MEMORANDUM REPORT

To: NCWQCB
From: Quartz Valley Indian Community
Date: November 29, 2007
Re: Comments on *Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA* (NCRWQCB, 2007)

(If there are questions regarding any of the content in this memorandum, please contact Eli Asarian at eli@krisweb.com or 707-443-4743)

On February 27, 2007 the members of the Klamath Basin Tribal Water Quality Work Group (Work Group) met with staff from the U.S. Environmental Protection Agency (EPA) and the North Coast Regional Water Quality Control Board (NCRWQCB) to discuss the on-going Klamath River Total Maximum Daily Load (*Klamath TMDL*) development effort. NCRWQCB staff shared a document entitled *Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA* (NCRWQCB, 2007), which details their proposed strategy. The framework for the implementation plan is logical and comprehensive. The table appears here as Appendix 1, to which we have added a column of responses and comments by the Work Group.

Klamath River nutrient pollution has been widely recognized since the 1950s (Phinney and Peak, 1960; CH2M Hill, 1985; Kier Associates, 1991). The adult salmon kill in the Klamath River in September 2002 (CDFG, 2003; Guillen, 2003), the chronic high mortality of juvenile salmon (Nichols and Foott, 2005), and the identification of problems with toxic algae in the Klamath Hydroelectric Project (KHP) reservoirs (Kann and Corum, 2006) all point to extremely serious Klamath River water quality issues.

The Tribes are hopeful that the mainstem *Klamath TMDL* can avert the potential collapse of Klamath River salmon stocks by spurring measures to abate water pollution in the timeframe necessary for their recovery -- i.e. in the context of the Pacific Decadal Oscillation (Collison et al. 2003). In the Upper Klamath Basin, including Keno Reservoir, the Lost River sucker and shortnose suckers are, similarly, imperiled and will serve as indicators of whether water quality is, in fact, being restored, and whether TMDL implementation is proceeding as planned.

Only major topics from the implementation table are discussed below. For the sake of brevity points from previous *Klamath TMDL* comments by Work Group members (QVIC, 2006; Yurok Tribe, 2006) are not repeated here. Those are, however, easily accessible on-line at the Work Group's website: http://www.klamathwaterquality.com.

The two most important points to be made in these comments are:

- The restoration and maintenance of ecosystem function should be the principle around which TMDL implementation should be organized. This will entail removing, or setting back levees; restoring sinuosity in channelized stream reaches; expanding wetlands; and removing dams to provide free-flowing river reaches. Limits to road densities and timber

harvests should be established in order to restore natural hydrologic and sediment supply regimes.

- The NCRWQCB should prepare a proper implementation plan for the California portion of the Lost River. The implementation plan recommended by U.S EPA in its March, 2007 Lost River TMDL (all EPA can do is "recommend" at this point) is inadequate. The Tribes request that the NCRWQCB either include Lost River implementation in the mainstem Klamath TMDL, or create a separate implementation plan for an improved Lost River TMDL.

Klamath River Interstate Water Pollution Challenge

The North Coast Regional Water Quality Control Board relies on the cooperation of the Oregon Department of Environmental Quality (ODEQ), U.S. Environmental Protection Agency (U.S. EPA), Tribes and other land- and water management agencies to attain "delivery of water across the OR/CA boundary that meets CA water quality objectives" (NCRWQCB, 2007).

If the water pollution control programs for Upper Klamath Lake, the tributaries to the lake, that for Lost River and Lower Klamath Lake do not succeed, then pollution of the mainstem and lower Klamath River will persist.

Although NCRWQCB authority does not, of course, extend into Oregon, cooperative agreements with ODEQ, the U.S. EPA and other collaborators should be very clear in terms of which entity is responsible for which water quality restoration action, responsibility for the program of monitoring, and the timeline in which water quality recovery is to be accomplished. For example, the NCRWQCB should work with the U.S. EPA to insure that actions needed in the Lost River basin, including Lower Klamath Lake, are clearly defined in the forthcoming *Lower Lost River TMDL* (U.S. EPA, currently under review).

