Delta Science Program

Review Panel Summary Report

Bay Delta Conservation Plan (BDCP) Effects Analysis Conceptual Foundation and Analytical Framework and Entrainment Appendix

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Executive Summary

This document describes the initial (Phase 1) recommendations of a seven-member Independent Scientific Review Panel (hereafter "Panel") on the adequacy of two appendices of the Effects Analysis component of the Bay Delta Conservation Plan (BDCP). Phase 1 specifically addressed BDCP Appendix A: Conceptual Foundation and Analytical Framework, and a draft of BDCP Appendix B: Entrainment. After preliminary examination of the existing Effects Analysis appendices and supporting documents, the Panel met on October 25-27, 2011, in Sacramento, California, to hear background presentations from ICF consultants (hereafter, "consultants") and other contributors to the Effects Analysis, agency and public comment, and to assemble initial review recommendations. This report is a synthesis of the Panel's deliberations based on the collective written and presentation information prepared for Phase 1. The two appendices available to the Panel represent the initial effort by agencies and consultants to evaluate the effects of the BDCP on covered species and their habitat; additional chapters of the Effects Analysis will be reviewed next year as part of Phase 2.

The Panel recognizes that designing an effects analysis of a multifaceted solution set to a very complex suite of stressors in a very large, intricate system is challenging. The Panel found the Conceptual Foundation and Analytical Framework to provide an admirable start to a vision of how to systematically assess BDCP effects. However, the Effects Analysis does not yet provide the "big picture" necessary to evaluate how the effects of complex hydrodynamic, geophysical and ecological changes in the Bay-Delta are going to be synthetically analyzed as a system to ensure conservation and management of covered species, and that ecological processes of the Bay-Delta will be preserved and enhanced under future operations.

We also consider that review and refinement of such an effects analysis requires an iterative process and recognize our potential role in that effort. In the case of the BDCP Effects Analysis, such an iterative, and hopefully adaptive, process will be particularly important because we found the present draft with only the two (of proposed nine) appendices to be somewhat confusing, incomplete and fragmented, and as a result, our review seemingly premature. To ensure that the Effects Analysis achieves its intended purpose and provides population viability for covered species, we believe that the following major issues should be addressed in the next draft:

- *Recommendation 1:* Goal of Effects Analysis needs to be clearly defined.
- *Recommendation 2:* The Framework appendix needs to follow a logical flow and provide a "road map" indicating how the Effects Analysis will build toward the overall goal (see Recommendation 1)
- *Recommendation 3:* The analytical framework should define the nature and structure of the integration of results (a.k.a., "roll-up") and how the overall assessment of the efficacy of the plan will be determined. This integration should be summarized by individual species.
- *Recommendation 4:* The Panel believes the fundamental currency of the Effects Analysis should be species population viability.

- *Recommendation 5:* The framework should use all available best science and describe why other current science was excluded and provide justification for the exclusion.
- *Recommendation 6:* The Effects Analysis needs to build on an already well-populated ecological context.
- *Recommendation 7:* Adaptive management needs to be an explicit process in the Effects Analysis to deal with fundamental uncertainties.
- *Recommendation 8:* The Effects Analysis needs to address temporal and spatial scales more comprehensively and appropriately.
- *Recommendation 9:* Analyses of the individual actions need to be scaled to an integrative analysis that includes all relevant conservation measures of the 19 possible
- *Recommendation 10:* Factors used in model evaluation (e.g., Table A-11) should be expanded to consider the robustness of the model results and the proximity of the model predictions to population level effects.
- *Recommendation 11:* More detail and specifics need to be incorporated into the descriptions of hydrodynamic and other physical model structure, calibration, assumptions, uncertainties, etc.

While we recognize that the BDCP Effects Analysis involves a large, complex process with various levels of completion and detail that have yet to be satisfactorily integrated, the Panel's Phase 1 review raises many issues that suggest the findings of the Effects Analysis could be highly uncertain under its present formulation. The conceptual framework should more explicitly consider how uncertain analyses of effects will guide monitoring and filling of information gaps and specific actions under an adaptive management plan that is integrated across both the Effects Analysis and implementation of the BDCP.

Introduction

This document describes the initial, Phase 1 review recommendations made by the seven-member Independent Scientific Review Panel (Appendix 1; hereafter "Panel") on the adequacy of the Effects Analysis component of the Bay Delta Conservation Plan (BDCP). This review was structured under a Scope of Work and time schedule (Appendix 2) involving two phases. Phase 1 specifically addressed the BDCP Appendix A, Conceptual Foundation and Analytical Framework sections (hereafter generally referred to as "Appendix A"), and a draft of BDCP Appendix B: Entrainment (hereafter generally referred to as "Appendix B"). The second phase of the Panel's review is proposed to encompass the BDCP chapter that summarizes the comprehensive Effects Analysis, as well as the remaining technical appendices. After preliminary examination of the existing Effects Analysis and supporting documents, the Panel met on October 25-27, 2011, in Sacramento, California (see Appendix 3), to hear background presentations from ICF consultants (hereafter, "consultants") and other contributors to the Effects Analysis, agency and public comment, and to assemble initial review recommendations. This report is a synthesis of the Panel's recommendations based on the collective written and presentation information prepared for Phase 1.

The BDCP Working Draft was released November 18, 2010 without a detailed Effects Analysis. In an interim review, a National Research Council panel cited the absence of a viable Effects Analysis as one of the most critical gaps "in the science in the BDCP and the corresponding conservation actions" (NRC 2011). As a critical component for the BDCP, the current working draft Effects Analysis is intended to provide the best scientific assessment of the likely effects of BDCP actions on the species of concern and ecological processes of the Bay-Delta system. The Appendix A, Conceptual Foundation and Analytical Framework (Foundation and Framework), describes the high-level vision, purpose, and regulatory foundation for the Effects Analysis. It also provides an overview of the proposed methods to accomplish the analysis. It is further supported by a series of technical appendices developed around common stressors or groups of similar effects (see Appendix B). Although it is problematical to separate the BDCP from its Effects Analysis, it is important to note that the Panel was explicitly tasked to review the Conceptual Foundation and Analytical Framework, and the associated Entrainment Appendix B, not the BDCP *per se*. However, there was consensus across the Panel that the Effects Analysis should be a stand-alone document, requiring critical information (e.g., in the Analytical Framework) from other, more comprehensive sources such as the BDCP.

Despite this narrow mandate, or perhaps due to it, the Panel struggled to meet the purpose of our review given the incomplete and fragmented state of the current draft Effects Analysis. While we understand the importance of obtaining early critical review of the emerging principles and structure of the Effects Analysis and its application through the entrainment analysis, we concluded that this review was fundamentally premature. One important example: as we understood it, the goals and objectives of the BDCP were still under revision at the time of this review. The Effects Analysis does not yet provide the "big picture" necessary to evaluate how the effects of complex hydrodynamic, geophysical and ecological changes in the Bay-Delta are going to be synthetically analyzed as a system to ensure conservation and management of listed species under the Federal Endangered Species Act (ESA) and the California Natural Community Conservation Planning Act (NCCPA), and that ecological processes of the Bay-Delta will be preserved and enhanced under future operations. The potential ecosystems effects of the BDCP must evaluate all ramifications of not only the mitigation/compensation measures and changes in water management but also restoration, habitat management and other conservation actions consistent with the distribution and ecology of the covered species and broader Bay-Delta ecosystem processes.

To minimize redundancy and consolidate the Panel's recommendations, we have organized the questions from the Panel Charge (Appendix 2) into topical categories under which our key recommendations are grouped (with the original questions mandated to the Panel): Each of the Panel's 11 recommendations have been cross-referenced to the relevant questions, below (Appendix 4)

Goals, Purpose, Objectives and Scope

1. *How well will the Foundation and Framework, as designed, meet its major goals?*
2. *How well are the purpose and scope of the Foundation and Framework defined and described?*

Completeness, Structure and Effectiveness of Description

3. *How effectively does the Foundation and Framework describe the key elements of the ecological context of the BDCP? (details of the ecological context are found in Chapter 2 of the plan)*
4. *How complete is the Foundation and Framework; how clearly is it described?*
5. *Are the Foundation and Framework internally consistent and scientifically valid?*
6. *How clearly does the Foundation and Framework identify baseline(s) or other reference points (e.g., goals and objectives) for the effects analysis?*

Approach and Analysis

7. *How well does the Foundation and Framework provide an approach for analyzing the effects of BDCP?*
8. *How well does the proposed Framework integrate analysis at various spatial and temporal scales?*
9. *How well does the Foundation and Framework articulate how best available science will be defined, assembled, summarized and integrated into the analysis?*
10. *How well does the Foundation and Framework describe the link between the adaptive management and the associated monitoring program and the effects analysis?*
11. *How well are the methods described to synthesize effects at the species, population, and ecosystem levels? (Note: The descriptions of the "roll-up" methods are still in development and will not be included in the Framework in time for this review. Additional details may be provided during the consultant presentation at the first workshop.)*
12. *How well are the proposed analytical tools defined, discussed and integrated?*
13. *Were the appropriate models used in the technical appendix? Were model results interpreted correctly? If model results conflicted, were appropriate interpretations made?*
14. *How clear and reasonable is the scale of analysis?*
15. *How rigorous of an analysis did the technical appendix provide for evaluating the effects of potential BDCP conservation measures on the specified variable(s)?*
16. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*

17. *How well was the vision of the Foundation and Framework applied in the technical appendix/analysis (i.e., the Entrainment Appendix)? How consistently was it applied?*

Models

18. *Does the Foundation and Framework adequately describe how quantitative and conceptual models will be used? Is the approach integrated, reasonable and scientifically defensible?*
19. *How well is the approach to analyze individual covered activities, including all conservation measures, as well as the cumulative impacts of a comprehensive strategy described?*
20. *How well does the Foundation and Framework describe how uncertainty will be addressed? How could it be improved?*
21. *Does the Foundation and Framework describe the appropriate suite of models that should be used?*
22. *How well does the Foundation and Framework describe how conflicting model results and analyses will be interpreted in the technical appendices?*
23. *How well are the models and analyses interpreted and summarized?*
24. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

The Panel has prepared this synthesis of our Phase 1 recommendations based on the following assumptions:

- The Effects Analysis is fundamentally a multispecies Habitat Conservation Plan (HCP), with the associated mandates, provisions and assumptions under the Endangered Species Act (ESA; Section 10[a]) that is designed to compensate for the taking of individuals by promoting survival of the population or species in some other way, but we realize that the ESA still does not specify how that should be accomplished (e.g., habitat management or restoration, reserve networks) (Wilcove *et al.* 1996).
- We are not only conducting a scientific review, but intend to provide constructive advice for the revision of the existing Phase 1 Effects Analysis documents and all new documents for Phase 2, as well as the BDCP overall.
- Our comments should be focused on Appendix A: Foundation and Framework
- We use Appendix B: Entrainment as a case study of how the Framework is applied, and provide some technical comments on it. We assume that we will see Appendix B again during Phase 2 and will provide more specific technical recommendations at that time.
- Our comments and recommendations will be used to further the design and structure of the “roll-up” (in this report, the Panel proposes a substitute term: *integration of results*).
- Phase 2 will involve a complete review of the Effects Analysis including all completed appendices.

