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Prepared for the U.S. Department of the Interior

Peer Review Panel Report on Draft Klamath Dam Removal Overview Report for the Secretary of the Interior (2012)

March 2012

Prepared by:

ATKINS

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Contents

Acronyms and Abbreviations

cfs	Cubic feet per second
DOI	United States Department of the Interior
FERC	Federal Energy Regulatory Commission
KBRA	Klamath Basin Restoration Agreement
KHSA	Klamath Hydroelectric Settlement Agreement
NAGPRA	Native American Grave Protection and Repatriation Act
NED	Net Economic Development
NHPA	National Historic Preservation Act of 1966
RED	Regional Economic Development
TMT	Technical Management Team

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1.0 Introduction

1.1 Peer Review Participants

Panel Members

Stephen Dow Beckham, Ph.D.
Charles C. Coutant, Ph.D.
William L. Graf, Ph.D.
Steve Higinbotham, P.E.
Dan Huppert, Ph.D.
Daniel Schindler, Ph.D.

Atkins Facilitators

Rebecca Burns
Tom St. Clair, Ph.D.

1.2 Background on the Klamath Dam Removal Overview Report for the Secretary of the Interior

Under the terms of the Klamath Hydroelectric Settlement Agreement (KHSA), the Secretary of the Interior is to make a determination (referred to as the Secretarial Determination) as to whether removal of four privately owned dams on the Klamath River in Oregon and California is in the public interest and will advance restoration of fisheries. As a part of this Secretarial Determination, the KHSA identified information needs and specific questions that should be addressed with new studies and analyses. For the Secretarial Determination process, additional detail was necessary for these questions beyond what was originally laid out in the KHSA. The four questions are as follows:

(1) Will dam removal and KBRA [Klamath Basin Restoration Agreement] implementation advance salmonid and other fisheries of the Klamath Basin over a 50-year time frame?

(2) What would dam removal entail, what mitigation measures may be needed, and what would these actions cost?

(3) What are the major potential risks and uncertainties associated with dam removal?

(4) Is dam removal in the public interest, which includes, but is not limited to, consideration of potential effects on local communities and tribes?

The purpose of the Klamath Dam Removal Overview Report for the Secretary of the Interior (Overview Report) is to provide a single, convenient synthesis of major findings from available technical reports that address each of the four questions listed above, including but not limited to new technical reports prepared by a federal team for the Secretarial Determination (Technical Management Team [TMT]). The Overview Report presents the analysis of two scenarios: dam removal and implementation of the KBRA (*Dams Out with KBRA*) and dams remain without implementation of the KBRA (*Dams Remain*), which are two of the five alternatives selected for analysis in the draft Environmental Impact Statement/

Environmental Impact Report. The *Dams Out with KBRA* scenario includes the removal of the four facilities (J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams), as described in the KHSA; transfer of Keno Dam to the United States Department of the Interior (DOI); and full implementation of the KBRA. The *Dams Remain* scenario would continue current operations with the dams remaining in place and PacifiCorp operating under the current Federal Energy Regulatory Commission (FERC) license. The Overview Report does not present findings or recommendations as to whether implementation of the agreements is in the public interest (Question 4); that determination will be made by the Secretary of the Interior. The Overview Report does, however, present information for a public interest determination, including the potential effect of implementing the two agreements on the national economy, regional jobs, local communities, Indian tribes, and natural resources.

2.0 Purpose/Intent of Peer Review

As described in the TMT's Charge to the Peer Review Panel (Panel), the purpose of a peer review of the Draft Overview Report is to improve its quality and usefulness by ensuring that it accurately reflects major findings of cited reports, especially those relevant to the four questions of the Secretarial Determination, adequately covers major topic areas essential for a Secretarial Determination, reaches defensible conclusions, and presents information clearly. The review is also required to fulfill the Office of Management and Budget's guidance to federal agencies for a rigorous peer review process for Highly Influential Scientific Assessments (Office of Management and Budget 2004) and the White House Memorandum on Scientific Integrity (White House Memorandum 2009). The Overview Report is a Highly Influential Scientific Assessment that, upon dissemination, "…could have a potential impact of more than $500 million in any one year on either the public or private sector or that the dissemination is novel, controversial, or precedent setting, or has significant interagency interest" (Office of Management and Budget 2004). As such, the rigor of the peer review process for the Overview Report was increased; a larger number of reviewers was selected for the Panel, and opportunity for technical public comment was provided. The credibility and public acceptance of a report increases with a rigorous review process in an open and transparent fashion that includes public participation.

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3.0 Peer Review Process

Atkins North America (Atkins), a contractor specializing in conducting peer reviews, selected the Panel from a list of 34 potential candidates provided by the TMT. Eighteen individuals from academia, private consulting, and non-profit organizations were contacted to determine their interest, availability, and eligibility to serve on the Panel, and six individuals were selected (see Appendix A for biographical summaries of the reviewers). The Panel is made up of recognized experts from the following disciplines: natural resources economics, riverine geomorphology, dam removal engineering, aquatic ecosystems, Pacific salmonid biology, and anthropology. Once interest and availability were confirmed, the credentials of each candidate were evaluated to verify that no real or perceived conflicts of interest existed. In addition, each candidate specifically disclosed any potential conflicts of interest according to the National Academies' Conflict of Interest Disclosure process.

The Panel received background information, such as the KHSA and KBRA, and key technical reports prepared as part of the Secretarial Determination process (these documents are on the official Klamath Restoration website at http://klamathrestoration.gov) concurrent with receiving the Overview Report. On January 25, 2012, two days after its release on the official website, a link to the Overview Report was distributed to the Panel, and hard copies were mailed to each reviewer. The TMT issued a Charge to the Peer Review Panel that directed members to focus on ensuring that the Overview Report accurately reflects cited reports, adequately covers major topic areas essential for a Secretarial Determination (i.e., the four questions listed in Chapter 1), reaches defensible conclusions, and clearly presents information. Panel comments were to avoid matters of policy and law (such as advice on the amount of uncertainty acceptable for decision making), which are within the purview of the federal government. In addition, peer review of the Overview Report was not to extend to peer review of the other cited reports that have already undergone peer review.

A 12-day public review of the Overview Report also began on January 25, 2012. Atkins collated and organized, by section and topic area, all comments received from the public and made them accessible to the Panel via a file-sharing website. The Panel was asked to consider only those public comments that were technical or scientific in nature to determine whether the comments justify modification of the Overview Report. The Panel independently reviewed the technical comments submitted by the public and considered them during preparation of their comments and their face-to-face deliberations; however, the Panel had no obligation to respond to public comments.

From February 13 to 17, 2012, the Panel convened in daily face-to-face meetings in Seattle, Washington; these meetings were facilitated by two Atkins staff members. On the first day, the DOI Program Manager for the Klamath Basin Secretarial Determination and the Program Manager for the Klamath River Dams Project Office attended to explain the charge to the Panel and answer questions. The two DOI representatives also provided the Panel with contact information for TMT members so that they could be contacted if the Panel had specific technical questions or needed clarifications during their deliberations. The Panel contacted several members of the TMT via phone over the course of the week to obtain clarifications.

The review was organized around a series of questions pertaining to Sections 4.1 through 4.4 of the Overview Report, as well as some broad questions that are directed at an overall report evaluation. During the course of the week, the Panel prepared individual responses to the TMT's questions based on their fields of expertise and then compiled and integrated those responses into a draft report. These questions and responses form the outline of this peer review report. Responses to the questions are generally organized to include short statements describing the review comment, clear and concise recommendations, and, if required, discussion to add detail to the comment. Additionally, to provide a concise statement of their overarching comments, the Panel included a section entitled "General Review Comments on Overview Report" (see Chapter 4) as a high-level summary. Finally, Appendix B contains generally minor, detailed comments.

Atkins reviewed and edited the peer review report for clarity, conducted technical editing and formatting, and then resubmitted the report to the Panel for a final review. After approval by each Panel member, Atkins then submitted the final peer review report to the TMT.

4.0 General Review Comments on Overview Report

In the opinion of the Panel, the Overview Report authors handled many difficult issues with vision, clarity, and skill. The Overview Report is an admirable synthesis of diverse research activities that can support decision-makers engaged in the issue of dam removal on the Klamath River.

The Overview Report is a particularly effective and accurate representation of the relevant science in the following regards:

- *Clarity*: The Overview Report is generally well written, well organized, and easy to read and understand. The sidebars, graphics, and photographs enhance the completeness of the individual sections; this is a major accomplishment considering the extensive source documentation that was used to develop the Overview Report.

- *Dam Removal Costs and Engineering:* The details for developing the physical removal of the dams and associated facilities are particularly comprehensive. The proposed schedules associated with reservoir drawdown and dam removal are designed to minimize impacts during fish migration windows and to allow for the transport of sediment from the reservoirs during normally high flows to minimize the concentration levels and deposition in downstream reaches. The overall development of the proposed removal schemes was well thought out.

- *Production Processes*: The process leading to the Overview Report was a hierarchy of scientific information and its analysis. This flow is a logical and valid way to condense a great deal of disparate scientific information into summaries and findings relevant to possible dam removal.

- *Water Quality:* Sections dealing with water quality are well done and achieve Overview Report objectives; they provide extensive data, discuss appropriate scientific methods, and present useful and informative results. The discussion of current challenges related to water quality in the Klamath River system and how these would change by removing dams is particularly strong. Certain issues that are understood with high confidence (e.g., the effect of water impoundment on cyanobacteria blooms) are described with appropriate authority, while issues with substantial remaining uncertainty (e.g., how implementation of the KBRA would affect water quality in Upper Klamath Lake) are qualified appropriately.

Despite these general strengths, the Overview Report could be edited to improve its effectiveness. These general observations may need to be addressed in multiple document sections, as they transcend individual, smaller-scale conclusions. General observations that require the authors' attention are discussed below.

- *Clarification of Scenarios:* Clearly describe the two scenarios compared in the initial pages of the Executive Summary and Introduction, not just on p. 59. Explain that exclusion of agency Biological Opinions and potential FERC licensing stipulations from the *Dams Remain* scenario was due to the expectation that such additions to the current dam operations would not occur for decades for engineering and legal reasons. Further, the effectiveness of such additions is not ensured.

- *Uncertainty*: Be more explicit in describing the relative uncertainties associated with various ecosystem responses to the two restoration scenarios. The Overview Report does not discuss the range of potential outcomes and associated unknowns to the degree expressed in the original technical reports. Some responses are known with high levels of confidence, while others involve substantial uncertainties. As written, the Overview Report does not reflect these differences effectively; for example, the discussion on p. 102 is very good but should be included earlier in the report.

