Support for the Klamath Settlement Agreement
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I wish to express thanks to the Klamath Settlement Science Team for having made their time and expertise available to me to allow a detailed evaluation of the science and rationale behind the proposed Settlement Agreement. In particular, Mike Belchik, Nick Hetrick, Tom Shaw, and Larry Dunsmoor spent considerable time with me going over the technical details that underpin the Settlement Agreement and in particular, the expected flow regimes. My review of the technical work underpinning the Settlement Agreement was greatly facilitated by the USFWS 'White Paper' authored by N. J. Hetrick, T. A. Shaw, P. Zedonis, and J. P. Polos of the Arcata Fisheries Program of the USFWS. This document in conjunction with several full days of technical discussions by the principal authors in Arcata allowed a detailed and comprehensive review to be completed prior to the discussions held in Mt. Shasta on April 10th and 11th.The opportunity for open discussion provided during the science meetings on April 10th and 11th were also very helpful and served to reinforce my opinion to support the Settlement Agreement.

My initial concerns that precluded me from supporting the Settlement Agreement were broadly centered on the following main points:

1. Apparent lack of variation in winter and spring flows over a wide range of water year types.
2. Apparent sustained low flows below 1000 cfs during the later summer and early fall.
3. The potential affects of groundwater pumping on stream flows.
4. Uncertainty on the relationship between the Drought Management Plan and river flows during extreme drought conditions.
5. Other Factors

Prior to addressing each of these major issues, I want to commend the parties for their clear understanding of the technical basis behind the Hardy Phase II recommendations that served as the starting point for their evaluation of flow regimes. As noted in Hardy et al., (2006) the exceedence based flow recommendations (Base Flows) were target flows and did not incorporate any considerations of Upper Klamath Lake levels necessary for support of its endangered species nor the balancing necessary to consider beneficial out-of-stream uses of Klamath water for both agriculture and the wildlife refuge. It was also beyond the scope of that work to fully consider tributaries, dam removal, and restoration actions throughout the basin now being contemplated under the Settlement Agreement. The other components of the Hardy Phase II recommended flow regime associated with overbank and pulse flows and

Ecological Base Flows (i.e., 95 percent exceedence flows) were also recognized and considered in their evaluation of the Settlement flows as noted below. My detailed review of the technical information made it readily apparent that the flow regimes being considered under the Settlement Agreement are clearly an extension of the Hardy Phase II recommended flow regimes that reflect the necessary balance for agriculture, refuge deliveries, target lake elevations for the endangered Klamath Lake suckers, flood control curve, increased storage capacity of Upper Klamath Lake and factor in reasonable and achievable restoration actions both within Klamath Lake and upstream tributaries.

**Apparent lack of variation in winter and spring flows over a wide range of water year types**

My discussions with several individuals working on the Settlement Agreement made it clear to me that many people in the Klamath Basin do not necessarily understand the subtle difference between the various components of the flow recommendations provided in Hardy Phase II. One component, the 'Base Flow' recommendations, is represented by the exceedence flow based table (i.e., Table 27). These flow recommendations are target flows on a monthly basis by water year type that focus on providing variable habitat conditions for the anadromous species and other aquatic resources in the river. Flows associated with exceedence ranges lower than about the 10 percent level (i.e., high flows that are equaled or exceeded only 10 percent of the time) are superseded by the Hardy Phase II Overbank and Pulse Flow recommendations. In that context, it is not appropriate to be concerned with the prediction of available physical habitat values even if these higher flows would indicate reductions in available habitat as some individuals have expressed. As emphasized in the Hetrick et al. (2008) "whitepaper":

> "Even if the Hardy Phase II baseflow recommendations were implemented, flows during the wet years would surpass the Phase II schedule and habitat values would, in some cases, be lower during spill events than those calculated for the flow recommendations. We note that the Hardy Phase II flows are baseflow targets and that higher flows associated with pulse or overbank flows (i.e., spills) are also a component of the Hardy Phase II flow regime", and that "While flood flow events can diminish habitat availability, they are essential for geomorphic and channel maintenance processes that create and maintain quality and diversity in fish habitat conditions, a point well described by Hardy et al. (2006)."

