MEMORANDUM

To: John Hamilton, US Fish and Wildlife Service

From: John Hefner

CC:

Date: August 4, 2010

Subject: Independent Peer Review of the Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River

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This memorandum presents a summary of the major comments submitted to PBS&J by two independent peer reviewers on the *Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River* (July 16, 2010). Detailed comments are also provided (Attachment A) as are complete reviewer (Attachment B). The reviewer's resumes are included in Attachment C.

General Comments

The two peer reviewers of the subject document found the authors' presentation approach to reasonable and the background information comprehensive. They agreed that consistency of thought and overall logic presented in the report were good. Most importantly, the reviewers believed conclusions drawn and presented in the report seem to be scientifically plausible. Few typos and grammatical issues were identified by the reviewers. However, one reviewer felt that the there was too much use of fisheries jargon. He also felt that there was not enough map information to inform the reader about locations referenced in the report.

Both reviewers had serious concern that there was not enough use of primary literature sources and descriptions of the findings of those studies to fully support the conclusions of the report. As on reviewer put it: "...it was also very clear that they did not, in many cases, adequately mobilize and describe the relevant scientific literature and data available to defend their statements. They made their case but did not thoroughly enlist the primary studies to strongly attempt to defend or prove their case." References to primary sources and more explanation of the findings of those studies would strengthen the report considerably.

One reviewer felt that limiting the scope of the report to the effects of dams and dam removals on individual species and their populations and not considering broader community-level or ecosystem-level interactions to be a significant shortcoming of the report. The reviewer suggested that the report could be made more complete by considering and evaluating the broader riparian effects, food web effects, riparian-aquatic interaction effects, species interaction effects, or any of the more complex, higher level effects such as river connectivity and river function. Similarly the second reviewer felt that the related topic

of the relationship between diversity and ecosystem stability/services should be explored. If these omissions are intentional, the authors of the report may want to inform the reader up front.

Finally, one reviewer felt that the "total lack of quantitative evaluation and any weighting of ecological, social, and economic benefits and costs" could be viewed by some scientists as a significant report deficiency. The authors may wish to inform the reader that this more inclusive evaluation is intentional and beyond the scope of the work, if in fact that is the case.

Attachment A: Specific Comments

The following are collated near verbatim (with minor editing for clarity) section-by-section reviewer comments, questions and suggestions:

1.4.1 para. 2: The last sentence may be true, though it conveys subjective opinion about the process.

1.4.2: It is not clear that "The report…" at beginning of para. 2 and 4 is "this report" and hence, it is unclear about how this document fits into the larger process. A flow diagram of the process would be helpful.

Pg 12, footnote. It is not clear why the Ackerman et al (2006) model was excluded—specifically why could the BSG not agree?

Pg 13 para.1-3: These paragraphs describe major projects and management efforts rather than watershed condition. Recommend moving up to section 1.4.

Section 2.1.1: A couple of summary tables with 303(d) listed parameters by stream/reach and the relative discharges of each stream would be helpful.

Section 2.1.1: The headers "Conditions without dams and KBRA in…" is correct, but one could frequently read as "without dams and without KBRA" rather than "without dams and with KBRA".

Section 2.1.1.2: As written, it was unclear why Wood R. is considered a significant source of P if the Wood is 19% of P loading to UKL and 25% of discharge. These values suggest a low relative loading compared to other water sources.

2.1.1.4 para. 2: "UKL was historically eutrophic, but…" awkward sentence structure.

2.1.1.4 para.4: "Water is also lost from the lake through evapotranspiration" change to evaporation?

2.1.1.4 para.6: "…fish kills have occurred more frequently…" What resident fishes are common and what dies in kills?

2.1.2: Not clear why the authors state that the seasonality of purchased water is unknown—presumably it would become available during irrigation season, or am I missing something?

2.1.3 para.1: What is the potential for owners to sell water rights and how much water is reasonably expected to become available? Is it 5,000 AF or 30,000 AF?

2.1.3 para.2: Agency Lake Ranch and Barnes Ranch lands are not well described.