- *Sediment:* Include more information on (1) the fate of released sediments, (2) particle sizes of the sediments, including the sand-sized particles, and (3) chemical characteristics of the sediment. As is the case with most dam removals, the fate of the sediments behind the dams is of primary importance.

- *Fish Passage:* Present an assessment of the fish passage facilities at the Keno and Link River dams. These dams are to remain with implementation of the *Dams Out with KBRA* scenario; however, much of the anticipated success of repopulating the upper Klamath Basin with anadromous salmon and steelhead depends on successful passage at these dams. The fish passage facilities at these dams and the ability of adults to pass upstream and juveniles downstream are inadequately presented in the Overview Report.

- *Tribal Rights:* Clarify the various situations of the six tribes involved in decisions about the future of dams, fisheries, irrigation, and other water uses in the Klamath watershed because each has its own history and sometimes different federal relationships and entitlements. Some individual Indians have trust lands secured through allotments or homesteads with water rights and riparian settings.

- *Adaptive Management and Monitoring:* Explicitly state that the *Dams Out with KBRA* scenario represents a serious commitment to an appropriately scaled monitoring and assessment program. This monitoring and assessment program is critical, both for developing an adaptive management program for the Klamath system and for capitalizing on this opportunity to learn about ecosystem responses to dam removal in general.

- *Maps:* Include additional and improved maps to place the Overview Report in an informative geographic context. Of greatest importance is to include a large, detailed map showing the locations of places and features important to the report. Wherever possible, show features and locations mentioned in the Overview Report on one map. Current maps are deficient in this regard.

- *Keno and Link River Dams:* Explain the rationale for leaving Keno and Link River dams in place while others are proposed for removal early in the Overview Report. The reasons appear to be tied to Reclamation's Klamath Project.

- *Reclamation's Klamath Project:* Explain Reclamation's Klamath Project with additional text and maps so that the reader understands its extent and significance for water management, agriculture, and wildlife refuges. Important provisions of the KBRA and the retention of Keno and Link River dams are tied to this irrigation project.

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5.0 Responses to Broad Review Questions

In their Charge to the Peer Review Panel, the TMT included four broad review questions for the Panel to address as an overall evaluation of the Overview Report. The Panel's responses to these questions are provided below.

1. Does the report meet the expectations laid out in the "Purpose and Scope of this Report" (Section 1.1 of the Overview Report) in terms of the scientific and technical subjects covered, the depth of that coverage, and the clarity of the report?

The Overview Report generally meets the expectations laid out in the "Purpose and Scope of this Report," except for some specific instances discussed elsewhere in this peer review report. Generally, the Overview Report connects to the sound science that underlies its conclusions, provides a depth of coverage suitable for the anticipated audience, and provides clearly stated concepts and conclusions.

2. In the judgment of the reviewers, do the Overview Report sections covering "Introduction," "Technical Input and Public Outreach," and "Data Collection Processes" provide the context needed for the reader to understand the issues, the technical content in the report, and the significance of the findings and conclusions?

The Overview Report sections covering "Introduction," "Technical Input and Public Outreach," and "Data Collection Processes" generally provide the necessary context required for readers to understand the issues, contents, and significance of the authors' findings and conclusions; however, some specific areas do not achieve these results; those are described below.

Keno and Link River Dams

Comment 2-1: Keno and Link River dams are integral parts of the Klamath River ecosystem in both the *Dams Remain* and the *Dams Out with KBRA* scenarios.

> **Recommendation:** Add descriptive text, images, and tabular data to Section ES 1.2 or to the Introduction regarding the Keno and Link River dams.
>
> **Discussion:** Keno Dam and, to a lesser degree, Link River Dam are important to understanding the context of the Overview Report and to providing a complete picture of the Klamath River fluvial ecosystem. Neither dam will be removed, but both are mentioned throughout the Overview Report. The introductory sections would be more useful to decision-makers and readers if more information about the two were included. Images, text narrative, and tabular data could characterize them so that readers understand their critical roles in the control of river flows and the diversion of water from the river. Describe the fish passage structures of these dams to complete the picture of potential mobility of fish that migrate upstream from the current locations of the dams that might be removed.

Maps in the Overview Report

Comment 2-2: The maps included with the Overview Report are useful, but they do not provide decision-makers and readers with enough geographic information.

> **Recommendation:** Add at least three maps: general geography, hydrography of the Klamath Reclamation Project, and precipitation distribution in the Klamath Basin.
>
> **Discussion:** Well-chosen and designed map figures can improve the Overview Report's effectiveness to decision-makers and can provide valuable context; for example, in the Introduction, the addition of a full-page map or (better still) a fold-out map showing the entire basin with as many place names and highways as possible along with hydrography would help the reader become better oriented. Use an easily readable font for map names. The common editorial standard is that place names used in the text should appear at least once on a map to aid the reader in developing a geographic knowledge of the river basin; this standard should be adopted by report authors whenever possible.
>
> Although many additional maps could be included, three are critical: (1) a large general location map, (2) a medium-sized map of Reclamation's Klamath Project , and (3) a small precipitation map showing the distribution of water available for physical and biological river processes. Each map fulfills a specific function. The general location map in the Introduction would provide a context for decision-makers and a guide to specific places referenced in the Overview Report. The Reclamation's Klamath Project map is important because this major water feature will be part of any future scenario. A map showing the distribution of precipitation in the basin would clearly demonstrate one of the basic aspects of water in the basin: much more rainfall occurs in the lower basin than in the upper basin, a geographic reversal from many western watersheds.
>
> Maps that show the current and future spatial distribution of habitat available to anadromous fishes should emphasize which portions of the new habitat are contingent on fish being able to migrate around thermal and anoxic migration barriers; for example, Map 4.1-4 could overlay stippling on the areas of the historical habitat that would be available to fish with the *Dams Out with KBRA* scenario, but only if temperature and oxygen conditions were adequate.

Economics

Comment 2-3: In Section 4.4.1, the Overview Report does not clearly explain how the Net Economic Development (NED) account differs in concept from the Regional Economic Development (RED) account. Further, the section fails to explain how the estimated changes in county tax revenues could be used in the context of the other two economic measures.

> **Recommendation:** In the introduction to Section 4.4.1, clearly explain the differences between the economic measures included in the NED account and the measures included in the RED account. Also explain the role of the estimated change in local property tax revenues.

Discussion: Section 4.4.1 incorrectly explains the difference between NED and RED accounts as follows (paragraph 2, p. 136): "The primary difference between the NED and RED is geography. The NED analysis evaluates net economic benefits from the perspective of the entire nation, while a RED analysis evaluates economic impacts on a local region specified for the analysis." While the RED focuses on regional changes in the economy, and the NED measures costs and benefits at the national level, the key conceptual difference between the two analyses is not geography. The benefit-cost analysis reflected in the NED account measures what people are willing to pay for the improvements minus what the improvements will cost. The benefits include the economic values of fishing, recreation, and other uses of the Klamath River with the *Dams Remain* scenario versus *Dams Out with KBRA.* The RED economic impact estimates (which are reasonably presented in Sections 4.4.1.2 through 4.4.1.7) forecast changes in regional income and employment for the *Dams Remain* scenario versus *Dams Out with KBRA.*

The Section 4.4.1 introductory explanation of the economic assessments in Sections 4.4.1.1 through 4.4.1.7 should clearly note that the benefit-cost analysis attempts to quantify the economic value of numerous changes in the economic output in the Klamath Basin, both positive changes (benefits) and negative changes (costs). The RED account simply measures the changes in regional income and employment likely to be caused by the changed Klamath River system, without determining whether there are positive or negative net benefits. Income and employment changes will occur with any shift in the program expenditures, and this could be important to local businesses and governments, but they do not reflect the concept of net economic benefits that the NED analysis provides. That is the key distinction between NED and RED as described in the report. Also, Section 4.4.1 does not explain why the estimated change in county tax revenues (but not city or state tax revenues) are presented in Section 4.4.1.8. Every change in a local economy will have impacts on sales taxes, property taxes, and income taxes. The Panel presumes that this is included as an aid to planning by the local governments.

3. Do the "Executive Summary" and "Summary and Findings" capture the major findings in the main body of the Overview Report adequately and accurately; do these sections miss any major findings in the Overview Report?

Both the Executive Summary and the Summary and Findings are generally effective at capturing and communicating the major results of the Overview Report; however, both sections would benefit from additional editing and inclusion of more information on select topics as detailed below.

Comment 3-1: The two restoration scenarios under consideration are not described clearly enough in the Executive Summary.

Recommendation: In the Executive Summary, clearly define the two restoration scenarios under consideration, in particular the *Dams Remain* scenario.

Discussion: The *Dams Out with KBRA* is relatively well represented, aside from needing more detail to explain that the Keno and Link River dams will be retained; however, the *Dams Remain*

scenario is not specifically described, such as the fact that the operating rules will not be changed and the KBRA will not be in effect under this scenario. These sections should highlight early on that all subsequent analyses in the Overview Report assume that the current operations will continue (i.e., without any re-licensing or emerging considerations from the Biological Opinions). The second paragraph of p. 59 captures this issue, but this is first introduced to the reader too late in the Overview Report. The Executive Summary should more clearly state that the *Dams Remain* scenario has substantial risks and uncertainties associated with the future trajectories of fish populations and water quality.

Comment 3-2: The expected hydrologic responses to the two restoration scenarios are not highlighted sufficiently in the Executive Summary.

Recommendation: Improve the Executive Summary by including a graph that summarizes the annual hydrograph under three scenarios: historic (free-flowing), current (with all dams), and restored (*Dams Out with KBRA*). This comparison is not conveniently made anywhere in the Overview Report. It is central to the restoration proposal and should be highlighted accordingly.

Comment 3-3: The introductory section of ES.3 does not clearly state that the Keno and Link River dams would remain in operation in the *Dams Out with KBRA* scenario.

Recommendation: State clearly that the Keno and Link River dams would remain in operation in the *Dams Out with KBRA* scenario, and provide the rationale for this decision.

Comment 3-4: Update the Executive Summary to reflect revisions to the main body of the Overview Report.

Recommendation: Update the Executive Summary once other edits to the main body of the Overview Report have been made in response to other comments in this peer review report.

Comment 3-5: The Summary and Findings section does not sufficiently express the uncertainties in the responses to restoration options.

Recommendation: Edit the Summary and Findings section to qualify conclusions appropriately.

