REVIEW OF THE 2008 NATIONAL MARINE FISHERIES SERVICE'S BIOLOGICAL OPINION ON THE LONG-TERM CENTRAL VALLEY PROJECT AND STATE WATER PROJECT OPERATIONS, CRITERIA AND PLAN

Prepared for the Center of Independent Experts
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1. Executive Summary

This review evaluates and comments on the use of the best available scientific and commercial information as it pertains to the development of the draft 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). The OCAP is large and complex, having impacts that are broad spatially and often interlinked, reflecting the migratory nature of the species under consideration and the physical and biological interconnections among habitats of river systems. This has presented a significant challenge to develop and implement technical tools to assess, as well as forecast impacts, particularly in a variable and changing environment (e.g. climate change) where data limitations are significant. Within this context, the BO has been successful overall in applying the best available information in a scientifically sound manner.

A series of sequential analyses relate river hydrology, delta hydrodynamics and river temperature to salmon mortality and population dynamics to assess effects on individuals and from this, on populations. The life cycle framework used is appropriate in this context. The sequential analyses are reasonably comprehensive for winter- and spring-run Chinook and Central Valley steelhead, and where information was lacking, reasonable surrogates are used. The same cannot be said for green sturgeon, where information/data limitations inhibit quantitative application of model outcomes from the physical habitat to effects on individuals and the population. As a result, there is a stronger reliance on qualitative assessments for the Southern Distinct Population Segment than is desirable. There are improvements that can be made in the use of technical tools as they pertain to salmon, including: (1) more transparent use of the life cycle approach in framing how impacts at various life stages translate into effects on individual fitness and ultimately the dynamics of populations; (2) use of daily time steps; (3) enhanced temporal and spatial monitoring of temperature; and (4) improved abundance estimates for steelhead and green sturgeon.

While most of the basic assumptions underlying the analyses are clearly stated and are scientifically defensible, there are some that would benefit from more explicit attention including (1) the additive nature of stressors and non-linear responses; (2) demands for water and flood-control regulation are independent of the climate change scenario; and (3) availability of b(2) water into the future. The assumptions do introduce uncertainties that need to be considered. Quantitative examination of uncertainty is limited to the hydrologic modeling and climate

change analyses, otherwise it is treated qualitatively. The BO would benefit from a more explicit documentation of the qualitative uncertainties associated with the analyses and assessments.

The biological assessment and BO provide an adequate assessment of individual responses of fish to certain effects where the information/data is sufficient to do so (i.e. the best available information is applied). However, the dearth of knowledge/data for green sturgeon inhibits an adequate assessment of fish responses and a thorough understanding of the risks to individuals and populations for this species. Assessment of risk is also hindered for Central Valley steelhead because of sparse and indirect estimates of abundance for the distinct population segment and knowledge concerning life history plasticity (i.e. anadromy versus residency). The modeling of climate change effects across a range of scenarios is informative and reasoned. An improved understanding of the potential indirect effects of altered flow and temperature regimes on the ecological community within which the fish reside is needed for a more complete assessment of risks. Conclusions drawn about how the proposed actions affect species' demographic tended to be qualitative; however, the evidence provided to support the conclusions was appropriate. The BO would benefit from development of population models using inputs from the sequential life stage analyses to refine the assessment of population responses.

2. Introduction

a) Background – As described in the statement of work (see Appendix 2), 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 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). The review focuses on the technical aspects of the NMFS BO and the information provided in the OCAP biological assessment. The review does not aim to 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 the OCAP proposed by the US Bureau of Reclamation (Reclamation). Following the issuance of the 2004 BO, three separate peer review processes (CALFED Science Program, Center for Independent Experts 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 sought independent peer review of the BO to ensure that NMFS has used the best available information for its analysis.

The proposed action is the continued operation of the CVP and SWP. In addition to current day operations, several other actions are included: (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.

The NMFS' draft Opinion on the proposed action was written in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.). The final version of this draft Opinion is to supersede the 2004 OCAP Opinion and to be based on (1) the initiation package provided by Reclamation, including the OCAP BA, received by NMFS on October 1, 2008; (2) the supplemental analysis of effects on the proposed critical habitat of Southern DPS of green sturgeon and supplemental information regarding the EFH assessment on fall-run Chinook salmon; (3) other supplemental information provided by Reclamation; (4) declarations submitted in court proceedings pursuant to Pacific Coast Federation of Fishermen Association (PCFFA) *et al*. v. Gutierrez *et al*.; and (5) scientific literature and reports.

