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**An Independent Peer Review of the  
Central Valley Project and State Water Project  
Operations, Criteria and Plan Biological Assessment  
and the  
NMFS Biological Opinion**

**Independent Peer Review for the Center for Independent Experts**

Prepared for NTVI

By

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**January 21, 2009**

## Executive Summary

This review pertained to the Central Valley Project and the State Water Program of California's Central Valley. I reviewed the data provided in the Central Valley Project and State Water Project Operations, Criteria and Plan (OCAP) Biological Assessment (BA) and the NMFS Biological Opinion (BO) to determine whether NMFS adequately assessed the individual responses of fish to certain effects (*i.e.*, flows, water temperatures, diversions, *etc.*) and whether the best available information was used by NMFS on how fish are likely to respond to those impacts.

The BA and BO are complex, comprehensive documents that meet the requirements of ESA for assessing jeopardy to the listed species in question. The review included a listing of important editorial comments and suggestions, followed by responses to the review terms of reference. A large number of comments on the technical aspects of the documents were presented in the review.

Most of my review comments will primarily serve to strengthen these documents. However, it is very unlikely that incorporation of my suggestions and comments will change the conclusions of the BO because it is sufficiently organized, documented, and substantiated to support the ultimate findings relative to the requirements of the ESA, as described in Section 10.0. When the BO is completed, and if the recommendations listed above are incorporated into the BA and/or BO as appropriate, these documents will form a more rigorous basis for the formal ESA conclusions.

## Introduction

### Background

This review pertained to the Central Valley Project and the State Water Program of California's Central Valley. I reviewed the data provided in the Central Valley Project and State Water Project Operations, Criteria and Plan (OCAP) Biological Assessment (BA) and the NMFS Biological Opinion (BO) to determine whether NMFS adequately assessed the individual responses of fish to certain effects (*i.e.*, flows, water temperatures, diversions, *etc.*) and whether the best available information was used by NMFS on how fish are likely to respond to those impacts. The purpose of this independent review is to evaluate and comment on the use of the best available scientific and commercial information as it pertains to the development of the 2008 NMFS BO on OCAP. I evaluated and commented on the technical information, models, analyses, results and assumptions in the proposed OCAP that form the basis for the assessment in the BO.

**Terms of Reference** – The Terms of Reference of this review are as follows:

- Are the technical tools used in the NMFS OCAP BO (*e.g.*, modeling, calculations, analytical and assessment techniques) able to determine impacts to the individuals and to the populations?

- Are assumptions clearly stated and reasonable based on current scientific thinking?
- Do the biological assessment and BO adequately assess the individual responses of fish to certain effects (*i.e.*, flows, water temperatures, diversions, *etc.*) and was the best available information used by NMFS to evaluate how fish are likely to respond to those impacts.
- Do the data, analyses, results, and conclusions presented lead to a thorough understanding of the risks to individuals and populations from the proposed project impacts? If not, what relevant scientific information should be considered?
- Are the analytical techniques capable of determining the significance of project impacts for Endangered Species Act (ESA) purposes? If not, what additional or alternative analytical techniques are recommended? What *available* science should be used to best address the impacts of this large-scale water project as examined in the BO?
- Were uncertainties considered in the BO? If so, were they described in a way that frames the data or puts it in the proper perspective (*e.g.*, the appropriate time scale, or the likelihood that an event will happen)? What uncertainties and limitations were not addressed that might impact the BO substantively?
- In the absence of available information to establish probable responses to impacts (*e.g.*, survival across the Delta, steelhead population estimates, steelhead losses at the Delta pumps, spring-run Chinook salmon populations above Red Bluff Diversion Dam), were reasonable scenarios developed to identify types of exposures? Were comparisons made to other species with similar impacts?
- Were relevant published and unpublished studies on ESA-listed fish species, similar species, ecological theory, and computer simulation/modeling missed?
- Was evidence provided to support conclusions relative to species responses to demographic changes (*e.g.*, changes in fecundity rates, changes in growth rates for individuals, and changes in numbers of individuals that immigrate or emigrate from populations)? Was evidence provided to support the conclusions about how the proposed actions affect the species' demographics?
- Further Purposes of the Review -- In addition to answering the fundamental questions posed above, another intended use of this review is to help ensure that best available information is used for future ESA consultations, such as early consultation components for OCAP, and the South Delta Improvement Program. Reviewers shall address possible inadequacies in the NMFS BO (*i.e.*, Did the BO apply the available information in a scientifically sound manner?).

## **Description of Review Activities**

The size and extent of the BO and BA precluded careful reading of every page in the time allotted. I therefore used a strategy of focusing on critical sections, especially with regard to the terms of reference, and skimming the rest, or searching for important aspects in the large volumes of text. Likewise I only reviewed ancillary materials when they were deemed important to identifying weaknesses or satisfying the terms of reference.

#### Items reviewed:

1. Draft Biological Opinion on the long-term Central Valley Project and State Water Project Operations Criteria and Plan. National Marine Fisheries Service December 2008.
  - a. *BO Introductions – Sections 1.0 through 3.0*
  - b. *Section 4 – some portions studied for review and familiarity. (It should be noted than any comments by me relative to green sturgeon are based on the assumption that the southern DPS was in fact found to be at risk of extinction – since sections 4.2.3.3 & 4 are incomplete in the BO.)*
  - c. *Sections 5-9*
2. Long-term Central Valley Project and State Water Project Operations Criteria and Plan – Biological Assessment, including appendices. US Bureau of Reclamation. April 29, 2008.
  - a. *BA Chapter 2 – Tried to digest - the Operational Plan is too complex for complete understanding, in a brief review, by an expert from outside the CV area.*
  - b. *BA Chapters 4, 6, and 8 - Skimmed*
  - c. *BA Chapter 9 – Reviewed carefully*
  - d. *BA Chapter 10-13 – Studied as necessary*
  - e. *BA Appendices D – R – Studied as necessary*
3. Reviews of the 2004 Biological Opinion (4 documents ~ 75 pages) – *Only referred briefly to several of these*
4. Background information on the ESA and NMFS' responsibilities for implementing the ESA is available from the NMFS Office of Protected Resources web site at:  
<http://www.nmfs.noaa.gov/pr/laws/esa.htm>. -- *Quickly reviewed some sections of this*

### **Summary of Findings in accordance to the Terms of Reference**

Overall, the BO and BA, and their appendices, are extremely comprehensive and thorough documents that cover an incredible amount of technical information for this complex OCAP situation. For the most part, the reports are well-written. Details of my review are presented below. Some general comments on the documents, though, include:

- Although some details are lacking, as noted in my comments below, the BO is sufficiently organized, documented, and substantiated to support the ultimate findings relative to the requirements of the ESA, as described in Section 10.0.
- Both documents, but more so the BO, need additional reorganization. The sections are unbalanced in their treatment of the topics.
- Topics in the BO are not treated consistently from section to section. It seems that some similar sections were completed by different authors who did not confer on the range or

methods of coverage for their respective sections (see detailed comments below for examples).