Discussion: The Summary and Findings section focuses at the appropriate level of detail to effectively communicate the primary findings of the Overview Report. The one reservation the Panel has about this section is that many of the expected responses to dam removal are stated without properly qualifying their uncertainties. Most of the main conclusions produced from the Overview Report require explicit qualification; for example, Table 5-1 states that restoration will "…expand opportunity to create springtime flushing flows…which are anticipated to reduce juvenile salmonid disease." In fact, the Panel's understanding is that the increase in spring flows will be quite modest, and that any increase in the likelihood of bed-scour is more a function of changes in sediment characteristics following dam removal. Whether increased bed-scour will substantially reduce salmon diseases is highly uncertain. Another noteworthy example is in the

second paragraph on p. 270: "Dam removal would reestablish steelhead upstream of...and increase habitat available to this species by 420 stream miles." It is not clear that steelhead would establish, given the unknowns of whether they are capable of navigating the poor water quality in Upper Klamath Lake. Overall, the Summary and Findings section should qualify some of the conclusions it currently states with complete confidence.

4.	Does the Overview Report base its conclusions upon the best available science? Are there any significant peer-reviewed scientific papers that the Overview Report omits from consideration that would enhance its scientific quality?

The Panel was favorably impressed with the way the Overview Report was developed through a process designed to use the best available, peer-reviewed science. The relevant scientific papers have been included in the analysis chain (exceptions are noted in our detailed comments and additional recommended references, Appendices B and C, respectively). Despite the tone of some comments from the public, the science appears to be reliable for a Secretarial Determination. Nonetheless, the authors should consider including further description of the process of scientific analysis and development of the summary and findings early in the Overview Report, in accord with the following comments and recommendations.

Science and Decision Making

Comment 4-1: The public often misunderstands what science is and how it is used in the decision-making process for resources such as the Klamath River, and though the Overview Report briefly mentions the roles of science and decision making, the discussion is too limited to be effective.

Recommendation: Expand the discussion of science in sections ES.1 and ES.1.1 to more fully outline how science works.

Discussion: One of the most important actions the authors can do for readers is to place the Overview Report and the work upon which it is based in its correct context relative to science and decision making. The Introduction correctly explains that the Overview Report and its supporting research represent the best scientific understanding of (1) how the present system is operating, and (2) what would happen in the system if certain decisions and choices are made. The Introduction would be stronger if it also explained the difference between data (for example, measurements made in the field or generated by models) and science.

The Overview Report should present science as a process of drawing conclusions from a rigorous methodology of proposing hypotheses, collecting data, assessing support for hypotheses with existing data and models, and building an understanding of the system by going through this process iteratively. The Overview Report and the massive research that supports it depend on this highly standardized process. There is no debate about what science is, and the Overview Report should say so. When the authors state that "the science indicates..." what they really mean is "the scientific method applied to the available data indicate that…." While science seeks to reduce uncertainties, for complex situations such as assessing the costs and benefits of removing dams

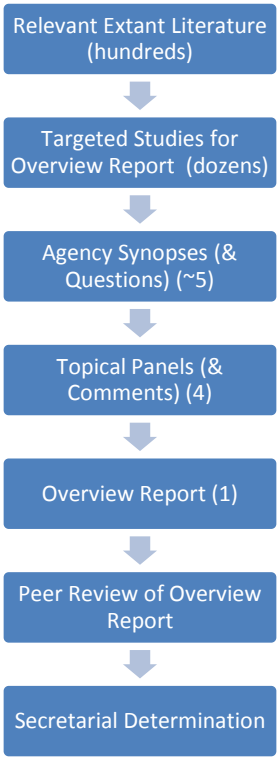
from the Klamath Basin, substantial uncertainties are unavoidable. Policy decisions therefore inevitably occur under substantial uncertainty. Appendix J of the KHSA also specifies that the scientific process includes "transparency and integrity in preparation, identification, and use of scientific and technological information." Statements such as these can then lead the reader to the critical point that the Overview Report does not offer the "right" answer, but rather defines what we know and what we expect will happen if certain decisions are made.

Scientific Process Used for Overview Report

Comment 4-2: Make the process of evaluating the scientific information clearer (e.g., in Section 3) and ensure that the Secretary understands the scientific limitations of the advice provided by its expert panels.

Recommendation: Provide an enhanced discussion and flow chart of the development and synthesis of scientific information for the Secretarial Determination.

Discussion: Organizers of the process leading up to the Overview Report apparently envisioned a hierarchy of flow for scientific information, although it was not specifically stated as such. The Overview Report would be improved if this hierarchy were stated specifically in the Executive Summary, Introduction, or Section 3, and perhaps diagrammed. The following appears to be the hierarchy:



Process Used to Develop and Review Scientific Information for Inclusion in the Overview Report and Relative Number of Documents Used/Produced at Each Stage

This flow is outwardly logical and an apparently valid way to condense a large amount of disparate scientific information into summaries and findings relevant to possible dam removal.

Basin agencies and tribes sought to bolster the scientific base for managing Klamath fishery resources. The relevant extant literature was fragmentary and not always directly pertinent to the issues as the agencies and tribes saw them. These bits and pieces were insufficient for rational management of the Klamath fishery resources in the view of a National Research Council panel (National Research Council 2004). Further, the KHSA and its appended KBRA implied or stated needs for additional specific scientific information. As a result, the multi-agency TMT initiated a set of targeted studies by agencies and contractors intended to fill the gaps in scientific information. They also commissioned a series of technical synopses, which were to muster the scientific evidence to contrast the *Dams Remain* and *Dams Out with KBRA* scenarios.

The accumulated scientific information was vetted by a set of topical expert panels. The panels were charged to answer detailed questions posed for each panel by the TMT for which the answers were presumed to be crucial for a determination of benefits for fish populations of dam removal. Each panel was given a short time period in which to review the information and arrive at a reasoned summary of the topic and offer opinions regarding the strength of evidence for dam removal or continuation with the current operating hydropower facilities. Typically, they had one week of homework plus one week of face-to-face meetings in which to hear presentations and write their reports. Their task was complicated by the incomplete state of the KBRA plans, which consisted more of general objectives than assured actions.

Although each panel ultimately concluded that the evidence they reviewed favored dam removal, they were not able to assimilate all relevant information on their topics (as evidenced by critical comments on their drafts by peer reviewers), were distracted by some TMT questions, faced much uncertainty, and were left to conclude that most issues could be answered only qualitatively rather than quantitatively, as would be hoped for from scientific information. As put succinctly by the final Coho/Steelhead panel report: "… a decision to proceed with the [dam removal] projects should be understood as a decision to pursue a hypothesis of increased fish production, for which there is evidentiary support for qualitative responses, but whose quantitative outcome is largely unknown" (p. 71).

The last three steps of the hierarchy were (1) preparation of the Overview Report, (2) the Panel's review of the Overview Report (this peer review report), and (3) the expected Secretarial Determination.

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6.0 Panel Responses to Review Questions for Specific Sections

In their Charge to the Peer Review Panel, the TMT included a series of review questions for specific Overview Report sections. The Panel's responses to these questions are provided below.

5.	Expected Effects of Dam Removal and KBRA on Physical, Chemical, and Biological Processes that Support Salmonid and Other Fish Populations (Section 4.1 of the Overview Report)

5a.	Do the findings presented in this section of the report accurately and adequately reflect the findings in the cited reports?

This section generally distills the extensive physical, chemical, and biological information in the source reports accurately and adequately. The synthesis is clearly aided by prior subject-area evaluations for other purposes (e.g., total maximum daily load reports) and compilations commissioned for this assessment (e.g., Hamilton et al. 2011). Reports from topical review panels helped highlight important considerations and information limitations (e.g., Dunne et al. 2011; Goodman et al. 2011). The latter report identified deficiencies in available information that limited definitive and quantitative conclusions about responses to dam removal and the KBRA plans, which are not always reflected in the Executive Summary and full text of the Overview Report. At least one topic of interest to public commenters (hatcheries) could benefit from a consolidated discussion. The Panel elaborated on these two concerns.

Discussion of Uncertainties

Comment 5a-1: The Overview Report does not discuss the range of potential outcomes and associated unknowns to the degree expressed in the original technical reports.

> **Recommendation:** Edit the Overview Report to clarify the distinction between responses known with high certainty versus those that have, and always will have, high uncertainties associated with them. This is particularly critical for the discussion of expected responses of fish populations to restoration.
>
> **Discussion:** Based on first principles of current understanding of ecosystem dynamics and fish biology, it is very reasonable to expect that dam removal will improve habitat for fish, including improvement of water quality in the Klamath ecosystem; for example, providing access to substantially more spawning and rearing habitat would likely increase the productivity, diversity, and viability of fish populations. Similarly, removing dams would reduce the hydrologic residence time in the river, thereby eliminating most of the habitat that allows toxic cyanobacteria to flourish in nutrient-rich water; however, the uncertainties in these expectations are associated with the quantitative estimates of the magnitude of responses to restoration.
>
> The magnitude of physical and biological responses is contingent on a wide variety of habitat-related responses. The magnitude of fish response to dam removal will depend on factors such as (1) whether peak flows will increase enough to produce sufficient stream bed-scour to reduce densities of polychaetes and the prevalence of myxozoan diseases, (2) whether water quality will

improve enough to enable fish passage into the upper Klamath tributaries, including cold water refugia, and (3) the extent to which ongoing climate change will alter flow and thermal regimes in ways that affect salmon biology. Substantial uncertainties are associated with estimating how each of these various factors will play out, thereby producing even greater uncertainty in estimates of how fish will respond to either of the two restoration alternatives. While these factors and their uncertainties are discussed in the Overview Report, they are not emphasized as much as they should be, given the discussion provided in several of the technical reports.

Citation of Background Reports

Comment 5a-2: Although some sections appropriately cite the relevant source literature, the Overview Report does not consistently cite relevant source reports for its summary discussions.

Recommendation: Improve each topical section by citing the primary technical document from which it obtained and summarized the information.

Hatcheries

Comment 5a-3: Consideration of hatcheries is scattered throughout the Overview Report and is difficult to understand.

Recommendation: Present hatchery considerations as a consolidated discussion of both current operations within the Klamath system and their likely use as part of the KBRA.

Discussion: Public comments on the topical panel reports and the Overview Report reflected a high interest, both pro and con, in the use of existing and potential hatcheries for reintroductions of salmonids to the project area and upper Klamath Basin with dam removal. Information regarding hatcheries is now scattered throughout the Overview Report, making it difficult to understand; for example, it is stated that a large part of the fall Chinook run is from hatchery production, but hatchery fish are not included in estimates of population sizes to result from the *Dams Out with KBRA* scenario (p. 61). The Chinook and Coho/Steelhead panels expressed concern that hatchery fish could overwhelm the genetics of wild fish (p. 85 box, p. 88 box, respectively). Hatchery releases could be timed to avoid the high suspended-sediment loads from dam removal (p. 97 box). Fish handling facilities at Iron Gate Hatchery would be removed, but the hatchery would remain and operate for eight years following decommissioning, pending a water supply (p. 119). Costs for hatchery improvements and operations would be increased (p. 223). A new hatchery is listed in the economic impacts of KBRA plans (Table 4.4.1-30).

