at that time.

Table 1. Frequency by month of northward (including a few zero flows) or southward flows under NAA vs. LOS, and NAA vs. HOS. Columns in italics indicate those years and months when the direction of flow differed between NAA and the selected scenario. For example, in April there were 47 years when NAA flow was northward, in 5 of which LOS was southward, and 35 years when both flows were southward, out of a total of 82 years.

Month	NAA North		NAA South		All LOS North	NAA North		NAA South		All HOS North
	LOS North	<i>LOS South</i>	<i>LOS North</i>	LOS South		HOS North	<i>HOS South</i>	<i>HOS North</i>	HOS South	
Oct	0	0	1	81	1	0	0	8	74	8
Nov	0	0	2	80	2	0	0	25	57	25
Dec	3	0	1	78	4	3	0	0	79	3
Jan	4	0	11	67	15	4	0	12	66	16
Feb	8	0	18	56	26	8	0	19	55	27
Mar	6	0	25	51	31	6	0	36	40	42
Apr	42	5	0	35	42	44	3	5	30	49
May	25	16	0	41	25	31	10	6	35	37
Jun	1	0	9	72	10	1	0	9	72	10
Jul	0	0	1	81	1	0	0	1	81	1
Aug	0	0	0	82	0	0	0	0	82	0
Sep	0	0	3	79	3	0	0	38	44	38
All months	89	21	71	803	160	97	13	159	715	256

Magnitude of negative OMR flows

Entrainment rates are a function of population distribution and abundance, season of occurrence in the Delta, and flow conditions including export rates (or OMR conditions). The months of vulnerability for each species of concern were taken from the BDCP documents. For adult longfin and delta smelt the season of vulnerability is from December through March. For juvenile delta smelt the season is from March through June.

The effects of overall flow conditions, i.e. how relatively wet or dry it is, were assessed by grouping the months of vulnerability for all 82 modeled years into quartiles of outflow in the NAA; e.g., for adult delta smelt which are considered vulnerable during December-March, there were 82 months in each quartile of outflow. We examined conditions of OMR, river inflow and outflow under several operational scenarios. We examined differences under four levels of wetness for each month using outflow in the month as a measure of wetness. Historically fish are more often salvaged under drier conditions than under.

In Figure 5.3 we present comparisons of the HOS and LOS scenarios for each quartile of outflow (under the NAA scenario to ensure comparison of the same years in each graph).

Under the HOS and LOS alternatives, OMR differs from NAA during the seasons of sensitivity for adult delta smelt (Dec-Mar) and juvenile delta smelt (April-June).

Three patterns can be seen:

1. In the season of vulnerability for adult smelt (December – March), HOS and LOS both show about a 1000-5000 cfs increase toward positive in OMR under all quartiles of outflow, but all OMR values are strongly negative except in the wettest quartile of the data. Exports in December and January can be high and the use of a north Delta diversion can improve OMR (but see “Concerns over modeling” above). For juvenile smelt, the increase in OMR flow under LOS and HOS is smaller and less consistent. In all cases the level of OMR flow is much less negative than in December – March.
2. The HOS and LOS alternatives differ only slightly except during the drier periods when OMR flow is slightly less negative under HOS than under LOS.
3. Under wetter conditions all alternatives produce median OMR flows in the range targeted as protective in the Biological Opinions (more positive than -5000, but see Modeled Impacts on Delta Smelt in Chapter 6). The use of NDD under high-flow conditions allows the HOS and LOS to avoid the extreme negative OMR values that occur under NAA because of the high south Delta export rates that are possible then.

Thus, in summary, model results suggest that reverse flows in the south Delta become more positive under both LOS and HOS for all quartiles of outflow. These changes can be seen both in the frequency and in the distribution of flows in the two seasons of vulnerability and the four quartiles of NAA outflow. In wetter months the north Delta diversion does not fully replace south Delta exports until river inflows are relatively high, so that OMR remains negative in most months of smelt vulnerability. Changes in OMR during the period of vulnerability of young delta smelt are smaller than those during December – March because all alternatives are constrained by the Biological Opinions to a much higher baseline OMR flow.

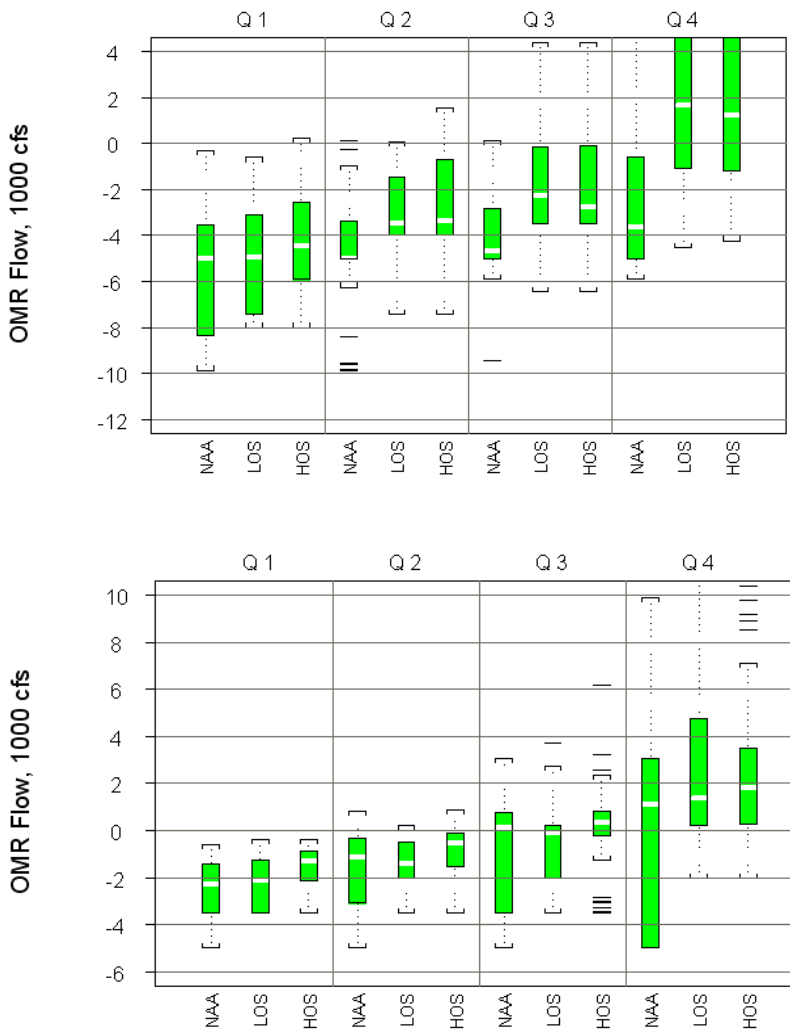


Figure 5.3. Values of OMR under the three alternatives for BDCP shown for quartiles of outflow under the No-Action Alternative. Boxes show first and third quartiles with the median as a white bar. The whiskers encompass points within 1.5 times the interquartile range, and the short lines are outliers. Top, period when adult longfin and delta smelt are vulnerable (Dec-March). Bottom, period when juvenile delta smelt are vulnerable (March-June).

Indirect effects

Net or tidally-averaged flow on the lower San Joaquin River at Jersey Point is parameterized as QWEST. This flow can be negative (i.e., eastward), which is considered an indicator of flow conditions unfavorable to fish. Negative QWEST could alter the speed or path of fish migrating through the Delta, thereby prolonging their migrations or making them susceptible to adverse conditions in the Delta. No field estimates of indirect effects have been made and they are conceptually difficult because the biological effects are difficult to define and because the net flows in the lower San Joaquin River are small compared to tidal flows. Nevertheless, regulatory agencies, particularly the CDFW and the

NMFS, have long expressed concern that negative values of QWEST due to project operations present fish with impediments to their effective migration.

The “east-west flow pattern in the San Joaquin River” referred to in the justification for CM#1 is apparently QWEST. QWEST is calculated in the Dayflow water balance program (<http://www.water.ca.gov/dayflow/>) as:

$QSJR + QCSMR + QMOKE + QMISC + QXGEO - QEXPORTS - QMISDV - 0.65 (QGCD - QPREC)$,
i.e., the sum of inflows from San Joaquin River, eastside streams, and the Sacramento River via the Cross-Delta Channel and Georgiana Slough, minus south Delta exports, miscellaneous diversions in the Delta, and a fraction of the difference between precipitation and consumptive use within the Delta. However, for CALSIM modeling Delta consumptive use (QGCD), Delta precipitation (QPREC), and Delta miscellaneous diversions (QMISDV) are unavailable so the above equation simplifies to:

$QWEST = QSJR + QMOKE + QCSMR + QXGEO - QEXPORTS$.

QXGEO increases with Sacramento River flow and also depends on DCC gate operations. Specifically, QXGEO changes as 13.3% of Sacramento River flow with both DCC gates closed and 29.3% with both gates open (Dayflow documentation cited above). Sacramento River flow into the Delta will decrease by the amount diverted in the north Delta. Thus, among the flows controlled under BDCP, QWEST decreases by 100% of south Delta export flows and 13.3% or 29.3% of north Delta diversion flows depending on DCC gate positions.

There are many covered species of fish that migrate through or reside in the central Delta (Table 5.2). At least one of these species is present in the Delta during every month but August. Conditions in the central Delta are important for migratory species that spawn in the San Joaquin or Mokelumne Rivers because the entire population must pass through the central Delta. By contrast, only a fraction (unknown) of Sacramento fish enter the central Delta during migration. To cover the species that would be most affected by changes in flows in the San Joaquin River, we limit discussion to outmigrating salmonid juveniles (February – April) and upmigrating San Joaquin salmon (September – November).

Juvenile salmon

The occasional high springtime flow requirements of HOS (to benefit longfin smelt) coincide with the smolt emigration season (February – April). In drier conditions (the drier two quartiles) there is very little difference between NAA and LOS (Figure 5.4). The occasional occurrence of high flow requirements in HOS produce some differences between LOS and HOS scenarios, but mostly in the second quartile when the high flows are more likely to be triggered than in the driest quartile. All project scenarios diverge from the NAA under the wetter scenarios as more water is diverted from the north Delta and substitutes for high south Delta exports (Figure 5.4). The several thousand cfs differences in wetter months are occurring against baseline flows in the realm of 20000 cfs and greater, whereas the changes in flows in drier conditions are very small because limited North Delta diversion operations at low flows do not affect broad indices of Delta flow such as QWEST.

Table 5.2. Species of fish covered by BDCP that occur within the Central Delta for specific life history stages and the season of sensitivity to changes in flow conditions due to project operations (from various sources).

Species and Life History Stage within the Delta	Timing
Sacramento and San Joaquin steelhead juveniles	February - April
Winter-run Chinook salmon juveniles	November - April
Spring-run Chinook salmon juveniles	March-May
Green sturgeon	November-December
Delta smelt adults	December-March
Delta smelt juveniles	April-June
Longfin smelt adults	December-February
Longfin juveniles	February-March
Upmigrating San Joaquin steelhead	September-April
Upmigrating spring-run Chinook salmon	March-August
Upmigrating winter-run Chinook salmon	January-May
Upmigrating fall-run salmon Chinook salmon	September-November

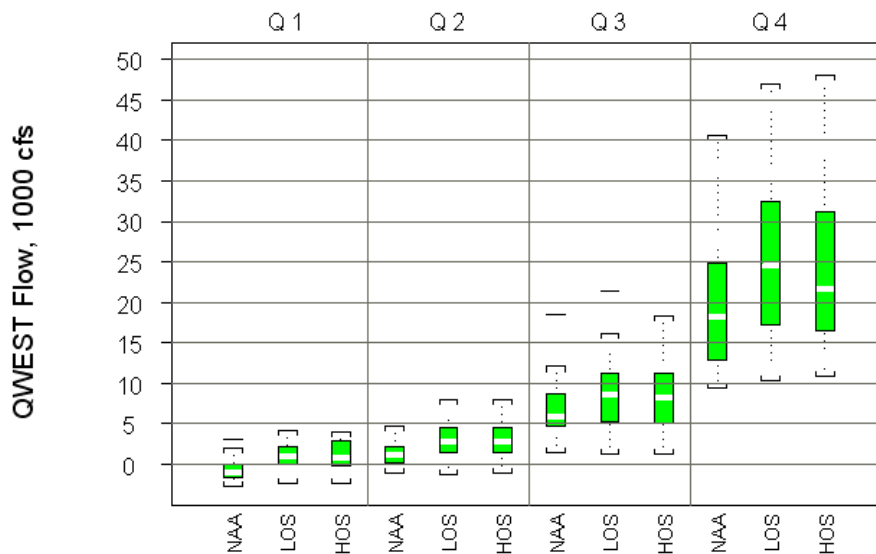


Figure 5.4. Feb-April QWEST flow for NAA and 3 alternative operational scenarios, grouped by quartiles of outflow. Two outliers for each scenario in Quartile 4, with values of 52,000 - 98,000 cfs, were cut off to allow better resolution of the lower values.

Adult San Joaquin fall-run salmon

Upmigrating salmon adults to the San Joaquin River pass through the south Delta and the lower San Joaquin River during September - November. In the fall there is very little difference among the alternatives that is not dwarfed by occasional high inflows due to flood releases or early winter storms (Figure 5.5). However, all alternatives show a general increase in QWEST compared to values for NAA because the use of the North Delta

Diversion is much less restricted and can more often substitute for south Delta diversions that are often operating at maximum flow under NAA.

In summary, project scenarios have small effects on QWEST in any season; changes in QWEST are smaller than those in OMR because use of the North Delta diversion does not translate into direct increases in flow, as it can for OMR. This is true for both the spring and fall. The high flows in HOS produce increases in QWEST in months around median wetness.

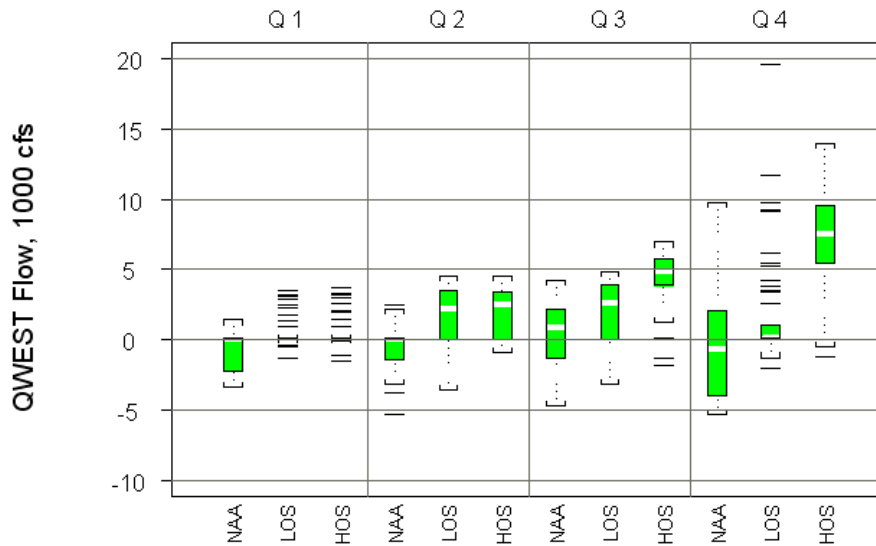


Figure 5.5. QWEST flows for the September-November season grouped by quartile of outflow. One outlier for each scenario in Quartile 4, with values of 22,000 – 30,000 cfs, was cut off to allow better resolution of the lower values.

Conclusion

The analysis presented here demonstrates broad improvement in in-Delta conditions under BDCP, as measured by changes in OMR and QWEST. However, we reiterate our concerns over the likelihood that Delta flows would actually be managed in the manner prescribed by the modeling. Changes in the frequency of reverse flows and their magnitude were somewhat obscured by the high variability among years, even those with similar hydrology. Some of this variability is a consequence of carry-over storage and the specifics of operational rules that may be triggered by conditions in one year but not another even if hydrology is similar. In the context of this variability, the improvements in flow conditions during periods of vulnerability of the smelt and salmon species were modest.

In analyzing model results of the operational scenarios we were surprised to see benefits occurring under dry conditions. The restrictions on North Delta diversions limit its operations to times of substantial river flows, so its ability to substitute for south Delta diversions should be limited to times of high flow. In fact, over a broad range of

intermediate flows, the north Delta diversion augmented south Delta exports, rather than substituting for them. Thus, improvements to in-Delta flow conditions happened mostly in the highest quartile of Delta outflow under NAA. The differences between flows under the LOS and HOS were generally rather small.

Chapter 6: Estimated Effects of BDCP Flows on Smelt

Introduction

This chapter takes the model projections for three scenarios discussed in Chapter 5 (NAA, HOS, and LOS) and uses various simple statistical models to estimate the potential effects of these flows on delta and longfin smelt. The principal flows of interest are:

- Winter and spring flows in Old and Middle Rivers, which affect adult and larval to juvenile delta smelt, respectively
- Fall outflow, which may influence extent of habitat and therefore subsequent recruitment of delta smelt
- Spring outflow, which has a statistical relationship with subsequent abundance of young-of-the-year longfin smelt

We did not consider export effects on longfin smelt, for which there is no available statistical model and therefore no method to estimate losses without additional analysis beyond the scope of this review.

In making the calculations presented here we were constrained to use the CALSIM model output for the various flows by month and year. The concerns expressed in Chapter 5 apply here: *we do not believe that the system will actually be operated to obtain monthly patterns of flow like those in the CALSIM output.* This is particularly true in January and October, when wild swings in flows from one year to the next indicate a situation that would be very unlikely in the real system.

Direct Losses of Delta Smelt

Flows in Old and Middle River are related to salvage of delta smelt and other fish at the south Delta fish facilities. Annual salvage in turn is generally assumed to be a small fraction of entrainment losses, particularly for young (small) fish, because of various other losses attributed to export pumping, including predation in the waterways leading to the facilities and inefficient capture of delta smelt by the facilities.

Here we present estimates of export entrainment losses as a fraction of the population of delta smelt during the adult stage and the larval to early juvenile stage, only a small fraction of which is salvaged (Kimmerer 2008). The calculations were based on results of Kimmerer (2008) as amended for adult delta smelt by Kimmerer (2011). The general procedure was to determine a relationship for each of these two life stages between survival and flow variables that were available from CALSIM. Flows used were Old and Middle River flow (OMR) for adults, and net inflow (i.e., inflow less north Delta diversion flow, NDD) and export flow in the south Delta for larvae and juveniles combined.

We modeled the entire period of CALSIM analysis (WY 1922-2003) for the BDCP scenarios, and the historical period (1955-2003) for comparison. We calculated losses as described in

Appendix C for the BDCP scenarios for both time periods, and for the historical period using Dayflow variables and OMR flows from USGS monitoring.

The principal assumptions were:

- The relationships used to calculate survival or recruitment accurately reflected the corresponding population parameters; that is, the confidence intervals of the predictions were assumed to include the true values of the population parameters with 95% probability. Note that these analyses (Kimmerer 2008, 2011) have not been repeated by any analysts, although Miller (2011) provided a detailed critique. This is rather worrisome, because both the BiOP and several published modeling studies rely on the accuracy of those analyses (Maunder and Deriso 2011, Rose et al. 2013a, b).
- Changes due to BDCP actions were cumulative such that each factor could be examined in isolation from the others, and its effect considered separately from the others.
- The only changes considered were those due to the entrainment effects of flow. Long-term changes in sea level, tidal prism, temperature, salinity, and physical configuration of the Delta were neglected, despite their likely influence on the exposure of the smelt population to export entrainment. Exceptions to this were the influences of these factors on flows modeled by CALSIM.
- The flow time-series produced by CALSIM accurately reflected the influence of the various changes (but note concerns expressed above and in previous chapters).
- The broad spatial distributions of delta smelt will not differ substantially from those existing when the above analyses were made. This may not be true if the fraction of the population in the north Delta is higher now and in the future than when the analyses were made (Miller 2011, Kimmerer 2011).

Losses of adult delta smelt were calculated as a linear function of OMR flows. Annual percent loss under each of the three scenarios was similar for the historical and modeled time periods (Figure 6.1). The estimated proportion of adults lost to entrainment was slightly lower for the NAA than for the historical period, reflecting overall lower export flows presumably because some operating rules were not in force during the historical period. The High- and Low-Outflow scenarios (HOS and LOS) both had proportional losses that were ~ half of those under the NAA, or a net change in loss of about 3%/year.

Losses of larval + juvenile smelt were modeled as a function of exports from the south Delta and inflow to the Delta less diversions from the North Delta facility. The patterns for young smelt were somewhat similar to those for adults but with larger differences among scenarios. The NAA had substantially lower losses than the historical condition over the historical period (Figure 6.2). Flows projected for both the HOS and LOS resulted in much lower losses than for the NAA, with losses under the HOS reduced to ~2%/year on average.

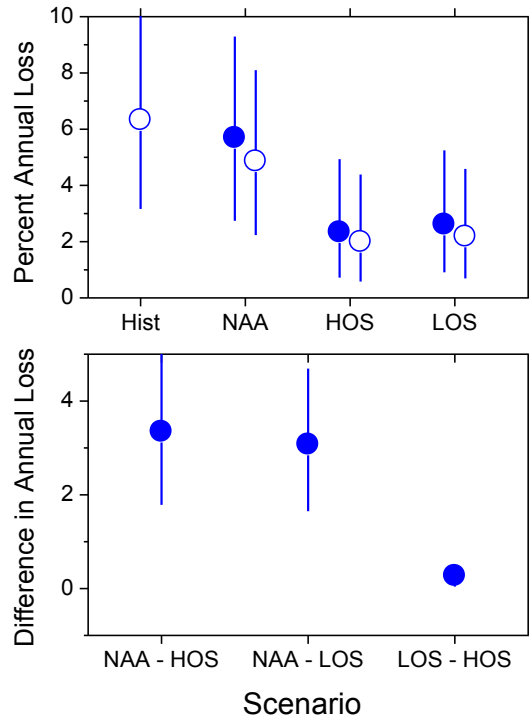


Figure 6.1. Annual percentage of adult delta smelt lost to export pumping for three scenarios and the historical time series. Symbols give means (see text) and error bars give the 95% confidence limit calculated as quantiles of the 1000 simulated samples of the respective distributions. Top panel, percent annual loss for 1922-2003 (filled symbols) and for 1980-2003 (open symbols) including the historical data. Bottom panel, differences between pairs of model scenarios.

We combined results for adults and larvae + juveniles within each calendar year by first calculating the proportion of the population that would remain after 20 years at the mean values in Figures 6.1 and 6.2, then multiplying the proportions remaining to get the influence of these scenarios over both life stages. This is effectively a long-term survival percentage. These are not predictions, and are useful only for examining differences among scenarios. The resulting percentages were 38% for the HOS, 23% for the LOS, and 2% for the NAA (Table 6.1). In other words, the two scenarios with a north Delta diversion resulted in 19- and 11-fold increases in survival over a 20-year period.

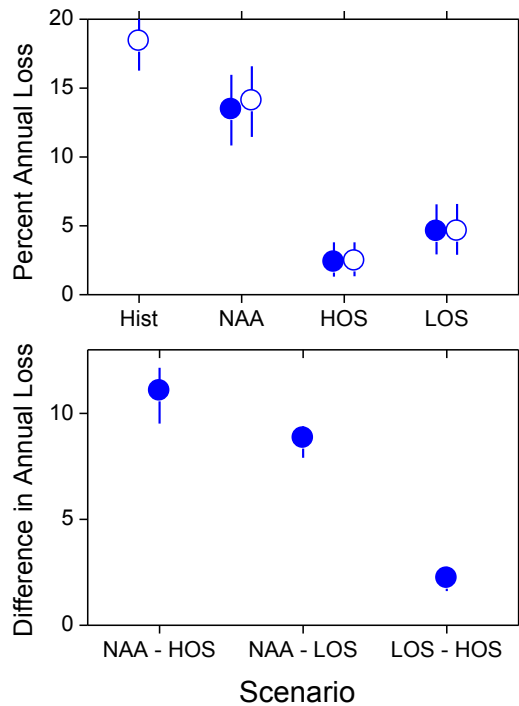


Figure 6.2. As in Figure 6.1 for losses of juvenile delta smelt.

These numbers are highly uncertain, since the value for NAA is so small and variable (Table 6.1). There are indications that losses have been overestimated, especially given the potentially large subpopulation of young delta smelt that may be resident in the Cache Slough complex, where they are immune from effects of export pumping in the south Delta (Miller 2011). Using the upper confidence limits of the projected population size at the end of 20 years (i.e., the lower 95% confidence limits of the loss estimates) the ratios of population remaining after 20 years would have been 14 for HOS and 9 for LOS. These confidence limits do not account for any upward bias in loss estimates, and the loss estimates can and should be refined to reflect current understanding.

Nevertheless, the results of this analysis show a substantial improvement in long-term survival of delta smelt under HOS and to a lesser extent LOS, *provided the water projects are operated in ways that result in flows similar to those in the simulation*. Taken at face value the mean difference in losses between NAA and either of the other scenarios would have roughly sufficed to reverse the decline in delta smelt during the early 2000s.

Table 6.1. Percent of delta smelt population remaining for each of three BDCP scenarios after 20 years of losses at the rates estimated and shown in Figures 1 and 2. Values given with 95% confidence intervals.

	Adults	Juveniles	Combined
NAA	31 ± 22	6 ± 4	2 ± 2
HOS	62 ± 25	62 ± 15	38 ± 19
LOS	59 ± 25	39 ± 15	23 ± 13

Outflow Effects

Two time periods are considered for effects of changed outflow: fall for delta smelt and spring for longfin smelt. These effects are typically cast in terms of X2. For this analysis we calculated X2 from outflow as determined by CALSIM, using the monthly relationship in Jassby et al. (1995), as has been done for all previous analyses of relationships of X2 to abundance indices or habitat of fish (e.g., Feyrer et al. 2007, Kimmerer et al. 2009). CALSIM also produces X2 but it is for the previous month and is somewhat different from that used previously, particularly since it is said to account for sea-level rise and the effects of additional tidal prism due to marsh restoration. Since we were focused on the early long-term (ELT), we elected for now to neglect these considerations and use an X2 value that reflected the anticipated outflows in the same way as in the analyses of X2 effects on fish.

Fall X2 Effects on Delta Smelt

The USFWS Biological Opinion (BiOP) for delta smelt proposes to use X2 in the September-December period as a management tool. The principal basis for this action is the analyses of fall habitat indices (Feyrer et al. 2007, 2011) and an unpublished analysis relating the Summer Towntnet index to the previous fall Midwater Trawl index and X2:

$$TNS_{y+1} \sim a + bMWT_y + cX2_y + \varepsilon_y \quad (6.1)$$

where TNS is the summer townet index, MWT the fall midwater trawl index, y is year, ε is error, a, b, and c are fitted parameters, and the time frame was restricted to after 1987 to account for the changes in the foodweb resulting from the introduction of the clam *Potamocorbula amurensis* (See Chapter 7 regarding food limitation of delta smelt).

This model assumes that the main effect of fall X2 on delta smelt is through a combination of survival and growth and therefore population reproduction in the following spring, resulting in effects on abundance in the following summer. Equation 6.1 is somewhat illogical in modeling TNS as an additive function of MWT and X2, and it is also strongly influenced by the data point from 1998, the wettest fall among those included in the analysis. Removing that point weakens that relationship somewhat, although it remains strong. Nevertheless, we fitted an alternative model:

$$\log(TNS_{y+1}) \sim a + b \log(MWT_y) + cX2_y + \varepsilon_y \quad (6.2)$$

which is more in keeping with the form of the other X2 models (Jassby et al. 1995). This model was fitted to all the data since 1987 using a robust regression method to allow for

some over-dispersion in the residuals (function *rlm*, Venables and Ripley 2003). The regression coefficients were $a=2.7$, $b= 0.62 \pm 0.22$, and $c= 0.061 \pm 0.55$, $R^2=0.68$, and diagnostic plots revealed that this model was appropriate for the data (Figure 6.3). In particular 1998, and unusually wet year, did not have a strong influence on this relationship.

We extrapolated from this model to the BDCP scenarios using the CALSIM-modeled outflows. The target was the summer townet index, which we examined as a ratio to that predicted under NAA. In contrast to earlier analyses, we did not attempt to relate this to long-term population growth.

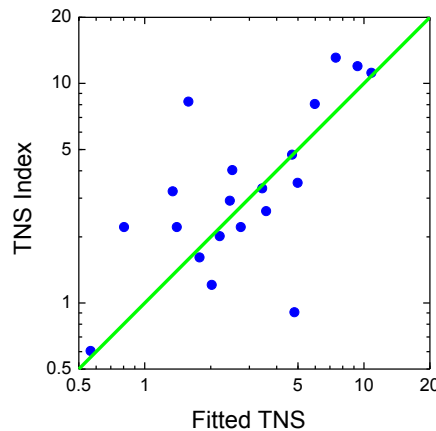


Figure 6.3. Fitted and measured summer townet index (TNS) with a 1:1 line. Values were fitted using Equation 6.2.

The modeled monthly outflow values were converted to X2 according to the monthly equation in Jassby et al. (1995), with the initial value (October 1921) set to the equilibrium X2 for the modeled flow. This was combined with historical monthly mean X2 values and all were averaged over September-December. Equation 6.2 was then used to predict the summer townet index from the mean fall midwater trawl index from 1988 to 2011 and X2 for the three scenarios.

Results showed HOS to have, on average, a slightly higher summer townet index than under NAA (Figure 6.4). The ratio of townet indices determined under HOS to that under NAA was 1.02, i.e., a 2% greater index under HOS, with 10th and 90th percentiles of 0.89 and 1.10 respectively. About a third of the values had lower confidence limits below zero, indicating low confidence that a real increase would be achieved under these conditions.

