An Overview of the Draft Conservation Strategy For the Bay Delta Conservation Plan

December 17, 2008

INTRODUCTION

This document is intended to provide an overview and synopsis of the draft proposed Conservation Strategy, including its key components, for the Bay Delta Conservation Plan (BDCP). It reflects the substantial progress to date by the BDCP Steering Committee in developing the Conservation Strategy for the plan, and builds upon concepts set out in the BDCP Planning Agreement dated October, 2006, and the subsequent Points of Agreement issued by the Steering Committee in November, 2007. It is intended to enable the Steering Committee to confirm a number of the key components of the draft Conservation Strategy as they now stand and thereby help guide the remaining work that is necessary to complete a proposed conservation plan by June, 2009, pursuant to the Endangered Species Act (ESA), Natural Communities Conservation Planning Act (NCCPA), and/or the California Endangered Species Act (CESA). The draft BDCP will then undergo further detailed environmental review and analysis. This document is, importantly, also intended to describe more fully those components of the draft Conservation Strategy that will be rigorously evaluated through detailed analysis beginning in January, 2009, using conceptual modeling tools such as the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP), CALSIM II, and DSM2.

Specifically, this overview contains the following:

a. an introduction to the draft BDCP Conservation Strategy and a description of the fundamental problems it is intended to address

b. a description of the overall approach to developing the Conservation Strategy;

c. a description of the draft planning principles used to assist in the integration of the core elements enumerated below;

d. a description of a number of the key components of the draft Conservation Strategy, including an overview of the approach to the development of the draft strategy, draft biological goals and objectives as currently formulated for aquatic species and habitats; core elements designed to address water conveyance and operations, habitat restoration, and other stressors; and a process for an adaptive management and monitoring program.

e. a description of key outstanding issues and challenges facing the Steering Committee as it moves forward with the planning process; and

f. a description of the anticipated next steps and schedule for the planning process.

Substantial drafts of sections of the Conservation Strategy have been developed over the course of 2008 and remain under development. They are available as drafts to Steering Committee members and the public, and are referred throughout this Overview. The Steering Committee recognizes that considerable additional work remains to complete a draft of the proposed BDCP by June, 2009, and a draft joint environmental impact statement/report (EIS/EIR) on the plan by the end of 2009, to allow for completion of the final BDCP by the end of 2010. This work will result in refinements, modifications, changes, and additions to the Conservation Strategy and other elements of the BDCP. Upon completion of a draft of the BDCP, the plan will be distributed for further public review and comment along with draft environmental review documents prepared under both the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The work of the Steering Committee will not stop at this juncture; rather, it will continue as the NEPA/CEQA process unfolds, and more information, analysis, and public input become available. It is expected that the BDCP will evolve throughout this process and that additional changes and modifications will be made to the plan before it is finalized at the end of 2010. Subsequent approvals of the plan following the completion of these NEPA/CEQA reviews will result in the issuance of long-term incidental take authorizations under federal and state endangered species laws for those activities covered by the plan.

THE BDCP CHALLENGE

The general problems and challenges of the Bay Delta are both extensive and well documented. The primary challenge facing the BDCP process is how to address comprehensively the increasingly significant and intensifying conflict between the ecological needs of a range of at-risk Delta species and natural communities that have been and are adversely affected by a wide range of human activities while providing for adequate and reliable water supplies for people, communities, agriculture, and industry.

Several native species that occur in the Sacramento-San Joaquin Delta are at-risk (or high risk) of extinction due to significant perturbations to the Delta ecosystem over the last century including, among other things: fundamental changes to the hydrodynamics of the Delta from levees; large upstream storage dams and diversions; diversions of water from within the Delta and its tributaries; entrainment of fish and food-web resources at water diversion facilities; construction of a network of navigation and irrigation canals; a reduction or elimination of a significant portion of the historically available tidal marshes, floodplains, and riparian habitats; the continued discharge of contaminants from urban and agricultural areas and sources; the invasions of exotic plan and animal species; and legal or illegal harvest of native species.

At the same time, water conveyed through the Delta has been the engine of enormous growth and prosperity. One of the world's largest agricultural and urban economies is dependent on continued diversions of water from the Delta. The significance of these economies to Californians and to the nation cannot be overstated, and yet the continued vitality of these economies may be threatened if the issues of water reliability and supply are not adequately and comprehensively addressed. The Delta and the surrounding Central Valley are also now inhabited by more than a million people who have transformed the landscape to intensive agricultural and urban land uses. Continued population growth, migration, and world trade will exacerbate these pressures.

As the ecological health of the Delta declines because of these numerous factors, the conflicts between the imperatives of species conservation and reliable water supplies have become more pronounced, as amply evidenced by the recent court decisions regarding the intersection of the federal and state endangered species acts and the operation of the state and federal water projects. Other factors, such as the continuing subsidence of lands within the Delta, increasing seismic risks and levee failures, and sea level rise associated with climate change, serve to further exacerbate these conflicts. Simply put, the system as it is currently designed and operated does not work from either an environmental or economic perspective, and calls out for fundamental, systemic change.

Securing that change in a lasting and durable manner requires a considerable investment of time, effort, money, and political will. Modifying or moving water diversion infrastructure to reduce the environmental impacts of water diversions and provide the opportunity to implement system-wide ecological improvements to the Delta ecosystem will cost billions of dollars. Restoring large areas of floodplain and inter-tidal marsh will require the cooperation and commitment of landowners and communities who occupy the Delta. Substantial resources will also be required to support efforts to address numerous other factors contributing to the decline of ecological conditions in the Delta, including enforcing harvest regulations, reducing polluted discharges from urban and agricultural landscapes, financing new and potentially less environmentally harmful water management infrastructure, and minimizing the expansion of invasive species within the Delta. In short, efforts to improve the functionality of the Delta ecosystem and advance the recovery of at-risk species require the active support of stakeholders and the people of California, and this support is dependent upon reliable water supplies to meet important water needs and the California economy.

Public water agencies are demonstrating their interest in such a comprehensive approach through their active participation in and financial support for the development of the BDCP. Water diverters require authorizations from state and federal fish and wildlife agencies to continue exporting water from the Delta legally. Before committing billions of dollars of new debt for new infrastructure, habitat restoration, and other activities, public water agencies seek assurances that these investments will yield reliable water supply benefits over time. They also seek assurances from the state and federal fish and wildlife agencies that operations of these new facilities will be permissible, and that the operations will continue under a predictable and reliable set of rules.

Finally, the implementation of the BDCP will occur in the context of considerable and confounding uncertainties, driven in part by the ecological complexity of the Delta itself, in part by the substantial unknowns about how the ecology of the Delta functions and how it may respond to major changes in water infrastructure and habitat restoration, and in part by the fact of ongoing climate change and other drivers. To manage these uncertainties while providing assurances that the BDCP will achieve both water supply and conservation objectives, a Conservation Strategy for the Delta must be flexible enough to respond to new information and changing circumstances, but definitive enough to serve as the basis for the issuance of the regulatory authorizations.

STRUCTURE OF THE DRAFT BDCP CONSERVATION STRATEGY

The BDCP Conservation Strategy will consist of multiple components that individually and collectively will be designed to achieve the goals and objectives of the plan. Several of these components are more developed than others and have already been the subject of review and revision by the Steering Committee. They are included here by reference, and detailed in supporting documentation. Other components remain under development, and will be built into the draft of the BDCP prior to the substantial analyses and review of the plan pursuant to the NEPA/CEPA processes.

The BDCP is designed to achieve a set of BDCP overall planning goals and objectives (which will be described in Section 1.2, *BDCP Overall Goals and Objectives*) and biological goals and objectives, which are described as a working draft of section 3.2, *Biological Goals and Objectives*. The draft Conservation Strategy also includes a comprehensive set of conservation measures – described as working draft section 3.4, *Conservation Measures* -- that are designed to provide for the conservation and management of covered species and natural communities upon which they depend and to avoid, minimize, and compensate for the potential impacts of covered activities (which will be enumerated in Chapter 4, *Covered Activities*) on covered species and their habitats. The draft conservation measures include certain actions to improve flow conditions, increase food production, restore habitat, reduce harmful contaminants, reduce entrainment, and reduce non-native species.

The BDCP recognizes the considerable uncertainty regarding the understanding of the Delta ecosystem and the likely outcomes of implementing the conservation measures, both in terms of the nature and the magnitude of the response of covered species and of ecosystem processes that support the species. Consequently, the Conservation Strategy will be implemented adaptively over the term of the BDCP. The Conservation Strategy will contain comprehensive adaptive management and monitoring plans that have been partially developed to date and which will ultimately be fully described in section 3.5 *Monitoring Plan* and section 3.6 *Adaptive Management*.

The purpose of monitoring and adaptive management components of the Conservation Strategy is to guide the long-term decision-making process for its implementation, to evaluate progress, to improve the efficiency and effectiveness of the conservation measures in achieving the BDCP biological goals and objectives and to adjust measures and approaches to address changed environmental conditions that may develop in the Delta in the future (e.g., effects of climate change and sea level rise). The BDCP Monitoring Plan, currently under development, will include a combination of system-wide and conservation measure-specific monitoring and research to provide increased knowledge of the effectiveness of conservation actions through BDCP implementation.

The Conservation Strategy will also embrace an Adaptive Management Program to ensure the continuous input of data, knowledge, and up-to-date scientific information to enhance the efficacy of the BDCP conservation measures and increase their capacity to meet the goals and objectives of the plan. The adaptive management process will guide the implementation of conservation measures and allow measures to be modified or new conservation measures adopted in response to results from BDCP monitoring and research programs and other new scientific information.

Finally, the BDCP will also provide a governance structure for the plan, which will describe the decision-making procedures and apparatus that will govern the implementation of the plan and the allocation of responsibilities to ensure compliance with the terms and conditions of all applicable permits and other authorizations. The governance section will also describe decision-making roles and responsibilities regarding the implementation of conservation measures, managing funding and budgeting matters, executing the adaptive management and monitoring programs, and consulting with stakeholders, public agencies, and the general public, and resolving disputes that may arise.

OVERALL APPROACH TO THE DRAFT BDCP CONSERVATION STRATEGY

This section provides a brief description of the overall approach of the draft BDCP Conservation Strategy and how a number of core elements will meet the multiple goals and objectives of the BDCP. The working draft of section 3.3, titled *Approach to Conservation*, provides a more complete description of the overall approach and is in the process of continued revisions based upon numerous comments received.

The Conservation Strategy will consist of the description of its biological goals and objectives, a description of the conservation measures, and the monitoring and adaptive management programs which will guide implementation of the BDCP. The primary components of the measures themselves will consist of: (1) the construction of new north Delta diversion facilities and an isolated conveyance facility in conjunction with operation of existing facilities; (2) detailed criteria that will govern the operations of the conveyance system across a range of hydrological conditions; (3) restoration of tidal marsh, floodplain, and riparian, and upland transition habitat; and (4) actions to address and control contaminants, invasive species, and predation and to address other potentially important non-conveyance and non-habitat-related stressors on covered species (collectively called "other stressors"). The BDCP has to date made considerable progress in framing a number of these key components of the Conservation Strategy that will be carried forward for further analysis and deliberation as part of the planning process. These key components are described below. Further details may be found in the working drafts of the sections of the conservation plan that are under development and are referred to throughout.

A major challenge for the BDCP Conservation Strategy is the restoration of key ecosystem functions in the highly altered environment of the Delta. The Delta was once a vast marsh and floodplain dissected by meandering channels and sloughs that provided habitat for a rich diversity of fish, wildlife, and plants. The Delta of today is a system of artificially channeled and dredged waterways constructed into unnaturally static geometries initially designed to support farming and later limited urban development on Delta islands, protect against flooding and convey floodwaters out of the Central Valley. Delta waterways provide transportation corridors for commercial and recreational ships and boats, and convey water for urban and agricultural uses inside and outside of the Delta. The physical disturbances within the Delta, combined with multiple other environmental challenges to the ecosystem (including highly altered hydrological conditions, harmful contaminants in discharges, invasions by many harmful non-native species, and habitat degradation and loss) have contributed to declines in fish, wildlife, and plant species and other organisms.

To address these multiple environmental stressors on the Delta ecosystem, the BDCP Conservation Strategy will include a comprehensive integrated package of conservation measures that incorporate physical improvements (e.g., habitat restoration, fish passage improvements), improved ecosystem processes (e.g., improvements in flow patterns, improved food web, enhanced habitat quality and availability), and direct enhancement of production and survival of covered species (mark-select fisheries, conservation hatcheries, and reductions of toxicants and non-native predators). This comprehensive, ecosystem-based approach to addressing multiple stressors is essential to making significant contributions to the recovery of covered species and to the restoration of a naturally functioning ecosystem while securing a reliable freshwater source for human use.

Water operations conservation measures are being developed to improve flows and enhance aquatic habitat in the Delta, in conjunction with meeting the BDCP planning goals for water supply and supply reliability, through the construction and operation of new facilities and the operation of existing facilities. The primary component in water operations is the construction and operation of new north Delta diversion facilities and an isolated conveyance facility to carry water to the existing south Delta SWP and CVP facilities. Both the movement of diverted freshwater around the Delta and improvements to operations exporting freshwater through the Delta (described as dual facilities operations) is expected to provide the flexibility to operate the water export system such that the Delta ecosystem and covered fish species habitat can be improved over existing conditions. Dual operations of new and existing diversion facilities is expected to reduce present levels of entrainment of fish (particularly delta and longfin smelt) and invertebrates and the export of organic material and nutrients. Constructing state-of-the- art positive barrier fish screens on in-river and on-river intakes along the Sacramento River and employing flexible operational scenarios should minimize fish mortality at the new north Delta diversion sites. The north Delta diversion facilities are an integral part of the Conservation Strategy and are expected to enable covered fish species to gain maximum benefits from other conservation measures, while meeting the water supply reliability goals of the BDCP. The flexibility associated with the operation of dual facilities is expected to allow for habitat restoration to be implemented in the western, eastern, and south Delta and enhanced organic production generated from these restored habitats to pass through the interior Delta with a corresponding reduction of risk of fish entrainment at the south Delta facilities.