Goals, Purpose, Objectives and Scope

Recommendation 1: Goal of Effects Analysis needs to be clearly defined. (The comments below directly address the Charge to the Panel questions 1, 2, 3, 6 and 14, above)

The Effects Analysis begins with developing the Conceptual Foundation (Appendix A). The goals are stated early on as two co-equal goals: (1) to provide for the conservation and management of Bay-Delta species; and (2) to improve current water supplies and reliability (p. A-2). While these are certainly the overall goals of the BDCP, they lack specificity with respect to a conceptual foundation and analysis framework, especially for an effects analysis. Developing more detailed goals would provide greater transparency when assessing the effects of the project. Although it might sound like a subtle distinction, the Panel was uncertain whether the goal of Appendix A was to use science to predict the outcome of implementing the BDCP or to provide an analytical framework (i.e., a set of rules) to guide the development of an effect analysis to predict the outcomes of the BDCP. For example, based on the background and principles developed in the draft BDCP and the Conceptual Foundation and Analytical Framework for Effects Analysis (Effects Analysis Appendix A), the Panel believes that the end product of the framework should be to use the best available science to make predictions about the individual and cumulative effects of the BDCP actions and conservation measures on the covered species (i.e., threatened and endangered, at-risk, and species of concern identified in the BDCP). Goals of the evaluation should include the synergistic effects of the various actions on the species and the interplay among the covered species (see Recommendation 3).

Constructing a more comprehensive conceptual model of the Delta ecosystem points out a critical missing scale of analysis: the Bay-Delta ecosystem as a whole. Because the covered species represent components of a larger Delta ecosystem, another goal should assess the impacts of the conservation actions, singly and interactively, on the Delta ecosystem as a whole. Any shifts in the Delta will also affect interconnected critical systems. This raises another goal of how the impacts of the conservation actions cascade into the Suisun and San Francisco Bay estuary.

While the larger BDCP document develops detailed goals of the overall plan of action, Appendix A needs sufficient detail to clarify the overall conceptual model being used and the strategy implemented to determine the potential effects of BDCP implementation. As it currently is developed, the population models proposed for the Analytical Framework appear well-developed given the state of the science, but higher level ecosystem structures are lacking, leading to gaps in the effects approach. The lack of structure also applies to the processes currently operating within the Delta and to the implementation of proposed conservation actions; the simplistic vision model leaps from coarse to small-scale population models, a structure that fails to consider, for example, synergistic interactions among conservation actions or initial impacts at different scales. Life cycle models for each species have yet to be developed that address all conservation measures and proposed actions of the BDCP.

Based on the background and principles developed in the draft BDCP and Appendix A, the Panel believes that the goal of the framework should be to understand the potential cumulative effects of the conservation actions within the BDCP on the covered species and Bay-Delta ecosystems. For each of the covered species, the assessment should evaluate how each of the individual conservation acts will affect the long-term health of the species in the Delta. The evaluation should include the synergistic effects of the various actions on the species and the interplay among <u>all</u> of the interacting species.

We acknowledge that the current state of knowledge will not enable the Effects Analysis to fully evaluate synergistic effects, including all or most species, resulting in considerable uncertainty in the final assessment. Appendix A indicates that uncertainty will be addressed with adaptive management and monitoring but with no specific process described. Therefore, the Effects Analysis should at least specify what actions might be taken if and when monitoring is determined to be insufficient to inform adaptive management.

Completeness, Structure and Effectiveness of Description

Recommendation 2: The Framework Chapter needs to follow a logical flow and provide a "road map" indicating how the Effects Analysis will build toward the overall goal (see Recommendation 1). The comments below directly address the Charge to the Panel questions 4, 7, and 9.

Appendix A, Conceptual Foundation and Analytical Framework does not follow a clear organization. The panels feels that Appendix A should be reorganized and begin with: 1) a clear discussion of the objectives and approach that the Effects Analysis will take to meet its goal; and, 2) a discussion of how the analytical framework will facilitate an integration of modeled effects results from each of the effects appendices. This discussion should then be followed with 3) the vision for the BDCP, conceptual models, and ecological context for the Delta.

Panelists were left wanting a "roadmap" of how the analytical framework is to be used to guide the Effects Analysis and how each of the other appendices (Appendix B through H) are related to the conservation measures contained in the BDCP. Such a roadmap does not appear in the reviewed draft but a reasonable first attempt at such a roadmap was provided in Chip McConnaha's presentation to the panel on October 25 (and shown here, below, in Fig. 1). This illustration provides insight into how conceptual models, analytical framework and effects appendices interact to support synthesis of modeled effects of the BDCP. This illustration should go farther to include assigning where each of the conservation measures are addressed within the Effects Analysis. Table A-12 "BDCP Covered Activities and Appendices" (p. A-61) provides this information but it is up to the reader to put these elements together. This should be moved to the beginning of the Analytical Framework and integrated with some version of Fig. 1.

The appendix would be improved if the current section A.3: "Analytical Framework" (p. A-42 of the draft document) is moved to the beginning of Appendix A. The discussion of how results from each of the appendices will be integrated is currently addressed in Section A.3.3.6 "Integrating Results" (p. A-53); this discussion should also be moved earlier in the chapter and should be expanded.

Section A.3.3.6 "Integrating Results" provides some background into the qualitative scoring system, including four criteria, which will be used in aiding the "roll up". Not clear to the panel was to what extent the synergistic effects of individual conservation measures will be treated within the "roll up". The lack of documentation about

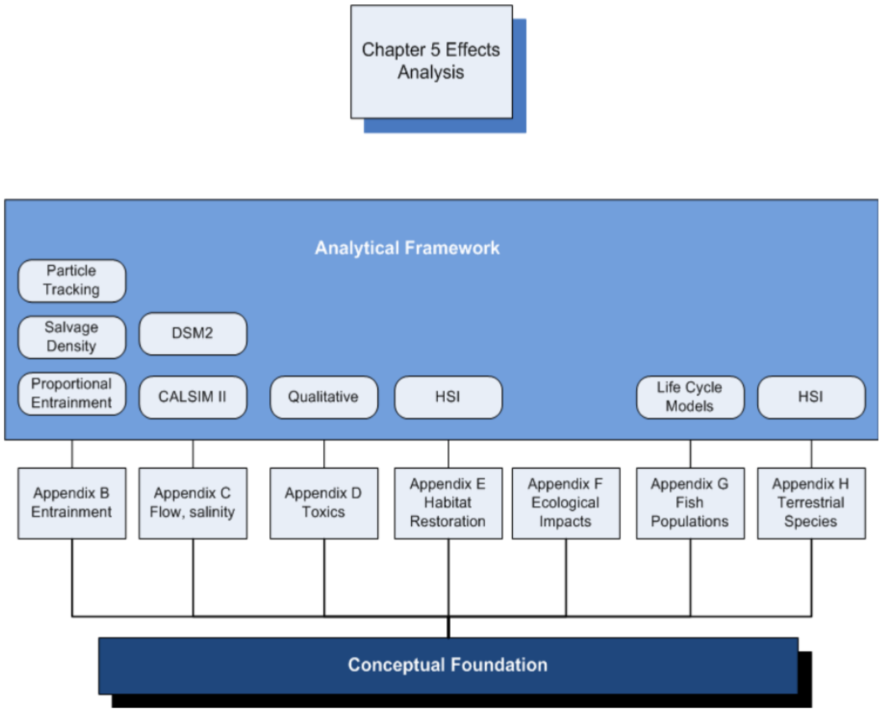

Figure 1: A roadmap of how Conceptual foundations, Analytical Framework and Effects Analysis Appendices will support synthesis of overall BDCP Effects and "roll-up" contained in Chapter 5 of the BDCP. Figure from C. McConnaha's presentation to the BDCP Effects Analysis Review Panel on October 25, 2011.

considerations given to these synergies is representative of an overall incomplete picture about underlying assumptions and scientific uncertainty.

The BDCP "logic chain" approach was missing from the Conceptual Foundation and Analytical Framework. Previous BDCP planning efforts have utilized a "logic chain" approach to organize the overall conservation plan (Reed et al. 2010; Logic Chain User Guide v.3.0). The logic chain articulates a pathway from a plan's goals and objectives, to the specific measures designed to achieve those aspirations, to the monitoring, research, and metrics that will capture the effects of the conservation measures and through an adaptive management process that adjusts conservation effort in light of progress made towards goals and objectives. The logic chain captures the underlying rationale and assumptions for the conservation measures that comprise the overall conservation strategy and establishes benchmarks against which progress can be measured.