- There are many acronyms used throughout the BO, and some are undefined, or are used tens or hundreds of pages subsequent to their first definition. It would therefore be helpful if the BO had a list of abbreviations and acronyms similar to that found in the BA (the BO needs its own list because some acronyms appear in the BO that are not listed in the BA's abbreviation list).

The review was performed at two major levels: 1) a list of important editorial comments on the BO and BA (minor errors were ignored); and 2) answers to questions posed for reviewers in the terms of reference.

### **General Editorial Comments on Biological Opinion:**

1. The draft BO would benefit from detailed technical editing. I noticed numerous grammatical, punctuation, and relatively minor technical errors, particularly in certain sections, as I reviewed the BO and the BA and its Appendices. These were too numerous to list.
2. The following sentence from p. 11 of the BO does not make complete sense: "In addition, a co-manager's review draft of the Central Valley was issued, and comments received."
3. The wording of the following statement creates a loophole in the decision process: "The quantity, quality, or availability of one or more constituent elements of critical habitat are not likely to be reduced upon being exposed to one or more of the stressors produced by the proposed action" (BO, p. 14, Table 2-1, Step C – also Table 9-4). I believe the intent of this statement is that "if any one or more of the constituent critical habitat elements will be reduced by one or more stressors of the proposed action" is true, then there is no decision of Not Likely to Adversely Affect (NLAA). As it reads, if any one of the constituent elements of critical habitat is not likely to be affected, then there can be a ruling of NLAA, even though other constituents are experiencing a negative effect.
4. BO Figure 2-6, p. 20, needs some explanation of abbreviations. For example, what do BPL and DG stand for?
5. I note a discrepancy in the list of effects (proposed actions) that the BA and BO are addressing. The BO lists the following effects: "In addition to current day operations, several other actions are included in this consultation. These actions are: (1) an intertie between the California Aqueduct (CA) and the Delta-Mendota Canal (DMC); (2) Freeport Regional Water Project (FRWP); (3) the operation of permanent gates, which will replace the temporary barriers in the South Delta; (4) changes in the operation of the Red Bluff Diversion Dam (RBDD); and (5) Alternative Intake Project for the Contra Costa Water District." (BO, p.33).

However, the BA lists those effects plus three others on Page 2-1:

- (5) Sacramento River Water Reliability Project,
- (7) Operational elements of the American River Flow Management Standard, and
- (8) Minor operational changes that are identified in this chapter.

6. The organizational structure of Section 4 of the BO is questionable. The BO addresses the following species and their critical habitats: Central California Coast steelhead, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and Southern DPS of North American green sturgeon. Section 4.2.1 addresses Chinook salmon. The title of section 4.2.1.2 is “Sacramento winter chinook”, yet subsection 4.2.1.2.2 is entitled “Factors Responsible for the Current Status of Winter-Run, Spring-Run, and CV Steelhead”, without preceding similar overviews for Spring-run or CV Steelhead, like there was for Winter Run. (These subsections were found much later in the 4.2.1 section.)
7. Also note that several key sections are missing from the Table of Contents between pages 39 and 103 and between 185 and 225.
8. The acronym EWA is not defined at the top of page 61, nor anywhere previously. (BO, p.61).
9. The Term TCP on page 70 and eleven other instances in the BO is never defined. I note the term “temperature compliance point” about five lines above TCP on 70, and assume that is TCP. However, further description of the “temperature compliance point”, if that is TCP, would be very helpful, especially for understanding the discussion in the last paragraph of p. 333 (BO).
10. The following sentence is incomplete: “*Lindley et al. (2007)* indicate adult spring-run tributaries from the Sacramento River primarily between mid April and mid June.” (BO, top p. 73).
11. In the last paragraph on p. 76 (BO), the reference to Table 9 should probably read Table 4-5.
12. The reference to Table 7 at the bottom of p. 88 does not appear to relate to any table. Furthermore, the intended table for CV steelhead seems to be missing.
13. The references to Figure 7 on p. 89 do not refer to a figure that relates to the CV steelhead topic being discussed.
14. The reference to “X2” on p. 91 is undefined anywhere in the BO.
15. Much of page 151 is redundant with page 46 (BO).
16. Has the following been rectified? “NMFS acknowledges that this is a reversal of the approach we described in sections 2.3.1 and 2.3.2. The final Opinion will be consistent with regard to the order of presentation between the analytical approach and this section.” (BO, top, p. 163).
17. The reference to Figure 6-3 on p. 163 (BO) should probably be 6-1.
18. The following heading, on p. 169 (BO) “6.2.5 Effects of the Action on Spring-run and CV Steelhead Critical Habitat in Clear Creek” should include winter-run, as well as spring-run and steelhead, since winter run are also addressed in the section.
19. Section 6 seems to be very inconsistently organized and is therefore difficult to follow. For example, Section 6.2 and section 6.3 each start with a subsection referred to as “Deconstruct the Action”, but the following, similar sections (6.4, 6.5, 6.6, and 6.7), do not include a “Deconstruct the Action” section, among other dissimilarities.
20. Likewise I note that the sections on assessment of response of individuals, populations, and species seem to be jumbled and disorganized, and not always following the approach laid out in Figure 2-1. The adherence to this approach seems to vary dramatically among the subsections of Section 6.0.

21. In Section 6.2, the subsections on “Assess the Risk to Individuals” (6.2.3) and “Assess the Risk to Populations” (6.2.4) are both incomplete. The former section only addresses spring-run and the latter only addresses steelhead, yet the entire section 6.2 is about the effects of Clear Creek and Whiskeytown on CV steelhead and Spring-run chinook salmon.
22. Reference to Figure 20, near the top of p. 175 (BO) is inaccurate: there is no Figure 20.
23. The section “6.3.4 Effects of the Action on Winter-run, Spring-run, CV Steelhead Critical Habitat, and Southern DPS of Green Sturgeon Proposed Critical Habitat” on p 194 (BO) has no text in it.
24. The term “40-30-30” is used throughout the BO and BA, but is never defined.
25. The figure on p. 184 (BO) is labeled incorrectly.
26. Table 6-11 on p.191 (BO) does not need the right-hand column since there are no entries in it.
27. Why is the organization of Section 9.2 different from Sections 9.3, 9.4, and 9.5? In particular, why does Section 9.2 not include a subsection on “Future Baseline Stress Regime...”, like the other analogous sections do?
28. The following statement, from top of p. 334 (BO) should be reconsidered, because, taken literally, it equates mortality with survival, which are the opposites of each other: “Mortality of naturally-produced winter-run, which must avoid predators immediately upon emerging from spawning gravels as fry, is most likely lower than the survival.....”.
29. Table 9-4 on p. 337 (BO) does not indicate the meaning of the shading in the right-hand column.
30. Sections 9-4, 9.5.3.1.1, 9.5.3.2, 9.5.4.1.4, 9.5.4.2, 9.5.5.2, 9.5.6.1.1, 9.5.6.1.2, 9.5.6.2, 9.6.1, and 9.8 are unfinished.