2.1.4.1 para. 3: This background para. on DO should be moved up, perhaps to a general section on WQ parameters of interest, their effects on biota and relevant thresholds. Alternatively, should at least be moved up to the first mention of DO issues.

2.1.4.1 para. 6: Last sentence—what are the months adult salmonids migrate? A figure with the run timing of salmonid populations would be useful for the reader not steeped in KB salmonids, even if stylized.

2.1.4.1 para. 7: It is not clear what Lost R. diversion channel or Klamath Straits drain are or what the flows are for.

2.1.4.2 para. 2: It is not clear why trout size in Keno ladder has declined or what other fishes are in Keno Reservoir. Jeld-Wen is not defined.

2.1.4.3 last para: It is not clear what "interrupted flows" are or whether they are naturally occurring. Also, what is the potential to restore the hydrologic function of Buck Lake?

Attachment A: Specific Comments

2.1.4.4: The "plumbing" of this reach is complex and a diagram would be very helpful for visualizing the flows, impacts, groundwater inputs, and refugia.

2.1.6 para. 4: Is there any information available on how much of a nutrient trap the reservoirs are?

2.1.9 para.2: What the effects of reed canary grass on riparian birds in general?

2.1.12 last para: How do KBRA management changes relate to future predicted drought conditions?

2.1.13 Table 1: More information on the data in this table and the data sources would help readers rigorously evaluate the information. I am still not clear what the two categories represent
(Actual post project estimates and historical and potential production estimates).
Klamathon Racks is not shown on the map or well described in the text.

2.1.13.4: Next to last para: What is the explanation for this conclusion?

2.1.13.6: Historical harvest can be used, but there is an implicit assumption that watershed habitat conditions during the 1925-1961 period and 2012-2020 periods are similar and would support similar smolt production. I suspect habitat and watershed conditions will have changed substantially between the two periods. The KlamRas model is frequently cited and should be better described.

2.1.13.6 para 1: What evidence is there for this very plausible suggestion?

2.1.13.7: Steelhead and Pacific lamprey are discussed without much background. Would Pacific lamprey colonize tributaries above UKL as well?

2.1.14: A brief summary of the current effects of the pathogens listed would be useful here.

2.1.15: I found this section confusing because the "options" were not well described and most of the effects cited relate to conditions below IGD, not above.

2.1.16: How do KBRA conditions affect the future likelihood of disease given the known environmental changes anticipated and the effects of those changes on disease transmission and expression?

2.1.16 para.1: Additional documentation is needed.

2.1.16 last para: Clarify what is meant here.

2.1.17.3: Citations of studies on bull trout food habits could strengthen this section.

2.1.17.4 para.1: When were the two suck species listed under the ESA?

2.1.17.6 para. 3 and 4: Provide studies to support these plausible conclusions.

2.1.17.9 para. 3: The Pearsons and Temple (2010) citation is relevant if the supplementation produced natural densities of salmon; if supplementation produced unnaturally high salmon densities, the example seems misleading as this case is not expected to occur without dams. The section on redband trout is out of phylogenetic order.

2.1.17.9 Last para: Provide primary references to support this conclusion.

2.1.17.18: This statement seems weak as there will likely be increases in Pacific lamprey allowing recolonization and KBRA would presumably have positive effects via improved habitat and hydrology on resident lampreys.

2.1.18.2: In some cases in this report, it is stated that there will be little change to the existing situation. But in some cases it is not at all clear what the existing situation is. For example is the species of interest increasing,

Attachment A: Specific Comments

stable or decreasing? Are there any strong or reliable trends? This seems to be important but is seldom addressed.

2.1.18.3 pg. 49 last sentence: How many nest sites would be lost? 10? 100? How are overwintering waterfowl distributed between UKL and PR reservoirs?

2.1.18.10: Would breeding bird survey data for Willow Flycatcher and Cliff Swallow be useful? (http://www.pwrc.usgs.gov/BBS/)

2.1.18.15: Are there any potential negative effects to deer if the habitat does not return to a predam condition?