The Effects Analysis is an important part of the logic chain because the analysis provides the initial basis for the link between actions and anticipated outcomes in an effort to achieve project goals and objectives. Given the previous reliance on the logic chain approach, the Conceptual Foundation and Analytical Framework should consider how the Effects Analysis will inform the BDCP logic chain. As noted by a previous science panel (Reed *et al.* 2010), "To effectively use the logic chains to build the plan, it will be essential to clearly lay out linkages among logic chains, effects analysis, implementation plan, monitoring and research components, and adaptive management. It is clear to the Panel, and those who briefed them, that there need to be feedbacks between the logic chains and the Effects Analysis. The Effects Analysis will become a new and important set of data for the Plan, and the process of incorporation of those data in the decision processes and logic chains needs to be described explicitly."

Recommendation 3: The analytical framework should define the nature and structure of the integration of results (a.k.a., "roll-up") and how the overall assessment of the efficacy of the plan will be determined. This integration should be summarized by individual species. (The comments below directly address the Charge to the Panel questions 1, 7, 11, 12, 13, 19 and 23, above)

The use of the term "roll up" is not clear for the reader. Considering the amount of scientific and regulatory vernacular already contained within the Effects Analysis, it would be prudent to stop using the term "roll up" and replace it with a more descriptive title such as "integration of results".

Without the Panel's ability to see an example of the integration of results, the Panel had difficulty assessing the continuity between the analytical framework, the analytical methods and the end product. The Panel feels that this integration needs to reflect the Panel's proposed goal for the Effects Analysis (see Recommendation 1): "to understand the potential cumulative effects of the conservation actions within the BDCP on the covered species and Bay-Delta ecosystems." Inherent in the Effects Analysis is the need to place species effects in the context of the BDCP's influence on the broader ecological processes of the Bay-Delta system (see Recommendations 6 and 8).

There are two important aspects of the integration of results process that need to be included in the analytical framework. First, we recommend that the consultants develop a set of well-articulated steps to developing species-specific models, explicitly stating assumptions, describing the areas of uncertainty, and assessing the cumulative impacts of the BDCP on listed species. Second, we recommend that the conclusions from each individual effects appendix be summarized by species in the summary chapter (BDCP Chapter 5) and that species-specific evaluations should incorporate synergistic effects to the extent possible (Recommendation 2).

Once these issues have been addressed in the Analytical Framework, the panel recommends that the consultants develop a draft integration of results for one species that can be reviewed prior to the scheduled formal spring review. The panel will provide feedback which can then be integrated by the consultants into the next revision.

Species-Specific Models

The integration of results is the centerpiece of the Effects Analysis, providing a summary of the impacts of the conservation measures on the listed species. As a result, it is critical that the Analytical Framework provide an explicit roadmap of how the integration of results will be developed and how the information will be synthesized into an overall assessment of the impacts of the BDCP on the listed species. We feel that the qualitative methods for assessing the impacts of stressors and enhancers described in Appendix A are insufficient to allow a valid assessment, especially given that most detailed effects analyses have not been provided to the Panel.

Section A.3.3.6 states that because life cycle models are not available for many species, "qualitative methods figure prominently in the roll-up of impacts". The qualitative methods in the current draft, however, make it almost impossible to assess the relative effects of stressors and enhancers on listed species. Without accurate measures of the relative effects of stressors and enhancers, the cumulative impacts of the BDCP cannot be assessed. In the ideal case, the impact of stressors and enhancers would be based on a common metric such as population viability (see Recommendation 4), population size, and population growth. In cases where there is insufficient information to make assessments at the population level, there needs to be a common currency that allows valid comparisons of the various impacts. Alternatives may include estimates of the proportional decrease or increase that stressors and enhancers may have on the population or the amount and quality of habitat for a species.

For species without well-developed life-cycle models, development of common metrics will require making assumptions in order to assess the relative impacts of stressors and enhancers on a species. We feel that even simple models of population metrics with well-articulated and reasonable assumptions are superior to qualitative assessments. We encourage the consultants to develop a set of well-articulated steps to developing species-specific models, stating their assumptions, describing the areas of uncertainty, and assessing the cumulative and synergistic impacts of the BDCP on covered species.

Summary of Results from Effects Analysis Appendices (Appendix B-Appendix J)

The consultants recognized in their presentation to the Panel that the process of integrating results still needs significant refinement. The panel agrees that the results integration needs to be improved both for the individual appendices (e.g. Appendix B: Entrainment) and for the overall analysis (BDCP Chapter 5).

Appendix B, Table B-254 (which was acknowledged as being incomplete) was provided as an example of an approach to integrate the effects of one stressor (entrainment) on the listed species. None of the panel members felt that Table B-254 was an effective approach for displaying a comparison of simulation results. The panel felt that all of the stressors and enhancers should be summarized in a separate table for each species. In addition, the table should incorporate weight of evidence when there were conflicting model results.

When integrating the results from all the Appendices (BDCP Chapter 5), the effects for each individual species should be summarized. In addition, there should be a discussion of how these overall effects will interact with each other. (e.g., see Recommendation 2, 9 and 11).

For example:

Specific Species (e.g., Steelhead)

- Summary of Appendices
  - Entrainment

    - Subsections of the appendix (e.g., Salvage-Density Method)
        - ✓ Conclusions (i.e. stated in Entrainment appendices)
  - Flow, Salinity, Passage, and Turbidity
    - Key conclusions
  - Toxics
    - Key conclusions
  - Habitat Restoration
    - Key conclusions
  - Ecological Impacts
    - Key conclusions
  - Fish Population
    - Key conclusions
  - Terrestrial species
    - Key conclusions
  - Analysis not Used
    - Key conclusions
  - Construction and Maintenance Impacts on Covered Fish
    - Key conclusions
- Synthesis of cumulative and interacting effects

Recommendation 4: The Panel believes the fundamental currency of the Effects Analysis should be species population viability. (The comments below directly address the Charge to the Panel questions 1, 4, 5, 6, 7, 10, 14, 15, 16, 17, 20 and 24, above)

Population viability criteria (abundance, population productivity, genetic and phenotypic diversity, population spatial distribution) should be used to evaluate project effects (dual conveyance and conservation measures) on each of the covered species to the extent possible (e.g., Boyce 1992). These criteria were identified in the Conceptual Foundation (p. A-32) and details of the criteria were described by McElhany *et al.* (2000) for salmon. The scale of the Effects Analysis should be at the population level rather than subcomponents of the population. Effects on subcomponents should be expanded to the population level as needed to provide comparisons across activities and species. Use of a common currency, such as population viability criteria, should facilitate the cumulative effects analyses that integrate the synergistic effects of all actions and conservation measures on each of the covered species.

The Panel anticipates that effects of some actions on population viability will be difficult to quantify, in part because information about viability criteria may be lacking for some species. Additionally, the relative importance of each of the four population viability criteria (abundance, population productivity, genetic and phenotypic diversity, population spatial distribution) to species conservation may vary with species and this should be discussed in the framework. The Effects Analysis should attempt to evaluate the effect on population viability criteria to the extent possible while describing the certainty or uncertainty about the assessment. Critical assumptions and uncertainties in the methodology should be clearly identified and presented in the effects analyses.

Appendix B: Entrainment provides an example of why the Effects Analysis should be described at the population level rather than at the local subcomponent level. For example, entrainment of longfin smelt was estimated to be 14-44% higher during preliminary proposal (PP) conditions compared with existing biological conditions in dry years, but 5-20% lower during critical low water years. While these relationships might seem to be highly significant to the casual reader, their value to conservation planners is much greater if they can be described at the population level. For example, if entrainment involves only 1% of the longfin smelt population, then the overall project effects are relatively minor even if the alternatives have a 100% difference in observed mortality. However, if the results apply to 50% of the population, then the project has a much higher potential impact and such impacts deserves special attention. The Panel recognizes that there is a tradeoff in certainty at the local scale versus population scale, such that error propagates as one expands the Effects Analysis to the population level. This uncertainty should be described to the extent possible. The Panel may have additional comments on error propagation when it reviews technical aspects of the appendices. The effects analyses, such as Appendix B, should consider error propagation.

The Effects Analysis should evaluate project effects on other viability criteria in addition to population abundance to the extent possible. If the Effects Analysis cannot provide an assessment on a criterion such as population diversity or spatial structure, then the authors should say so, or indicate if such criteria do not appear to be relevant given what is currently known about the species. Furthermore, indices of productivity, such as fish body growth, should be considered as part of the evaluation of conservation measures.

In Appendix B, additional viability criteria could have been examined among Chinook salmon. A recent study by Miller *et al.* (2010) indicates that naturally-produced Chinook salmon in the Central Valley have multiple life history types. Therefore it is important to evaluate size-at-age of entrained salmon as a means to consider entrainment of various life history types. Likewise, many hatchery salmon (winter, spring, fall races) are released and should be evaluated separately from natural origin salmon. Juvenile hatchery salmon are often larger than natural origin salmon and hatchery salmon likely have different habitat preferences, migration rates, and migration routes, suggesting that vulnerability of hatchery and naturally-produced salmon to project effects may differ. The degree to which the effects analyses cannot distinguish between hatchery versus naturally-produced salmon or life history types is part of the evaluation of uncertainty. Most winter and spring hatchery Chinook salmon can be identified via coded-wire-tag, but relatively few of the much more abundant hatchery fall Chinook salmon are marked (Williams 2006). The Effects Analysis did attempt to distinguish between winter, spring and fall races of Chinook salmon, as it should. A major uncertainty in the analysis, as touched upon in the appendix, is that it is difficult to identify juvenile spring versus fall Chinook salmon. Misclassification of entrained spring Chinook as fall Chinook (undercounting entrainment of spring Chinook) would have a significant error when assessing the impact on spring Chinook salmon (ESA-listed) but little effect on the abundant fall run.

