MEMORANDUM

To: John Hamilton, U.S. Fish and Wildlife Service, Yreka, CA

From: John Hefner, PBS&J, Raleigh, NC

CC:

Date: November 15, 2010

Re: Expert Review of the Document Entitled: Compilation of Information to Inform USFWS Principals on the Potential Effects of the Proposed Klamath Basin Restoration Agreement (Draft 11) on Fish and Fish Habitat Conditions in the Klamath Basin, with Emphasis on Fall Chinook Salmon.

This memorandum presents a summary of the major comments submitted to PBS&J by two independent expert reviewers of Hetrick, N.J., et. al. (2009). Compilation of information to inform USFWS principals on the potential effects of the proposed Klamath Basin Restoration Agreement (Draft 11) on fish and fish habitat conditions in the Klamath Basin, with emphasis on fall Chinook salmon. Arcata Fisheries Technical Report TR 2009-11. U.S. Fish and Wildlife Service. The complete comments of the reviewers follow the summary.

The two reviewers are eminently qualified to provide expert evaluations of the subject document. Both reviewers are PhD fisheries biologists with extensive experience in fishery management and research in the Pacific Northwest. One reviewer has over 35 years experience holding state and federal fishery management leadership positions in the region. The second reviewer is a supervisory government research scientist with over fifty peer reviewed publications related to salmon biology, riverine habitat management and watershed restoration.

Both reviewers were uniformly positive about the report. They agreed that the report was comprehensive, well written, and its content consistent with the author's intentions as described in the introductory sections. They agreed that conclusions presented in the report followed logically from the body of the report and that models used in the report were applied appropriately. Both reviewers agreed that the document was useful for its intended purpose as described in the title.

As was their charge, both reviewers provided useful suggestions for improving the report. They independently suggested that relating the anticipated effects of dam removal in the Klamath Basin to those actually observed with other removals and restoration management actions in the region would be beneficial. It was specifically suggested that including experiences on the Rogue River related to removal of the Savage Rapids and Gold Ray Dams would be informative. Additionally, one of the reviewers strongly suggested adding a number of "fundamental" references throughout the report. To assist the authors with this process, the reviewer included an extensive bibliography related to dam removal. The bibliography is attached after the reviewer comments.

The complete verbatim reviews as formatted by the reviewers follow:

Reviewer 1

General comments

Completeness – the report, in general, does a good job of managing the expectations of the reader. The introduction outlines what the report and will not cover and thus is complete in terms of covering the topic it identifies that it will cover.

Scientific approach – the scientific approach, for the most part, is a combination of literature, empirical data, and the modeling of different scenarios. This is a very reasonable approach to large-scale actions such as dam removal and changes to water quantity.

Consistency of thought – consistency of thought was apparent throughout the document. The modeling that occurred in one section was utilized in other sections and thus conclusions were built upon on another.

Soundness of conclusions – the conclusions drawn from the analysis seems reasonable and logical in relation to the results. In addition, the conclusions are consistent between sections.

Note

1. Did not review, in detail, the following sections of the document – 1, 2, 4, and 6

Strengths

1. Well written document. Easy to read, assumptions are typically laid out and the analysis is relatively clear.

Weaknesses

1. The need for more fundamental references in the introduction paragraphs of each section reviewed. Only two to four papers were referenced, when other papers might be more relevant. Generalized statements typically have one to three references associated with them.

2. Each section has a context but it is not evident when starting a new section. One suggestion is to identify the specific questions the section is attempting to answer so the reader has a better understanding of what the section will address.

Specific comments

III. Geomorphology and channel maintenance Pages 61 to 83

Sediment supply and transport – Page 61 –

It is important to point out the Schumm conceptual model is a fairly simplistic model to use, but nonetheless an important model to help conceptualize the potential effects of dam removal.

It is important to point that the change in bed material size will also vary according to specific parameters such as stream channel gradient, sediment supply composition, etc. Understanding the importance of the change moving downstream is important but it is also important to point out there are several driving variables.

Generalizations such as "human disturbance increase erosion rates, or there is a progressive decrease in particle size as bedload moves downstream needs to have references. Make sure there are references for these types of statements in the geomorphology and channel maintenance and the rest of the document. That is critical to the document's credibility.