By contrast, the predicted ratio of townet index for LOS:NAA was about the same as that for HOS:NAA about half of the time, and the other half of the time it was much lower, with large confidence intervals related to the uncertainty in the prediction from the model. The calculated ratio had a median of 0.98 with 10th and 90th percentiles of 0.60 and 1.10. This peculiar pattern arose from the patterns of outflow in the CALSIM output (see Chapter 5). We have very low confidence that these patterns reflect how the system would really be

operated, and therefore suggest these results be considered as conditional on proposed operational rules.

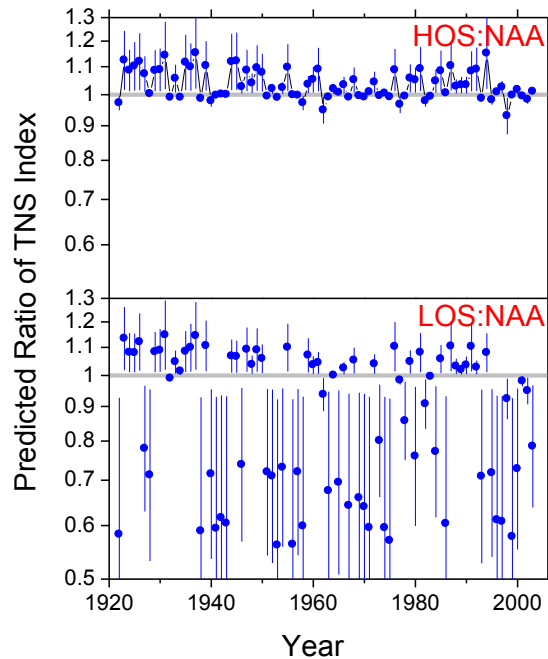


Figure 6.4. Ratios of predicted TNS index by year from HOS (top) and LOS (bottom) to those from NAA.

Spring Outflow/X2 Effects on Longfin Smelt

Longfin smelt has the strongest relationship of abundance index to X2 of any fish (Jassby et al. 1995). The index for a given level of X2 has declined, but the response to flow has not changed. We updated the latest published version of this relationship (Kimmerer et al. 2009) by adding two step changes in time: one in 1987-1988 corresponding to the spread of the clam *Potamocorbula amurensis*, and the other in 2003-2004, the POD decline (Thomson et al. 2010). The statistical model used was

$$\log_{10}(LFS_y) = a_y + bX2_y + \varepsilon_y \quad 6.3$$

Where LFS is the annual index of longfin smelt abundance from the fall midwater trawl survey, y is year, X2 is monthly values averaged over either January-June (as in Jassby et al. 1995) or March-May, and ε is error. Fitting parameters are a , which takes one of three values by year group, and b , the slope of the X2 relationship.

The resulting relationship (Figure 6.5) shows both the effect of X2 and the two step-changes in abundance index. Diagnostic statistics showed that the model was appropriate. Since we were interested in the difference between the two alternative flow scenarios and NAA, the only parameter that concerned us here was b , which had a value of $-0.054 \pm 0.005 \text{ km}^{-1}$, essentially identical to previously published values. Averaging X2 over March-May

gave a slope of $-0.049 \pm 0.005 \text{ km}^{-1}$, and the fit was slightly inferior to that of the January-June model.

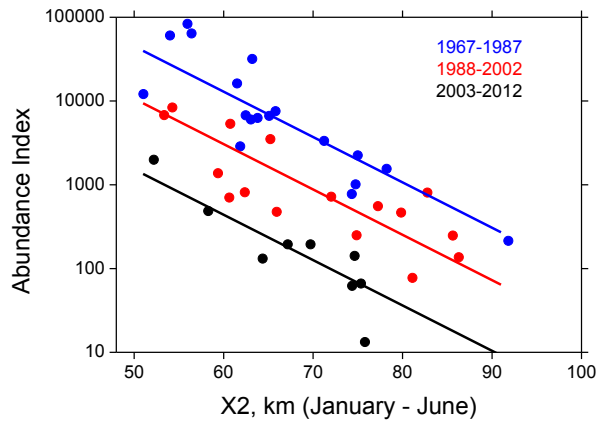


Figure 6.5. Abundance index of longfin smelt vs. X2 averaged over January-June, with step changes between 1987 and 1988 and between 2002 and 2003. Colors of points and lines indicate the time period.

The months selected in the original analysis were based on the assumption that the (unknown) X2 mechanism operated during early life history of longfin smelt, which smelt experts linked to this period. Autocorrelation in the X2 values through months means that statistical analysis provides little guidance for improving the selection of months. A better understanding of the mechanism(s) underlying the relationship would probably allow this period to be narrowed and focused, but for now there is little basis for selecting a narrower period for averaging X2.

The predictions from the above model were then applied to the X2 values calculated from the CALSIM projections of outflow for the 82-year period. We did not attempt to propagate prediction error because it is small compared to variability in outflow. Applying the January-June value for the three selected scenarios resulted in scant differences in predicted abundance indices (Figure 6.6). The median \log_{10} ratio of indices for HOS:NAA was 1.00 (mean 1.05) with 10th and 90th percentiles of 0.91 and 1.27. Corresponding values for LOS:NAA were median 0.92 (mean 0.92) and percentiles of 0.83 and 1.00.

Thus, changes in outflow resulting from the CALSIM projections of spring outflow were small, particularly on the scale of the high variability with X2. HOS provided a minuscule increase in the mean but the median did not change from NAA, indicating that half of the years had higher, and half lower, values under HOS than under NAA. LOS gave values that were ~8% lower than those under NAA.

Although it would be desirable to link such calculations to a population-dynamics model, no such model is available; furthermore, previous analyses have shown that abundance of longfin smelt is highly predictable from X2 and, more recently, groups of years as done above. This does not mean that stock-recruit relationships are unimportant; an alternative analysis models a recruitment index, the log of the ratio of MWT to the MWT value 2 years

earlier, as a function of X2 (Nobriga and Rosenfield, in prep.). However, it is unlikely this analysis would indicate a stronger effect of X2 on longfin smelt under BDCP.

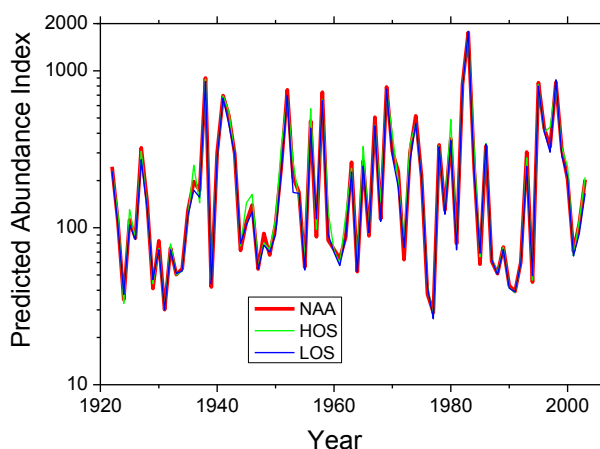


Figure 6.6. Predicted abundance from the model in Figure 6.3 for the three BDCP scenarios. The intercept for the third time period (2003-2012) was used to calculate these indices.

Conclusions

The modeled flow changes under BDCP have mixed effects on the two smelt species. For delta smelt, changes in flow in the south Delta had a marked effect on survival of both adult and young smelt, such that gains of several percent a year would be forecasted for the difference between the NAA and the two with-project alternatives. Effects of outflow on delta smelt were small for HOS compared with NAA, while projections under LOS showed about half the time a marked reduction in predicted summer abundance index compared to NAA. Effects of spring outflow on longfin smelt were not very large.

The results for delta smelt were somewhat surprising, since food supply is clearly an important limitation (Chapter 7) and more likely implicated in the decline than export losses. We nevertheless stand by these results subject to the following contingencies:

- The water projects will be operated to achieve similar flow patterns as in the CALSIM output we used in our analysis.
- Future re-analyses of the influence of export pumping on delta smelt are used to refine these estimates.
- Effects of increasing temperature, introductions of quagga or zebra mussels or other high-impact species, changing flow-X2 relationship, rising sea level, and catastrophic inundation of Delta islands do not materially alter the trajectory of delta smelt.

The last point is presented almost facetiously – things will change, in some ways we can predict and other ways we cannot. The BDCP takes account of some of these changes but others are just as likely over the time frame of the project and should be accounted for

(Chapter 8). Nevertheless, at present we lack the capability to include these factors in a more thorough analysis, but believe it should be done.

Longfin smelt, by contrast, are unlikely to be much affected by BDCP. The anticipated changes in outflow are rather minor, and the flows needed for substantial changes in longfin smelt abundance are likely too great to be practically achieved.

Chapter 7: Likely Response of Listed Fishes to Physical Habitat Restoration

Introduction

This Chapter focuses on the proposed restoration of physical habitat in the Delta and Suisun Marsh. Because of time constraints we have focused on the potential benefits of floodplain and marsh restoration to delta and longfin smelt. These benefits are postulated to occur through expanded physical habitat for the fish, or through export of food from the restored areas to smelt habitat.

Summary of Assessment

The BDCP proposes to restore 55,000 acres of subtidal to intertidal habitat¹ of which 20,600 acres is to be allocated among various Restoration Opportunity Areas (ROAs) in the Delta and Suisun Marsh and the remainder to be allocated later. If completed this restoration will substantially increase the inundated portion of the Plan Area; for example if all 7000 acres assigned to Suisun Marsh were restored it would roughly triple the area exposed to tidal action.

The ROA's include Suisun Marsh, Cache Slough, and the eastern, southern, and western Delta . The documentation is unclear on the depth profiles of these areas and for calculations below we have assumed that about half of each will be intertidal and the remainder subtidal with a mean depth of 2 meters. The document lists the aquatic and terrestrial species expected to benefit from these actions, but here we focus only on their likely effects on the two smelt species.

Our results to date lead to the following preliminary conclusions:

- Delta and longfin smelt are usually food-limited, meaning that population levels would rise if there were more zooplankton in their rearing areas. This limitation is probably stronger in spring-fall than in winter.
- The BDCP is overly optimistic about the likely benefits of tidal marsh restoration to the smelt species, particularly the extent of food production.
- A review of the literature suggests that tidal marshes may either import or export phytoplankton and zooplankton.
- Under highly favorable assumptions about production and export of plankton, restored tidal marshes could make at most a modest contribution to extant plankton production.

¹ "Habitat" means the location and conditions in which a population of a species lives; here we follow the BDCP document in using the term to mean a physical space. We likewise use "restore" to mean to prepare that space for the potential occupation of one or more species, irrespective of the previous condition of the space.

- The subpopulation of delta smelt that inhabit the Cache Slough complex through summer may benefit from additional physical space in that area. The same could be true in Suisun Marsh although current use by smelts is low.
- The high level of uncertainty about outcomes points to the use of moderate- to large-scale experimental restoration projects to determine whether the proposed restoration will achieve the food-production goals and, if so, how to design them optimally.

Marsh Restoration

Review of conceptual basis

The BDCP anticipates many benefits to delta and longfin smelt. Although the documentation is unclear on the expected magnitudes of these benefits, it is uniformly optimistic that they will contribute substantially to recovery of the species. Here we focus on two potential benefits to the smelts from the restoration of tidal habitats. First, the restored habitats are expected to provide a food supply that will enhance the food supply available to the smelts. Second, the restored habitats are expected to provide additional physical space, resulting in an increase in smelt abundance. Neither of these proposed benefits is well developed in the documentation, and the literature cited seems to have been selected to support the claims made. The BDCP documentation furthermore contains factual errors and misinterpretations that cast doubt upon the projections that are made, however qualitative. We therefore conducted a reasonably thorough analysis of these specific claims, within the constraints of time available.

The first outcome requires two conditions: 1) that the smelt populations are currently food-limited, meaning that an increase in concentration of food organisms would result in a higher abundance of smelt; and 2) that the restored marshes will produce and export enough food organisms to make a difference to the population status of the smelts.

BDCP Appendix 5E uses “prod-acres” to index the expected productivity of phytoplankton in the restored areas. However, this index is conceptually flawed in two ways. First, it uses an estimate of growth rate rather than production of phytoplankton, which is the product of growth rate and biomass. Second, it assumes implicitly that all phytoplankton growth is available as food for the zooplankton consumed by the smelt species, but analyses published on the San Francisco Estuary and elsewhere show that most of the production is consumed by benthos and by microzooplankton such as ciliates (e.g., Lopez et al. 2006, Lucas and Thompson 2012, Kimmerer and Thompson submitted).

The smelt species are expected to occupy some of the restored habitats. This may provide benefits in the form of increased opportunities for individual fish to find suitable conditions such as spawning substrate, food patches, or shelter from predators. A potential benefit is to diversify the locations in which the smelt species occur, in an attempt to increase resilience of the populations to local perturbations such as high-temperature periods or toxic spills.

Analysis of components

For effects of food production and export we assessed the evidence for food limitation of the smelt populations, and for the amount of food (zooplankton) that restored marshes would export to waters where the smelt species occur. For physical habitat we examined current patterns of occurrence to determine the likely effect of additional physical habitat on the smelt species.

We do not address other potential indirect impacts of marsh restoration, or interactions with other proposed projects. Restoration of extensive areas of marsh will increase the tidal prism in the restored area. This will affect tidal currents and elevations both locally and all the way to Carquinez Strait, and therefore affect salinity penetration and the movement of sediments. The effects on salinity have been included in the modeling presented in BDCP documents, but we did not review this. The U.S. Army Corps of Engineers has proposed a project, now on hold, to deepen the Sacramento Deep-Water Ship Channel, which is currently an important part of the habitat of delta smelt. This and other non-BDCP projects should be taken into account when considering impacts of BDCP.

Are smelt species food-limited?

What is the evidence for and against food limitation in delta and longfin smelt? By food limitation we mean a situation in which an increase in concentration of food organisms would result in a higher abundance of smelt. This does not require that all or even most fish have depressed growth or reproductive rates, only that at least some of them do. Substantial food limitation would require the following to be true:

1. The density of food organisms is too low to support the maximum growth rate of the fish.
2. Therefore some fish are in poorer condition or grow more slowly than under food satiation.
3. Either or both of the following:
 - a. Survival over a life stage depends on condition and therefore food supply
 - b. Reproductive rate of an adult varies with growth rate during development through its effect on maturity or total eggs per female.
4. Higher reproduction leads to a larger population, all else being equal. We assume this condition must be true as a straightforward consequence of population dynamics.

Food limitation could occur at one or more life stages, which may occupy different parts of the estuary. During spawning and early life delta smelt are mostly in freshwater. During the late larval stage (~July) until the pre-spawning migration in December, part of the population is in the low-salinity zone (LSZ, salinity ~0.5-5), and part is in the Cache Slough-Liberty Island complex in the North Delta (Sommer et al. 2011). Longfin smelt also spawn in freshwater but move earlier and further seaward (Rosenfield and Baxter 2007, Kimmerer et al. 2009). We refer to fish between metamorphosis from the larval stage to their spawning migration as juveniles (i.e., including all fish caught in the fall midwater

trawl survey). Both smelt species consume available plankton in their habitat, with the size of prey related to that of the fish.

Food limitation is surprisingly difficult to demonstrate in a fish population. Nearly all populations must be food limited to some degree. However, food limitation of individual fish can be difficult to detect. The prey and the fish are spatially patchy and temporally variable, so the degree of food limitation is sporadic and patchy. Great differences among individuals in feeding success result in differences in growth and survival, such that the survivors are those that have been well fed. Feeding success also interacts with other influences such as predation risk and physiological stress.

The analysis of food limitation relies on a variety of direct and indirect evidence (Details in Appendix D). Some studies suggest food limitation inferred from correlations of abundance or length with measures of food availability, indices of gut fullness and physiological condition of field-caught smelt, and laboratory-derived estimates of feeding rate in relation to food concentration. A few other studies do not support food limitation in these species. However, the weight of evidence suggests that food is limiting the populations of both smelt species.

Export of food from shallow restored areas

One purported benefit to smelts of restored shallow areas is that elevated food production in these areas will be exported as a subsidy to open waters where the smelts are abundant. The implicit conceptual model is that these shallow areas will produce an excess of phytoplankton and zooplankton that will then be exported by stream flow or tidal currents. A subsidy of phytoplankton could stimulate zooplankton production in the open waters, since the zooplankton in this estuary are chronically food-limited in their growth or reproduction (Müller-Solger et al. 2002, Kimmerer et al. 2005). However, grazing by clams is likely to prevent such a subsidy from having much effect on zooplankton production. The alternative subsidy is that of zooplankton grown within the restored areas, including larger forms such as mysids that are consumed by juvenile longfin smelt and adult delta smelt.

The magnitude of any subsidy depends also on the transport process. Where the transport is mediated by tidally-driven currents, the subsidy will be related to the tidal exchange and the difference in biomass between the restored area and the open water. Where it is mediated by river flow, the subsidy will depend on the net flow and the biomass in the restored area.

Here we examine the literature on subsidies from marshes, use a simple model to estimate the magnitude of such a subsidy of either phytoplankton or zooplankton, and estimate the proportional flux from the Suisun Marsh to Suisun Bay using output from a particle-tracking model as a measure of the extant subsidy. Our conclusions are:

- The literature does not support a confident assertion that marshes will subsidize zooplankton of the open waters.
- Calculated subsidies of phytoplankton and zooplankton are modest under optimistic assumptions about in-marsh production and design of restoration sites.

- A subsidy of zooplankton from Suisun Marsh to Grizzly Bay cannot be very large under current conditions, and is unlikely to be much larger with the proposed extent of restoration.

Do shallow areas export phytoplankton or zooplankton?

Marshes can be major producers of organic matter because of their extensive vegetated surface exposed to sunlight, shallow waters leading to light penetration through all or most of the water column, and the continual supply of nutrients from the open waters and from land (Figure 7.1). This appears to be true even for recently restored marshes (Howe and Simenstad 2011). Over the long term, mass must balance, so production in excess of respiration by organisms within the marsh must be either buried or exported as organic matter or organisms to adjacent estuarine waters.

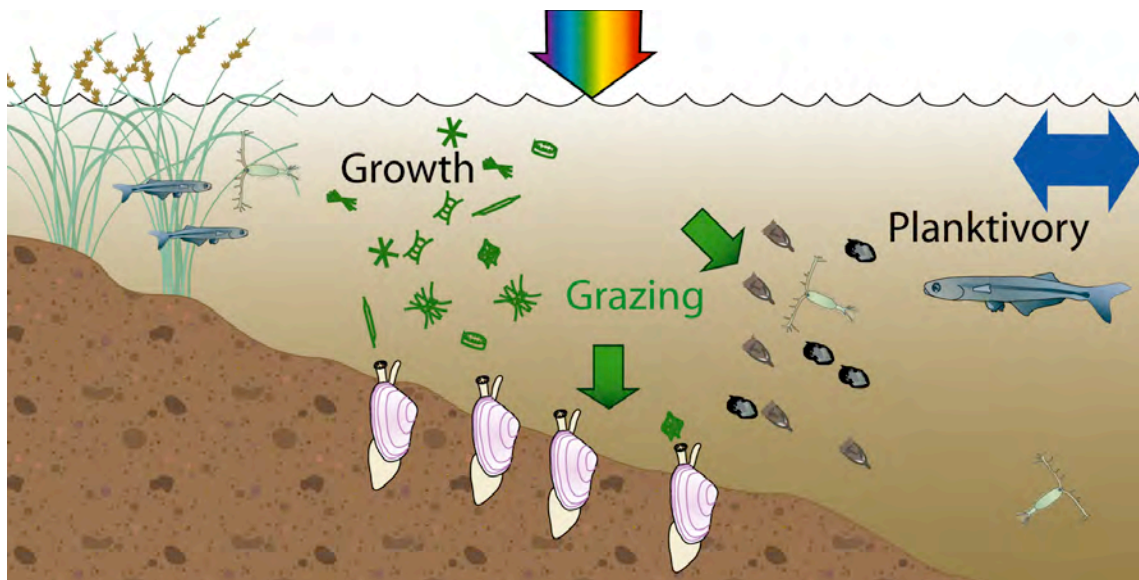


Figure 7.1. Conceptual model of the production of food for pelagic fish in a low-order tidal marsh channel. Because the water is shallow (and may be clearer than in adjacent channels) light penetration is good and growth of phytoplankton and benthic microalgae is high. Losses of phytoplankton occur through benthic grazing and by pelagic grazing, chiefly by microzooplankton but also by larger zooplankton such as copepods that can be consumed by fish. Benthic grazers filter a certain volume of water every day, so the shallower the water the more intensive the grazing on the plankton of the marsh. Small planktivorous fish such as Mississippi silversides seek shelter in the shallowest and vegetated areas; thus consumption of zooplankton is also more focused and more selective for larger organisms in shallow water. Tidal exchange of water with the adjacent higher-order (larger) channel transports nutrients, organic matter, and plankton between marsh and channel, but the direction of transport for zooplankton may be in or out of the marsh depending on the outcomes of the various production and consumption processes.

Export of organic matter from marshes to adjacent estuarine waters was first considered as the "outwelling hypothesis" (Odum 1980, Nixon 1980). This hypothesis holds that the export of labile organic matter provides an important subsidy to nourish adjacent waters of the estuary or continental shelf.

The outwelling hypothesis originated in studies of extensive, rich marshes on the east and Gulf coasts, but even there, quantitative demonstrations of its importance to estuarine or coastal foodwebs were few (Dame et al. 1986). Much of the difficulty arises from the technical challenge of measuring a small net flux in a large tidal signal with high variability (Dame et al. 1986). In addition, dissolved and particulate organic matter produced by rooted vegetation can be highly refractory and therefore largely unavailable to estuarine pelagic foodwebs, which are usually fueled mainly by phytoplankton (Sobczak et al. 2002, 2005).

Marshes can be sites of high productivity by benthic or planktonic microalgae because they are shallow, so waters are well-lit. Therefore a marsh could export organic matter as living phytoplankton. However, the extent of this export depends on consumption within the marsh, including consumption of phytoplankton by benthic grazers in shallow waters, as illustrated for flooded islands in the Delta by Lopez et al. (2006). Often overlooked in attempts at a mass-balance of phytoplankton is the high rate of consumption by microzooplankton, which typically consume about 60% of the production by phytoplankton in estuaries (Calbet and Landry 2004, York et al. 2011). Thus, the production actually available for consumption by mesozooplankton, and for export, is considerably lower than would be expected from estimates of primary production.

For zooplankton the magnitude and direction of the flux depends on behavior and on size- and taxon-specific patterns of mortality. In particular, visual predation by fish can exert strong control on the size distributions, and therefore species distributions, of zooplankton (Brooks and Dodson 1965). Vertical movements of zooplankton and hatching or settlement of larvae can lead to spatial patterns of abundance that do not reflect tidal transport (Houser and Allen 1996). Consumption of zooplankton by small fish that seek food and shelter in shallow areas can reduce zooplankton abundance near shore, and shift the size distribution toward smaller forms, in lakes (Brucet et al. 2005, 2010), lagoons (Badosa et al. 2007), and marshes (Cooper et al. 2012). The outcome can be net fluxes into shallow areas (Carlson 1978, Kimmerer and McKinnon 1989), and marshes can be simultaneously sinks for copepods and areas of aggregation for bottom-oriented larvae (Mazumder et al. 2009).

Thus, marshes may act either as net sources or sinks for plankton in the adjacent waters, depending on the availability of habitat for small fish and the degree of colonization by benthic grazers such as clams. The exact details of the exchange processes depend on the physical configuration of the marsh including permanence of inundation (Brucet et al. 2005), residence time of the water (Lucas and Thompson 2012), and the biological composition, i.e., the kinds and abundance of producers and consumers within the marsh including transient organisms (Kneib 1997). If the excess organic matter is being

transported by fish as in some east coast marshes (Kneib 1997), little benefit would accrue to planktivorous fish in the open waters such as the smelts.

Few of these aspects have been examined in marshes of the San Francisco Estuary. Long-term studies of Suisun Marsh have revealed a lot about fish assemblages (e.g., Matern et al. 2002, Feyrer et al. 2003) and medusae and some zooplankton (Wintzer et al. 2011, Meek et al. 2013), and some detailed studies of exchange processes have been undertaken (Culbertson et al. 2004). Zooplankton abundance is highest in small sloughs of long residence time (P. Moyle, UC Davis, personal communication).

Foodwebs in diverse marshes of the San Francisco Estuary are supported more by local plant production than by estuarine phytoplankton (Howe and Simenstad 2007, 2011). This implies a division of organic-matter sources between those supporting littoral and marsh foodwebs and those supporting pelagic foodwebs (Grimaldo et al. 2009).

Lehman et al. (2010) estimated the fluxes of various substances in and out of Liberty Island, a flooded island in the Cache Slough complex in the northern Delta. They found large seasonal shifts in the magnitude and direction of fluxes. In particular, seasonal chlorophyll flux was into Liberty Island in spring and out in fall, based on point measurements, and into the island in all seasons but more so in spring and summer, based on the continuous measurements. Fluxes of copepods were out during spring and fall, and in during summer, based on a total of six sampling days. Although Lehman et al. (2010) linked fluxes into Liberty Island with storage within the island, it was equally likely to have been a function of consumption, particularly since high inward fluxes of chlorophyll and zooplankton occurred in summer when biological activity would have been high.

A few other marshes and restoration sites in the estuary have been investigated for their potential links to open waters. The South Bay Salt Ponds, which began to be reconnected to the tidal action of the Bay in 2006, are highly productive and may export organic matter to nearby estuarine waters (Thebault et al. 2008). A marsh at China Camp in San Pablo Bay was a net sink for mysids, probably through predation within the marsh (Dean et al. 2005).

Calculated subsidies

Here we assume that the restored areas will actually produce an excess of phytoplankton or zooplankton over adjacent waters, and ask what additional level of food availability to the smelt would result. This is based on a very simple model using data from IEP monitoring, described in detail in Appendix E (See Figure 7.2). The basis of this model is to calculate the subsidy based on high levels of biomass and growth rate in a 2500-acre marsh that is closely connected to smelt habitat and has an optimum rate of exchange with the open water. We assume smelt habitat is represented by the Low-Salinity Zone (LSZ), which has a volume of about 0.5 km³.

A subsidy is maximized by a large marsh close to the smelt habitat, with tidal exchange close to but not above the net population growth rate of the plankton (Figure 7.3). The subsidy is degraded or even reversed by consumption (clams, planktivorous fish) within the marsh. Water depth may have a positive or negative effect on the subsidy.

The simple model in Appendix E shows that under an extremely favorable set of conditions both within and outside of the marsh, a modest subsidy of phytoplankton is possible.

Phytoplankton input to the LSZ could amount to 16%/day, or about half of the daily net production in the LSZ. However, smelt species do not eat phytoplankton, and the conversion of phytoplankton to zooplankton depends on factors in the open water such as grazing. The direct subsidy of zooplankton would be about 3%/day, also under unrealistically ideal conditions. Although this is not negligible, any reduction in this value would effectively eliminate the subsidy to open water.

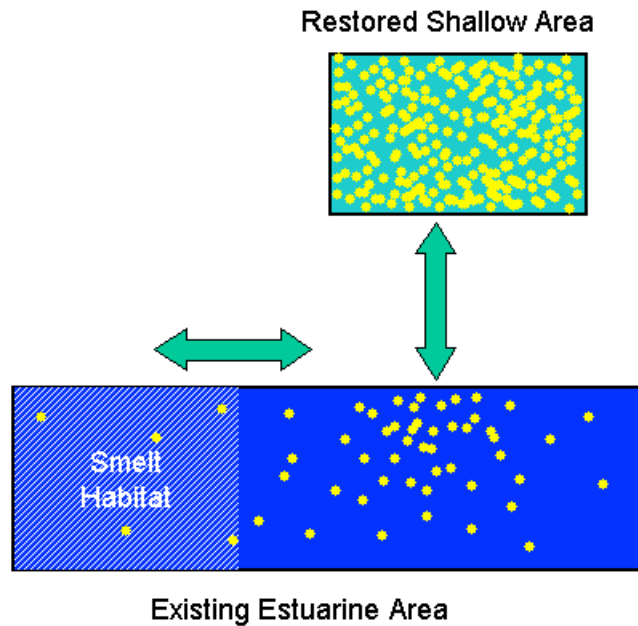


Figure 7.2. Schematic diagram of a subsidy of zooplankton (yellow circles) from a restored tidal marsh or other shallow area to an existing estuarine area. Zooplankton move by dispersion (double-sided arrows) between the restored and existing areas, and within the existing area from the outlet of the restored area to other regions of the estuary including smelt habitat. Advection may alter the flow of zooplankton, for example, if the restored area is on a creek that produces a net flow into the existing area.

Zooplankton export from Suisun Marsh

One of the proposed restoration areas is in the northern end of Suisun Marsh. We estimated the subsidy of copepods to the LSZ from this region using IEP monitoring data and using a particle-tracking model to estimate exchange rate (Appendix E). If the copepods behaved as passive particles, this subsidy would amount to about 2%/d of the population in the LSZ. This is unlikely to produce a noticeable increase in copepod biomass, as their potential population growth rates are on the order of 10%/d. However, particles that migrate to the bottom tidally or remain near the bottom, as most zooplankton

do in the estuary (Kimmerer et al. 2002), were essentially trapped within the northern marsh. Behavioral responses to tidal currents, consumption within the marsh, the distance from the mouth of the marsh to the habitat of the smelts, and the operations of the salinity control gate on Montezuma Slough would all reduce or even eliminate this subsidy.