2.1.19 pg. 56: The Howe (1968) citation characterizing the Klamath runs as "not equal" to Columbia runs feels out of place as the per-human run size (salmon per human) seems more important to wealth and stability than absolute run size.

2.1.21: How many salmon, steelhead and lamprey would be available in the Copco 1 and IGD reservoir reaches after removal? What is the cultural value of trading a recent non-native species (perch) with returning salmon and steelhead and lamprey? With which group(s) are the perch and bass fisheries popular? These seem important to evaluating the loss of the yellow perch fishery. The authors cite spring Chinook as more value on a per fish basis than fall Chinook; certainly the same is true for salmon vs. perch.

2.1.21.2: What is the potential for inland commercial fisheries under dam removal?

2.1.21.2: Second part of para.2: Is this extra harvest necessarily a benefit to the salmon?

2.2.4 pg 61: How might the duration of and variability in warm water periods affect salmonids and how does that relate to thermal regimes under the two actions?

2.2.4.1: Why would temperatures below IGD continue to degrade?

2.2.4.4: A short description of the current proposed dam removal plan and plans to ameliorate short term effects would be helpful. Also, through the discussion of the direct effects of dam removal, it would be helpful to explicitly define the time scales for "short" and "long" term effects. I did not follow the logic in the third paragraph of this section.

2.2.5: Table 4 has a section labeled "Geomorphic Processes" while discussion of sediment dynamics is subsumed as a topic in 2.2.5. Given the importance of dams on sediment dynamics/geomorphic processes and the importance of sediment dynamics on fish habitat, I would suggest elevating the topic to its own section, placed after sections on hydrology and temperature but before nutrients.

2.2.7 para. 2: Plausible conclusion but needs references.

2.2.7 pg. 68 first full para: Could point out that Pacific salmon and steelhead evolved in a geomorphically unstable region and have frequently been exposed to episodic high sediment loads.

2.2.7 pg 69: Many, if not most anadromous salmonid species are thought to function as metapopulations and increased connectivity and subpopulation diversity are thought to increase metapopulation (e.g., ESU) persistence. The metapopulation concept should be introduced and could be used to evaluate the potential effects of actions, especially connectivity, throughout.
Also, marine derived nutrient delivery to headwater streams is not discussed anywhere as a potential benefit to dam removal—what role did MDNs play in the historic landscape and how might restoration of MDN delivery via salmon, steelhead, and lampreys benefit these species and others (such as bull trout)?

2.2.8.3 pg 71 first full para: The meaning of this paragraph is unclear.

Attachment A: Specific Comments

2.2.8.4 para.1: Dwinnell Dam is not identified on the map.

2.2.8.6: What are the probable effects of altered temperature regime under dam removal on adult and juvenile coho mainstem migration? Specifically, would the change increase or decrease the probability of a 2002-type die-off?

2.2.8.7: Are summer, fall, and winter steelhead considered parts of the same ESU by NMFS (implied but not explicitly stated)? How much of the change in time series of abundance is thought to be related to ocean regime?

2.2.8.12 First sentence: At which locations? Mainstem? How much use of tributaries is there in these fish?

2.2.9: What is the habitat of the polychaete and how does it relate to reservoirs? How do DO concentrations affect the polychaete relative to other benthic invertebrates (e.g., does low DO below dams favor the polychaete?)

2.2.12.1: Might largescale suckers occur afterward? Would Bull trout then be able to migrate?

2.2.12.4-6: The sections on suckers are thin on detail compared to other sections.

2.2.13.12: There appears to be no prediction or conclusion in this section.

2.216.1: Why the reference to sockeye salmon?

3.1 pg. 98 last para: Might it be useful here to recast the emphasis of this section to point out that changes in mean temperature are not likely to strongly negatively affect groundwater temperatures, even for fast flowing/short residence time systems. Rather, the big effects will be on daily maximum temperatures in stream with little GW input.