### **General Editorial Comments on Biological Assessment:**

1. The BA needs grammatical editing in many places. One of many such examples: “The upstream reservoirs release water to provide water for the Delta of which can be exported a portion through Jones pumping plant to store in the joint reservoir San Luis or deliver down the Delta Mendota Canal.” (BA, p.2-1, top of page).
2. It is odd that Chapter 11 (BA) is entitled “Upstream Effects” since it discusses the downstream effects of projects as noted in the first sentence of the chapter: “This chapter focuses on the Central Valley Project (CVP) and State Water Project (SWP) project operations and how the operations affect flow and water temperature in river reaches downstream of project reservoirs.” (BA, p. 11-1).
3. Possible important typo in first sentence of the second paragraph of BA, Appendix D, p. D-1, where 1992 perhaps should be 1922.

### **Comments in accordance to the Terms of Reference**

- **Are the technical tools used in the NMFS OCAP BO (e.g., modeling, calculations, analytical and assessment techniques) able to determine impacts to the individuals and to the populations?**

It is extremely difficult to discern, without in-depth knowledge of the myriad details, whether the water models have actually accounted for the numerous complexities, nuances, and exceptions set forth under each of the long list of water management agreements and requirements (see Tables 1-1 and 1-2, BA, pp. 1-15 through 1-19 for a complete list of all the CVP and SWP “proposed actions”). For one such example, the detail described for the “Yuba Accord” alone (BA, pp. 2-22) is extremely complex, and this is just one of a huge number of proposed actions that must be incorporated into the models.

Does the modeling flow illustrated in Figure 9-1 (BA and BO) include transfer of flow information through the temperature model to the salmon survival model (since flow and other attributes are also important to survival)? If not, it should.

The “Cal-Sim II model simulates 82 years of hydrology for the region spanning from water year 1922 to water year 2003.” (BA, p. 9-5 and BA Appendix D, p. D-1)). What about the years after 2003? This is important for two reasons. First, the model will be more accurate if it includes all the possible years of data. Second, as the climate gradually changes, it is particularly important to have the most recent years of data included in the model.

The descriptions of the CALSIM-II modeling scenarios are too esoteric for a reviewer from outside the area to follow. Some of the confusion arises from the following.

1. Appendix D, page D-1, states: “The model operates in six or seven steps to simulate the different regulatory regimes: D1485, D1641, B2, Joint Point of Diversion (JPOD), EWA, and EWA2 if needed.” However, there is no summary description of these regimes in the BA, BO, or Appendix D.
2. Furthermore, the ensuing text on BA Appendix D, pages D-1 through D-3 utilize acronyms and references to situations that are too obscure to then understand how the model functions.
3. There is no formal definition of Study 6.0, Study 7.1, Study 7.2, Study 8.0, etc. referred to on D-1 and subsequent pages of Appendix D, and in captions of some figures in the BA and BO.
4. There is a reference to a CU model with no description of that model, on the bottom of page D-5.

An apparent assumption about ignoring “indoor water demands” in the CALSIM-II model raises concerns (BA, App D, D-5, second paragraph from bottom). If this indoor water demand amounts to any more than a few percent of the total flow wherever it is removed, or if the total cumulative indoor demand is more than a few percent, then this assumption could lead to serious miscalculations of the effect of water withdrawals.

Without a more complete understanding of how the water management was modeled in CALSIM-II, it is very difficult to determine whether the modeling of the effects on individuals and populations was accurate and/or adequate. The discussion at the bottom of p. 9-5 and top 9-6 in the BA raises some concerns. For example, the statement that “Next is the Transfers environment. This environment is deactivated and no transfers are dynamically simulated for these studies.” (BA, p. 9-5) is surprising in that the “transfers” are part of the impacts to



fisheries. Since the proposed action is the continued operation of the CVP and SWP and five other new actions (BO, p.33), it seems the water modeling should include all transfers. If they are ignored, how can the effects on fisheries be determined?

The BO could be greatly improved if there was a section specifically devoted to an explanation of all the water condition studies, e.g., Study 6.0, Study 7.1, Study 7.2, Study 8.0, etc., and what conditions each one represents (or at least an obvious reference to the section on “Modeling Studies and Assumptions” in the BA (pp. 9-33 to 9-58)).

The quantitative models referred to in Section 2.4.1 were not applied in the BO to the degree that was implied in that section, and illustrated in Figure 2-11. In fact, I could only find one reference to SALMOD anywhere else in the BO.

Some of the tools used to derive a basis for conclusions are not explained very well. For example, Figure 6-3 (BO) refers to “Estimated monthly hazard estimate used to assess predation in the E.A. *Gobbler* sub-routine of the Fishtastic! juvenile analysis module (Tucker 1997, Vogel *et al.* 1988).”, but there are no explanations of this process in the text.

The temperature models do not appear to account for temperatures in all habitats (BA, Figure 9-5). The reaches that are modeled are all important to the survival of fishes, but so are the unmodeled reaches. Even if temperatures are found to be adequate in the modeled reaches, poor temperatures in unmodeled reaches could turn out to be limiting survival.

Because the salmon mortality models do not appear to include inputs from the DSM2 model (Figure 9-1 BA), the lack of accounting for the physical habitat constraints of the highly modified delta, and its associated water exports, apparently are unaccounted for. How then do the results from the DSM2 influence the outcomes or conclusions regarding survival in the BO?

In some cases, it is unclear how the outputs from the CALSIM-II or the temperature models are input to the salmon mortality models (BA, pp. 9-24 to 9-27). At the top of page 9-24 (BA), it states: “The salmon models use simulated temperature results and CVP/SWP operation results from CalSim-II, described above.” However, nowhere do I see a description of how CalSim-II results are direct inputs to the salmon models. Rather, I see the temperature models take CalSim-II flows as inputs and provide temperature outputs, as described in Table 9-3. Furthermore, Figure 9-1 shows information flowing from Cal-Sim-II to the temperature models not vice versa.

The description of the Reclamation salmon model states that it uses both CalSim-II-produced flows, as well as SRWQM temperatures, as inputs (App L, p. L-1). However, there is no description of how the flows and/or temperatures are actually input to the Reclamation salmon model, anywhere in the BO, BA, or BA Appendix L.

I cannot determine from either the BA or the BO whether the CALSIM-II model accounts for all diversions, or just the major water exports. Such information might be expected to appear on pages 9-5 to 9-7 of the BA. This is an important consideration because, if the model only accounts for the major exports, then a significant, cumulative effect of the hundreds of smaller

diversions and withdrawals may be unaccounted for. At a minimum, this should be explained somewhere in the documents if not already.