Suckers are one of the most important and sensitive beneficial uses in the Upper Klamath Basin and Lost River, and measures taken to implement TMDLs need to be sufficient to recover these species. Such measures should follow the recommendations of the National Research Council (NRC, 2004).

Upper Klamath Lake and its tributaries: Implementation of the *Upper Klamath Lake TMDL* (ODEQ, 2002) and related water quality management plans (ODA, 2004) rely heavily on voluntary measures. The TMDL's monitoring requirements are vague and there is no required action for improving flows in tributaries above the lake to assist in water quality improvement. The Upper Klamath Basin Working Group (formerly known as the Hatfield Working Group) has been attempting to restore Upper Klamath Lake and its tributaries since 1996. Extensive areas of lakeside wetlands have been recreated near the mouth of the Williamson and Wood rivers and in Agency Lake.

With regard to tributaries, substantial progress has been made in the lower Wood River (UKBWG, 2007), but the Working Group was only able to fund one third of the worthwhile conservation projects proposed in the 2006 grant competition (UKBWG, 2006). Additionally, the *Sprague and Sycan River Watershed Assessment* is stalled due to local resistance (UKBWG, 2006). Meetings have

been hostile with regard to water management and some funding for conducting the analysis from the Oregon Watershed Enhancement Board may have to be turned back due to lack of progress. The *Upper Basin Watershed Restoration Plan* is also behind schedule and meeting similar resistance.

Keno Reservoir: The *Klamath TMDL* must succeed in abating acute water quality problems in the reach extending from Keno Dam upstream to Klamath Falls. This reach can exhibit both nocturnal and diurnal anoxia for up to five weeks each year (Deas and Vaughn, 2006). Settlement negotiations related to the Klamath Hydroelectric Project (KHP) federal government relicensing process suggest that Keno Dam will be spared decommissioning, while the four KHP dams downstream of Keno Dam could be removed. If nutrient pollution problems are not resolved expeditiously in Keno Reservoir, the recovery of Klamath River salmon through dam removal could be severely confounded. The Klamath Straits Drain and other agricultural drainage sources to the Klamath River degrade water quality by discharging large quantities of untreated nutrient-rich, oxygen-poor water into Keno Reservoir (NRC 2004).

The historic conditions of the area around Keno Reservoir are shown in Figure 1 and are described in NRC (2004) as follows:

> "Between Lake Ewauna and Keno, the river meandered through a flat, marshy country (Henshaw and Dean 1915, p. 655) for about 20 miles before descending over a natural rock barrier that stretched across the river at Keno. Water in the river periodically backed up behind the reef at Keno and spread out upstream, flowing into Lower Klamath Lake through Klamath Straits."

A vast wetland complex covered virtually the entire lowland area between Keno and Klamath Falls and was connected to Lower Klamath Lake (NRC, 2004).

The height of the Keno Dam approximates the original bedrock sill at Keno that was blasted to drain wetlands and expand agricultural production (NRC, 2004). Today, however, extensive levees and dikes isolate the Klamath River from the remaining wetlands (Figure 2), denying their historic ability to buffer the river from receiving nutrients from storm runoff and agricultural discharges from adjacent farm fields.

An issue that is underappreciated, yet critically important, is that channelization and diking impairs natural river processes that retain (i.e. remove from the water column) nutrients through denitrification, growth of attached algae, and the settling of organic matter. The result of channelization and diking in the upper Klamath River basin is, then, is much higher downstream nutrient loading than would have occurred historically. As described by Dodds and Bernot (2005):

> "Several additional management methods that have not been regularly employed may prove to be useful in maximizing N retention and removal in lotic ecosystems. These include: 1) Maximizing substrata heterogeneity within the stream channel and creating backwaters where high rates of N flux can occur (for example, encouraging both nitrification and denitrification). … 3) Restoring channelized lotic ecosystems that inherently decrease the ability of the system to handle increased N loads. *This restoration should include reversion to historical sinuosity, channel complexity, and connectivity to riparian wetlands as well as decreasing mean depth of the water column in the river channel.*" (emphasis added)

