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To: Oregon Department of Environmental Quality
From: Crystal Bowman, Environmental Director of the Quartz Valley Indian Reservation
Date: May 27, 2010
Re: Comments on *Draft Upper Klamath and Lost River Subbasins Total Maximum Daily Load and Water Quality Management Plan*

INTRODUCTION/SUMMARY

Overall the technical analysis presented in the *Draft TMDL* is clear and provides a solid foundation for remediation of the river's pollution problems. We commend the efforts of ODEQ and the other members (NCRWQCB, U.S. Environmental Protection Agency, and Tetra Tech) of the Klamath TMDL development team. In our comments here, we offer some constructive suggestions for improving the document. For example, one important topic that is not addressed in the *draft TMDL and WQMP* is the effects of hydropower peaking and bypass operations on nutrient concentration and form.

While we still have some concerns regarding the Klamath TMDL water quality model, expressed in many rounds of previous comments on California's Klamath TMDL, it is our opinion that on the whole the model is robust enough to serve its intended purposes in the TMDL (i.e. setting load allocations). It is abundantly clear that the current nutrient concentrations in the river are far higher than natural background and that substantial reductions are necessary to restore water quality.

<u>We strongly support the nutrient reductions proposed in the *Draft TMDL and WQMP;* however, we have serious concerns that the proposed water quality management plan is unlikely to be effective for that purpose.</u> A primary reason is that Oregon's laws and regulations regarding environmental protections are relatively weak compared to California's. For example, the strategy proposed to address the effects of private land forestry is to rely upon the implementation of Oregon's existing Forest Practices Act rules, which were found to be inadequate to protect coldwater fish resources by National Marine Fisheries Service (NMFS 1998) and an Independent Multidisciplinary Science Team (IMST 1999) convened by the State of Oregon.

Aspects of the water quality restoration plan look good on paper, such as requirements for Designated Management Agencies to develop implementation management plans, yet it remains to be seen how effective such efforts will actually be in practice. We encourage ODEQ to be proactive and aggressive in implementing the water quality management plan, and to move the process forward as quickly as possible.

Many efforts are already underway in the Upper Klamath Basin to improve water quality. We applaud such efforts; however, to our knowledge, these efforts have yet to result in measurable instream improvements. ODEQ and other regulatory agencies must not confuse activity and effort with real evidence of success. Restoration activities must be strategically planned and then implemented with enough scope and magnitude that they actually begin to result in measurable improvements to water quality and habitat complexity.

To restore water quality in the Klamath River, real and substantive changes in land and water management will be necessary.

We are cautiously optimistic about the proposed water quality improvement accounting and tracking program under development by ODEQ, California, U.S. EPA, and PacifiCorp. It offers promise for cost-effective water quality improvements, but only if properly implemented. One shortcoming of the program is its lack of specific mention of the role of Klamath River basin Tribes in the development of the program.

Treatment wetlands constructed for nutrient removal could play a pivotal role in reducing nutrient loads in the Klamath River and we offer some recommendations on wetland implementation, including a proposal to use the outflows from constructed wetlands to establish a network of thermal refugia around Keno Reservoir. We note, however, that engineered solutions such as treatment wetlands should complement, not serve as a substitute for more direct source reduction and restoration of habitat complexity.

The comments below are organized into two sections. First, the 'General Comments on Important Issues' section addresses major topics. The 'Specific Comments on Minor Issues' uses the same chapter/section numbering system as the *Draft TMDL and WQMP*. The topics addressed in the General Comments on Important Issues section are:

- Restoration of Habitat Complexity and Ecosystem Function
- Non-Point Source Nutrient Reductions: Activity Does Not Necessarily Result in Success
- Importance of Thermal Refugia
- Using Easements or Land Acquisition to Expand Riparian Wetlands along Keno Reservoir
- Water Quality Improvement Accounting and Tracking Program
- Constructed Wetlands
- Effects of Hydropower Peaking/Bypass Operations on Downstream Water Quality
- Private Land Forestry
- Data sharing

GENERAL COMMENTS ON IMPORTANT ISSUES

Restoration of Habitat Complexity and Ecosystem Function

As noted in comments regarding California's Klamath TMDL provided by the Quartz Valley Indian Community (QVIC 2007) and the Yurok Tribe (2009), the Lost River, Klamath River, and Lower Klamath Lake ecosystems have been profoundly diminished and degraded over the past century. A major component of the water quality problems of these areas is not simply nutrient pollution, but also channelization, diking, and simplification -- the loss of connection between stream channels and wetlands. This lack of habitat complexity reduces the ability of wetlands and riparian vegetation to serve as nutrient sinks. Additionally, it reduces the quality of aquatic habitat available for fish including the coldwater species that are the beneficial uses that the TMDL seeks to restore.

If TMDL implementation in the Klamath River, Lost River, and Lower Klamath Lake is to succeed the continuing trend of habitat degradation and channel simplification must be reversed. Reductions in nutrient inputs, alone, will <u>not</u> be sufficient to restore ecosystem function.

We encourage ODEQ to lay out a more bold restoration vision in the *Draft TMDL and WQMP*, even if the agency lacks the authority to guarantee its outcomes.

Non-Point Source Nutrient Reductions: Mere Activity Does Not Necessarily Result in Success

Reducing the impacts of agricultural activities on private lands offers perhaps the most important opportunity for the improvement of water quality in the entire Klamath Basin, and thus is a critically important issue for TMDL implementation.

The *Draft TMDL and WQMP* proposes that the water quality effects of agricultural activities on private lands be addressed through the development of Agricultural Water Quality Management Area Plans (AgWQMAPs) to be implemented by Local Area Advisory Committees (LACs). AgWQMAPs for the Klamath Headwaters and Lost River have been in place since 2004 and 2002, respectively. The LACs have issued status reports summarizing their activities implementing the AgWQMAPs. It is clear that positive activities such as riparian fencing and the development of conservation plans are occurring and we encourage these efforts; however, we note that <u>evidence of activity is not evidence of success, or even measurable progress</u>. Restoration activities must be strategically planned, then implemented with enough scope and magnitude that they actually begin to result in measurable improvements to water quality and habitat complexity.

We have not studied the Oregon projects in detail but restoration efforts in other areas have often focused on activities that are easy to implement, but which fail to address the core stressors to aquatic habitat. For example, in the Shasta and Scott river valleys of California, much commendable effort has gone into activities such as riparian planting, riparian fencing, and screening agricultural diversions. These activities have resulted in some minor improvements; however, comparatively little effort has gone into reducing surface water diversions and groundwater pumping (pumping has actually increased). In some cases, inappropriate projects such agricultural wells were funded with "restoration" or "water conservation" money, actually causing further impairment of instream flows. Thus, fish populations in those valleys have continued to decline as these rivers and their tributary streams have become progressively more and more de-watered.