No biological models were used on CV steelhead or green sturgeon, as they were on Chinook (see last statement on BA, pp. 9-110).

The descriptions of the Climate Change models on pp. 9-28 to 9-29 are very difficult to follow. The explanation would be greatly enhanced by one or more conceptual graphics.

The sea level in climate change study 9.0 is assumed to be 1 ft (BA, p. 9-95). As stated, “Given available Delta model-applications, the assumption featured in this study is a 1-foot sea level rise coupled with a 10% increase in tidal range.” (BA, App R, R-2). The development of this 1-foot sea level rise assumption is discussed in Section 2.3 of Appendix R. However, many additional assumptions are components of this basic assumption, and many of those are debatable. Although I do not necessarily disagree with the conclusions drawn in Section 2.3 of Appendix R, I believe there is sufficient doubt in the 1-ft value, that the climate change models described in the BA should have used a range of values encompassing 1 ft to test “what-if” scenarios about increments in sea level rise, rather than relying solely on the 1-ft value.

**• Are assumptions clearly stated and reasonable based on current scientific thinking?**

The assumptions about the baseline non-viability of the Winter Run, Spring Run, and CV Steelhead are all clearly spelled out and reasonable relative to the VSP process for salmon (McElhany et al. 2000) (sBO, pp. 63-68). These conclusions are supported by other studies as well (BO, pp. 67-68). The same is true about the conclusion concerning Winter-run critical habitat being degraded and not providing “the conservation value necessary for the recovery of the species.” (BO, p. 72).

Two specific assumptions raise concerns:

- “Generally, however, we assume that the consequences of impacts to older reproductive and pre-reproductive life stages are more likely to affect population growth rates than impacts to early life stages.” (BO, p. 20, middle of page).
- “As discussed above, in the absence of other information we assume that fitness consequences to later life stages are more likely to have resulting population level effects than impacts to early life stages.” (BO, p. 22, 2<sup>nd</sup> Paragraph).

These assumptions may be true but not necessarily. So much depends on the particular life cycle of the population being studied and the interplay of the life cycle with environmental variation. The result of this process has been referred to as the survival “bottleneck” and it varies among species, life histories, habitat types, and annual variation in environmental drivers.

The BA Appendix D lists six basic assumptions of the CALSIM-II model on page D-28. Assumptions 1 and 3 do not raise concerns. However, the four other assumptions have the potential to significantly affect the outcome of modeling, namely: 2) “....based on significant CVP/SWP operator input and represents coarse estimates of project operations over all hydrologic conditions.”; 4) “The model assumes that facilities, land-use, water supply contracts and regulatory requirements are constant representing a fixed level of development rather than one that varies in response to hydrologic conditions or changes over time.”; and 5) Groundwater has only limited representation in CalSim-II and groundwater resources are the assumed mass balance “closure term”, i.e., they are infinite; there is no upper limit to groundwater pumping.”; and 6) “Water quality boundary conditions in the Delta were used from the CalSim-II Common Assumptions development effort. The sensitivity of boundary conditions patterns changing to modified assumptions and the impact this has on results has not been explored.” Any or all of these assumptions, if not closely met, could alone or synergistically result in dramatically different model outcomes that do not closely represent reality.

The following assumptions for the Reclamation salmon model are listed in the BA p. 9-24, and Appendix L, p. L-5. This is also assumption 6 on p. L-6. “Eggs are assumed to hatch upon exposure to 750 TUs following fertilization. Fry are assumed to emerge from the gravel after exposure to 750 TUs following egg hatching into the pre-emergent fry stage.” There is no apparent support for these assumptions, which should definitely either be described or be referenced to a scientific citation.

The assumptions listed for The Reclamation Salmon Model (BA p.L-6), the SALMOD (BA, p. P-7-8) and the IOS model (N-7-10), although reasonable, are all questionable, as are any modeling assumptions. If any one of the assumptions were violated during the modeling, the results could be affected. Worse, if multiple assumptions were violated within any model, errors could be either offset or compounded to the extent that each assumption is violated. The primary problem is that we often do not understand the extent or direction of the violation.

Even more risky outcomes can result when models are sequenced. That is, a model that is based on outputs from other models (e.g., CalSim-II and a temperature model feeding into a salmon model), can lead to even more dramatically erroneous outcomes. This is why model sensitivity analysis of model uncertainty is required. Outputs from models that will become inputs to second-level models should have uncertainty levels or confidence intervals as inputs to the second-level models. (Similar limitations and concerns about assumptions are described in the BA (pp. 9-107 to 9-110)).

- **Do the biological assessment and BO adequately assess the individual responses of fish to certain effects (*i.e.*, flows, water temperatures, diversions, *etc.*) and was the best available information used by NMFS to evaluate how fish are likely to respond to those impacts.**

In many cases, the BO adequately addresses the effects of the proposed actions on individuals and populations. For example, in Section 6.2.1.1, there is a very good discussion of how Clear Creek flows and hydrograph influence Spring-run and CV steelhead (BO, pp. 163-165).

In several cases, however, the BA and BO do not adequately address the individual responses of fish to certain effects. For example, in the BO, Table 2-3, third cell from top, p. 30: “Chapter 2 (project description) has many gaps regarding the description of the proposed action.”

The Environmental Baseline described in Section 5 does not appear to address the conditions found in the San Joaquin or its tributaries, even though some CVP and/or SWP actions are planned for that area. Tables 1-1 and 1-2 of the BA (pp. 1-15 through 1-19) show a number of proposed actions that are subject of the consultation and that occur in the Friant, West San Joaquin, and San Felipe divisions and do not appear to be addressed under the Environmental Baseline, nor in the “Effects of Proposed Actions” section (6.0), described in the BO. It was also noted that the CV steelhead ESU includes documented occurrences of steelhead from those divisions in the Mokelumne, Calaveras, Tuolumne, and Merced Rivers (BO, p. 86).

The word “many” should be replaced with “most” or “almost all” in the following passage from p 150 (BO) “Although efforts have been made in recent years to screen some of these diversions, many remain unscreened.” This is because the paragraph goes on to say: “Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile salmonids. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001).”

I question the statement, under Risk to Populations, on p. 193 (BO) that “Likelihood of survival and recovery is not impacted,...”. This pertains to the Sacramento River and Clear Creek. While I do not disagree that the survival of the population is unimpacted, I wonder whether the population-based recovery is assured under the scenarios evaluated. In support of this, I note that in the pages preceding this statement, under the topic of Risk to Individuals, the following statements pertaining to steelhead are made:

1. “Loss of spring-run and steelhead juveniles in Clear Creek in 4 –10 percent of driest years modeled due to warm temperatures” (BO, p. 190).
2. “Reduction in habitat available in Clear Creek without b(2) water to support flows above Minimums” (BO, p. 190).
3. “Operations of ACID and RBDD will block or delay adult winter-run, spring-run, CV steelhead,...” (BO, p. 191).
4. “Less cold water available from Spring Creek Tunnel, therefore, reduced suitability of habitat for spring-run and steelhead in Clear Creek.” (BO, p. 191).
5. “Operations of RBDD will cause higher predation rates on juvenile winter-run, CV steelhead, and green sturgeon as they pass through Red Bluff Lake and the diversion gates” (BO, p. 192).
6. The top paragraph on p. 194 (BO) also lists a number of habitat issues for steelhead.