The Overview Report could be improved if hatchery considerations were more fully described and grouped together for easy reference. Such a section could include the following topics, in addition to the instances in the Overview Report noted above. The KHSA describes the need for production-hatchery continuity and requires a plan for Iron Gate Hatchery after removal of Iron Gate Dam (Interim Measure 19). The KBRA has explicit (although not detailed) references to hatcheries. It includes a statement that there should be an appropriate balance between hatchery

and wild fish to minimize negative interactions with wild fish (p. 16, item C). Although natural reintroduction is expected to occur, the California Department of Fish and Game is to develop guidelines for the development and use of a conservation hatchery to speed reintroduction (p. 44). Reintroductions with hatchery fish, the conservation hatchery, and adaptive management are discussed in KBRA Section 11.4.1, with the conservation hatchery considerations spelled out in KBRA Section 11.4.4. The Chinook Expert Panel asserted that a conservation hatchery should be a "temporary technological fix" with the advice that a hatchery should not be used for long-term supplementation. The Hendrix Chinook model (Hendrix 2011) contained numerous hatchery-related inputs and results, including a rise in Chinook production in the basin with both natural and hatchery reintroduction, and a drop in basin production after termination of Iron Gate Hatchery (although the dates differ from those given elsewhere). Other likely aspects of the use of hatcheries in the reference documents were not identified by the Panel.

5b. In the judgment of the reviewers, are there any important information gaps that limit the fundamental understanding of the likely effects of implementing the agreements on Klamath fisheries and fish populations?

Recent research associated with the KHSA has generated an unusually rich understanding of the biophysical and socioeconomic characteristics of the Klamath Basin. In many instances, the Overview Report builds upon the information generated in the research to offer insightful support for decision making; however, the Panel found several crucial gaps in information. In some cases, the required data are available in source documents, but in other cases, the information is not available, so that the resulting knowledge gap contributes to uncertainty in decision making. The most important knowledge gaps are described below.

Status of the KBRA

Comment 5b-1: The KBRA includes discussions on fish restoration and several other key factors associated with dam removal. The document does, however, acknowledge that specific implementation processes have not been thoroughly developed. Because of this, some uncertainty exists about the overall effectiveness of implementation efforts.

Recommendation: Develop more detailed implementation plans so that, as the project moves forward, the types of uncertainty can better be identified and the level of uncertainty defined.

Discussion: In projects such as this, it is important to illustrate the improvements that are expected to occur. As Judge James Redden ruled in rejecting (several times) the Columbia River Basin Salmon Biological Opinion by the National Oceanic and Atmospheric Administration National Marine Fisheries Service, evidence must exist that important projects such as habitat improvement will be carried out. There also must be explicit feedback from monitoring of KBRA projects to ensure that adaptive management can actually occur (as highlighted by the topical panels). There is a risk that insufficient attention would be given to the monitoring and evaluation necessary for effective adaptive management. As experience with other salmon restoration

projects (including dam removal) shows, a lack of follow-up studies and evaluations usually occurs. The expectations expressed in the KBRA and the Overview Report and their referenced studies should be tested. The KBRA suggests that there will be follow-up, but those plans should be more firm. The Overview Report could better emphasize this uncertainty, because the *Dams Out* scenario explicitly includes "*with KBRA*." A thorough examination of the restoration alternative is constrained by the details provided with which to evaluate the KBRA (e.g., hatchery plans, irrigation).

Reservoir Sediments

Comment 5b-2: The Overview Report does not adequately discuss the characteristics of reservoir sediments, particularly the sand fraction of those materials.

Recommendation: Expand the discussion of reservoir sediments, possibly by expanding Section 4.3.1 or elsewhere.

Discussion: The Overview Report places considerable emphasis on a description of reservoir sediments as fine-grained (i.e., silt, clay, and organic material). The Overview Report would be more effective with additional discussion of these sediments. The source documents show that sand generally accounts for about 15 percent of the total amount of sedimentary materials behind the dams. The Overview Report would benefit from an expanded discussion of the likely fate of those sand materials because they will inhibit fish spawning on gravels downstream from Iron Gate Dam if they accumulate substantially there.

An accurate and complete commentary on the sand contents of the reservoirs would state that the sand is not equally distributed across the reservoir floors. Sand is likely to be concentrated in deltas at the heads of the reservoirs and along the now-drowned stream courses. Source documents show that when the reservoirs are drained, the remaining sediments are likely to be 30 to 50 percent sand (Reclamation 2011a), and eventually some of these sands are likely to be transported downstream.

In-stream Transport of Sand Sediments

Comment 5b-3: Although the Overview Report extensively discusses fine sediments (silt, clay, and organic particles), it does not include research results from the source documents for the downstream fate of sand eroded from the reservoirs.

Recommendation: Expand the sediment discussions in the Overview Report (especially in, but not limited to, Section 4.3.1).

Discussion: Sediments in transit (such as the sands from reservoir storage) are likely to be deposited temporarily on spawning gravels, only to be remobilized in subsequent high-flow events. In the period before river regulation by dams, the 100-year flow event was probably 35,000 cubic feet per second (cfs), a magnitude not likely to be seen under current conditions. High-flow events or pulses will likely be 3,000 cfs to 5,000 cfs, sufficient to continue the

downstream transport of sand, so that within a decade or so, most of the sand is likely to be evacuated from reservoirs, winnowed from spawning gravel downstream from Iron Gate Dam, and transported in the mainstem Klamath River downstream from its confluence with Cottonwood Creek.

In-stream Transport of Fine Sediments

Comment 5b-4: The Overview Report discusses fine sediments in the reservoir and river systems extensively; however, it does not adequately address where such sediments are likely to be stored while in transit to the ocean. The Overview Report implies that the fine sediments from the reservoirs will wash completely to the ocean, but in fact some will likely remain in the river system for a period of time.

Recommendation: Describe more completely the likely fate of some of the fine material that will be temporarily deposited in a few predictable locations.

Discussion: Fine-grained sediments from the reservoirs will likely be swept far downstream when the reservoirs are drained because these sediments are likely to be suspended in the flow. Some of these sediments, however, are likely to be deposited in backwater areas, on floodplain surfaces, and in the few wide reaches of the channel. Such deposition is highly likely because the flow diminishes from its peak after a dam breach (on the falling limb of the hydrograph). It is therefore likely that the landscape within a few feet of the elevation of the low-flow water surface will be draped with fine mud, a condition not likely to last more than several years.

Contaminants in Reservoir Sediments

Comment 5b-5: Section 4.4.9 provides only a brief review of contaminants in reservoir sediments, and supplies no data. The Overview Report fails to adequately convey the certainty associated with the extensive database describing contaminants in the sediments.

Recommendation: Improve Section 4.4.9 by expanding the discussion, including representative data, and indicating the nature of standards for sediment quality.

Discussion: Section 4.4.9 is unlike its neighboring sections in the Overview Report in that it seems abbreviated and does not share the extensive data collected and published in the supporting documents. Use of the term “elutriate” seems unnecessary in this general document and it might be eliminated. Provide easily understood summary statistics for common contaminants in the sediments, along with the currently accepted, safe concentrations for these contaminants. Such a reporting strategy can give decision-makers confidence that the risk from exposure is in fact low by showing the numbers rather than simply making the statements that “no preclusions were identified” or “most chemicals …were generally relatively low.” Describe the preclusions, chemicals, and how they are “generally relatively low.” Write the section to include summary data compared to some identifiable standard so that the reader knows what chemicals are of interest and how low their concentrations actually are. Also, use the term “contaminants” in place of “chemicals.”

Readers and decision-makers would be greatly aided if this section included information on standards for comparison. Such standards might be those for unimpacted watersheds or established standards used by the U.S. Environmental Protection Agency, Environment Canada, the European Union, or, for dredge material, the U.S. Army Corps of Engineers. Many data in the supporting documents can be used here for background information.

Stream Bed Mobility

Comment 5b-6: The Overview Report mentions the mobility of bed sediments but does not provide enough text to show its importance as a connection between physical and biological processes.

Recommendation: Add a brief paragraph describing the connections among depth of flow, size of bed particles, and biological implications of these connections.

Discussion: The mobilization of particles on the bed of the channel downstream from Iron Gate Dam depends directly upon the depth of flow in the channel. The greater the depth of flow, the larger the particles likely to be moved. The development of disease-related organisms in the bottom sediments is more likely if the bed materials remain immobile for long periods (on the order of years). Under natural, pre-regulated river conditions, the occasional large flood event, combined with considerable intra-annual flow variability, ensured that bed particles were frequently moved and redistributed. With dams in place, this variability largely ceased, and diseases for fishes related to bed conditions became more likely. Further, because the particle size in stream beds will decrease downstream of the dam sites, less extreme flows will be required to produce bed-scour. These issues are not described with sufficient emphasis in the Overview Report.

Fish Passage at Keno Dam and Link River Dam

Comment 5b-7: Fish passage evaluations upstream from this dam removal project are beyond the scope of this study; however, there may be some benefit to briefly describing the normal operations of the two dams immediately upstream (Keno and Link River dams) and their relationship to or impact on the overall project.

Recommendation: Briefly describe the two dams (including their fish passage facilities) immediately upstream from J.C. Boyle Dam. The addition of photos would also be helpful.

Discussion: Aside from the high-temperature/low-dissolved oxygen "bottleneck" for migration in the Keno pool (well discussed in the panel reports and the Overview Report), getting adult salmon and steelhead over these two upstream dams is fundamental to range expansion after removal of the four downstream dams. Hamilton et al. (2011, p. 21-22) indicate that each of these dams has fish passage facilities with minimum flows for effective fish passage of 100 cfs and 300 cfs for Link River and Keno, respectively. The KBRA plans include improvement of the Keno fish passage facilities, scheduled for 2020-2021.

5c.	Are the findings reasonable regarding the likely effects of implementing the agreements on Klamath fisheries and fish populations?

Aside from the concerns listed above (Questions 5a and 5b), the findings are reasonable and defensible based on the available science. As described elsewhere in the Overview Report (Question 5b), the current lack of detail on how the KBRA will be implemented, and the expected responses to these actions, limits a thorough assessment of the ultimate hydrologic, water quality, and fish responses to restoration. This is not a weakness of the Overview Report but a reality of the agreement development process.

6.	Dam Removal Detailed Plan and Estimated Cost (Section 4.2 of the Overview Report)

6a.	Do the findings presented in this section regarding the detailed plan for dam removal accurately and adequately reflect the findings in the cited reports?