We encourage ODEQ to do whatever it can to ensure that grant funds (and other incentives) intended to improve water quality go in fact to the highest-priority projects that will result in the most water quality and habitat benefits, rather than be spent in a random scattergun approach.

Importance of Thermal Refugia

Given the poor water quality conditions that exist during the summer and early fall periods in the Klamath River, access to water quality refugia are extremely important to juvenile and adult salmonids. The mouths of tributaries, in particular, provide critical thermal refugia in many rivers (U.S. EPA 2003), including the Klamath (Belchik 1997, 2004; Sutton 2004). The *Draft TMDL and WQMP* provides very little discussion of this important topic, and we request that appropriate information on the subject be added to the *Draft TMDL and WQMP*. In the wetlands section below we propose the use of constructed wetlands to create a network of thermal refugia around Keno Reservoir.

Using Easements or Land Acquisition to Expand Riparian Wetlands along Keno Reservoir

The Klamath River in what is now the Keno Reservoir reach was once surrounded by thousands of acres of wetlands (Figure 1) that supplied natural water filtration, water storage, and hyporheic connections that promoted river cooling. The Klamath River in Keno Reservoir is now almost completely channelized and confined. Channelized rivers have lower rates of nutrient attenuation (Bernot and Dodds 2005, Yurok Tribe 2007).

A functional riparian buffer needs to be restored adjacent to the river in addition to constructed wetlands (see below). As noted in Yurok (2007) and Karuk (2007) comments on the Lost River TMDL, marsh buffers could promote mildly acidic conditions, potentially retarding the growth of the bluegreen algal species *Aphanizomenon flos-aquae* that washes out of Upper Klamath Lake and can further proliferate and add to nutrient enrichment in Keno Reservoir. Figure 2 shows the Keno Reservoir reach with remnants of natural marsh areas, but mostly agricultural development with no riparian buffer strip.

Several flat benches exist below Lake Ewauna that could be used to set up pilot-scale and, then, larger constructed wetlands. Remnant intact marshes and wetlands extend northward from the Straits Drain to Miller Island, where wetlands are fragmented, but where a large contiguous riparian wetland area could potentially be restored. If the terrace north of Gore Island and across from the Straits Drain were reclaimed as wetlands, sinuous multiple channels of the Klamath River could be reconfigured. This would slow river flow transit time and assist in nutrient removal.

Reconnecting floodplains to riparian marshes can also increase water storage capacity and foster surface water and groundwater connections (hyporheic zone) that can moderate water temperatures and provide refugia (ODEQ 2008). Such an area could also provide optimal sucker habitat.

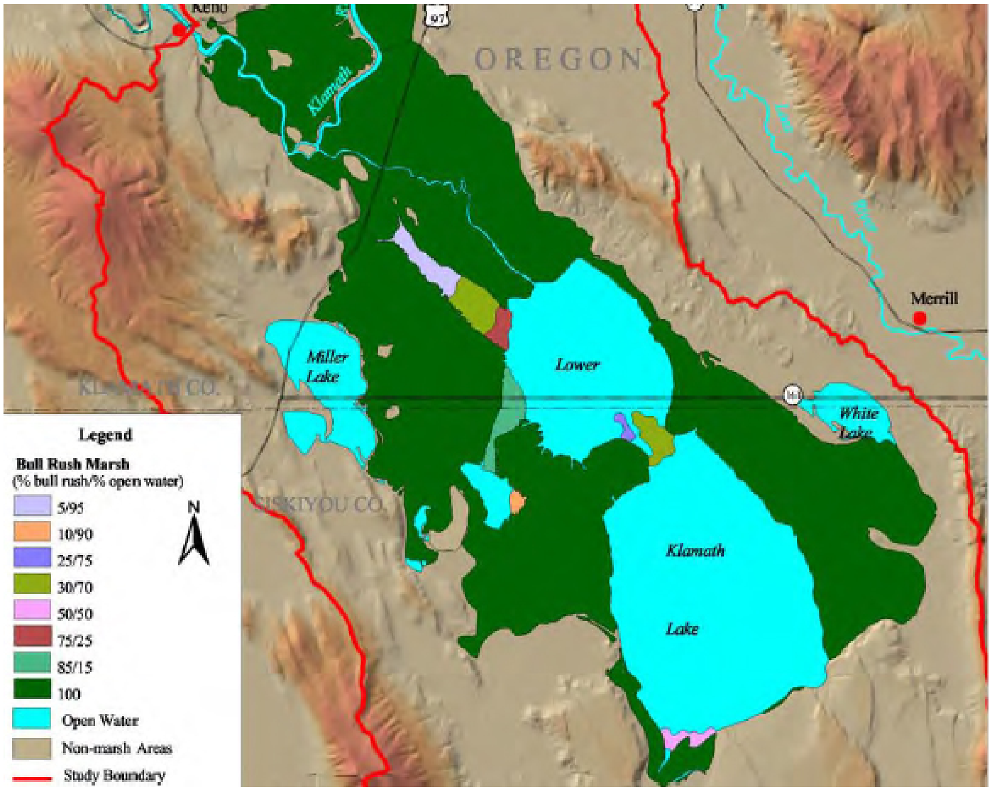

Figure 1. Historic size of Lower Klamath Lake and associated wetlands are shown in the map above, with wetlands broken down by percentage of cover by bulrushes. Note extensive marsh areas surrounding the Klamath River at upper left. Map from USBR (2005).