Figure 1. Photographs take on June 30, 1907 by the U.S. Bureau of Reclamation looking west from Wild Horse Butte towards Keno, prior to draining of the wetlands. Wild Horse Butte is a hill approximately one mile southeast of the present-day confluence of the Klamath Straits Drain and the Klamath River. These photographs are part of the Brown Album, a collection of 256 images of the early 1900s Klamath Basin, available online at the Klamath Waters Digital Library website.[1]

[1] http://klamathwaterlib.oit.edu/cdm4/results.php?CISOOP1=all&CISOBOX1=brown%20album&CISOFIELD1=CISOSEARCHALL&CISOOP2=exact&CISOBOX2=&CISOFIELD2=CISOSEARCHALL&CISOOP3=any&CISOBOX3=&CISOFIELD3=CISOSEARCHALL&CISOOP4=none&CISOBOX4=&CISOFIELD4=CISOSEARCHALL&CISOROOT=all&t=a

Figure 2. The impounded reach of the Klamath River near the town of Keno, Oregon shows how little functional riparian buffer area remains. Nutrients from farming activities flush directly into the river, promoting nutrient enrichment. Map from Google Earth.

Keno Reservoir is U-shaped in cross-section with a low width-to-depth ratio and only a narrow band of shallow water along its margins. A waterbody with such morphological characteristics would be expected to have low nutrient retention (Dodds and Bernot, 2005; Biggs, 2000; Seitzinger, 2005). The historical channel and connected adjacent wetlands, by comparison, would have exhibited a much higher nutrient retention capability. As noted above, Keno Dam is likely to remain in place, but improvements could be made to the reservoir, such as adding fringing wetlands to increase complexity and nutrient retention.

Deas and Vaughn (2006) recommend immediate action on a pilot scale to test the ability of wetlands to improve water quality in Keno Reservoir. The *Klamath TMDL* should make similar recommendations with the potential use of easements as a financial incentive. Subsequently, the NCRWQCB, ODEQ and U.S. EPA staff should work with the Bureau of Reclamation and the Upper Klamath Basin Working Group to make such restoration projects a priority.

Klamath Straits Drain: Agricultural drain water from the federal government's Klamath Reclamation Project, including the lower Lost River, Tule Sump and Lower Klamath Lake sub-basins are pumped into the Klamath River at the Straits Drain, near the California-Oregon border. Straits Drain water is a major contributor of nutrient pollution (QVIC, 2006; Yurok, 2006), including periodic pulses of unionized ammonia.

In order to abate nutrient pollution from the Straits Drain, Tule Lake and Lower Klamath Lake need to be expanded. Mayer (2005) showed that nutrient loads released from the Lower Klamath Lake Wildlife Refuge were far less than incoming loads, though part of that was due to a decreased quantity of water outflow. Lower Klamath Lake is a peat bed that has the potential to be a giant nutrient sponge. The National Research Council (2004) called for its expansion to allow Lost River sucker and Shortnosed sucker recovery. The *Draft Lower Lost River TMDL* (U.S. EPA, in review) includes Lower Klamath Lake, and it should recommend expanding the lake as a step toward meeting TMDL implementation goals and to restoring the sucker species' habitat beneficial use. If the habitat needs of sucker species were being met in the lower Lost River, Tule Lake and Lower Klamath Lake sub-basins, then there would not likely be water quality problems at the Straits Drain or in the Keno reach.

Lower Lost River: The lower Lost River is confined by levees and consists largely of agricultural return water for much of the year (USFWS, 2001). Deliveries from Upper Klamath Lake through the A-Canal for the Klamath Project water users add substantially to the Lost River's nutrient load.

Ground water depletion has the potential to reduce contributions from spring sources in the few remaining Lost River reaches supporting suckers (USGS, 2005). Sucker distribution during summer is limited to impoundments and there is limited spawning access or success for the Lost River sucker population upstream of the Tule Sump (NRC, 2004). (See comments by Yurok Tribe, 2006, on *Pre-Draft Lower Lost River TMDL*).