The Effects Analysis should clearly identify and discuss key assumptions and methodological uncertainties associated with each analysis so that the reader has information to judge reasonableness and uncertainty of the estimates produced by each approach. A sensitivity analysis could facilitate the evaluation of uncertainty, especially for species where the assumption may affect the findings at the population level. For example, as noted above, what is the effect of incorrectly classifying juvenile spring Chinook as fall Chinook given that population abundance of spring Chinook is very low? What is the effect of expanding observed entrainment to total entrainment, including predation and louver efficiency effects? Table B-6 is a brief attempt to highlight some of the benefits and limitations of each method. The appendix mentioned a summary of benefits and limitations in Section B.3.11 but did not contain this section.

Recommendation 5: **The framework should use all available best science and describe why other current science was excluded and provide justification for the exclusion.** (The comments below directly address the Charge to the Panel questions 9 and 13, above)

All models are simplifications of reality to varying degrees. For this reason, the robustness of conclusions should be evaluated using alternative methods, models, and assumptions. The alternative methods should be selected from among the best available science, not all possible models. Antiquated techniques, models with known shortcomings, or faulty assumptions should be automatically excluded as inappropriate. There is no value in using substandard or faulty methods and then assigning a low weight to compensate for their acknowledged limitations. Justify the models/methods included and excluded in the analyses and provide rationales for decisions in all cases.

Using this approach, the alternative models should be fewer and with more similar weight than an original list of alternatives. This general philosophy is consistent with recent multi-model inferential techniques that recommend using only reasonable models (Burnham and Anderson 2002). As discussed below in Recommendation 7, we recommend excluding models and approaches that are less credible, by weighting model results based on the strength of evidence, robustness of conclusions, and relevance of model results to population-level effects.

Recommendation 6: **The Effects Analysis needs to build on an already well-populated ecological context.** (The comments below directly address the Charge to the Panel questions 5, 7, 8, 11 and 14, above)

The Panel was impressed overall by the comprehensive ecological context provided in the Conceptual Foundation and Analytical Framework (Appendix A; A.2.5-A.2.6). In particular, the Ecological Background (A.2.5), and especially Ecological Drivers (A. 2.5.2), provides valuable information on both the current conditions and dynamics, as well as future (climate change, but unfortunately not anthropogenic demand for water and undeveloped land) constraints, on the Bay-Delta's ecological forcing factors. Several narrative and schematic conceptual models provide further insight; although, the bulk of the conceptual models remain to be utilized in other appendices. Albeit brief, the Ecological Principles (A.2.6) provide 13 concepts that should be essential to, but are often absent in (Noss *et al.* 1997), every large-scale, multiple species HCP. As noted elsewhere, the Analytical Framework of the current draft Effects Analysis does not explicitly incorporate many of these principles (e.g., adaptive management) within the Entrainment Appendix draft.

The Panel particularly appreciated the development of a number of detailed ecological principles in Appendix A. These included ecological drivers, and also principles based on a BDCP Science Advisors report (BDCP Science Advisors 2007). However, these ecological principles also need to be incorporated into and referred to within each of the detailed appendices. We recognize that not all principles would significantly influence particular analyses, yet providing different modeling scenarios based on those principles seems appropriate. In the entrainment study (Appendix B), for example, the analysis approach did not seem to vary the temporal dimension except for the consideration of different water years (see Recommendation 8).

Assessing the impacts of all of these management actions singly and in combinations on the covered species is not sufficient. Most of the conservation actions will impact a variety of species that are not covered species, and therefore may not be modeled. This reflects an overall conceptual model that jumps from a coarse grain vision of a whole system to a population level assessment without consideration of community-level trophic, mutualistic, or other interactions among species. These non-covered species, however, may interact with the covered species as part of their food web, as food, as trophic or habitat competitors or as predators; some may enhance covered species populations indirectly or compete behaviorally for space. Lacking that structure in the conceptual foundation means that focused modeling of a single covered species may lack sufficient detail to adequately predict future population changes. Thus, the effects analyses should also consider the effects of the conservation actions on the species that may interact with the covered species. The Panel understands that the science required to develop interactions among species may not be well developed. However, even simplified models may provide insight into the actual overall impact of the BDCP.

Specifically, while the background on the pelagic organism decline (POD) and the complex relationships and processes associated with the pelagic food web in the Bay-Delta (A.2.5.1) provides an essential foundation for understanding the situation of many of the threatened and endangered species that are motivating the Effects Analysis, the lack of a comprehensive perspective about the greater food web and other ecological interactions (e.g., wetland, detritus-based) affecting declines in Bay-Delta biota (particularly Pacific salmon) is disappointing, even though recognized in Sobczak *et al.* (2002, 2005), Howe and Simenstad (2011), and DRERIP conceptual models. Such a decompartmentalized, single-focus view of the ecological structure, processes and threats in the Bay-Delta is not surprising given the precipitous decline in POD species, but it is diagnostic of an analysis that will fall well short of addressing the effects of the BDCP on the broader Delta <u>and Bay</u> ecosystems (NRC 2011) and address the still-pervasive failure of multispecies HCPs to address the “…mosaic of habitats and species assemblages across a large area…treated as one functional system…” (Noss *et al.* 1997). In the Panel’s opinion, the Bay-Delta as a functioning estuarine system, in the broader and more accepted definition of estuarine processes (i.e., inclusive of tidal freshwater; Fairbridge 1980; Day *et al.* 1989; Perillo 1995; Elliott and McLusky 2002), does not end at the down-estuary excursion of X2 nor at the upstream end of salinity intrusion.

A good effects analysis depends on a thorough understanding of the ecology of all covered species, including their vulnerability to further changes in ecosystem processes and trade-offs among different conservation measures. As just one example, both the historic, anthropogenically-driven and the proposed future BDCP changes are comparatively dismissed for ESA listed Sacramento River/Central Valley winter, fall and late-fall, and spring run Chinook salmon despite the fact that their vulnerability to hydrological changes and wetland losses, and unknown response to BDCP conservation measures, should be a critical subject of this HCP. Whether this is because they (particularly the ocean-type, sub-yearling components) are questionably assumed to "…be in the Plan Area for a relatively short period of time" or the Plan Area is not indicative of the dependence of these ESU and life-history types on much larger landscape scales is unclear. That they represent at-risk populations that are tightly linked to wetland, detritus-based food webs and rear in lower floodplain and tidal regions of the Delta (Williams 2006; Miller *et al.* 2010) would argue for expansion, not restriction, of the ecological scope and landscape scale of the Effects Analysis. Accordingly, the Effects Analysis would benefit from expanded descriptions of the ecological settings and interactions, and particularly spatial and temporal variability, of all listed species in an appropriately expanded Plan Area.

In the absence of seeing any of the other appendices beyond Appendix B: Entrainment, it is unclear to the Panel whether the proposed Habitat Restoration or Fish Population Analysis appendices will take a more comprehensive ecological approach; the topical descriptions provided to the Panel do not suggest so. The potential ecosystems effects of the BDCP cannot be assessed rigorously without considering all ramifications of not only the mitigation/compensation measures (e.g., entrainment) and changes in management of water diversion, but also restoration, habitat management and other conservation actions at the Delta-San Francisco Bay system scale-consistent with the distribution and ecology of the covered species. Thus, in the case of anadromous salmonids, even historic, proposed and anticipated future changes in the watersheds need to be taken into explicit consideration.

While these ecological context sections of the Conceptual Foundation and Analytical Framework provide optimistic hints of guidance to the Effects Analysis, there is considerable room for improvement. For instance, even though there is not an ESA requirement, a useful approach in many HCPs is to relate the plan to historical conditions as a baseline to which the effects of proposed management and conservation measures can be compared. Other than entrainment, the present draft Effects Analysis does not specifically identify what BDCP conservation measures would be evaluated relative to historical conditions. Does this presume that the "regime shift" proposed by the POD investigators (Baxter *et al.* 2010) is generic across all the Bay-Delta ecosystems and ecological processes? If not, what degraded processes can be managed to improve conditions for listed species and the broader ecological states and processes? As mentioned previously, it is unclear whether the POD paradigm is appropriately characterizing the suite of alternatives and opportunities for Effects

Analysis or whether the BDCP can apply management and conservation to move some degraded conditions and processes back toward a historical baseline.

To better characterize change from that historical baseline, the Effects Analysis could be more comprehensive in qualifying and quantifying anthropogenic changes beyond just land use. We realize that some of this background is effectively covered in the BDCP, but the Panel believes that because the Effects Analysis should be a stand-alone document, the changes most relevant to assessing BDCP effects on listed species needs to be reiterated with focus on those changes that the BDCP management and conservation measures can address. This would be most effectively linked to BDCP management and conservation measures if presented as an 'anthropogenic drivers' assessment that identifies the ecological conditions and processes, and their external drivers, that have changed extensively, and specifically those that BDCP proposes to address. An example of such a deficiency in the current Effects Analysis (although it might ultimately appear in the future Flow, Passage, Temperature and Salinity appendix, but that appears to be narrowly restricted to fish movement) is the need for historical hydrology and sources of change to unaltered historical patterns. This should include expanded discussion about the watershed characteristics of the major rivers nourishing the Delta, and how watershed differences and changes are manifested in water quality, sediment loading, and other water quality characteristics in the San Joaquin and Sacramento rivers flows (e.g., Table 1, Monsen *et al.* 2007).

Similar to the desirability of this historical context to realistic BDCP conservation measures, the Effects Analysis needs to expand the effects of predictable future conditions beyond only climate change. The likely effects of future changes in anthropogenic drivers of the supplies of unpolluted water, land, sediments and other elemental resources that support ecological processes and functions in the Bay-Delta also need to be explicitly included in the Effects Analysis. As a start, Fig. A-8 could be expanded or replicated to at least characterize likely future changes in these anthropogenic drivers.