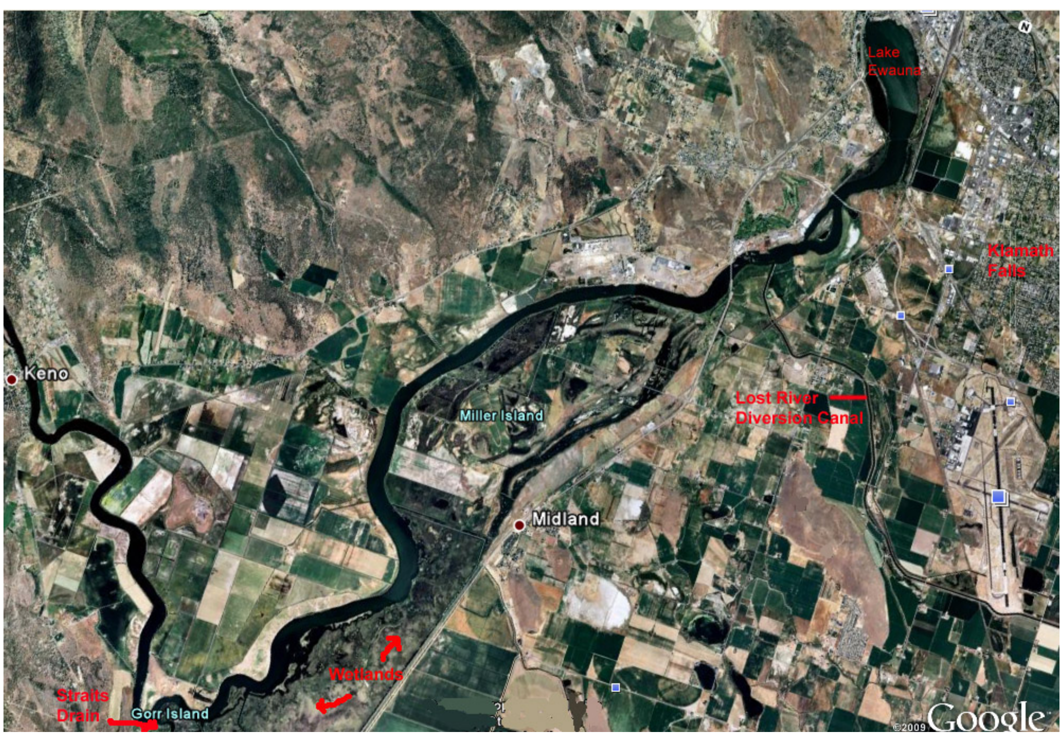

Figure 2. This image in the Klamath River in the Keno Reservoir reach is captured from Google Earth.

Water Quality Improvement Accounting and Tracking Program

We are very supportive of the general concept of water quality improvement accounting and tracking program under development by ODEQ, California, U.S. EPA, and PacifiCorp. It offers promise for cost-effective water quality improvements, but only if properly implemented. There are important details that are not yet addressed which need further development.

There must be strong evidence and a high likelihood that any pollution trading allowed will have at least as positive an effect on water quality, at the site of the discharge, as pollution control done in a "normal" way – that is, pollution reduced at the source, rather than at an alternate site.

Given that pollution trading could result in substantial economic benefit to the entities responsible for pollution discharges, because pollution trading could be much cheaper than on-site compliance, the burden of proof should be on such entities to demonstrate that pollution trading will be effective. Also, due to the uncertainties surrounding their effectiveness, the predicted outcomes of pollution trading should contain some safety factor (i.e. >200% of the effectiveness of on-site compliance, perhaps larger if the uncertainties are particularly large) to assure that the water pollution reduction goals are met.

One shortcoming of the proposed program is the lack of specific mention of the role of the Klamath River basin Tribes in the development of the program. This should be rectified.

We offer detailed ideas about construction of treatment wetlands used for bio-filtration below, but also wish to state clearly that natural riparian wetland systems in the Keno Reservoir and the Lost River need to be restored, and that the size and bio-filtration capacity of Tule Lake and Lower Klamath Lake need to be increased. We do not look at constructed wetlands as a substitute for these wetland restoration measures, but they could be used in conjunction with natural wetland restoration. Both efforts are needed because of the extremely high nutrient loading from Upper Klamath Lake and the Lost River to the Klamath River. Riparian wetland and lake expansion are also needed to recover ESA-listed sucker species (NRC 2004), which are designated beneficial uses of the Klamath River under the Clean Water Act.

Constructed Wetlands

Constructed wetlands are one of the primary nutrient reduction methods likely to be utilized in the proposed water quality improvement accounting and tracking program. In this section, we offer some suggestions on the placement, effects, usage, and design of such wetland systems. Although these comments below may be useful to ODEQ ongoing collaboration among all interested parties is encouraged to develop a comprehensive approach. Nevertheless, ODEQ should encourage constructed wetlands to reduce nutrients in the Klamath River by offering any services to allow implementation to occur in a timely manner.

Design Considerations for Constructed Wetlands:
The optimal wetland design characteristics (e.g. depth, area, volume, hydraulic residence time, and vegetation) for nutrient removal vary depending upon climate, the concentration of the various chemical forms of nutrients and organic matter in the inflowing water, the desired levels

of reduction of such chemical constituents, and the volume of water requiring treatment. We will not attempt to address wetland design considerations in detail in these comments; however, there are many relevant studies available for the ODEQ staff to review (Kadlec and Knight 1996; Phipps and Crumpton 1994; U.S. EPA 1993, 1999, 2000; WHG and TP 2007) including several which are specific to the Klamath Basin (Deas and Vaughn 2006, Lyon et. al 2009, Lytle 2000, Mahugh et. al 2008).

Best Locations for Constructed Wetlands:
We recommend treatment wetlands with different types of characteristics depending upon their location along the Klamath River. These wetlands should be optimized to remove the specific forms of nutrients or organic matter that are abundant at a particular location.

Removal of dissolved phosphorus requires long hydraulic residence times (i.e. substantially greater than 7 days). During the summer, the majority of the phosphorus in the Klamath Straits Drain is in dissolved form (Sullivan 2009). Thus, wetlands constructed to treat discharges from the Klamath Straits Drain would have to be sized to accommodate these long residence times.

From the upstream extent of J.C. Boyle Reservoir to the upstream extent of Copco Reservoir has the highest concentrations of nitrate of anywhere along the mainstem Klamath River[1]. Nitrate is the form of nitrogen most easily removed by wetlands[2], so this reach provides unique opportunities for nitrogen removal. Flat land suitable for wetland construction is currently scarce in that reach, largely limited to several hundred acres on PacifiCorp's ranch located between Stateline and Copco Reservoir (for example, see Figure 3). If J.C. Boyle and Copco Dams were removed, however, additional relatively flat land, currently submerged under the reservoirs, would become available for wetland construction. The area submerged under Iron Gate Dam is much steeper, and is probably not suitable for wetland construction. J.C. Boyle Reservoir would be the most optimal location, as it is located above the high-volume springs that would dilute nutrient concentrations.

[1] During summer, water released from Keno Dam has high levels of ammonia and organic matter, with most of the organic matter in dissolved, not particulate, form (Sullivan et al., 2008). In the five miles of river between Keno Dam and J.C. Boyle Reservoir, most of the ammonia is converted to nitrate. Additionally, a portion of the organic matter is transformed into inorganic nutrients. These trends continue in the J.C. Boyle Reservoir, the dewatered J.C. Boyle Bypass Reach, and the J.C. Boyle Peaking Reach downstream.
[2] For example, Lyon et al (2009) states: "Ammonia will require approximately 10 times the wetland area (or HRT) of that needed to process nitrate since it must be nitrified to nitrate under oxidized conditions." (p. 6)