The draft *Lost River California TMDL* (U.S. EPA, in review) stresses the need to reduce non-point source pollution from agricultural operations. It does not recognize the need to restore ecosystem function and it fails to recommend restoration of riparian areas reconnecting the river with nutrient-stripping wetlands, nor expanding Tule Lake. It proposes a target of reducing nutrients by 50 percent, but provides no determination whether such reduced nutrient load will accomplish mainstem *Klamath TMDL* objectives for the Keno reach.

Further, the *Lower Lost TMDL* designates the Klamath Basin Water Users Association as the lead organization for its plan implementation and makes no mention whatsoever of the interest in nor any role to be played by the Tribes in Lost River pollution abatement. Shaping a process controlled by the pollution source producers ensures gridlock and makes a science-driven adaptive management program extremely unlikely. NRC (2004) noted that despite huge expenditures of money on restoration, the USBR and the USFWS were not pursuing an adaptive management strategy for sucker recovery.

Deas and Vaughn (2006) note that there is a substantial contribution of nutrients from the Lost River to the Klamath River through the Lost River Diversion Canal and the North Canal. Water quality problems with the Keno reach of the Klamath River cannot be solved without reducing pollution from the lower Lost River, Tule Lake, Lower Klamath Lake and the Straits Drain. We request, therefore, that the *Klamath River and Lower Lost River TMDL implementation processes be combined.*

PacifiCorp Relicensing

The *Implementation Work Plan Outline* (NCRWQCB, 2007) acknowledges important water quality issues that have come to light in the context of the proposed federal government relicensing of the Klamath Hydroelectric Project:

- the role of the KHP reservoirs in nutrient pollution of the Lower Klamath River
- production of toxic algae in the Klamath River, and
- the nature and frequency of fish disease epidemics.

Work Group member Tribes have commented on KHP relicensing formally ever since 2004 (see www.klamathwaterquality.com) and have contributed to Klamath River science by formulating nutrient budgets for the KHP reservoirs (Kann and Asarian, 2005) and free-flowing Klamath River reaches (Asarian and Kann, 2006a; Kann and Asarian, 2006). The Tribes have also documented chronic problems with the production of toxic algae in KHP reservoirs (Kann, 2005; 2006; Kann and Corum, 2006) and the persistence of toxic algae all the way to the Klamath River estuary (Yurok Tribe Environmental Program, 2006).

PacifiCorp (2004; 2006; 2007) has countered that KHP reservoirs are nutrient sinks, or traps, that benefit Klamath River water quality, but the Work Group has demonstrated that there is a significant body of evidence that shows that the reservoirs are periodic sources of nutrients (Kann and Asarian, 2005; Asarian and Kann 2006a) and of toxic algae pollution (Karuk Tribe, 2007).

The California State Water Resources Control Board and the Oregon Department of Environmental Quality have the responsibility to determine whether the proposed relicensing of the KHP by the federal government comports with the water quality standards and objectives of the States. Through the issuance – or withholding – of Clean Water Act Section 401 certificates, States may require water quality-related mitigation measures on the hydroelectric project.

The Work Group Tribes have not yet been able to review the Klamath TMDL model ouputs in any detail, but if the TMDL water quality model suffers from the same issues as PacifiCorp's water quality model (Asarian and Kann, 2006b) then the TMDL model may not provide an accurate tool for assessing the impacts of the KHP on Klamath River water quality and may, therefore, undermine the findings of the States' 401 certifications. This would be a highly undesirable outcome, and is one to be scrupulously avoided.

The evidence which demonstrates the links between the KHP reservoirs and incidences of fish disease outbreaks (Stocking and Bartholomew, 2004; in press); toxic algae blooms (Kann and Corum, 2006); and nutrient pollution (Kann and Asarian, 2005; Asarian and Kann, 2006) is substantial. Unless Klamath TMDL model performance can be significantly improved the *Klamath TMDL* should employ, instead, a weight of evidence approach in assessing these water quality-related problems. If the best scientific information available indicates that dam removal would improve Klamath River water quality, the *Klamath TMDL* should so state. Monitoring plans for the TMDL's implementation related to the KHP should include both with- and without-dam contingencies.