Sediment deposition – Page 62 –

The following paragraph needs references. Making generalization necessitates references

A slow moving or still area in a waterway allows sediment deposition to occur. As such, pools exhibit a higher relative composition of fine sediment than riffles. In addition, flows within the mid-channel of a stream typically move at a higher velocity and therefore are capable of transporting larger substrates than water flowing nearer to the shore. In high velocity areas of a channel, small particles have a low probability of being entrained or settling out. In depositional zones of the channel, sand and gravel may be deposited and accumulate, forcing the channel to migrate. As a result, bars are established and the channel may become braided. Gravel bars may appear stable, but are often scoured by flood flow events and are replaced by sediments delivered from upstream sources. As vegetation establishes on bars, they become increasingly resistant to erosion or mobilization. In-channel deposits may also take the form of point bars, where sediments are deposited on the inside bends of meanders.

Biological effects – Page 63

The following statement needs a reference:

Excessive and chronic deposition of sediments that result from accelerated erosion rates can be detrimental to aquatic biota such as fish, benthic macroinvertebrates, and amphibians by altering their physiology and habitats at a magnitude and frequency interval that exceeds naturally occurring, sediment-induced disturbance rates.

There needs to be more citations than Kondolf 1997 for most of these statements.

Pre Dam Removal – Existing condition upstream of Iron Gate Dam – Page 63

Very good description of potential channel changes due to the dams as well as channel modification.

Existing condition downstream of Iron Gate Dam – Page 65

The fossilized bar are an important observation, very good

Page 65 – "The success of mainstem spawning and presence and distribution of spawning gravels downstream of tributaries and pools and in riffles within this reach indicate that spawning gravels have been replenished following the numerous peak flow events recorded since the construction of IGD in 1962."

Has there been documented success of spawning or are these first generation fish from a hatchery? It is unknown to me and likely others not familiar with the Klamath what the origin of the fish are in the system and in this section.

Post dam removal – geomorphic response – Page 67

Do you have any references for the following statement (Page 67)?

The evolution of the new channel within low gradient reaches in the PacifiCorp Project reach and downstream of IGD would likely initiate with multiple channels of degradation and widening, followed by lateral movement and incision until a quasi-equilibrium, stable state is reached as the river reaches its original grade and a dominant, mainstem channel persists. The time required for the channel to reach equilibrium condition (months, years, or decades) would be highly dependent upon the rate of dam removal and frequency, magnitude and duration of hydrologic events.

Who will be doing the following study (Page 67)?

This will be a subject of intensive study in the period leading up to dam removal.

Page 67- Do you expect to the coarse and fine sediment to be mobilized during the same time periods, or will coarse sediment "show up" later due to the reduced distance traveled per each flow event?

Case study – Marmot Dam – Page 70

Why limit the review to one case study when there have been several dam removals that have been published? It seems like a more thorough literature review on dam removals would be beneficial in giving different potential impacts a true context.

V. Potential change in fish production – Page 91

Pre dam removal – background – the lack of a multi-species approach to examine fish production could limit the potential understanding and quantification of benefits of the project.

Objectives – Page 92 – what does the comparison of the two different water models have to do with fish production? I can see that different results could

affect the potential production numbers, but this section seems disjunct with the fact that the larger section is fish production. Please reconsider re-ogranization so the flow of information makes sense to the reader.

Page 94 – the following statement is important and the authors should look for other references to support this beyond the modeling:

> " Early fall spills reduced estimates of adult spawning habitat availability, while increases in spring flows over historical baseline conditions resulted in increased fry and juvenile rearing habitat availability."

This section is not clear to me in the larger context. Why were the modeled flows compared to the historic flows actual v. potential production? What are the questions being asked and answered? I have read this several times and realize that I as a reviewer do not have any context for this section aside from the fact that 1. There is a water agreement in place, and 2. There will likely be dam removal in the future.

Post dam removal – anadromous fish habitat above Iron Gate Dam (Page 97)

Page 98 - Good point - Dam removal would decrease the likelihood of the occurrence of redd superimposition by allowing spawning adults that currently concentrate below IGD (Magneson 2006; Magneson et el. 2008; Magneson 2008; Figure V-13), to disperse upriver, thereby having potential to improve adult to juvenile production ratios.

Page 98 – It is important to note that for the following statement the quality of bank habitat will likely not be the same and thus alter the potential densities seen along one bank v. the opposite bank.

> We calculated a coarse approximation of habitat gains for salmon fry upstream of IGD by doubling the stream distance under the assumption that 1 km of added accessible channel would equate to 2

km of additional bank habitat (676 km increase in channel distance times 2 stream banks = 1,352 km of bank habitat, excluding side channels, mid-channel islands, etc).