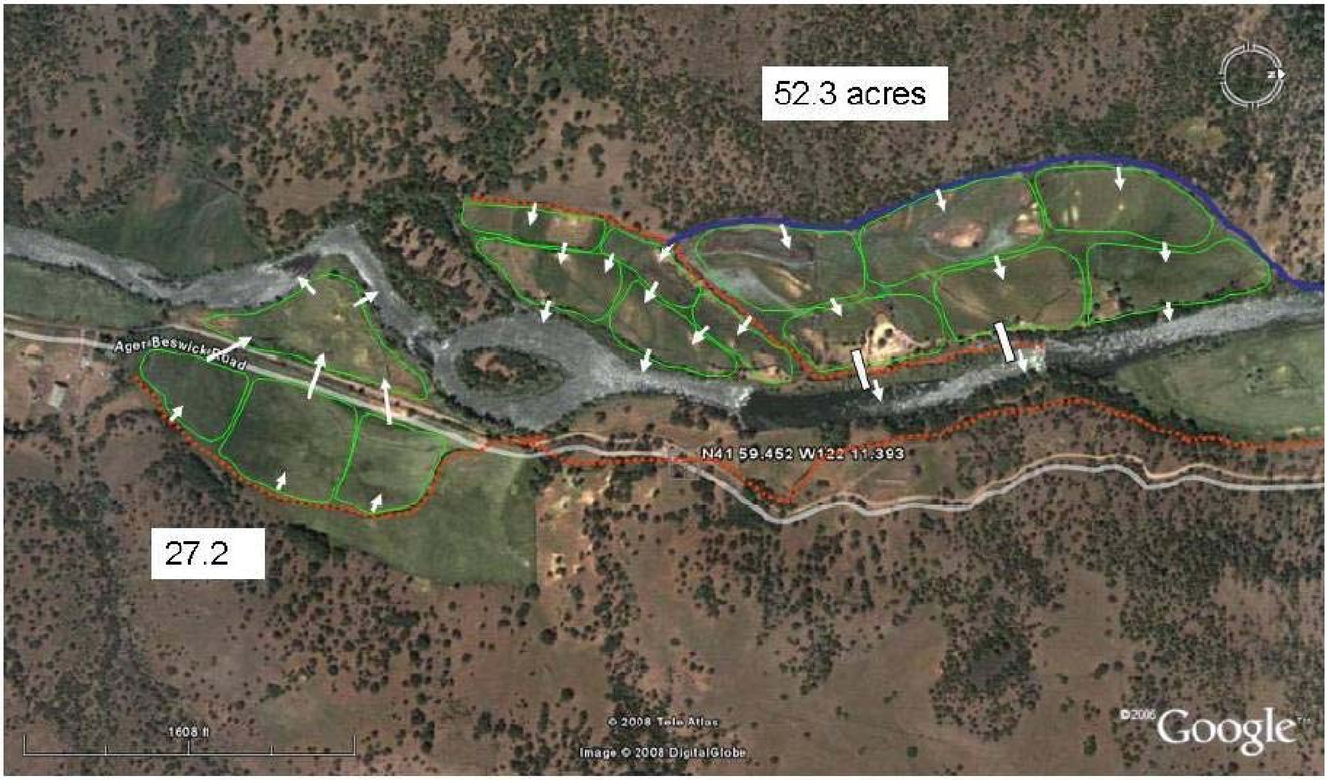

Figure 3. A gently-sloping area on PacifiCorp's ranch upstream of Copco reservoir that is suitable for placement of constructed wetlands. Figure from Lyon et al. (2009), accompanied by the following caption: "Conceptual layout of surface flow wetlands at Site 013 on the Klamath River upstream of Copco reservoir. As much as possible, this makes use of the pre-existing gravity fed canals (in red) and when necessary, installs new channels (in blue)."

Previous and Ongoing Klamath River Studies Regarding Constructed Wetlands for Nutrient Removal:

The U.S. Bureau of Reclamation (USBR) and PacifiCorp have each conducted studies regarding the use of wetlands for nutrient removal in the Upper Klamath River Basin.
Lytle (2000) applied the Kadlec and Knight (1996) model to calculate the area of treatment wetlands required to treat the 70- to 133 cfs flows of the Klamath Straits Drain prior to its discharge into the Klamath River, concluding that an area of between 1,633 and 3,114 acres could achieve "a 61% reduction in total P concentration (0.41 to 0.16 mg/L) and a 90% reduction in total nitrogen including NH3-N [ammonia]."

Deas and Vaughn (2006) did literature research and calculations to investigate the potential of wetlands to remove particulate organic matter between Link Dam and Keno Dam. Their estimated scale for significantly reducing nutrients was 1,400 acres. A 5,000-acre marsh was thought sufficient to filter the entire upper Klamath River flow. However, they recommended that a pilot scale project be constructed to test effectiveness before large scale construction is considered. Mahugh et al. (2008) inventoried potential sites around Keno Reservoir for possible placement of pilot and full-scale treatment wetlands, and modeled potential effectiveness of such wetlands, and that team has submitted a proposal to USBR to construct a pilot project, but we are unclear whether the project has been funded. Lyon et. al (2009) conducted a similar study, but in addition to Keno Reservoir, also included areas between Keno and Iron Gate Dams.

Opportunities for Constructed Wetland to Serve as Water Quality Refugia
During the summer season, Lake Ewauna and Keno Reservoir have the worst water quality in the entire mainstem Klamath River. Due to the extreme oxygen demand imposed by the organic matter in the water and sediments, the entire water column of the reservoir can be nearly devoid of dissolved oxygen for weeks at a time, and fish kills are common (FERC 2007). Also, due to its location, Keno Reservoir lacks the cool oxygen-rich refugia provided in downstream reaches by mountain tributaries.

If properly designed and located, the outflows from treatment wetlands could serve as critical thermal refugia along those Klamath River reaches that now lack refugia in summer, such as Keno Reservoir. In treatment wetlands with complete canopies of emergent vegetation (e.g. cattail and bullrush), the plants and thatch (accumulated dead plant material) intercept the incoming solar radiation and prevent it from warming the water below. Given sufficient hydrologic residence time (which will vary according to factors such as inflow temperature - it was ~5 days in the Tres Rios wetland in Arizona described by Kadlec 2005), temperatures in fully vegetated wetlands in arid climates reach a "balance temperature" which is typically several degrees lower than mean air temperature due to evaporative cooling3[3] (Kadlec 2005). Thus, wetland outflow temperatures can be substantially lower than wetland incoming temperatures as has been demonstrated in municipal wastewater treatment systems in Tres Rios (Kadlec 2005), the Imperial Valley (Kadlec 2005), Sacramento (Kadlec 2005, Nolte and Associates 1998), Gustine/Los Banos (Gearheart, pers. comm.) and Arcata (Gearheart, pers. comm.).

One important conclusion that can be drawn from this science is that <u>anywhere that mean air temperatures are less than or equal to mean water temperatures in the river, and there is relatively flat land available for wetlands to be constructed, outflows from constructed wetlands have the potential to provide thermal refugia</u>. This potential is greatest in higher elevation areas, such as above J.C. Boyle reservoir.