The real world

Several features of the actual restoration site would alter the subsidy to open waters from the analyses above. First, the enlarged restoration area will alter the tidal prism and therefore the exchange rate. The proposed restoration for Suisun Marsh would increase the inundated area 2-3-fold, with a corresponding increase in tidal currents. Since most of the exchange will be mediated by tides, this could substantially increase the exchange rate. Whether this would increase or decrease the subsidy would depend on the net population growth rate achieved in the marsh in relation to the exchange rate. Resolving the change in residence time would require a 3D model with very accurate bathymetry throughout the region. It is impossible to tell with available information whether the stronger tidal connections would result in a greater subsidy from Suisun Marsh, or whether this would be offset by zooplankton behavior or by consumption within the marsh. Such calculations could be done using a hydrodynamic and particle tracking model and some reasonable assumptions about zooplankton behavior.

The BDCP documents acknowledge (but then mostly ignore) that grazing by clams that settle in or near restored subtidal areas may remove all or most of the phytoplankton production and some of the zooplankton. Grazing by clams and zooplankton (including microzooplankton) removed all of the phytoplankton production in the LSZ nearly all the time from late spring through fall during 1988 – 2008 (Kimmerer and Thompson submitted.). Whether clams settle in the newly restored areas is critical in determining whether the area can export any phytoplankton (Lucas and Thompson 2012). At present clams are not abundant in Suisun Marsh except for the larger Suisun and Montezuma Sloughs, where they probably remove a substantial fraction of the phytoplankton and small zooplankton that would otherwise enter Grizzly Bay.

Zooplankton organisms are not passive, and undergo tidal migrations in Suisun Bay (Kimmerer et al. 1998, 2002). It is very likely that they will do so also in marsh channels, which would greatly lengthen the residence time for copepods produced in the marsh, particularly in the far northern area of Suisun Marsh. In addition, several studies have shown that zooplankton organisms may also be consumed by various planktivorous fish within a marsh, resulting in a net flux of zooplankton into the marsh (see literature review above).

Finally, some of the proposed restoration sites are far from the centers of distribution of delta and longfin smelt. Travel times from these sites to where the fish are may be on the order of weeks to months in the dry season or when the North Delta diversions are operating (Kimmerer and Nobriga 2008). A plankton population can double or halve its biomass in a few days depending on local food supply and predation. Thus, any export of zooplankton from a restored area should be assumed to subsidize only the local area.

All of these considerations are based on rather crude models of exchange and population processes. That is appropriate given the level of specificity of the BDCP design.

Nevertheless, this analysis raises significant questions about the putative subsidy from restored areas to estuarine foodwebs. To address this uncertainty, long before any actual restoration takes place a program of analysis, modeling, and experimental restoration should be undertaken.

Likely use of restored areas

Like other fish, smelt use a variety of habitats and appear to explore their environment to find suitable places for spawning, growth, and development. As pelagic fish, their principal habitat is open waters of the estuary, either in freshwater during the larval to early juvenile stages in spring to early summer, or in the low-salinity zone until winter. The low-salinity zone during summer-fall is generally in the western Delta and Suisun Bay, including the channels of Suisun Marsh. Delta smelt appear to be surface-oriented, which would allow them access to shallow areas (Aasen 1999).

The fundamental problem for both smelt species in the open-water, brackish regions of the estuary is the low food supply (discussed above) and possibly also the decreasing turbidity (Kimmerer 2004). Those trends may be difficult to reverse, spelling trouble ahead for the smelts. However, in recent years some proportion of the delta smelt population has remained in freshwater in the Cache Slough complex, despite high temperature there (Sommer and Mejia 2013). This may provide an alternative habitat in which the smelt population can either avoid poor conditions in the LSZ, or hedge its bets on future conditions. Longfin smelt are apparently not very abundant in Cache Slough.

Delta and longfin smelt have been collected in the Suisun Marsh fish survey (Matern et al. 2002). Delta smelt are not common in Suisun Marsh during summer-fall but were formerly common in winter to early spring (Matern et al. 2002) when the fish are migrating and spawning. About 0.7% of 3291 otter trawl samples from the Suisun Marsh survey during May-October of 1982 – 2009 and about 3% of 3320 samples during November – April contained delta smelt, mostly maturing juveniles and adults. The low catches in summer were not due to small size of the fish, since young-of-the-year longfin smelt of the same size range were captured frequently in that program. Temperature in the larger sloughs is ~1°C higher than in Grizzly Bay in July and August, based on IEP and UC Davis monitoring data, but if smelt avoid the warmer water in summer it does not explain the low catches for all of May-October. Longfin smelt are much more abundant in the Suisun Marsh channels than delta smelt, occurring in 8% of samples in May-October and 12% of samples in November-April with no obvious differences among the various sloughs.

The 20mm survey catches smelts during spring-summer in Montezuma Slough in Suisun Marsh and in central Suisun Bay including one station in Grizzly Bay near the major western entrance to the marsh. A graphical comparison of catch per trawl in these locations did not reveal a consistent difference for either species. A similar comparison of catch per trawl between Montezuma Slough and Grizzly Bay in the Fall Midwater Trawl survey also did not reveal a consistent difference, except that delta smelt were somewhat less abundant in the slough than in Grizzly Bay during September. Thus, it appears delta and longfin smelt are roughly as abundant in the larger sloughs of Suisun Marsh as in the open water of the estuary.

The key question for this aspect of restoration is whether additional physical habitat would result in larger populations of smelt. Abundance of delta smelt is related to an index of habitat availability based on salinity and turbidity (Feyrer et al. 2007, 2011, Nobriga et al. 2008). However, the size of the LSZ (volume or area) does not seem to be strongly related to the abundance of either smelt species (Kimmerer et al. 2009, in press). This may be because the LSZ is a contiguous stretch of water whose physical features are ephemeral, and the fish can move around readily within that region. In contrast, shallow tidal areas may offer enough physical structure to provide a wealth of sub-habitats with variable conditions. In that case, having more habitat area could lead to a greater abundance of fish. Note that a relationship between the quantity of habitat and the size of a fish population need not rely on a density-dependent relationship between habitat and the survival or reproduction of individual fish, which seems unlikely for delta smelt at current population levels.

Thus, we are cautiously optimistic that restoration of habitat may result in colonization and subsequent population expansion of delta smelt in the Cache Slough area including the Sacramento Ship Channel (Moyle 2008, Sommer and Mejia 2013). Longfin smelt seem unlikely to benefit from this. We cannot determine whether either species would benefit from similar restoration in the Suisun Marsh or the western Delta. The other restoration sites are too remote from the current population centers to offer much reason for optimism about their colonization by either smelt species.

Floodplain

The BDCP proposes to alter the Fremont Weir at the upstream end of the Yolo Bypass so that the Bypass would flood at lower stages of the Sacramento River. We consider here only the likely effects on the smelt species.

Review of conceptual basis

Although the smelt species do not use floodplain as habitat, elevated production of plankton on the floodplain may provide a subsidy to smelt habitat. This situation differs slightly from that of the potential subsidy from marshes discussed above. First, the floodplain is a flow-through system so that increased biomass of plankton will be transported by the mean, river-derived flow rather than by tidal flow. Second, residence time on a floodplain varies with flow conditions, from hours to a few days under high-flow conditions to effectively infinite in ponds remaining after the floodplain stops draining.

Analysis of components

Apart from its suitability as habitat for fish and other species, the Yolo Bypass may also support foodwebs within the estuary. The mechanism for this would be higher phytoplankton and zooplankton production because of shallow depth and better light penetration than in river channels, as well as higher temperature (Lehman et al. 2007). Whether this translates to zooplankton is uncertain; zooplankton abundance on the Bypass was similar to that in the Sacramento River during 1998-2001 (Sommer et al. 2004). Plankton biomass on a floodplain may increase late in the season as residence time

increases and fish switch to larger prey (Grozholtz and Gallo 2006), but that was not observed on the Yolo Bypass in most years (Sommer et al. 2004).

At very high flows residence time on the Bypass is probably too short to allow for a buildup of biomass, while at lower flows such a buildup may occur but the rate of export may be low (Schemel et al. 2004). This implies that, as with tidal exchange in marshes (Figure 7.3), there is an intermediate range of flow that maximizes export of plankton.

A subsidy from the Yolo Bypass may be more or less direct to delta smelt habitat, notably in the Cache Slough complex at the southern end of the Bypass. In addition, it may subsidize the low-salinity habitat used by both smelt species in late spring through fall.

In Appendix F we examine the evidence for a subsidy of zooplankton to the open water of the estuary under the current configuration using existing zooplankton data. We do not actually calculate the magnitude of the subsidy, since several factors would intervene to alter conditions. In particular, the Bypass could be flooded later in the year than is now the case, and the greater light penetration and higher temperature would provide for greater plankton production than now occurs. Furthermore, Bypass flow would represent a greater proportion of total inflow to the Delta later in the year, resulting in less dilution of the plankton coming off the Bypass.

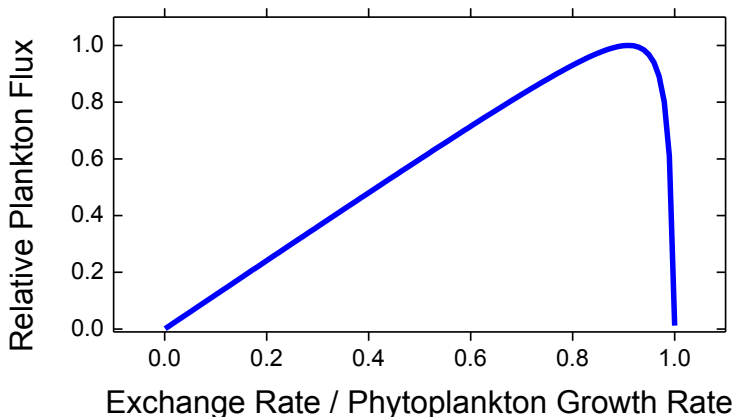


Figure 7.3. Relative magnitude of phytoplankton flux from a tidal marsh as a function of exchange rate, scaled to the growth rate of the phytoplankton. The model is based on a balance among import of nutrients to the marsh, uptake of nutrients to support growth of phytoplankton, and export of phytoplankton. All nutrient uptake is by phytoplankton, there is no consumption, and the phytoplankton concentration in the receiving water is zero.

Our analysis shows no evidence that the open waters of the estuary receive a detectable subsidy of phytoplankton or zooplankton. If anything, plankton abundance is inversely related to Yolo Bypass flow, either during the month of sampling between flow during the winter and zooplankton abundance in the following summer.

Conclusions

There are many reasons for restoring physical habitat in the Delta and Suisun Marsh, and a host of species that are likely to benefit. Among the listed fish species, young salmon use marsh and floodplain during residence, salutatory downstream movement, and active migration. However, it is unclear whether conditions in the Delta have a substantial role in the population dynamics of salmon, and therefore we have elected to focus on the smelt species, for which the Delta is a key part of home (Sommer and Mejia 2013).

The BDCP is overly optimistic about the potential benefits to delta and longfin smelt of physical habitat restoration. Longfin smelt do not appear to use marshes as habitat to any great extent. Delta smelt are also considered pelagic but their persistent abundance in the Cache Slough complex, and greater abundance in shallow rather than deep water, suggests some potential benefit to their population of expanded marsh in that area. The magnitude of this benefit is impossible to predict, as is the degree to which marsh and floodplain restoration might cause an increase, or reverse the decline, in the delta smelt population. Under these conditions it is premature to assert that the restoration activity will have such an effect, until studies including pilot projects and even some smaller full-scale restoration projects can show whether an effect is to be expected.

The idea that restored marsh and floodplain will export substantial amounts of zooplankton to the open waters of the estuary is not tenable. The ecology of shallow waters suggests that shallow areas are more likely to be sinks for zooplankton. Even if they were sources, simple mass-balance considerations indicate that the resulting export would produce at most a small enhancement of extant zooplankton of the open waters. This idea should be dropped from discussions of BDCP, although experimental work should press ahead to determine under what conditions marsh habitats could be sources of significant food for delta and longfin smelt in the open waters.

Chapter 8: Regulatory Oversight and Assurances

Introduction

The previous chapters have demonstrated the relatively high uncertainties associated with proposed conservation actions in BDCP. These uncertainties will likely result in the need to change Plan goals and objectives in the future, along with the prescribed conservation measures to address them.

This chapter addresses the question whether the draft Bay Delta Conservation Plan includes governance policies that are “transparent and resilient to political and special interest influence.” We divide our analysis into two parts: (1) analysis of the regulatory oversight of plan implementation and adaptive management; and (2) evaluation of the regulatory assurances and proposed 50-year “no surprises” guarantee.

Regulatory Oversight

Introduction

The draft BDCP vests primary responsibility for implementing the Plan in a Program Manager, who shall “ensure that the BDCP is properly implemented throughout the duration of the Plan” (BDCP 7-2). The Program Manager’s authority is broad and includes protection and restoration of habitat, reduction of ecological stressors, management of conserved habitat, coordinated operation of the CVP and SWP, and development of the new facilities authorized by the Plan (BDCP 7-3).¹

The Program Manager’s implementation of the BDCP is subject to oversight by the Authorized Entity Group, which will be comprised of the Director of the California Department of Water Resources as operator of the SWP, the Regional Director of the U.S. Bureau of Reclamation as operator of the CVP, and one representative each of the CVP and SWP contractors if the contractors are issued permits under the Plan (BDCP 7-8).² The BDCP also covers certain diversions of water that are not part of CVP or SWP operations and recognizes that these water supply operators may seek incidental take permits under the terms and conditions of the BDCP. If this occurs, these water projects would become Authorized Entities, but would not be members of the Authorized Entity Group (BDCP 7-8).

¹ The Program Manager also will have responsibility over the Implementation Office, which will assist the Program Manager in all aspects of implementation of the Plan, BDCP 7-4 to 7-5, and the Science Manager and Adaptive Management Team as described in Chapter 9 of this report.

² A question has arisen whether the fish and wildlife agencies legally may grant incidental take permits to the CVP and SWP contractors under the federal Endangered Species Act and the California Natural Community Conservation Planning Act. We address this question in the Appendix G.

The Authorized Entity Group’s authority over the BDCP also is broad and multifaceted. The draft BDCP states:

The Authorized Entity Group will provide oversight and direction to the Program Manager on matters concerning the implementation of the BDCP, provide input and guidance on general policy and program-related matters, monitor and assess the effectiveness of the Implementation Office in implementing the Plan, and foster and maintain collaborative and constructive relationships with the State and federal fish and wildlife agencies, other public agencies, stakeholders and other interested parties, and local government throughout the implementation of the BDCP (BDCP 7-8 to 7-9).

This oversight structure means that the Authorized Entity Group will exercise significant authority over both the coordinated operation of the CVP and SWP and implementation of the BDCP itself. Indeed, the draft Plan declares that the Program Manager “will report to the Authorized Entity Group, and act in accordance with the group’s direction” (BDCP 7-2).

The draft Plan vests regulatory responsibility within the BDCP in a “Permit Oversight Group,” which is composed of the Regional Director of the U.S. Fish and Wildlife Service, the Regional Administrator of the National Marine Fisheries Service, and the Director of the California Department of Fish and Wildlife (BDCP 7-11). It then states that the three agencies “are expected to issue regulatory authorizations to the Authorized Entities” pursuant to the federal Endangered Species Act and the California Natural Community Conservation Act (BDCP 7-11).

The draft Plan also provides that, “[c]onsistent with their authorities under these laws, the fish and wildlife agencies will retain responsibility for monitoring compliance with the BDCP, approving certain implementation actions, and enforcing the provisions of their respective regulatory authorizations” (BDCP 7-11). This means that, although the USFWS, NMFS, and CDFW will work together as members of the Permit Oversight Group for the purpose of supervising implementation of the BDCP, each agency will retain its independent regulatory powers over the CVP, SWP, and other water users under the federal and state Endangered Species Acts.³

This structure is consonant with both the Endangered Species Acts and the California Natural Community Conservation Planning Act, because it separates the regulatory oversight responsibilities of the federal and state fish and wildlife agencies from the operational responsibilities of the Program Manager and the Authorized Entity Group. This structural delineation is undermined, however, by the draft Plan’s more detailed definition of the “function” of the Permit Oversight Group, which blurs the distinction between implementation and regulation. It also is undermined by provisions in the draft Plan that grant the Authorized Entity

³ This independent regulatory authority is subject, however, to an important caveat—the draft Plan’s requirement of consistency between future section 7 consultations and the BDCP—as described below. See pp. 7-8 to 7-9.

Group—rather than the regulatory agencies—veto authority over changes to the conservation measures, biological objectives, and adaptive management strategies, as well as over amendments to the BDCP itself.

Regulatory vs. Programmatic Responsibilities: Implementation

The draft Plan grants the Permit Oversight Group a significant role in implementing the conservation goals and adaptive management strategies of the BDCP:

The Permit Oversight Group will be involved in certain decisions relating to the implementation of water operations and other conservation measures, actions proposed through the adaptive management program or in response to changed circumstances, approaches to monitoring and scientific research (BDCP 7-11).

It then provides that the Permit Oversight Group “will have the following roles, among others, in implementation matters”:

- *Approve, jointly with the Authorized Entity Group, changes to conservation measures or biological objectives proposed by the Adaptive Management Team.*
- *Decide, jointly with the Authorized Entity Group, all other adaptive management matters for which concurrence has not been reached by the Adaptive Management Team.*
- Provide input into the selection of the Program Manager and the Science Manager.
- *Provide input and concur* with the consistency of specified sections of the Annual Work Plan and Budget with the BDCP and with certain agency decisions.
- *Provide input and concur* with the consistency of the Annual Delta Water Operations Plan with the BDCP.
- Provide input and accept Annual Reports.
- *Provide input and approve* plan amendments⁴ (BDCP 7-11 to 7-12: emphasis added).

These definitions are poorly drafted, and they assign programmatic authority to the fish and wildlife agencies that may undermine their regulatory responsibilities. We therefore recommend that the draft BDCP be revised in two ways:

First, where the parties to the negotiations want to grant the Permit Oversight Group authority to determine whether certain actions or documents are consistent with the BDCP, the Plan should define its responsibilities more clearly and precisely than does the current language—*e.g.*, “provide input and concur”; “provide input

⁴ The draft Plan also contains a placeholder “function,” which states that the Permit Oversight Group also may play a role in “decision-making regarding real-time operations, consistent with the criteria of *CM1 Water Facilities and Operation* and other limitations set out in the BDCP and annual Delta water operations plans.” As the details of this role as still under negotiation, we do not address it here except to note that the role of the Permit Oversight Group should be clearly defined and limited to regulatory oversight as explained in the text.

and accept”; and “provide input and approve.” Thus, the draft Plan should be revised to state:

The Permit Oversight Group shall have exclusive authority to determine whether the Annual Work Plan Budget and Annual Delta Operations Plan are consistent with the BDCP. If the Permit Oversight Group does not issue a determination of consistency, the document in question shall be revised and resubmitted to the Permit Oversight Group for approval or further remission and revision.

Second, the Permit Oversight Group’s role should be limited to regulatory oversight. The “functions” listed in the draft Plan conflate the Permit Oversight Group’s regulatory responsibilities with the programmatic implementation duties that are best left with the Program Manager and the Authorized Entities Group. Although there is some practical value in collaboration among the regulators and the regulated—*e.g.*, having the fish and wildlife agencies give their “input” during the drafting of annual operations plans—it is better policy to maintain the exclusive regulatory role of the Permit Oversight Group. A regulatory agency that has a stake in the creation of the program and policy decisions that it must ultimately review will not be able to bring its independent judgment to bear in evaluating those same decisions for consistency with the Plan and other applicable laws.

The conflation of regulatory and programmatic responsibilities is especially dangerous in the case of revisions to the biological objectives, conservation measures, and other adaptive management strategies. As currently written, the draft Plan grants the Authorized Entity Group an effective veto over proposed changes to these programs, even if the Adaptive Management Team, the Science Manager, the Program Manager, and the Permit Oversight Group have concluded that changes are needed to ensure programmatic compliance with the BDCP or to fulfill the requirements of the federal and state Endangered Species Acts (BDCP 7-11).

A better course would be to revise the draft Plan to allow the Science Manager and Adaptive Management Team—subject to oversight and approval from the Program Manager and Authorized Entity Group—to make revisions to the biological objectives, conservation measures, and other adaptive management strategies. These changes then would be submitted to the Permit Oversight Group for review and approval or remission. The Permit Oversight Group also should have independent authority to revise the biological objectives, conservation measures, and other adaptive management strategies if it concludes that the existing programs are inadequate to comply with the BDCP or other governing law.

Regulatory vs. Programmatic Responsibilities: Policy Modifications and Amendments to the BDCP

A similar problem exists for modifications to the BDCP itself. The draft Plan recognizes that “Plan modifications may be needed periodically to clarify provisions or correct unanticipated inconsistencies in the documents” (BDCP 6-45). It then

identifies three types of plan modifications: administrative changes, minor modifications, and formal amendments. Only the latter two concern us here.

The draft Plan defines “minor modifications” as including transfers of acreage between Restoration Opportunity Areas or conservation zones and “[a]djustments of conservation measures or biological objectives . . . consistent with the monitoring and adaptive management program and intended to enhance benefits to covered species” (BDCP 6-46). It then describes “formal amendments” as including, but not limited to:

- Changes to the geographic boundary of the BDCP.
- Additions of species to the covered species list.
- Increases in the allowable take limits of covered activities or the addition of new covered activities to the Plan.
- Substantial changes in implementation schedules that will have significant adverse effects on the covered species.
- Changes in water operations beyond those described under *CM1 Water Facilities and Operations*. (BDCP 6-47).

The “minor modifications” and “formal amendments” thus include all aspects of BDCP implementation that will be vital to the success or failure of the BDCP. Yet, the draft Plan expressly provides that the Authorized Entities may veto any such changes.⁵ For minor modifications, the draft BDCP states: “If any Authorized Entity disagrees with the proposed minor modification or revision for any reason, the minor modification or revision will not be incorporated into the BDCP” (BDCP 6-46).⁶ The draft Plan similarly declares that formal amendments “will be subject to review and approval by the Implementation Office and the Authorized Entities.”⁷

The BDCP is fundamentally a set of terms and conditions that allow the principal regulatory agencies—the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the California Department of Fish and Wildlife—to authorize the construction and operation of physical improvements to the Delta that will facilitate more reliable (and, one may hope, more environmentally sustainable)

⁵ Please note that the draft BDCP states that the Authorized Entities—not the Authorized Entity Group—hold this veto power. This may be a typographical error, as the Authorized Entities are not granted implementation decisionmaking authority (except through the Authorized Entity Group) any other place in the document. If it the BDCP negotiators in fact intend to vest veto authority in the Authorized Entities, however, this is especially problematic as the Authorized Entities potentially include water users other than those that comprise the Authorized Entity Group. BDCP 7-8.

⁶ By contrast, if any of the fish and wildlife regulatory agencies disagrees with a proposed minor modification, its rights are limited to insisting that the proposal be treated as a formal amendment to the Plan. BDCP 6-46.

⁷ At least in the case of formal amendments the draft Plan recognizes a relative parity in the rights of the regulators and the regulated, acknowledging that such amendments “will require corresponding amendment to the authorizations/ permits, in accordance with applicable laws and regulations regarding permit amendments.” BDCP 6-47. It also states, however, that the “fish and wildlife agencies will use reasonable efforts to process proposed amendments within 180 days.” BDCP 6-46.

exports of water by the CVP and SWP. Although the motivating purpose of the BDCP is to facilitate this water development, the regulatory agencies' foundational responsibility is to ensure that the project does not jeopardize the continued existence of the species that are listed for protection under the federal and state Endangered Species Acts.

To accomplish this essential obligation, the fish and wildlife agencies must both insist on an initial set of biological objectives, conservation measures, and conditions on coordinated project operations that will fulfill this purpose; *and* they must have the means of ensuring that the implementation of the BDCP will continue to achieve that goal throughout its fifty year term.

We do not believe that the draft Plan satisfies this second requirement, as it vests veto authority over necessary changes in the biological objectives, conservation measures, adaptive management strategies, and the terms and conditions of the BDCP itself, not in the regulatory agencies, but in the regulated entities that comprise the Authorized Entity Group. We therefore recommend revision of the draft Plan to require that all “minor modifications” and “formal amendments” to the BDCP be subject to review and approval by the Permit Oversight Group.

As explained above, we also recommend that the draft Plan be revised to authorize the Permit Oversight Group itself to initiate and make changes to the biological objectives, conservation measures, and other adaptive management strategies that the fish and wildlife agencies conclude are needed to ensure the protection and recovery of the species listed under the federal and state Endangered Species Acts. This unilateral authority must extend to all of the identified “minor modifications” and to at least one of the defined “formal amendments”—*viz.* “substantial changes in implementation schedules that will have significant adverse effects on the covered species” (BDCP 6-47).⁸

The other listed “formal amendments”—which include alteration of the geographic boundaries of the Plan and the addition of new species and covered activities—are different, as they include possible changes to the scope and structure of the BDCP, rather than adaptive changes to the implementation and achievement of the goals of the existing BDCP. The draft Plan therefore properly states that formal amendments

⁸ The governance structure set forth in the current draft Plan also may jeopardize the likelihood that the BDCP will be incorporated into the Delta Plan. *See* California Water Code § 85320-85322. The Delta Reform Act provides:

The BDCP shall include a transparent, real-time operational decisionmaking process in which *fishery agencies ensure that applicable biological performance measures are achieved in a timely manner with respect to water system operations.* [*Id.* § 85321 (emphasis added).]

The Authorized Entity Group's veto authority over changes to the biological objectives, conservation measures, and adaptive management strategies means that the fish and wildlife agencies would not have the power to ensure that the biological measures will be achieved. The draft Plan therefore violates this statutory mandate, and the CDFW and the Delta Stewardship Council consequently would likely be precluded from incorporating the BDCP into the Delta Plan.

"will involve the same process that was required for the original approval of the BDCP"--i.e., approval of both the Authorized Entities and the Permit Oversight Group (BDCP 6-47).⁹

Regulatory Assurances and the “No Surprises” Policy

Introduction

The draft Plan proposes to create two types of “regulatory assurances.” First, it seeks to eliminate the uncertainties associated with consultation under section 7 of the federal Endangered Species Act for coordinated CVP and SWP operations by stipulating that future biological opinions shall be consistent with the terms and conditions of the BDCP. Second, it offers “no surprises” guarantees both for deviations between the biological opinions and the BDCP and for future changes to the BDCP itself. In addition, the draft Plan places difficult scientific, legal, and political burdens on the state and federal governments’ power to terminate the incidental take permits and to rescind the BDCP.

In our judgment, these regulatory assurances compound the risks described in the preceding section because they severely constrain the fish and wildlife agencies’ ability to respond to inadequacies in the biological objectives, conservation measures, and other adaptive management strategies—even apart from the veto authority that the draft Plan vests in the Authorized Entity Group.

Section 7 Consultation and the BDCP

According to the draft Plan, once the facilities authorized by the BDCP are constructed, the Plan will largely displace the existing section 7 consultation requirements applicable to coordinated CVP and SWP operations: “On the basis of the BDCP and the companion biological assessment, it is expected that USFWS and NMFS will issue a new joint biological opinion (BiOp) that would supersede BiOps existing at that time as they relate to SWP and CVP actions addressed by the BDCP” (BDCP 4-2). The draft Plan then requires that the new biological opinion (as well as any subsequent biological opinions issued during the 50-year term of the BDCP) be consistent with the terms and conditions of the BDCP itself:

The BDCP is intended to meet the requirements of the ESA and provide the basis for regulatory coverage for a range of activities identified in the Plan. . . .

⁹ The draft Plan also provides that, “[i]n most cases, an amendment will require public review and comment, CEQA and NEPA compliance, and intra-Service Section 7 consultation,” and it requires the fish and wildlife agencies to use “reasonable efforts to process proposed amendments within 180 days.” BDCP 6-47. 180 days is probably insufficient time, however, to allow for section 7 consultation, internal agency analysis of the effects of proposed formal amendments on listed species and their habitat, and the drafting, public review, and completion of a new or supplemental EIS/EIR.

It is also worth noting that even this limited “bilateral” approval process for structural amendments to the BDCP may not be consistent with federal law. The ESA rules provide that all incidental take permits “are issued subject to the condition that the National Marine Fisheries Service reserves the right to amend the provisions of a permit for just cause at any time during its term.” 50 C.F.R. § 222.306(c).

Unless otherwise required by law or regulation, in any Section 7 consultation related to a covered activity or associated federal action and covered species, USFWS and NMFS will each ensure that the resulting BiOps are consistent with the integrated BiOp for the BDCP (BDCP 6-44).

We do not necessarily object to this consistency directive. An important goal of the BDCP is to provide all parties—especially the Authorized Entities—with a measure of regulatory and operational certainty that will enable them both to invest in the new facilities and to make water management decisions in their respective service areas in reliance on water deliveries from the CVP and SWP. To the extent that future section 7 consultations conform to the terms of the BDCP, that certainty is enhanced. We also note the first clause of the second sentence quoted above, which expressly reserves the authority of USFWS and NMFS to issue biological opinions that depart from the terms of the BDCP if necessary to comply with the governing law. This law, of course, includes section 7(a)(2) of the federal ESA, which requires all consulting agencies to ensure that their actions are “not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat.” 16 U.S.C. § 1536(a)(2).

We do believe, however, that the proposal to substitute the BDCP for section 7 consultation as the principal means of applying the federal Endangered Species Act to the CVP, SWP, and other Authorized Entities reinforces our recommendations from the preceding section—*viz.* that the Permit Oversight Group must maintain the independent regulatory prerogatives that the fish and wildlife agencies currently possess and must have authority to approve or to deny proposed changes in the biological objectives, conservation measures, and other terms and conditions of the BDCP as required to protect and recover the species covered by the Plan. Our support for the biological opinion/BDCP consistency directive should be read with this caveat.