In addition to the expected ecological benefits, water supply reliability will substantially improve with the north Delta diversion and isolated facility because these facilities will be constructed to be more resilient to catastrophic events (e.g., levee breaching from earthquakes and floods) and sea level rise than the existing through-Delta conveyance system.

Physical habitat restoration would include restoration of tidal marsh, floodplain, riparian and transitional upland habitats throughout the Delta and Suisun Marsh that are expected to enhance habitat, residence time and food productivity for covered species. Core elements of the habitat restoration conservation measures are described below. Additional actions are further described in sections 3.3.2 through 3.3.6 of chapter 3.

Other stressors conservation measures are actions that address stressors on covered species and natural communities that may be related to, but are not strictly limited to, the loss of habitat and the operations of conveyance facilities. Other stressors include harmful contaminants, non-native predators and competitors, entrainment by diversions, and harvest. Implementation of conservation measures addressing other stressors is expected to reduce adverse effects on covered species. Numerous measures to address other stressors may be important to help achieve BDCP goals and objectives.

The working draft of Chapter 3 includes a complete list of the potential other stressor reduction conservation measures. Some measures, such as control of ammonia discharge from wastewater treatment plants, may be important for covered species.

Ammonia may suppress the primary productivity of the entire ecosystem and thereby could limit food supply for covered species. If the abundance of covered species is currently food limited , and food production is limited by ammonia , then reducing ammonia discharges may be an important conservation measure for the BDCP. For some covered species, control of invasive species, enforcement of harvest regulations, reductions in endocrine disrupting compounds, or other measures may also be important.

Other conservation measures, such as control of exotic predators, may enable the BDCP to achieve conservation objectives with a much smaller investment of money and water. Broad-scale reduction of exotic predators like striped or largemouth bass, however, may be difficult to accomplish. Predator control and other conservation measures could, however, save substantial water if implemented in a targeted manner as part of a larger, integrated strategy similar to integrated pest management. For example, predation is a documented problem in Steamboat and Sutter Sloughs. Increased Hood bypass flows could limit establishment of largemouth bass during wetter years, but this may not be an efficient use of water during drier years. Rather targeted efforts to identify and control populations of bass in specific reaches during dry years prior to juvenile migration may save thousands of juvenile salmonids during critical years when their mortality would be most detrimental to the long-term population. Further measures will be incorporated into sections 3.3.2 through 3.3.6 of the working draft of Chapter 3 as the planning process progresses.

PLANNING PRINCIPLES

The Steering Committee convened an Integration Team over the last quarter of 2008 to propose an approach to identifying the core conservation measures – those measures generally thought to be central to a potential BDCP Conservation Strategy – and integrating those core measures, which had been identified by the Habitats, Water Conveyance and Operations and Other Stressors Workgroups. The need for this integration reflects the interrelationship between many of these measures, and was undertaken to help ensure that conservation measures fit into a comprehensive framework.

To help guide their deliberations, the Integration Team developed several planning principles. They are included here as an information item only to inform the Steering Committee and others on how the team formulated its approach to developing the core elements, which are also enumerated below. These principles are not intended to alter or supplant the Planning Goals or Conservation Objectives set out in the BDCP Planning Agreement nor modify the draft overall goals or biological goals and objectives that remain under consideration by the Steering Committee. The Steering Committee may elect to incorporate these principles-- as currently enumerated or as further refined -- into an appropriate location in its proposed Conservation Strategy if it proves useful to further clarify the approach to the integration of measures and the underlying rationales for the BDCP.

1. **<u>Provide a Comprehensive Set of Conservation Measures to Recover Species</u>**: Recovery of endangered species would require strategic investment in a combination of habitat restoration, reduction of other stressors, and changes in water supply infrastructure and operations.
2. **<u>Divert More Water in the Wetter Periods and Less in Drier periods:</u>** An approach that shifts diversions away from sensitive ecological periods and locations would provide an opportunity to avoid the existing need to divert all water in excess of minimum regulatory requirements in drier periods, and would reduce conflicts between water supply and species conservation.
3. **<u>Focus on Biological and Physical Processes:</u>** Restoration of key biological and physical processes, including alteration of water project operations and other factors related to flow and hydrodynamic functions, on seasonal and inter annual time scales are more likely to benefit covered species than processes that vary substantially from natural patterns.
4. **<u>Build In Flexibility</u>**: Flexible water management infrastructure and operational criteria, and an adaptive regulatory regime are more likely to achieve both water supply and conservation objectives.
5. **<u>Address Scientific Uncertainty directly Through Adaptive Management:</u>** Due to scientific and other uncertainties, it may not be possible to identify a single set of conservation measures or an operating regime that will definitively achieve the BDCP conservation goals. Rather, the conservation strategy must be structured to perform across a range of circumstances, and conservation measures may need to be restructured, depending on changing circumstances and new information that would inevitably emerge. In the case of project operations, water agencies may be permitted to divert more than they divert under existing conditions, or water agencies may be asked to reduce diversions in order to achieve the goals of the BDCP. The success of this approach would require clear, measurable performance objectives, an adequate performance monitoring and assessment program, and a clear decision making pathway for making program corrections as part of a robust institutional framework.
6. **<u>Provide for Reliable Water Supplies</u>**: Providing a reliable and sufficient water supply is essential for the state economy and to the success of the BDCP. Achieving both water supply and ecosystem conservation objectives would likely require redesign of the existing conveyance system with new points of diversion, changing Delta hydrodynamic conditions in a manner that would create new opportunities for habitat restoration and enhancement in various areas of the Delta, along with a full suite of habitat restoration and other stressor reduction mechanisms.

BDCP BIOLOGICAL GOALS AND OBJECTIVES

The draft biological goals and objectives for the BDCP are currently described in a working draft of section 3.2, which has focused to date on biological goals and objectives for covered fish species. These biological goals and objectives will be expanded to address terrestrial covered species following development draft biological goals and objectives for the terrestrial covered species in early 2009. All draft biological goals and objectives are subject to additional refinement through the planning process as the adaptive management program is further refined and as new information becomes available, and they may incorporate additional measurable metrics (spatial and temporal) to assist in plan implementation.

The USFWS's Five-Point Policy for HCP's provides guidance for the development of biological goals and objectives (65FR 106:35250-35252) and states that "…the Services and HCP Applicants will clearly and consistently define the expected outcome, i.e., biological goal(s)." Biological goals are defined as broad guiding principals for development of the conservation strategy that can be parsed into more manageable subsets of biological objectives. These objectives, in turn, provide measureable metrics by which to measure progress in meeting plan goals and help inform the adaptive management process. The BDCP biological goals and objectives will be consistent with guidance provided in the Five-Point Policy and with the BDCP NCCP Planning Agreement conservation goals and objectives.

These draft biological goals and objectives are purposefully framed to reflect and respond to the significant ecological complexity of the Delta and the substantial scientific uncertainties associated with it. They are designed to serve several important functions in the Conservation Strategy. The first is to describe the desired biological outcomes of the Conservation Strategy, and how those outcomes will contribute to the long-term conservation of covered species and their habitats. The second is to serve as important yardsticks by which to measure progress in achieving those outcomes across multiple temporal and spatial scales. A third, closely related function is to provide the context and framework for the monitoring programs and monitoring metrics by which to evaluate the effectiveness of the conservation measures themselves, and to inform the adaptive management program through which adjustments to the plan may occur over the course of its implementation.

The ecological complexity of the Delta and the extent of scientific uncertainty associated with this complexity require a Conservation Strategy that is flexible, testable, and scientifically grounded. The BDCP draft Conservation Strategy is built on a set of core hypotheses about how to restore the ecological processes and functions necessary to achieve biological goals and objectives over time. The core hypotheses are intended to provide an orderly, scientifically-disciplined approach to managing complexity and uncertainty. These core hypotheses will be tested and evaluated, verified or adjusted as implementation proceeds through an adaptive management process. The draft biological goals and objectives are part of this overall approach. They are designed as a conceptual hierarchy, the components of which are measurable, transparent and verifiable. They are intended to be consistent with the goals and objectives of existing recovery plans and other regional species plan goals that have been established for the covered species so that the implementation of the BDCP contributes to the long-term conservation of covered species and their habitats. (please refer to Table 3.Xa in the working draft of the goals in section 3.2 of the Conservation Strategy).

The biological goals and objectives are organized hierarchically on the basis of the following ecological scale:

- Ecosystem Goals and Objectives. Ecosystem goals and objectives are focused on improvements to the overall condition of hydrological, physical, chemical, and biological processes in the Delta in support of achieving goals and objectives for covered natural communities and covered species.
- Natural Community Goals and Objectives. Natural community goals and objectives are focused on maintaining or enhancing ecological functions and values of covered natural communities. Achieving natural community goals and objectives also serve to conserve habitat of associated covered species and other native species.
- Species-Specific Goals and Objectives. Species-specific goals and objectives address species-specific stressors and habitat needs that are not addressed under the higher order ecosystem and natural community goals and objectives and species-specific viability parameters as they relate to life stage occurrence of covered fish species in the Delta.

Figures 1 and 2 illustrates these hierarchical relationships between the broad, species-level goals, the BDCP-specific biological goals and objectives, the conservation measures that are designed to achieve the biological goals and objectives (see Section 3.4, Conservation Measures), and the monitoring and adaptive management components of the Conservation Strategy (see Section 3.5, Monitoring Plan and Section 3.6, Adaptive Management). The effectiveness of the BDCP conservation measures will be measured through their effects on the population viability attributes shown in the second tier of the **Figure 1** pyramid. The adaptive management and monitoring tier of the pyramid provide the BDCP with the information necessary to adjust BDCP implementation based on new scientific information as it becomes available over the term to the BDCP to improve the effectiveness of the Conservation Strategy in achieving the BDCP biological goals and objectives.

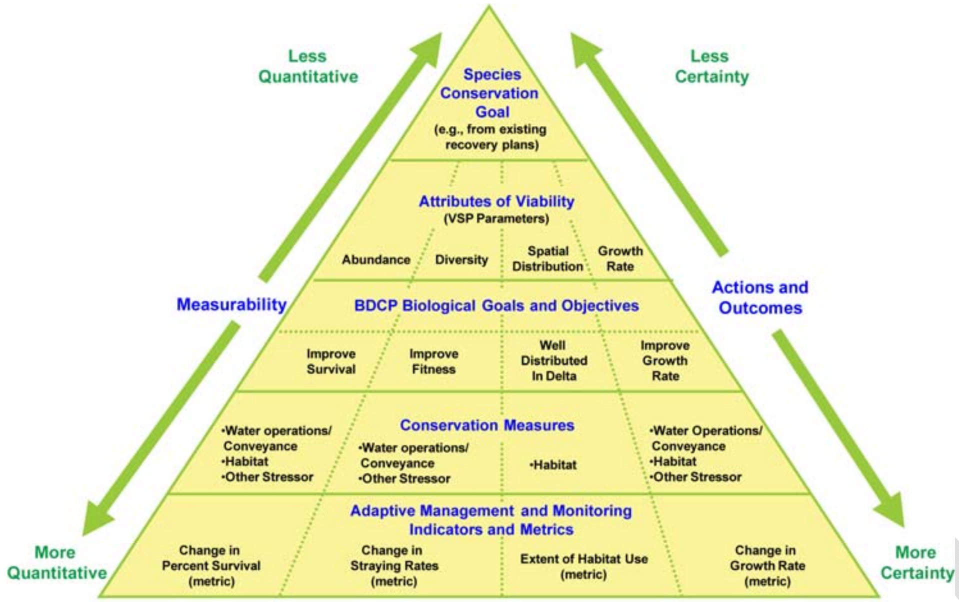

Figure 1
Biological Goals and Objectives: Hierarchical Relationships

The hierarchical relationship among these ecological scales and larger species-specific goals are illustrated in **Figure 2**. The conservation measures that would serve to achieve each of the biological goals and objectives that are presented in Table 3.Xb and the population viability attributes that would be addressed by each of the biological objectives for each of the covered fish species is presented in Tables 3Xc-3Xi. BDCP system and effectiveness monitoring, monitoring metrics, and adaptive management targets that would be used to assess the population-level response of the covered fish species to implementation of the conservation measures are presented in Section 3.5 Monitoring Plan.

Figure 2
Relationships Among G&O Tiers

CORE ELEMENTS OF THE DRAFT CONSERVATION STRATEGY

The many specific measures that may be proposed in the BDCP are enumerated in substantial detail in the working draft of section 3.4 of the plan. These sections are currently under review and revision in response to numerous comments received on them by Steering Committee members and other entities.

The following is an enumeration of "Core Elements" of the Conservation Strategy which have been the focus of the Integration Team to date because of their importance for the plan as a whole and because defining their key parameters is an essential step in proceeding with the further evaluation of the plan itself through modeling and other evaluations anticipated in early 2009.

The Core Elements described below are likely to form the nucleus of the BDCP Conservation Strategy. Other conservation measures described in the draft BDCP Chapter 3 will also be necessary to achieve the BDCP Planning Goals and biological goals and objectives. The Steering Committee, with the assistance of the consultant team, will evaluate, add, and integrate other conservation measures during the remainder of the BDCP planning process. The list of Core Elements considered by the Integration Team includes:

1. Elements that shape the overall architecture of the new hydrodynamic system that will be developed as a result of the BDCP.
2. Measures that appear likely to be included in any scenario to rehabilitate the Delta ecosystem and water supply system.
3. Elements that can and should be planned or constructed in the next five to ten years.

Ten Core Elements are listed below, followed by a brief description of the lessons learned to date regarding their interaction, and a discussion of the relationship of these Core Elements to the working draft biological goals and objectives. The remainder of this section provides descriptions of each of these Core Elements, accompanied by discussion of the key assumptions and biological rationale,[1] significant issues or concerns, and next steps associated with further refinement of each element. A subsequent section will identify other conservation measures and describes how these other measures will be integrated into the Conservation Strategy.