Rangeland Management

Although direct livestock grazing impacts on mainstem Klamath River riparian zones are generally limited, there is intensive stream-side grazing just above Horse Creek. Ironically, some Klamath River riparian areas below Iron Gate Dam have been deforested, after having been retired as rangelands, for residential and recreational uses.

Above Iron Gate Dam, substantial tributary impacts from grazing still occur in Shovel and Spencer creeks. Below the KHP, the riparian zones of the Bogus, Cottonwood, Willow, and Horse Creek tributaries have all been altered by livestock grazing. Bogus Creek is spring fed and has served as a refugia for salmon and steelhead (Kier Associates, 1999), but there are indications that water temperature increases occurred there between 1996 and 1999. Diversion for stock water and pasture irrigation may be contributing more to thermal problems there are direct impacts to the riparian zone from grazing.

The *Klamath TMDL* should foster the development of farm and ranch plans, including the identification of sensitive riparian habitats on both the mainstem Klamath River and it tributaries. The TMDL should advance the policy of acquiring sensitive habitats, i.e, through a program of conservation easement acquisition. Such a program would promote riparian health, improve fish habitat and increase riparian nutrient filter capability while improving the economic viability of cattle ranching.

Public land grazing is a lesser issue and can be addressed through an updated MOU between the NCRWQCB and the responsible federal agencies (see public land timber harvest section below).

Streamflow Issues

The flow of the Klamath River is controlled in large part by the U.S. Bureau of Reclamation (BOR), which releases water from Upper Klamath Lake at Link River Dam. Even so, the *Klamath TMDL* should include a discussion of the findings of the Hardy and Addley (2001) that flow releases at Iron Gate Dam should never fall below 1,000 cfs to maintain healthy downstream conditions for Pacific salmon. According the U.S Bureau of Reclamation, the *Klamath Project Operations Plan for 2007* has adopted flow levels similar to those recommended by Hardy and Addley (2001) as a result of U.S. District Court ruling CIV. NO CO2-2006 SBA (BOR, 2007).

It is encouraging to see clear language in the *Klamath TMDL* implementation outline (NCRWQCB, 2007) regarding the need to protect and restore adequate flow to protect beneficial uses, e.g., "Work with State Division of Water Rights to establish a flow objective that addresses thermal refugia protection, fish disease, and algae blooms."

The NCRWQCB should also consider exerting its direct authority in the *Klamath TMDL* to increase flows, where water quality impairment can best be abated by improving flows (U.S. Supreme Court, 1994).

The Karuk Tribe Department of Natural Resources (Soto and Hentz, 2003) has been conducting flow surveys of Middle Klamath River tributaries that serve as summer refugia for juvenile salmon

and steelhead (MKWC, 2007). The *Klamath TMDL* should reference these data and make clear statements about the need to maintain flows in streams that serve as refugia. The SWRCB Water Rights Division needs to explicitly recognize the need to limit further surface and ground water diversion in important Klamath River tributaries and along the mainstem river. The U.S. EPA (2003) points out the importance of maintaining the spatial distribution of thermal refugia for the conservation of Pacific salmon species.

The *Klamath TMDL* must prevent alteration of hydrologic conditions by timber harvest and road construction activities (Jones and Grant, 1996) in Klamath Basin tributary watersheds. Such alteration can increase the frequency of damaging peak flood flows and decrease summer base flows (see below). The worst problems of this nature are in tributaries below Weitchpec, where 17 of 23 streams lose their surface flow in late summer before they can reach the Klamath River as a result of cumulative effects from timber harvest (Kier Associates, 1999).