“No Surprises”

The draft Plan contains two “no surprises” guarantees. The first applies to changes in coordinated CVP and SWP operations or water supply capabilities that may be required by future biological opinions that do not conform to the BDCP. The second is a more general “no surprises” commitment that protects the Authorized Entities from certain changes to the BDCP itself¹⁰.

According to the draft Plan, “Ecological conditions in the Delta are likely to change as a result of future events and circumstances that may occur during the course of the implementation of the BDCP” (BDCP 6-30). The draft then lists seven “Changed Circumstances Related to the BDCP”—levee failures, flooding, new species listings, wildfire, toxic or hazardous spills, nonnative invasive species, and climate change (BDCP 6-31). For each of these “reasonably foreseeable” changes, the draft Plan describes the “planned responses” that BDCP administrators will undertake (BDCP

¹⁰ As noted in chapter 2, USBR is not covered by the “no surprises” assurance. BDCP 6-29.

6-31 to 6-42).¹¹ The draft Plan states that the responses “have been designed to be practical and roughly proportional to the impacts of covered activities on covered species and natural communities, yet sufficient to effectively address such events” (BDCP 6-30). The BDCP budget will include funds to cover the costs of implementing some of the planned responses to “reasonably foreseeable” changed circumstances (BDCP 6-30).¹²

The draft Plan also recognizes that “unforeseen circumstances” may require changes to the biological objectives, conservation measures, adaptive management strategies, or the terms and conditions of the BDCP itself. It defines unforeseen circumstances as “changes in circumstances that affect a species or geographic area covered by an HCP that could not reasonably have been anticipated by the plan participants during the development of the conservation plan, and that result in a substantial and adverse change in the status of a covered species” (BDCP 6-42 citing 50 C.F.R. § 17.3 & 50 C.F.R. § 222.102). The draft Plan contains a similar definition of “unforeseen circumstances” under state law. These are “changes affecting one or more species, habitat, natural community, or the geographic area covered by a conservation plan that could not reasonably have been anticipated at the time of plan development, and that result in a substantial adverse change in the status of one or more covered species” (BDCP 6-43 citing California Fish & Game Code § 2805(k)).

The draft Plan then sets forth the following regulatory assurances under federal and state law:

Under ESA regulations, if unforeseen circumstances arise during the life of the BDCP, USFWS and/or NMFS may not require the commitment of additional land or financial compensation, or additional restrictions on the use of land, water, or other natural resources other than those agreed to in the plan, unless the Authorized Entities consent (BDCP 6-42).

¹¹ The Implementation Office is charged with identifying the onset of a changed circumstance, working with the Permit Oversight Group to fashion a response, and for implementing and monitoring the responsive actions (BDCP 6-31).

¹² This funding process is described in Chapter 8 of the draft BDCP. See BDCP 8-60 to 8-64. The draft states generally that, to “allow for the ability to respond to changed circumstances should they occur, the Implementation Office should maintain a reserve fund for covering costs of changed circumstances” (BDCP 8-61). The draft Plan explains that this is because “the risk of some changed circumstances—*e.g.*, failure of levees attached to tidal marsh and floodplain restoration—and cost of remedial measures increases as greater portions of the conservation strategy are implemented.” *Id.*

The draft BDCP only includes levee failure and wildfire damage to preserved lands as possible “changed circumstances for which responses are expected to result in additional implementation costs.” *Id.* It omits “changed circumstances related to climate change, flooding, failure of water operations infrastructure, nonnative invasive species, new species listings, and toxic or hazardous spills,” explaining that the response costs for these are accounted for in the initial BDCP funding, will be paid by the state and federal governments under the “no surprises” guarantees, or would be the responsibility of a third party. BDCP 8-61 to 8-62.

In the event of unforeseen circumstances, CDFW will not require additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources without the consent of the plan participants for a period of time specified in the Implementation Agreement (BDCP 6-43).¹³

As noted above, for federal agencies that are subject to section 7 consultation (including consultation for coordinated CVP/SWP operations), the draft Plan contains an additional “no surprises” pledge if new biological opinions contain operational or water supply restrictions that differ from those set forth in the BDCP:

Furthermore, USFWS and NMFS will not require additional land, water, or other natural resources, or financial compensation or additional restrictions on the use of land, water, or other natural resources regarding the implementation of covered activities beyond the measures provided for under the BDCP, the Implementing Agreement, the incidental take permits, and the integrated BiOp (BDCP 6-44).

The purpose of these regulatory assurances is to exempt the Authorized Entities from any of the costs of complying with the federal and state Endangered Species Acts except as defined in (and funded pursuant to) the terms of the BDCP. These “no surprises” guarantees therefore may place the financial burden of some future changes to the BDCP and project operations exclusively on state and federal taxpayers.

Although both federal Endangered Species Act regulations and the California Natural Community Conservation Planning Act authorize “no surprises” guarantees, we believe, given the uncertainties outlined in the previous chapters, that there is a significant risk that the costs of compensating the projects and their contractors for future “unforeseen” hydrologic, engineering, and operational changes will be excessive. More importantly, we are concerned that the state and federal governments’ assumption of liability may deter the fish and wildlife agencies from making changes to future biological opinions or to the BDCP itself that the agencies believe are necessary to protect and recover listed species. The following example focusing on the “reasonably foreseeable” changed circumstance of climate change illustrates our concerns.

The draft Plan defines climate change as “[l]ong-term changes in sea level, watershed hydrology, precipitation, temperature (air or water), or ocean conditions that are of the magnitude or effect assumed for the effects analysis and that adversely affect conservation strategy implementation or covered species are considered a changed circumstance” (BDCP 6-41). It then provides that the

¹³ The draft Plan notes that, under California law, “such assurances are not applicable in those circumstances in which CDFW determines that the plan is not being implemented in a manner consistent with the substantive terms of the Implementation Agreement.” BDCP 6-43 (citing California Fish & Game Code § 2820(f)(2)).

“occurrence of this changed circumstance will be determined jointly by the Implementation Office and fish and wildlife agencies” (BDCP 6-41).¹⁴

According to the draft Plan, however, alterations in the ecosystem and threats to listed species caused by climate change will not trigger any management or regulatory responses beyond those set forth in the BDCP. “Because the BDCP already anticipates the effects of climate change, no additional actions will be required to remediate climate change effects on covered species and natural communities in the reserve system” (BDCP 6-41). Rather, the Adaptive Management Team will monitor these changes and the Implementation Office will “continually adjust conservation measures to the changing conditions in the Plan Area as part of the adaptive management program” (BDCP 6-42).

The draft Plan also states that all responses to climate change “will be made as part of the adaptive management and monitoring program. Measures beyond those contemplated by the adaptive management and monitoring program are not likely to be necessary because the conservation strategy was designed to anticipate a reasonable worst-case scenario of climate change. *A change in conservation measures in response to climate change beyond that considered in Chapter 3, Conservation Strategy, and through the adaptive management and monitoring program is considered an unforeseen circumstance.*” (BDCP 6-42: emphasis added).

There are two serious problems with this changed circumstances strategy:

First, although the “biological goals and objectives [of the BDCP] have been established at the landscape level to take climate change into account during conservation strategy implementation,” and the “conservation strategy, monitoring and research program, and adaptive management and monitoring program already include responses to anticipate climate change effects at the landscape, natural community, and species scales” (BDCP 6-42), the draft Plan correctly anticipates that the biological objectives, conservation measures, and other adaptive management strategies are likely to be modified over time as required to respond to the changed conditions brought about by climate change. Yet, as described previously, all such modifications are subject to approval by the Authorized Entities (BDCP 6-46). The fish and wildlife agencies consequently lack independent authority to determine the appropriate policy and management responses to climate change, even within the confines of the defined responses set forth in Chapter 3 of the BDCP.

Second, changes in conservation measures that differ from the defined responses are “unforeseen circumstances,” which trigger the “no surprises” guarantee. Again, while the draft Plan anticipates a broad array of ecological changes likely to be caused by climate change, and lays out a detailed set of programmatic responses, it is folly to believe that the BDCP scientists and negotiators have correctly identified

¹⁴ We reiterate here the problems that we identified in the preceding section: conflation of the fish and wildlife agencies’ regulatory and programmatic roles and the granting of an effective veto to the regulated entities through the Implementation Office.

all of the hydrologic changes, biotic responses, and risks to the ecosystem that will in fact occur over time. As one recent interdisciplinary study of California water policy emphasized:

New approaches to ecosystem management under changing conditions will require continued, large-scale experimentation aided by computer modeling. This task is complex, because experiments, especially on a large scale, often yield ambiguous results. Also, as with hydrology, the past is not always a good predictor of the future with many ecosystems. Linking human and natural systems, combined with changes in climate and influxes of alien species, creates novel, dynamic ecosystems with no historical analog. Thus, efforts to restore ecosystem functions and attributes involve hitting a moving, only partially visible target. Finally, ecosystem changes are often nonlinear and interrelated. Declines in habitat quality or abundance reduce ecosystem resiliency, with the result that even small changes in conditions can lead to abrupt system collapse and reorganization to a new state. Such thresholds or tipping points are difficult to predict. *Taken together, these factors suggest that efforts to improve conditions for California's native aquatic species will necessarily involve trial and error, and that success is far from guaranteed.*

* * *

The difficulty is compounded by the high uncertainty of success for specific actions, given ecosystem complexity, gaps in knowledge of how to manipulate many key processes, and, most important, continuing change in climate, invasive species, and other conditions in California. *As a result, a flow regime or water quality target that seems adequate today may not provide the same services in 20 to 30 years. Aiming at a moving target in semi-darkness means that there will be many misses.* (From: Hanak et al., 2011: emphasis added).

The potential consequences of the “no surprises” guarantee in this context are troubling. Fisheries biologists generally agree that diminished seasonal outflow and warming water temperatures place several listed species at risk of extinction (see Cloern et al., 2011; Moyle et al., 2013). The projects that would be authorized by the BDCP should reduce some of the sources of stress on these species by reducing entrainment and predation and by creating substitute habitat, but they will not address several other important stressors such as diminished summer and fall outflow and rising water temperatures. Therefore, sometime during the 50-year term of the BDCP, it may be necessary to construct additional upriver storage (*e.g.*, by increasing the capacity of Shasta Reservoir) to enable more sustained cold-water releases to protect salmon spawning and out-migration.

Yet, under the draft Plan, this action would constitute an “unforeseen circumstance,” because it falls outside the defined responses to climate change set forth in the BDCP. The consequence would be that the state and federal taxpayers would have to bear all of the costs of constructing and operating the new or expanded storage,

even though the fish and wildlife agencies determined that this action is needed to protect one or more listed species from extinction (while maintaining reservoir releases and exports at the levels and timing authorized by the BDCP).

Alternatively, if funding were not available to construct the new storage capacity, and the fish and wildlife agencies made jeopardy findings and issued new biological opinions that altered reservoir release requirements in a manner that reduced water supply or export capacity, the state and federal governments would have to compensate the Authorized Entities for the value of the lost water or the cost of replacement supplies.¹⁵

For these reasons, we do not believe that the 50-year “no surprises” guarantees are wise or prudent policy. We understand that the Authorized Entities seek to protect their capital investment and obtain maximum security of their water service capabilities, and that a relatively fixed set of biological objectives, conservation measures, and operational constraints help to achieve these goals (BDCP 1-26). But a 50-year commitment is ill-advised in an ecosystem as complex, variable, and scientifically inscrutable as the Delta. As our colleague Peter Moyle has observed, in the Delta Ecosystem, “[o]ver-negotiation of details in advance is unlikely to enable adequate responsiveness and flexibility” and “even the most well-informed, scientifically based management will encounter surprises and make mistakes” (From Moyle et al., 2012).

The parties to the BDCP negotiations therefore should consider separate “no surprises” guarantees—one governing construction of the BDCP projects, and a series of operational “no surprises” commitments that would be reevaluated every

¹⁵ During the July 23, 2013, meeting with DWR Director Mark Cowin and CDFW Director Chuck Bonham, Director Cowin stated that it was not the parties’ intent to apply the “no surprises” policy to actions taken outside the plan area that may be required to address the effects of climate warming or other changed conditions on listed species. Although we were pleased to learn this, we retain the concerns described in the text for two reasons: First, the draft Plan does not state that new infrastructure or operational changes needed to ensure the survival of species covered by the BDCP are exempt from the “no surprises” guarantee if they are located outside the plan area. Rather, the draft links CVP and SWP facilities and water supply operations upstream of the plan area to the conservation measures that may be required to protect covered species and their downstream habitat (BDCP 1-20). Without an explicit limitation on the “no surprises” guarantee to new, “unforeseen” conservation measures undertaken within the plan area, we believe that there is an unacceptable risk that the Authorized Entities could raise a plausible claim that the “no surprises” policy exempts them from liability for new facilities and operational changes upstream of the plan area that are needed to protect covered species within the plan area.

Second, the draft Plan expressly extends the “no surprises” assurance for future section 7 consultations over new facilities and other changes in CVP operations that are outside the plan area and not part of the BDCP covered activities. The draft Plan stipulates that “USFWS and NMFS will further ensure that the terms of any BiOp issued in connection with projects that are independent of the covered activities and associated federal actions do not create or result in any additional obligation, cost, or expense to the Authorized Entities” (BDCP 6-44).

If the parties to the BDCP negotiations do not intend for the “no surprises” guarantee to cover new construction and project operational changes outside the plan area, then they should revise the draft Plan to say so explicitly and clearly. We also recommend that the sentence quoted above, which exempts the Authorized Entities from all costs associated with section 7 consultations to project facilities and operations other than BDCP covered activities be deleted.

ten years based on *current* information on the appropriateness of the biological objectives, the success or failure of the conservation measures, species survival and recovery, overall ecosystem health, climate change, invasive species, discharges, the effects of authorized project operations, other stressors, and regulatory compliance.

We have chosen ten years for the recommended length of renewable “no surprises” assurances because a ten-year period is likely to include a variety of different types of water years and thus will be sufficiently lengthy to enable BDCP managers and regulators to evaluate how well the biological objectives and conservation measures perform across a spectrum of hydrologic conditions. At the same time, ten years is short enough to minimize the risk that the terms and conditions of the BDCP become antiquated and ineffective in light of the inevitable and unpredictable changes to the ecosystem. Indeed, a series of renewable ten-year “no surprises” guarantees could create a constructive incentive for the parties to the BDCP to monitor progress and achievement of the biological objectives and conservation measures and to make adaptive management changes as required to sustain and recover the covered species and their habitat.¹⁶

Revocation of Incidental Take Permits and the BDCP

Many of our concerns about the rigidities of the draft Plan and the scope and length of the regulatory assurances would be lessened if there were an effective means of revoking the incidental take permits and thus rescinding the BDCP. But there is not.

As described in the draft Plan, the “Permit Revocation Rule,” adopted in 2004, allows the federal fish and wildlife agencies “to nullify regulatory assurances granted under the No Surprises rule and revoke the Section 10 permit only in specified instances, including where continuation of a permitted activity would jeopardize the continued existence of a species covered by an HCP and the impact of the permitted activity on the species has not been remedied in a timely manner” (BDCP 6-48: quoting 69 Fed. Reg. 7172 (Dec. 10, 2004)). The draft Plan states,

¹⁶ There is nothing in federal or state law that requires that the term of a “no surprises” guarantee be coextensive with the term of the HCP/NCCP. Indeed, the California Natural Communities Conservation Planning Act requires that the duration of all regulatory assurances be based on a careful assessment of the limits of scientific understanding of the covered species and their habitat. California Fish & Game Code § 2820(f) states that the CDFW’s “determination of the level of assurances and the time limits specified in the implementation agreement for assurances may be based on localized conditions and shall consider”:

- (A) The level of knowledge of the status of the covered species and natural communities.
 - (B) The adequacy of analysis of the impact of take on covered species.
 - (C) The use of the best available science to make assessments about the impacts of take, the reliability of mitigation strategies, and the appropriateness of monitoring techniques.
 - (D) The appropriateness of the size and duration of the plan with respect to quality and amount of data.
- ***
- (H) The size and duration of the plan.

however, that the “USFWS or NMFS will begin the revocation process only if it is determined that the continuation of a covered activity will appreciably reduce the likelihood of survival and recovery of one or more covered species and that no remedy [other than revocation] can be found and implemented” (BDCP 6-49).

Similarly, under the California Natural Communities Conservation Planning Act, the Department of Fish and Wildlife may revoke the state incidental take permit “if necessary to avoid jeopardizing the continued existence of a listed species” (BDCP 6-49: citing California Fish & Game Code § 2820(c)).¹⁷ The federal and state fish and wildlife agencies also may revoke the permits if the Authorized Entities fail to fulfill their obligations under the BDCP, but only following the dispute resolution process set forth in the Implementing Agreement and “providing the Implementation Office and Authorized Entities with a reasonable opportunity to take appropriate responsive action” (BDCP 6-49).

Before the fish and wildlife agencies may revoke the incidental permits, they must follow a variety of procedures and substantive standards. These include determining, in concert with the Implementation Office, “whether changes can be made to the conservation strategy to remedy the situation” and whether “there are additional voluntary implementation actions that the Authorized Entities could undertake to remedy the situation.”

More importantly, the draft Plan also requires the federal fish and wildlife agencies to determine whether they or some other agencies can take actions to ensure the survival of the listed species, rather than imposing such burdens on the parties to the Authorized Entities:

The USFWS or NMFS will determine whether the fish and wildlife agencies or other state and federal agencies can undertake actions that will remedy the situation. The determination must be based on a thorough review of best available practices considering species population status and the effects of multiple federal and nonfederal actions. *It is recognized that the fish and wildlife agencies have available a wide array of authorities and resources that can be used to provide additional protection for the species, as do other state and federal agencies* (BDCP 6-48 & 6-50: emphasis added).

The draft Plan thus makes it difficult for the fish and wildlife agencies to revoke the incidental take permits if the biological objectives, conservation measures, and adaptive management changes do not achieve their primary goal of protecting and recovering the listed species. Procedural and substantive rigor is not in and of itself

¹⁷ Section 2820(c) actually addresses a more limited violation of the terms of an NCCP, providing for suspension or revocation if a plan participant fails to “maintain the proportionality between take and conservation measures specified in the implementation agreement and does not either cure the default within 45 days or enter into an agreement with the department within 45 days to expeditiously cure the default.” California Fish & Game Code § 2820(c). The more general revocation standard is set forth in section 2820(b)(3)(A)-(D) of the Act.

reason to doubt this last line of defense against extinction. But two additional facts lead us to the conclusion that permit revocation is not likely to be a credible means of ensuring the survival of the species if the BDCP fails its most essential task.

First, neither the federal fish and wildlife agencies nor the California Department of Fish and Wildlife have ever revoked an incidental take permit. Indeed, there is only one case in which a federal incidental take permit has been suspended, and that was for the permittee's violation of the terms and conditions of the habitat conservation plan, rather than because of changes in ecological conditions or the permittee's failure to agree to amendments to the biological objectives and conservation measures¹⁸. Revocation of the incidental take permits covered by the BDCP therefore would be an unprecedented event.

Second, a decision to revoke the incidental take permits would not be simply a scientific determination that the BDCP—as written today and implemented at some future date during its 50-year existence—is not adequate to ensure the conservation and recovery of the listed species. Although the BDCP assigns the authority to revoke the state incidental take permit to the Director of the California Department of Fish and Wildlife (BDCP 6-50), it stipulates that “[a]ny decision to revoke one or both federal permits must be in writing and must be signed by the Secretary of the Interior or the Secretary of Commerce, as the case may warrant” (BDCP 6-49).¹⁹ In our judgment, this poses an undue risk that the revocation decision would be based on science *and* political considerations. Indeed, there would seem to be no other purpose for elevating the revocation authority from the fish and wildlife agencies to the two Cabinet-level Secretaries.

For these reasons, we do not believe that the state and federal authority to revoke the incidental take permits compensates for the deficiencies in the draft BDCP described above.

Conclusion

We conclude that governance structure set forth in the draft BDCP is neither “transparent [nor] resilient to political and special interest influence.” The draft undermines the authority of the federal and state fish and wildlife agencies both by assigning them program responsibilities and by granting the Authorized Entities veto power over changes to the biological objectives, conservation measures, and adaptive management strategies that may be needed to ensure that the Plan achieves its stated goals. To address this deficiency, we recommend that the BDCP be revised to remove the Permit Oversight Group from program decisionmaking and to clarify the regulatory authority of the fish and wildlife agencies both within the BDCP and in their independent roles as principal regulators under the federal and

¹⁸ See U.S. Fish and Wildlife Service Letter to Victor Gonzales, President of WindMar Renewable Energy, Feb. 2, 2012 (decision of partial suspension of incidental take permit).

¹⁹ This would change the process for permit revocation set forth in the federal ESA rules, which vest revocation authority in the Director of the U.S. Fish and Wildlife Service. 50 C.F.R. § 17.22(b)(7).

state Endangered Species Acts and the California Natural Community Conservation Planning Act.

We also believe that the regulatory assurances contained in the draft Plan jeopardize the ability of the fish and wildlife agencies to respond to changed conditions that may require future revisions to the biological objectives and conservation measures of the BDCP. The “no surprises” guarantees—by which the state and federal governments would assume the financial costs of new infrastructure and regulatory changes in CVP/SWP operations needed to address the effects changed circumstances not provided for in the BDCP—are especially troubling. To address this problem, we recommend that the proposed 50-year “no surprises” guarantees be converted into a series of renewable guarantees—the first to cover construction of the projects authorized by the BDCP and the successors to cover project operations for sequential ten-year periods.

Finally, although the fish and wildlife agencies retain the authority to revoke the incidental take permits—and thus to rescind the BDCP—if necessary to avoid jeopardizing any listed species, the draft Plan makes it difficult to do so by requiring the federal agencies to take action against other stressors on the species before determine that it is necessary to revoking the permits. The draft also removes the revocation decision from the federal agencies themselves and places it with the Cabinet-level Secretaries in whose Department the fish and wildlife agencies are located. We believe that these heightened substantive and procedural requirements reduce the likelihood that permit revocation would serve as an effective backstop in the event that the BDCP fails to achieve its overriding purposes of ensuring the survival and contributing to the recovery of the species. Indeed, these limitations on permit revocation strengthen our conclusions that the governance problems described throughout this chapter be repaired so that the fish and wildlife agencies retain the authority to insist on changes to the biological objectives and conservation measures of the BDCP as required to achieve species conservation and recovery.

CHAPTER 9: SCIENCE AND ADAPTIVE MANAGEMENT IN BDCP

Introduction

From the outset BDCP makes it clear that it will be science-based and adhere to the principles of adaptive management. The plan recognizes that all 22 conservation measures that are designed to meet the plan goals and objectives face high levels of uncertainty and that measures used to implement them will inevitably require adjustment and refinement. Indeed, given the unprecedented complexity of BDCP, it will most certainly fail without substantial investments in a program of science and monitoring linked to a robust adaptive management program that allows it to change course.

At the time of this review, the science and adaptive management component of BDCP was, by the project proponents' own admission, a work in progress with many of the key elements yet to be determined. We briefly review here the available information with the understanding that these elements are likely to change, possibly considerably, before the public draft is released.

Adaptive Management Program

The plan documents recognize that BDCP is compelled to adhere to an array of standards for adaptive management of the program (summarized in Chapter 3 of BDCP). This includes requirements of USFWS and NMFS five-point policy on adaptive management (65 Fed. Reg. 35241-35257), NCCPA requirements for monitoring and adaptive management programs (Fish & Game Code § 2820(a)(7) & (8), and the requirements of the Delta Reform Act for science-based adaptive management of all ecosystem and water management programs in the Delta (Water Code § 85308(f)).

The BDCP documents describe the well-known adaptive management cycle involving: *plan*, where management problems are recognized leading up to a plan of action to test management actions, *do*, where plans are implemented, accompanied by monitoring, and *evaluate*, where monitoring information is evaluated to measure effectiveness, and information learned initiates anew the planning portion of the cycle. As described in BDCP, the conceptual approach to adaptive management is closely aligned to the approach codified in the Delta Plan and the draft Delta Science Plan.

Governance and Implementation of Adaptive Management

BDCP envisions that its adaptive management program will be organized and run by its Implementation Office. The office will be run by a Program Manager who will be hired by the Authorized Entity Group (AEG). The AEG will be made up of DWR, Reclamation, and the state and federal water contractors. The Program Manager

selects and supervises a Science Manager, who takes on the responsibilities of running the adaptive management programs and coordinating, in unspecified ways, all science and monitoring activities.

The Science Manager will chair and manage an Adaptive Management Team (AMT) made up of a broad array of regulators, regulated entities, and science programs. These include representatives appointed by members of the AEG, the Permit Oversight Group (POG: CDFW, USFWS, NMFS), the Interagency Ecological Program (IEP), Delta Science Program (DSP), and NOAA Southwest Fisheries Science Center. This group will receive input from a Technical Facilitation Subgroup, part of a Stakeholder Council made up of multiple of stakeholder groups, regulated entities, and regulating entities.

The AMT, led by the Science Manager, will have the responsibility for designing, administering and evaluating the BDCP adaptive management program, including the development of performance measures, monitoring and research plans, synthesis of data, solicitation of independent review, and developing proposals to modify biological goals and objectives as well as conservations measures.

The AMT is to operate by consensus only, meaning all members must agree to all actions. Where consensus cannot be reached the matter is elevated to the AEG and POG for resolution. As a matter of course, all changes in conservation measures and biological goals and objectives must be approved by the POG and AEG. The entity responsible for decisionmaking (for example, NMFS regarding changes in biological goals and objectives for salmon) will decide the issue. However, as discussed in Chapter 8, *any member of the AEG or POG may request review of the decision at the highest level of the relevant federal department or state, up to the appropriate department secretary or the Governor of California* (BDCP Chapter 7, Section 7.1.7).

An essential goal of the adaptive management program—seeking consensus for all decisions from all regulated and regulating entities as well as key providers of science—is understandable and, if it could be achieved, laudable. However, for several reasons this is unlikely to be successful.

First, as discussed in Chapter 8, this structure confuses the roles of regulators and regulated entities. It gives exceptional decision power to regulated entities, particularly those with a great financial stake in outcomes (state and federal water contractors). We are skeptical that difficult, perhaps costly decisions could be achieved in an efficient and effective manner since *any* member of the AEG or POG can, in effect, elevate any decision, no matter how trivial, to the highest levels of government. This is likely to have a chilling effect on decisionmaking, making all parties cautious and risk-averse. These traits—caution and fear of taking risks—are antithetical to the principles of adaptive management by which all management decisions are viewed as experimental and inherently risky. The most likely outcome from this approach to governance of adaptive management is that preliminary decisions made during the initial phases of the plan are, through sheer inertia, likely to remain permanent, rendering the concept of adaptive management moot.

Second, the AMT is made up of a mix of regulators, regulated entities, and scientific providers such as IEP and DSP. This places the science providers in the position of being decisionmakers, creating clear conflicts of interest. Most importantly, as discussed below, this eliminates one of the most important aspects of science in support of adaptive management: scientific independence.

Adaptive Capacity

The AMT, with approval from the POG, AEG or higher federal and state authorities, will oversee implementation of the adaptive management program, presumably through the Science Manager. A central issue likely to arise when finalizing BDCP is the adaptive flexibility available. All such programs have a natural tension between wanting to provide assurances—such as how much water will be exported from the Delta—and needing flexibility in amount and timing of exports to test and implement adaptive management programs. The current BDCP documents offer little to no guidance on adaptive capacity. This is likely to play a major role in how adjustments are made in conservation measures and, more importantly, how real-time operations (an element of adaptive management) are implemented. BDCP has sought to defer this decision, both within the document and to its Decision Tree process (discussed below).

Science Program

Science should underpin the discussions and information needed to make and implement adaptive management decisions. The extensive literature on adaptive management cites a strong, well-funded, and well-organized science and monitoring program as essential for adaptive management. The BDCP documents do not provide extensive information about science to support adaptive management, other than a solid commitment to build and support a strong science program and, in the EIR/EIS, a significant funding commitment. As currently described, the science program would be run by the Science Manager under the direction of the Program Manager and the AEG. The role of the science manager would be to fund an array of activities, guide synthesis and analysis, and coordinate with the numerous public and private institutions working on the Delta. Beyond this, there are few specifics.

BDCP's current efforts on science have come in for extensive criticism from several entities, including the National Research Council (2012), the Delta Independent Science Board (Memo to Delta Stewardship Council dated May 20, 2013) and the Public Policy Institute of California (Hanak et al., 2013, Gray et al., 2013). To be fair, the project proponents recognize that the BDCP science program is a work in progress and likely to change before the public draft of the plan is released. However, several significant issues will need to be resolved:

- *Integration:* the National Research Council in its review of Delta science was highly critical of the lack of integration of scientific efforts in the Delta. The NRC and others have pointed out that coordination is less effective than integration. BDCP is a once-in-a-generation opportunity to reorganize science in the Delta to make it more integrated and more effective for

addressing the major issues of the day. As structured, BDCP builds a new stand-alone science program that seeks to coordinate with other programs, such as IEP and DSP, rather than to integrate them. This is unlikely to prove successful.

- *Independence*: as noted above, the AMT blurs the distinction among decision-makers, regulated entities, and the providers of science and technical advice. In addition, the BDCP science program is, in effect, run by the regulated entities and lacks independence. This creates the potential for bias in the selection of what science gets funded and what is ultimately made available to the public. Given that most major disputes in the Delta come down to differences of opinion in court about the best available science, demonstrating scientific integrity and transparency should be the highest priority.
- *Oversight*: as currently structured, there is no independent oversight of the BDCP science program. There is a commitment to promoting peer-review of scientific work products and plans. In addition, there is mention of coordinating with the existing DSP and the Delta Independent Science Board. But oversight, which is essential for creating public assurances that the best available science is being utilized in decision-making, is currently absent from the plan.
- *Funding*: science is expensive, and for a program this large and complex, it is likely to be *very* expensive. There are no discussions regarding budget in the BDCP plan documents. However, in the administrative draft EIR/EIS there are substantial commitments to funding a science program. There are categories of funding (monitoring, research, etc.), but little information as to how it would be distributed, organized and administered. Still, this level of commitment is significant and necessary.