Throughout the BDCP development process the Steering Committee, working groups, and consultant team have sought the best available scientific and commercial information for development of the conservation strategy. There are extensive citations of scientific literature and other references in Chapter 3, particularly Section 3.4

[1] More detailed descriptions of and documented biological rationale for the Core Elements can be found in the draft of BDCP Chapter 3.

Conservation Measures. The descriptions of core elements presented here do not recreate this review of scientific literature. The rationale for the core elements and their presumed benefits has not yet been subjected to rigorous evaluation. While the descriptions of core elements include predictions of positive outcomes and explain mechanisms, there is large uncertainty associated with these predictions and explanations. Many of the predictions are based on data and published reports. The BDCP committees, aided by the consultant, will identify the underlying assumptions and hypotheses embedded in the core element descriptions, as well as competing hypotheses, identify literature and data that support or question these hypothesis, and characterize the level of certainty associated with each hypothesis.

List of Core Elements[2]

1. Modify the Fremont Weir and Yolo Bypass to provide higher frequency and duration of inundation
2. Move primary diversion point to north Delta diversion facilities with fish screens to reduce S. Delta entrainment
3. Hood Bypass Flow Criteria
4. Manage South Delta exports/hydrodynamics to reduce entrainment of fish and food resources
5. Delta Cross Channel operations
6. Large scale tidal marsh restoration in the Cache Slough area
7. Strategic Tidal Marsh Restoration in the West Delta
8. Large scale tidal marsh restoration in the Suisun Marsh area
9. Interim Tidal Gates
10. Delta Outflow Targets

Related Goals and Objectives

The BDCP Steering Committee has developed a set of draft biological goals and objectives, which are described briefly above and in further detail in Section 3.2 of the draft Conservation Strategy. Implementation of these Core Elements are anticipated to contribute substantially towards achieving each of the following ecosystem, natural community, and covered fish species biological goals:

1. Provide hydrodynamic conditions within Delta waterways that contribute to viable populations of covered fish species.
2. Increase primary and secondary production to increase the abundance and availability of food for all life stages of covered fish species.

[2] A complete list of the Other Stressors Conservation Measures that will be analyzed in January and February, 2009 and may be included in the BDCP as core elements is provided in Section 3.X.X.

3. Provide for the spatial distribution and connectivity of covered species habitats across the Delta to support the effective movement and genetic exchange of covered species within and among natural communities both inside and outside of the BDCP planning area.
4. Protect, enhance, and restore covered natural communities to provide habitat and ecosystem functions to increase the natural production (reproduction, growth, and survival), abundance, and distribution of covered species.
5. Increase the abundance of covered fish species by reducing sources of unnatural mortality.
6. Create conditions that support a viable population of delta smelt in the Delta and Suisun Bay.
7. Create conditions that support a viable population of longfin smelt in the Delta and Suisun Bay.
8. Increase the survival of juvenile Chinook salmon passing through the Delta.
9. Increase the growth of juvenile Chinook salmon that pass through and rear in the Delta to increase the likelihood for survival of juvenile Chinook salmon in San Francisco Bay and ocean habitats.
10. Maintain or increase life history diversity of all runs of Chinook salmon.
11. Increase the proportion of all runs of adult Chinook salmon that successfully migrate upstream through the Delta to upstream spawning habitats.
12. Increase the survival of juvenile steelhead passing through the Delta.
13. Increase the growth of juvenile steelhead that pass through and rear in the Delta to increase the likelihood for survival of juvenile steelhead in San Francisco Bay and ocean habitats.
14. Maintain or increase life history diversity of Central Valley steelhead.
15. Increase the proportion of adult Central Valley steelhead that successfully migrate upstream through the Delta to upstream spawning habitats.
16. Maintain and conserve a viable population of Sacramento splittail in the Delta.
17. Increase the proportion of green sturgeon that successfully migrate upstream through the Delta to upstream spawning habitats.
18. Increase juvenile green sturgeon habitat availability.
19. Maintain or increase life history diversity of green sturgeon.
20. Increase the proportion of white sturgeon that successfully migrate upstream through the Delta to upstream spawning habitats.
21. Increase juvenile white sturgeon habitat availability.
22. Maintain or increase life history diversity of white sturgeon.

In addition, it is anticipated that the Core Elements that provide for restoration of inundated floodplain and tidal marsh habitats would also contribute towards achieving biological goals and objectives for the terrestrial covered species, which will be developed in January, 2009.

Each of the listed goals contains specific objectives that can be found in Section 3.2 of the draft BDCP Chapter 3. In addition to the ecosystem and natural community goals and objectives, several draft species-specific goals and objectives for Delta smelt, longfin smelt, Chinook salmon, Central Valley steelhead, Sacramento splittail, green sturgeon and white sturgeon, also found in Section 3.2. These Core Elements are designed to help meet many of these aquatic covered species biological goals and objectives and will also be important for meeting objectives for terrestrial species that are currently being developed.

Lessons Learned re Interaction of Core Elements

The Core Elements are likely to interact substantially with one another to strongly influence the future hydrodynamic patterns of the Delta. The BDCP Steering Committee and consultants participated in a series of modeling analyses to evaluate these interactions and identify synergies and trade-offs both between Core Elements and other factors including upstream reservoir levels, Delta inflows, and S. Delta water quality. The analyses mostly relied on the CaLite and DSM2 models to characterize hydrologic, hydrodynamic, water quality, and water supply responses to various rules for operating the export of water from the Delta, assuming a constant demand for water. The key lessons of theses analyses are summarized below:

- Large scale tidal marsh restoration, particularly in Cache Slough and Suisun Marsh, substantially changes hydrodynamics, and can also change salinities and even the location of X2.
- Increases in the Hood Bypass flow requirement results in increased diversions from the South Delta to meet water demand.
- New diversions from the north Delta affect tidal influence (bi-directional flow) in the Sacramento River and Steamboat and Sutter Sloughs, while large-scale tidal marsh restoration in the Cache Slough region can offset this affect by reducing tidal action influence up these channels.
- Even with rules specifying preferential north Delta diversions and a relatively low Hood Bypass flow requirement, there are still sizeable, although substantially reduced, south Delta diversions. These residual diversions combined with strategic operation of the cross channel gates in late summer and early fall appear to be sufficient to achieve most water quality standards in the south and central Delta.

- Delta Cross Channel gate operations have a large effect on South Delta water quality. Large reductions in S. Delta diversions results in higher salinity levels in the Southern and Central Delta due to less dilution from fresher Sacramento River water, but this outcome can be largely offset by strategic operations of the cross channel gates and some continued base level of S. Delta diversions.
- Even with relatively low Hood Bypass flow requirements, a fully isolated facility with 15,000 cfs capacity would not meet water supply demands or existing levels of water delivery and performs relatively poorly compared to dual conveyance scenarios.
- High Hood bypass criteria under a fully isolated facility causes large reductions in exports and excessive declines in upstream storage. This is due to the fact that minimum export levels must be maintained and can only be achieved after meeting the minimum Hood bypass target..
- Modeled changes in Delta infrastructure and operating rules generally result in changes in Delta inflow and upstream reservoir releases. In some cases, the model predicts extreme changes in upstream reservoir management due to the models logic for allocating water between upstream and downstream objectives. In reality, new allocation logic or additional operational constraints would accompany new infrastructure and rule changes resulting in a better balance between upstream and downstream objectives (see next steps). Efforts are ongoing to improve model performance.
- Even with relatively restrictive rules for diversions, exports were limited by South of Delta storage. One model run indicated that expanding use of existing South of Delta storage, by approximately 1 million acre-feet, combined with a 15,000 canal and dual diversion points, could significantly increase flexibility in meeting water supply and environmental objectives. The same is generally true related to North of Delta storage.

Core Element No. 1: Modify Fremont Weir and Yolo Bypass to Provide Higher Frequency and Duration of Inundation

Modify Fremont Weir and Yolo Bypass to Provide Higher Frequency and Duration of Inundation: The Fremont Weir would be modified to improve passage for fish and allow for more frequent inundation of the Yolo bypass floodplain. An operable gate would be incorporated into the weir added such that inundation of the bypass could occur in winter and spring on a more frequent basis at lower flow stages of the Sacramento River than under existing conditions.

DESCRIPTION

- To increase the frequency and duration of inundation of floodplain habitat in the Yolo Bypass, the Fremont Weir would be notched to an estimated elevation of 17.5 feet and fitted with an operable gate(s) that, when operated, would allow

Sacramento River water to flow into the Yolo Bypass when Sacramento River stage at the weir exceeds 17.5 feet. The operable gate(s) would be designed and operated to provide for the efficient upstream and downstream fish passage to and from the Yolo Bypass into the Sacramento River. Preliminary analyses indicate that significant benefits to covered fish species and communities could be achieved through the seasonal inundation of the bypass with flows of approximately 2,000 to 4,000 cfs for 30 to 45 days between January 1 and May 15. More specific design elements of this measure can be found in draft Chapter 3, Conservation Measure "FLOO1.1".

ASSUMPTIONS AND BIOLOGICAL RATIONALE

The majority of historical floodplain in the Sacramento/San Joaquin River system has been lost. This has resulted in a reduction of highly productive rearing habitat for juvenile salmon and spawning and rearing habitat for other native species such as splittail. Loss of floodplain habitat has reduced the input of organic and inorganic material and food resources into adjoining riverine habitat and the downstream bay and estuary. A key assumption is that flow through the bypass on a more frequent basis for longer duration creates more spawning and rearing opportunities for native fishes. Flows through the bypass on a more frequent basis could also improve productivity inputs that benefit covered fish species, as well as other species downstream in the delta. Recent research has suggested that covered fish species, particularly splittail and Chinook salmon, would significantly benefit from actively managing the frequency, duration, and timing of seasonal inundation of the Yolo Bypass (Sommer et al. 1997, 2001, 2004). Such inundation is expected to improve spawning and rearing conditions for splittail to allow increased growth and survival of individuals, to improve migration for salmonids and sturgeon by improving passage conditions, and to export phytoplankton, zooplankton, and other organic material to Cache Slough, the lower Sacramento River, the western Delta, and Suisun Bay. Although uncertain at this time, transport analysis suggests that this increase in food supply may benefit delta and longfin smelt and possibly enhance productivity in the western Delta and Suisun Marsh.

Flow through the Yolo Bypass would provide juvenile salmon superior rearing conditions and an alternative pathway for migration that would circumvent a new, north Delta diversion facility. The number of fish that migrate through the Yolo Bypass will depend upon a combination of factors, some of which we can control:

- The behavior of migrating juvenile salmon at a flow split.
- The configuration and operation of the Fremont weir notch and gates.
- The amount of water diverted through the notch and gates.
- The duration of flow into the bypass.
- The amount of flow in the Sacramento River at the notch.

- The timing of inflow into the bypass. Different timing will benefit different runs. Real time monitoring and operations could substantially increase efficiency.

Issues and Concerns

During the initial habitat restoration opportunity identification process, scientists and stakeholders have identified several potentially significant issues that should be addressed during planning including:

- Changes in the weir and changes in the use of the bypass could affect existing flood capacity, and would need to be coordinated with current and future flood control activities.
- Pollutant discharges may be more concentrated if water is diverted into the bypass upstream of discharge locations. Increased concentrations of pollutants may result in greater impact to covered fish species and thus may require increased treatment. Increased frequency of flows through the bypass will impact existing land uses and landowners, including crop production by delaying planting, and existing wildlife management potentially reducing revenues from agricultural production, and increased weed management requirements.. Additional public land acquisition may reduce local government tax revenues from lost agricultural production, and could adversely affect local agricultural viability.
- Increased frequency of flows through the bypass could affect terrestrial species, by reducing prey availability for raptors, forage for wintering waterfowl, and delaying nesting by ground nesting birds.
- The benefits of improved production of inorganic and organic materials within the bypass to downstream habitats and species are uncertain. Food resources generated may not be of suitable quality or type for covered species, or invasive *corbula* in Suisun Bay may consume most of these new resources.
- More frequent inundation of the bypass may accelerate the erosion of levees in the bypass and in downstream locations unless appropriate protections are put in place in these areas.
- More frequent inundation of the bypass may exacerbate the methylation of mercury over current levels as well as increase the re-suspension and transport of some contaminants to downstream areas.
- More frequent inundation of the bypass may increase the difficulty of mosquito control.
- Increased frequency and duration of inundation could reduce current levels of public access for waterfowl hunting, recreation, and educational purposes.

Next Steps

- Continue coordination with potentially affected landowners, the public, and governmental organizations through the Lower Yolo Basin Planning Forum and other public outreach avenues to help refine the proposed project.

- Continue to refine the proposed conservation measure based on DRERIP review and other scientific input.
- Develop quantified predictions of biological benefits based on hydrodynamic and species models.
- Undertake further evaluation of design of modified weir (gates, graduated, depth)
- Continue evaluation of the magnitude of controlled flow through the notch.
  - 2,000 – 4,000 cfs average monthly number preliminary range (may vary on a daily basis)
    - Water supply impacts of diverting water into the bypass .
    - Uncertainties about whether it is enough water and enough velocity and or too much residence time.
    - Interaction of Sacramento inflow with Cache and Putah Creek inflows.
  - Continue evaluation of timing of weir operations
  - Early inundation good for winter run while late inundation is good for splittail and food production, but bad for agriculture.
  - Determine how are flows are managed once an event starts to minimize stranding.
  - Develop decision tool to evaluate effect to crop patterns.

- Coordinate with the Yolo Natural Heritage Program and Vic Fazio Yolo Wildlife Area to assess and develop mitigation measures as needed to address terrestrial species impacts.
- Identify issues that can be addressed with Other Stressors Conservation Measures,(e.g., increase in predator species and predation on salmon smolts can be mitigated or reduced by implementing predator control).