Recommendation 7: Adaptive management needs to be an explicit process in the Effects Analysis to deal with fundamental uncertainties. (The comments below directly address the Charge to the Panel questions 10, 20 and 24, above)

The Panel believes that an essential part of the Effects Analysis is to evaluate where uncertainty exists within the analysis because this information should be considered when developing adaptive limits associated with the adaptive management framework. Highly uncertain outcomes should be associated with a broader range of potential corrective actions that may be triggered under the adaptive management plan in order to achieve the predefined objectives and goals of the program. In other words, the adaptive limits of the adaptive management plan should be less constrained to achieved objectives and goals if the Effects Analysis indicates a highly uncertain outcome. Given the extensive uncertainties in not only the predictable responses of covered species to BDCP management actions and conservation measures, but also the cumulative effects among species and ecological functions of the broader Bay-Delta system, adaptive management needs to be applied rigorously within the Effects Analysis as well as in the implementation of the BDCP. This requires that, paralleling the BDCP, Appendix A contain an explicit and detailed adaptive management plan that describes how alternative management and conservation actions will be assessed individually and cumulatively. Adaptive management needs to be integrated into both planning and implementation, and science is the key to that integration (Noss *et al.* 1997).

For example, assessing the importance of uncertainties in the appropriate spatial and temporal scales to consider interactions among management and implementation actions (see Recommendation 8, below) is not just the purview of the BDCP implementation. It should be integrated into the Effects Analysis planning and evaluation process as well, preferably in an adaptive management framework (Noss *et al.* 1997). A non-adaptive 'linear comprehensive management' (Bailey 1982; Noss and Cooperrider 1994) approach to spatial scales "*assumes that knowledge about ecosystems and effects of humans on them can be extrapolated across large regions*" and "*bases management on assumptions that effects are local*" and temporal scales "*assumes that effects of human activities on ecosystems are generally short-term and reversible*". Conversely, in an adaptive management framework, spatial scales should consider that *"…all ecosystems are connected and that local actions can have major effects on other or larger regions up to the global*" and that temporal scales recognize that *"…effects of human activities may be long-term and/or have time lags before effects are observed*" (Noss *et al.* 1997).

While adaptive management applied to implementation will presumably be used to evaluate species and other ecosystem responses to actual operational experiments, and used to modify BDCP practices and actions, planning is more limited. However, the ability of hydrodynamic and other models to evaluate alternate scenarios in water flow into, across and out of the Delta, as well as BDCP conservation actions that will modify those and related ecosystem processes, can provide the mechanism to adaptively assess trade-offs among the scenarios. However, the Panel can imagine scenarios where effects will be difficult to quantify with reasonable certainty, and therefore little change is implemented or additional water is allowed for export because monitoring cannot detect a potential adverse effect.

Likewise, uncertain outcomes should be accompanied by a more rigorous monitoring program as a means to reduce uncertainty in the actual measured effects of the implemented project on viability of each covered species. Identification of uncertainty in project outcomes during the effects analysis stage of conservation planning can be an important tool for guiding the overall strategy to achieve projective objectives and goals (once they are defined), and for identifying specific monitoring needs.

Approach and Analysis

Recommendation 8: The Effects Analysis needs to address temporal and spatial scales more comprehensively and appropriately. (The comments below directly address the Charge to the Panel questions 3, 4, 5, 7, 8, 10, 14, and 20, above)

Timing and Sequence of Conservation Actions

The order and timing of the conservation acts could have an effect on the overall benefits of the Plan to a covered species. For example, a covered species could sustain additional population declines before some of the conservation acts are fully implemented. As a consequence, timing of the actions could affect abundance levels in the near term and the ability of populations to respond to the eventual implementation of the conservation acts in the future.

Currently, assessment of the Plan's effects on covered species is based on the assumption that all conservation acts are implemented simultaneously at the end of the 50-yr plan and under prevailing population conditions. However, prevailing conditions at the time of implementation may differ from present. Trajectories of the anticipated population responses over time may also differ between species, resulting in unexpected synergistic effects that could impede recovery. For example, the benefits of habitat restoration on recruitment may be mitigated by delays in predator control. A sensitivity analysis is recommended to assess the effects of order and timing of conservation acts on species responses to the Plan. Any time-critical or order-sensitive conservation acts should be identified and prioritized. A feedback loop should be established that monitors implementation of any time-sensitive conservation acts.

The BDCP lists 19 specific conservation actions, some of which are specific spatial modifications of the Delta ecosystem structure and function, others of which might be considered temporary enhancements of the population dynamics of specific listed species. The Conceptual Foundation and Analytical Framework have yet to develop a framework in which the Panel can understand the overall management impact of these conservation actions. Many of the actions will have large magnitude effects on the ecosystem, such as the modification of flow regimes resulting from a North Delta pumping station or the large-scale restoration of tidal habitat. The impact of other actions is dependent on the scope and frequency of management itself, such as predator control and submerged aquatic vegetation removal. The timing, frequency, and magnitude of the conservation actions need to be explicitly developed. What will be the order of their implementation; for actions like predator control, what will be the extent, frequency and magnitude of their implementation? Without this type of a framework, the BDCP becomes difficult to assess.

An aspect of the framework implementing these management actions also needs to address non-monotonic changes in these actions over long time periods. For example, restoring tidal wetlands will not only change flow and tidal amplitudes, plants invading the newly opened sites will continuously change in composition and dominance for decades. Plus, their impact on the wetland will change as organic matter builds up and supports larger and more complex invertebrate and microbial populations. The models in the analytical framework suggest a stepwise shift in conditions, in contrast to the multiple dimensions and trajectories involved in tidal wetland restorations.

Ecosystem processes, whether physical or biotic, have multiple spatial and temporal dimensions. These conservation actions will have multiple spatial and temporal impacts. The BDCP is a large-scale ecosystem management project that involves manipulations at a variety of scales. Some of the conservation actions make permanent modifications of physical setting of the Delta system, modifications that consequently affect most ecological processes that would affect aquatic organisms. Organisms respond to a pattern of processes with temporal and spatial dimensions, not merely to the magnitude or to the extremes. In terrestrial habitats an example might be the fire regime of vegetation, sensitive to variations of frequency, type or season (Whelan 1995), while in aquatic systems like the Delta, flow rates of water, nutrients, and levels and duration of salinity all combine to encompass the limits of particular species (Keddy 2010). Assessing the conservation actions individually is critical to determining whether thresholds for the maintenance of a particular species' populations are crossed due to those actions. However, assessing the effects of the conservation actions should reflect not just those actions individually, nor adding up the individual plus/minus effects to some artificial index, but also assessing the sequence and cumulative impact of the conservation actions. By that, the Panel means that different conservation actions may synergistically enhance or cancel their individual effects, and assessment modeling needs to incorporate multiple actions simultaneously. For example, in the last two years, i.e., 2009–2010, acoustic-tag data on Chinook salmon shows the survival through the Old River has been higher than in the San Joaquin River. Among the fish that survived through the Old River to Chipps Island, the vast majority are salvaged fish. Hence, the salvage program that transports the smolts and thereby reduces their exposure to in-river predators may currently be an important avenue of migration (SJRGA 2011).

Complex aquatic systems like the Bay-Delta system may exhibit alternative stable states; small variations in the sequence or magnitude of environmental events like these management actions may push the ecosystem from one 'state' to another (e.g. Beisner *et al.* 2003, Knowlton 2004, Shurin *et al.* 2004, Didham and Watts 2005). The Delta has already been greatly modified that some have suggested it has shifted to an alternative stable state (BDCP Science Advisors 2007). Considering the environmental adversity created in the Delta by water removal, levee construction and loss of wetlands, high predator density and other changes, this strongly abiotically and disturbance structured system may resist simple restoration attempts (Didham and Watts 2005). The implementation of these multiple management actions in the BDCP may synergistically interact or inhibit one another, unknowns that are not considered in the models presented in the analytical framework.

Spatial and Temporal Scales Appropriate to Important Ecological Processes

As mentioned in the Introduction and Recommendation 6, the spatial scales linking ecological processes to function in the Bay-Delta do not appear to be embraced in the Effects Analysis. Neither are the temporal scales likely to encompass many of the responses to proposed BDCP conservation actions. Both of these deficiencies argue even more for the need for explicit adaptive management in the Effects Analysis process (see Recommendation 7).

Both the processes and the respondents (e.g., covered species) interact over various spatial scales that should be clearly framed in conceptual models and evaluated in numerical models, monitoring or even targeted special studies (e.g., short-term experiments). The hydrological interactions among conservation measures is perhaps the keystone example, where alternative designs and operations of water export in the north Delta not only have both near-field and far-field effects relative to entrainment (see Recommendation 11) but potentially extensive and cumulative far-field effects to multiple conservation actions lower in the estuarine gradient. How will the Effects Analysis evaluate these complex interactions? The future ecological performance of existing Delta features, such as the Yolo Bypass, that already support listed species may be impacted, not to mention the future BDCP conservation measures.

The Effects Analysis should also be proactive in assessing the realistic timeframes that should be expected for ecosystem responses to the various conservation actions, especially given the prognosis for significant future changes in many natural forcing factors. For instance, obvious uncertainties are associated with the time required for floodplain and tidal wetland restoration actions to become fully functional and it is not unreasonable to expect even the most progressive wetland restoration to take much longer than the 50-year Effects Analysis timeframe to achieve complete functionality (Williams and Orr 2002). Given that uncertainty, how will the Effects Analysis develop the diagnostics (targets, indicators, triggers) that should be used in an adaptive management approach that evaluates alternative management and conservation measures to ensure that they would at least be on the trajectory to functionality beyond 50 years? Furthermore, how will evaluation of the long-term response of conservation measures objectively incorporate future changes in forcing conditions and resources, such as suspended sediments, that already appear to be diminishing (e.g., McKee *et al.* 2006). Climate mediated changes in the timing and temperature of water delivered to the broader Bay-Delta system have similar implications for the need to explicitly project how conservation actions could be expected to perform under BCDP management scenarios.