To be effective, during revision of the plan documents, BDCP will have to address the considerable weaknesses in science governance, integration with other programs, independence and transparency, oversight and funding. Notably, there is a parallel process underway, led by the DSC, to develop a comprehensive plan for science in the Delta. This “One Delta, One Science” effort is essential for the success of BDCP. It seems to us that BDCP’s science effort should be fully integrated with the Delta Science Plan, if not led by the DSP. However, to date, BDCP has had limited involvement with this planning process.

Decision Tree

Earlier chapters of this review note that most controversial decisions, or decisions with high scientific uncertainty, are proposed to be resolved through adaptive management (i.e., *deferred*). One of the most important decisions will involve initial operations of the dual export facilities approximately ten years after issuance of the HCP/NCCP permit. The operations are to be based on the best available science on

how to meet the co-equal goals of ecosystem benefit and water supply, with the goal of meeting the HCP/NCCP conservation standards.

A fundamental tension exists between two competing hypotheses regarding BDCP. The first, controlling hypothesis is that better management of existing export volumes with the dual facility, coupled with significant investments in floodplain, channel margin, and tidal marsh habitat to improve food webs, will improve conditions for covered species sufficiently to meet the HCP/NCCP standards. The second, embedded within the agency red flag comments and “progress reports”, is that these steps are insufficient and that lower exports (higher outflow) will be needed to meet these standards. This issue is a paramount concern since it directly affects the economic viability of water supplied from the project.

As part of CM#1, BDCP will use a decision tree to address initial starting operations. As a starting point, BDCP embodies the two competing hypotheses in the LOS and HOS operating criteria, viewing them as brackets on the potential range of operations. The goal of the decision tree is to conduct a series of detailed studies and experiments to develop specific flow criteria, particularly for spring outflow (longfin smelt) and Fall X2 (delta smelt), in the decade before operation of the export facility begins.

The decision tree is the first, and probably most important, element of the BDCP adaptive management program. Much of the success of the adaptive management program will be tied to this element, since the original adaptive management and science infrastructure will presumably be built around addressing the competing hypotheses.

The decision tree approach to addressing starting operations is, in our view, laudable and appropriate. It makes no sense to wait until all uncertainties over this issue are resolved (a course of action proposed by diverse stakeholder groups). Experience says this issue will never be resolved to everyone’s satisfaction and will require constant (and contentious) adaptive management. This is a necessary and appropriate step. Regrettably, there is little information given in the BDCP documents about how the decision tree would be implemented, including who would fund it, how it would be structured, how decisions would be made, what science experiments would be conducted, etc. The lack of detail about the decision tree in the BDCP documents raises several key concerns:

- It takes time to develop and implement a large, complex scientific undertaking of the kind envisioned by the decision tree approach. The POD crisis in the mid-2000’s and the mobilization of the scientific community to address it is an example of a successful approach. But that still took considerable time and many issues addressed by the POD effort remain unresolved.
- To inform the potential placement and design of habitat restoration efforts to support food webs, new approaches to numerical modeling will be

needed that better represent how these habitats function. Finding and funding the technical teams for this kind of work will take time and resources. A particular concern is whether contracting will be run through existing state and federal agencies who are notoriously slow at developing contracts.

- In addition, field experiments will be needed to inform and calibrate these models. This involves identifying locations to conduct experiments, modeling and designing actions, acquiring land or easements, implementing pre-project monitoring programs, implementing actions, monitoring responses, and incorporating results into system models. All of these actions take time and resources, but as is well-known by anyone working on ecosystem restoration in the Delta, the rate-limiting step is inevitably the length of time it takes to secure permits (see recent review in Hanak et al., 2013).
- Because any decision made regarding flow and habitat will have multiple, competing constituencies and regulatory interests, an extensive and often contentious public engagement effort will be needed. The history of the Delta suggests that all such significant decisions are litigated, further slowing this process.

These four concerns, as well as others, make us skeptical that the decision tree is likely to achieve the goal of resolving operations issues within a 10 to 15 year time period. We cannot say with certainty that it will not be successful. A committed, well-funded, well-managed effort on the part of all parties may yield useful conclusions. However, given that this is the less likely outcome, it seems imperative that BDCP negotiate export operations criteria that, in the absence of a successful decision tree process, will be implemented at the start of the project.

Our work in previous chapters has cast doubt on the viability of the controlling hypothesis that underpins BDCP. To this end, we think it prudent to, at minimum, adopt the HOS operating criteria as the starting condition if the decision tree fails to identify operating procedures. In addition, if BDCP is truly committed to adaptive management and the use of best available science, it is not appropriate to set artificial boundaries—HOS and LOS—on the decision tree process. It is our view that the decision tree research effort should seek to define best operating procedures rather than being forced to operate within the HOS and LOS range. There is a reasonable chance that the decision tree process may ultimately determine that the HOS flow criteria are not protective enough.

Conclusion

The draft documentation provided by BDCP makes a strong commitment to the principles of adaptive management supported by a robust science program. Given the complexity of BDCP and the great scientific uncertainties underpinning many of the central elements of BDCP, this is absolutely necessary for success. As currently described, the BDCP adaptive management program either lacks sufficient

information to be assessed or is unlikely to achieve its overall goals and objectives. This stems from two basic problems:

- The adaptive management program has a confused and conflicting governance structure that, in our view, is likely to inhibit adaptation rather than promote it.
- There is insufficient information, beyond funding levels, to judge how the science program might function and how the knowledge it generates would be converted to action. The current information in the documents indicates that the program lacks integration with existing programs, scientific independence and transparency, and sufficient independent oversight.

We recommend that BDCP seek substantive engagement (beyond “coordination”) with the ongoing efforts by the DSC and the Delta Stewardship Council to develop a Delta Science Plan. The goal should be to integrate BDCP science and adaptive management into the broader science infrastructure of the Delta and not to construct a new, stand-alone science organization. Additionally, BDCP needs to revisit how adaptive management decisions are made, reallocating planning and decisionmaking authorities.

The decision tree process that seeks to resolve issues over initial operating criteria and habitat restoration investments is both appropriate and necessary. Unfortunately only limited information is available about this program so we cannot evaluate it. We are confident, however, that it is unlikely to resolve the major issues over the trade-offs between flow and ecosystem investments. For this reason, in the absence of resolution of decision tree process starting operations should be similar to HOS criteria.

Chapter 10: Summary and Recommendations

Introduction

We present a narrow review of aspects of BDCP that relate to conservation of federally listed fishes. We identify both strengths and weaknesses of BDCP's conservation measures in its effort to balance water supply reliability with ecosystem goals and objectives. Due to time and resource limits this review is incomplete. We did not examine all issues associated with aquatic ecosystems. For example, we did not evaluate habitat restoration on the San Joaquin River. Nor did we evaluate conservation issues for all covered fishes, giving limited attention to Sacramento splittail, San Joaquin steelhead, sturgeon and lamprey. Instead, we focused on the conservation measures that affect winter-run and spring-run Chinook salmon, delta smelt, and longfin smelt, because these measures are the most controversial and have greatest impacts on water supply operations. We also focused on a limited subset of the alternatives listed in BDCP documentation: the Early Long Term conditions under a No-Action Alternative (NAA), Low Outflow Scenario (LOS) and High Outflow Scenario (HOS)¹.

We summarize our findings on the six guiding questions identified in Chapter 1, plus several recommendations sought by the NGOs after we began our work. These are intended to help inform The Nature Conservancy and American Rivers in their engagement efforts with BDCP. Where appropriate, we describe alternative approaches that might be taken for BDCP to more effectively meet its goals. On many issues we have no recommendations.

Question 1: Operations

Do operations of the dual facilities meet the broader goal of taking advantage of wet and above average years for exports while reducing pressure on below average, dry and critically dry years? What substantive changes in operations (and responses, see below) are there both seasonally and interannually?

We analyzed the CALSIM data on export operations under NAA , HOS and LOS for ELT conditions. We note that the modeling of flows under BDCP has three compounding uncertainties: uncertainty over system understanding and future conditions, model uncertainties associated with CALSIM, DSM2 and UnTrim, and behavioral/regulatory uncertainty, where the model cannot fully capture operational flexibility. For this reason, model outputs should be viewed as

¹ NAA ELT is the no-project alternative using the 2008, 2009 BiOps with high spring outflow, 2025 climate and sea level conditions. LOS is with-project alternative with low fall and spring outflow, 2025 climate and sea level conditions. HOS is with-project alternative with high spring and fall outflow standards, 2025 climate and sea level conditions.

approximations useful for comparing different scenarios rather than as a predictor of future conditions. This issue influences all of our conclusions.

Based on our review we conclude:

- The array of existing and projected flow regulations significantly constrains operations in BDCP. The assumed operational flexibility associated with new North Delta facility is limited.
- HOS and LOS operations promote greater export during wet periods through increased use of North Delta diversions during the winter and spring. During dry and critical years, there is not much difference in *average* exports compared to NAA. For this reason, BDCP generally fails to meet the broader objective of reducing pressure on the Delta during dry periods.
- In some dry periods regulatory controls on OMR flows and North Delta diversions lead to significant increases in outflow and OMR flows over NAA. These unexpected results are the consequence of stricter flow requirements for HOS and LOS and operations being tied to previous water-year type in the fall and early winter. We are unsure if the project would actually be operated this way under these conditions.
- We evaluated how NAA, HOS and LOS performed during extended droughts. Of the three scenarios, HOS appears to be most protective of both supply and ecosystems by reducing the frequency and duration of dead pool conditions on Sacramento Valley reservoirs and assuring higher spring and fall outflows.

Recommendations: caution must be used in interpreting CALSIM model results for both export and environmental performance of BDCP due to compounding uncertainties. However, modeling results suggest that overall flow conditions are improved over NAA.

Question 2: Impacts of North Delta Facility

Based on operations criteria, does the Plan properly identify ecological impacts likely to occur adjacent to and in the bypass reach downstream of the new North Delta diversion facilities? If there will be direct and indirect harm to listed species by the facilities, does the Plan prescribe sufficient mitigation measures?

We reviewed the Conservation Measures and Effects Analysis of BDCP, including supporting appendices to evaluate conditions upstream of the North Delta facility, as well as near- and far-field effects of the facility itself. Our focus was on winter- and spring-run Chinook salmon, rather than all covered species. Based on this review we conclude:

- The BDCP consultants have appropriately identified the range of impacts on listed salmon likely to be associated with the operations of the North Delta facility. These include near-field effects such as impingement on intake

screens and high predation losses at the facility, to far-field effects such as reduced survivorship of juvenile salmon due to higher transit times and redirection into the interior Delta. Using multiple modeling approaches, they have created reasonable estimates of losses due to operation of the facility.

- Mitigation for take associated with the new facility includes restricting diversion flows during initial pulse flows in the river, predator control, non-physical barriers, real-time operations to protect outmigrants, and modification of the Fremont Weir to divert fish onto the Yolo Bypass. With the possible exception of benefits from Fremont Weir modifications the uncertainties over mitigation actions are all high.
- We see high potential value in the Yolo Bypass for mitigating the effects of North Delta diversions on juvenile salmon, particularly in drier conditions. Therefore, existing adaptive management programs on the Bypass must be supported, with accelerated pilot studies, monitoring and ecological modeling, to ensure success of any modifications of the Bypass.
- Mitigation is hampered by the lack of a viable adaptive management plan or real-time management plan in the current BDCP for the North Delta facility. Still, even with these uncertainties, if managed well, fully implemented and functioning as described in the plan, the actions appear to mitigate for losses associated with the North Delta facilities.
- These mitigation efforts alone are unlikely to lead to significant increases in salmon populations, and extinction risk remains high for winter- and spring-run Chinook salmon, particularly during extended drought and warm periods when reservoirs are low. However, reservoir management is not within the scope of BDCP.

Recommendations: given the uncertainties over mitigation for the North Delta facility, we recommend that all mitigation actions be evaluated and completed prior to initiating operations the North Delta facility. Of highest priority is to bolster and complete adaptive management activities in progress on the Yolo Bypass. Additionally, we recommend establishing an adaptive management and real-time management program with the capacity to conduct significant experiments in flow management, predator control, and non-physical barrier implementation *prior* to initiating facility operation. These should be conditions of the HCP/NCCP take permit.

Question 3: In-Delta Conditions

Are changes in operations and points of diversion prescribed in the Plan sufficient to significantly improve in-Delta conditions for covered species? The focus is on listed species, including delta and longfin smelt, steelhead, winter and spring run Chinook, and green sturgeon.

We focused our analysis on in-Delta conditions that may affect delta smelt and longfin smelt. We reviewed the effects analysis and supporting documentation and conducted our own modeling based on CALSIM output. Based on this work we conclude:

- The CALSIM output we used showed conditions that appeared anomalous based on our understanding of how the system would actually be operated. Although we have been assured that these conditions were logical consequences of model design and operation to meet flow requirements, we remain unconvinced that they reflect actual future operations under the hydrologic conditions simulated. We therefore caution that **the conclusions below are contingent upon the actual operations of the system resembling those in the model output**. They are also contingent on the biological models accurately reflecting responses of the species to flow conditions.
- Roughly half of the export from the Delta will go through the North Delta facility. In addition, OMR flow regulations are more restrictive (protective) under HOS and LOS scenarios than NAA. Thus the incidence of positive OMR flows rose from 11% under NAA to 16% under HOS and LOS conditions. HOS and LOS are consistently more protective of smelt than NAA under these modeling assumptions.
- OMR flow regulation under HOS and LOS for October through January is governed by previous water year type. This leads to anomalously high (positive) OMR flows and corresponding outflow during some dry periods, creating apparent benefits for delta smelt. We are uncertain if this would manifest in real operations.
- Entrainment results in fractional population losses of delta smelt that can be calculated from modeled flow conditions. Based on these calculations, we estimate that HOS and LOS reduced fractional population losses by half compared to NAA. If actual operations were similar to the model results, they would lead to significant decreases in entrainment.
- Estimates of relative differences in long-term survival percentages (not predictions) showed a 19-fold increase for HOS and 11-fold increase for LOS over NAA, albeit with large uncertainty. A difference of this magnitude over the last 20 years would have reversed the decline of delta smelt in the 2000s.
- Increases in spring outflow are projected by the models to produce only a very small increase in longfin smelt abundance index under HOS compared to NAA, and a comparable decrease under LOS.
- Increases in fall outflow under HOS are projected to produce a small increase in recruitment by the following summer, and under LOS a modest

decrease, but because of high variability in the data used to make these predictions, these values are very uncertain.

Recommendations: we remain uncertain about significant reduction in fractional population losses of delta smelt under the new HOS and LOS operating criteria. We recommend investment in resolving these uncertainties before operations are finalized. If these relationships are supported, then operational rules need to be refined to protect the benefits of these improvements over a broad range of conditions.

Question 4: Benefits of Habitat Restoration

Are covered pelagic fish like longfin smelt and delta smelt likely to benefit from restoration of floodplain and tidal marsh habitat at the scale proposed by the Plan? Given the current state of knowledge, and assuming that all Plan commitments are met, are these efforts likely to result in relaxed X2 and spring outflow standards?

A fundamental hypothesis embedded in the BDCP goals and objectives is that improvements in physical habitat, particularly floodplain and tidal marsh, will improve conditions for covered fishes. We focused our assessment on the relationship between habitat restoration and longfin and delta smelt. Based on this analysis we conclude:

- BDCP correctly identifies food limitation as a significant stressor on delta and longfin smelt, particularly in spring through fall. Increasing food availability in smelt rearing areas would likely lead to increases in population.
- Tidal marshes can be sources or sinks for phytoplankton and zooplankton. Most appear to be sinks, particularly for zooplankton. There is high on-site consumption of productivity within marshes.
- Even under the most highly favorable assumptions, restored marshes would have at best a minor contribution to plankton production in smelt rearing areas.
- Smelt can benefit by having direct access to enhanced productivity. This is likely the case for the subpopulation of smelt that reside in Cache Slough.
- BDCP is too optimistic about benefits of tidal marsh and floodplain restoration for smelt, particularly the extent of food production. These optimistic views are indirectly guiding the LOS outflow criteria. There is no clear connection, however, between the two and investments in marsh restoration are unlikely to lead to reduced demand for outflows.

Recommendations: it is possible but unlikely that marsh restoration will materially improve conditions for smelt, although other ecosystem and species benefits of marsh restoration are much more likely. Only moderate- to large-scale experimental restoration projects are likely to resolve this uncertainty and to help

in designing future efforts. BDCP should design and describe a specific program to resolve this issue. Until this uncertainty is resolved flow management will remain the principal tool to mitigate project impacts.

Question 5: Governance

Does the Plan provide achievable, clear and measurable goals and objectives, as well as governance that is transparent and resilient to political and special interest influence?

We analyzed the proposed governance structure of BDCP, including the responsibilities and authorities of new entities such as the Authorized Entity Group (AEG), the Permit Oversight Group (POG), the Adaptive Management Team (AMT), Implementation Office, Program Manager and Program Scientist. Based on this review we conclude the following:

- The governance plan, as structured, blurs the responsibilities between implementation and regulation. It grants AEG final decisionmaking power over actions that should be solely within the authority of the permitting agencies. It also involves the permitting agencies too heavily in implementation of the project.
- As written, the plan grants the AEG veto authority over proposed changes in the program, including any changes in biological goals and objectives or conservation measures.
- The AEG has the power to veto any minor modification, revision or amendment to the Plan that may be necessary to manage listed species.
- The regulatory assurances set forth in the draft Plan severely constrain the fish agencies' ability to respond to inadequacies in biological objectives.
- Given the high uncertainties inherent in BDCP, it is very likely that unforeseen circumstances will require significant changes in biological goals and objectives and conservation actions. Under the 50-year "no surprises" guarantee, the fish agencies assume financial responsibility for many significant changes. This liability could deter needed regulatory changes to BDCP and CVP/SWP operations.
- The procedural hurdles necessary to revoke the incidental take permit of BDCP are so great that revocation is unlikely to occur over the 50-year life of the permit. Indeed, permit revocation and termination of the BDCP would be unprecedented under both state and federal law.

Recommendations: The POG should be granted exclusive regulatory authority to determine whether budgets and workplans are consistent with the permit and to approve revisions to the biological goals and objectives or amendments to the plan. It should have the authority to initiate changes needed to insure protection of the covered species. The POG's functions should be limited to regulatory oversight

rather than direct involvement in implementation. There should be a “no surprises” guarantee for construction of the project. Upon completion of the project, there should be renewable “no surprises” guarantees every ten years. These renewals should be based on conditions at the time of renewal and appropriateness of biological goals and objectives. This approach creates an incentive for all parties to adapt to changes in conditions to sustain covered species, rather than simply fulfilling obligations on conservation measures.

Question 6: Science and Adaptive Management

Is there a robust science and adaptive management plan for BDCP? As described, is the proposed “decision tree” likely to resolve major issues regarding Fall X2 and Spring Outflow prior to initial operations?

We reviewed the science and adaptive management plans in both the plan and EIS/EIR documents. Most issues with high uncertainty or controversy in the Plan are relegated to resolution through an adaptive management process. Based on the documentation, we conclude:

- Given the major uncertainties facing BDCP a robust, well-organized and nimble adaptive management plan will be necessary. The current plan adheres to and strongly promotes the principles of adaptive management and science.
- The requirement of unanimous consent for all decisions by the AMT, and veto power of any member of the AEG and POG is a barrier to adaptive management.
- There is a blurring of the responsibilities between regulators and those responsible for implementation of adaptive management that has the potential to create conflicts. There is a conflicting relationship between AMT decisionmaking and the scientific organizations providing support for decisionmaking.
- The plan recognizes the importance of adaptive capacity, meaning flexibility in operations and actions that allow for learning. Yet it does not describe this capacity in a meaningful way.
- There is almost no description of a science program. What is provided lacks evidence for integration with existing programs, transparency, independence from bias and influence, and structured oversight. These are all necessary for success.
- The decision tree process to establish initial operating conditions is appropriate. Done well, it can resolve many issues. However, it is unlikely to resolve the central issue over starting conditions in time to implement them.

- Although difficult decisions are relegated to a future adaptive management program, actually implementing such a program on such a scale will be very difficult and will require careful design. BDCP does not provide information sufficient to determine whether it will be effective. We remain skeptical that it will.

Recommendations: many of the recommendations for changes in governance made previously will go a long way toward improving the adaptive management program, including the separation of regulators from implementation efforts. However, the plan still needs a complete description of how its adaptive management program would function. The AMT, in whatever form it takes, should be advised by a science program, without scientists responsible for decisionmaking. The science program should be integrated with existing Delta science programs, rather than inventing a new parallel program. The best opportunity for integration is the current efforts to establish a Delta Science Plan through the Delta Science Program and Delta Stewardship Council. Given that the decision tree is unlikely to fully reduce uncertainties in time, coupled with our concerns over how the project would be operated rather than modeled, we recommend that default starting operating conditions be negotiated that approximates the HOS scenario, with a goal of identifying and operationalizing attributes of this scenario that are most beneficial to listed fishes.

Appendices

Appendix A: Operational rules for the North Delta Facility

Appendix B: Impaired Flows into an Impaired Estuary

**Appendix C: Effects of changes in flow conditions on
entrainment losses of delta smelt**

Appendix D: Evidence for food limitation of the smelt species

Appendix E: Model of plankton subsidy from marsh to estuary

Appendix F: Effects of Floodplain Inundation

**Appendix G: Can incidental take permits be issued to water
contractors?**

Appendix A: Operational rules for the proposed North Delta Facility (from Draft Administrative Bay Delta Conservation Plan).

1 **Table 3.4.1-1. Water Operations Flow Criteria**

Parameter	Criteria														
Old and Middle River/San Joaquin inflow-export ratio	<ul style="list-style-type: none"> October, November: Flows will not be more negative than an average of -2000 cfs during D-1641 San Joaquin River pulse periods, or -5,000 cfs during nonpulse periods. November, December: Flows will not be more negative than an average of -5,000 cfs and no more negative than an average of -2,000 cfs when the delta smelt action 1 triggers. January, February: Flows will not be more negative than an average of 0 cfs during wet years, -3,500 cfs during above-normal years, or -4,000 cfs during below-normal to critical years, except -5,000 in January of critical years. March: Flows will not be more negative than an average of 0 cfs during wet or above-normal years or -3,500 cfs during below-normal to critical years. April, May: Allowable flows depend on gaged flow measured at Vernalis. If Vernalis flow is below 5,000 cfs, OMR flows will not be more negative than -2,000 cfs. If Vernalis is 5,000 to 6,000 cfs, OMR flows will not be more negative than -1,000 cfs. If Vernalis exceeds 6,000 cfs, OMR flows will be at least 1,000 cfs. If Vernalis exceeds 10,000 cfs, OMR flows will be at least 2,000 cfs. If Vernalis exceeds 15,000 cfs, OMR flows will be at least 3,000 cfs. If Vernalis exceeds 30,000 cfs, OMR flows will be at least 6,000 cfs. June: Similar to April, but if Vernalis is less than 3,500 cfs, OMR flows will not be more negative than -3,500 cfs. If Vernalis exceeds 3,500 cfs, OMR flows will be at least 0 cfs. If Vernalis exceeds 10,000 cfs, OMR flows will be at least 1,000 cfs. If Vernalis exceeds 15,000 cfs, OMR flows will be at least 2,000 cfs. July, August, September: No constraints. 														
Head of Old River gate operations	<ul style="list-style-type: none"> December, June 16 to September 30: Operable gate will be open. All other months: Operable gate will be partially or completely closed as needed to support OMR flow criterion and, via real-time operations, to minimize entrainment risk for outmigrant juvenile salmonids and/or manage San Joaquin River water quality. 														
Spring outflow	<ul style="list-style-type: none"> March, April, May: As described in Section 3.4.1.4.4, <i>Decision Trees</i>, initial operations will be determined through the use of a decision tree. If at the initiation of dual conveyance, the best available science resulting from structured hypothesis testing developed through a collaborative science program indicates that spring outflow is needed to achieve the longfin smelt abundance objective the following water operations would be implemented within the decision tree. The evaluated starting operations would be to provide a March-May average outflow scaled to the 90% forecast for the water year, with scaling as summarized in the table below. <p style="text-align: center;">March-May Average Outflow Criteria for "High Outflow" Outcome of Spring Outflow Decision Tree</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Exceedance</th> <th>Outflow criterion (cfs)</th> </tr> </thead> <tbody> <tr> <td>10%</td> <td>>44,500</td> </tr> <tr> <td>20%</td> <td>>44,500</td> </tr> <tr> <td>30%</td> <td>>35,000</td> </tr> <tr> <td>40%</td> <td>>32,000</td> </tr> <tr> <td>50%</td> <td>>23,000</td> </tr> <tr> <td>60%</td> <td>17,209</td> </tr> </tbody> </table>	Exceedance	Outflow criterion (cfs)	10%	>44,500	20%	>44,500	30%	>35,000	40%	>32,000	50%	>23,000	60%	17,209
Exceedance	Outflow criterion (cfs)														
10%	>44,500														
20%	>44,500														
30%	>35,000														
40%	>32,000														
50%	>23,000														
60%	17,209														

Table 3.4.1-1. Continued

Parameter	Criteria						
	<table border="1"> <tr> <td>70%</td> <td>13,274</td> </tr> <tr> <td>80%</td> <td>11,382</td> </tr> <tr> <td>90%</td> <td>9,178</td> </tr> </table> <ul style="list-style-type: none"> • Alternatively, if best available science resulting from structured hypothesis testing developed through a collaborative science program shows that Delta foodweb has improved, and evidence from the collaborative science program shows that longfin smelt abundance is not strictly tied to spring outflow, the alternative operation under the decision tree for spring outflow would be to follow flow constraints established under the Bay-Delta Water Quality Control Plan. • February, June: Flow constraints established under the Bay-Delta Water Quality Control Plan will be followed. • All other months: No constraints. 	70%	13,274	80%	11,382	90%	9,178
70%	13,274						
80%	11,382						
90%	9,178						
Fall outflow	<ul style="list-style-type: none"> • September, October, November: As described in Section 3.4.1.4.4, <i>Decision Trees</i>, initial operations will be determined through the use of a decision tree. Within that tree, the evaluated starting operations would be to implement the USFWS (2008) BiOp requirements, and the alternative operation would be to revert to the Bay-Delta Water Quality Control Plan requirements. The alternative operation would be allowed, if the research and monitoring conducted through the collaborative science program show that the position of the low-salinity zone does not need to be located in Suisun Bay and the lower Delta, as required in the BiOp, to achieve the BDCP objectives for Delta smelt habitat and abundance. • All other months: No constraints. 						
Winter and summer outflow	<ul style="list-style-type: none"> • Flow constraints established under the Bay-Delta Water Quality Control Plan will be followed. 						
North Delta bypass flows	<ul style="list-style-type: none"> • October, November: Flows will exceed 7,000 cfs. • July, August, September: Flows will exceed 5,000 cfs. • December through June: Variable, as shown in Error! Reference source not found. 						
Export to inflow ratio	<p>The export to inflow (E:I) ratio for CM1 operations is under development. Two options are under consideration, with the primary difference being the location at which inflow from the Sacramento River is measured.</p> <p>Option 1 (assumed in the low-outflow scenario [LOS] and the evaluated starting operations [ESO] scenario):</p> <ul style="list-style-type: none"> • Combined export rate is defined as the diversion rate of the Banks Pumping Plant and Jones Pumping Plant from the south Delta channels. • Delta inflow is defined as the sum of the Sacramento River flow downstream of the proposed north Delta diversion intakes, Yolo Bypass flow, Mokelumne River flow, Cosumnes River flow, Calaveras River flow, San Joaquin River flow at Vernalis, and other miscellaneous in-Delta flows. <p>Option 2 (assumed in the high-outflow scenario [HOS]):</p> <ul style="list-style-type: none"> • Combined export rate is defined as the sum of the diversion rate of the Banks Pumping Plant and Jones Pumping Plant from the south Delta channels and the diversion at the proposed north Delta intakes. • Delta inflow is defined as the sum of the Sacramento River flow at Freeport (upstream of the proposed north Delta diversion intakes), Yolo Bypass flow, Mokelumne River flow, Cosumnes River flow, Calaveras River flow, San Joaquin River flow at Vernalis, and other miscellaneous in-Delta flows. 						
OMR = Old and Middle Rivers							

1

Table 3.4.1-2. Flow Criteria for North Delta Diversion Bypass Flows from December through June

Constant Low-Level Pumping (December–June)								
Diversions up to 6% of river flow for flows greater than 5,000 cfs. No more than 300 cfs at any one intake.								
Initial Pulse Protection								
Low-level pumping maintained through the initial pulse period. For the purpose of monitoring, the initiation of the pulse is defined by the following criteria: (1) Wilkins Slough flow changing by more than 45% over a 5-day period and (2) flow greater than 12,000 cfs. Low-level pumping continues until (1) Wilkins Slough returns to prepulse flows (flow on first day of 5-day increase), (2) flows decrease for 5 consecutive days, or (3) flows are greater than 20,000 cfs for 10 consecutive days. After pulse period has ended, operations will return to the bypass flows identified below under Post-Pulse Operations. These parameters are for modeling purposes. Actual operations will be based on real-time monitoring of fish movement. If the first flush begins before December 1, May bypass criteria must be initiated following first flush and the second pulse period will have the same protective operation.								
Post-Pulse Operations								
After initial flush(es), Level I operations apply. After 15 total days of bypass flows above 20,000 cfs, Level II operations apply. After 30 total days of bypass flows above 20,000 cfs, Level III operations apply.								
Based on the objectives stated above, it is recommended to implement the following operating criteria:								
<ul style="list-style-type: none"> Bypass flows sufficient to prevent upstream tidal transport at two points of control: Sacramento River upstream of Sutter Slough and Sacramento River downstream of Georgiana Slough. These points are used to prevent upstream transport toward the intended intakes and to prevent upstream transport into Georgiana Slough. 								
Level I			Level II			Level III		
December–April			December–April			December–April		
Sacramento River Flow			Sacramento River Flow			Sacramento River Flow		
Is Over	Is Not Over	Bypass Flow	Is Over	Is Not Over	Bypass Flow	Is Over	Is Not Over	Bypass Flow
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low-level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 80% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 60% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 50% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,600 cfs plus 60% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	13,400 cfs plus 50% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	12,000 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	no limit	18,400 cfs plus 30% of the amount over 20,000 cfs	20,000 cfs	no limit	15,900 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	no limit	13,000 cfs plus 0% of the amount over 20,000 cfs

Table 3.4.1-2. Continued

May			May			May		
Sacramento River Flow			Sacramento River Flow			Sacramento River Flow		
Is Over	Is Not Over	Bypass Flow	Is Over	Is Not Over	Bypass Flow	Is Over	Is Not Over	Bypass Flow
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low-level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 70% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 50% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 40% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,400 cfs plus 50% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	13,000 cfs plus 35% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	11,400 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	no limit	17,900 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	no limit	14,750 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	no limit	12,400 cfs plus 0% of the amount over 20,000 cfs
June			June			June		
Sacramento River Flow			Sacramento River Flow			Sacramento River Flow		
Is Over	Is Not Over	Bypass Flow	Is Over	Is Not Over	Bypass Flow	Is Over	Is Not Over	Bypass Flow
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low-level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 60% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 40% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 30% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,200 cfs plus 40% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	12,600 cfs plus 20% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	10,800 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	no limit	17,400 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	no limit	13,600 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	no limit	11,800 cfs plus 0% of the amount over 20,000 cfs

Appendix B: Impaired flows into an impaired estuary

The Sacramento River watershed is the main source of inflow to the Delta and is integral to current operations of the SWP and CVP. The construction of a new North Delta facility will not change the reliance on the Sacramento watershed very much. However, in conjunction with limited changes in reservoir operations and modifications to the Yolo Bypass, it will alter the timing of inflows to the Delta.