Core Element No. 2: Move primary diversion point to north Delta diversion facilities with fish screens to reduce entrainment and expand opportunities to achieve planning and conservation goals

New North Delta Diversion: Move primary diversion point to north Delta diversion facilities with state of the art fish screens to reduce direct impacts on covered species by entrainment at South Delta diversions, provide expanded opportunities to implement comprehensive conservation measures Delta-wide, improve aquatic ecosystem foodweb processes, and restore more natural flow patterns in the Delta and facilitate habitat restoration in the south Delta.

DESCRIPTION

The new north Delta diversion facility would consist of multiple intake structures along the Sacramento River between Walnut Grove and Freeport with a combined capacity of 15,000 cfs. A new canal would be constructed along the eastern or western perimeter of the Delta to convey water diverted from the north Delta to the Banks and Jones pumping facilities for export into the state and federal water projects. Preliminary analysis by DWR suggests that construction and operation of an eastern route would be less expensive.

The North Delta diversion facility would allow for water supply to be diverted around the Delta in tandem with south Delta operations exporting freshwater through the Delta (described as dual facilities operations). This would provide the flexibility to operate the water export system such that the Delta ecosystem and covered fish species habitat can be greatly improved over existing conditions. The flexibility associated with operation of dual facilities would allow habitat restoration to be implemented in the western, eastern, and south Delta because additional organic production generated from these restored habitats could pass through the interior Delta with reduced risk of entrainment at the south Delta facilities. The north Delta diversion facilities would provide the flexibility to support flow patterns that may emulate natural processes more closely than the current through-Delta conveyance system and would enhance the function of restored tidal marsh habitat in the western, eastern, and southern Delta. Hydraulic residence time, and therefore productivity, in the interior Delta is expected to increase while unnatural reverse flows on Old and Middle rivers associated with fish entrainment would be reduced.

The amount of water diverted at the new north delta diversion would be limited by several factors, including hydrology, canal capacity and bypass flow criteria (see Hood Bypass below), which would specify the amount of flow that must remain in the Sacramento River below the new diversion facilities. No diversions from the North Delta would occur when river flows dropped below the minimum bypass criteria. Flow to and diversions from individual intake structures must also be limited to provide sufficient sweeping velocities past the new fish screens.

The Fish Facilities Technical Team proposed three different designs for fish screens depending on the size and location of individual intakes, and a range of options for the number and size of intakes ranging from 15 intake structures with a capacity of 1,000 cfs each to three large intakes with a capacity of 5,000 cfs each (cite: include as appendix). DWR staff are currently conducting a value engineering analysis to determine the optimal number, size, and location of intakes and fish screens.

ASSUMPTIONS AND BIOLOGICAL RATIONALE

Construction of new north Delta diversion and conveyance facilities offers the greatest potential for achieving the BDCP Planning Goals and biological goals and objectives by providing for expanded opportunity to implement conservation measures Delta wide. Without a new northern diversion point, conservation actions in the central and southern Delta would be limited or excluded. With the new northern diversion, conservation measures that restore south Delta habitat and provide for Delta-wide hydrodynamic changes would result in improved aquatic ecosystem processes, distribution, connectivity, migration, transport, and residence time, as examples. In short, new north Delta diversion and conveyance facilities allow for the reestablishment of ecosystem complexity that the current management system simply cannot accommodate.

The north Delta diversion facilities would also enable public water agencies to operate more flexibly and on a seasonal basis in response to sensitive fisheries periods. The ability to shift the timing and location of diversion allows for water supply goals to be met while minimizing adverse impacts on covered species by entrainment. A large, 15,000 cfs facility would allow achievement of water supply goals by diverting more water during the wettest periods and less water during drier periods. This added flexibility could also allow for operational changes to compliment implementation of other conservation strategies, such as variable salinity regimes, floodplain inundation and tidal habitat restoration in the southern Delta.

The new fish screens would perform far better than the screening facilities at the existing South Delta diversion. New facilities will be equipped with positive barrier screens and operated to prevent the salvage, handling, transport and release of fish back into the Estuary required because of the placement of the existing diversion facilities in the Southern Delta. Unlike the existing diversion facility, a continuous downstream flow past the new intakes would provide adequate sweeping velocities to move migrating fish and larvae out of the entrainment zone. At the existing facility, fish that escape entrainment during a flood tide remain continuously vulnerable to entrainment on subsequent flood tides. Entrained fish are also exposed to an increased risk of predation of fish in Clifton Court Forebay. The North Delta Screens would not require salvage and handling of fish and thus would reduce mortality associated with it.

Issues and Concerns

During the initial planning process, stakeholders have identified several potentially significant issues that should be addressed during subsequent planning including:

- Concerns that new and expanded diversion facilities could enable water agencies to divert excessive amounts of water from the Delta ecosystem. However, the capacity of these facilities will not be greater than the current pumping capacity in the Southern Delta, if not properly regulated. (Note that the capacity of these facilities will not be greater than the current pumping capacity in the southern Delta.)
- Construction of multiple intakes, pipes, and a new canal could disrupt irrigation and drainage systems essential to agricultural production on land bisected by these facilities requiring extensive planning and engineering to mitigate these concerns.
- Construction of multiple intakes, pipes and a new canal will likely have adverse impacts on terrestrial species that will need to be mitigated.

- Pollutant discharges may be more concentrated if water is diverted upstream of discharge locations. Increased concentrations of pollutants may result in greater impact to covered fish species and thus may require increased treatment.

  Diversions of water from the Sacramento River will reduce flow and velocity in downstream channels, which increase the need for conservation measures that reduce the impact of exotic predators on native species of concern.

- Reductions in downstream flow and velocity could increase the frequency of bi-directional flows, travel time, and mortality for larval fish whose survival is dependent on timely movement to pelagic rearing habitat.
- Very large fish screens are relatively untested and maybe more prone to failure without proper maintenance.
- Diversions could result in bi-directional tidal flows in the vicinity of the new diversions, reducing the benefits of decreased South Delta diversions on juvenile fish and larvae.
- Diversions downstream of the Sacramento Regional Wastewater Treatment Plant outfall would potentially increase drinking water treatment requirements.
- North Delta diversions could lead to increased salinity in the Delta adversely affecting agricultural production and municipal water supplies which divert directly from the Delta if not properly regulated.
- An isolated facility could reduce support for maintenance of levees based on the reduced need to protect through Delta conveyance.
- An isolated facility with 15,000 cfs may be too large or not large enough to cost-effectively maximize conservation and water supply benefits.

NEXT STEPS

- Complete value engineering analysis to determine the number, size, and location of intake structures and the best strategy for connecting intakes to the canal.
- Determine alignment of the canal.
- Develop and analyze a Hood bypass flow requirement to minimize the biological effects of reductions in flow, velocity, and water quality downstream of the diversion points.
- Develop operational rules that which optimize water supply objectives in relation to bypass follow requirements and minimize the need for south Delta diversions during critical periods.
- Develop governance mechanisms to ensure adequate water is conveyed to meet demands while protecting against excessive diversions of water from the new facility to the detriment of the ecosystem.

Core Element No. 3: Hood Bypass Flow Criteria

As described in Core Element 2, above, the new north Delta intakes would generally be operated preferentially over south Delta facilities in order to reduce entrainment in the south Delta and improve the quality of diverted water. In order to protect habitat in the mainstem Sacramento River and downstream distributaries, it will probably (likely?) be necessary to establish bypass flow criteria to ensure sufficient flow to provide adequate approach and sweeping velocities for fish moving towards and past the fish screens. Bypass flow criteria may also be necessary to provide transport and to protect spawning and rearing habitats for all the covered species. These flow criteria could vary by season and magnitude of river flows, and are called the Hood Bypass Flow Criteria.

DESCRIPTION

Insufficient information is available to prescribe Hood Bypass Flow Criteria, but the BDCP participants have agreed on an initial range of criteria for purposes of analysis. There is little controversy that the low end of the range would provide adequate downstream sweeping velocities, as described below. At the other end of the range, higher bypass flow criteria would be established if it were determined that they are required to provide sufficient migration corridor flows juvenile salmonids, larval Delta smelt that originate in the mainstem Sacramento, and other larval and juvenile stages of covered and desirable species. Higher bypass flow criteria may also facilitate transport of foodweb resources from the watershed to the western Delta. The initial proposed range to accomplish these goals is described below:

- December 1 through June 30 maintain a Sacramento River bypass flow of not less than 11,000 cfs when the Yolo Bypass is not inundated and a bypass flow of not less than 9,000 cfs when flows entering the Yolo Bypass at Fremont Weir are 2000 cfs (daily average) or greater;
- July 1 through August 30 maintain a Sacramento River bypass flow of not less than 5,000 cfs;
- September 1 through November 30 maintain a Sacramento River bypass flow of not less than 7,000 cfs for fall salmon attraction and migration;
- Preferentially operated the water diversions located in the upstream reach (Hood to Freeport) when river bypass flows are less than 15,000 cfs. The northern diversions may be designed and constructed to have a larger diversion capacity than diversions located further downstream to allow greater water supply deliveries under preferential diversion operations when river flows are low. Preferential diversion operations are intended to maintain a positive net downstream flow within the river at the point of diversion under all tidal stages;
- Maintain a minimum downstream sweeping velocity of 0.8 ft/sec across operating diversions during the period from December 1 through June 30 and a minimum sweeping velocity of 0.4 ft/sec from July 1 through November 30.

> Sweeping velocity and bypass criteria may be met by preferentially operating the diversion during ebb tide. A flood tide (closed) and ebb tide (open) operation would likely be the preferred operation for incoming river flows less than 20,000 cfs;

The initial Hood Bypass Flow Criteria resulting from these proposals are depicted in Figures 3, 4, and 5 below.

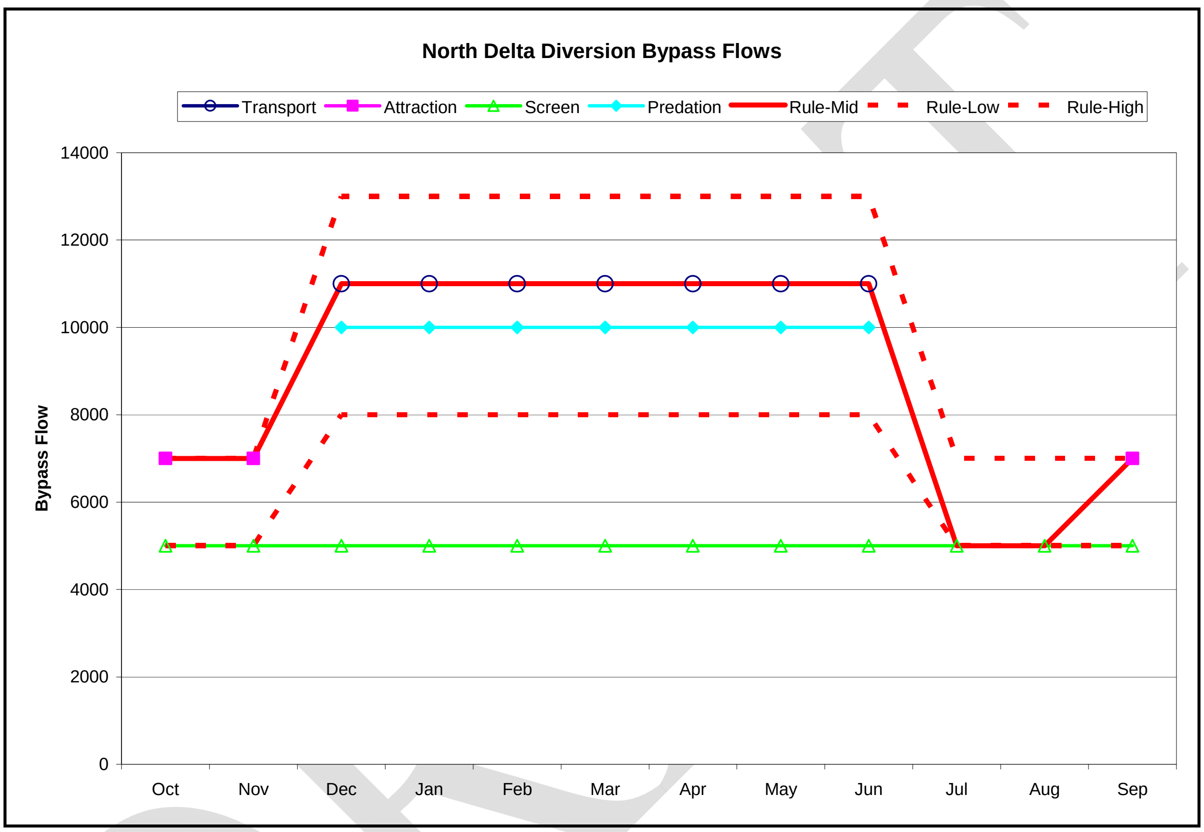

Figure 3. DRAFT Consultant's proposal for minimum Hood bypass flow rule

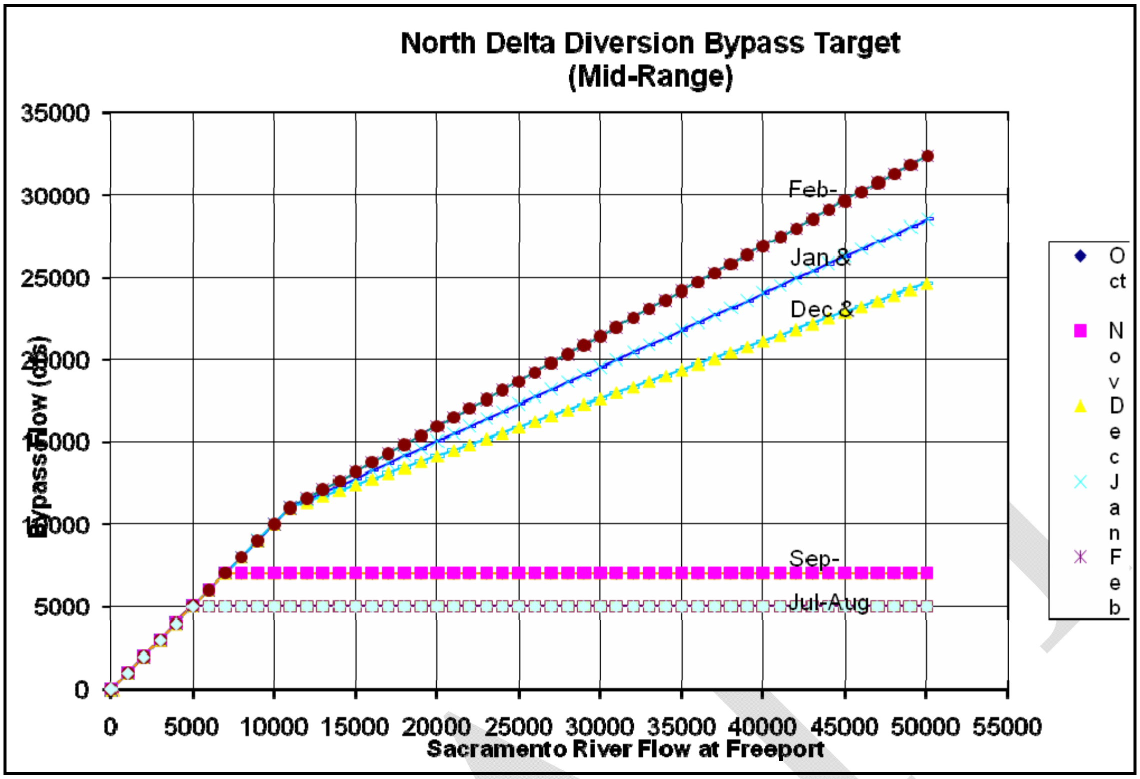

Figure 4. Consultant proposed mid-range target.