3.1 Last para: "aquasition" is an excellent Freudian slip?

Summary and throughout: An important topic that is lacking is the relationship between diversity and ecosystem stability/services. Specifically, recent papers by Schindler, Quinn and Hillborn provide relevant examples that the Portfolio effect and biocomplexity (e.g., life history diversity in salmon) damp the effects of environmental variability on population abundance at the metapopulation scale. Improved habitat diversity, increases in life history diversity, increases in the number of subpopulations, and the increased connectivity among subpopulations following dam removal all suggest further benefits and probability of population persistence in the presence or absence of climate change.

Table 4: The table provides an excellent summary of the findings that will be a valuable resource to readers. I would suggest reorganizing it more logically (e.g., BGA precedes Geomorphic processes). Where possible it would be good to identify which risks and benefits are minor (unlikely), moderate, or major (probable).

Specific comments on Table 4:

Nutrients: What is specific benefit of reduced HRT?
Hydrology: What are the effects of KBRA flows in drought years?
Coho salmon w/dams: Is the benefit not also true for the w/out dam state?
Bull trout: What is the role of marine derived nutrients?
Anadromous fish habitat: What is the role connectivity/ metapopulation structure?
Recreational reservoir fisheries, w/out dams: What is the benefit of replacement with mainstem anadromous fishery in PR? See also 4) under Steelhead w/out dams.
Steelhead w/ dams: Would fishing opportunities not also continue w/out dams?
Geomorphic processes: This could move up. W/out dams risk should include movement of sediment plug downstream.

Attachment A: Specific Comments

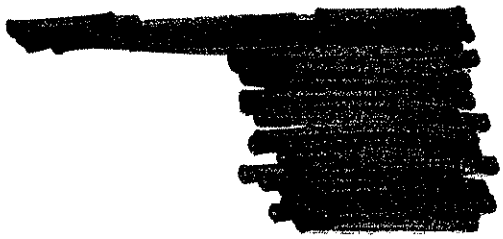
Figure 2: It is unclear what data sources are and/or how data were simulated. An indication of minimum pool level would be helpful.

Figure 4: This figure may not be necessary since it could be easily explained in the text.

Figure 6: Because the number for the current dams is so low, it may be good to put an arrow with the number indicating that it is low.

Figure 9: Why include only to Spencer Creek? Why not include UKL tribs?

Attachment B: Reviewer Comments



John M. Hefner
Senior Scientist
PBS&J
1616 Millbrook Road
Raleigh, North Carolina 27609

Dear Dr. Hefner,

Please find below my letter report describing my peer review of the 16 July 2010 draft of the document:

Synthesis of the Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River (Draft)

My review is as an expert in the field of fisheries biology and freshwater ecology. I am currently primarily employed by the University of [redacted] where I direct a research program focused on anadromous fish migration and ecology in regulated rivers and monitoring of freshwater resources. My strengths in conducting this review are a broad training and experience in fisheries ecology, marine science, fisheries management, and environmental monitoring, including Pacific salmonids and Pacific lamprey. My primary limitation in conducting the review is a lack of experience or knowledge with the specific details of the Klamath Basin populations, ecosystem and associated literature, though I have direct knowledge of identical species or similar species in the nearby Columbia and Willamette basins. I am conducting this review as a private consultant and do not represent the University in the following work.

I have reviewed the document to:

"review the subject document and prepare a letter report critiquing its completeness, scientific approach, consistency of thought, and soundness of conclusions. In essence the reviewer is asked to determine if the document represents "good science" and if conclusions in the report seem reasonable based on the best available scientific information." Specifically I have evaluated, as relevant, "the clarity of hypothesis, the validity of the research design, the quality of the research design, the quality of the data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, the

extent to which the conclusions follow from the analysis, and the strengths and limitations of the overall product."

The purpose of the document is to provide expert synthesis of available data, empirical models, conceptual models, expert opinion, and literature that 1) describe the current effects of four lower Klamath River dams on fish and wildlife in the basin, 2) predict the effects on the ecosystem and fish and wildlife populations after a) no change, or b) dam removal and implementation of the Klamath Basin Restoration Agreement (KBRA).