The *Klamath TMDL* should also recognize the role of wetland restoration as a potential mechanism for water storage and recommend increasing wetlands for water quality, fisheries and streamflow benefits. The NCRWQCB staff should resist endorsing "water bank" subsidies in the *Klamath TMDL* that must be paid every year to farmers and ranchers. Instead the TMDL should favor payments for the retirement of water rights, particularly on marginally productive agricultural land or in those sensitive riparian zones where conservation easements are needed.

Private Timberland Management

The NCRWQCB (2007) has laid out very clear objectives to bring timber harvest on private lands into compliance with the TMDL goals of reducing water pollution and maintaining tributary refugia. This is a very positive direction.

The key to successful implementation, however, is to set explicit thresholds for road density, rates of timber harvest and disturbance of unstable slopes or soil types. Guidance on limits of prudent risk for logging and road building, based on the scientific literature, have been offered in Table 5 of previous Klamath River TMDL comments provided by the Quartz Valley Indian Community (2006).

As noted by Kier Associates (1999), highly erodible decomposed granitic terrain runs through the Middle Klamath River Basin, resulting in widespread areas of high erosion risk, particularly in the Beaver and Horse Creek watersheds. Lower Klamath tributaries have extremely steep terrain and disturbance of areas at high risk of producing debris torrents should be avoided. The Work Group recommends the use of the shallow landslide stability model (SHALSTAB) (Dietrich et al., 1998) as a tool for preliminary identification of these high risk areas (see Kier Associates, 2005).

The *Klamath TMDL* should recommend removing the most unstable areas from timber harvest rotations.

The *Klamath TMDL* implementation plan should include studies exploring watershed disturbance rates, examining the location of roads and timber harvest activity, and resulting changes in channel conditions that contribute to stream warming. Increased peak flows resulting from extensive timber

harvest and road networks can fill pools and change the width-to-depth ratio of streams; this is a particular concern in watersheds which lie substantially in the transient snow zone (Jones and Grant, 1996).

The U.S.F.S. has recognized high cumulative effects risk in Beaver Creek and Horse Creek because very high rates of timber harvest on private lands within those watersheds (Figure 3).

Figure 3. This photo of the Horse Creek watershed shows widespread clear cuts in the transient snow zone that pose high cumulative effects risk. Photo courtesy of and copyright by Michael Hentz.

Public Land Timber Harvest

The *Klamath TMDL* workplan outline (NCRWQCB, 2007) invokes the 1981 Management Agency Agreement (MAA) between the SWRCB and federal land management agencies, but notes that an updated Memorandum of Understanding (MOU) is needed with the "USFS and BLM that addresses road maintenance and road density in addition to timber harvest BMPs that protect thermal refugia and riparian function." The January 1997 storm caused 437 miles of stream channel scour.

De la Fuente and Elder (1998) found that rates of land-sliding were much greater on harvested lands (e.g. see Figure 4). This argues strongly for an updated MOU.

The *Salmon River TMDL* (NCRWQCB, 2005b) recognized that the *Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources* (Elder et al., 2001) is the equivalent of a TMDL implementation plan. The *Klamath TMDL* should, similarly, reference the several USFS

watershed analyses (SRNF, 2003b; KNF 2000; 2003a) and road network studies (SRNF, 2003a; KNF, 2002) and recommend the funding actions from them to reduce road-related erosion.

The ultimate goal should be to reduce road networks sufficiently that annual maintenance becomes practical and widespread road bed failures in major storm events can be prevented.