One of the goals of BDCP and the Delta Plan is to create a more natural flow regime. As noted in Chapter 4, there is little natural about the landscape, and humans are fully integrated into the ecosystem. Still, returning more natural seasonal flow changes will help in managing species whose life history traits are tied to flow cues.

The projected changes in outflow under BDCP are presented in Figure 3.1. These monthly averages are compared to current (not ELT) unimpaired outflow from the Delta, an imperfect measure of outflow under unregulated conditions that can be used for comparison of BDCP scenarios. All alternatives, including the no-project alternatives, do little to alter the significant changes in Delta outflow regime. The winter flood pulse associated with high runoff from mixed rain/snow storms has been greatly reduced in all but wet years. More significantly, the spring snowmelt pulse is attenuated, and largely missing in most of the drier years. Only late summer/early fall baseflow seasons have flows that are equal to or larger than unimpaired conditions.

Since the Sacramento outflow is a dominant signature for estuarine conditions (second to tides), we examined the magnitude of change in inflow from the Sacramento and compared it to unimpaired flow conditions. We used two simple methods to illustrate the magnitude of change overall and relative changes between ELT scenarios. The first involves calculating a monthly impairment index, I , where:

$$I = (\text{scenario flow}) - (\text{unimpaired flow}) / (\text{unimpaired flow})$$

Where I approaches 0, the scenario flow is less impaired, where $I > 0$ scenario flows exceed unimpaired flows and where $I < 0$, scenario flows are less than unimpaired flows. The magnitude of I is a simple way of describing the magnitude of seasonal impairment. These results are summarized in Figure 3.2 for all water year types.

The impairment index is strikingly similar in pattern for all year types, with high negative impairments during the winter and spring and high positive impairments for the summer and early fall. This result is surprising because there are only subtle differences between year classes. The only significant variation between year classes occurs in the late summer/early fall when Fall X2 outflow rules predominate.

This broad similarity in impairment highlights how uniform the hydrology of the Delta has become: an issue raised in Lund et al., 2007 and Hanak et al, 2011 as contributing to the regime change in Delta ecosystems. It also shows how little effect the HOS and LOS scenarios are likely to have on Sacramento inflows to the Delta.

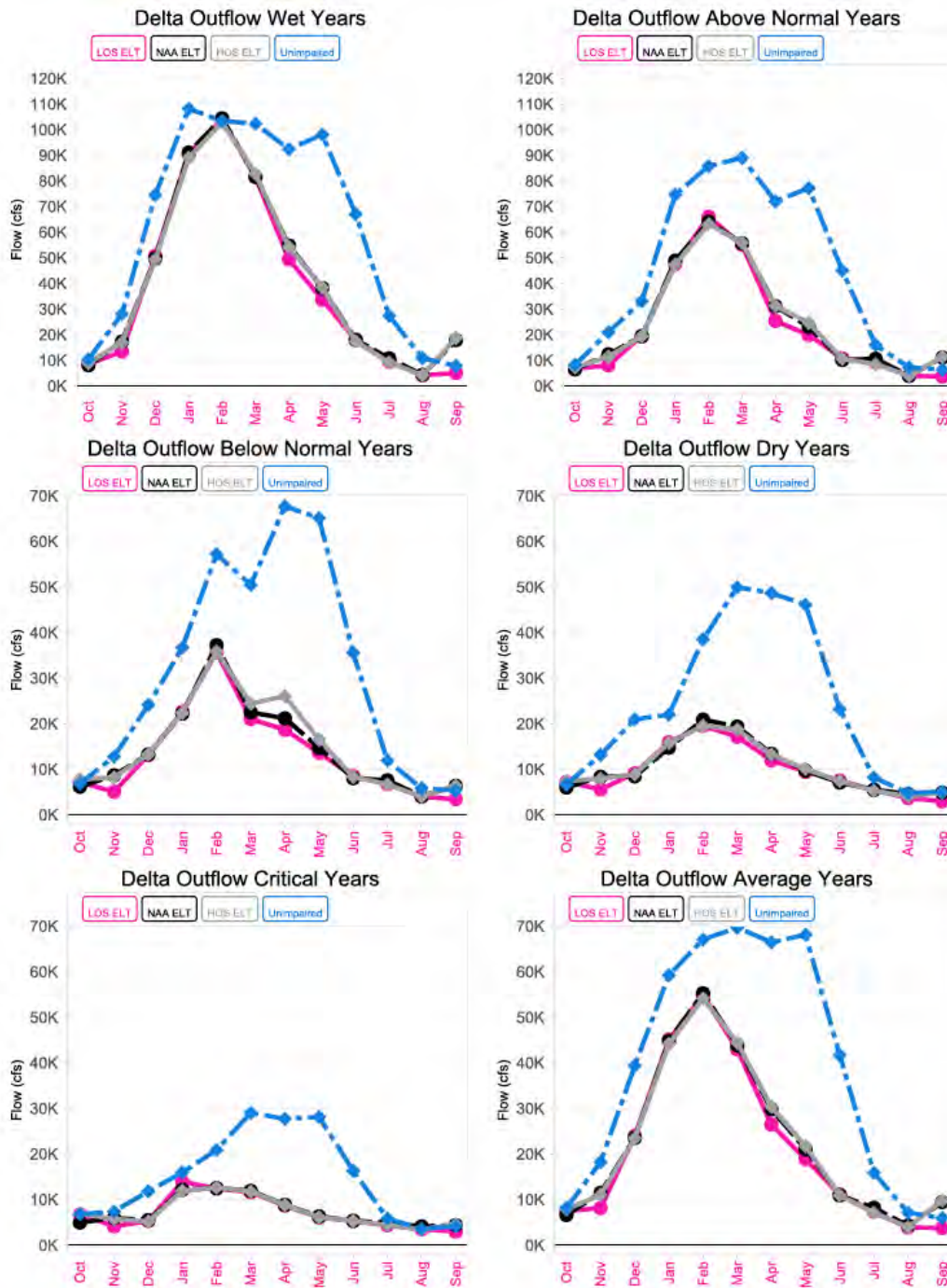


Figure 3.1: Delta outflow under HOS, LOS, and NAA ELT in comparison to unimpaired outflow

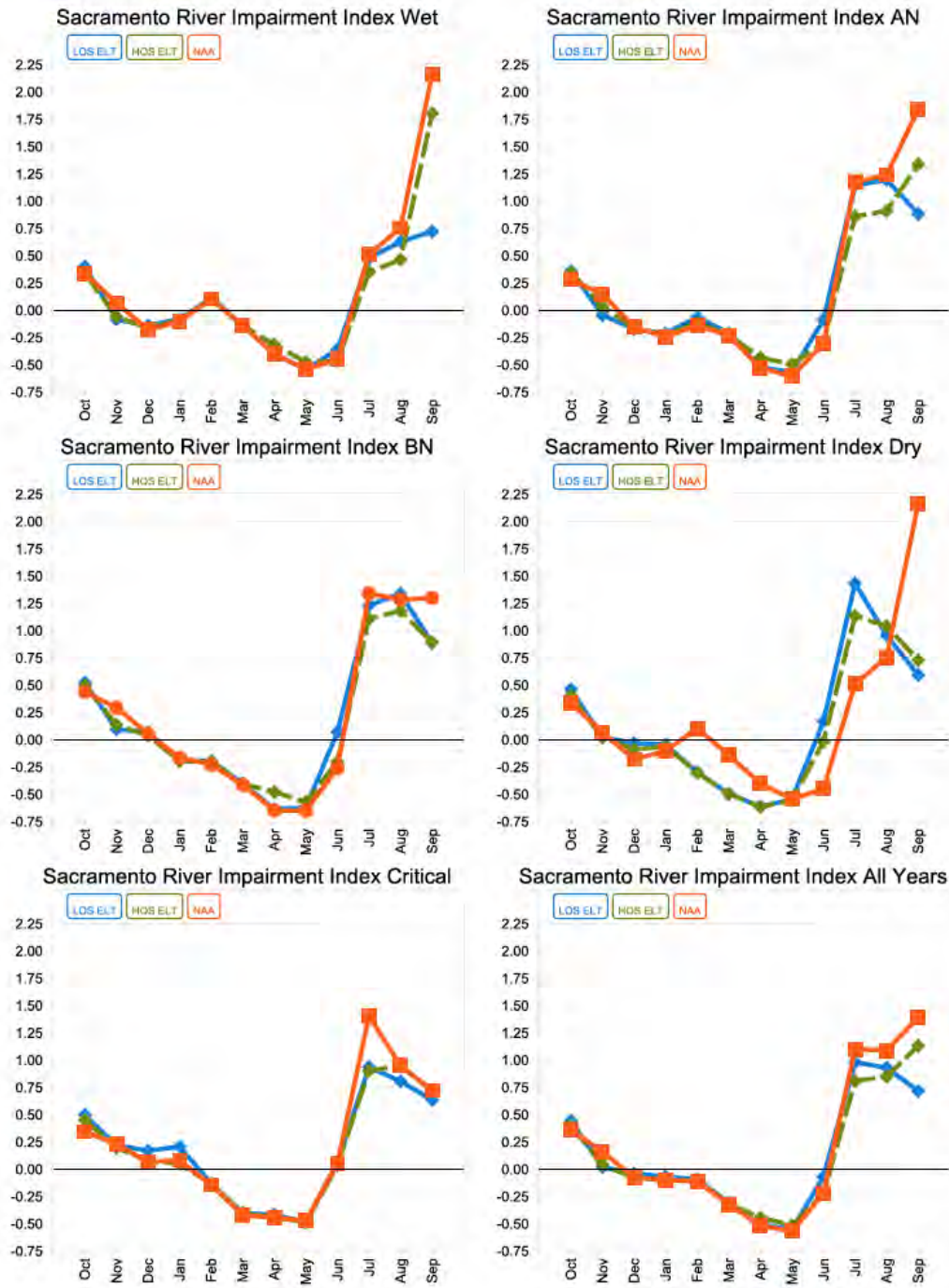


Figure 3.2: Sacramento River impairment index for HOS, LOS and NAA ELT.

A second approach can be used to characterize total impairment of individual year types. In this, we have plotted unimpaired vs. impaired flow for each scenario and each year type, and fitted a line and calculated r^2 . The deviation of the slope of the line from 1 (impaired = unimpaired) illustrates the overall magnitude of impairment, while r^2 is a measure of variation in relative impairment. These results are shown in Figures 3.3-3.5.

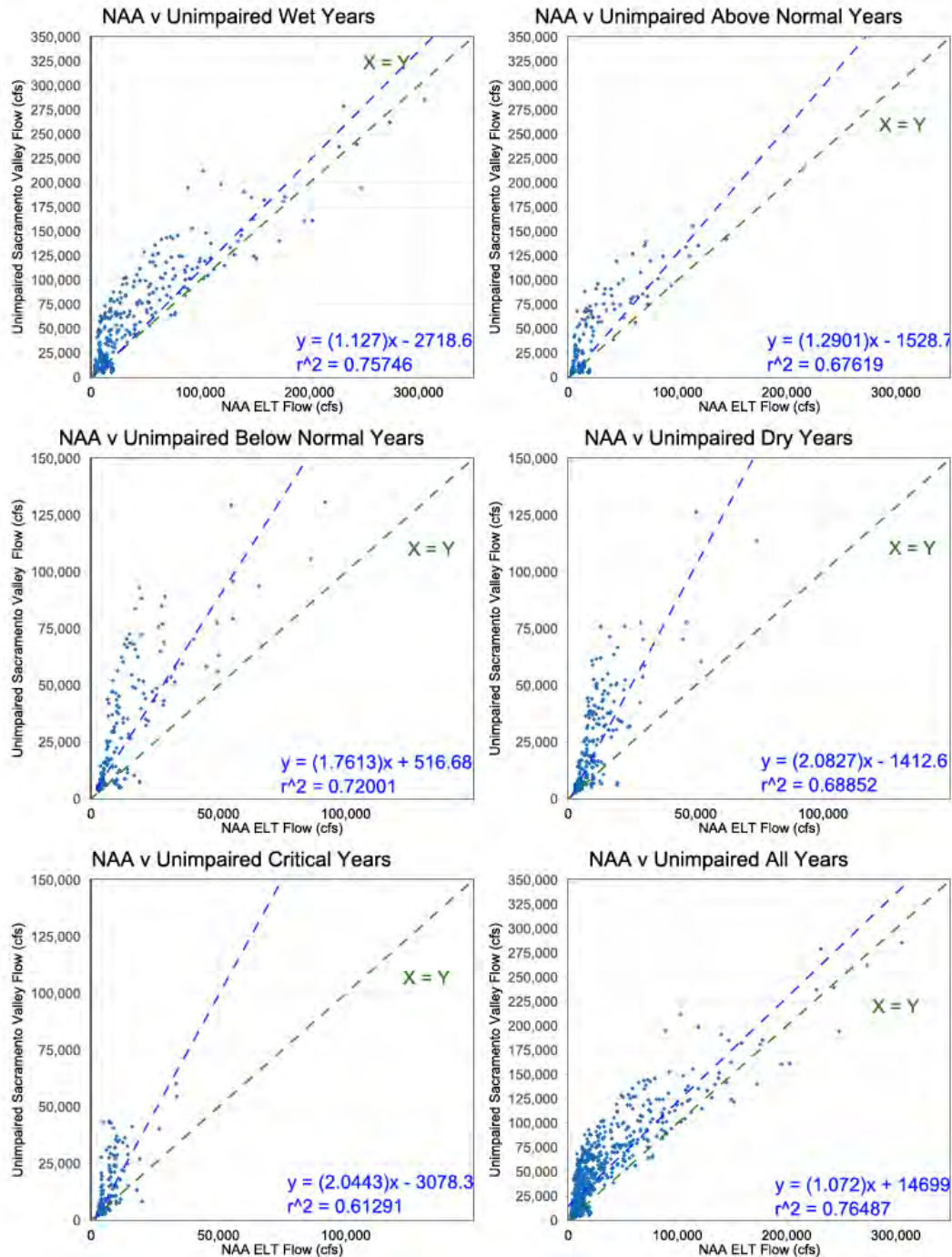


Figure 3.3. Scatterplot of NAA alternative Delta outflows vs. estimated unimpaired flows for ELT conditions. Higher slope and lower r^2 provide a relative measure of impairment.

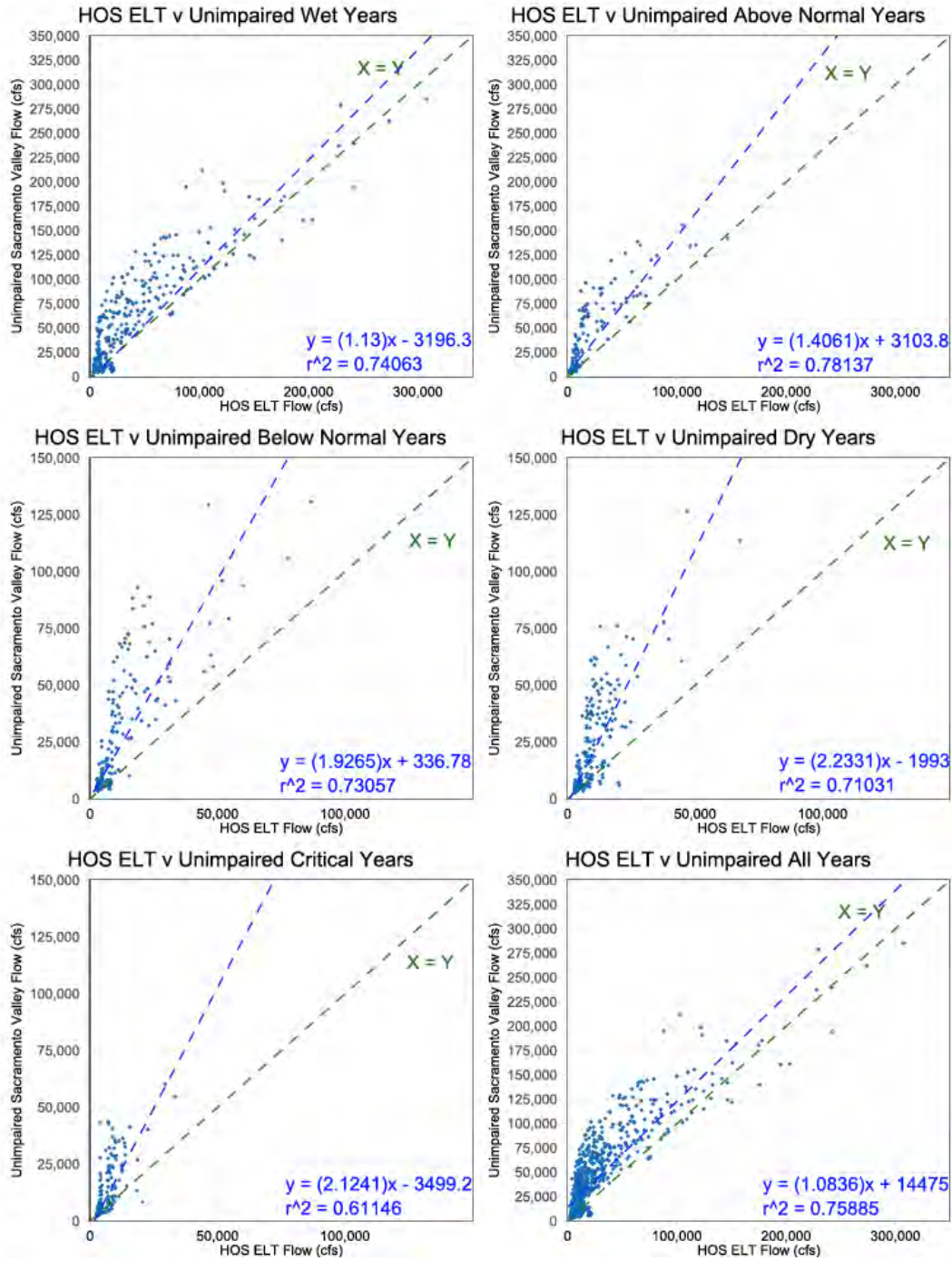


Figure 3.4: Scatterplot of HOS alternative Delta outflows vs. estimated unimpaired flows for ELT conditions. Higher slope and lower r^2 provide a relative measure of impairment.

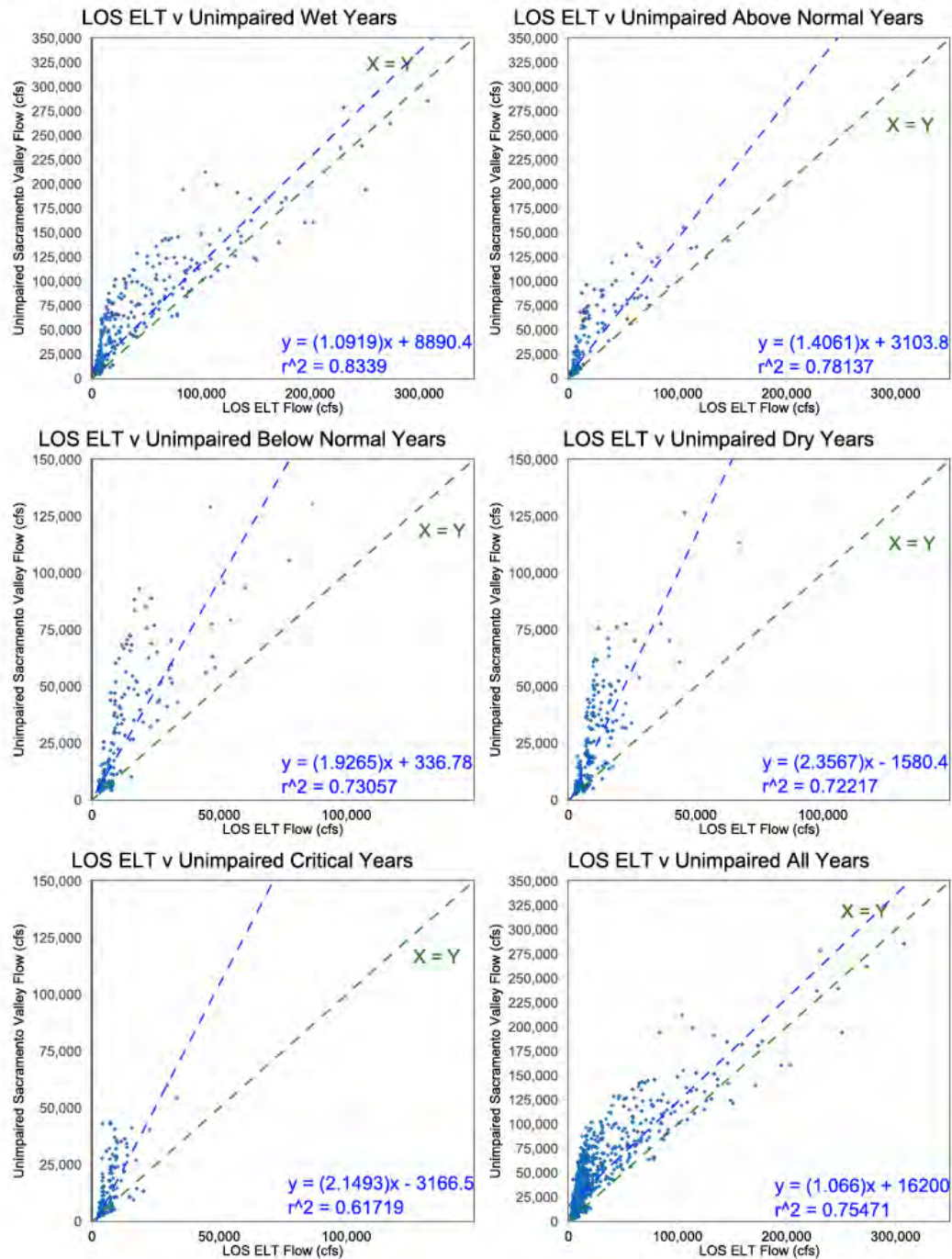


Figure 3.5. Scatterplot of HOS alternative Delta outflows vs. estimated unimpaired flows for ELT conditions. Higher slope and lower r^2 provide a relative measure of impairment.

The results of impairment scatterplots shows that in general, the magnitude of impairment, as measured by slope, and the magnitude of variation from unimpaired flow, as measured by r^2 , are least in wet years and maximum in drier years. This reflects the dominance of water use and operations on Delta hydrology during dry

years when the capacity for water alteration is greatest. In addition, there appears to be no substantive difference between the scatterplots of the different scenarios.

Conclusion

Examination of two closely related flow regimes, Delta outflow and Sacramento inflows, show that there is little difference in NAA, HOS, and LOS conditions. All represent high levels of impairment, in comparison to unimpaired flows, and the new North Delta facility and changes in export timing and magnitude have little impact on overall flow regime.

Appendix C: Effects of changes in flow conditions on entrainment losses of delta smelt

This Appendix describes the methods and results of analyses of flows in the South Delta and their potential effects on delta smelt. The general procedure was to determine a relationship between survival or recruitment during some life stages of delta smelt, and calculate the expected response based on conditions modeled using CALSIM and using historical data. CALSIM results were available for 1922-2003 for three BDCP scenarios: NAA, HOS and LOS. Historical data were used for inflow, export flow, and outflow during 1955-2003, and Old and Middle River flows from 1980 to 2003.

The calculations were based on results of Kimmerer (2008) as amended for adult delta smelt by Kimmerer (2011). Miller (2011) pointed out some potential biases in that analysis. Young delta smelt may be more abundant in the northern Delta than previously believed, which would mean that the proportional losses calculated by Kimmerer (2008) were too high (Miller 2011); however, this potential bias was not considered amenable to quantitative analysis with the available data (Kimmerer 2011). Nevertheless, the estimates of entrainment losses and reductions in losses herein may actually be somewhat overestimated.

The principal assumptions for this analysis are stated in Chapter 6. For the analyses of export losses we used a resampling method to account for uncertainty in the underlying statistical relationships between flow and entrainment. The error distributions from these models were sampled 1000 times to arrive at uncertainty estimates. The same 1000 samples were used for each year and scenario. This allowed us to include variability due to model uncertainty, and to allow direct comparisons among scenarios. The calculation was repeated for each year to provide the variability due to the hydrological conditions modeled under each scenario. Confidence limits were estimated as quantiles of the resulting set of simulated values for each parameter.

Losses of adult delta smelt

Losses as a proportion of the population of adult delta smelt had been estimated from salvage density, catches in the Spring Kodiak and Fall Midwater Trawl surveys, and flows in the south Delta (Kimmerer 2008, 2011). We related these estimates to total southward flow in Old and Middle Rivers:

$$Q_{sd} = \text{mean}_{\text{Dec-Mar}} \left(\begin{array}{l} 0, Q_{OM} \geq 0 \\ -Q_{OM}, Q_{OM} < 0 \end{array} \right) \quad (1)$$

where Q_{SD} is mean flow in the South Delta during December-March, and Q_{OM} is monthly mean or modeled flow in Old and Middle Rivers.

Estimated annual proportional losses P_L were related to Q_{SD} by linear regression for each year during which data were available (water years 1995-2006),

$$P_L \sim \max(0, a + bQ_{SD}) \quad (2)$$

where $a = -0.03$ and $b = 0.0082 \pm 0.0034$ are regression coefficients. P_L was calculated using a revised estimate of the scaling factor Θ which accounts for uncertainty in the calculation of P_L ; Θ has a mean of 22 and standard deviation of 5.2 (Kimmerer 2011).

Because P_L is a mortality we calculated means for a 20-year period by converting these values to survival, calculating geometric means, and converting back to proportions lost:

$$\overline{P}_L = 1 - \frac{1}{N} \prod_{i=1}^N (1 - P_{Li}) \quad (3)$$

where the overbar indicates a mean, N is the total number of years, and P_{Li} is the proportional loss for each year. The 20-year period was somewhat arbitrary but is roughly the timescale for the decline in abundance of delta smelt. To examine differences between pairs of the three scenarios we calculated the arithmetic means of differences for each pair.

There was little difference in mean P_L values between the full time series used in the analysis and the reduced time series that included the historical period (1980-2003). The No-Action Alternative (NAA) had a slightly lower percent annual loss than the historical period. The High and Low-Outflow scenarios (HOS and LOS) had similar values that were slightly below half of that of the NAA, or a net change in loss of about 3%/year.

Losses of juvenile delta smelt

Losses as a proportion of the population of juvenile delta smelt had been estimated from the spatial distribution of fish in the 20mm survey and flows in the south Delta supplemented by particle-tracking results (Kimmerer and Nobriga 2008, Kimmerer 2008). We related these estimates to total inflow to the Delta and export flow, noting that these results may vary depending on the proportion of inflow that is from the San Joaquin River. As with adults, CALSIM output was averaged over March – May for each year and scenario.

Annual proportional loss was calculated from a regression originally derived from particle-tracking data and applied to estimated losses of young smelt:

$$P_L \sim \max(0, a + bQ_{In} + cQ_{Ex} + dQ_{In}Q_{Ex}) \quad (4)$$

where $a = -3$, $b = 0.36 \pm 0.17$, $c = 0.90 \pm 0.24$, and $d = -0.10 \pm 0.03$ are regression coefficients (Kimmerer 2008).

P_L values were accumulated and plotted as above (see Figures in Chapter 6). The annual means for the NAA were somewhat lower than the historical values, reflecting overall lower export flows than in the historical period. Both of the alternative scenarios resulted in substantial decreases in loss rates from about 14%/year to 3-5 %/year, and the LOS showed about a 2%/year higher loss rate than the HOS.