Section 6.3.5 does not include any definitive conclusions about whether there are project effects on critical habitat. This is somewhat confusing, though, since section 6.3.4 has no text at all.

The discussion of PCEs for green sturgeon (BO, p. 198) is uneven. There are 7 PCEs listed, several of which are followed by a rating. The others have no rating, but appear to have action comments. The conclusion at the bottom of the page does not fully reflect the preceding statements.

It is unclear whether the following statement was addressed in the evaluation of impacts. “The lack of compliance with the bypass ratios during all facility operations alters the true efficiency of louver salvage used in the expansion calculations and therefore under estimates loss at the TFCF.” (BO, p. 255). Were these underestimates rectified prior to adding this loss to the mortality models?

The mortality comparison made between tagged hatchery-reared, fall-run yearling smolts and natural winter-run fry to smolts (BO, p. 334) raises a number of questions. Primarily the different lengths of life-span involved makes the comparison quite questionable. I suggest either modifying the last sentence in the paragraph to something like: “Mortality of naturally-produced winter-run is most likely even worse since they emigrate at a smaller size”, or dropping the last three sentences of this section altogether. The same comments may apply to the middle paragraph on page 343, the bottom of page 346 (BO).

Section 9.3.5.1, which refers to Antelope, Mill, Deer, Big Chico, and Butte Creek Spring-Run Chinook Salmon (BO, p. 350) actually only addresses the effects of the proposed action on Antelope Creek Spring-Run. Where are the other creeks’ spring-runs addressed?

**• Do the data, analyses, results, and conclusions presented lead to a thorough understanding of the risks to individuals and populations from the proposed project impacts? If not, what relevant scientific information should be considered?**

In general, the data, analyses, results, and conclusions do lead to a thorough understanding of the risks from the proposed project. However, I have noted some specific concerns as follows.

Data presented for Spring Run adult timing is contradictory between the in-text description on bottom of p. 72 and top of p. 73 and that shown in Table 4-4. The text states that they spawn in the fall but the table shows them absent in the fall. Likewise for juvenile Spring Run, Table 4-4 shows them only present in certain months, but the text on pp. 73-74 describes that some are yearlings, meaning they would remain in some freshwater habitats throughout the year.

The cohort replacement values in tables 4-2 and 4-5 may be incorrectly calculated. Because chinook salmon are multi-aged at return, the calculation of cohort replacement should include the number of fish returning from each brood year. In the tables, it appears that the calculation was based simply on dividing the number escaping in one year by the number escaping three years earlier.

Also, there are errors in the median values of Tables 4-2 and 4-5. The median is defined as the middle value between the largest and smallest observation, when all values are ordered (Sokal

and Rohlf 1995). For example, the correct value for the median in the column “5-Year Moving Average of Cohort Replacement Rate” of Table 4-5 is 1.94, not 2.3.

Errors in the calculated cohort replacement values notwithstanding, I do not agree with the implication from the assessment that “The 5-year moving average cohort replacement rate, however, has remained above 1.0 since 1993.” The main issue is that, in the way this moving average was calculated from the previous 5 years, it is essentially retrospective. Three of those last five years of values are below 1, another is very close to 1, and the overall trend in the last five years is downward. Furthermore, the moving average shows an obvious downward trend from 2002 onward.

The information presented in Section 6.2 of the BO for individuals and populations (sections 6.2.3, 6.2.4) is incomplete. Section 6.2.3, for individuals, only discusses spring-run, but not steelhead. Section 6.2.4, for populations, only discusses steelhead and not spring-run.

Section 6.3 of the BO “Deconstruct the Action” seems to be incomplete. The one paragraph in that section only addresses the RBDD, but there are a number of other Shasta and Sacramento River current and proposed actions that potentially impact the species in question.

The treatment of species, individuals and populations is very uneven among the different divisions described in Section 6.0. Some of sections address all three, some address individuals and populations, but not species, others address just species, but not individuals or populations (e.g. Section 6.5 East Side Division), and, in one case, no specific treatment of species, individuals, or populations (Section 6.6 Delta Division). This makes it difficult to follow a summary of the overall effects.

Table 9-2 (BO, p. 329) may be missing some additional effects of the Delta pumping on Winter-run. The table lists the effects of the Jones and Banks pumping plants but it does not include the effects of the numerous other diversions, pumps, screened and unscreened. (This comment applies to where this was repeated in all the other similar sections.)

The following issue should be considered for winter-run and spring-run salmon, in sections 9.2 and 9.3, as well as steelhead in section 9.4. “The effects of chlorpyrifos, diazinon, and malathion pesticides products that contaminate aquatic habitat in the Sacramento River and Bay/Delta result in both individual fitness level consequences and subsequent population level consequences for steelhead (NMFS 2008).” (BO, p. 353). If those substances have been found to affect steelhead in the Bay/Delta area, they most likely affect salmon similarly.

Furthermore, the same can be said of the discussion of contaminants relating to green sturgeon on p. 373 (BO), first full paragraph. While all the contaminant effects listed there likely influence green sturgeon more dramatically (since they are benthic feeders), many of these same effects can and do affect salmonids. These issues have not been fully addressed for salmonids in the BO. In fact, these sources of contaminant-related harm were described on p. 48 of the BO, but they were not considered as stressors in all of the “Exposure” tables of Section 9.

The title of section 9.5.5.2 includes Auburn/Dry steelhead (BO, p. 363). However, this population has never been mentioned previously. Neither Sections 4.0 or 6.0, on population status and the effects of projects on them, has been addressed for these populations.

Section 9.6.4 contains some important summary information relative to the risk to the green sturgeon population, but it does not definitively state whether there is an expectation of increased risk to the population.

The segment about green sturgeon “..specific PCEs for estuarine areas...” on p. 377 (BO), is truncated and should include additional effects besides only addressing migratory issues. In particular, the topic of water quality, and perhaps sediment quality, should be listed, especially since contaminants were thoroughly described as having important effects just a few pages previous to this (see BO, p. 371).

- **Are the analytical techniques capable of determining the significance of project impacts for Endangered Species Act (ESA) purposes? If not, what additional or alternative analytical techniques are recommended? What *available* science should be used to best address the impacts of this large-scale water project as examined in the BO?**

The analytical techniques, as described in Section 2.0 of the BO, are capable of determining the significance of this project on ESA-listed species. For one thing, the listed species are already very vulnerable to further decline, even without the project effects. Secondly, the project effects are clearly of further detriment to the listed species, so that the conclusions of significant project effects are quite obvious.