Since none of the local reports investigating the potential for treatment wetlands in the Klamath (Deas and Vaughn 2006, Lyon et. al 2009, Lytle 2000, Mahugh et. al 2008) predicted wetland outflow temperatures, we did some "back-of-the-envelope" calculations using air and water temperature data from 2007-2008 to provide a rough assessment of what constructed wetland temperatures outflows might be in the Upper Klamath Basin, and how they compare to current river water temperatures (Table 1). <u>The results are striking, suggesting strong potential for wetlands to provide thermal refugia</u>. During months where high temperatures are a potential concern (May-October), mean monthly air temperatures at Klamath Falls Airport are ~3.4°C cooler than mean monthly water temperatures at Keno Dam. Assuming that treatment wetland outflow temperatures are several degrees cooler than air temperature in arid climates such as the Upper Klamath (see discussion above), that would <u>suggest that treatment wetland outflow temperatures could be on the order of ~5.4°C cooler than Keno Dam water temperatures</u> (Table 1). This temperature differential is great enough to have potential to provide significant thermal refugia. We emphasize here that these are preliminary results and that more in-depth calculations

[3] In contrast, balance temperatures in humid climates can be higher than mean air temperature (Kadlec 2005).

(e.g. applying the equations supplied by Kadlec 2005) should be used to refine these estimates, as these initial estimates may only be within +/- approximately 3°C of reality.

Table 1. Comparison of 2007-2008 monthly mean air temperatures (from the Klamath Falls Airport: http://www.wunderground.com/history/airport/KLMT), estimated constructed wetland outflow temperatures (estimated from air temperatures), and Keno Dam water temperatures (from USGS: http://or.water.usgs.gov/proj/keno_reach/monitors.html).

	Temperature ˚C			
Month	Air	Estimated Wetland (Air minus 2)	Keno Dam Water	Difference of Estimated Wetland & Keno Dam
May	12.0	10.0	15.8	-5.8
Jun	15.1	13.1	19.0	-5.9
Jul	20.3	18.3	22.9	-4.6
Aug	18.7	16.7	22.1	-5.4
Sep	14.4	12.4	18.0	-5.6
Oct	7.5	5.5	10.8	-5.3
Mean	14.7	12.7	18.1	**-5.4**

If a sufficient percentage of mainstem river flow was routed through wetlands, it could potentially be possible to go beyond creating localized refugia and even reduce mainstem river temperatures overall (though residence time in Keno Reservoir may confound this possibility). As noted above, a combination of constructed wetlands and reconnection of natural riparian wetlands through purchase or acquisition of easements is likely optimal because it also supplies potential sucker habitat.

Due to the decomposition of organic matter within treatment wetlands, dissolved oxygen in wetland outflows are typically low (though not zero) and may therefore require re-aeration prior to discharge back to the river if the outflow were intended to serve as water quality refugia. Aeration could be accomplished either through a weir structure (if there is enough gravity fall) or mechanical re-aeration. If wetlands discharged into a high gradient river reach (such as near site of J.C. Boyle Dam), re-aeration may not be required prior to discharge (low D.O. may be tolerable because water would quickly re-aerate as water flowed downstream).

Recommendations for Action:
We recommend that as soon as it is practical to do so, several small-scale pilot wetland treatment systems should be constructed. Pilot projects could be used not only to demonstrate the effectiveness of treatment wetlands, but also to determine the best methods to implement, maintain, and operate larger-scale systems (Deas and Vaughn 2006). Following successful pilot projects, larger-scale treatment systems should then be constructed. The outflow of all these wetland treatment systems should be optimized to serve as thermal refugia, if the thermal refugia service proves to be feasible.

Effects of Hydropower Peaking/Bypass Operations on Downstream Water Quality

The *Draft TMDL and WQMP* contains no discussion of how peaking/bypass operations between J.C. Boyle Reservoir and Copco Reservoir affect nutrient concentrations. These effects are summarized briefly in the following paragraphs. Additional details are contained in comments by the Hoopa Valley Tribe (2006), Karuk Tribe (2006), Quartz Valley Indian Reservation (QVIR 2007), Resighini Rancheria (2006), and Yurok Tribe (2006) on the Federal Energy Regulatory Commission's Draft Environmental Impact Statement for the Klamath Hydroelectric Project.

As PacifiCorp (2005) itself has acknowledged, peaking operations decrease the nutrient removal capacity of the Klamath River by inhibiting growth of attached algae. The mechanisms include: 1) increasing water depth and turbidity during the day, thereby reducing the amount of light that can penetrate the murky water and reach the river's bottom to promote the production of nutrient-removing periphyton, 2) creating daily cycles of wetting and drying along the channel margin, and 3) daily scouring of streambed. Additionally, peaking decreases water transit time (higher flows move faster), allowing less time for biological activity. This impairment of nutrient-removal capacity results in increased nutrient concentration downstream.

Bypass operation below J.C. Boyle and Copco Dams allow the diverted water to avoid a turbulent journey down the river that would help break down organic matter and phytoplankton. Nitrogen and phosphorus are more easily removed in downstream reaches when in inorganic form (ammonia and nitrate for nitrogen; orthophosphorus for phosphorus) than when bound up in organic matter. The longer it takes for the organic matter to become mineralized into inorganic nutrients, the further downstream those nutrients will travel before being removed from the water column. Thus, the bypass operations delay the natural improvements in water quality that occur as the Klamath River flows downstream from Keno Dam.

We request that the final *TMDL and WQMP* include an analysis of the effects of hydropower peaking and bypass operations on nutrient concentration and form. Additionally, the final *TMDL and WQMP* should include requirements to eliminate these impacts.

Private Land Forestry

The water quality effects of timber harvest and roads on private lands are an important issue generally in the Klamath River Basin, but play a particularly critical role in the impairment of coldwater tributaries. For example, Spencer Creek is a Klamath River tributary that currently drains into J.C. Boyle reservoir. It contains low-gradient stream habitat that is rare in tributaries of the Middle/Upper Klamath Basin. Following the likely removal of J.C. Boyle, Copco, and Iron Gate dams, a restored Spencer Creek could provide excellent habitat for coho salmon. The *Draft TMDL and WQMP Plan* found that current riparian shade is 60% lower than the estimated maximum potential, current water temperatures at the mouth of Spencer Creek are 10 ºC warmer than its natural thermal potential (Figure 4), and that a substantial portion of this water warming is due to the lack of vegetative shade. Examination of aerial photographs of the Spencer Creek watershed and the surrounding areas shows more bare ground than trees, with the forest confined to narrow strips (Figure 5), a powerful illustration of the poor condition of private timber lands in the Oregon portion of the Klamath River Basin.

The *Draft TMDL and WQMP* relies on the Oregon Department of Forestry's ongoing implementation of Oregon's Forest Practices Act (FPA) to ensure that private land forestry activities do not result in water quality impairment. Unfortunately, these regulations have long been recognized as inadequate for the protection salmonid habitat and water quality. For example, the Independent Multidisciplinary Science Team (IMST 1999) was convened by the State of Oregon to assess whether the FPA rules were sufficiently protective to restore wild salmonids in Oregon. The IMST found that the existing rules were not adequate on several bases, including water quality issues such as sedimentation resulting from landslides and roads. We are not aware of any significant improvements to the Oregon FPA rules to address the shortcomings identified by the IMST. The National Marine Fisheries Service has also recognized the shortcomings of the FPA rules and has made recommendations to the State of Oregon (NMFS 1998), but these recommendations have not yet been implemented.