Page 99 – Is there data to calculate the proportion of days in the upper river that are conducive to spring Chinook salmon for adult holding and spawning? If there is thermograph data then such a calculation could be relatively simple by making assumptions about preferred thermal ranges and the number of days they occur (Pess et al. 2008).

Fish habitat below Iron Gate Dam –

Page 100 – steelhead were not mentioned in the analysis, this the first time. Perhaps some mention prior to this point would be important in order to make the point at the end of the section.

Reviewer 2

Letter Report on compilation of information on the potential effects of the proposed Klamath Basin Restoration Agreement on fish and fish habitat conditions

The following is my brief review and assessment of the document entitled "Compilation of information to inform USFWS principals on the potential effects of the proposed Klamath Basin Restoration Agreement (Draft 11) on fish and fish habitat conditions in the Klamath Basin, with emphasis on fall Chinook salmon" released by the Arcata Fish and Wildlife Office of the U.S. Fish and Wildlife Service on 21 January 2010. It is my understanding that the document was prepared as an information resource to inform and guide the principal entities involved in planning and implementation of the Klamath Basin Restoration Agreement (KBRA) and the associated Klamath Hydroelectric Settlement Agreement. The compilation consists of information drawn from the scientific literature and technical documents, data interpretations, professional judgments, and specific analyses regarding alternative scenarios. The compilation is divided into several principal sections including water quantity, water quality, geomorphology, fish health, anadromous fish production, and real time management. Anticipated production responses during the pre and post dam removal periods are discussed in several sections.

Water quantity –

Restoration of a hydrograph more closely aligned to salmon life histories will be an important factor in the success of salmon restoration strategies as asserted in the compilation. This is borne out by previous experience with changes in survival and run size in the Klamath, as well as by restoration efforts in nearby anadromous fish systems including the Rogue, Sacramento, and Willamette Rivers.

It is reasonable to assert that more rationale water management to meet multiple needs in the Klamath Basin will be advantageous but it must also be recognized that conflicts between fish and irrigated agriculture will continue to be a difficult issue. Idling of irrigated agricultural land and increased water storage in tributary areas can be important tools but

will also not be without controversy and cost. Accordingly, their contribution remains uncertain.

The compilation makes extensive use of habitat modeling to predict responses to alternative operational strategies, particularly the Hardy phase II model (Hardy 2006). Habitat models have a higher degree of uncertainty than models dealing only with physical parameters such as flow and temperature. Their use in this analysis is appropriate so long as the interpretive limits of such models are recognized. Their use here primarily relies on their ability to predict improved or depressed responses. This type of rank order comparison is generally a reasonable application of the methodology in my judgment. The actual models used have been conservatively interpreted and rely on generally accepted relationships that have been successfully applied in other similar situations.

Water quality –

Reduced water temperature is appropriately identified as a key factor in producing a positive restoration response in both the upper and lower basin. Blue-green algae blooms have clearly been linked to both elevated temperature and nutrient levels. Algal blooms and subsequent depression of dissolved oxygen levels in Upper Klamath Lake and in the Klamath River are identified as important factors in reduced fish survival. Again this has been borne out by previous observations of variability in survival in the Klamath, as well as by management measures linked to temperature and dissolved oxygen in nearby anadromous fish systems including the Rogue, Sacramento, and Willamette Rivers. This analysis and predicted improvements are appropriately linked to anticipated improvements in survival of juvenile endemic suckers in Upper Klamath Lake.

Temperature modeling methods as used here have been demonstrated in previous applications and have a good degree of reliability. Their use in the compilation for predictive purposes appears appropriate.

Geomorphology and channel configuration –

Not only the experience at Marmot Dam (Sandy River, Oregon) discussed in the compilation, but several other recent dam removal projects in the region have demonstrated that accumulated sediments can be transported relatively quickly and with limited adverse

effect by instream flow events. The experiences in the Rogue following the recent removal of Savage Rapids and Gold Ray Dams are instructive examples. In these cases, the scheduling for in-water work did not allow the same timing of coffer dam removal with a natural flow event that was accomplished at the Marmot Dam site. Never the less, sediment appears to have been carried downstream quickly with only minor adverse effects on fish and other aquatic life. The similarities of the mainstem Rogue River to the mainstem Klamath suggest that applicable information from these dam removal experiences should be assessed and added to the compilation.