Appendix D: Evidence for food limitation of the smelt species

Delta smelt larvae consume mainly early life stages of copepods, switching to adult copepods as soon as they are able to catch and ingest them (Nobriga 2002, Hobbs et al. 2006, L. Sullivan, SFSU, pers. comm.). Juvenile delta smelt feed mainly on adult copepods (Moyle et al. 1992, Lott 1998, Nobriga 2002, Hobbs et al. 2006), although they consume other zooplankton such as cladocerans in freshwater. The diets of adults include larger organisms such as mysids and amphipods (Bippus et al. poster 2013; Johnson and Kimmerer 2013 talk).

Evidence in favor of food limitation (numbers in parentheses indicate the steps in the logic chain in Chapter 7)

Both smelt species

1. (1) Following the spread of the overbite clam *Potamocorbula* in 1987, sharp declines occurred in phytoplankton biomass and productivity, diatom production, and abundance of copepods and mysids, which are the principal prey of both species (Alpine and Cloern 1992, Kimmerer et al. 1994, Orsi and Mecum 1996, Kimmerer and Orsi 1996, Kimmerer 2005, Winder and Jassby 2011)
2. (1) At around the same time abundance indices of several fish species declined, notably anchovy, longfin smelt, and striped bass (Kimmerer 2002, 2006, Kimmerer et al. 2009), indicating an overall response of estuarine fish populations to the decline in food abundance. The decline in anchovy abundance in brackish waters (but not in high salinity) was particularly sharp and closely tied in time to the 1987 decline in phytoplankton biomass.

Delta smelt

3. (1) Gut fullness of delta smelt larvae was positively related to copepod density (Nobriga 2002). This suggests that when there is more food the smelt larvae eat more.
4. (1) Feyrer et al. (2003) found that delta smelt guts averaged about 40% full in Suisun Marsh before *Potamocorbula* arrived. This was similar to the gut fullness of most other fish species. It suggests that if there were more food the fish would have eaten more, or that there is some other limit to gut fullness.
5. (1) The functional response of larval delta smelt from laboratory experiments shows that the feeding rate saturates at a prey concentration well above that seen in any zooplankton samples in the smelt habitat during May–July of 1993–2011 (L. Sullivan, SFSU, unpublished; see Figure A7.1).

6. (2) Glycogen was depleted in 30% of fish in summer and 60% of fish in fall of 1999 (Fig. 28C in Bennett 2005) which could be interpreted as evidence of poor nutrition either because of a food shortage or because of some toxic effect; however the frequency of toxic damage was <10% in these fish.
7. (2) Mean lengths declined in either 1989 (Bay Study) or 1993 (FMWT study; Fig. 29 in Bennett 2005). The latter year is when the copepod *Pseudodiaptomus forbesi* shrank back from the LSZ in summer-fall, presumably because of the combined effects of clams and the introduction of other copepods. Bennett (2005, Figure 30) also showed positive relationships between mean length of delta smelt and copepod density (Bennett Fig. 30).
8. (3a) Copepod biomass is correlated with an index of survival from summer to fall (Kimmerer 2008).
9. (3a) Abundance data show evidence for density dependence between summer and fall when the early years are included (Bennett 2005 Fig. 17). A likely cause of density dependence is food limitation, although other mechanisms are also possible.
10. (1-4) Several model analyses show strong effects of food supply on the population rate of increase (Maunder and Deriso 2011, Rose et al. 2013a, b, Kimmerer and Rose, in prep). Note, however, that these models are incomplete and can only show effects based on what is in them.
11. A multivariate autoregressive (MAR) model (Mac Nally et al. 2010) showed weak support for a positive link between calanoid copepod abundance and delta smelt abundance index.

Longfin smelt

12. (1) Longfin smelt prey mainly on mysids after summer (Feyrer et al. 2003). Mysids declined sharply after 1987 (Orsi and Mecum 1996, Winder and Jassby 2011).
13. (Overall) Abundance of longfin smelt declined sharply after the introduction of *Potamocorbula*, when the strong effect of freshwater flow is taken into account (Kimmerer 2002, Kimmerer et al. 2009). Striped bass, which also feed on mysids (Feyrer et al. 2003), also declined at that time.
14. A multivariate autoregressive (MAR) model (Mac Nally et al. 2010) showed weak support for a positive link between calanoid copepod abundance and longfin smelt abundance index.

Evidence that does not support food limitation or is missing

15. The abundance of delta smelt did not change when *Potamocorbula* arrived or 1993, which were the two times of greatest change in calanoid copepod abundance in the low-salinity habitat of delta smelt

16. A changepoint model (Thomson et al. 2010) showed no link between abundance of various zooplankton and abundance indices of either smelt species.
17. Sampling for zooplankton is at too coarse a scale to represent the prey abundance that the smelt perceive, and the spatial distribution of prey cannot be replicated in the laboratory. Therefore it may be misleading to extrapolate functional responses from the laboratory to the field.
18. There is no direct evidence for effects of food on survival, maturity, or fecundity.

Appendix E: Model of plankton subsidy from marsh to estuary

Here we assume that the restored areas will actually produce an excess of phytoplankton or zooplankton over adjacent waters, and ask what additional level of food availability to the smelt would result. This is based on a very simple model and some calculations using data from IEP monitoring, as noted below. These calculations are unpublished except where a citation is given; details of calculations are available on request.

The additional zooplankton biomass available to the open-water areas as a result of production in restored shallow subtidal areas depends on the excess production in the restored areas, the resulting gradient in biomass, the tidal exchange rate between the restored areas and open waters, and the net population growth rate of the zooplankton in the open waters. The benefit of that additional supply to the smelt species depends on the proximity of the restored area to the population centers of the smelt (Fig. 7.2).

A simple model of this subsidy is:

$$F = (B_R - B)V_R X / BV \quad (1)$$

where F (d^{-1}) is the subsidy as a daily proportion of plankton biomass in the receiving water, B is biomass per unit volume, V is volume, B_R and V_R are biomass and volume in the restored area, and X is exchange rate as a daily proportion of the volume of the restored area (d^{-1}). Biomass and volume units cancel out.

It is clear from Equation 1 that the subsidy is maximized when the restored area is large, the zooplankton biomass in the restored area is well above that in the open water, and exchange rate is high. However, there is an interplay among biomass B_R , volume V_R , and exchange rate X . First, water depth has three competing effects: 1) Phytoplankton growth rate is highest in shallow water where light penetration is high; 2) For a given area of restoration, volume is inversely related to water depth; 3) any bivalve grazing consumes phytoplankton and zooplankton in inverse proportion to depth. Second, as the exchange rate X increases, net population growth rate within the restored area decreases as organisms are removed by the exchange. If there is no exchange there is no subsidy, but at high levels of exchange there is also no subsidy because the zooplankton are being mixed rapidly compared to their internal growth processes (see Figure 7.3). Cloern (2007) showed that the efficiency of conversion of phytoplankton to zooplankton in a linked shallow-deep system was maximized when the tidal exchange rate X was equal to the net population growth rate of the primary consumers.

It is beyond our scope to model explicitly the growth and other processes and consequent biomass levels. However, it is possible to constrain the total phytoplankton and zooplankton biomass within a marsh using available data. During strong blooms nutrients are converted to phytoplankton biomass, but conversion is incomplete because some is lost to other foodweb components such as

detritus, bacteria, and zooplankton. Thus, the total amount of dissolved inorganic nitrogen (DIN, comprising nitrate, nitrite, and ammonium) can set an upper limit to total phytoplankton biomass.

We used data from the IEP water quality and zooplankton monitoring programs from 1975-2012. Data used were from May to October to avoid the high variability of winter flows, and to focus on the dry season when the smelt species may be most constrained by food supply. Data were taken from the low-salinity zone, extended to a salinity of 0.5 – 10, about the range of salinity where delta and longfin smelt are abundant in their first summer, and averaged by year and month.

Chlorophyll was converted to phytoplankton C using a carbon:chlorophyll ratio of 50, under the assumption of high light availability. To examine bloom conditions, we used only data for which phytoplankton biomass exceeded 200 mgC/m³. From these data, we determined the zero-intercept of a linear model of phytoplankton carbon vs. dissolved inorganic nitrogen (DIN), under the assumption that this represented the maximum conversion of DIN to phytoplankton biomass. This corresponded to about 900 mgC/m³ (about 40% of the sum of phytoplankton C and DIN converted to C using a molar ratio of 6.6:1). We used that value as the upper limit for phytoplankton C in a marsh. Calanoid copepod C for adults and copepodites was estimated to be about 2.5% of actual phytoplankton C, and we assumed that this proportion would apply to the maximum phytoplankton C, or about 23 mgC/m³. Using the same data the median phytoplankton and calanoid copepod C in the open water during 1994 – 2011 were 73 and 3 mgC/m³ respectively.

The optimum exchange rate was calculated separately for phytoplankton and for zooplankton. For calculation we assume a mean depth of 2m and an area of 1000 ha (2500 ac) in the restored area. From Lopez et al. (2006) the growth rate of phytoplankton in a shallow area can be modeled as

$$\mu_P = -0.09 + 1.91/H, \quad (2)$$

where H is water depth. At a water depth of 2m, this evaluates to 0.86 d⁻¹, which we use although a similar model using data from the LSZ in 2006-2007 gave a growth rate that was about 25% lower. We assume that benthic grazing in the restored area is negligible, but cannot neglect grazing by microzooplankton. This can be modeled either as:

$$g = \max(0, 0.93 \mu_P - 0.3) \quad (3)$$

based on experimental results from the Low-Salinity Zone in 2006-2007 (York et al. 2011), or

$$g = 0.6 \mu_P \quad (4)$$

from a review of microzooplankton grazing estimates, using values for estuaries (Calbet and Landry 2004). These yield growth rates of 0.5 and 0.35 d⁻¹ respectively. The latter value is probably more generally representative of a wide range of conditions and for this analysis gives a higher net phytoplankton growth rate.

Using an exchange coefficient X set to be close to the net phytoplankton growth rate less grazing of 0.35 d^{-1} and using the volume of the LSZ of 0.5 km^3 as V in Equation 1, we get:

$$F = (B_R - B)V_RX / BV = (900 - 73) (1000 \times 10^{-2} \times 2 \times 10^{-3}) 0.35 / (73 \times 0.5)$$

or about 0.16 d^{-1} . This is about half of phytoplankton growth, and about twice the (negative) net of growth less grazing by microzooplankton and clams in the LSZ based on field measurements during 2006-2008, which is now subsidized by mixing from other areas of the estuary. Thus, the extremely ideal conditions proposed above would lead to a substantial subsidy of phytoplankton to the LSZ. However, this assumes nearly perfect tuning of the exchange, ideal growth of the phytoplankton with no benthic grazing within the restored area, and perfect mixing of the discharged phytoplankton into the LSZ, which is unlikely because of its tidal movement in relation to the outlet of any marsh.

For calanoid copepods the equivalent calculation to that above is

$$F = (23 - 3) (1000 \times 10^{-2}) \times (2 \times 10^{-3}) 0.1 / (3 \times 0.5)$$

or about 0.03 d^{-1} . As before, this represents an upper limit of the likely subsidy to LSZ zooplankton. This corresponds to a turnover time of about a month, considerably longer than the population turnover time of the copepods. As with phytoplankton, this is an upper limit of the potential subsidy of copepods, which would be reduced by behavioral resistance to movement such as vertical migration, and by excess predation in the marsh compared to the adjacent open waters. Both of these reductions are likely to be very large.

Zooplankton export from Suisun Marsh

One of the proposed restoration areas is in the northern end of Suisun Marsh. Biomass of calanoid copepods in the southern part of the marsh was about $2\times$ that of the adjacent Grizzly Bay, based on a short-term field study and long-term monitoring data (Kimmerer and Marcal 2004). Biomass in the smaller sloughs to the north is apparently higher although nothing has been published on that (J. Durand, UC Davis, pers. comm.).

We used output from the UnTRIM hydrodynamic model (MacWilliams et al. in prep., Kimmerer et al. in press) and the FISH-PTM particle tracking model (Kimmerer et al. in prep.) to examine the residence time of particles within Suisun Marsh during the dry season. The hydrodynamic model simulates the entire estuary including marsh channels and bathymetry, but is not specifically set up to replicate flows in the marsh and therefore the results should be considered preliminary. For the entire network of channels it should give acceptable results, but to model the smaller sloughs would require a finer grid for that area.

The PTM was run for 45 days in a dry period in the historical data set (starting 1 July 1994) to examine the influence of vertical movement on retention in the estuary. The model was started with particles released throughout the northern estuary in a pattern similar to the distribution of the copepod *Eurytemora affinis*, the most abundant LSZ resident zooplankton species before *Potamocorbula* was

introduced. Over 9000 particles were released for each run at approximately the same number per unit volume throughout the marsh. Residence time was estimated as the rate of decline of the log of total particles remaining in the marsh.

For neutrally-buoyant (i.e., passive) particles, the residence time of the marsh was about 28 days, and particles continuously left the marsh during the 45-day run. Particles that either sank or migrated tidally (down on the ebb and up on the flood) had a more complex pattern but generally the particles in the northern part of the marsh did not leave the marsh during the 45-day run.

Taking the passive case first and using available bathymetric data for the volumes of the marsh and Suisun Bay, Equation 1 can be reduced to the following:

$$F = (B_R / B - 1) \times V_R / (RT \times V) = (B_R / B - 1) \times 0.07 / (28 \times 0.11) \\ = 0.02 (B_R / B - 1)$$

Based on the existing data cited above for Suisun Marsh, this flux would provide an additional 2%/d of copepods to Suisun Bay if the copepods behaved as passive particles. This is unlikely to produce a noticeable increase in copepod biomass, as their population growth rates are on the order of 10%/d. Any tidal migration or tendency to remain near the bottom (which can be common among zooplankton in shallow, well-lit waters) would greatly reduce or even eliminate the net flux from the marsh to the open waters.

Appendix F: Effects of floodplain inundation

This Appendix explores available data on the response of phytoplankton and zooplankton biomass to flooding of the Yolo Bypass. This is to provide a basis for anticipating effects on the estuarine foodweb from floodplain inundation at lower flows in the Sacramento River.

One assumption underlying BDCP plans for increased inundation of the Yolo Bypass is that it would provide a source of phytoplankton and zooplankton to the open waters of the estuary. If so, the much larger floods that occasionally inundate the Bypass now should produce measurable increases in phytoplankton and zooplankton at monitoring stations in the estuary.

The basis for this analysis was to use the IEP monitoring data to try to detect an influence of inundation of the Bypass on phytoplankton biomass as chlorophyll concentration, and zooplankton biomass calculated from abundance. IEP data were obtained from six stations in the western Delta to eastern Suisun Bay.

Chlorophyll concentration has been determined since 1976 in the zooplankton survey. Abundance of zooplankton has been determined since 1972 by species and gross life stage. We used data on adult and juvenile calanoid copepods, which are common in the diets of delta smelt and other fishes. Abundance data were converted to biomass using carbon mass per individual by species and life stage (see Kimmerer 2006 for details; carbon estimates have been updated).

Neither chlorophyll nor copepod biomass showed any effect of inundation of the Bypass. This lack of response is clear for copepod biomass in Fig. F.1, which shows that under high flows in the Bypass the biomass was generally lower than when flows were lower. The data have been stratified by groups of years separated by the time that the clam *Potamocorbula amurensis* was introduced. During both periods biomass was generally higher when the Bypass was dry than when it was flowing at a low rate ($< 500 \text{ m}^3\text{s}^{-1}$). Biomass increased slightly in a handful of times when the Bypass was flowing at a higher rate, but even with this increase biomass still did not match that at the lowest flows. The difference in biomass between the pre- and post-clam period is notable at low Bypass flows.

Most of the high flows in the Bypass occurred during winter when zooplankton biomass is at its seasonal low. Inundation of the Bypass later in spring at a lower stage of the Sacramento River than is now necessary might provide conditions for higher productivity, but the lack of response of the current system at lower Bypass flows is not promising.

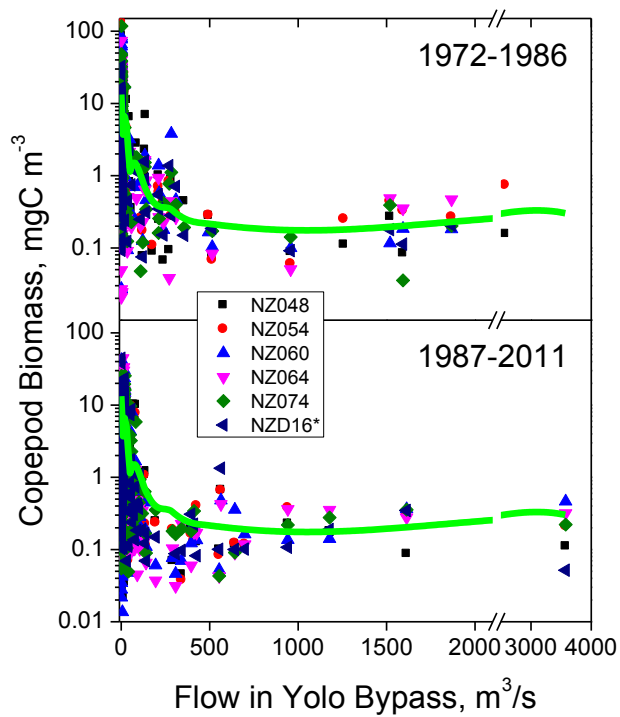


Figure F.1. Copepod biomass as a function of flow in the Yolo Bypass for two time periods. Symbol shapes and colors show the sampling stations from the IEP zooplankton monitoring survey. Green line is from a generalized additive model with a loess (locally-weighted) smoothing function applied to the pre-1987 period and shown in the lower graph for comparison.

Appendix G: Can incidental take permits be issued to water contractors?

Do the federal Endangered Species Act and the California Natural Community Conservation Planning Act allow the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the California Department of Fish and Wildlife to issue incidental take permits to the Central Valley Project and State Water Project contractors?

This question is significant, because the draft BDCP provides that the Authorized Entity Group shall be comprised of the Director of the California Department of Water Resources as operator of the SWP, the Regional Director of the U.S. Bureau of Reclamation as operator of the CVP, and one representative each of the CVP and SWP contractors if the contractors are issued permits under the Plan. BDCP 7-8. If we correctly understand the premise of this question, it is that only the owners and operators of the two projects—the U.S. Bureau of Reclamation and the California Department of Water Resources—are eligible to hold the incidental take permit that would govern construction and operation of the facilities authorized by the BDCP.

Although there is no definitive answer to this question, we conclude that the CVP and SWP contractors may receive incidental take permits. We base this conclusion on four factors: (1) There is nothing in either the federal Endangered Species Act or the California Natural Community Conservation Planning Act that prohibits the fish and wildlife agencies from issuing incidental take permits to entities such as the CVP and SWP contractors who receive water service from (and therefore are beneficiaries of) the permitted project operators. (2) The text of both statutes allows for the grant of incidental take permits to persons or entities other than the owners and direct operators of the projects governed by an HCP and NCCP. (3) There is precedent for the inclusion of both government entities and private landowners and resource users within a single HCP/NCCP. (4) There are good reasons both for the CVP and SWP contractors to seek the protections of an incidental take permit and for the fish and wildlife agencies to include the contractors within the management structure of the BDCP. It is therefore likely that the courts would defer to the agencies' decision to issue incidental take permits to the contractors.

The incidental take permitting and HCP provisions of section 10 of the federal ESA authorize the taking of individual members of a listed species that otherwise would be prohibited by section 9(a)(1)(B) of the Act. 16 U.S.C. § 1538(a)(1)(B). The take prohibition of section 9 applies to “any person subject to the jurisdiction of the United States.” *Id.* § 1538(a)(1). The statute defines “person” as meaning

an individual, corporation, partnership, trust, association, or any other private entity; or any officer, employee, agent, department, or instrumentality of the Federal Government, of any State, municipality, or political subdivision of a State, or of any foreign government; any State, municipality, or political subdivision of a State; or any other entity subject to the jurisdiction of the United States. [*Id.* § 1532(13).]

This definition expressly includes the CVP and SWP contractors, which are comprised primarily of instrumentalities of the state (and, in the case of the CVP, includes some individuals). The statute thus extends eligibility for (limited and conditional) exemption from the take prohibition of section 9 to the project contractors, and it contains no exclusion from this eligibility based on the fact that the contractors do not themselves own or operate the project.

The California Natural Community Conservation Planning Act addresses this question even more directly. In its articulation of the purposes of the statute, the Legislature stated:

Natural community conservation planning is a cooperative process that often involves local, state, and federal agencies and the public, including landowners within the plan area. The process should encourage the active participation and support of landowners and others in the conservation and stewardship of natural resources in the plan area during plan development using appropriate measures, including incentives. [California Fish & Game Code § 2801(j).]

The Act also declares that “Any person, or any local, state, or federal agency, independently, or in cooperation with other persons, may undertake natural community conservation planning.” *Id.* § 2809.

Indeed, the fish and wildlife agencies approved this type of multiparty, multijurisdictional, cooperative approach in the Orange County HCP/NCCP for the protection of the coastal gnatcatcher, other target species, and their habitat. The cooperating and individually permitted entities include the County of Orange, the cities of Anaheim, Costa Mesa, Newport Beach, Irvine, Laguna Beach, Orange, and San Juan Capistrano, as well as other participating public and private landowners and water users, such as Southern California Edison, the Metropolitan Water District, Irvine Ranch Water District, the Irvine Company, UC Irvine, the California Department of Parks and Recreation, and transportation corridor agencies. COUNTY OF ORANGE, FINAL NATURAL COMMUNITY CONSERVATION PLAN AND HABITAT CONSERVATION PLAN, CENTRAL AND COASTAL SUBREGION (1996), document available at <http://www.naturereserveoc.org/documents.htm>. Although this situation does not precisely mirror the relationship between the CVP and SWP and their contractors, it does serve as precedent for creation of an HCP/NCCP that includes both land and resource management agencies and public/private land and resource users as incidental take permit holders.

Finally, it makes sense for the CVP and SWP contractors to seek the protections of the incidental take permits governing operation of the facilities authorized by the BDCP, as it is their uses of project water that would potentially violate the federal and state take prohibitions. The contractors thus would benefit both from the security provided by the incidental take permits and from participation in the decisions that would shape implementation and compliance with the terms and conditions limiting coordinated CVP/SWP operations set forth in the BDCP. Concomitantly, it is in the fish and wildlife agencies' interest to have the contractors participate as permittees so that disputes between the contractors and USBR and DWR as project operators may be resolved within the forum of the Authorized Entity Group, rather than outside the purview and procedures of the BDCP. Under these circumstances, we believe that it is likely that the courts would defer to the fish and wildlife agencies' reasonable interpretation of the statutes as authorizing the grant of incidental take permits to the CVP and SWP contractors. *See Chevron U.S.A. v. Natural Resources Defense Council*, 467 U. S. 837 (1984); *American Coatings Ass'n. v. South Coast Air Quality Dist.*, 54 Cal.4th 446 (2012).

References

- Aasen, G.A. 1999. Juvenile delta smelt use of shallow-water and channel habitats in California's Sacramento-San Joaquin Estuary. *California Fish and Game* 85(4): 161-169.
- Alpine, A.E. and J.E. Cloern. 1992. Trophic interactions and direct physical effects control phytoplankton biomass and production in an estuary. *Limnology and Oceanography* 37: 946-955.
- Arthington, A.H. 2012. *Environmental Flows: Saving Rivers in the Third Millennium*. Berkeley: University of California Press.
- Badosa, A., D. Boix, S. Brucet, R. Lopez-Flores and X.D. Quintana. 2006. Nutrients and zooplankton composition and dynamics in relation to the hydrological pattern in a confined Mediterranean salt marsh (NE Iberian Peninsula). *Estuarine Coastal and Shelf Science* 66(3-4): 513-522.
- Baxter, R. D., R. Breuer, L. R. Brown, L. Conrad, F. Freyer, S. Fong, K. Gehrts, L. Grimaldo, B. Herbold, P. Hrodey, A. Mueller-Solger, T. Sommer, and K. Souza. 2010. *Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results*. Sacramento: Interagency Ecological Program for the San Francisco Estuary.
- Bay Institute. 1998. *From the Sierra to the Sea: The Ecological History of the San Francisco Bay-Delta Watershed*. http://www.bay.org/sierra_to_the_sea.htm
- Bennett, W.A. 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. *San Francisco Estuary and Watershed Science* 3(2): Issue 2 Article 1.
- Bippus, T., A. Cardoza, T. Lee, P. Poirier, and S. Slater. 2013. Comparison of Adult Delta Smelt Prey Use between Wet (2011) and Dry (2012) winters. Poster at IEP Workshop, Folsom CA, April 2013.
- Brooks, J.L. and S.I. Dodson. 1965. Predation, body size, and composition of plankton. *Science* 150: 28-35.
- Brucet, S. et al. 2005. Zooplankton structure and dynamics in permanent and temporary Mediterranean salt marshes: taxon-based and size-based approaches. *Archiv fur Hydrobiologie* 162(4): 535-555.
- Brucet, S. et al. 2010. Factors influencing zooplankton size structure at contrasting temperatures in coastal shallow lakes: Implications for effects of climate change. *Limnology and Oceanography* 55(4): 1697-1711.

- Calbet, A. and M.R. Landry. 2004. Phytoplankton growth, microzooplankton grazing, and carbon cycling in marine systems. *Limnology and Oceanography* 49(1): 51-57.
- Cloern J, N. Knowles L. Brown, D. Cayan, M. Dettinger, T. Morgan, D. Schoellhamer, M. Stacey, M. van der Wegen, R. Wagner, A. Jassby. 2011. Projected Evolution of California's San Francisco Bay-Delta-River System in a Century of Climate Change. *PLoS ONE* 6(9): e24465. doi:10.1371/journal.pone.0024465
- Cloern, J.E. 2007. Habitat Connectivity and Ecosystem Productivity: Implications from a Simple Model. *American Naturalist* 169(1): E21-E33.
- Cooper, M.J., K.F. Gyekis and D.G. Uzarski. 2012. Edge effects on abiotic conditions, zooplankton, macroinvertebrates, and larval fishes in Great Lakes fringing marshes. *Journal of Great Lakes Research* 38(1): 142-151.
- Culberson, S.D., C.B. Harrison, C. Enright and M.L. Nobriga. 2004. Sensitivity of Larval Fish Transport to Location, Timing, and Behavior Using a Particle Tracking Model in Suisun Marsh, California. In: F. Feyrer, L.R. Brown, R.L. Brown and J.J. Orsi (Editors), *Early Life History of Fishes in the San Francisco Estuary and Watershed*. American Fisheries Society Symposium Vol. 39. American Fisheries Society, Bethesda MD, pp. 257-267.
- Dame, R. et al. 1986. The outwelling hypothesis and North Inlet, South Carolina. *Marine Ecology Progress Series* 33: 217-229.
- Dean, A.F., S.M. Bollens, C. Simenstad and J. Cordell. 2005. Marshes as sources or sinks of an estuarine mysid: demographic patterns and tidal flux of *Neomysis kadiakensis* at China Camp marsh, San Francisco estuary. *Estuarine, Coastal and Shelf Science* 63(1-2): 1-11.
- Feyrer, F., B. Herbold, S.A. Matern and P.B. Moyle. 2003. Dietary shifts in a stressed fish assemblage: Consequences of a bivalve invasion in the San Francisco Estuary. *Environmental Biology of Fishes* 67: 277 - 288.
- Feyrer, F., K. Newman, M. Nobriga and T. Sommer. 2011. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. *Estuaries and Coasts* 34(1): 120-128.
- Feyrer, F., M.L. Nobriga and T.R. 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.
- Fleenor, W., W. Bennett, P. Moyle, J. Lund. 2010. On Developing Prescriptions for Freshwater Flows to Sustain Desirable Fishes in the Sacramento-San Joaquin Delta. Presented to the State Water Resources Control Board, Feb. 2010. <http://deltasolutions.ucdavis.edu>.