We realized that ODEQ's authority to resolve the situation is limited due to existing laws, regulation, and politics; however, we feel compelled to note the approach outline in the *Draft TMDL and WQMP* to address the water quality impacts of forestry on private lands is unlikely to succeed.

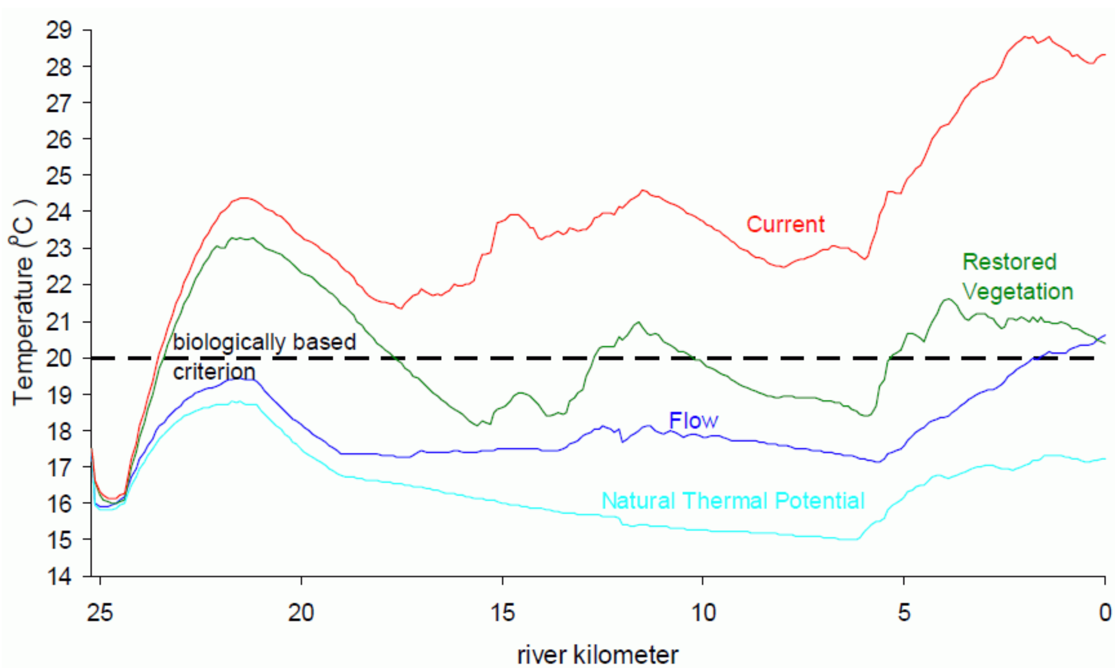

Figure 4. Predicted 7-day average maximum temperatures for Spencer Creek in different four modeled scenarios for July 2-21, 2001. Figure A32 from the *Draft TMDL and WQMP*.

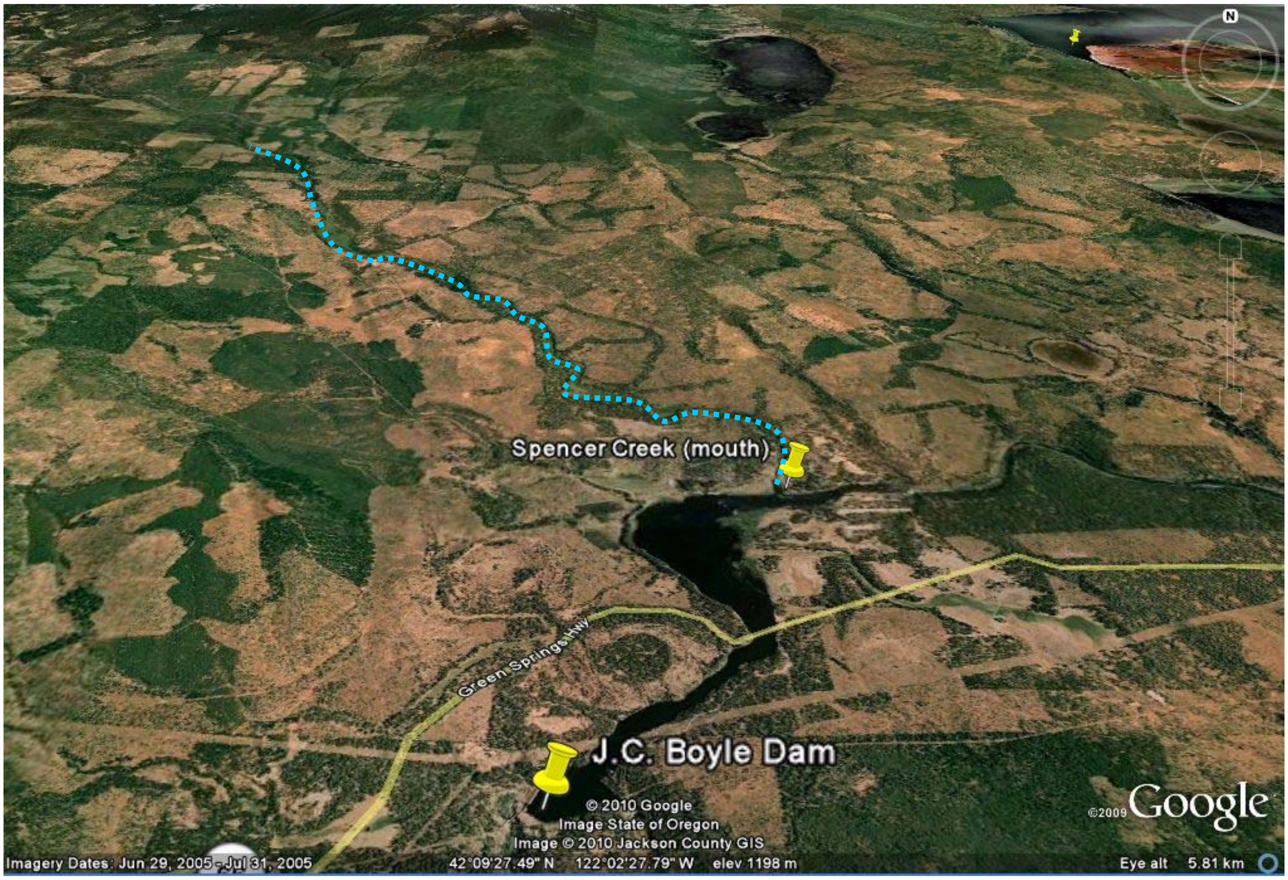

Figure 5. Oblique aerial photograph of Oregon forests, looking north from J.C. Boyle Reservoir. The dotted blue line shows approximate path of lower Spencer Creek. Image from Google Earth.