The focus of the review is on listed and non-listed anadromous fishes and considers effects above and below Iron Gate Dam (IGD) separately from those below IGD. The document is to be used by the Secretary of the Interior to make a determination for dam removal and enactment of the KBRA or a negative determination to leave dams in place without enactment of the KBRA. The criteria to be used by the Secretary are whether removal and the KBRA will advance the restoration of Klamath Basin salmonid fisheries and whether a positive action is in the public interest, including affected local communities and tribes.

In my reading of the report, this document will be specifically used as a component in support of a non-use economic valuation study that will help guide the SD, as a resource for Expert Panels to the Secretary, and possibly during preparation of NEPA and CEQA documents (these purposes are outlined on pgs. 11-12, but, as written, are not fully clear to me; see below for more detail).

Chapter 1 provides background on the policy issues and context for the document, Klamath Basin resource programs, and the purposes and future uses of the document.

Chapter 2 provides the summary and synthesis of effects under existing and the two future conditions. Chapter two comprises the bulk of the document and includes both narrative background information on natural history and ecosystem condition and reviews of specific effects by location and population or ecosystem component. The document ends with a treatment of the likely effects of climate change on both future conditions and a summary matrix of effects.

Overall, it is my opinion that the document represents "good science" as the conclusions are reasonable and are based, to my knowledge, on sound ecological principles and the best available information.

The general approach is reasonable and in line with the purpose(s) of the document. Specifically, the authors have reviewed effects on relevant population and ecosystem components and have reviewed each under current conditions (providing the reader with background on current status) and then under each potential future action. Importantly, the authors considered effects at multiple spatial and temporal scales, including effects within and across population and ecosystem components. The review correctly places emphasis on both

mean conditions and variation in conditions through space and time (e.g., temperature). The review structure is logically divided at IGD because effects below the dam differ strongly from those within the Project Reach (PR; IGD to Link River Dam) and above the PR. The review focuses on factors known to affect the distribution, abundance, and population growth rates/viability of focus species: hydrologic regime, temperature, sediments, nutrients, dissolved oxygen, access to and connectivity of habitats, disease, habitat diversity and heterogeneity.

The metrics considered include both abundance and other factors recently recognized as important to sustainable populations and fisheries including metapopulation structure, life history diversity, and environmental heterogeneity. The influence of important factors outside the Basin or acting at large scales are considered, including effects of changing climate and changing ocean conditions and productivity. I have made minor suggestions for strengthening the conceptual context of the review below.

I found the treatment of effects under the two conditions to be consistently and logically evaluated, with no evident bias toward presenting benefits or risks under either action. For example, the risks under removal and KBRA are presented in Table 4, and risks related to removal of reservoirs are evaluated clearly. The limitations of the author's conclusions are presented clearly in most cases. I found no evidence that the conclusions in the document went beyond those drawn from source studies, and rather, that the limitations of cited studies were typically clearly articulated. Review of data sources appears broad and comprehensive. I found the section on diseases and climate change exceeded my expectations for a document of this type by the inclusion of the topics and completeness of treatment.

In short, the overall strengths of the document include a solid presentation of the background material, a logical approach to synthesizing and evaluating the general effects of dams and reservoirs, a comprehensive treatment of the major factors known to affect the species of concern, the major ecosystem processes affecting them, and how both are affected by dams.

The weaknesses of the document are primarily related to presentation. Specifically, the current draft assumes a quite knowledgeable reader and freely uses fisheries jargon and occasionally refers to specific locations without reference to previously described locations or locations on the provided map. The overall organization is logical, though several improvements could be made, as detailed below. The most substantive weakness in my reading is in presentation of results from other studies because, in some cases, I had a difficult time understanding what results were being presented (e.g., I still am unclear what the volitional passage data in figures 7&8 represent). More importantly, in these cases it was difficult to critically evaluate the findings presented because there was little or no information presented on the reported study assumptions, data sources, limitations, etc. (e.g., the Oosterhout 2005 results in Figure 7&8). A refreshing exception was review of the data and models on coho salmon summarized in Table 2. In general, I found the treatments of steelhead and Pacific lamprey to be less organized and comprehensive compared to treatments for salmon.