Once the relatively minor comments made elsewhere in this review document have been incorporated into the BO, I believe the BO will meet the intent of the ESA requirements, as described in the BO (p. 12): “Section 7 of the ESA and the implementing regulations (50 CFR 402), and associated guidance documents (*e.g.*, USFWS and NMFS 1998) require biological opinions to present: (1) a description of the proposed Federal action; (2) a summary of the status of the affected species and its critical habitat; (3) a summary of the environmental baseline within the action area; (4) a detailed analysis of the effects of the proposed action on the affected species and critical habitat; (5) a description of cumulative effects; and (6) a conclusion as to whether it is reasonable to expect the proposed action is not likely to appreciably reduce the species’ likelihood of both surviving and recovering in the wild by reducing its numbers, reproduction, or distribution or result in the destruction or adverse modification of the species designated critical habitat.”

- **Were uncertainties considered in the BO? If so, were they described in a way that frames the data or puts it in the proper perspective (*e.g.*, the appropriate time scale, or the likelihood that an event will happen)? What uncertainties and limitations were not addressed that might impact the BO substantively?**

Uncertainty was not always fully addressed, either due to 1) lack of information or analyses, 2) inability to account for compounded uncertainties, or 3) due to regulatory decisions.

*Lack of information or analyses* – For example, Ford et al. (2006) recommended that uncertainties be better quantified in the CALSIM-II model. “...large uncertainty remains in the new representation due to large unaccounted for flows and salt loads (closure terms) and bias in the salinity model.” They therefore concluded that “Estimation of the magnitude of model errors under various conditions from a formal and documented error analyses.....” Have these been implemented? If not, then some results in the BA and BO remain questionable.

*Inability to account for compounded uncertainties* – Each value estimated in a model has an associated uncertainty. When information from one model flows to another, as illustrated in Figure 2-11, and estimates depend on estimates from previous model(s), then there are compounded uncertainties. The variances from each estimate are summed to estimate the total variance. This was apparently never done in any of the BA modeling.

*Regulatory Decisions* - For one example, the BO states in sections 1.5.2 and 1.5.3 that, of all the CVP and SWP hatcheries, only the Nimbus Hatchery was considered in the BO, and the Oroville Dam and associated projects were left out of the BO, because they would be considered under separate consultations. This leaves some significant activities out of the evaluation of impacts. Cumulative effects regarding important hatchery influences, such as genetic introgression and competition between hatchery and wild juveniles, and the uncertainties of these cumulative activities, leaves some questions about project impacts unanswered.

- **In the absence of available information to establish probable responses to impacts (e.g., survival across the Delta, steelhead population estimates, steelhead losses at the Delta pumps, spring-run Chinook salmon populations above Red Bluff Diversion Dam), were reasonable scenarios developed to identify types of exposures? Were comparisons made to other species with similar impacts?**

The BA and BO addressed as many of the ecological and biological effects as possible using all available information, and given the gaps in available data. Generally speaking, salmon, steelhead, and sturgeon ecological and biological information is rapidly expanding, both for Central Valley populations and for similar populations outside the Central Valley. This fact, together with the expanding knowledge base specific to Central valley populations, allows fisheries scientists to have more confidence in their conclusions about the responses of populations to habitat alterations. In fact, I have argued previously that fisheries managers often have sufficient knowledge to make informed decisions in the best interest of fisheries resources notwithstanding the incremental benefits from continuing research (Knudsen 2002, p. 301). Although there is always some doubt and uncertainty, and some shortcomings of the analyses as pointed out in this review of the current BA and BO, fisheries scientists have the capability to make correct recommendations.



- **Were relevant published and unpublished studies on ESA-listed fish species, similar species, ecological theory, and computer simulation/modeling missed?**

For the most part, the answer to this question is yes. Several other reports that might have been helpful for the analyses are Banks et al. (2000), Sommer et al. (2001), Jager and Rose (2003).

- **Was evidence provided to support conclusions relative to species responses to demographic changes (e.g., changes in fecundity rates, changes in growth rates for individuals, and changes in numbers of individuals that immigrate or emigrate from populations)? Was evidence provided to support the conclusions about how the proposed actions affect the species' demographics?**

Yes. In general, the preliminary sections provided very comprehensive coverage of the species' life history and habitat needs, as well as the anticipated effects of the proposed actions. Section 9 provided good summaries and syntheses of the ways in which project-related actions would affect (or not) the various biological aspects of the populations being analyzed.

- **Further Purposes of the Review --In addition to answering the fundamental questions posed above, another intended use of this review is to help ensure that best available information is used for future ESA consultations, such as early consultation components for OCAP, and the South Delta Improvement Program. Reviewers shall address possible inadequacies in the NMFS BO (i.e., Did the BO apply the available information in a scientifically sound manner?).**

The BO did not thoroughly follow the process presented in Section two (see Figure 2.4). For one example, there was little mention of PCEs in Section 9, except for in the section on green sturgeon. Otherwise, most of the assessments in Section 9.0 only loosely followed the process illustrated in Figure 2-4. Closer adherence to that process would have provided the framework for a more systematic analysis.

As noted in the following quote, it was somewhat disturbing for this reviewer to find that the document being reviewed is not really finished: "As a result of these recommendations, NMFS has made, and continues to develop, revisions to this Analytical Approach section. In general, the approach remains the same, but materials have been added or refined to address some of the comments provided by the Panel. Not all recommendations have been addressed as of this draft and several sub-sections are unfinished. We hope, however, that the following presentation has improved in clarity and overall logical presentation." (BO, p. 8-9. Although I believe the inclusion of the unfinished portions will not likely influence the conclusions, it seems somewhat inappropriate to ask reviewers to fully meet the terms of reference without a fully completed document to review. Hopefully, future BOs will be completed before they are submitted for review.

## **Conclusions and Recommendations in accordance to the Term of Reference**

The BA and BO are complex, comprehensive documents that meet the requirements of ESA for assessing jeopardy to the listed species in question. Most of my review comments will primarily serve to strengthen these documents. However, it is very unlikely that incorporation of my suggestions and comments will change the conclusions of the BO. When the BO is completed, and if the recommendations listed above are incorporated into the BA and/or BO as appropriate, these documents will form a more rigorous basis for the formal ESA process.