Recommendation 9: Analyses of the individual actions need to be scaled to an integrative analysis that includes <u>all</u> relevant conservation measures of the 19 possible. The comments below directly address the Charge to the Panel questions 16 and 19, above)

The Panel is unclear as to how the Effects Analysis will deal with the complex interactions that are likely to occur among some or most of the proposed categories of conservation measures. For example, Appendix B does not consider the effects of other conservation measures that are occurring simultaneously (and vice versa). Nor does it explicitly describe which of the conservation measures are considered within the analysis or what assumptions have been made related to the interaction between or among conversation measures and their effect on entrainment. The analysis in Appendix B places a strong focus on the South Delta pumps, but does not adequately address entrainment in a new North Delta facility. The entrainment analysis needs to describe in detail how changes in the <u>overall</u> Delta geometry configuration was incorporated into DSM2 used for modeling hydrology under future conditions. It is also equivocal how water export operations and intra- and interannual variability of environmental conditions are taken into account cumulatively. Conservation actions particularly vulnerable to further quantity, temporal or spatial changes in hydrology, such as floodplain and tidal wetland restoration, need to be examined under all water management scenarios; will estuarine wetland restoration actions be potentially constrained by water export in the northern Delta, differently than they have performed under current (south Delta export) conditions? Because not all conservation measures are relevant, it would be helpful to include a table or interaction matrix that illustrates the relevant conservation measures that should logically be included for each individual (appendix) analysis.

Recommendation 10: **Factors used in model evaluation (e.g., Table A-11) should be expanded to consider the robustness of the model results and the proximity of the model predictions to population level effects.** The comments below directly address the Charge to the Panel questions 21, 22, 23, and 24, above)

The current weighting factors for model results include the following (Table A-11):

a. Scientific credibility
b. Usage
c. Strength of conclusions
d. Variability of results

We believe those weighting factors can be improved upon. Peer-reviewed methods (i.e., scientific credibility) are not a good criterion, *per se*, for weighting. For example, statistical methods peer-reviewed in a biological journal may not have received the same rigor of review as methods in statistical journals, and vice versa. Similarly, frequency of usage may not be a reliable criterion. Methods can be institutionalized by repetition within closed scientific communities, not because they are correct but, rather, because they are familiar.

Instead, we recommend weighting criteria should include the strength of conclusions, robustness of results (i.e., variability of results), and appropriateness of the predicted endpoints. Robustness should focus on whether decisions regarding the overall efficiency of the proposed conservation acts would change as a result of assumptions violations or alternative model input values. Ultimately, decisions need to address the possible advantageous or deleterious effects of the proposed Plan on the viability of covered species. This is the level at which robustness must be considered. A sensitivity analysis should be performed to determine the robustness of the Plan's outcomes under a range of model assumptions, environmental conditions, and performance.

Furthermore, models and methods that make inferences to the growth rate and viability of Delta populations should be given more credence than methods that make inferences only to specific life stages, migration processes, or subpopulations. Our recommendation that the effect assessments should be at a covered-species population-level implies a hierarchical weighting system that emphasizes population-level inferences. Lines of evidences that directly lead to population-level assessments should be weighted more than indirect assessments.

Models

Recommendation 11: More detail and specifics need to be incorporated into the descriptions of hydrodynamic and other physical model structure, calibration, assumptions, uncertainties, etc. (The comments below directly address the Charge to the Panel questions 8, 13, 18 and 21, above)

Flow is the master control variable for many of the model analyses throughout the Effects Analysis. As such, it is essential that the method of deriving the flow field be explicitly stated for each environmental model and that project and future changes in external forcing factors affecting flow (e.g., reservoir discharges) be explicitly incorporated.

As shown in Figure A-16, CALSIMII and DSM2 models will be the key drivers for flow information for the environmental models. Therefore, a description of the set-up of these models is essential. This description needs to include figures of the geometric configurations for the run and a reference to a calibration document that demonstrates that the model can be reliably run in these altered configurations associated with habitat restoration and other changes in the system's configuration. We recognize that the geometric configuration information is currently deemed to be sensitive information. However, hydrodynamic models may be sensitive to the placement of these habitats. The location of flooded islands can influence tidal ranges, salinity, and river source distribution both on a local and regional scale of the Delta.

The particle tracking modeling for Appendix B is a good example of why it is important to understand the underlying assumptions. For that analysis, the geometry for DSM2 was altered to reflect the future configurations (ELT and LLT) of the Delta. The DSM2 hydrodynamic model in a one-dimensional model that is calibrated for stage and flow to a specific geometry based on observational data. As was discussed in the Public Session (Deanna Sereno, Contra Costa Water District), for this BDCP analysis, the DSM2 model was re-calibrated for the altered geometric cases based on comparison with a multi-dimensional (UnTRIM? RMA?) hydrodynamic model of the Delta. There was no mention of this significant effort in the Appendices and no reference to a calibration document of this effort.

As a second example of flow assumptions in Appendix B, flow for the Old and Middle River (OMR) flow proportional entrainment regressions use data derived from CALSIMII simulations. However, CALSIMII does not directly provide flow information at Old and Middle Rivers. To get this flow field, "ORM flows can be approximated as about half of the San Joaquin River flows (fraction diverted into Old River near Mossdale) minus the SWP/CVP south Delta exports" (p. B-24). The use of the 50% estimation is a big assumption. The flow split could be better estimated using DSM2 runs or observational data in the region. Given that there already appears to be significant conflict between the Kimmerer (2008) and Miller (2011) results for these regressions, it seems essential to not add more uncertainty with gross estimations of flow in the region.

Because the panel is composed of scientists with very diverse backgrounds, not all the panelists will be able to review the subtle details of each model. We recommend that there be an independent peer review of all models used for the appendices by experts in those fields.

Conclusions

The Panel recognizes that designing an effects analysis of a multifaceted solution set to a very complex suite of stressors in a very large, intricate system is challenging, to say the least. We also consider that review and refinement of such an effects analysis requires an iterative process and recognize our role in that effort. In the case of the BDCP Effects Analysis, such an iterative, and hopefully adaptive, process will be particularly important because we found the present draft to be incomplete and fragmented, and our review premature. In the next draft of the Effects Analysis we hope that the following major issues will be addressed:

- The Effects Analysis requires clear focus, including specific objectives of the Analytical Framework. The framework needs to provide clear roadmap of how the Effects Analysis should be evaluated.
- Careful attention to the design of the "roll up" analysis is critical. This includes renaming the synthesis to reflect its goal – to synthesize effects of multiple factors (appendices) for each of the covered species.
- A system for documenting and uncertainties related to the analyses, including an objective means for evaluating available science, and clear identification of information gaps that should be the explicit focus of adaptive management.
- The Effects Analysis should move towards adopting a single "currency" for evaluating effects on covered species. This should be at the level of the population viability.
- The framework for evaluating model outputs needs to be reconsidered using metrics of model performance and stability over popularity.
- The Effects Analysis needs to include an integrative analysis of the impacts of implementation of multiple conservation measures on covered species. This must include an analysis of the timing of sequence of implementation of different conservation measures. The Effects Analysis should consider time scales beyond the present 50-year analysis, especially with respect to conservation measures such as wetland restoration, a centerpiece of the BDCP. The Effects Analysis also needs to consider whether the Conservation Acts will be implemented in a timely manner to avoid further declines of critical species before the project is completed.
- Analysis of future conditions, and particularly critical forcing factors that drive variability in the Bay-Delta's ecological processes, need to go beyond just climate change and BDCP conservation measures to include anthropomorphic demand for water, sediments and space.
- Overall, there needs to be better documentation of models and their underlying assumptions and known limitations.

- The consultants should develop a draft integration of results for one species that can be reviewed prior to the scheduled formal spring review. The panel will provide feedback which can then be integrated by the consultants into the next revision.
- We recognize that the BDCP and its associated Effects Analysis involve a very large and complex process. In our initial review, we raise many issues that suggest the findings of the Effects Analysis could be highly uncertain. The conceptual framework should more explicitly consider how uncertain analyses of effects will guide monitoring and filling of information gaps, and specific actions under the adaptive management plan.

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Appendix 1

BDCP Effects Analysis Science Review

Panel Members

Nancy Monsen – Delta Hydrodynamics, Stanford University

Dr. Monsen's research has focused on multi-dimensional hydrodynamic modeling of the Sacramento-San Joaquin Delta for the last sixteen years. Her PhD research was based on the TRIM3D hydrodynamic model. She also has consulting experience with the DELFT3d hydrodynamic model. She is a Research Associate in the Environmental Fluid Mechanics Laboratory, part of the Civil and Environmental Engineering Department, at Stanford University. Prior to working at Stanford, she worked for ESA PWA (formerly Philip Williams and Associates) for a year and a half and at the U.S. Geological Survey (Menlo Park, National Research Program) for ten years. Dr. Monsen earned her doctorate in Civil and Environmental Engineering at Stanford University.