The charge for the present review was 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. Additionally, 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), was to be considered. The data provided in both the OCAP BA and the NMFS BO were to be reviewed.

My area of expertise in relation to the present review is in the evolutionary ecology of fishes, particularly that of salmonid fishes. In section 3 of this report, I thus address each of the questions presented under the terms of reference on the basis of this expertise, recognizing that I am neither an expert in hydrology or water management.

b) Terms of Reference – Following are the questions posed under 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?

- 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?).

c) Description of Review Activities – The review commenced on 15 December 2008, with the release of the contract and review materials. A deadline of 9 January 2009 was set for the delivery of my report. Access to the review documents was provided on an FTP site from which they were download, including the NMFS draft BO (December 2008) and appendix, the OCAP BA (August 2008), and reviews of the 2004 NMFS BO. All these documents were studied

In undertaking the review, I focused on the questions presented under the term of reference, applying my expertise in fish evolutionary ecology to evaluate and comment on the use of the best available scientific and commercial information as it pertains to the 2008 draft NMFS BO on the OCAP.

3. Summary of Findings in Accordance with 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?***

After reviewing the NMFS draft BO (and the associated OCAP BA) and reading previous reviews of earlier BO versions (Anderson et al. 2005, 2008, Deas et al. 2008, Maguire 2006, McMahon 2006) and NMFS responses to reviews (NMFS 2005), I am of the opinion that there have been considerable strides in the application of technical tools for determining impacts, particularly to individuals. A series of sequential analyses are used to assess effects on individuals and critical habitat. Models relating to river hydrology, delta hydrodynamics and river temperature feed into salmon mortality models to assess effects on individuals. These sequential analyses are reasonably comprehensive for winter- and spring-run Chinook and Central Valley steelhead, and where information was lacking, reasonable surrogates are used. Unfortunately, a lack of data/information for green sturgeon, including direct population size estimates, has limited analytical assessment and resulted in a stronger reliance on qualitative assessments of the Southern Distinct Population Segment than might be desirable.

Biological Opinion has benefited from a consideration of a life cycle approach, whereby a population's growth rate (or fitness) is a result of events (impacts) at different life stages and transition rates between stages. However, the approach could be more comprehensively applied throughout the BO. It is introduced early in the BO, but becomes somewhat hidden when assessment of the risk of proposed actions is examined. Given that particular actions may have sublethal effects that cross life stages, a life cycle framework provides an effective means of capturing these. It also provides an explicit means of moving from individual effects towards population effects (i.e. population vital rates and growth).

Following are specific points relating to the use of the technical tools:

- The BO would be improved by increased integration of models and available information to more transparently identify the linkages among life history stages and spatial effects (e.g. how changes in one river section may affect other sections).

- It was not always clear what time steps were being used, and the reader is forced to refer to Table 9-1 of the OCAP BA to find out the model time step (which range from monthly to hourly). The monthly time step used in the Reclamation Temperature model is too crude to capture important (daily) variability likely to affect the habitat (e.g. ecological community) and fitness of individual fish (e.g. Mather et al. 2008).

- In terms of inputs into the technical tools, enhanced temporal (daily) and spatial recording of temperature data within the Central Valley system would be valuable. Spatial coverage should not only include improved main stem temperature monitoring, but also that of tributaries below and above dams, as well as vertical temperature profiles within reservoirs (see also Deas et al. 2008). Given existing technology (e.g. temperature loggers) this should neither be difficult nor expensive. Moreover, the return for investment could be considerable in terms of improving data quality for models and

improving management capabilities (e.g. water release from reservoirs and use of Temperature Control Devices).

- There also is a need for improve monitoring, particularly of steelhead and green sturgeon (e.g., abundance information is frequently lacking). A general dearth of information about green sturgeon constrains the biological assessment and opinion.

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

Table 2-3 of the BO effectively documents general assumptions, and their bases, made in analyzing the effects of the proposed action. Chapter 9 of the OCAP BA provides a description of many of the basic assumptions associated with study scenarios used in the modeling.

There are, however, a few instances where assumptions could be more clearly addressed.

- Throughout the BO, stressors are generally assumed to be additive. While it is mentioned in a few places in the BO that this may not be the case, more explicit recognition of the potentially non-linear and non-additive nature of stressors would be appropriate. This will add uncertainty to the models.

- An assumption underlying the climate change models that should be explicitly identified is that demands for water and flood-control regulation do not vary across the six scenarios (9.0-9.5) presented. While it may be difficult to predict future demands, this uncertainty needs to be recognized in the modeling exercise. It would seem unlikely that demands would be unchanged from the OCAP BA future operations baseline. Thus, while there may not be a more reasonable assumption, there needs to be explicit recognition of the uncertainty this introduces.