## **Appendix for the Bibliography of Materials used prior and during the peer review.**

See the list of documents reviewed under the section “Items Reviewed on p. 3

### Literature Cited:

- Banks, M. A., Rashbrook, V. K., Calavetta, M. J. , Dean, C. A., and Hedgecock, D. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley. *Canadian Journal of Fisheries and Aquatic Sciences* 57: 915-927.
- Ford, D., L. Grober, T. Harmon, J.R. Lund, and D. McKinney. 2006. Review Panel Report San Joaquin River Valley CalSim II Model Review. CALFED Science Program – California Water and Environment Modeling Forum.
- Jager, H. I., and K. A. Rose, 2003. Designing optimal flow patterns for fall chinook salmon in a Central Valley, California, river. *North American Journal of Fisheries Management* 23: 1-21.
- Lindley, S. T., et. al. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in The Sacramento-San Joaquin Basin. *San Francisco Estuary and Watershed Science* Vol. 5, Issue 1 [February 2007]. Article 4.. <http://repositories.cdlib.org/jmie/sfews/vol5/iss1/art4>
- Sokal, R. R. and Rohlf, F. J. 1995. *Biometry*. W.H. Freeman Company. New York.
- Sommer, T., D. McEwan, and R. Brown. 2001. Factors Affecting Chinook Salmon Spawning in the Lower Feather River. Pages 269-297 in *Contributions to the Biology of Central Valley Salmonids. Scripps Institution of Oceanography Library*.

## **Appendix for the Statement of Work**

### **Attachment A: Statement of Work for Dr. Eric Knudsen**

#### **External Independent Peer Review by the Center for Independent Experts (CIE)**

#### **Review of the 2008 National Marine Fisheries Service's (NMFS) Biological Opinion (BO) on the long-term Central Valley Project (CVP) and State Water Project (SWP) Operations, Criteria and Plan (OCAP)**

#### **Project Background:**

The purpose of this independent review is to evaluate and comment on the use of the best available scientific and commercial information as it pertains to the development of the 2008 NMFS BO on OCAP. The review will focus on the technical aspects of the NMFS BO and the information provided in the OCAP biological assessment (BA). The review will not determine if NMFS' conclusions regarding the project's potential to jeopardize the continued existence of listed species (anadromous salmonids, green sturgeon, and killer whales) are correct.

In 2004, NMFS issued a BO (2004 BO) on OCAP proposed by the US Bureau of Reclamation (Reclamation). Following the issuance of the 2004 BO, three separate peer review processes, by the CALFED Science Program, CIE and a summary review by the NMFS Southwest Fisheries Center, identified technical deficiencies in the 2004 BO. The 2004 BO also has been legally challenged, and Reclamation requested re-initiation of consultation in 2006. The OCAP includes water management operations that provide drinking water to over 23 million people and thousands of acres of agriculture in California. This consultation involves both Federal and state agencies, and affects local water districts and users. Given the complexity and sensitivity of the OCAP consultation, NMFS is seeking independent peer review of the BO to ensure that NMFS has used the best available information for its analysis.

The charge to the CIE reviewers is to evaluate and comment on the technical information, models, analyses, results and assumptions in the proposed OCAP that form the basis for the assessment in the BO. The reviewers should additionally consider pertinent background information, such as previous NMFS BOs that pertain to CVP water operations (*i.e.*, 1993 Winter-run Chinook salmon BO and the 2000 Trinity River Restoration Program BO) and the CALFED's adaptive management process (*i.e.*, the Salmon Decision Process). The reviewers should review both the data provided in the OCAP BA and the NMFS BO. For example, they should review how NMFS assessed the individual responses of fish to certain effects (*i.e.*, flows, water temperatures, diversions, *etc.*) and whether the best available information was used by NMFS on how fish are likely to respond to those impacts.

#### **Overview of CIE Peer Review Process:**

The NMFS Office of Science and Technology coordinates and manages a contract for obtaining external expertise through the CIE to conduct independent peer reviews of stock assessments and various scientific research projects. The primary objective of the CIE peer review is to provide an impartial review, evaluation, and recommendations in accordance to the Statement of Work (SoW), including the Terms of Reference (ToR) herein, to ensure the best available science is utilized for NMFS management decisions.

The NMFS Office of Science and Technology serves as the liaison with the NMFS Project Contact to establish the SoW which includes the expertise requirements, ToR, statement of tasks for the CIE reviewers, and description of deliverable milestones with dates. The CIE, comprised of a Coordination Team and Steering Committee, reviews the SoW to ensure it meets the CIE standards and selects the most qualified CIE reviewers according to the expertise requirements in the SoW. The CIE selection process also requires that CIE reviewers can conduct an impartial and unbiased peer review without the influence from government managers, the fishing industry, or any other interest group resulting in conflict of interest concerns. Each CIE reviewer is required by the CIE selection process to complete a Lack of Conflict of Interest Statement ensuring no advocacy or funding concerns exist that may adversely affect the perception of impartiality of the CIE peer review. The CIE reviewers conduct the peer review, often participating as a member in a panel review or as a desk review, in accordance with the ToR producing a CIE independent peer review report as a deliverable. At times, the ToR may require a CIE reviewer to produce a CIE summary report. The Office of Science and Technology serves as the COTR for the CIE contract with the responsibilities to review and approve the deliverables for compliance with the SoW and ToR. When the deliverables are approved by the COTR, the Office of Science and Technology has the responsibility for the distribution of the CIE reports to the Project Contact. Further details on the CIE Peer Review Process are provided at <http://www.rsmas.miami.edu/groups/cie/>

### **Requirements for CIE Reviewers:**

- 1) We request three CIE reviewers to conduct an independent peer review.
- 2) Each CIE reviewer's duties shall not exceed a maximum total of 7 days - several days for document review and several days to produce a written report of the findings.
- 3) Each CIE reviewer may conduct their analyses and writing duties from their primary location (desk review). Each written report shall be based on the individual reviewer's findings.
- 4) Each CIE reviewer shall produce an independent summary report addressing the elements identified in the ToR (Annex 1) and the format specified in Annex 2.
- 5) The expertise among the CIE reviewers shall include anadromous fishery management in managed water system, ability to interpret hydrodynamic and fishery dynamics models, hydrology, familiarity with Pacific anadromous fish and life history requirements, and fish stock assessment and biostatistics.

The CIE reviewers shall have the expertise necessary to complete an impartial peer review and produce the deliverables in accordance with the SoW and ToR as stated herein (refer to the ToR in Annex 1).

### **Statement of Tasks for CIE Reviewers:**

The CIE reviewers shall conduct necessary preparations prior to the peer review, conduct the peer review, and complete the deliverables in accordance with the ToR and milestone dates as specified in the Schedule section.

Prior to the Peer Review: The CIE shall provide the CIE reviewers contact information (name, affiliation, address, email, and phone) to the Office of Science and Technology COTR no later than the date as specified in the SoW, and this information will be forwarded to the Project Contact.

Pre-review Documents: Approximately two weeks before the peer review, the Project Contact will send the CIE reviewers the necessary documents for the peer review, including supplementary documents for background information. The CIE reviewers shall read the pre-review documents in preparation for the peer review.