Greg Ruggerone – Anadromous Fish

Dr. Ruggerone is senior scientist for anadromous fisheries studies and brings 30 years of experience in anadromous fisheries ecology and management to Natural Resources Consultants (NRC). He has investigated population dynamics, ecology, and management of Pacific salmon in Alaska and the Pacific Northwest since 1979. He was the Project Leader of the Alaska Salmon Program, University of Washington, from the mid-1980s to early 1990s where he was responsible for conducting and guiding research at the Chignik and Bristol Bay field stations, preparing salmon forecasts, and evaluating salmon management issues. Most of his research involves factors that affect survival of salmon in freshwater and marine habitats, including climate shifts, habitat degradation, predator-prey interactions, and hatchery/wild salmon interactions. He is currently a member of the Columbia River Independent Scientific Advisory Board and the Independent Scientific Review Panel. He recently served as the fish ecologist on the Secretary of Interior review of dam removal on the Klamath River. During the past six years, he has evaluated salmon fisheries throughout the North Pacific for sustainability using guidelines developed by the Marine Stewardship Council. He has conducted. Dr. Ruggerone received a Ph.D. in Fisheries from University of Washington in 1989. (http://www.nrccorp.com/staff/staff_ruggerone.htm)

Charles Simenstad – Pelagic/Native Fish

As a Research Professor at the School of Aquatic and Fishery Sciences, University of Washington, Prof. Charles ("Si") Simenstad investigates shallow-water community and food web structure, and restoration ecology, of estuarine and coastal marine ecosystems along the Pacific Northwest coast, from San Francisco Bay, the Oregon and Washington coasts, Puget Sound, and Alaska. Ecosystems that have especially attracted his interests include: coastal marshes, mudflats and eelgrass of Pacific

Northwest estuaries; nearshore, kelp-dominated shores of the Aleutian Islands, Alaska, and Puget Sound, Washington; and the complex estuarine wetlands of San Francisco Bay-Delta. Much of his recent research is involved in the Columbia River estuary, where he is particularly intrigued by ecological processes associated with estuarine turbidity maxima and the importance of brackish marshes and forested wetlands to the resilience of juvenile Pacific salmon. Much of this research has focused on the role of ecosystem structure and change, and the associated ecological (e.g., food web) interactions that are regulated by strong ecological interactions (e.g., keystone species such as sea otters), natural disturbance, or sensitivity to anthropogenic effects, such as wetland alteration. Si has also become increasingly interested in large-scale interactions across landscapes that alter fundamental ecosystem structure and processes at local scales, such as river flow diversion and regulation influences on estuarine communities and food webs, and the strategic planning of ecosystem restoration and preservation at different scales (http://fish.washington.edu/people/simenstd/)."

John Skalski – Fishery population dynamics and modeling

Dr. Skalski is a Professor of Biological Statistics in the School of Aquatic & Fishery Sciences, College of the Environment, at the University of Washington. He is also an adjunct professor in Quantitative Ecology and Resource Management and Wildlife Sciences, and an instructor in the Center for Quantitative Sciences. His expertise is in sampling theory, parameter estimation, mark-recapture theory, and population dynamics. His research focuses on the development of sampling methodology, field designs, and statistical tests for human-induced and natural effects on organismic and ecological systems. He is the statistician in charge of survival compliance testing at all 13 major hydroprojects in the Snake-Columbia River system. He has authored or coauthored over 100 technical reports on salmonid survival studies and over 40 peer-reviewed articles on tagging studies. Dr. Skalski is a member of the American Statistical Association, The Wildlife Society, and the American Fisheries Society. He is also a Certified Wildlife Biologist through The Wildlife Society.

Alex Parker – Aquatic Ecology/Food Webs

Dr. Parker is a Research Scientist at the Romberg Tiburon Center and holds adjunct appointments in the Departments of Biology at San Francisco State University and Santa Clara University. Dr. Parker completed his PhD work at the College of Marine Studies, and the University of Delaware studying microbial biogeochemistry in the Delaware Estuary. Dr. Parker's current research focus is related to nutrient effects on primary and secondary production in the San Francisco Estuary. Additionally, he is involved in projects in polar ecosystems and the equatorial Pacific Ocean.

Tom Parker, Plant Communities

Thomas Parker is Professor of Ecology and Evolution at San Francisco State University who studies the ecology and evolution of plant communities, focusing on their dynamics. Current research includes the effects of climate change on tidal wetlands of the San Francisco Bay-Delta, and the ecology and evolution of *Arctostaphylos* species in chaparral and other communities (http://bio.sfsu.edu/people/v-thomas).

T. Luke George, Terrestrial Ecology

Dr. George has been a faculty member in the Department of Wildlife at Humboldt State University since 1991. He specializes in the design, implementation, and analysis of demographic, population monitoring, and habitat selection studies of terrestrial vertebrates. His recent work has focused on estimating demographic parameters and modeling habit selection of threatened and at risk species including the San Clemente sage sparrow, northern spotted owl, greater sage grouse, and tricolored blackbird. Dr. George assisted with the development of a population viability analysis (PVA) of the San Clemente sage sparrow and has served as an advisor on PVAs of Western snowy plovers and San Clemente loggerhead shrikes. He has conducted research on habitat selection and space use of Steller's jays and common ravens in Redwood National and State Parks and has advised state and federal agencies on strategies to reduce nest predation by corvids on marbled murrelets, Western snowy plovers, and other threatened and endangered species in California.

Appendix 2

Scope of Work

DELTA SCIENCE PROGRAM

INDEPENDENT SCIENCE REVIEW

Bay-Delta Conservation Plan Effects Analysis

Conceptual Foundation and Analytical Framework and Technical Appendices

SCOPE AND Charge to Reviewers

BACKGROUND

The Bay Delta Conservation Plan (BDCP) is being prepared by the California Department of Water Resources and a group of water agencies, with the cooperation of state and federal agencies, and other interest groups. The BDCP is being developed to satisfy the Federal Endangered Species Act (ESA) and the California Natural Community Conservation Planning Act (NCCPA). When complete, the BDCP will provide the basis for issuing ESA and NCCPA permits for operations of the state and federal water projects. The plan would be implemented over 50 years. The BDCP Planning Agreement has the following planning goals:

- Provide for the conservation and management of Covered Species within the Planning Area;
- Preserve, restore and enhance aquatic, riparian and associated terrestrial natural communities and ecosystems that support Covered Species within the Planning Areas through conservation partnerships;
- Allow for projects to proceed that restore and protect water supply, water quality, and ecosystem health within a stable regulatory framework;
- Provide a means to implement Covered Activities in a manner that complies with applicable State and federal fish and wildlife protection and laws, including CESA and FESA, and other environmental laws, including CEQA and NEPA;
- Provide a basis for permits necessary to lawfully take Covered Species;
- Provide a comprehensive means to coordinate and standardize mitigation and compensation requirements for Covered Activities within the Planning Area;
- Provide a less costly, more efficient project review process which results in greater conservation values than project-by-project, species-by-species review; and
- Provide clear expectations and regulatory assurances regarding Covered Activities occurring within the Planning Area.

The BDCP Working Draft was released November 18, 2010 without a detailed effects analysis. The effects analysis, a critical component for the BDCP, is intended to provide the best scientific assessment of the likely effects of BDCP actions on the species of concern, and ecological processes of the Bay-Delta system. The effects analysis will, out of necessity, rely heavily on the application of models to quantify the likely results of the plan. These will include conceptual, numerical, hydrodynamic, operational, and species models. The BDCP effects analysis is being conducted and documented through a series of technical appendices centered around common stressors or groups of similar effects. The first appendix, Conceptual Foundation and Analytical Framework (Foundation and Framework), describes the high-level vision, purpose, and regulatory foundation for the effects analysis. It also provides an overview of the proposed methods to accomplish the analysis. The next technical appendices are as follows (the title or specific content of each appendix may change):

- **Entrainment.** A synthesis of the relevant analyses related to entrainment of the covered fish.
- **Flow, Passage, Temperature, and Salinity.** A synthesis of the effects of BDCP actions on flow in the Delta and effects, in turn, on fish passage, salinity, turbidity, dissolved oxygen, and temperature.
- **Toxics.** A synthesis of the effects related to metals and pesticides.
- **Habitat Restoration.** An analysis of the potential effects of the proposed habitat restoration on physical parameters that, in turn, affect covered fish.
- **Ecological Effects.** An assessment of biological factors that affect the ecosystem that are not specific to covered fish, including predation, food supply, and submerged aquatic vegetation.
- **Fish Population Analysis.** A "roll-up" of the effects described in all of the previous appendices to describe the overall effects of BDCP on species and populations.
- **Terrestrial Species.** An assessment of the effects of BDCP action on all of the non-fish covered species and associated natural communities.
- **Analyses Not Used.** A summary of the methods used in earlier versions of the effects analysis or used during the current effort, but not retained in BDCP, and why.

The first phase of the review will cover the Foundation and Framework and the Entrainment Appendix (Appendix B). The second phase of the review will cover the BDCP chapter that summarizes the effects analyses and the remaining technical appendices.

INDEPENDENT SCIENCE REVIEW PANEL

The BDCP participants have requested an initial independent scientific review of 1) the draft Foundation and Framework, and 2) the Entrainment Technical Appendix to assess their scientific soundness. An Independent Science Review Panel (Panel) will initially convene to review the Foundation and Framework to ensure it is of sufficient robustness and scientific quality to serve its intended purposes, and will review Appendix B as an example of the application of the conceptual understanding, methods and analyses discussed in the Foundation and Framework.

The BDCP participants also envision that the Panel will reconvene on occasion to evaluate the results of the Foundation and Framework for covered terrestrial and aquatic species. BDCP participants expect that a scientifically sound and feasible Foundation and Framework will enable an assessment of the likely effects of BDCP water management and ecosystem restoration conservation measures. At a subsequent meeting, the Panel will likely assess how well the Foundation and Framework performed in achieving its goals and objectives.

CONCEPTUAL FOUNDATION AND ANALYTICAL FRAMEWORK PURPOSE AND SCOPE

A conceptual foundation is a set of scientific theories, principles, and assumptions that describe how an ecosystem functions. The conceptual foundation determines how information is interpreted, what problems are identified, and as a consequence, the range of appropriate solutions. For the BDCP, the conceptual foundation is the scientific outline of the biological effects analysis that guides how the analysis is organized and displayed. The Analytical Framework describes the general methodology and structure of the analysis of the effects of the BDCP on the covered aquatic species. The purpose of the Analytical Framework is to provide a general scheme and logic for the effects analysis. Major tools and models that are likely to be used in the analysis are discussed; additional tools and detailed methodologies will be discussed in each appendix relating to a stressor category. The intent of the Analytical Framework is to lay out a general approach to the analysis of the effects of BDCP actions.