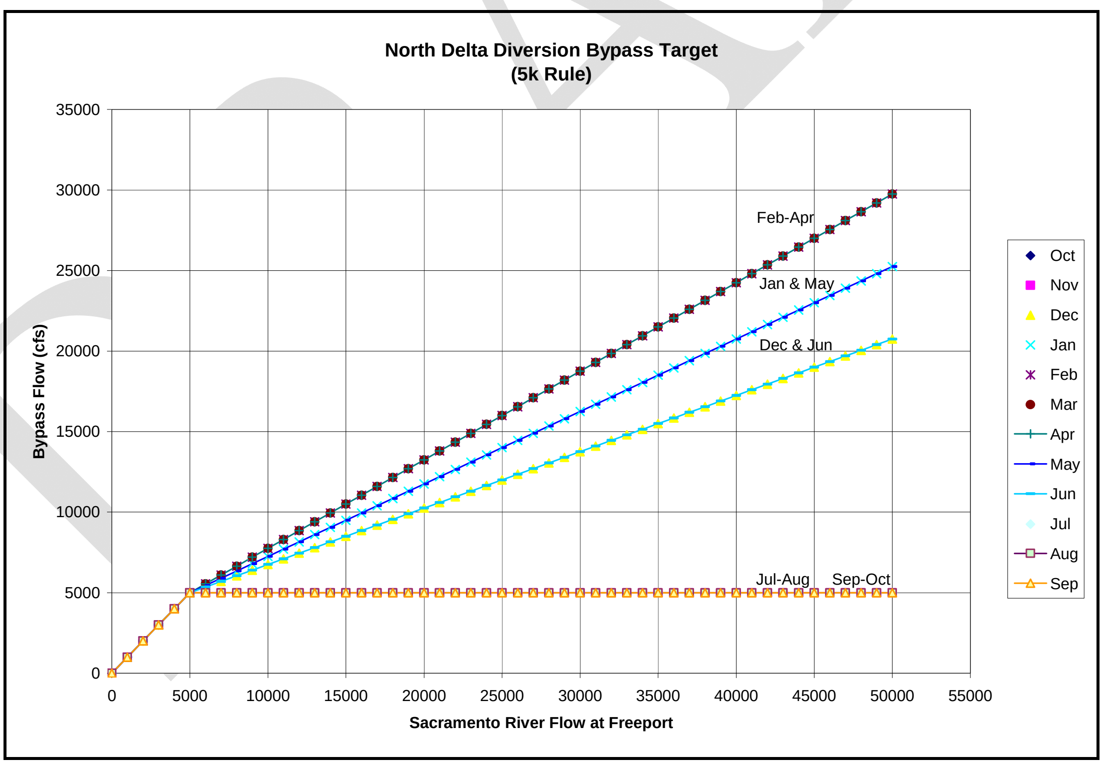

Figure 5. Minimum North Delta diversion bypass flows depicted as a function of Sacramento River flow for the 5kcfs rule.

ASSUMPTIONS AND BIOLOGICAL RATIONALE

Diversions at the proposed North Delta intakes would decrease flows in the Sacramento River and downstream distributaries, Sutter Slough, Steamboat Slough, Georgiana Slough, and the Delta Cross Channel. Sutter and Steamboat Sloughs are particularly important migration corridors for juvenile Chinook salmon and probably other native species. Predation by non-native species in some areas of the Delta is thought to be a major stressor causing reduced survival of migrating juvenile fish, although predator abundance is relatively low in the north Delta Sloughs. Decreased flows in these sloughs will increase tidally driven bi-directional flows, which may result in increased exposure to predators, both by improving conditions for predators and by increasing transit time for covered species through predator infested waters. Preliminary modeling, however, indicates that these impacts could be reduced by predator control efforts or offset by benefits associated with additional restoration and passage improvements in Yolo bypass and Cache Slough. Yolo bypass actions (see above) will route some portion of downstream migrating fish around Steamboat and Sutter Sloughs, as well as but may also provide superior habitat for growth and survival of juvenile salmonids. Restoration in Cache Slough has the potential to both mitigate the increased tidal excursion that would likely result from reduced downstream flow in the mainstem and the sloughs and provide improved foraging opportunities for covered fish species.

Reduced flows in the Sacramento River and its distributaries may also delay transport of larval life stages of Delta smelt and other species that originate in the Sacramento River upstream of Rio Vista. These delays could prevent larvae from reaching suitable foraging habitat before they exhaust their egg sacs. Hood Bypass flows that transport planktonic larval to suitable rearing habitat in less than 5-8 days should be sufficient to minimize mortality associated with a new diversion.

Factors considered in developing the Hood Bypass Flow Criteria proposed for analysis include: seasonal timing and life stages of different fish in the river and near the intakes; seasonal changes in biological processes; planktonic particle, nutrient and organic material transport rates at different river flows; attraction flows needed for salmon, steelhead, splittail, smelt and other upstream migrating adult fish; juvenile transit times and survival rates; relationship between river flow and tidal dynamics, seasonal floodplain flows and expanded tidal marsh habitat.

ISSUES AND CONCERNS

- Considerable uncertainties exist as to bypass flow requirements that are sufficient to meet fisheries' needs and yet will allow diversions adequate to meet the BDCP water supply goals. If bypass flow requirements are unnecessarily stringent, they will increase entrainment . Additional experimentation, modeling and analysis is needed to identify optimal bypass flow requirements that balance reduced entrainment at the South Delta pumps with the benefits of a new North Delta intake.

- Some bypass flow requirements have been suggested to counteract the effects of predation by non-native species. It may be possible to reduce predation levels using other stressor reduction measures rather than water flows for expedited transport through areas of predator concern.
- Similarly, bypass flow requirements have been developed to reduce tidal excursion flow in order to allow fish to avoid predation, but it has been suggested that some of the habitat restoration proposed in the Cache Slough area could reduce tidal excursion. Recent modeling results do not indicate a large reduction in tidal excursion from restoration, but additional modeling will be needed to further investigate this relationship. (Note: Greater tidal incursion may also be an effective means for controlling invasive species.)
- Bypass flow requirements may also affect salt water intrusion and some interests may seek water quality objectives to protect their points of diversion or seek access to the new conveyance facility.
- Over time, as large-scale habitat restoration projects are implemented, the resulting ecosystem benefits may reduce the need for high bypass flow requirements in all year types, but it is difficult to estimate these benefits at present.

NEXT STEPS

- Continue to assess effects of north Delta diversions on survival of covered species in north Delta channels, comparing estimated increased growth and survival of salmonids and other covered species through the Yolo bypass with estimates of increased predation and mortality of covered species in the mainstem and downstream distributaries.
- Continue to evaluate tidal marsh restoration effects on Sacramento River flow and stage.
- Review results of ongoing USGS fish tagging to gain better understanding of migration paths and predation impacts.
- Investigate whether real-time monitoring can be used to pulse flows strategically rather than maintaining high flows continually over many months.
- Conduct further analysis to determine whether location and operation of multiple intakes can be designed to assist in maintaining desirable instream flow conditions.
- Conduct additional hydrologic simulation and particle tracking modeling to examine the interactions among operating parameters and habitat enhancement proposals as part of re-evaluating and refining Sacramento River bypass criteria as part of an integrated BDCP process for developing final conservation actions.
- Evaluate alternative criteria for percentage of Sacramento River flows above the minimum criteria that may be required to bypass the diversion needs to be further

analyzed and integrated into a Delta-wide conservation action (an example of such an approach is shown in Figure 4).

- Additional evaluation of bypass flow requirements to adequately consider: 1) variation in precipitation and hydrology of the Sacramento River within and among years; 2) seasonal timing of various life stages of covered fish occurring near and downstream of the facilities; and 3) the relationship between river flows and physical and biological processes that affect survival, growth and abundance of covered species.

Core Element No. 4: Manage South Delta exports/hydrodynamics to reduce entrainment of fish and food resources.

There are at least five ways to manage South Delta hydrodynamics to reduce entrainment:

1. Decrease Old and Middle River Flows by reducing south Delta exports
2. Isolate Middle or Old River corridors to remove, at least seasonally, one of these corridors from the zone of entrainment
3. Gates to limit entrainment or control channel flows in the West or Central Delta
4. Positive Barrier fish screens with the isolated corridor (e.g., 2000 to 5000 cfs)
5. Increase San Joaquin River flows

This Core Element focuses on decreasing Old and Middle River reverse flows by reducing south Delta exports rather than by increasing San Joaquin River flows, for which there is limited control through the BDCP process. The element also includes an interim program to test the efficacy of temporary gates to reduce entrainment. The other measures are briefly described below and will be further evaluated in subsequent planning.

DESCRIPTION

Minimize the movement of fish into the southern delta and the subsequent entrainment of fish by altering flows in the Southern Delta and/or modifying channel configurations. Southern Delta flows are determined by a combination of all South Delta exports, local diversions and San Joaquin inflows. There are several parameters that have been used to correlate South Delta conditions with the entrainment of fish. These include use of (1) exports alone, (2) exports plus ½ of the San Joaquin River flows (3) reverse flows in Old and Middle Rivers. Old and Middle River reverse flows were used in this element as an indicator of South Delta hydrodynamics and entrainment. This action would primarily limit Old and Middle Reverse flows during December through June when covered species are most vulnerable, but would also entail opportunistic reductions during other seasons to minimize perturbations of natural hydrodynamic patterns. Achieving reductions in Old and Middle reverse flows would be accomplished by controlling South Delta exports.

Simply reducing South Delta exports to zero would require additional exports from the north Delta to achieve BDCP water supply objectives, and more diversions from the north Delta could adversely impact covered species utilizing the Sacramento River. Thus, this action really entails achieving some balance between reduced South Delta diversions and increased north Delta diversions. It may be possible to maintain greater South Delta exports, by managing their impacts utilizing a combination of gates (see Core Element No. 9), new siphon and intake and screen facilities in the South Delta, which would allow Old River to flow north at all times. These options should be evaluated especially if the Hood bypass criteria become too restrictive.

While there are be many complicated ways to establish criteria for Old and Middle River flows, a simplified approach is proposed at this time to allow more detailed evaluations to proceed over the next several months. An adaptive range of flows during the December through June based on real-time monitoring is the most likely the approach that will ultimately be adopted by BDCP. Specific numbers for specific months will be difficult to set at this time for modeling purposes. Therefore, an average Old and Middle River flow over a large range of months was selected. The average OMR flows for the December through June was set at -3,500 cfs and the period July through November at -5,000 cfs. It is likely that the actual allowable flows during the January through mid-March period will be more negative than -3,500 cfs and the period Mid-March through May could be less negative. However, the average of -3,500 for this entire period of December through June is used to capture this variation without making the OMR criteria overly complicated at this time. As discussed below the,-5,000 cfs is considered protective during months where there are few covered fish species in the Delta (July through November)

ASSUMPTIONS AND RATIONALE

One indicator of reduced entrainment is Old and Middle River (OMR) reverse flows less negative than -5000 cfs in the December through early March. This has been shown to result in very little salvage of both delta smelt, longfin smelt and larger migrating salmon under most conditions. Old and Middle Reverse flows much above this level can result in much higher salvage. From March through June the effects of Old and Middle River flows on the entrainment of small fish is related to their distribution. Those fish in the southern Delta are more susceptible to entrainment than those in the North and West Delta. All other things being equal, south Delta export reductions will reduce entrainment and net reverse flows in Old and Middle Rivers. It will also increase flows in the general area of Jersey Point on the San Joaquin River (Qwest).

Hypothesized benefits of reductions in OMR reverse flow conditions include:

- Reduced entrainment of adult Delta Smelt that move east of Jersey Island (Dec.-Jan). These eastward movements may be triggered by early run-off/turbidity events that encourage smelt to expand range in the plume of turbidity. Entrainment of adult smelt about to spawn in the winter could be disproportionately harmful to the population.