Management of peak flow events is also identified as an important factor in controlling stream-side vegetation and in maintaining desirable channel configurations and habitat complexity.

Fish health –

The compilation identifies the parasite *Ichthyophthirius* and the bacterial disease columnariasis (*Flavobacterium columnare*) as important factors affecting survival of upstream migrating adult salmonids. The myosporidians *Ceratomyxa shasta* and *Parvicapsula minibicornis* are likewise identified as key factors reducing survival of juvenile salmonids. While all of these organisms are believed to be endemic to the area, altered water quality parameters have clearly exacerbated their adverse impacts.

The compilation appropriately points to anticipated fish survival benefits associated with improved juvenile and adult fish health resulting from increased flows, reduced temperatures, and reduced reservoir areas. These benefits are likely to be substantial as predicted based on water management experiences in other river systems such as the Rogue and Willamette.

Fish production –

Fall Chinook information is identified as being most complete and thus most reliable for predicting restoration responses in the Klamath system. As there is substantial fall Chinook habitat in use below Iron Gate Dam, these predictions are well supported by past responses to varying water quantity and quality conditions in the lower portion of the Klamath River.

Reasonable inferences can be made, however, for other anadromous species including for spring Chinook, coho, and steelhead utilizing more limited in basin information supplemented by information from other similar river systems. Estimates of production potential for the upper Klamath developed by Chapman (1981) and Huntington (2004), as cited in the compilation, are examples of application of such standard methods. The Rogue River, in particular, has many physical and biological similarities to the Klamath. It has undergone a series of dam removals and the addition of upstream storage which has partially been used to reshape flow and temperature profiles to benefit anadromous fish survival. Additional comparison of experiences in the Rogue to those proposed for the Klamath would be instructive.

The compilation does correctly stress the lower level of certainty in attempting to assess responses by species which must make use of upper basin and tributary habitats to a higher degree than fall Chinook. The degree of success in restoring populations of spring Chinook, coho, and steelhead will hinge on success in restoring tributary habitats, passage and in-stream flow as well as management of the mainstem Klamath. Success in reestablishing an upper basin run of spring Chinook will probably present the greatest challenge and will require success of all aspects of the KBRA.

This section of the compilation largely overlooks discussion of endemic sucker and lamprey populations. Implications for sucker restoration are discussed in the section on water quality but could be further referenced here. My understanding is that additional information on lamprey habitat, requirements and possible responses is now being assembled. That information should be discussed or referenced here when available.

Real time management –

This is the one area of the compilation which goes beyond providing background information and potential responses to altered river conditions. This section identifies a real time management application that could be used as a decision-informing process for recreating a more natural hydrograph and thus, normative river conditions. The compilation appropriately identifies such a strategy as the most likely means of restoring natural species assemblages in the basin.

Such an approach to in-season management has strong support in the literature and has enjoyed some success in other river basins such as the Columbia. The controversies which

have arisen with attempts to apply such an approach in other basins also suggest that its application and degree of future success will not be without challenge. This discussion could be strengthened by some referencing and comparison to mechanisms that have been tried or are in use elsewhere.

Pre dam removal –

The compilation contains discussion of the pre dam removal and post dam removal periods in several sections. It must be recognized that the time frame for the pre dam removal period remains quite variable so long as dam removal dates remain uncertain. This means that appropriate strategies and likely responds in the pre dam removal period remain uncertain as well. Perhaps alternative strategies or schedules should be identified which could be implemented as appropriate, once this variable is better defined.

It must also be recognized that few benefits of habitat improvements beyond some flow alterations are likely to be fully realized in the first decade. Presuming that the pre dam removal period is approximately one decade as currently anticipated, benefits of most riparian, wetland and other watershed restoration activities will not be fully realized until during the post dam removal period.

Post dam removal –

As noted above, completion and maturing of habitat restoration actions has a long and indefinite time line which may impact restoration strategies and schedules. Success of proposed real time management strategies including management high flow events are somewhat uncertain at this time and will be important factors in shaping both the pre and post removal periods.

In reviewing this compilation of information, I have concluded that the authors and analysts made reasonable and credible use of available information and used generally accepted methods of evaluation and prediction. I believe that this document is scientifically adequate for its intended use. I do suggest that the compilation can be improved by the addition of further relevant information as it becomes available. Short-term response to dam removal in the Rogue Basin is certainly one of these and further information relevant to restoration of other species including lamprey is a second.

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