Overbank and pulse flows that exceed the Hardy Phase II Base Flow recommendations are necessary for the physical, chemical, and biological processes of channel maintenance and riparian maintenance flows that create and maintain the habitats associated with the target Base Flow recommendations. As noted in the Hardy Phase II report, the existing infrastructure of the Klamath Basin does not unduly impact these higher flow

regimes. More importantly, the Real Time Management (RTM) analyses of the Settlement flows presented by Hetrick et al. (2008) as a potential method of implementing the water allocation proposed under Settlement show that these flow events will also be maintained given the management objectives of filling the lake early in the spring under both the flood control and target lake elevations for suckers. This will result in the high probability of lake spills over a wide range of water year types. My concern in the initial review of the Settlement Agreement was the apparent lack of variation in the winter and spring flows over a wide range of water year types as reflected in the WRIMS model flow duration summaries provided for my review. This was the only technical information that I had access to at the time of my initial review. During my detailed technical review, it became apparent that the WRIMS model outputs do not necessarily reflect anticipated daily flows within the river that would be achieved under the Settlement Agreement given the nature of that model (i.e., a planning tool) and how flows would be managed under the proposed RTM Operations tool. The detailed analysis conducted by Hetrick et al. (2008) clearly show for example, in many water years during the winter and spring periods, the WRIMS monthly time step would indicate a flow at Iron Gate on the order of 5,000 cfs while the RTM-based analysis shows Upper Klamath Lake in spill mode, with predicted flows at Iron Gate Dam more on the order 10,000 to 20,000 cfs. These differences in projected flow regimes are attributed to the nature of the WRIMS model structure, monthly time step, and conservative nature of the modeling assumptions. A careful comparison between the RTM-based analysis versus the WRIMS modeling show that on an annual basis, the total volume of water released within the Klamath River is similar for most years. However, the expected flow outcomes of the RTM model are expected to maintain both overbank and pulse flow characteristics as recommended in the Hardy Phase II work. Based on this review of the RTM-based flows, this approach should be explored further and refined as necessary to meet ecological objectives for river flows. In my opinion, the RTM-based flow management under the constraints of water deliveries, flood control, and target lake elevations for suckers will still result in adequate variation of winter and spring flow regimes and meet the required ecological flow regime characteristics of both overbank and pulse flows. The RTM analyses also demonstrated to me that over the intermediate ranges of water year types (i.e., 10 to 90 percent exceedence ranges) that expected daily flow regimes are within acceptable levels of the Hardy Phase II target flow recommendations given the required balancing with target lake elevations critical to the endangered sucker.

**Apparent sustained low flows below 1000 cfs during the later summer and early fall**

The other component of the flow regime highlighted in the Hardy Phase II recommendations relate to the Ecological Base Flow recommendations, and my concerns of allowing flows below 1000 cfs during the late summer and early fall due to the increased ecological risk from temperature and disease factors under

existing conditions. However, it should be noted that the Base Flow recommendations (Table 27 in Hardy Phase II), that the flow recommendations during July and August at exceedences greater than about 75 percent are in fact lower than 1000 cfs. What was critical to understand is that the Hardy Phase II concerns over the ecological risk from disease and thermal affects when flow fall below 1000 cfs were driven by the conditions with the dams in place. What became clear from the extended review of the technical work in the Settlement Agreement in conjunction with the work of Dumsmoor as part of the FERC relicensing of PacifiCorp facilities is that these conditions are anticipated to significantly improve with dam removal. My own assessment of anticipated channel conditions in the Copco to Iron Gate Dam reach in conjunction with the improved water quality and temperature regimes lessen these concerns under Settlement flow regimes. It is my opinion that the cold water refugia that will exist from tributaries and large springs in this reach as well as the anticipated shift in the thermal regime is anticipated to reverse the 2-3 week shift in run timing currently experienced in the main stem Klamath. Once the dams are removed, it may be that lower flow releases from Keno will result in improved thermal conditions in specific reaches due to lack of thermal dilution associated with existing reservoir conditions. These combined factors have led me to believe that the threshold flow at which significant concerns over thermal and disease factors will drop well below 1000 cfs to something on the order of 700 to 800 cfs.