- Reduced entrainment of larval Delta smelt (March –May). The population level magnitude of this benefit depends on how many Delta smelt spawn or potentially could spawn in the central or southern Delta (assuming cross channel closed and positive Q-west). The benefits of this action may be to substantially expand the range of suitable spawning and rearing habitat for Delta smelt, if entrainment is the only limiting factor, which is unlikely.
- Longfin smelt: it is unclear whether longfin smelt would be affected solely by reverse flows in Middle and Old rivers, since they are primarily found west of Sherman Island and would only move eastward of Sherman Island during periods of increased salinity coincident with periods of negative Q-west (see below), which could be triggered by excessive exports .
- Reduced entrainment of juvenile San Joaquin, Mokelumne, Calaveras, and Cosumnes salmon and steelhead (March – June).
- Expand the potential to restore tidal habitat in the southern Delta.
- Potential reduction in entrainment of juvenile Sacramento River Chinook salmon, particularly those that move into the Central Delta via Georgiana Slough. Closed Delta cross channel gates between December and June prevent most movement of juvenile Chinook salmon into the OMR entrainment zone. Other juveniles could be entrained via 3-Mile slough, but only in periods of negative Q-west.

ISSUES AND CONCERNS

- *Water supply:* Decreases water supply or requires increased diversions from North Delta facility. Conversely, large South Delta exports allow larger Hood bypass flows on the Sacramento River without losing water supply. In combination with North Delta diversions, increases the water supply over current court-ordered exports during the winter and spring.
- *Water Quality:* Reduction in South Delta exports, marginally increases salinity in the south and central Delta due to less dilution of saltier San Joaquin River inflows and Delta island discharges, particularly in late summer and early fall. These increases in salinity would have minimal negative effects for covered species, but could have negative impacts for agricultural or municipal water users who divert from the South Delta if these the salinity levels exceed those needed by these uses. This effect could be mitigated by increased pumping and opening the Delta Cross Channel during these months or other measures.
- *Contaminants:* Reduction in south Delta exports could increase the concentration of pollutants in the south and central Delta due to lower dilution of pollutants discharged from the San Joaquin and Delta Islands. This could result in a series of

negative biological responses. Increased concentrations of pollutants may result in greater impact to covered fish species and thus may require increased treatment of pollutants at their source. Other measures may need to be taken to reduce the impact of pollutant discharges.

- *Water Temperature:* South and Central Delta water temperatures could increase during critical periods to the detriment of covered species to the extent that imported Sacramento River water is cooler than the water in the San Joaquin River and Delta channels.

NEXT STEPS

- Continue water supply modeling to determine the optimal balance between reducing South Delta exports and increasing diversions from the north Delta to optimize benefits for covered species.

Core Element No. 5: Delta Cross Channel operations

Modify Delta Cross Channel Gate Operations to Improve Fish Survival and Downstream Transport of Nutrients: The operations of the Delta Cross Channel (DCC) will change under future conditions with new diversion facilities and new science. DCC operations will be managed to balance South Delta water quality concerns with conservation objectives for covered species.

The DCC operations not only influence migration patterns of covered species, but they also indirectly interact with the Hood Bypass flow requirement and South Delta export levels to change conditions for covered species. Like the Hood Bypass flow requirement, DCC closures push more water down the Sacramento and its distributaries. When the DCC is open, a larger Hood Bypass flow would be necessary to achieve desired flow conditions in the Sacramento and its distributaries, and this in turn, would require greater S. Delta diversion to achieve water supply objectives. In addition, DCC operations strongly influence the spatial distribution of water quality and hydrodynamic impacts associated with South Delta exports.

Better flow conditions in the north Delta channels enable fish migration and movement, organic and inorganic nutrient transport, and hydrologic conditions by minimizing open periods and/or operating tidally or during daytime only, while minimizing effects to agricultural and municipal water quality.

DESCRIPTION

The Delta Cross Channel is a gated conveyance canal designed to transport water from the Sacramento River into the interior Delta. The DCC gate is located on the Sacramento River near Walnut Grove. When the gate is open, more water and fish move from the Sacramento River into the Central Delta via the Mokelumne River channels. This inflow from the Sacramento River improves water quality in the South and Central

Delta. When the gate is closed, more water and fish move down the Sacramento River and its natural distributaries, largely bypassing the Central Delta and providing a faster and more direct migratory pathway for covered species, which is expected to result in higher survival.

Our current operating assumption is that the DCC would be closed between from November through June and be open during July and August. In September and October, the DCC would be open half the time, but actively operated to minimize harm to covered species through strategies such as night-time closures.

ASSUMPTIONS AND BIOLOGICAL RATIONALE

Juvenile Chinook salmon, and presumably a number of other fish species, move from the Sacramento River into the interior Delta when the DCC is open. Results of studies suggest that survival of juvenile Chinook salmon passing into the Delta through the DCC is lower than survival of those migrating down the mainstem Sacramento River . Closure of the DCC currently is required between February and May under D-1641 for fish benefits for up to 45 days, but adverse effects of an open DCC operation to anadromous fish, and can other fish, also occur outside of this closure period. Furthermore, open gates decrease velocities and increase bi-directional flows in the Sacramento River and its distributaries, slowing the migration of covered species and increasing their vulnerability to predation or mortality from poor habitat. Therefore, lengthening the closure period, particularly in late fall and early winter, or operating on a tidal or daily cycle, is likely to improve survival of salmonids, as well as other fish.

BDCP modeling analyses predict that closure of the DCC in the summer and early fall months could degrade water quality (increased salinity) in the central and southern regions of the Delta. Opening the gates or actively operating them in the late summer and fall may be sufficient to maintain central and south Delta water quality levels above the existing agricultural and municipal water quality standards.

ISSUES AND CONCERNS

Scientists and stakeholders have identified several potentially significant issues that should be addressed during the planning process including:

- Changes to DCC operations could adversely affect water quality for municipal and agricultural uses in central and south delta seasonally.
- Lengthening gate closure periods would impact recreational boating and the consideration of a boat lock around the DCC.
- The adverse effects of DCC open operations on salmonids may not equate to adverse population level effects.

- The operations of DCC change hydrodynamics and net flow in Sacramento River downstream as far as Rio Vista and its principal distributaries, Steamboat and Sutter sloughs.
- Operation of the DCC when Rio Vista flows are controlling may limit North Delta diversions and essentially shift exports to the South Delta.

NEXT STEPS

- Continue to refine the proposed gate operations based on additional ongoing field studies and model simulations to further evaluate if closures on day/night or tidal cycles would be beneficial.
- Continue to seek input from third parties that may be impacted by changes in gate operations.
- Develop quantified predictions of population effects based on integrated species and hydrodynamic models.
- Evaluate costs associated with improving the gate operations for implementing ease of closures and openings.
- Evaluate of hydrodynamic relationship of DCC operations and interim tidal gates.
- Confirm if assumptions about salmon movement at night are valid (preliminary USGS/DWR findings from acoustic tagging may confirm this).
- Develop designs and costs for a boat lock around the DCC

Core Element No. 6: Large scale tidal marsh restoration in the Cache Slough complex

Restore freshwater tidal wetlands in the Cache Slough complex: The Cache Slough complex has been recognized as likely the best functioning area of the Delta. It includes Liberty Island, which is the only model for freshwater tidal marsh restoration in the Delta for native fishes. It supports multiple covered fish species and is presumably one of the last known areas where Delta smelt and longfin smelt spawn and rear successfully. Carefully restoring the amount of freshwater tidal wetlands and subtidal habitat and protecting upland habitat could benefit multiple covered species and the delta ecosystem. Preliminary modeling indicates restoring 5,000-10,000 acres in the Cache Slough complex to tidal action has positive hydrological benefits to the Sacramento River, nearby sloughs, and the upper Estuary allowing greater flexibility in operation of a North Delta diversion.

DESCRIPTION

The Cache slough area provides excellent opportunity to expand habitat supporting multiple aquatic and terrestrial covered species. Restoration of freshwater intertidal marsh and shallow subtidal habitats would be designed to support the physical and biological attributes that benefit covered species. Approximately 21,000 acres of public and private lands in the area are suitable for restoration. Areas for restoration would be identified by working with interested landowners.

Design elements of this conservation measure include:

- restoring a mixture of intertidal and subtidal habitats, and protecting adjacent uplands to accommodate future sea level rise.
- construction of new or enhancement of existing levees to provide flood protection for adjacent landowners as appropriate.
- modifying ditches and cuts and levees to encourage more natural tidal circulation and better flood conveyance based on local hydrology.
- restoring tributary stream functions to establish more natural patterns of sediment transport (e.g., Ulatis Flood Control channel) to improve spawning conditions for delta smelt and other fish and macroinvertebrates; and
- farming tules and using dredge material in subsided areas to raise ground surface elevations to a level suitable for tidal marsh restoration.

Assumptions and Biological Rationale

The majority of historical freshwater tidal marsh in the Sacramento/San Joaquin Delta system has been lost. This loss of tidal marsh has reduced the availability and quality of spawning and rearing habitat for many native species, by reducing the input of organic and inorganic material and food resources into adjoining deep water habitats (sloughs and channels) and the downstream bay and estuary. The Cache Slough complex has been identified as a significant area for spawning and rearing of delta smelt and other pelagic species. The hypothesis for this restoration is that the area will provide a major source of food and organic matter to covered fish species and the rest of the aquatic ecosystem in the lower Sacramento River, Delta, and Suisun Bay. Cache Slough, in conjunction with floodplain enhancement in the Yolo Bypass, provides an opportunity to reestablish the ecological gradient from river to floodplain, to intertidal wetland and open channel and bay characteristic of less altered estuaries. In addition, hydrodynamic modeling indicates that increased tidal exchange in the Cache Slough complex may have beneficial effects by reducing or eliminating reverse flows in Steamboat and Sutter Sloughs and the mainstem Sacramento River associated with a operation of a North Delta diversion, thus enhancing movement of juvenile salmonids through these waterways and ameliorating lower flows that could result from north Delta exports. This conservation measure also may provide enhanced aquatic productivity to the western Delta and Suisun Marsh.

Issues and Concerns

Significant issues that should be addressed as planning continues include:

- Restoration of habitat in the Cache Slough complex may not provide the expected benefits to covered species without careful design and implementation.
- Restoration in Cache Slough complex may have adverse effects on existing land uses and landowners, including crop production and existing wildlife use and local government tax revenues.
- Restoration in Cache Slough complex may have adverse effects on terrestrial species.
- The benefits of improved production of inorganic and organic materials within the Cache Slough complex may not accrue to downstream habitats. This is likely primarily due to the presence of introduced clams.
- Increased tidal action associated with restoration may affect adversely levees in Cache Slough complex and downstream.
- Increased intertidal marsh may result in methylation of mercury.
- Increased tidal freshwater marsh may exacerbate or reduce mosquito populations.
- Restoration in this area may benefit non-native species more than native species.
- Restoration of intertidal marsh vegetation may contribute to the reduction of ammonia and excess nutrients in the Delta and in sequestration of methyl mercury generated in upstream seasonally flooded habitats.
- Restoration in the Cache Slough complex may have adverse effects on operation of the North Bay Aqueduct.

NEXT STEPS

- Continue coordination with affected landowners, the public, and government agencies through the Lower Yolo Bypass Planning Forum, Yolo and Solano County habitat conservation planning processes and other public outreach avenues to better understand and address concerns about existing land uses to help refine the proposed action Continue to evaluate the relationship of restored habitat in Cache slough area to hydrology of Sacramento River, adjacent sloughs and upper Estuary, including evaluating affects to X2/salinity.
- Continue to refine the proposed action based on DRERIP review and other scientific input.
- Link hydrological transport and particle models with food web models to estimate the benefit of improved nutrient input to the upper estuary.
- Fully describe the benefits and effects for intertidal marsh restoration and adjacent upland habitat protection on terrestrial covered species.

Core Element No. 7: Strategic Tidal Marsh Restoration in the West Delta

Restore tidal and subtidal marsh habitat in the West Delta: Tidal and subtidal marsh and channel margin habitat located in the western delta may provide an important linkage between upstream and downstream habitats. This area's location at the confluence of the Sacramento and San Joaquin Rivers make it uniquely important to improving connectivity among the communities and species of the Delta. However, only small areas within the west delta are suitable for intertidal marsh restoration.

DESCRIPTION

The West Delta includes multiple small areas where intertidal marsh, subtidal aquatic, and channel margin habitat can be restored or created. Areas suitable for restoration include Decker Island, portions of Sherman, and Brannon Islands, Dutch Slough, and portions of the north bank of the Sacramento River where elevations and substrates are suitable. Restoring intertidal marsh in the west Delta will presumably enhance the habitat quality of the corridor, linking current and future restored habitat in the Cache Slough Complex with habitat in Suisun Marsh and Bay and to provide intertidal marsh habitat within the anticipated future eastward position of the low salinity zone with sea level rise. Restoration in these areas also may enhance rearing habitat for Delta and longfin smelt and outmigrating juvenile salmon.

ASSUMPTIONS AND BIOLOGICAL RATIONALE

The majority of historical freshwater marsh in the Sacramento/San Joaquin delta system has been lost. Restoring freshwater intertidal marsh and shallow subtidal aquatic habitats in the West Delta hypothetically would improve survival of covered species by: increasing rearing habitat area for juvenile Chinook salmon, Sacramento splittail, and possibly steelhead ; improving future habitat areas for delta smelt and longfin smelt within the low salinity zone that is anticipated to move eastward with sea level rise; increasing the production of food for rearing salmonids, splittail, and other covered species ; providing additional refugial habitat; and increasing the availability and production of food locally in the western Delta by exporting organic material via tidal flow from the marsh plain and organic carbon, phytoplankton, zooplankton, and other organisms produced in intertidal channels into adjacent open water areas.

ISSUES AND CONCERNS

During the initial habitat restoration opportunity identification process, scientists and stakeholders have identified several potentially significant issues that should be addressed during planning including:

- Restoration of habitat in the West Delta may not provide the expected benefits to covered species and instead may provide additional habitat for non native species.
- Restoration of tidal action and flows to currently leveed habitat may impact existing land uses and landowners, the integrity of levees in the area for restoration, threatened infrastructure and adversely affect agricultural production.
- Additional public lands in the area may reduce local government tax revenues.