The reference documents used to generate this Overview Report section, such as the Detailed Plan for Dam Removal–Klamath River Dams (Reclamation 2011b) are comprehensive and present the information in a logical and understandable manner. Information transferred from the individual reference documents is accurate but, in the opinion of the Panel, is not sufficient to fully understand the dam removal process, as discussed below.

Project Description

Comment 6a-1: The information is insufficient to fully understand the layout of the individual facilities at each dam.

> **Recommendation:** Provide additional information on the arrangement of the dams and associated facilities (i.e., locations of individual structures that supplement the photos). This information would provide a better understanding of how the layout and expanse of each individual project may affect the reservoir drawdown and dam removal options.

Reservoir Drawdown

Comment 6a-2: Diversion facilities used during the initial dam construction are appropriately planned to be used during reservoir drawdown. These facilities were abandoned after construction and must be rehabilitated prior to their use for reservoir drawdown. The Panel concurs that these features are important aspects for a successful drawdown of the reservoir, both in terms of time and elevation.

> **Recommendation:** Briefly define the steps necessary to rehabilitate the abandoned diversion facilities used during construction at J.C. Boyle Dam, Copco 1 Dam, and Iron Gate Dam. Include a discussion on their benefit in terms of drawdown duration and reservoir level. Include potential risks or impacts to schedules if these diversion facilities cannot be successfully rehabilitated.

Comment 6a-3: Logistics for draining the reservoirs in conjunction with dam removal activities are not clear.

> **Recommendation:** Elaborate on the reservoir drawdown options at each dam in conjunction with dam removal sequencing. Perhaps figures could be developed to illustrate the various phases of reservoir drawdown, including the components available for drawdown during each phase and the concurrent stages of removal of the various dam components.

6b. Are the estimated dam removal costs adequately presented and explained?

The supporting documents for the construction cost estimates contain significant details about process and content. The designers had sufficient data for breaking down the dam removal activities in discrete packages so the costs accurately represent the actual work to be executed. The comments below are intended to help improve the presentation of the cost analyses.

Comment 6b-1: Background information is not provided for the decision-makers to understand the process for developing cost estimates.

> **Recommendation:** Add a brief discussion regarding the information used to develop the detailed cost estimates for the removal of dams and associated structures.
>
> **Discussion:** The Panel understands that original design drawings were provided to the TMT for developing removal plans, sequencing work, and deriving quantities. The drawings also provide information regarding access roads, haul routes, and potential disposal sites for specified materials. This background information was used to develop construction methods, sequencing of drawdown and removal activities, durations of individual activities, and overall construction schedules. The detailed cost estimates were prepared based on the above background information and reflect a reasonable level of confidence for feasibility level designs. This background information would substantiate the degree of confidence in the cost estimate.

6c. Are the dam removal mitigation actions adequately presented and explained?

A number of mitigation activities specifically related to removal of the four dams were identified. The Panel concurs with the mitigation activities that have been identified and has the following comments relative to each.

Fish Relocation

Comment 6c-1: The Overview Report identifies plans for relocating most of the fish trapped behind each dam during reservoir drawdown but does not elaborate on how this will be accomplished. While the Panel agrees that a detailed plan for how this is to be accomplished is not necessary for the Overview Report, the following recommendation is provided for consideration:

Recommendation: Add a statement that methods for fish capture and release will comply with appropriate state and federal requirements.

Culturally and Historically Significant Sites

Comment 6c-2: The Overview Report acknowledges that the obligation of compliance with Section 106 of the National Historic Preservation Act (NHPA) (1966) has commenced, but it does not identify documentation as an important means of mitigation.

Recommendation: Because original plans, specifications, measured drawings, and historical photos document all phases and features of the PacifiCorp hydropower facilities, they can be submitted to the Library of Congress as mitigation for removal or partial removal under Section 106 of the NHPA.

Discussion: Preservation of the original plans, specifications, measured drawings, and historical photographs is far less expensive than ordering new measured drawings and photographs. Mitigation by documentation must be coordinated with the California and Oregon state historic preservation offices and the Advisory Council on Historic Preservation.

Comment 6c-3: The Overview Report does not identify the Native American Grave Protection and Repatriation Act (1990) (NAGPRA).

Recommendation: Meet the concern raised by some tribal communities about the potential impacts of *Dams Out with KBRA* by specific reference to NAGPRA and its protocols.

Discussion: Because of the potential of *Dams Out with KBRA* to expose former Native American burial sites, villages, rock shelters, cairns, stone rings, quarries, lithic scatters, and ceremonial sites, compliance with NAGPRA is mandated. The matter is complicated because the non-federally recognized Shasta Nation may be most affected. In anticipation of NAGPRA issues, the tribes can create procedures for NAGPRA requirements.

Development of New or Modification of Existing Recreation Facilities

Comment 6c-4: The level of information provided for new and existing recreational facilities is adequate for this level of study; however, the following recommendation is provided for consideration:

Recommendation: Add language that recognizes the need to coordinate final layouts of recreational sites with the appropriate stakeholders during the final design process. Some features identified in the partial removal plans may be considered for public access.

Comment 6c-5: The Overview Report does not mention the possible acquisition of river corridor lands currently owned by PacifiCorp for development of new recreation sites and facilities to offset boat ramps and campgrounds that may be removed.

Recommendation: Mention the potential for land exchanges between PacifiCorp and the Bureau of Land Management, the State of California, the State of Oregon, or Siskiyou and Klamath counties for the acquisition of new properties, including those with historical cultural resources, for recreation and heritage tourism in the Klamath River corridor between Keno and Iron Gate dams.

Discussion: Mitigation for loss of reservoir recreation and reservoir shoreline recreation can be met by development of new sites and facilities. Historical resources in the upper Klamath River canyon include the Yreka-Keno Stage Road (Topsy Road and Topsy Grade), Pokegama Log Chute, hand-dug irrigation ditches and stacked stone walls, homestead cabins, pioneer cemeteries, grade of the Klamath Lake Railroad, Greek ovens, Klamath Hot Springs at Beswick, and other features. These sites may attract sightseers, campers, hikers, and bicyclists, as well as whitewater rafters and fishers.

Fencing

Comment 6c-6: Although the level of discussion for fencing is appropriate for this level of study, it could be enhanced with additional information.

Recommendation: Consider using language that states that final fencing requirements must be identified during the final design process after decisions have been made on full versus partial dam removal, land disposition, and the extent and type of reservoir revegetation.

Culvert Relocation

Comment 6c-7: It would be helpful to understand the relative location of these culverts and why they must be relocated or modified.

Recommendation: Identify the need for culvert relocation or protection and describe the most probable method for providing protection.

Wetlands Replacement

Comment 6c-8: The Overview Report does not elaborate on specific wetland replacement activities that would be proposed to mitigate the loss of the reservoirs, but the Panel concurs with the likelihood that minimal restoration would be required. The level of discussion for this activity seems appropriate until the designs are further developed.

Recommendation: Assess mitigation locations and measures in final designs.

Bat Habitat Replacement

Comment 6c-9: The need and proposal for addressing existing bat habitat have been adequately addressed for this level of design for full dam removal.

Recommendation: Consider adding language that indicates that for the partial dam removal options, replacement of bat habitat may not be required.

Groundwater Wells

Comment 6c-10: The level of data collection performed to date for determining groundwater level impacts with loss of reservoirs may not be sufficient.

Recommendation: Make certain that the current determination (level of investigations) is sufficient to withstand any claims of groundwater impacts beyond the limits of the current studies. Experience would suggest that unwarranted claims are likely to appear but may be difficult to dispute.

Freshwater Mussel Relocation

Comment 6c-11: The Panel concurs with the described plan to temporarily relocate freshwater mussels to nearby tributaries and then return them once the dams have been removed. Details for this activity are adequately described.

Expansion of the 100-Year Floodplain

Comment 6c-12: Much has already been accomplished to identify potential flood risks during the 100-year flood following dam removal. The Overview Report also identifies the need to update the existing Flood Warning System to reflect these changes.

Recommendation: The level of studies that has been performed to date is appropriate, but language should be added that identifies plans for sharing this information with affected public entities. If this has already been done, so indicate in the Overview Report.

Bridge and Culvert Relocation

Comment 6c-13: The rationale and details for the proposed Jenny Creek Bridge relocation are not fully presented. This activity is relatively small compared to overall project costs, but the relocation effort may be significant.

Recommendation: Provide background information on the relocation effort. The new bridge would need to be at least above the 100-year flood level and probably designed to current load standards. Depending on the topographic setting in the vicinity of the existing roads, the span may be quite long. Further, there may be some merit to constructing the new bridge prior to dam removal if there would be a benefit to the dam removal contractor for site access.

Downstream Water Intake Protection

Comment 6c-14: The Overview Report recognizes the need to address potential modifications to water intakes along the reach of the river that will be affected by the higher concentrations of sediment during dam removal; however, the levels or types of modifications are not presented. Due to much higher expected concentrations of very fine suspended sediment, required modifications could be significant.

Recommendation: Describe typical modifications that may be needed to address the higher concentrations of fine sediment.

City of Yreka Water Supply Line

Comment 6c-15: The Overview Report adequately describes proposed modifications to the existing water supply line based on a preliminary layout of the proposed scheme. The level of design effort is adequate; however, the following recommendation is provided:

Recommendation: There may be a benefit to pointing out the addition of a higher construction contingency cost based on the level of design effort, with the realization that final designs will need to be coordinated with the City and other affected entities. The rationale for eliminating the river crossing is not justified at this time, unless existing data suggest that the bedrock in the vicinity of the existing crossing is very deep; if not, a safe design for a river crossing is achievable.

6d. Are there important information gaps that limit the understanding of the engineering, mitigations, or costs associated with dam removal?

The Overview Report contains extensive analyses to develop the dam removal scenarios. The concepts developed are based on existing data and, as needed, the acquisition of additional data to support the level of effort required to prepare feasibility-level designs. Current construction cost analysis was used to develop the dam removal costs. The proposed designs and cost estimates are generally comprehensive, but there are some areas where additional background information could be extracted from the reference documents to improve the understanding of these processes.

Engineering Aspects of Dam Removal

Comment 6d-1: Gaps exist in the level of understanding of the engineering for the dam removal processes as described under Question 6a. These gaps can easily be addressed by incorporating much of the information already available in the reference reports.

Mitigation Activities

Comment 6d-2: Information for mitigation measures is generally adequate for a feasibility-level design. Recommendations for enhancing the level of understanding are in Question 6c.

Costs for Dam Removal

Comment 6d-3: Individual summary cost estimates for the dam removal alternatives are adequate; however, discussion could be added (Question 6d-4) that describes the basis for developing these estimates. Such background will instill more confidence in the cost figures by the decision-makers.