- In developing abundance estimates based on redd counts, no justification is provided for assuming 2 fish per redd and why such an assumption is conservative (see section 5.1.2). By contrast, Hannon and Deason (2008; referred to in the BO) assume a range from 1 redd per female to two redds per female when estimating adult population abundance.

- Unclear on pg 117 of the BO whether it is reasonable to assume the use of b(2) water would continue into the future. By contrast, on pg 222 it is stated that we cannot assume b(2) or b(3) water are committed for fishery uses.

- The implicit assumption that the particle tracking model provides a first estimate of the likelihood of entrainment appears to be substantiated by telemetry studies. However, little detail is provided to the reader by which to assess this (i.e. the degree to which the findings of the telemetry studies parallel the model).

- ***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.***

The biological assessment and BO do adequately assess the individual responses of fish to particular effects where there is sufficient information/data upon which to base such an assessment. However, the dearth of knowledge/data for green sturgeon inhibits an adequate assessment of fish responses for this species.

Critical temperatures for thermal limits are drawn from laboratory experiments, where temperatures remain constant and other stresses minimized. While this does represent the best available information for assessment, the question remains how representative these are of the natural environment. The approach of applying fix thermal limits, given this uncertainty, appears to be appropriately conservative.

Comment is made to the effect that salmonids show local adaptation to thermal regimes, implying that thermal tolerance may evolve. While this may be correct, the evidence suggests that differences in upper lethal temperatures and optimal temperatures for growth among salmon populations from very different thermal environments are often subtle and not necessarily in predicted directions (e.g. Konecki et al. 1995, Jonsson et al. 2001, Finstad et al. 2004, Larsson et al. 2005).

- ***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?***

The data, analyses, results and conclusions presented provide a reasonable understanding of the risks to individuals and populations from the proposed project impacts for winter- and spring-run Chinook and Central Valley steelhead, but not green sturgeon. The lack of data/knowledge about green sturgeon inhibits this (e.g. abundance, physiological limits, behaviour, life history).

The incorporation of climate change scenarios in analysis has been critical for evaluating how fish are likely to respond to impacts from the action. Climate change presents an additional challenge for water management into the future (Milly et al. 2008), including that of the Central Valley (Cayan et al. 2008). The approach for incorporating climate change involved sensitivity analysis of the OCAP BA future operations baseline (with and without sea level rise) against four climate change scenarios for 2030 that represent a range of possibilities based on available climate projection information. The projections used were reasoned and represent what appear to be among the best available. While the approach does not allow an assessment of relative likelihood of differing scenarios (a far more entailed undertaking), it does provide an idea of the range of change/affects that could be expected (i.e. varying from: less warming to more warming from historical; and, drier to wetter than historical). The potential responses of the fish to climate change will be affected by their inherent phenotypic plasticity and/or their ability to respond evolutionarily, much as it is to forms of change.

Indirect effects of altered temperature patterns through associated changes in the surrounding ecological community are necessarily qualitative given the dearth of quantitative information. However, changes to the predator community appear to be given greater significance in the BO than that to the forage community of the fish. No clear justification is given for this. While predation is lethal and easier to detect, changes to the prey community may be of equal or greater importance through sublethal effects on, for example, fish growth and physiological condition that may ultimately affect fitness. A more balanced and inclusive incorporation of affects on the fish prey base would be valuable.

One aspect concerning the risk to Sacramento River *Oncorhynchus mykiss* (and to a lesser extent those of the American River, which is already heavily impacted by hatchery releases) that needs more thorough investigation is the apparent shift from anadromy to residency. What does this means for phenotypic and genetic diversity of the population and distinct population segment? In a related sense, what is the role that rainbow trout may play, or not, as a reservoir *O. mykiss* biodiversity within the Central Valley? Habitat loss and altered flow and temperatures appear to be contributing to this shift from anadromy to residency among *O. mykiss*, which may constitute a loss not only of life history diversity but also genetic diversity (see Williams et al. 2008).

- ***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?***

Development of population models (e.g. population viability analysis, life table analysis) from the sequential life stage analyses would refine the assessment of population responses. Moreover, it would allow for an analysis of sensitivity or elasticity and insight into those life stages and impacts that particularly affect the population growth rate.