- The benefits of improved production of inorganic and organic materials within the West Delta may be reduced by the presence of *corbula* in Suisun Bay.
- Restoration of habitat in the West Delta may impact existing terrestrial species.

NEXT STEPS

- Continue to refine the action through coordination with affected landowners, government agencies, and interested stakeholders in the West Delta.
- Continue to evaluate the effect of restored habitat in West Delta on the position of X2/salinity.
- Continue to refine the proposed action based on DRERIP review and other scientific input.
- Link hydrological transport and particle models with food web models to estimate the benefit of improved nutrient input to open water habitat.

Core Element No. 8: Large scale tidal marsh restoration in the Suisun Marsh area

Suisun Marsh is the estuary's largest brackish water marsh complex. It supports many listed and sensitive terrestrial and aquatic species. Much of the marsh currently is diked former tidal marsh and is managed for waterfowl (52,000 acres). The majority of the Marsh is privately owned and is protected under the Suisun Marsh Preservation Act. Restoration of a portion of these diked marshes to tidal influence already is being planned as a part of the Suisun Marsh Restoration and Management Plan. Return of diked marsh to tidal influence would significantly benefit a number of listed terrestrial and aquatic species. Certain covered fish in particular would be benefited by expanding available spawning and rearing habitat while other listed species in the marsh would benefit. Restoration also may contribute nutrients and food to adjacent open water habitats.

Delta outflow and tidal flow are the primary drivers of the salinity gradient (both north to south and west to east) in the Marsh. The State Water Resources Control Board Water Quality Control Plan for the Marsh (1995) requirement preparation and implementation of the Plan of Protection for Suisun Marsh which established salinity objectives that play a significant role in the seasonal, annual, and long-term salinity variability of the region. The resulting salinity is one factor that influences salinity in the Delta-Suisun region. The Montezuma slough salinity control structure is operated to minimize salinity in the marsh during the late summer and fall to maintain low salinity water for marsh management purposes. Modeling has shown that restoration of tidal marsh habitat has been shown to influence the salinity in the Delta depending on restoration location in the Marsh.

DESCRIPTION

The Suisun Marsh Habitat Restoration and Management Plan (in development) is evaluating alternatives which would provide for restoration of up to 9,000 acres of brackish intertidal marsh (S. Chappell pers. comm.). Much of Suisun Marsh is currently at elevations which could be restored to intertidal habitat. With future sea level rise and ongoing subsidence this opportunity would be lost. This core element proposes to opportunistically restore additional brackish intertidal marsh as lands become available for restoration. Anticipated actions to restore brackish intertidal marsh habitat include: acquisition of lands to restore intertidal and subtidal habitats and protect adjacent upland habitat to accommodate sea level rise; cultivating tules or other techniques to raise elevations of shallowly subsided lands; removing levees to reintroduce tidal exchange to diked lands; and using remnant sloughs to reintroduce tidal connectivity to assure proper tidal circulation within restored tidal marsh. In addition operation of Montezuma Salinity Control Structure would be evaluated, and operations modified if deemed appropriate in light of salinity requirements.

ASSUMPTIONS AND BIOLOGICAL RATIONALE

The underlying hypothesis for this conservation action is that restoring brackish intertidal marsh within Suisun Marsh would reduce the adverse effects of stressors related to food and habitat availability on covered species by: increasing rearing habitat area for Chinook salmon, Sacramento splittail, and possibly steelhead ; increasing the production of food for rearing salmonids, splittail, and other covered species ; increasing the availability and production of food in Suisun Bay and the major sloughs within the marsh by enhancing phytoplankton and zooplankton production and availability; locally providing areas of cool water refugia for delta smelt ; reducing periodic low dissolved oxygen events associated with the discharge of waters from managed seasonal wetlands; creating brackish habitat which is not as susceptible to invasion by aquatic plant species and most non-native predators; increasing the extent of habitat available for colonization by sensitive terrestrial species including Suisun thistle, Suisun marsh aster and soft-bird's beak; and enhancing and increasing the extent of tidal marsh for salt marsh harvest mouse and Suisun shrew.

ISSUES AND CONCERNS

During the initial habitat restoration opportunity identification process, scientists and stakeholders have identified several potentially significant issues that should be addressed during planning including:

- Intertidal habitat restoration within Suisun Marsh will impact existing land uses and landowners, including existing wildlife management and public access for hunting, fishing, and recreational purposes. Public land acquisition may adversely affect local government property tax revenues.
- The benefits of improved production of inorganic and organic materials from the marsh plain may not accrue significant benefits to covered species either because it

is not of suitable type or quality for pelagic species or because it will be largely consumed by introduced clams (*Corbula*) in Suisun Bay.

- Restored habitats may benefit non native species if not properly designed and implemented.
- The planning process needs to coordinate closely with the Suisun Marsh Restoration and Management Plan process.
- Restoration of intertidal habitat within Suisun Marsh could increase salinities in the Marsh and potentially the western and central Delta, depending on the restoration location.
- Alterations to through Delta conveyance could result in reduced freshwater inflow to the marsh and increased salinity compromising existing water quality standards and seasonal wetland management practices.
- The role of the Montezuma salinity control gate should be considered in future management in light of future sea level rise and changed water operations.

NEXT STEPS

- Continue coordination with affected landowners, government agencies, and interested third parties through the Suisun Marsh Management Planning process, other planning efforts, and other public outreach avenues to better understand and address concerns about existing land uses to help refine the proposed action.
- Continue to evaluate the relationship of restored habitat in Suisun Marsh to X2/salinity.
- Continue to refine the proposed action based on DRERIP review and other scientific input.
- Link hydrological transport and particle models with food web models to estimate the benefit of improved nutrient input to Suisun Bay.
- Continue to evaluate the effects of other core elements on Suisun Bay and Marsh.

Core Element No. 9: Interim Tidal Gates

Reduce Fish Entrainment, and Improve Water Reliability with Temporary Gate Installation: Temporary gates would be installed in sloughs on the western and eastern side of Bacon Island, in the Central Delta, and operated seasonally and on tidal cycles to provide added protection to fish, food resources, and nutrients, as well as improve water reliability for south delta diverters. The installation of these gates are being proposed independent of the BDCP so that they may proceed during the interim period, but they also are considered a core element of the BDCP because of their important linkages to meeting the dual purposes of contributing to the recovery of covered species and water supply reliability during the near term.

DESCRIPTION

The interim gate project, also known as the two-gate project, is proposed to reduce the risk of entrainment of delta and longfin smelt, as well as other aquatic species, food and nutrients while improving water supply reliability. The project would entail the installation and operation of two gates; one gate would be installed in Old River on the eastern side of Bacon Island, and the second gate would be installed in Connection Slough on the western side of Bacon Island. The gates would be operated as soon as possible (pending permits and installation) and during the near term period until they are found to be no longer needed once an isolated facility is operational, or are replaced by permanent structures. They would be operated during late winter and spring to protect smelt and food and nutrient resources. The gates would be capable of being opened and closed on a real time basis, such that they may be operated on tidal cycles. They would be operated at the direction of the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game. Initially, gates would possibly tidally operated (closed on flood, open on ebb) for 14 days in response to an initial storm event to minimize the movement of preferred smelt habitat (turbidity and salinity) in the south Delta entrainment zone. Later in the season, the gates would be closed on flood tides and opened on ebb tides, to eliminate or reduce movement of smelt towards the pumps while continuing to allow passage of other fish.

Gates would be designed to be easily removed in the event that monitoring results indicate that they are not accomplishing their intended purposes. Additional details of this core element can be found in WOCM8.

Assumptions and Biological Rationale

The operations of the CVP and SWP result in water being pulled toward the pumps in the south Delta in the opposite direction of natural flow patterns. This leads to the loss (entrainment) fish, food organisms, and nutrients as they are pumped into aqueducts. Delta smelt, in particular, are susceptible to entrainment when they move into the lower Sacramento and San Joaquin Rivers in late winter and early spring as they begin to move from Suisun Bay into warmer, fresher parts of the Delta for spawning. Adults appear initially to begin to move upstream from Suisun Bay into the Delta between late December and March depending on winter storm events that influence salinity, temperature, and turbidity. The hypothesis supporting the installation of the interim gates is that the gates can be operated in response to monitoring of flow, salinity, and turbidity to reduce movement of delta smelt, other important fish, food and nutrients into Old and Middle Rivers, and thus reduce entrainment of these resources. To test this hypothesis, the project would include an intensive monitoring program of fish distribution, salinity, turbidity, temperature, dissolved oxygen, chlorophyll A, and other physical and biological parameters.

ISSUES AND CONCERNS

During the development of this proposed conservation measure, scientists and stakeholders have identified several potentially significant issues that should be addressed during planning, including:

- When closed, the gates may block the movement of other important fish, including salmonids and sturgeon.
- The particle tracking modeling that has been the basis for analysis of anticipated benefits from gate operations may not reflect actual delta smelt behavior, and the assumptions regarding smelt movement in response to salinity, turbidity and flow may not adequately predict smelt movement. Therefore, the gates may not provide the benefits intended for delta smelt.
- Operations of the gates will impact recreational boating during periods of closure.
- Numerous permits must be obtained, including sections 401 and 404 of the Clean Water Act, section 10 of the Rivers and Harbors Act, California Department of Fish and Game Streambed alteration agreement, Reclamation Board encroachment, Federal and State ESA permits, and others.
- The gates may affect water quality in the central and south Delta.
- Local landowners may not support installation of the gates.

NEXT STEPS

- Continue to refine the action through coordination with affected landowners, government agencies, and interested third parties.
- Continue to evaluate and model the relationship of this core element with the effects of other mesures that may be implemented during the near term, such as its relationship to Delta Cross Channel Operations.
- Continue to refine the proposed action based on DRERIP review and other scientific input.

Core Element No. 10: Delta Outflow Targets

Delta outflows provide for downstream transport of fish and other aquatic organisms as well as nutrients and food supplies into the lower reaches of the Delta and Suisun Bay. Delta outflows also control, in balance with upstream salinity intrusion from the bay, the location of the low salinity region of the estuary (correlated with and often described as the location of "X2"). Appropriate targets for Delta outflow have been vigorously debated by the BDCP working groups, and remain controversial. No agreement has yet been reached regarding a single set of outflow criteria or even on a range. For purposes of the next round of analysis and evaluation, the Integration Team proposes that the Steering Committee rely upon the outflow targets contained in the current Water Quality Control Plan (D. 1641), with the understanding that outflow targets above and below this range will also be evaluated in subsequent modeling and analysis.

DESCRIPTION

The location of the low salinity habitat within the estuary is determined by the balance between freshwater inflow from rivers and tidal flow from San Francisco Bay. Freshwater outflows to meet the X2 requirement include both flows from upstream tributaries and releases from reservoir storage. Strictly speaking, X2 is the location in km of the 2% near-bottom isohaline relative to the Golden Gate Bridge. Current X2 regulations are based on an attempt to shape the seasonal distribution of the salinity field to reflect a natural runoff pattern, with X2 being lower in the estuary (more seaward) when previous outflow has been higher, and higher (more landward) when previous outflow has been lower. The X2 standard under D. 1641 prescribes salinity or freshwater outflow according to a sliding scale based on available stored water and recent unimpaired flow in the watershed. Current X2 standards are set based on the number of days within a particular month the X2 location must be at or west of Chipps Island or Roe Island, and the appropriate control point for any given month is determined by the maximum allowable X2 location (i.e., minimal allowable outflow) and the location of X2 during the latter portion of the previous month. Allowing for a two-week lag between X2 and outflow, X2 will be located at Collinsville, Chipps Island and Roe Island when Delta outflows equal 7,100, 11,400 and 29,200 cfs, respectively. Existing X2 standards apply only to the period from February 1 through June 30. During that period, reservoir releases and exports must be adjusted to result in an outflow of at least 7,100 cfs from February through June.

ASSUMPTIONS AND BIOLOGICAL RATIONALE

The abundance of some fish and invertebrate species, including at least one or two covered fish species, correlate positively with the location of the low salinity zone within the estuary. In particular, Suisun Bay and the western Delta are believed to be important habitat areas, as a transition zone between the freshwater and riverine habitats of the Bay and upstream watershed. Open water habitat within Suisun Bay and lower reaches of the Sacramento and San Joaquin rivers serve as spawning, larval and juvenile rearing, adult holding and foraging habitat for many species, and as a migration corridor for anadromous fish species including salmon, steelhead and sturgeon. Factors that may contribute to the relationship between X2 location and juvenile fish abundance include increased productivity and availability of high quality habitat within Suisun Bay, downstream transport of fish, food and organic matter, reduced temperature and/or ammonia concentrations with lower X2, residence time, inundation of backwater and floodplains with high flows, and the distribution of the earlier lifestages of fish into habitats that are located further downstream with decreased vulnerability to direct and indirect effects of south Delta export operations.

ISSUES AND ASSUMPTIONS

- The historical X2 correlations have weakened for a number of the species.
- Some believe that the hypothesized benefits from X2 are more likely attributable to inflow than to outflow.
- Some believe that the hypothesized benefits from X2 are more likely attributable to its role in diluting effects of ammonia discharges in the upstream watershed and the Bay.
- The benefits associated with X2 may decrease at higher outflow levels, and the water costs of meeting existing X2 standards become very high at higher outflow levels, suggesting a diminishing cost-effectiveness from the standard as it is now implemented (leading some to suggest elimination of the Roe Island trigger).
- Some recent research suggests that some of the habitat values now associated with X2 location can be provided in other regions of the estuary, e.g. Liberty Island.

NEXT STEPS

- Evaluate a range of outflow targets based on additional modeling. For the upper range, update and modify simulated delivery allocation decisions to help protect upstream storage to the extent possible.
- More effectively fine tune proposed spring outflow targets to reduce dry and critical year upstream storage impacts.
- Explicitly understand tradeoffs between outflow, upstream storage, and water supply reliability through more focused modeling.
- Evaluate proposed fall X2 targets and understand implications for water supply and upstream storage (cold-water pool and instream flow requirements).
- Continue to refine proposed targets based on DRERIP review and other scientific input.