Comment 6d-4: The quantitative procedure used to generate the range of costs associated with dam removals in Section 4.2.1 is unclear. The short description of the Monte Carlo model in the sidebar on p. 108 does not provide enough detail to understand how the likely range of costs was generated for each dam.

Recommendation: Explain what cost variables were assigned probability distributions and how these were derived. Use one dam as an example.

Discussion: Dam removal costs will vary due to uncertainties encountered during the process. Summarize specific physical descriptions of the possible difficulties (reported in Reclamation 2011b) for each dam so that readers better understand contingencies that could affect costs. Describe in more detail the risks inherent in the removal process elements and how they are entered into the Monte Carlo modeling. Provide a logical and intuitive explanation of how a Monte Carlo model provides a meaningful understanding of the likely range of costs.

7.	Risks and Uncertainties of *Dams Out with KBRA* [and *Dams Remain*] (Section 4.3 of the Overview Report)

The Panel modified Question 7 from that provided by the TMT to include a discussion of risks and uncertainties about the *Dams Remain* scenario, in addition to those related to the *Dams Out with KBRA* scenario.

7a.	Are the possible risks and uncertainties of dam removal characterized in an understandable and defensible manner?

The restoration scenarios considered here involve a variety of critical uncertainties about the probable responses of the Klamath River ecosystem to the restoration activities. The Overview Report thoroughly discusses many major sources of project uncertainties; however, some responses are known with high certainty, and these should be distinguished from those with high uncertainty.

Comment 7a-1: The risks and uncertainties of dam removal are not as clear, particularly in the Executive Summary, as they should be. Certain aspects of the system response to restoration are better defined (more certain) than others. Such distinctions are important.

Recommendation: Edit the Overview Report to highlight the distinction between what is known with confidence and critical uncertainties.

Discussion: The Overview Report could benefit from a table that clearly emphasizes what is known with various levels of certainty about the ecosystem responses to dam removal. While the authors should be more explicit about the uncertainties associated with dam removal, they should also emphasize things they know well. The table should have multiple levels of certainty about specific outcomes. Include the table in the Executive Summary and encourage authors to assign specific ecosystem responses to qualitative risk categories. The table on the following page is provided only as an example; authors should make their own assessments of which factors to list and in which uncertainty category the factors would be placed. A table would provide a coherent and accurate depiction of the knowns and unknowns associated with dam removal.

Example Summary of the Confidence Levels Associated with the Two Scenarios

Confidence in Available Information	*Dams Remain*	*Dams Out with KBRA*
High	Persistence of toxic bluegreen algae in reservoirs.	Reduced residence time of water in system.
	No option for fish to access cold water refugia high in watershed.	
	Flow regime promotes build-up of myxozoans in sediments.	
	Sediment contaminant concentrations are relatively low compared to critical standards.	Unlikely that sediment mobilization will increase contaminant exposure to humans and wildlife.
Medium	Predatory impacts of exotic predators on salmonids.	Successful migration of fish through Upper Klamath Lake to habitat in upper watershed.
		New flow regime may scour stream beds and reduce myxozoans and associated diseases.
		Effects of sand on spawning conditions downstream of current reservoirs.
Low	Effects of ocean conditions.	Effects of ocean conditions.
		Improved water quality in Upper Klamath Lake in response to KBRA.
		Response of river periphyton to increased nutrient transport.

Comment 7a-2: The *Dams Remain* scenario has substantial risks and uncertainties that are not described as well as those for the *Dams Out with KBRA* scenario.

Recommendation: Clearly describe the scenarios early in the Executive Summary and Introduction. Explain that there are numerous uncertainties for both the *Dams Remain* scenario and the *Dams Out with KBRA* scenario.

Discussion: The Overview Report reasonably communicates the likely effects of dam removal and restoration on Klamath fisheries and fish populations. One conceptual complication with the Overview Report is the alternative to which the *Dams Out with KBRA* scenario is compared. The *Dams Remain* scenario has substantial uncertainty associated with it in terms of estimating how the ecosystem will behave in the future; for example, estimates of water quality, viability of fish

populations, and productivity of fisheries under the *Dams Remain* scenario are all subject to substantial uncertainty. The potential outcomes of the *Dams Remain* scenario include the possibility of further degradation of desired ecosystem states. The Overview Report would be more effective if it explicitly described the risks associated with the *Dams Remain* scenario. Discuss whether fish populations would be more likely to spiral toward extinction, whether fisheries closures would continue to be more frequent, and whether water quality in the reservoirs and rivers would be unlikely to recover to suitable standards given possible restoration actions in the upper watershed. While most of these risks are listed in the sidebar on p. 63, they are not sufficiently emphasized in the Executive Summary and the main body of the Overview Report.

Section 4.4.2.3, p. 217, exemplifies this problem as it describes only the benefits of the *Dams Out with KBRA* scenario. The concluding section (and the earlier discussion supporting the conclusions) should consider a matrix of the costs and risks versus the benefits for each of the two scenarios being considered (*Dams Remain* versus *Dams Out with KBRA*). As currently written, the Overview Report draws all the attention of uncertainty and risk to the *Dams Out with KBRA* scenario while, in fact, both scenarios have substantial uncertainties and risks associated with them. Accurately describing the uncertainties and risks of the *Dams Remain* scenario will provide more balance and reduce the focus on the unknowns associated with the *Dams Out with KBRA* scenario .

Risk of Cost Exceedence

Comment 7a-3: Issues that may impact project costs are listed but are not adequately explained. The risk of implementing the plan for rehabilitating the existing diversion structures could be included.

Recommendation: Elaborate on how these specific issues will affect schedule and ultimately project delays and costs. Assess the impacts for potential problems that could affect the ability to use the abandoned diversion structures.

Comment 7a-4: The Overview Report proposes a method to reduce risks for monitoring construction costs so that early indications of potential overruns could be identified and appropriate actions taken through the identified “meet and confer” process (KHSA, Section 8.7.2) to minimize the potential for delaying construction.

Recommendation: Consider a Request for Proposal process for dam removal activities. This process requires contractors to become more familiar with the project and better understand potential risks for meeting schedules and staying within their bid estimates.

Comment 7a-5: The ability to rehabilitate the existing diversion structures has not been presented as a potential risk to construction delays.

Recommendation: Evaluate potential impacts that could occur if the diversion structures could not be rehabilitated.

Risk of Short-Term Flooding During Dam Removal

Comment 7a-6: The risks of short-term flooding during dam removal are evaluated for each dam. The critical structures that pose the greatest risks are the embankments at J.C. Boyle and Iron Gate dams. Due to these risks, removal of these features has been scheduled for the normal low flow periods (July through September) when the risk is significantly less. Most of the other hydraulic structures at both of these facilities will already have been removed and the reservoirs drained to the lowest points possible. The evaluation of flood risk was based on a flood with a recurrence interval of 100 years based on the specific time of year. The selection of the 100-year flood is appropriately conservative for this level of study, and it appears that provisions for accommodating this event are reasonable. The Overview Report adequately evaluates flood risks during construction, and the analysis results are reasonable.

Recommendation: In either Section 1.2.1 or Section 4.3.3, improve the presentation of the natural, unregulated flood regime of the river and use it in a comparison with the current hydrologic regime and the expected regime following dam removal.

Discussion: The source documents are rich in simulations and statistical summaries of the recorded history of stream flows at several stream gages in the system. The Overview Report should take advantage of these data to provide a backdrop for possible flooding during the dam removal. Considerable information has been developed for the hydrology and flood geomorphology of the system, and this information puts potential flooding during removal in a clear context showing that a maximum increase in the annual flood of only about 7 percent and an increase in flood stage of only about a foot and a half above normal flows would be expected during the removal episode. Potential inundation areas are also mapped in the source documents, so it would be fair to describe the limited extent of such properties. Note, however, that it would be inadequate to say, “there is little to worry about.” It would be better to provide numbers with explanations based on flood data.

Risk to Cultural and Historic Resources

Comment 7a-7: Historical resources are ignored in the discussion.

Recommendation: Address the range of specific risks for cultural resources, both prehistoric and historic.

Discussion: The risks to cultural resources include exposure and removal of human remains and of prehistoric and historic cultural resources (artifacts, structures, etc.). Risk factors include destruction of sites without data recovery by bank slumping; water or wind erosion; failure to observe the legal protocols of NAGPRA; illegal excavation and collecting; and vandalism to remaining features associated with the hydropower projects of the upper Klamath River. The Overview Report should broaden the discussion of risks to include vandalism and theft. The river corridor is isolated and distant from the offices of potential monitors and enforcement agencies. The Klamath District Office, Bureau of Land Management, is in Klamath Falls; the Siskiyou County Sheriff and the California State Police offices are in Yreka. The offices of the Klamath Tribes are in

Chiloquin north of Upper Klamath Lake, and the offices of the Karuk Tribe are in Happy Camp. In addition, a scenario of *Dams Out with KBRA* may transform the upper Klamath River canyon between Keno, Oregon, and Hornbrook, California, into a setting of national interest for both education and heritage tourism. Those who like to explore remote places will find a stunning landscape and a variety of historical cultural resources. These sites, if properly preserved and administered, have the potential to attract visitors and have impact on the local economy.

Comment 7a-8: The Overview Report does not adequately address the partial removal of facilities in terms of the documented historical significance of the hydropower systems.

Recommendation: Preservation (in whole or in part) of power houses, canals, penstocks, fish hatcheries, and ancillary structures has the potential to benefit recreation and education wherever it does not impede the natural geomorphic evolution of the river.

Discussion: If *Dams Out with KBRA* occurs, the upper Klamath Basin and canyon may become a national setting for educational opportunities about the history of dam removal, engineering technology of electrification, and propagation of anadromous fish. Partial removal may have cost benefits and also support of the local economy's heritage tourism.

Comment 7a-9: The *Dams Out with KBRA* scenario does not address the fate of the electrical transmission systems not to be used by PacifiCorp (Sections ES.3.1 and ES.3.2 or ES.4.4).

Recommendation: Identify the costs and plans for the preservation, documentation, or removal of electrical transmission systems. Include an assessment of the transmission systems in the Section 106 compliance procedures under the NHPA.

Discussion: The Overview Report does not discuss the probable removal of parts of the electrical transmission systems (towers, lines, etc.) from the hydropower facilities. Because the transmission systems are part of the engineering design and are integral to the purposes of the facilities, they merit assessment. Removal can be mitigated by documentation. Removal may also have significant positive impacts on the restoration of the historic landscape of the Klamath River canyon.

7b. Are there any important information gaps relative to potential risks associated with dam removal?