Data sharing

There is little discussion in the *Draft TMDL and WQMP* regarding sharing of the monitoring data to be collected by the Designated Monitoring Agencies and other entities. Experience shows that both public and private entities sometimes withhold data that discloses conditions that do not reflect well on management. ODEQ should require that all monitoring data and photographs collected as part of TMDL implementation be made publicly accessible on the Internet.

SPECIFIC COMMENTS ON MINOR ISSUES

Chapter 1: Draft Upper Klamath and Lost River Subbasins TMDL Introduction

1.2.4 Tribal Trust Responsibilities

We are glad to see the statement that "The Department must consider federal tribal trust responsibilities in the Klamath River basin since TMDLs are subject to the approval of the USEPA." (p. 1-8)

Chapter 2: Draft Klamath River Dissolved Oxygen, Chlorophyll, pH, Ammonia Toxicity, and Temperature TMDL

2.3.1 Dissolved Oxygen, pH and Ammonia Toxicity

Figures 2.4 to 2.8 show D.O., pH, and ammonia toxicity. They are not very comprehensive (show only a very small amount of the total available data), but are sufficient to serve their intended purposes of documenting water quality impairment and longitudinal trends.

2.4 Seasonal Variation

On page 2-19, it is noted that "The following plots present data from 1995 to 2003 as reported by Tetra Tech 2006". This citation is erroneous; it should be TetraTech (2004).

2.5 Water Quality Modeling Overview

On page 2-22, it is noted that "Indeed, the entire TMDL modeling process has been a case study for collaboration at both technical and policy levels, with participation of two federal agencies, two state agencies, and private consultants over a five year period." It should be noted that several Klamath River basin Tribes were also involved in the process and merit mention here.

2.6.1 Pollutant Identification

Discussions of BOD on page 2-24 and 2-25 may provide more detail and equations than is necessary.

On page 2-26, it is noted that "Shade from riparian vegetation was not explicitly considered in the Klamath River analysis for the following reasons…" It is our understanding that topographic shade (i.e. from ridges, but not vegetation such as trees) was included in the water quality model and thus may merit mention here.

2.6.2 Upstream Condition - Upper Klamath Lake

On page 2-27, is stated that: "Despite restoration efforts, regular sampling of phosphorus concentrations in Upper Klamath Lake has not revealed a statistically significant temporal trend (data from personal communication with Jacob Kann of Aquatic Ecosystem 2009). The trend analysis used the nonparametric Seasonal Kendall method to test for montonic [sic] trends in the water quality data using the program WQHydro (Aroner 2009)."

This is passage is confusing and appears to unintentionally mislead readers. It should be re-worded for clarity. First, it should be noted that while there has been restoration effort, much of the most significant projects around the lake, such as levee breaches in the Williamson River Delta have only occurred within the past few years and thus have not yet become fully functional ecosystems (i.e. wetland vegetation is still developing). It may be that positive effects will become apparent in future years and it would be pre-mature to dismiss these efforts as ineffectual in the Draft TMDL and WQMP. Second, the data were collected by the Klamath Tribes and it would be more appropriate to cite the Tribe as the source of the data rather than Dr. Kann. Third, the passage appears to suggest that the Dr. Kann did the statistical analysis when, in fact, the analysis was conducted by ODEQ. This should be made more clear. Fourth, a few more details about the trend analysis should be included (i.e. what time-frame was used [annual, June-September?] and what were the p-values or other appropriate statistics?)

2.6.4 USBR's Klamath Project: Lost River Diversion Channel and Klamath Straits Drain

Overall, this section provides an informative and well-illustrated summary of the effects of the Klamath Project on water quality (i.e. that on a mass-basis it is a nutrient sink but that it increases nutrient concentrations in the river, because it is more a water sink than it is a nutrient sink). A note should also be added providing the historical context of how agriculture has contributed to the degradation of water quality and aquatic habitat in the basin - something like: "In addition to diversions and discharges, agriculture has been the driving force in the historical changes in land and water use that have degraded water quality and aquatic habitat in the Klamath River and Lost River basins over the past century. These changes have included conversion of lakes and wetlands to farmland, construction of reservoirs, the channelization and straightening of stream channels into ditches."

On page 2-30 "Rykbost and Charlton 2001" is mis-cited as "Rybost and Charlton 2001"

On page 2-33, it is stated that "Briefly, the operation of Keno Dam appears to decrease dissolved oxygen by 0.1 mg/L in Keno impoundment and increase temperature by 0.7 °C at the outfall." Also, Figure 2-43 ("Predicted 7-day average of the daily maximum temperature (°C) in Klamath River at Keno Dam") on page 2-57 is a graphical illustration of the same point. It was our impression that PacifiCorp's water quality modeling effort indicated a substantially larger effect on water temperatures. If this is true then the magnitude of the difference between the two model results should be discussed, as well as an explorations of the potential reasons why (is it related to a change in the reef elevation?).

2.6.11 Natural Sources

On page 2-33 and 2-34, it is stated that, "Specifically, there is a spring complex which contributes approximately 225 cfs (6.36 cms) just upstream of the JC Boyle powerhouse. Based on sampling from other springs in the basin and examining the nutrient mass balance in the river, we estimated an inorganic phosphorus concentration of 0.07 mg / L and nitrate-nitrite concentration of 0.25 mg N/L" Actually, it is our understanding that the values used in the TMDL water quality model for PO4 concentrations in the springs are 0.066 mg/L (close to, but not identical to 0.07) with a small amount of algae and OM, for a total P concentration of 0.0688 mg/L (IFR and PCFFA 2009).

2.6.13 Keno impoundment Source Evaluation

On page 2-37, it is stated that "In 2000, USBR's operations of Lost River Diversion channel was unique compared to other years, in that flows were diverted into the Klamath River during September (Jon Hicks, USBR, personal communication)." Based on information presented in Sullivan et al. (2009), this appears to have occurred in 2008 as well. The Lost River Diversion channel did discharge to the Klamath in September, because Sullivan et al. (2009) states that "The Lost River Diversion channel, which conveys water both to and from the Klamath River at different times of the year, was sampled only when flow was towards the Klamath River, which occurred in spring and fall." Appendix B of Sullivan et al. (2009) shows data collected on 9/16/2008 and 9/30/2008.

2.7.1 Natural Conditions Baseline
On page 2-41, it is stated that "The natural conditions baseline scenario simulated the Klamath River from Upper Klamath Lake to the Pacific Ocean in the absence of all dams, except for Link Dam, but represented the presence of the historic Keno Reef (a natural basalt outcrop that was removed prior to construction of the Keno dam). Keno Reef was represented using data provided by the Bureau of Reclamation." It would be useful to add a note regarding how the height of the reef compares to the current dam/reservoir elevation.