Below I provide specific comments and suggestions for improvement of the document.

Title: Wow. Accurate, but it's a mouthful.

Could present a preferred citation format.

1.4.1 pp 2: Last sentence may be true, though it conveys subjective opinion about the process.

1.4.2 Not clear to me that "The report…" at beginning of pp 2 and 4 is "this report" and hence, I was unclear about how this document fits into the larger process. A flow diagram of the process would be helpful.

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2.1.21 How many salmon , steelhead and lamprey would be available in the Copco 1 and IGD reservoir reaches after removal? What is the cultural value of trading a recent non-native species (perch) with returning salmon and steelhead and lamprey? With which group(s) are the perch and bass fisheries popular? These seem important to evaluating the loss of the yellow perch fishery. The authors cite spring Chinook as more value on a per fish basis than fall Chinook; certainly the same is true for salmon vs. perch?

2.1.21.2 What is the potential for inland commercial fisheries under dam removal?

Pg 61. How might the duration of and variability in warm water periods affect salmonids and how does that relate to thermal regimes under the two actions?

2.2.4.1 Why would temperatures below IGD continue to degrade?

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Pg 71 first full pp. I did not follow the meaning of this pp.

Pg 73. Dwinnell Dam not identified on map.

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Pg. 99: "aquasition": excellent Freudian slip?

Pg 100 and throughout. An important topic that is lacking is the relationship between diversity and ecosystem stability/services. Specifically, recent papers by Schindler, Quinn and Hillborn provide relevant examples that the Portfolio effect and biocomplexity (e.g., life history diversity in salmon) damp the effects of environmental variability on population abundance at the metapopulation scale. Improved habitat diversity, increases in life history diversity, increases in the number of subpopulations, and the increased connectivity among subpopulations following dam removal all suggest further benefits and probability of population persistence in the presence or absence of climate change.

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Nutrients: what is specific benefit of reduced HRT?

Hydrology: What are the effects of KBRA flows in drought years?

Coho salmon w/dams: is the benefit not also true for the w/out dam state?

Bull trout: role of marine derived nutrients?

Anadromous fish habitat: role connectivity/ metapopulation structure?

Recreational reservoir fisheries, w/out dams: benefit of replacement with mainstem anadromous fishery in PR? See also 4) under Steelhead w/out dams.

Steelhead w/ dams: would fishing opportunities not also continue w/out dams?

Geomorphic processes: could move up. w/out dams risk should include movement of sediment plug downstream.

Climate change: See pg. 100 comment above.

Figure 2: I'm unclear what data sources are and/or how data were simulated. Indication of minimum pool level would be helpful.

Figure 9: why include only to Spencer Creek? Why not include UKL tribs?

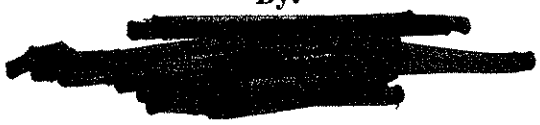
Please do not hesitate to contact me if any of the above is not clear.

[redacted]

Critique of

"Synthesis of the Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River"

By:



The information is presented in a clear, readable style. There are very few typos and few organizational or grammatical issues.