- Gray, B., B. Thompson, E. Hanak, J. Lund, and J. Mount. 2013. *Integrated Management of Delta Stressors: Institutional and Legal Options*. San Francisco: Public Policy Institute of California.
- Grimaldo, L.F., A.R. Stewart and W. Kimmerer. 2009. Dietary segregation of pelagic and littoral fish assemblages in a highly modified tidal freshwater estuary. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 1: 200-217.
- Hanak, E., J. Lund, A. Dinar, B. Gray, R. Howitt, J. Mount, P. Moyle, and B. Thompson. 2011. *Managing California's Water: From Conflict to Reconciliation*. San Francisco: Public Policy Institute of California.
- Hanak, E., J. Lund, A. Dinar, B. Gray, R. Howitt, J. Mount, P. Moyle, and B. Thomposon. 2011. *Managing California's Water: From Conflict to Reconciliation*. San Francisco: Public Policy Institute of California.
- Hanak, E., J. Lund, A. Dinar, B. Gray, R. Howitt, J. Mount, P. Moyle, and B. Thomposon. 2011. *Managing California's Water: From Conflict to Reconciliation*. San Francisco: Public Policy Institute of California.
- Hanak, E., J. Lund, J. Durand, W. Fleenor, B. Gray, J. Medellin-Azuara, J. Mount, P. Moyle, C. Phillips, B. Thompson. 2013. *Stress Relief: Prescriptions for a healthier Delta Ecosystem*. San Francisco: Public Policy Institute of California.
- Hobbs, J.A., W.A. Bennett and J.E. Burton. 2006. Assessing nursery habitat quality for native smelts (Osmeridae) in the low-salinity zone of the San Francisco estuary. *Journal of Fish Biology* 69: 907-922.
- Houser, D.S. and D.M. Allen. 1996. Zooplankton dynamics in an intertidal salt-marsh basin. *Estuaries* 19(3): 659-673.
- Howe, E.R. and C.A. Simenstad. 2007. Restoration trajectories and food web linkages in San Francisco Bays estuarine marshes: a manipulative translocation experiment. *Marine Ecology Progress Series* 351: 65-76.
- Howe, E.R. and C.A. Simenstad. 2011. Isotopic Determination of Food Web Origins in Restoring and Ancient Estuarine Wetlands of the San Francisco Bay and Delta. *Estuaries and Coasts* 34(3): 597-617.
- Jassby, A.D. et al. 1995. Isohaline position as a habitat indicator for estuarine populations. *Ecological Applications* 5: 272-289.
- Johnson, A. and W. Kimmerer. 2013. Feeding ecology of adult delta smelt during a seasonal pulse of turbidity. Presentation at IEP Workshop, Folsom CA, April 2013.
- Kimmerer, W. and D. Marcal. 2004. Zooplankton Abundance Patterns in Grizzly Bay. IEP Newsletter 17 (1): 11-16

- Kimmerer, W.J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? *Marine Ecology Progress Series* 243: 39-55.
- Kimmerer, W.J. 2004. Open water processes of the San Francisco Estuary: From physical forcing to biological responses. *San Francisco Estuary and Watershed Science* 2(1): Issue 1, Article 1.
<http://repositories.cdlib.org/jmie/sfew/vol2/iss1/art1>.
- Kimmerer, W.J. 2005. Long-term changes in apparent uptake of silica in the San Francisco estuary. *Limnology and Oceanography* 50: 793-798.
- Kimmerer, W.J. 2006. Response of anchovies dampens effects of the invasive bivalve *Corbula amurensis* on the San Francisco Estuary foodweb. *Marine Ecology Progress Series* 324: 207-218.
- Kimmerer, W.J. 2008. Losses of Sacramento River Chinook salmon and delta smelt to entrainment in water diversions in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 6(2): Issue 2 Article 2.
- Kimmerer, W.J. 2011. Modeling delta smelt losses at the south Delta export facilities. *San Francisco Estuary and Watershed Science* 9(1): Article 2.
- Kimmerer, W.J. and A.D. McKinnon. 1989. Zooplankton in a marine bay. III. Evidence for influence of vertebrate predation on distributions of two common copepods. *Marine Ecology Progress Series* 53: 21-35.
- Kimmerer, W.J. and J.J. Orsi. 1996. Causes of long-term declines in zooplankton in the San Francisco Bay estuary since 1987. In: J.T. Hollibaugh (Editor), *San Francisco Bay: The Ecosystem*. AAAS, San Francisco, pp. 403-424.
- Kimmerer, W.J. and J.K. Thompson. Phytoplankton growth balanced by clam and zooplankton grazing and net transport into the low-salinity zone of the San Francisco Estuary. Submitted, *Estuaries and Coasts*.
- Kimmerer, W.J. and K.A. Rose. Environmental influences on an endangered estuarine fish investigated with an individual-based model. In prep., *Ecological Applications*.
- Kimmerer, W.J. and M.N. Nobriga. 2008. Investigating particle transport and fate in the Sacramento-San Joaquin Delta using a particle tracking model. *San Francisco Estuary and Watershed Science* 6(1): Issue 1 Article 4.
- Kimmerer, W.J., E. Gartside and J.J. Orsi. 1994. Predation by an introduced clam as the probable cause of substantial declines in zooplankton in San Francisco Bay. *Marine Ecology Progress Series* 113: 81-93.

- Kimmerer, W.J., E.S. Gross and M. MacWilliams. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? . *Estuaries and Coasts* 32: 375-389.
- Kimmerer, W.J., E.S. Gross, and M.L. MacWilliams. Tidal migration of estuarine zooplankton investigated using a particle-tracking model. In prep., *Limnology and Oceanography*.
- Kimmerer, W.J., J.R. Burau and W.A. Bennett. 1998. Tidally-oriented vertical migration and position maintenance of zooplankton in a temperate estuary. *Limnology and Oceanography* 43: 1697-1709.
- Kimmerer, W.J., M.H. Nicolini, N. Ferm and C. Peñalva. 2005. Chronic food limitation of egg production in populations of copepods of the genus *Acartia* in the San Francisco Estuary. *Estuaries* 28: 541-550.
- Kimmerer, W.J., M.L. MacWilliams, and E.S. Gross. Variation of fish habitat and extent of the low-salinity zone with freshwater flow in the San Francisco Estuary. In press, *San Francisco Estuary and Watershed Science*.
- Kneib, R.T. 1997. The role of tidal marshes in the ecology of estuarine nekton. *Oceanography and Marine Biology Annual Review* 35: 163-220.
- Lehman, P., T. Sommer and L. Rivard. 2007. The influence of floodplain habitat on the quantity and quality of riverine phytoplankton carbon produced during the flood season in San Francisco Estuary. *Aquatic Ecology*.
- Lehman, P.W., S. Mayr, L. Mecum and C. Enright. 2010. The freshwater tidal wetland Liberty Island, CA was both a source and sink of inorganic and organic material to the San Francisco Estuary. *Aquatic Ecology* 44(2): 359-372.
- Lopez, C.B. et al. 2006. Ecological values of shallow-water habitats: Implications for the restoration of disturbed ecosystems. *Ecosystems* 9(3): 422-440.
- Lucas, L.V. and J.K. Thompson. 2012. Changing restoration rules: Exotic bivalves interact with residence time and depth to control phytoplankton productivity. *Ecosphere* 3(12): Art. 17.
- Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, P. Moyle. 2007. *Envisioning Futures for the Sacramento-San Joaquin Delta*. San Francisco: Public Policy Institute of California.
- Lund, J., E. Hanak, W. Fleenor, W. Bennett, R. Howitt, J. Mount, and P. Moyle. 2010. *Comparing Futures for the Sacramento-San Joaquin Delta*. Berkeley, CA: University of California Press and Public Policy Institute of California.
- Mac Nally, R. et al. 2010. An analysis of pelagic species decline in the upper San Francisco Estuary using Multivariate Autoregressive modelling (MAR). *Ecological Applications* 20(5): 1417-1430.

- MacWilliams, M.L., E.S. Gross, and W.J. Kimmerer. Three-dimensional modeling of hydrodynamics and salinity in the San Francisco Estuary. In prep., San Francisco Estuary and Watershed Science.
- Matern, S.A., P.B. Moyle and L.C. Pierce. 2002. Native and alien fishes in a California estuarine marsh: Twenty-one years of changing assemblages. *Transactions of the American Fisheries Society* 131(5): 797-816.
- Maunder, M.N. and R.B. Deriso. 2011. A state-space multistage life cycle model to evaluate population impacts in the presence of density dependence: illustrated with application to delta smelt (**Hyposmesus** transpacificus). *Canadian Journal of Fisheries and Aquatic Sciences* 68(7): 1285-1306.
- Mazumder, D., N. Saintilan and R.J. Williams. 2009. Zooplankton inputs and outputs in the saltmarsh at Towra Point, Australia. *Wetlands Ecology and Management* 17(3): 225-230.
- Meek, M.H., A.P. Wintzer, N. Shepherd and B. May. 2013. Genetic diversity and reproductive mode in two non-native hydromedusae, *Maotias marginata* and *Moerisia* sp., in the upper San Francisco Estuary, California. *Biological Invasions* 15(1): 199-212.
- Miller, W.J. 2011. Revisiting assumptions that underlie estimates of proportional entrainment of delta smelt by state and federal water diversions from the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 9(1): Article 1.
- Mount, J., W. Bennett, J. Durand, W. Fleenor, E. Hanak, J. Lund, and P. Moye. 2012. *Aquatic Ecosystem Stressors in the Sacramento-San Joaquin Delta*. San Francisco: Public Policy Institute of California.
- Moyle, P., J. Kiernan, P. Crain, R. Quiñones. 2013. Climate change vulnerability of native and alien freshwater fishes of California: A systematic assessment approach. *PLoS ONE* 8(5): e63883. doi:10.1371/journal.pone.0063883
- Moyle, P.B. 2008. The Future of Fish in Response to Large-Scale Change in the San Francisco Estuary, California. *American Fisheries Society Symposium* 64: 357-374.
- Moyle, P.B., B. Herbold, D.E. Stevens and L.W. Miller. 1992. Life history and status of the delta smelt in the Sacramento-San Joaquin Estuary, California. *Transactions of the American Fisheries Society* 121: 67-77.
- Moyle, P.B., W. Bennet, J. Durand, W. Fleenor, B. Gray, E. Hanak, J. Lund, and J. Mount. 2012. *Where the Wild Things Aren't: Making the Delta a Better Place for Native Species*. San Francisco: Public Policy Institute of California.

- Moyle, P.B., W. Bennet, J. Durand, W. Fleenor, B. Gray, E. Hanak, J. Lund, and J. Mount. 2012. *Where the Wild Things Aren't: Making the Delta a Better Place for Native Species*. San Francisco: Public Policy Institute of California.
- Moyle, P.B., W. Bennett, J. Durand, W. Fleenor, B. Gray, E. Hanak, J. Lund, and J. Mount. 2012. *Where the Wild Things Aren't: Making the Delta a Better Place for Native Species*. San Francisco: Public Policy Institute of California.
- Müller-Solger, A.B., A.D. Jassby and D. Müller-Navarra. 2002. Nutritional quality of food resources for zooplankton (*Daphnia*) in a tidal freshwater system (Sacramento-San Joaquin River Delta). *Limnology and Oceanography* 47: 1468-1476.
- National Research Council. 2012. *Sustainable Water and Environmental Management in the California Bay-Delta*. Washington, DC: National Academies Press.
- Newman, K. B. 2003. Modeling Paired Release-Recovery Data in the Presence of Survival and Capture Heterogeneity with Application to Marked Juvenile Salmon. *Statistical Modeling* 3:157-177.
- Nixon, S. 1980. Between coastal marshes and coastal waters - a review of twenty years of speculation and research on the role of salt marshes in estuarine productivity and water chemistry. In: P. Hamilton and K. MacDonald (Editors), *Estuarine and wetland processes*. Plenum, New York, pp. 437-525.
- Nobriga, M., T. Sommer, F. Feyrer and K. Fleming. 2008. Long-term trends in summertime habitat suitability for delta smelt, *Hypomesus transpacificus*. *San Francisco Estuary and Watershed Science* 6(1): Issue 1 Article 1.
- Nobriga, M.L. 2002. Larval delta smelt diet composition and feeding incidence: environmental and ontogenetic influences. *California Fish and Game* 88: 149-164.
- Odum, E.P. 1980. The status of three ecosystem-level hypotheses regarding salt marsh estuaries: Tidal subsidy, outwelling and detritus-based food chains. In: V.S. Kennedy (Editor), *Estuarine Perspectives*. Academic Press, pp. 485-495.
- Orsi, J.J. and W.L. Mecum. 1996. Food limitation as the probable cause of a long-term decline in the abundance of *Neomysis mercedis* the opossum shrimp in the Sacramento-San Joaquin estuary. In: J.T. Hollibaugh (Editor), *San Francisco Bay: The ecosystem*. AAAS, San Francisco, pp. 375-401.
- Perry, R. W., J. R. Skalski, P. L. Brandes, P. T. Sandstrom, A. P. Klimley, A. Amman, and B. MacFarlane. 2010. Estimating Survival and Migration Route Probabilities of Juvenile Chinook Salmon in the Sacramento-San Joaquin River Delta. *North American Journal of Fisheries Management* 30:142-156.
- Rose, K.A., W.J. Kimmerer, K.P. Edwards and W.A. Bennett. 2013. Individual-based modeling of delta smelt population dynamics in the upper San Francisco

- Estuary. I. Model Description and Baseline Results. *Transactions of the American Fisheries Society* 142(5): 1238-1259.
- Rose, K.A., W.J. Kimmerer, K.P. Edwards and W.A. Bennett. 2013. Individual-based modeling of delta smelt population dynamics in the upper San Francisco Estuary. II. Alternative baselines and good versus bad years. *Transactions of the American Fisheries Society* 142(5): 1260-1272.
- Rosenfield, J.A. and R.D. Baxter. 2007. Population Dynamics and Distribution Patterns of Longfin Smelt in the San Francisco Estuary. *Transactions of the American Fisheries Society* 136(6): 1577-1592.
- Schemel, L.E., T.R. Sommer, A.B. Muller-Solger and W.C. Harrell. 2004. Hydrologic variability, water chemistry, and phytoplankton biomass in a large floodplain of the Sacramento River, CA, USA. *Hydrobiologia* 513(1-3): 129-139.
- Sobczak, W.V. et al. 2005. Detritus fuels ecosystem metabolism but not metazoan food webs in San Francisco estuary's freshwater Delta. *Estuaries* 28(1): 124-137.
- Sobczak, W.V., J.E. Cloern, A.D. Jassby and A.B. Muller-Solger. 2002. Bioavailability of organic matter in a highly disturbed estuary: The role of detrital and algal resources. *Proceedings of the National Academy of Sciences, USA* 99(12): 8101-8105.
- Sommer, T. and F. Mejia. 2013. A place to call home: a synthesis of delta smelt habitat in the upper San Francisco Estuary. *San Francisco Estuary and Watershed Science* 11(2).
- Sommer, T. R., B. Harrell, M. Nobriga, R. Brown, P. Moyle, W. Kimmerer, and L. Schemel. 2001. California's Yolo Bypass: Evidence That Flood Control Can Be Compatible with Fisheries, Wetlands, Wildlife, and Agriculture. *Fisheries* 26(8):6-16.
- Sommer, T., F.H. Mejia, M.L. Nobriga, F. Feyrer and L. Grimaldo. 2011. The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary. *San Francisco Estuary and Watershed Science* 9(2).
- Sommer, T.R., W.C. Harrell, A. Mueller Solger, B. Tom and W. Kimmerer. 2004. Effects of flow variation on channel and floodplain biota and habitats of the Sacramento River, California, USA. *Aquatic Conservation: Marine and Freshwater Ecosystems* 14: 241-267.
- Thebault, J., T.S. Schraga, J.E. Cloern and E.G. Dunlavy. 2008. Primary production and carrying capacity of former salt ponds after reconnection to San Francisco Bay. *Wetlands* 28(3): 841-851.

- Thomson, J. et al. 2010. Bayesian change-point analysis of abundance trends for pelagic fishes in the upper San Francisco Estuary. *Ecological Applications* 20(5): 1431 -1448.
- Venables, W.N. and B.N. Ripley. 2003. *Modern applied statistics with S*. Springer-Verlag, New York, 548 pp.
- Vogel, D. A. 2008. *Pilot Study to 1 Evaluate Acoustic-Tagged Juvenile Chinook Salmon Smolt Migration in the Northern Sacramento–San Joaquin Delta, 2006–2007*. Sacramento: California Department of Natural Resources.
- Whipple, A. A., R. M. Grossinger, D. Rankin, B. Stanford, and R. A. Askevold. 2012. *Sacramento-San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process*. Richmond, CA: San Francisco Estuary Institute-Aquatic Science Center.
- 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):Article 2.
Available:<<http://repositories.cdlib.org/jmie/sfews/vol4/iss3/art2>>.
- Williams, J. G. 2009. *Sacramento–San Joaquin Delta Regional Ecosystem Restoration Implementation Plan Life History Conceptual Model for Chinook Salmon and Steelhead*.
- Winder, M. and A.D. Jassby. 2011. Shifts in zooplankton community structure: implications for food web processes in the upper San Francisco Estuary. *Estuaries and Coasts* 34: 675-690.
- Wintzer, A.P., M.H. Meek and P.B. Moyle. 2011. Life history and population dynamics of *Moerisia* sp., a non-native hydrozoan, in the upper San Francisco Estuary (USA). *Estuarine Coastal and Shelf Science* 94(1): 48-55.
- York, J.L., B.A. Costas and G.B. McManus. 2011. Microzooplankton grazing in green water—results from two contrasting estuaries. *Estuaries and Coasts* 34: 373-385.

EXHIBIT E



March 11, 2016

SENT VIA EMAIL: CWFhearing@waterboards.ca.gov

Hearing Chair Tam Doduc
Hearing Officer Felicia Marcus
State Water Resources Control Board
P.O. Box 100
Sacramento, California 95812-0100

Re: Written Response to March 4 Requirement to Address Information Requests from California Water Research and Sacramento Valley Water Users

In the March 4, 2016 Revised Hearing Schedule, Revised Notices of Intent to Appear, Electronic Service and Submissions, and Other Procedural Issues Concerning the California WaterFix (CWF) Water Right Change Petition Hearing the State Water Resources Control Board (State Water Board) required that the Petitioners respond within seven days of that revised pre-hearing ruling "identifying how the concerns identified in the letters [February 4, 2016 from California Water Research, and February 17, 2016 and February 25, 2016 from Sacramento Valley Water Users] will be addressed." This letter provides information in response to the State Water Board March 4 notice.

On March 10, 2016, California Water Research submitted to the Department of Water Resources (DWR) and U.S. Bureau of Reclamation (USBR) a request for further information, which we are reviewing to develop an appropriate response.

The questions raised in the February letters from California Water Research and the Sacramento Valley Water Users are summarized by the State Water Board as a request to provide additional information on the hydrologic modeling used to support the CWF analyses for the EIR/S and the petition hearing. Specifically the Board requested "a complete list of the versions of all computer models used in producing analyses for the WaterFix". The three Tables provided below list this information.

Several models and analytical methods were used to characterize and analyze the operational changes in water operations in the State Water Project (SWP) and Central Valley Project (CVP) systems. These tools represent the best available technical tools for purposes of conducting the analyses at issue. The overall flow of information between the models is shown in Figure 1.

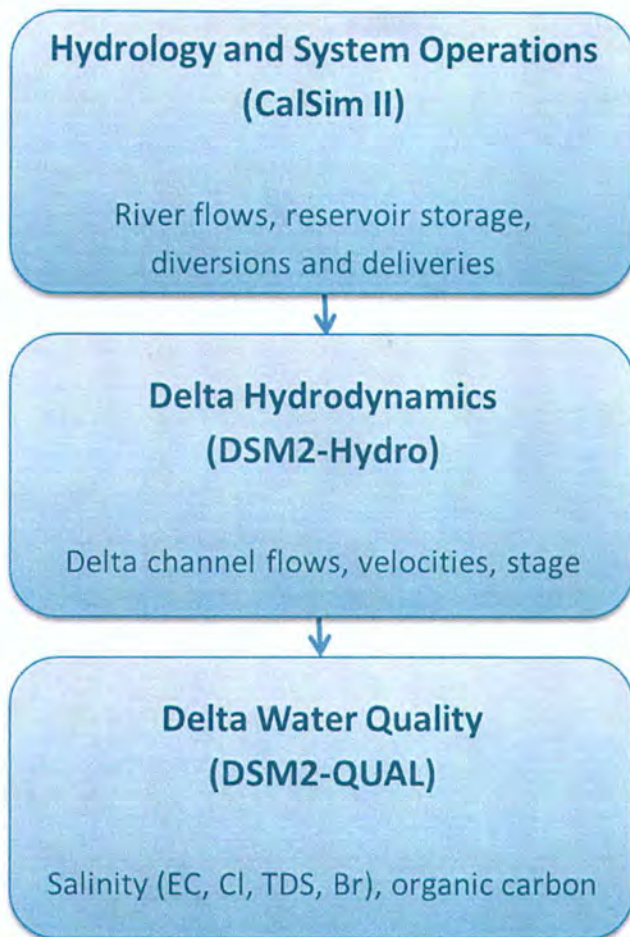


Figure 1. Use of Modeling Tools and Results in CWF Analyses

In general, CALSIM II is used to simulate the operations of the SWP and CVP. The output of this model is then used by the DSM2 model to simulate the hydrodynamics, water quality, and particle tracking. With the information generated from these models, the water supply, flows, and water quality can be compared under different operating scenarios. See Section 4.3 and Appendix 5A of the Draft BDCP EIR/S (Nov 2013) for a more detailed description of the various models.

CALSIM II and DSM2 are both public models and are available for download on DWR's Bay-Delta Office website <http://baydeltaoffice.water.ca.gov/modeling/index.cfm>. Consistent with DWR's policy of ensuring a transparent process, both the CALSIM II and DSM2 modeling input and output data used to support the CWF environmental impact analyses have been released to the public. Table 1 provides a summary of the data developed, including the CALSIM II version used, for the currently proposed CWF project (Alternative 4A) and the associated No Action Alternative for each of the environmental documents (including Final EIR/EIS that is in preparation), as well as information on when the information was made available to the public.

Table 1. Model Data and Availability Used in Developing BDCP/CWF Environmental Analyses

	Recirculated DEIR/SDEIS	Final EIR/EIS	CWF Biological Assessment for ESA Section 7	Change Petition
No Action Alternative	No Action Alternative at Early Long Term (ELT)	No Action Alternative at ELT with Fremont Weir updates	No Action Alternative at ELT revised per ESA requirements	Same as Biological Assessment (BA)
Alternative 4A	Modeled as a range between Alternative 4 H3 and H4 operations at ELT	Alternative 4A H3+ operations at ELT	Alternative 4A H3+ operations at ELT	Same as BA
CALSIM Version	2010	2010	2015	2015
Date Data Available	November 2011 (model runs developed for administrative record)	February 2016	February 2016	February 2016

Table 2 provides a summary of the hydrological models used for all the alternatives considered in the BDCP/CWF EIR/EIS as well as the ESA Section 7 draft Biological Assessment, including both the CALSIM II version and the DSM2 timespan. Table 3 includes the list of climate change sensitivity analyses that were conducted for the ESA Section 7 draft Biological Assessment.

Table 2: Summary of the CALSIM II and DSM2 models used for Alternatives evaluation in the BDCP/CWF EIR/EIS (2013 Draft, 2015 Recirculated Draft, and Preparation of Final) and CWF ESA Section 7 Biological Assessment

Alternative	Used in 2013 Draft EIR/EIS	Used in 2015 Recirculated Draft EIR/SDEIS	Used in Preparation Final EIR/EIS	Used in Biological Assessment	Calsim II version	DSM2 time span	Date Available to Public
Existing Conditions	X	X	X		2010	16 years	April 2012
No Action Alternative at Late Long Term (LLT)	X				2010	16 years	Nov 2011
No Action Alternative at ELT		X			2010	16 years	Nov 2011
Updated No Action Alternative at ELT			X		2010	16 years	Feb 2016
CWF Sec 7 BA Base Model				X	2015	82 years	Feb 2016
Alternative 1 A/B/C at LLT	X				2010	16 years	Nov 2011
Alternative 2 A/B/C at LLT	X				2010	16 years	Nov 2011
Alternative 2D at ELT – used Alternative 2 A/B/C at LLT as surrogate		X			2010	16 years	Nov 2011
Alternative 2D at ELT			X		2010	16 years	Feb 2016

Alternative	Used in 2013 Draft EIR/EIS	Used in 2015 Recirculated Draft EIR/SDEIS	Used in Preparation Final EIR/EIS	Used in Biological Assessment	Calsim II version	DSM2 time span	Date Available to Public
Alternative 3 at LLT	X				2010	16 years	Nov 2011
Alternative 4 H1 at LLT	X				2010	16 years	Dec 2013
Alternative 4 H2 at LLT	X				2010	16 years	Dec 2013
Alternative 4 H3 at LLT	X				2010	16 years	Nov 2011
Alternative 4 H4 at LLT	X				2010	16 years	Dec 2013
Alternative 4A at ELT – Used Alternative 4 H3 at ELT as a bookend		X			2010	16 years	Nov 2011
Alternative 4A at ELT – Used Alternative 4 H4 at ELT as a bookend		X			2010	16 years	Dec 2013
Alternative 4A at ELT			X		2010	16 years	Feb 2016
CWF Sec 7 BA Proposed Action (Alternative 4A)				X	2015	82 years	Feb 2016

Alternative	Used in 2013 Draft EIR/EIS	Used in 2015 Recirculated Draft EIR/SDEIS	Used in Preparation Final EIR/EIS	Used in Biological Assessment	Calsim II version	DSM2 time span	Date Available to Public
Alternative 5 at LLT	X				2010	16 years	Nov 2011
Alternative 5A at ELT - Alternative 5 at ELT as a surrogate		X			2010	16 years	Nov 2011
Alternative 5A at ELT			X		2010	16 years	Feb 2016
Alternative 6 A/B/C at LLT	X				2010	16 years	Nov 2011
Alternative 7 at LLT	X				2010	16 years	Nov 2011
Alternative 8 at LLT	X				2010	16 years	Nov 2011
Alternative 9 at LLT	X				2010	16 years	Nov 2011

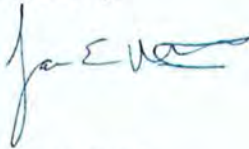
Table 3: Summary of the models used for climate change sensitivity analysis in the CWF Section 7 Biological Assessment

Alternative	Calsim II version	DSM2 time span	Date Available to Public	Purpose
CWF Sec 7 BA Base Model – at ELT under Q5 climate projection	2015	82 years	Feb 2016	Effects Analysis; Climate change sensitivity Analysis
CWF Sec 7 BA Base Model under current climate	2015	N/A	Feb 2016	Climate change sensitivity Analysis
CWF Sec 7 BA Base Model at ELT under Q2 climate projection	2015	N/A	Feb 2016	Climate change sensitivity Analysis
CWF Sec 7 BA Base Model at ELT under Q4 climate projection	2015	N/A	Feb 2016	Climate change sensitivity Analysis
CWF Sec 7 BA Proposed Action (Alternative 4A) – at ELT under Q5 climate projection	2015	82 years	Feb 2016	Effects Analysis; Climate change sensitivity Analysis
CWF Sec 7 BA Proposed Action (Alternative 4A) under current climate	2015	N/A	Feb 2016	Climate change sensitivity Analysis
CWF Sec 7 BA Proposed Action (Alternative 4A) at ELT under Q2 climate projection	2015	N/A	Feb 2016	Climate change sensitivity Analysis
CWF Sec 7 BA Proposed Action (Alternative 4A) at ELT under Q4 climate projection	2015	N/A	Feb 2016	Climate change sensitivity Analysis

In order to ensure consistency and comparability between alternatives for the EIR/EIS it was important to use the same version of the models for all alternatives. Therefore, although the CA WaterFix and other non-HCP/NCCP Alternatives were developed after release of the Draft EIR/EIS, and a slightly modified version of CALSIM II was available, it was decided to use the same base model of CALSIM II (2010) and patterning period for DSM2 (16 year record) for analysis of *all* new alternatives in both the 2015 Recirculated Draft EIR/SDEIS and forthcoming Final EIR/EIS. However, because the Endangered Species Act has a requirement to use Best Commercially Available Scientific Data, it was decided among USBR, USFWS, NMFS and DWR to use the most recent version of CALSIM II (2015) and a longer patterning period for DSM2 (82-year record) for the Biological Assessment. As noted in Table 1 above, the modeling conducted for the BA is the basis of the information that will be used in the case-in-chief in the Hearing process.

Due to the volume of data and the complexity of the associated models, the Department has found it more user-friendly to work with the requestor to ensure they have the information needed to utilize the data. It appears that this process is, in the words of Deirdre Des Jardins, "a major improvement." In some cases where the user is experienced and familiar with CALSIM II and/or DSM2 it has been efficient to provide a link allowing them to download the data directly. In either case, the Department has strived to provide the data in an effective and efficient manner.

Sincerely,



Tripp Mizell
Senior Attorney
Office of the Chief Counsel
CA Department of Water Resources



Amy L. Aufdemberge
Assistant Regional Solicitor
Office of the Regional Solicitor
U.S. Department of the Interior

cc: *Electronic Service*

Tom Howard, Executive Officer, State Water Resources Control Board
Michael Lauffer, Chief Counsel, State Water Resources Control Board
Electronic service list, March 8, 2016

Personal Service via U.S. Postal Service

Suzanne Womack and Sheldon Moore
Clifton Court, L.P.
3619 Land Park Drive
Sacramento, CA 95818

STATEMENT OF SERVICE

CALIFORNIA WATERFIX PETITION HEARING Department of Water Resources and U.S. Bureau of Reclamation (Petitioners)


I hereby certify that I have this day submitted to the State Water Resources Control Board and caused a true and correct copy of the following document(s):

PROTESTANT SAVE THE CALIFORNIA DELTA ALLIANCE, ET AL.'s OBJECTIONS TO EVIDENCE AND JOINDER IN OBJECTIONS TO EVIDENCE SUBMITTED BY THE SACRAMENTO VALLEY WATER USERS, LOCAL AGENCIES OF THE NORTH DELTA ET AL., CENTRAL DELTA WATER AGENCY ET AL., COUNTY OF SAN JOAQUIN ET AL., PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS AND INSTITUTE FOR FISHERIES RESOURCES ET AL., CITY OF ANTIOCH, CONTRA COSTA COUNTY AND CONTRA COSTA WATER AGENCY, COUNTY OF SOLANO, AND NATURAL RESOURCES DEFENSE COUNCIL ET AL.

PROTESTANT SAVE THE CALIFORNIA DELTA ALLIANCE, ET AL.'s REQUEST FOR OFFICIAL NOTICE IN SUPPORT OF OBJECTIONS TO EVIDENCE

to be served by **Electronic Mail** (email) upon the parties listed in Table 1 of the **Current Service List** for the California WaterFix Petition Hearing, dated July 11, 2016, posted by the State Water Resources Control Board at
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/service_list.shtml

I certify that the foregoing is true and correct and that this document was executed on July 12, 2016.

Signature: 
Name: Michael A. Brodsky
Title: Attorney

Party/Affiliation:
Save the California Delta Alliance, et al.

Address:
Law Offices of Michael A. Brodsky
201 Esplanade, Upper Suite
Capitola, CA 95010