2.7.3 Allocations to address DO, pH, excess algae and ammonia toxicity impairments
The Table 2-10 ("Point Source Waste Load Allocations using flow-weighted averages") on page 2-46 does not list the percent reductions required. The percent reductions values should be added to provide context to the allocations and make them more understandable. It appears to be a reduction of approximately 90%, approximately the same reduction required for non-point source loading, but this should be explicitly stated.

2.7.3.1 Point source and nonpoint source (except dams) nutrient allocations
Figure 2-38 shows an annual loading diagram for total phosphorus, but no similar diagram is presented for total nitrogen or organic matter. It might be helpful to include diagrams for these parameters as well.

2.7.4.3 Thermal Load Allocations: Dams
Table 2-15 ("Keno impoundment and JC Boyle Reservoirs Load Allocations in terms of a the [sic] surrogate measure of temperature offset") on page 2-59 sets allocations of up to ~0.5 ºC of degree for Keno and Boyle reservoirs. How will these allocations be accomplished?

2.7.5 Instream Targets
Figure 2-46 and Figure 2-46 on page 2-60 are excellent graphics, clearly displaying summer longitudinal trends in temperature, chlorophyll, and nutrient concentration with the TMDL allocation scenarios.

2.8.1 Uncertainty Analysis: Model Input Uncertainty
A note should probably be added on page 2-62 that nutrient concentrations of the JCB Boyle springs have never actually been directly sampled, but were calculated based on mixing equations. Given the large volume of flow, this is a source of uncertainty. Someday, somebody should directly sample these springs.

Chapter 3: Draft Lost River Dissolved Oxygen, Chlorophyll, pH, and Ammonia Toxicity TMDL

3.6.1.2 Nutrients
The statement on page 3-19 that "Available data indicate that a significant amount of nitrogen in the Lost River system is in particulate (organic) form." appears to be erroneous. Not all organic N is particulate, it can be dissolved. Recent USGS sampling found that the majority of the organic N in Keno Reservoir is dissolved (see Figure 3 in Sullivan et al. 2009) and this is likely to be similar in the Lost River given that Upper Klamath Lake contributes water to the system.

3.6.1.2 Point Sources

On page 3-19, it is noted that "Klamath Irrigation District has a permit to use herbicide in their irrigation system and is not associated with the pollutants in this TMDL." It would be useful to mention in the text which pesticides are permitted, so that readers of the TMDL can assess any potential toxic effects on aquatic ecosystems in the Lost River.

3.7.1 Nutrient and CBOD Reduction Analysis

It is noted on page 3-31 that Oregon's water quality standards will be met in the Lost River with a 50% reduction in carbonaceous biochemical oxygen demand (CBOD) and dissolved inorganic nitrogen (DIN); however, Chapter 2 of the *Draft TMDL and WQMP* requires a 90% reduction in these parameters in the discharge of the Straits Drain (terminus of the Lost River system) to the Klamath River. This seems somewhat inconsistent, and thus should be discussed somewhere in the *Draft TMDL and WQMP* (perhaps it was, and we did not notice).

Chapter 4: Draft Upper Klamath and Lost River Subbasins Tributary Temperature TMDL

4.1 Overview and Scope: Temperature Issues

Page 4-6 notes that "The potential causes of high water temperatures include urban and rural residential development near streams and rivers, irrigation water return flows, *past forest management within riparian areas*, agricultural land use within the riparian area, water withdrawals, and road construction and maintenance." (*emphasis added*). This appears to suggest the current timber harvest practices and rates do not contribute to high stream temperatures, and that only timber harvest in riparian areas matters. We disagree with both of those concepts. Some areas of the Klamath Basin have been so heavily logged that there is little forest remaining (Figure 5), and aerial photographs indicate that at least some of the harvest is recent (or the forest would have regenerated). Timber harvest outside riparian areas can cause landslides and other erosion that increases sediment levels in streams, increasing width-to-depth ratios, and resulting in stream warming.

4.4.3.3 Hydromodification: Dams, Diversions, and Water Management Districts

On page 4-19, it is noted that, "USBR (2003) calculated that the Jenny Creek watershed contributed 24,230 acre-feet per water year to the Rogue River Basin Project. USBR also predicts that without the project, flows in Jenny Creek would be an average of 6 cfs greater in July and 4 cfs greater in August." We have never seen anyone quantify the effects of these diversions on Jenny Creek flows, so are very interested to review the USBR (2003) document. That document is not listed in the references of the *Draft TMDL and WQMP*. It should be added.

Page 4-20 of the *Draft TMDL and WQMP* notes that PacifiCorp's diversion of water from Spring Creek (a Jenny Creek tributary) into Fall Creek for the purposes of hydropower generation warms Spring Creek approximately 2 ºC and Jenny Creek approximately 2.6 ºC degrees at the Oregon/California border. Table 4.8 (page 4-24) notes that PacifiCorp's allocation for temperature increase in Jenny and Spring Creeks is only 0.1 ºC. We are unclear on what the on-the-ground implications of this allocation are. Does this mean that PacifiCorp must cease its diversion of Spring Creek water?

4.5.1 Excess Load

This section of the TMDL presents very informative model results comparing the current water temperatures of several streams to their "natural thermal potential" in a simulation with maximal vegetative shade and natural flow conditions (no dams, no irrigation or drinking water withdrawals, no point sources, and no water imported into the watershed). For example, as noted above, with the elimination of diversions and an increase in vegetative shade, water temperature at the mouth of Spencer Creek could be reduced by over 10 ºC (Figure 4) and be highly favorable to coho salmon. We appreciate ODEQ's efforts in performing these analyses, as the information should be quite useful in guiding efforts to restore thermal refugia following dam removal.

Chapter 4: Draft Upper Klamath and Lost River Subbasins Water Quality Management Plan

5.3.4 Timeline for Implementing Management Strategies

On Page 5-13, it is stated that "DEQ recognizes that there has been and continues to be much progress towards improving water quality in the Upper Klamath and Lost River Subbasins." We are not aware of any data showing that in-river water quality conditions in the Upper Klamath or Lost River are getting better. It is true that some efforts are being made, but factors such as climate change that are detrimental to water quality are also progressing. As we noted above, activity and effort is different than progress or actual improvement. This may seem to be an issue of minor semantics, but actually it is important to distinguish between the two; thus, we suggest that "progress" in the passage above be changed to "effort".

5.3.7 Identification of Sector-Specific Implementation Plans

The web link listed for the Klamath Headwaters and Lost River Subbasin AWQMAPs (http://www.oda.state.or.us/nrd/water_quality/areapr.html) on page 5-17 is outdated. The current link is http://oregon.gov/ODA/NRD/water_agplans.shtml

5.3.10 Monitoring and Evaluation

This section appears to focus solely on water temperature. Is there a reason why nutrients are not measured? In addition, photo-monitoring is an easy and powerful tool for documenting and tracking both habitat conditions and projects. We recommend that ODEQ require and encourage photo monitoring as appropriate, and consider adding mention of photo monitoring to this section.

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