Figure 6 is a map depicting the location of the Core Elements. **Figure 7** shows the operational assumptions for future analysis.

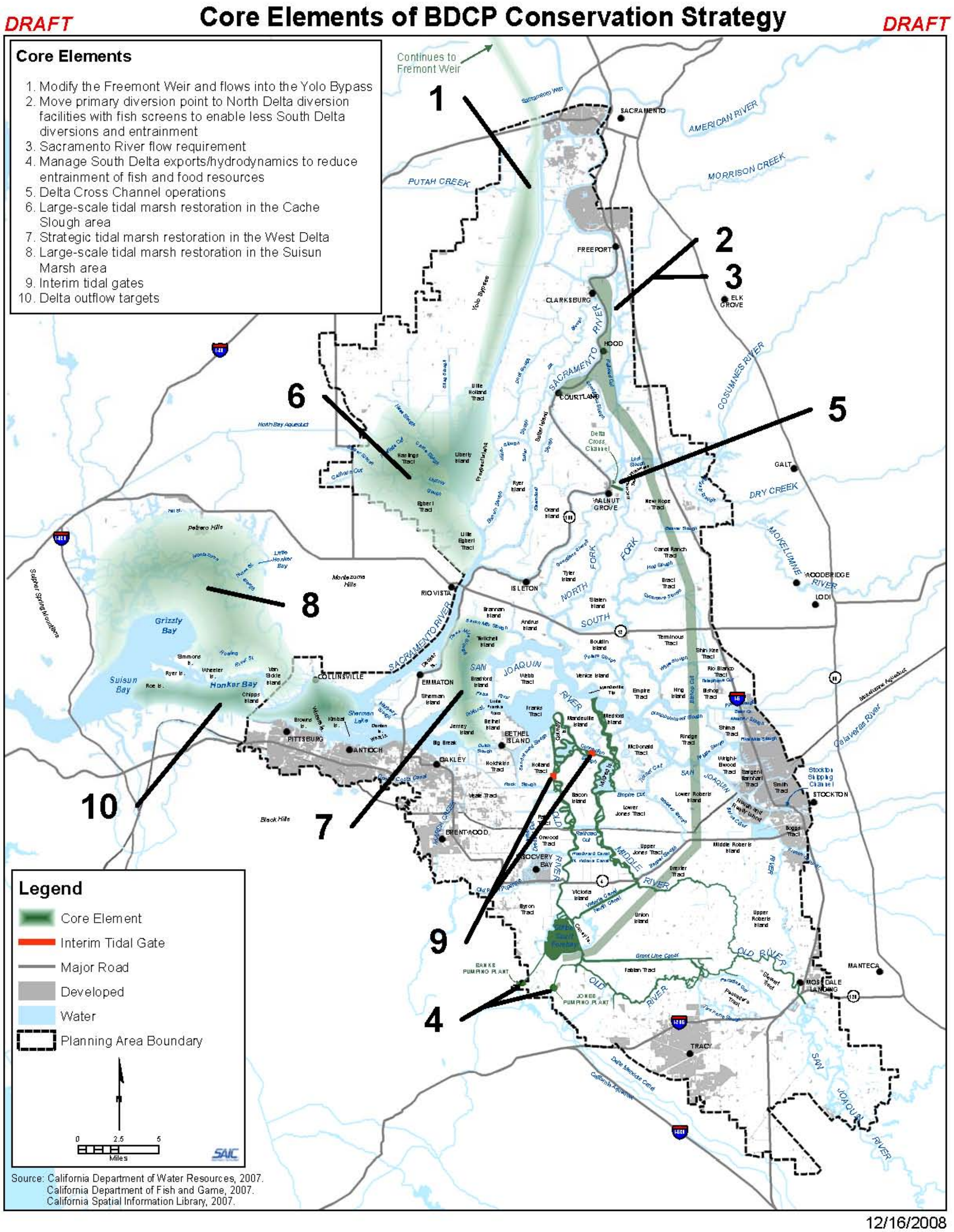

Figure 6. Core Elements of the BDCP Conservation Strategy.

Figure 7. Operational Assumptions for Future Analysis.

Operational Parameter	Operational Assumptions
Modification and Operation of Fremont Weir	Note: The parameters below only apply to controlled spills (Sacramento River at Fremont stage < 33 ft [NAVD88]). At current flood stage, spills into the Yolo Bypass are uncontrolled. Proposed Fremont Weir Notch Operation: Period of Potential Operation: December 1-May 15 Desired Duration of Inundation: 30-45 days Target Spill Discharge: 2,000-4,000 cfs Spill Frequency: As many times as hydrology allows Stage for Activation: 17.5 ft (NAVD 88) Sacramento River at Fremont
North Delta Diversion Minimum Bypass Flows **Option 1**	December 1 - June 30 - Bypass flows of 11,000 cfs before any diversion into North Delta Diversion when the modified Fremont Weir is not operational. - Bypass flows of 9,000 cfs when modified Fremont Weir spills are 2,000 cfs (daily average) or greater. July 1 - August 31 Bypass flows of 5,000 cfs September 1 – November 30 Bypass flows of 7,000 cfs
Option 2	Bypass flows of 5,000 Year round Additionally: At least 55% of river flows above minimum bypass flows during February – April, 45% during January and May, and 35% during December and June (applies to both Option 1 and 2)
Rio Vista Flows	Per D-1641 during September through January, 3,000 cfs for all other months
Delta Outflow/X2	Per D-1641
DCC Operations	November 1-June 30 Closed (except possibly on weekends May 15-June 30) July 1-August 31 Open as required for central and south Delta water quality September 1 – October 31 Open for up to 15 days per month as required for central and south Delta water quality Additionally: During closed periods if water quality in the interior Delta becomes a concern, allow for daily operations of closed at night for fish migration and open during the day for water quality purposes except during real time monitoring of peak fish migration periods.
Combined Old and Middle River Flows	Greater than -3,500 cfs during December 1- June 30 and greater than -5,000 cfs during July 1 – November 30
Interim Tidal Gates	Initial storm event of the season for 14 days: tidally operated (closed on flood, open on ebb) Later in season: tidally operated (closed on flood, open on ebb)

Adaptive Management and Monitoring Program

The BDCP will include adaptive management and monitoring programs to evaluate the effectiveness of the conservation measures and to address scientific uncertainties and knowledge gaps. These programs are currently under development, and are described in sections 3.5 and 3.6 of Chapter 3. This section provides a synopsis of the progress to date in developing the details of these program; further work remains.

While the BDCP conservation measures were developed on the basis of the best scientific and commercially available information and identify detailed actions to achieve the biological goals and objectives, over the term of BDCP implementation new data and information will be developed that will increase knowledge and help reduce uncertainties regarding the best approaches to implementing conservation measures. In addition, the Conservation Strategy anticipates the potential for substantial changes in Delta conditions that may result from climate change (e.g., sea level rise and hydrology in the Delta watershed), seismic events, potential large scale changes in land use, and other factors. The BDCP recognizes that monitoring and adaptive management are necessary to incorporate into plan implementation any new information and insight regarding actual changes and new projections of changing futures. As more is understood about the Delta ecosystem, adjustments to the implementation of BDCP conservation measures will be necessary and will be undertaken to improve effectiveness. The BDCP adaptive management process is designed to afford flexibility to make these adjustments, including modifications to, removal of, and additions of conservation measures and changes to the monitoring program as indicated by new scientific information.

The BDCP monitoring program will include activities to:

- determine the effects of the covered activities on covered natural communities and species;
- collect data necessary to effectively implement conservation measures;
- document the implementation and effectiveness of conservation measures;
- determine the appropriateness of the scientific relationships on which the assessment of effects and effectiveness are based; and
- assess the overall status of species, natural communities, ecosystem processes that support species and natural communities in the Delta.

Information gathered through the BDCP monitoring program, research conducted by the BDCP, and other research efforts will guide decision making during implementation. The BDCP monitoring and research programs are designed to determine and assess cause and effect relationships between implementation of specific conservation measures and the type and magnitude of species and ecosystem responses to those measures, as well as species and ecosystem responses to the implementation of combinations of conservation measures. Should strong cause and effect relationships be established, adaptive management provides the mechanism to concentrate efforts on the implementation of conservation measures that have been demonstrated to be more effective and to deemphasize or discontinue implementation of conservation measures that prove to be ineffective at achieving desired ecosystem, natural community, and species outcomes as articulated in the BDCP biological goals and objectives.

The BDCP monitoring program will coordinate with other existing monitoring and research programs in the Delta (e.g., Interagency Ecological Program, CALFED Science Program, Ecological Restoration Program (ERP)) currently undertaken by a number of entities, including DFG, DWR, USFWS, USGS, Reclamation, and academic institutions. Data collected through these other programs will be used by BDCP to help evaluate the effectiveness of BDCP implementation and assess the long-term status and trends of covered species populations and ecosystem conditions.

COMMENTS AND PENDING CHALLENGES

The changes in Delta land use and hydrology, water conveyance facilities, ways to reduce other stressors on fish species that are being contemplated in the proposed Conservation Strategy have raised concerns among Delta communities about the potential local and Delta-wide effects of such actions. The BDCP Steering Committee recognizes these concerns and the need for an intensified, ongoing dialogue with Delta communities and other members of the public to better understand and explore solutions to conflicts that may arise as a result of the implementation of the BDCP.

Currently, the issues and concerns identified to date include but are not limited to impacts to: existing land uses including agricultural land uses (and related agriculturally based elements of local economies) and public access areas; recreational activities and the economic benefits derived from those activities; property tax, in lieu fees and user fee revenues of local jurisdictions; potential regulatory effects on adjacent property owners; mosquito and vector controls; the production of methyl-mercury; the effects of the plan on other protected terrestrial species; the compatibility of the plan with flood control plans; the effects on existing irrigation and drainage infrastructure; adverse effects on local water quality such as salinity, dissolved oxygen, and organic carbon; existing water rights; effects on existing wastewater treatment operations of local jurisdictions; and local control over local land use

The BDCP Steering Committee will strive to resolve these issues, and additional concerns that may arise, through further detailed analysis in the BDCP as draft conservation measures are refined as well as during the environmental review process of the proposed plan, and through the design of avoidance and mitigation strategies for potentially unavoidable effects as the planning process progresses.

NEXT STEPS FOR COMPLETING THE BDCP

The schedule for the Steering Committee contemplates the publication by the federal and state lead agencies of a draft joint environmental impact statement/report on the proposed BDCP by the end of 2009, with extensive public reviews to follow. In order to meet this schedule, the scoping process for the NEPA/CEQA work has already commenced, and other work is underway to map out the necessary analyses that will be undertaken to ensure a full and complete environmental review of the proposed plan. The schedule also contemplates the completion of a working draft of BDCP by the end of June, 2009.

In January and February 2009 the Steering Committee will need to address a number of important and difficult issues that are intrinsic to such a large and complex conservation planning processes. The following is a brief enumeration of some of those challenging issues and the various tasks awaiting further work in the next two months.

Issues Currently Outside the Scope of the BDCP

Over the course of the BDCP planning process, the Steering Committee has raised a number of issues that extend beyond the current scope of the BDCP, yet are related to the actions being considered in the Conservation Strategy. In the upcoming months, the Steering Committee will consider these issues in detail and determine whether and how to address them within the BDCP. These issues include:

- ***Sacramento River Inflows:*** Sacramento River inflow targets, particularly in the spring, may be necessary to provide suitable conditions for covered species. Such inflow targets would affect upstream reservoir operations, which are currently outside the scope of the BDCP, and could adversely impact covered species upstream. Regardless of whether BDCP specifies inflow targets, changes in-Delta infrastructure and operations are likely to affect inflow patterns and upstream reservoir operation. It may be possible to identify moderate inflow targets that benefit covered species in the Delta without harming covered species upstream.

- ***San Joaquin River Inflows:*** Increased San Joaquin River flows could significantly improve water quality and conditions for covered species in the Southern Delta, but reoperation of upstream reservoirs is beyond the current scope of the BDCP and largely outside the control of members of the BDCP Steering Committee. Increases in San Joaquin River inflows could increase flexibility for increasing South Delta exports without harming covered species. It may be possible to build contingencies into the BDCP that allow for increased diversions of water from the Southern Delta if San Joaquin inflows are increased during the BDCP implementation period.

- ***New Water Storage Facilities:*** New storage facilities are currently outside the scope of BDCP. New storage, however, may help advance water supply and conservation goals. Some combination of improved operations of existing storage, new surface storage, and expanded groundwater storage is likely to occur in the future and may result in changes to the way the Delta is operated.

Central Issues

- Drafting a Conservation Strategy that will provide the eventual permit holders with sufficient assurances of predictability, while retaining sufficient flexibility during the implementation of the plan to address a changing Delta and the emergence of new information;
- Framing a governance structure that possesses the capacity to ensure that implementation decisions will be made in a scientifically sound and legally appropriate manner and in an orderly, timely and transparent fashion; and
- Building durable public understanding and support for the need to make fundamental changes to restore the Bay Delta and to provide ample opportunities for public access to the planning process.

On-going Tasks in January-February 2009

- Completing further analytical work on the Conservation Strategy using the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) Conceptual Models and other applicable models and methods to assess and refine the conservation measures;
- Further refining the operating parameters for the State Water Project (SWP), the Central Valley Project (CVP) for both the near-term and long-term BDCP implementation periods;
- Developing biological goals and objectives, and conservation measures for covered terrestrial species;
- Further describing the governance and implementation structures for the plan;
- Completing the draft adaptive management and monitoring plans, including an enumeration of changed circumstances and responsive measures and the approach to addressing unforeseen circumstances;
- Further refining conservation measures and their monitoring metrics in response to comments and new information;
- Continuing to solicit input and comment from the public -- including local governments and other in-Delta interests, and other stakeholders; and
- Expanding opportunities for coordination and integration of the BDCP with existing conservation plans and programs in the Delta and local communities.