The Overview Report provides a thorough overview of relevant information needed to assess the potential risks of dam removal. In particular, the Overview Report effectively incorporates key findings of the extensive research efforts performed over the past three years that have generated environmental and social data to produce new knowledge about the Klamath system; however, the following information gaps relative to potential risks associated with dam removal have been identified:

Comment 7b-1: Details of the KBRA are not adequately described to fully understand the risks and uncertainties of the *Dams Out with KBRA* scenario.

Recommendation: See recommendation and discussion under Question 5b.

Comment 7b-2: Identify the possible presence of a dam partially constructed at the head of Ward's Canyon prior to construction of Copco 1.

Recommendation: Identify the risk that within the reservoir of Copco 1 may be remains of a dam that may also require removal to enhance fish passage and restore river conditions.

Discussion: Siskiyou Power Company started construction of a dam at the head of Ward's Canyon. When the California-Oregon Power Company incorporated on December 15, 1911, it acquired the assets of Siskiyou Power. Copco engineers decided to abandon the initial dam and construct Copco 1 approximately 1,000 feet downstream to gain more solid rock for the north abutment of the dam (Boyle 1977). Any structures from the previous construction that were abandoned in place underwater may cause obstacles to fish migration and additional costs for removal after reservoir drawdown. The abandoned structures should be investigated for both risks to fish passage and any additional costs for removal.

8. Analysis of Information to Inform a Decision on Whether Dam Removal and KBRA are in the Public Interest (Section 4.4 of the Overview Report)

8a. Do the findings in this section accurately and adequately reflect the findings in the cited reports?

Section 4.4 builds upon the findings cited in the reports listed in Section 6. Some gaps exist related to cultural resources, thus omitting important findings from some cited reports; for example, the tribal issues and histories are documented and discussed in DOI 2011a and DOI 2011b, but the Overview Report does not draw adequately and accurately from these technical reports (see appendices B and C). Errors in dates of events, the creation and administration of reservations, and the onset of allotment and its consequences deserve correction (see Question 8b). Discuss the historical resources of the upper Klamath River canyon because of their inclusion in inventories and their potential for recreation and education.

The economic presentation is extensive, thorough, and in conformance with the findings of the cited reports. Nonetheless, the dominance of the non-use values is surprising, although the dominance correctly reflects the results of the cited (and peer-reviewed) study. The Overview Report would benefit from a brief discussion of the limitations and assumptions involved in this type of economic analysis (Fullerton and Stavins 1998; Bockstael et al. 2000).

8b. Are the major findings relative to the public interest brought forward into the Overview Report from the cited literature? Public interest includes regional and national economics and jobs, tribal values, and other societal values and issues.

The major findings regarding regional and national economics (jobs and income) are adequately summarized in Sections 4.4.1 and 4.4.4. Other aspects of social values and issues affected by dam

removal and river restoration are summarized in Sections 4.4.5, 4.4.6, and 4.4.12. These sections seem to adequately reflect the cited literature, with exceptions noted below.

Comment 8b-1: The Overview Report contains several inconsistencies in dates and information about the six tribes. It does not appear that the authors used the information in Current Effects of PacifiCorp Dams on Indian Trust Resources and Cultural Values (2011), a report researched and written by Thomas Gates and Marilyn Novell. Additionally, the Overview Report overlooks several recent, peer-reviewed studies on the prehistory, historic landscape, and tribes in the project area (see Appendix C).

Recommendation: Correct inconsistencies of fact and omission, especially in providing fuller details about the distinctive histories of the respective tribes and the nature of their relationships with the United States.

Discussion: Each tribe has a different history. Among the six tribes are those with a ratified treaty and those with unratified treaties. There are reservations created by treaty, executive order, and by purchase of federal fee lands. There are specific tribal rights affirmed by court decree, federal legislation, orders of the Secretary of the Interior, or position papers of the Solicitor of the Department of the Interior. There are tribal and individual trust lands secured under the Indian Homestead Act (1884), Section 1 and Section 4 of the General Allotment Act (1887), or within National Forests (1910). Five of the tribes possess federal acknowledgment and are under the trust (fiduciary) responsibility of the United States. One of the tribes is not federally recognized.

In addition, some of the tribes have substantial lands in trust; others have only modest landholdings. Some individual Indians have allotments or homesteads in trust. Some tribes were subjected to Termination in the latter twentieth century with consequent loss of reservations, exercise of trust responsibility, and all federal government services. Others were not terminated. Some tribes litigated successfully before the Court of Claims or the Indian Claims Commission and obtained judicially determined financial awards from the federal government.

The Overview Report refers to the “condemnation” of the lands of the Klamath Tribes. This matter deserves explanation. As a condition for Termination and loss of federal trust responsibility, the Klamath community split. Those “withdrawing” received a per capita payment for their interest in the reservation. The 474 “remaining” tribal members had their lands placed in a trust with the U.S. National Bank, Portland, Oregon. The “remaining” members voted in 1969 to dissolve this trust and receive a per capita distribution from the sale of their 135,000 acres. They received an initial payment in 1974 and a second payment in 1980. The sale of the Klamath Reservation resulted in payments of nearly $200 million to members of the Klamath Tribes.

Because the public often does not understand the unique relationship of Indian tribes with the federal government and the lack of a formal relationship between tribes and the states (except under the compact requirement of the Indian Gaming Regulatory Act of 1988), it is important that the Overview Report provide accurate, informative data about the tribes.

Comment 8b-2: The Overview Report discusses the *Dams Out with KBRA* scenario but does not clarify that some of the tribes have guarantees of water rights and that such rights are protected by treaty, court decision, and congressional legislation.

Recommendation: Explain that Indian water rights, even when not quantified for the tribes involved, are the consequence of important decisions and actions. Clarify that Indian water rights are guaranteed by treaty, court decision, and congressional legislation. Indian water rights are a matter of federal trust responsibility.

Discussion: Indian water rights are derivative from the case of *Cherokee Nation v. Georgia* (1831). Chief Justice John Marshall ruled that Indian tribes were "domestic dependent nations." He observed that they had sovereignty but that it was less than that of the greater sovereign, the United States. Nevertheless, the relationship, he said, was like that of a "ward to its guardian." The United States had trust responsibility for the tribes. This doctrine has endured for 180 years.

The hunting and fishing rights of the Klamath Tribes were reserved in their ratified treaty of 1865. In spite of Termination, the court ruled in *Kimball v. Callahan* (1974) that these rights survive. In *U.S. v. Adair* (1984) the court upheld the Klamath Tribes' right to sufficient water to support livelihoods based on hunting and fishing. The amount of water is not quantified. Because the Klamath Reservation was created to convert the tribes to a sedentary, agrarian lifestyle, the Winters Rights Doctrine (1908) is a further foundation for their water rights. When water withdrawals from the Trinity River had significant impact on the fisheries of the lower Klamath River, Congress in the Central Valley Project Improvement Act (1992) sought to fulfill "its trust responsibilities to protect the fishery resources." The Trinity River Restoration Project was part of the effort to protect tribal rights. In *Westland Water District v. U.S. Department of the Interior* (2004), the court concluded that restoration of the Trinity River fishery was "unlawfully long overdue." Fishing litigation has also confirmed the Yurok Tribe's rights and implies that there must be sufficient water to sustain that activity. Case law and Solicitor Opinions in 1993, 1995, and 1997 define federal trust responsibilities.

The KBRA is premised to become the standard whereby the Bureau of Reclamation distributes water in the upper Klamath Basin. The KBRA Drought Plan (July 11, 2011) included three tribes (Klamath, Karuk, and Yurok) along with other user interests in its formulation. The plan, however, turns over its implementation to the Oregon Water Resources Department to declare and revoke declarations of "Drought" and "Extreme Drought." These declarations could directly affect the water rights of the tribes and appear to be a transfer of trust responsibility from the federal government to a state. The state does not have a trust responsibility for tribes. If such is the intent in the KBRA Drought Plan, this responsibility must be included in the authorizing legislation implementing KBRA and should be so identified.

8c. Are there any important gaps in the information presented for a public interest determination?

Section 4.4 covers a wide category of public interest determination issues concerning the likely impact of implementing the *Dams Out with KBRA* scenario relative to the *Dams Remain* scenario. The range of issues in this section is sufficient to inform the decision as it pertains to economic benefits and impacts, social and tribal cultural effects, recreation, refuges, wild and scenic rivers, real estate, etc. Some specific public interest issues are not covered as accurately and thoroughly as needed; these are described below.

One comment below refers to the non-use values described in the "Klamath River Basin Restoration Non-use Value Survey Final Report." The Overview Report accurately summarizes the contents of two economic analyses; however, questions remain on the role of the research results in the logic of the presentation.

Reclamation's Klamath Project

Comment 8c-1: The Overview Report mentions Reclamation's Klamath Project several times, but its relationship with this project is not clear.

> **Recommendation:** Develop a large map showing and identifying all critical features of Restoration's Klamath Project, especially any mentioned in the Overview Report's text. Because the proximity of Restoration's Klamath Project is significant relative to this project, it would be beneficial to decision-makers to have a complete understanding of the overall layout of features discussed in the Overview Report and the cited KBRA. The map could be included either in Section 1.2.2 or in Section 1.2.7 relative to the discussions on the KBRA.
>
> **Discussion:** The *Dams Out with KBRA* scenario includes a number of provisions (such as tribes not exercising their water right claims) that would conflict with Reclamation's Klamath Project and improve certainty about water allocations for wildlife refuges. Although the text in Section 1.2.2 gives some project statistics (dams, canals, ditches, acres), there is no map to inform the reader about the geographic scale or locations of specific project details. This information would be helpful in illustrating the significance of the KBRA provisions, both functionally and economically.

Non-use Value Survey Results

Comment 8c-2: In the context of the extensive economic research described in Section 4.4.1, concern exists about the use of the non-use value survey results. Explain why the non-use value of coho salmon enhancement is used to represent the low end of the economic value spectrum, in contrast to the "total economic value" for the dam removal and stream enhancement.

> **Recommendation:** Explain the role of coho salmon enhancement as a "stand-in" for a low estimate of total value for the dam removal action.
>
> **Discussion:** The largest element in Section 4.4.1 covers the estimation of "total economic value" through a survey. Its explanation of the survey structure used to generate the data necessary for

estimating total economic value and the specific non-use value of Klamath River coho recovery are largely adequate.

The total economic values are estimated for two alternatives: one involving broad enhancement of the river system and the other reducing the extinction risk for coho salmon (Table 4.4.1-13; columns 2 and 3, respectively). The latter value is strictly non-use because coho would not be subject to allowable harvests (i.e., no use). Other non-use values presumably included in the total economic value estimate are associated with Chinook salmon enhancement, water-sharing, and other fish restoration projects. Hence, the non-use value estimated for coho salmon enhancement does not adequately represent the overall non-use values associated with the action plans under consideration. Perhaps the authors could include a short explanation of why they chose the coho-specific component of the non-use value as the lower bound estimate.