CIE reviewers shall access the following documents containing information related to the ToR:

1. Draft Biological Opinion on the long-term Central Valley Project and State Water Project Operations Criteria and Plan. National Marine Fisheries Service December 2008.
2. Long-term Central Valley Project and State Water Project Operations Criteria and Plan – Biological Assessment, including appendices. US Bureau of Reclamation. April 29, 2008.
3. Reviews of the 2004 Biological Opinion (4 documents ~ 75 pages)

These documents and other background material (or links to them) will be provided to the CIE reviewers by the Project Contact according to the schedule herein..

4. [possible other Background docs: previous NMFS BOs that pertain to CVP water operations (*i.e.*, the 2000 Trinity River Restoration Program BO and 2004 OCAP BO) and the CALFED's adaptive management process (*i.e.*, the Salmon Decision Process), VSP criteria.
5. Background information on the ESA and NMFS' responsibilities for implementing the ESA is available from the NMFS Office of Protected Resources web site at:  
<http://www.nmfs.noaa.gov/pr/laws/esa.htm>.

Documents 2. through 5. can be available for pre-review in September 2008. This list of pre-review documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process. Furthermore, the CIE reviewers are responsible for only the pre-review

documents that are delivered to them in accordance to the SoW scheduled deadlines specified herein.

Desk Peer Review:

The primary role of the CIE reviewer is to conduct an impartial peer review in accordance to the ToR herein, to ensure the best available science is utilized for NMFS management decisions (refer to the ToR in Annex 1).

Terms of Reference: The ToR for the CIE peer review is attached to the SoW as Annex 1. Up to two weeks before the peer review, the ToR may be updated with minor modifications as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

Independent CIE Peer Review Reports:

The primary deliverable of the SoW is each CIE reviewer shall complete and submit an independent CIE peer review report in accordance with the ToR, and this report shall be formatted as specified in the attached Annex 2.

**Schedule of Milestones and Deliverables:**

|                   |  |
|-------------------|--|
| 11/04/08          | CIE shall provide the COTR with the CIE reviewer contact information, which will then be sent to the Project Contact |
| 12/11/08          | The Project Contact will send the CIE Reviewers the pre-review documents   |
| 12/26/08-01/09/09 | Each reviewer shall conduct an independent peer review   |
| 01/16/09          | CIE shall submit draft CIE independent peer review reports to the COTRs  |
| 01/30/09          | CIE will submit final CIE independent peer review reports to the COTRs   |
| 02/07/09          | The COTRs will distribute the final CIE reports to the Project Contact   |

**Acceptance of Deliverables:**

Each CIE reviewer shall complete and submit an independent CIE peer review report in accordance with the ToR, which shall be formatted as specified in Annex 2, to Manoj Shivlani, CIE Lead Coordinator, via [shivlanim@bellsouth.net](mailto:shivlanim@bellsouth.net), and Dr. David Die, CIE Regional Coordinator, via [ddie@rsmas.miami.edu](mailto:ddie@rsmas.miami.edu). Upon review and acceptance of the CIE reports by the CIE Coordination and Steering Committees, the CIE shall send via e-mail the CIE reports to the COTR (William Michaels [William.Michaels@noaa.gov](mailto:William.Michaels@noaa.gov) at the NMFS Office of Science and Technology by the date in the Schedule of Milestones and Deliverables. The COTRs will review the CIE reports to ensure compliance with the SoW and ToR herein, and have the responsibility of approval and acceptance of the deliverables. Upon notification of acceptance, CIE shall send via e-mail the final CIE report in \*.PDF format to the COTRs. The COTRs at the Office of



Science and Technology have the responsibility for the distribution of the final CIE reports to the Project Contacts.

**Key Personnel:**

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**Request for Changes:**

Requests for changes shall be submitted to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the Contractor within 10 working days after receipt of all required information of the decision on substitutions. The contract will be modified to reflect any approved changes. The ToR and list of pre-review documents herein may be updated without contract modification as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

## ANNEX 1

### Terms of Reference

#### **For the 2008 National Marine Fisheries Service's (NMFS) Biological Opinion (BO) on the long-term Central Valley Project and State Water Project Operations, Criteria and Plan (OCAP) Peer Review**

- Are the technical tools used in the NMFS OCAP BO (*e.g.*, modeling, calculations, analytical and assessment techniques) able to determine impacts to the individuals and to the populations?
- Are assumptions clearly stated and reasonable based on current scientific thinking?
- Do the biological assessment and BO adequately assess the individual responses of fish to certain effects (*i.e.*, flows, water temperatures, diversions, *etc.*) and was the best available information used by NMFS to evaluate how fish are likely to respond to those impacts.
- Do the data, analyses, results, and conclusions presented lead to a thorough understanding of the risks to individuals and populations from the proposed project impacts? If not, what relevant scientific information should be considered?
- Are the analytical techniques capable of determining the significance of project impacts for Endangered Species Act (ESA) purposes? If not, what additional or alternative analytical techniques are recommended? What *available* science should be used to best address the impacts of this large-scale water project as examined in the BO?
- Were uncertainties considered in the BO? If so, were they described in a way that frames the data or puts it in the proper perspective (*e.g.*, the appropriate time scale, or the likelihood that an event will happen)? What uncertainties and limitations were not addressed that might impact the BO substantively?
- In the absence of available information to establish probable responses to impacts (*e.g.*, survival across the Delta, steelhead population estimates, steelhead losses at the Delta pumps, spring-run Chinook salmon populations above Red Bluff Diversion Dam), were reasonable scenarios developed to identify types of exposures? Were comparisons made to other species with similar impacts?
- Were relevant published and unpublished studies on ESA-listed fish species, similar species, ecological theory, and computer simulation/modeling missed?
- Was evidence provided to support conclusions relative to species responses to demographic changes (*e.g.*, changes in fecundity rates, changes in growth rates for individuals, and changes in numbers of individuals that immigrate or emigrate from populations)? Was

evidence provided to support the conclusions about how the proposed actions affect the species' demographics?

#### Further Purposes of the Review

In addition to answering the fundamental questions posed above, another intended use of this review is to help ensure that best available information is used for future ESA consultations, such as early consultation components for OCAP, and the South Delta Improvement Program. Reviewers shall address possible inadequacies in the NMFS BO (*i.e.*, Did the BO apply the available information in a scientifically sound manner?).

## **ANNEX 2**

### **Format and Contents of CIE Independent Reports**

1. The report should be prefaced with an Executive Summary with concise summary of goals for the peer review, findings, conclusions, and recommendations.
1. The main body of the report should consist of an Introduction with
  - a. Background
  - b. Terms of Reference
  - c. Description of Review Activities
2. Summary of Findings in accordance to the Term of Reference
3. Conclusions and Recommendations in accordance to the Term of Reference
5. Appendix for the Bibliography of Materials used prior and during the peer review.
6. Appendix for the Statement of Work
7. Appendix for other pertinent information for the CIE peer review.