Completeness and Scientific approach -- The report does an adequate job of identifying and considering, at least in a general, non-quantitative way, *individual species* and the potential effects on them of the dams remaining and the dams being removed. However, the presentation of effects only considers individual species, one at a time. It is strictly a species or population segment approach. Perhaps the report was conceived of in this way and intentionally limited to this scope. The fact remains, though, that there is no community-level or ecosystem assessment on the impacts of dams remaining vs. dams removed in the report. That is, there is no consideration of the broader riparian effects, food web effects, riparian-aquatic interaction effects, species interaction effects, or any of the more complex, higher level effects such as river connectivity and river function. Connectivity is discussed briefly, but it refers to *physical connectivity* more than *ecological connectivity*. None of the higher-level concepts useful in characterizing community structure and ecosystem function, such as the river continuum concept of Vannote et al. (1980), the serial discontinuity concept (Ward and Stanford 1995, Stanford and Ward 2001) of the flood pulse concept (Junk 1989; Junk and Wantzen 2004) are brought into the report at all. Ward et al (2002) reviewed 9 distinct conceptual frameworks useful for investigating rivers and evaluating changes in rivers such as dams added and dams removed. *None* of the many papers that they reviewed are in this report. There is much work that could be referenced and brought into this report to address these limitations (if the intent is to broaden the scope and present a more complete picture). In addition to the papers cited above, books such as "Return to the River" (Williams 2006) contain several papers that provide scientific background for issues related to natural river function.

This very obvious omission may have been intentional. However, a more complete assessment of the potential conditions associated with dams remaining and dam removal would frame the situation on this broader context, would consider ecosystem effects, community effects, and would then address the individual species effects, and their interactions, Only the anticipated individual species responses are considered in the report. Those omissions, and the resulting limitation of the scope of the evaluation, will be viewed by many scientists as a significant deficiency in the report.

Consistency of thought and soundness of conclusions. In many locations, the information presented and conclusions drawn are scientifically *plausible*, but too little primary literature is used to scientifically defend the statements being made. I have flagged several of these locations in the attached edited version, but there are many others besides the ones I have noted. In addition, too much emphasis was placed on referencing *Administrative Law Judge (2006)* and too little on primary literature. To this reviewer, it seemed that as experienced scientists their consistency of thought and their overall logic were good. To this reviewer, it did not seem that their logical thought processes were off base. But it was also very clear that they did not, in many cases, adequately *mobilize and describe the relevant scientific literature and data* available to defend their statements. They *made their case* but did not thoroughly enlist the primary studies to strongly attempt to *defend or prove their case*. This is a difficult task, but one that can be done more effectively. It starts with a command of the relevant scientific studies in and out of the basin. That is a broad literature in many disciplines and sub-disciplines that undoubtedly will take time to sift through. It may be beyond the planned scope to do so.

Another area of potential improvement in the report is in the way that the studies were referred to. Sometimes to provide strong evidence, it is necessary to not just passively refer to a study (as is typically done in the report) but let the reader know *what the study said*; i.e., exactly what result from that referenced study provided support for the point that the authors are trying to make. There are numerous places in the report where a slight elaboration of the actual result of the study would provide a clearer rationale for the authors' conclusions as to effects of dams vs. no dams.

It is certainly true that not all of the studies necessary for evaluating impacts have been done. Some studies on critically-needed information have not been done anywhere, let alone in the basin. For that reason, it might be useful for the authors to classify studies in support of key scientific points the authors are trying to make as conducted (1) in the Klamath Basin, (2) outside the basin but in the Northwest and (3) outside the northwest. It might also be useful to be able to quickly identify the three types of studies as they are referenced, i.e., bold and italics for (1), bold for (2) italics for (3) so that the reader can quickly see how effectively studies are brought to bear on the point being made.

There is clearly a total lack of quantitative evaluation and any weighting of ecological, social, and economic benefits and costs. An example would include loss of reservoir habitat versus gain in river habitat. This omission was evidently intentional; perhaps it is beyond the scope of the work. It will also be viewed by some scientists, however, as a significant deficiency.

Overall assessment:

The main positives of the report are its organization and clarity of text. There are several important omissions, however, and these omissions constitute the main shortcoming of the report. The shortcomings including the lack of a ecosystems/community perspective, the failure to provide a perspective in terms of river function and river connectivity concepts, a marginal usage of refereed primary literature to support what are generally reasonable assertions and conclusions, and a lack of quantitative assessment of benefits and costs. It is not clear how

many of these omissions were deliberate (i.e., outside of the planned scope of the report) and how many were accidental.

In addition, I have provided numerous comments on the draft itself, using track-changes. That draft with comments is also attached. I hope these comments prove useful

References:

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