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Appendix A
Reviewer Biographical Summaries

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Appendix A

Reviewer Biographical Summaries

Stephen Dow Beckham, Ph.D.

Dr. Beckham is Pamplin Professor of History, Emeritus, Lewis & Clark College. Professor Beckham retired in May 2011 after 42 years of college teaching. He earned his B.A. at the University of Oregon and his M.A. and Ph.D. at UCLA. He has specialized in teaching and writing about the American West, Native Americans, and American environmental history. His first book, *Requiem for a People: The Rogue Indians and the Frontiersmen* (1971), is a history of Indian-Euro-American relations in the watersheds of the Rogue and Klamath rivers in southwestern Oregon and northwestern California. The book has had numerous reprintings and is available in paperback. Beckham's doctoral dissertation was a biography of George Gibbs, a Harvard-educated lawyer and gold miner who came to the Klamath River in 1851 as secretary to the California Indian Treaty Commission. Beckham's subsequent work has involved a study of the historical landscape of the Klamath River corridor from Keno to Hornbrook mounted for the Bureau of Land Management, several consultant studies in the Klamath Basin, and eight years of work as an expert witness in *Karuk Tribe v. United States*, a case in the U.S. Claims Court over tribal ownership interests in the Hoopa Valley Reservation. Beckham has served as a witness in more than 30 court cases, particularly for the State of Oregon in assertions of the "navigation servitude" and public ownership of streambeds. He is the author or co-author of more than 130 consultant studies, numerous books, and special exhibits at museums from the Library of Congress to the Oregon Historical Society in Portland. He is a former "Oregon Professor of the Year" and recipient of the Asher Distinguished Teaching Award from the American Historical Association.

Charles C. Coutant, Ph.D.

Dr. Coutant retired as Distinguished Research Ecologist in the Environmental Sciences Division of Oak Ridge National Laboratory in 2005. He received his B.A., M.S., and Ph.D. in biology (ecology) from Lehigh University. He conducted field and laboratory studies on Pacific salmon in relation to nuclear facilities on the Columbia River for 5 years at the Atomic Energy Commission's Pacific Northwest Laboratory (Washington). He led a program on power station effects on aquatic systems at Oak Ridge National Laboratory (Tennessee) in the 1970s and early 1980s and held various research and administrative positions there for 35 years. He was active in publishing his research, developing guidelines for thermal discharges, and implementing Clean Water Act Sections 316(a) and 316(b) demonstrations for power station cooling systems. He was president of the American Fisheries Society in 1996–97. From 1989 to 2005, he served as a member of independent advisory groups for the salmon restoration programs in the Columbia River basin. Since retirement, Dr. Coutant has served part time as an ecological consultant to regulatory agencies and industry. His main interests are temperature effects, fish behavior and habitat selection, and research and analysis for minimizing the impacts of thermal-electric and hydropower generation on aquatic systems.

William L. Graf, Ph.D.

Dr. Graf is University Foundation Distinguished Professor Emeritus at the University of South Carolina and a Senior River Scientist for The Nature Conservancy. His B.A., MSc, Certificate in Water Resources Management, and Ph.D. in geography are from the University of Wisconsin, Madison. His research addresses two broadly defined topics: geomorphology and hydrology of rivers, and the intersection of science and policy for public land and water. He has conducted research and served in science review and oversight positions associated with water quality, water quantity, aquatic and riparian habitats, and endangered species in a variety of ecosystems including the Klamath River of California and Oregon, streams of the Colorado Plateau, Colorado River, Rio Grande in New Mexico, Platte River in Nebraska, and the Everglades, as well as rivers in the southeastern United States including the Savannah. He is a National Associate of the National Academy of Sciences, and he has chaired or been a member of more than a dozen National Research Council committees and boards. He is a Past President of the Association of American Geographers; he was appointed to the Presidential Commission on American Heritage Rivers; and he is a member of the Environmental Advisory Board to the Chief of the U.S. Army Corps of Engineers. His several books and more than 140 papers and book chapters have resulted from funding by agencies such as the National Science Foundation, National Park Service, U.S. Army Corps of Engineers, U.S. Department of Energy, U.S. Geological Survey, U.S. Department of Justice, and a variety of state and local agencies. His work has been recognized by awards from the Association of American Geographers and Geological Society of America. He has been awarded Guggenheim and Fulbright fellowships.

Steve Higinbotham, P.E.

Mr. Higinbotham has more than 40 years of experience as a hydraulic structures engineer in the design and modification of new and existing dams and appurtenances. He worked for 25 years with the Bureau of Reclamation in the Waterways and Concrete Dams Branch. While at Reclamation, he served as the Concrete Dams Team Leader on a multi-agency team for the Elwha River Restoration Project. The purpose of this project was to restore fish passage of several listed species of salmon. In that role, he was responsible for the development of dam removal alternatives for Elwha Dam (a 110-foot-high concrete gravity dam) and Glines Canyon Dam (a 200-foot-high concrete arch dam) on the Elwha River near Port Angeles, Washington. He also coordinated the design of water quality mitigation features required to accommodate the removal of these two dams. Mr. Higinbotham served as a consultant to review proposals for the removal of the four Lower Snake River Dams. He later participated as a co-author of an American Society of Civil Engineers publication entitled “Guidelines for Retirement of Dams and Hydroelectric Facilities.”

Dan Huppert, Ph.D.

Dr. Huppert is a Professor Emeritus at the School of Marine and Environmental Affairs, University of Washington in Seattle. After earning a Ph.D. in economics from the University of Washington in 1975, he worked for the National Marine Fisheries Service in San Diego for 15 years, exploring economic aspects of tuna policy and leading efforts to develop management plans for anchovy, mackerel, and squid fisheries. He participated on management plan teams and the Scientific and Statistical Committee for

the Pacific Fishery Management Council. After moving to Seattle in 1989, he began teaching courses in marine resources management and economics at the School of Marine Affairs. He joined the North Pacific Fishery Management Council's SSC for five years, ending in 1994. He has performed research for the National Marine Fisheries Service, including developing a report on the economics of salmon recovery, and participated on National Research Council Committees dealing with Alaska's Community Quota Development Program and the Louisiana Coastal Area Study. For the State of Washington, he led the Columbia River Initiative Economic Advisory Committee (2003–2004) and served on the Northwest Straits Commission Review Committee in 2004. Since 1997 he has served on the Northwest Power and Conservation Council's "Independent Economic Analysis Board." He served as the President of the North American Association of Fishery Economists from Spring 2009 to Spring 2011. His ongoing research interests include ocean fisheries management, marine aquaculture, economics of salmon restoration and hydropower systems in the Columbia basin, watershed planning, and coastal management.

Daniel Schindler, Ph.D.

Dr. Schindler is the Harriet Bullitt Chair of Conservation in the School of Aquatic and Fishery Sciences at the University of Washington. He earned a B.Sc. with Honours in Biology (1990) from the University of British Columbia, and a M.S. (1992) and Ph. D. (1995) from the University of Wisconsin-Madison. He was hired onto the faculty at the University of Washington in 1997 and teaches graduate and undergraduate students in limnology, aquatic sciences, and ecology. He has performed research on aquatic ecosystem dynamics and fish ecology for more than 25 years. Most of his current research is focused on a variety of issues regarding the functioning of watersheds supporting Pacific salmon in western Alaska and the socioeconomic dynamics of fisheries that operate in these ecosystems. He is a principal investigator of the University of Washington-Alaska Salmon Program that has performed field research in Alaska since the 1940s, and he spends several months of the year in the field in Bristol Bay. He has published more than 100 peer-reviewed papers in ecology, limnology, and fish ecology, and has provided service to a variety of governmental and non-governmental organizations. Schindler has been a recipient of the Distinguished Research Award from the College of Ocean and Fishery Sciences at the University of Washington. He also serves on the editorial board of the journals *Ecology*, *Ecological Monographs*, and *Ecosystems*.

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Appendix B
Detailed Comment Matrix

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Appendix B
Detailed Comment Matrix

Section	Location	Comment
Executive Summary	p. 11	First row of Table ES-4 "Accelerates when the river…" is not clear. What is accelerating?
Executive Summary	p. 11	Fifth row of Table ES-4 under Habitat Benefits seems somewhat misleading. Are the increases in springtime flushing flows expected to be large enough to change sediment bed movement? Or will this largely be a function of the likely composition of the bed with the *Dams Out with KBRA* scenario (i.e., smaller particle sizes)?
4.4.1, Economic Analysis	p. 135-197	Label subsections within 4.4.1 to be consistent with Sections 4.4.1.2 through 4.4.1.7. Several subsections in Section 4.4.1 have no numerical labels. Either label 4.4.1 subsections numerically, or eliminate the numerical labels for Subsections 4.4.1.3 through 4.4.1.7.
5.2.1, Mitigation Measures	p. 273, Table 5-3, Dam Removal Mitigation Measures	Address mitigation of the hydropower facilities determined eligible for the National Register of Historic Places by mentioning preservation of engineering drawings, plans, and historical photographs. Also, address the possibility of land acquisitions (PacifiCorp holdings) for campgrounds, hiking trails, river access points, bicycle paths, and development of educational programs related to remaining sites, structures, and objects documenting the hydropower projects.

Section	Location	Comment
5.4.1, Summary of Effects to National Economic Development (NED)	p. 277	Section addresses fishing, agriculture, and refuge recreation but does not mention camping, hiking, heritage tourism, or other probable recreational uses of the upper Klamath canyon.
5.4.3, Tribal	p. 282	The conclusions appear optimistic. Among the benefits of dam removal, the Overview Report states: "Primary among these [benefits] are greater anadromous fish harvests for some tribes in the lower basin, a return of salmon and steelhead to the upper basin for the Klamath Tribes, and a restoration of Klamath Tribes sucker fisheries." Some questions are unanswered: a. Where in the upper basin is the anticipated return location for salmon and steelhead? Is it to Spencer Creek and the base of Keno Dam? Is it to Link River? Is it to Lost River? Is it to Upper Klamath Lake? b. Where in the upper basin will the sucker fisheries be restored? Is it the Lost River fishery? Is it upper Klamath Lake and its tributaries?
6, References	p. 299	The Overview Report incorrectly cites Charles J. Kappler, *Indian Affairs: Laws and Treaties*, Vol. 2. The executive orders creating the Hoopa Valley and Yurok reservations are in Vol. 1 of this work. The revised citation is: Kappler, Charles J., ed. 1902-04 *Indian Affairs: Laws and Treaties*, *Vols. 1 and 2*. Washington, DC.: Government Printing Office.

Appendix C
Additional Cultural Resources References

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Appendix C

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