TIMELINE (Contract Covers Phase 1)

<u>October 2011</u>

The panel convenes in Sacramento to discuss the Foundation and Framework and Entrainment Technical Appendix and to make initial recommendations.

<u>November 2011</u>

Phase 1 panel report completed.

<u>March 2012</u>

The panel reconvenes in Sacramento to discuss both the BDCP chapter that summarizes the effects analysis and the remaining technical appendices.

<u>April 2012</u>

Panel report completed.

General Statement of Work – Phase 1

The panel will address the Phase 1 work in three stages.

1. The panel will review and analyze the reports and background materials related to the BDCP Effects Analysis in the context of the questions presented in the Charge to the Panel.
2. The panel will attend a technical meeting spanning three days in Sacramento, California, to discuss the review materials.
3. The panel will prepare a report of its findings with respect to the questions posed in the Charge. Each panelist will assist in conceptualizing, writing, and editing the oral and written reviews by responding to the issues and questions identified in the Charge.

Tasks to Be Accomplished by the Panel

Task 1: Read the review materials and supporting information identified in the Charge.

Task 2: Review Meeting

Task 2a: Participate in and offer professional insights during the meeting spanning three days to be held in Sacramento, California.

Task 2b: Contribute to the coordinated development of preliminary findings and assessments to be presented at the meeting.

Task 3: Draft initial recommendations

Task 4: Participate in the coordinated development of the Panel review report that responds to the issues and questions identified in the Charge.

Additional Tasks for Panel Chair (Alex Parker) and Lead Author (Si Simenstad)

One member of the panel will be selected to be the chair and one member will be selected to act as lead author.

Task 5: The Chair will coordinate communications within the panel during the review process, lead the deliberations of the panel during the meeting, and organize the work of the panel.

Task 6: The Lead Author will develop the structure of the panel's report, assemble individual panel contributions into the panel's report, and format and edit the final report.

Deliverables and Timeline- Phase 1

Task 1: October 25, 2011

Read and review all background material identified in the Charge.

Task 2a and 2b: 1:00 PM October 25- 12:00 PM October 27, 2011

Attend and participate in the panel meeting in Sacramento, CA.

Task 3: October 26, 2011

Present preliminary findings and recommendations at the meeting.

Task 4: November 26, 2011

The final review report, co-authored by all panel members, is due no later than 30 days after the meeting.

Guidelines for reports:
The report is expected to directly address the questions identified in the Charge. Format for the report is at the discretion of the panel; however, it is requested that the report contain a concise executive summary and a table of contents if the report is lengthy.

Representatives and Contact Information

DSP Contract Manager

Sam Harader

Delta Science Program,
980 Ninth St, Suite 1500, Sacramento CA 95814
(916) 445-5466
Sam.Harader@deltacouncil.ca.gov

Location of Work

Location for Tasks 1, 4, 5, and 6 are at Contractor's discretion. Contractor will provide all necessary working space, equipment and logistical support. No travel or per diem will be reimbursed for Tasks 1, 4, 5, and 6.

Tasks 2 and 3 will be carried out in Sacramento, California. The DSP will provide meeting space, computer equipment, and logistical support. Travel and per diem will be reimbursed for Task 2.

Exhibit A, Attachment 1

Charge to the Delta Science Program Independent Review Panel for the Phase 1 of the BDCP Effects Analysis Review

The Panel will be charged with assessing the scientific quality of the Foundation and Framework (Appendix A) and Entrainment Effects (Appendix B). The Panel will make recommendations for how these might be improved with respect to achieving their stated goals. Specific attention will be applied to the following questions:

Conceptual Foundation and Analytical Framework

1. How well are the purpose and scope of the Foundation and Framework defined and described?
2. How well will the Foundation and Framework, as designed, meet its major goals?
3. How effectively does the Foundation and Framework describe the key elements of the ecological context of the BDCP? (details of the ecological context are found in Chapter 2 of the plan)
4. Are the Foundation and Framework internally consistent and scientifically valid?
5. How well does the Foundation and Framework provide an approach for analyzing the effects of BDCP?
6. Does the Foundation and Framework adequately describe how quantitative and conceptual models will be used? Is the approach integrated, reasonable and scientifically defensible?
7. How well is the approach to analyze individual covered activities, including all conservation measures, as well as the cumulative impacts of a comprehensive strategy described?
8. How well does the proposed Framework integrate analysis at various spatial and temporal scales?
9. How well does the Foundation and Framework articulate how best available science will be defined, assembled, summarized and integrated into the analysis?
10. How clearly does the Foundation and Framework identify baseline(s) or other reference points (e.g., goals and objectives) for the effects analysis?
11. How well does the Foundation and Framework describe how uncertainty will be addressed? How could it be improved?
12. How well does the Foundation and Framework describe the link between the adaptive management and the associated monitoring program and the effects analysis?

13. Does the Foundation and Framework describe the appropriate suite of models that should be used?
14. How well does the Foundation and Framework describe how conflicting model results and analyses will be interpreted in the technical appendices?
15. How complete is the Foundation and Framework; how clearly is it described?
16. How well are the methods described to synthesize effects at the species, population, and ecosystem levels? (Note: The description of the "roll-up" methods are still in development and will not be included in the Framework in time for this review. Additional details may be provided during the consultant presentation at the first workshop.)

Technical Appendix

1. How well are the proposed analytical tools defined, discussed and integrated?
2. How clear and reasonable is the scale of analysis?
3. How well are the models and analyses interpreted and summarized?
4. How well was the vision of the Foundation and Framework applied in the technical appendix/analysis (i.e., the Entrainment Appendix)? How consistently was it applied?
5. How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?
6. Were the appropriate models used in the technical appendix? Were model results interpreted correctly? If model results conflicted, were appropriate interpretations made?
7. How rigorous of an analysis did the technical appendix provide for evaluating the effects of potential BDCP conservation measures on the specified variable(s)?
8. Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?

REVIEW MATERIALS

- Working Draft Conceptual Foundation and Analytical Framework Appendix
- Working Draft Entrainment Technical Appendix

SUPPORTING INFORMATION

- Highlights of the BDCP (December 2010) (http://resources.ca.gov/docs/Highlights_of_the_BDCP_FINAL_12-14-10_2361.pdf)
- BDCP Working Draft (2010) (http://baydeltaconservationplan.com/BDCPPlanningProcess/ReadDraftPlan/ReadDraftPlan_copy1.aspx)

- NRC 2011 Panel Report - A Review of the Use of Science and Adaptive Management In California's Draft Bay Delta Conservation Plan (http://www.nap.edu/openbook.php?record_id=13148&page=33)
- Science Advisors Draft Report on BDCP Goals and Objectives for Covered Fish Species (http://baydeltaconservationplan.com/Libraries/2011_Working_Groups/6-16-11_Draft_Final_BDCP_G_O_Science_Advisors_Report.sflb.ashx)
- Regulatory Framework for the BDCP Effects Analysis Relating to Species and Habitat Covered by the Plan and Incidental Take Permits

Appendix 3

DELTA SCIENCE PROGRAM

INDEPENDENT SCIENCE REVIEW

Bay Delta Conservation Plan (BDCP) Effects Analysis Conceptual Foundation and Analytical Framework and Entrainment Appendix

October 25-26, 2011

Meeting Location:
The Pagoda Building
429 J Street
Sacramento, CA 95814

PURPOSE
An Independent Science Review Panel will initially convene to review the BDCP Effects Analysis Conceptual Foundation and Analytical Framework to ensure it is of sufficient robustness and scientific quality to serve its intended purposes, and will review the Entrainment Technical Appendix as an example of the application of the conceptual understanding, methods and analyses discussed in the Foundation and Framework.
AGENDA

Order of agenda items and listed times are subject to change

TUESDAY - October 25, 2011

1. Opening Remarks — 1:00 – 1:30 P.M.
    - Welcome and Overview of the Review – Delta Science Program
    - Introduction to the BDCP – Federico Barajas, U.S. Bureau of Reclamation and Dale Hoffman-Floerke, CA Department of Water Resources

2. BDCP Effects Analysis Presentations — 1:30 – 3:30 P.M.
    - Fish Agency Perspective on Independent Science Review – Steve Culberson, Ph.D., U.S. Fish and Wildlife Service
    - Effects Analysis Regulatory Framework – David Zippin, Ph.D., BDCP Program Manager and Habitat Conservation Planning and Implementation Practice Leader, ICF
    - Conceptual Foundation/Analytical Framework (Appendix A) – Chip McConnaha, Ph.D., Principal and Ecosystem Biometrics Practice Leader, ICF
    - Entrainment Appendix (Appendix B) – Marin Greenwood, Ph.D., Aquatic Ecologist, ICF
    - Concepts for Roll-up – Chip McConnaha, Ph.D., ICF and Marin Greenwood, Ph.D., ICF

3. Discussion 3:30 – 5:00 P.M.
   - Panel and Presenter Round Table Question and Answer Period

4. Public Comment on the Science Review 5:00 – 5:30 P.M.
   - Public comment will be limited to 3 minutes per speaker. Comments must be relevant to the present science review.

WEDNESDAY - October 26, 2011

1. Review Panel Deliberation 8:30 A.M. - 12:00 P.M.

(Review Panel Only)

- Discuss the review materials
- Craft initial recommendations

Lunch 12:00 – 1:00 P.M.

2. Review Panel Deliberation (continued)

(Review Panel Only) 1:00-3:00 P.M.

- Finalize initial recommendations
- Plan presentation

3. Initial Recommendation from the Review Panel 3:00 – 4:30 P.M.

- Present initial findings and recommendations (Review Panel)
- Discuss findings (Review Panel and Presenters from the Previous Day)

4. Public Comment on the Science Review 4:30 – 5:00 P.M.

- Public comment will be limited to 3 minutes per speaker. Comments must be relevant to the present science review.

Adjourn 5:00 P.M.

Appendix 4

Panel Charge	Recommendation										
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