Another significant factor in this regard is related to the Drought Management Plan that is a key element of the Settlement Agreement. My discussions with the technical team have clearly shown that this plan is critical in addressing flow regime changes when critical drought conditions are being experienced in the basin. Under the assumption that the Drought Management Plan will be required and completed as part of the Settlement Agreement and that the plan will result in compromises for both in river and out-of-stream diversions it is an equitable tradeoff within the context of the Settlement Agreement for addressing aquatic resource needs both within the main stem Klamath River and sucker needs within Upper Klamath Lake.

**The potential affects of groundwater pumping on stream flows**

In my initial review of the Settlement Agreement I raised concerns regarding the potential affects of groundwater pumping on stream flows. Discussions with the technical personnel and statements by the Oregon Department of Water Resources during the April 10$^{th}$ and 11$^{th}$ meetings in Mt. Shasta have clarified this issue. It is evident that setting the groundwater pumping to levels in existence in 2000, setting a 6 percent reduction in flow in any of several critical springs around Upper Klamath Lake important for the Klamath Lake suckers and enforcement of Oregon laws that govern curtailment of groundwater pumping if stream flows are affected will provide the necessary protections for over utilization of groundwater resources in the basin. It is recognized that both monitoring and enforcement will need to be adequately addressed.

**Uncertainty on the relationship between the Drought Management Plan and river flows during extreme drought conditions**

An initial concern in my review of the Settlement Agreement and limited technical material provided on the WRIMS modeling was related to projected flows at high exceedence levels (i.e., > 90 percent) where late summer and early fall flows were reported as low as 400 to 500 cfs. Based on my review of the RTM analysis and a better understanding of the assumptions made in these model runs, I am convinced that flows of these magnitudes are likely underestimating actual river flows. As was noted previously, the RTM-based analysis of flows clearly show higher flows than that projected by the WRIMS runs on a daily basis and that the estimated evaporation from the existing reservoirs (~ 8,000 ac-feet/year) were not added into the projected modeled WRIMS flows. This is not to suggest flows during critical drought years are expected to be low, but that these flows are not as low as being projected under the WRIMS runs and do not reflect flows that will be anticipated under the Drought Management Plan.

**Other Factors**

Several other factors that came to light as part of my opportunity to discuss the technical basis of the Settlement Agreement are worth noting. I believe that monitoring diversion of water for the Klamath Project to the point of diversion is an important element of the Settlement Agreement. This will ensure that the proposed flow volumes are being met with the implementation of that water use in the hands of the water users. I believe that this will result in more efficient use of the available water as evidenced by improved agricultural practices in other basin to which I am familiar. I also believe that the increased habitat availability to suitable stream habitats not only within the main stem Klamath River above Iron Gate Dam but also in upper basin tributaries will result in improved productive capacity for the entire system. This view is strongly supported by analyses conducted by Hetrick et al. (2008) which show increased outmigrant production from the system under Settlement Agreement flow regimes even prior to dam removal. I am also confident that the water quality and temperature modeling conducted for the 'no dam' conditions by Dunsmoor and Mike Deas show vastly improved conditions for the main stem Klamath River and is supported by both the bioenergetics modeling and salmon production modeling reported in Hardy Phase II.

Although a policy issue, I am now more comfortable that the proposed work anticipated under the Settlement Agreement on both the Implementation Plan and Drought Management Plan are in fact required to be completed in order for the Settlement Agreement to remain in place. This eliminates my initial concern that these elements were left uncompleted prior to being able to support the Settlement Agreement.