Some consideration could be given to the application of Bayesian inference to assessing impacts (e.g. Hobbs & Hilborn 2006, Nelitz et al. 2007)

- ***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?***

The BO does consider uncertainties in general terms. Quantitative examination of uncertainty is limited to the analysis for CalSim-II, as well as to the effects of climate change where a range of scenarios are presented. Otherwise uncertainty tends only to be given passing mention. Detailed, quantitative examination of uncertainty across analyses/models requires considerable effort, likely beyond the capacity of the BO. The BO, however, would benefit noticeably from a more explicit documentation of uncertainties associated with the analyses and assessments (a section devoted to this would be appropriate). There are process uncertainties arising from natural variability, observational uncertainties arising from measurement and sampling errors, model uncertainties due to incomplete knowledge and simplifying assumptions to make models tractable, and estimation uncertainties arising from the assignment of parameter values

(described in Francis and Shotton 1997). All these are relevant to the BO and should be presented. The most substantive uncertainties and limitations surrounded the risk assessment for green sturgeon because of poor data quality and lack of knowledge.

- ***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?***

Given the lack of available information by which to establish probable responses, it is difficult to ascertain how reasonable the developed scenarios were. Inferences made from comparisons with other species and/or from other geographical locations did increase the confidence in the scenarios presented. Even so, the degree of uncertainty around these scenarios must remain high.

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

There are a number of papers in a recently published issue of the journal *Evolutionary Applications* (volume 1, issue 2 - Special Issue: Evolutionary perspectives on salmonid conservation and management) that present key principles and useful examples as they pertain to, for example, climate change (Crozier et al. 2008), dam affects on riverine conditions (Angilletta et al. 2008, Haugen et al. 2008, Williams et al. 2008) and habitat loss (McClure et al. 2008, Waples et al. 2008). There are also a few recent publications on impacts of hatcheries on wild fish populations (Araki et al. 2007, 2008) and the ability of captive breeding programs to conserve biodiversity (Fraser 2008), which may be useful in relation to the operations of the Nimbus and Trinity River Hatcheries (section 4.2.1.2.2.6). In terms of relations between thermal regimes and migratory success, Farrell et al. (2008) provide a useful review.

- ***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?***

There were few, if any, conclusions drawn relative to species' responses to demographic changes. Rather, both the biological assessment and the BO focus on how the proposed actions affect species' demographics. Much of the latter inference was qualitative; however, the evidence provided to support the conclusions was appropriate. As mentioned above, the BO could benefit from the incorporation of population models (e.g. population viability analysis, life table analysis).

4. Conclusions and Recommendations

The proposed action, as outlined in the OCAP and NMFS BO, is large and complex, having impacts that are broad spatially and often interlinked. This is, in part, a function of the highly

migratory nature of the species under consideration, which use and depend on a variety of different habitats through their life history, and the interconnections among the physical and biological habitats of river systems (i.e. from head water streams to the estuary) . As a result, it is a significant challenge to develop and implement technical tools to assess, as well as forecast impacts, particularly in a variable and changing environment (e.g. climate change). Within this context, the BO was successful overall in applying the available information in a scientifically sound manner.

The presentation of the information in the BO, however, will inhibit effective evaluation of the findings, whether it is by reviewers, managers or legislators. While the format of the BO may be legislated, it does result in considerable repetition (including verbatim repetition of paragraphs) and inefficient conveyance of the key information. A shorter document, eliminating redundancy and increasing the use of figures, tables and flow charts to convey key information (e.g. linkages across life history stages, derivation of mortality estimates, presentation of uncertainly about estimates), would be more effective in presenting the data, analyses, results and conclusions for the purpose of evaluation and forming opinions.

That aside, the BO provides a comprehensive assessment of impacts and risks given the data limitations. These limitations, however, are particularly acute for green sturgeon. Abundance estimates for Central Valley steelhead are also inadequate. These deficiencies should be addressed in future research and monitoring studies to help ensure that key information is available for future ESA consultations. The life cycle approach provides a sound framework for analysis, but should be applied more consistently throughout the BO. Application of population models is encouraged to be able to better assess population level effects and identify key life stages.

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Appendix 2 – Statement of Work for Dr. Ian A. Fleming

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, and Dr. David Die, CIE Regional Coordinator, via 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 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:

Contracting Officer's Technical Representative (COTR):

William Michaels
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Contractor Contacts:

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Project Contact:

Maria Rea
NMFS Sacramento Area Office
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Sacramento, CA 95814
Maria.Rea@noaa.gov Phone: 916-930-3623

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.

2. The main body of the report should consist of an Introduction with
    a. Background
    b. Terms of Reference
    c. Description of Review Activities

3. Summary of Findings in accordance to the Term of Reference

4. 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.