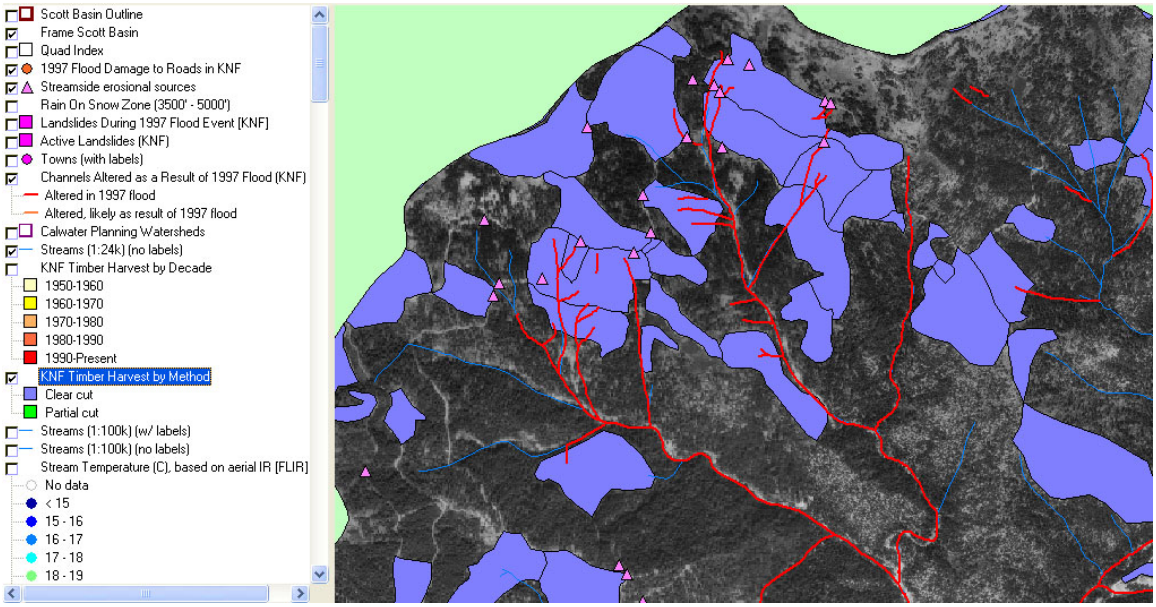

Figure 4. This lower Westside Scott River map shows the Kelsey Creek watershed, Klamath National Forest timber harvests in the 1980's and 1990's (blue) and the occurrence of flood damage sites (the pink triangles). The red lines are channels scoured by debris torrents. Lower Kelsey Creek warmed significantly because of these changes. A USGS 1996 orthophoto serves as the backdrop. From QVIC (2006).

The older style of even-age timber management on USFS lands has left a legacy of high cumulative watershed impacts and fire risks. The *Klamath TMDL* should recommend that future public land timber management restore the diverse stand age that promotes a hydrologic function more closely resembling the normal range of variability in which salmon and steelhead co-evolved (QVIC, 2006).

Irrigated Agriculture

The *Draft Implementation Work Plan Outline* (NCRWQCB, 2007) addresses the major irrigated agriculture issues, but leaves flow protection to voluntary measures, only. These will not likely work to protect and restore the bneficial uses of the basin's water resources (see "Streamflow Issues", above). The NCRWQCB (2007) recognizes that "wetlands can be used to decrease nutrient concentrations." As noted above, the *Klamath TMDL* needs to specifically address riparian wetland restoration along the Keno Reservoir, and to seek similar action in the Lower Lost River, Tule Lake and Lower Klamath Lake sub-basins in order to reduce pollution from the Klamath Straits Drain.

Waiver of waste discharge requirements should not be granted landowners that lack farm or ranch plans that provide water conservation and riparian mitigation strategies. The NCRWQCB (2007)

notes that funds for conservation measures are needed for TMDL implementation. Staff should consider recommending an economic study by NRCS to explore more salmon-friendly and sustainable agricultural methods, such as production of value-added products like organic grains or produce that have low water use requirements.

Fish Diseases

Fish disease studies by Oregon State University (Stocking and Bartholomew, 2004; in press) show that there is a concentration below Iron Gate Dam of the polychaete *Manayunkia speciosa* that serves as the intermediate host for *Ceratomyxa shasta*, the Klamath River's most widespread and virulent fish disease. Linkage between this disease and KHP operations is clear in that:

- Flow regulation below Iron Gate allows the accumulation of fine organic sediment and beds of the algae *Cladophora* to proliferate, providing ideal substrate for *Manayunkia*,
- Spores of *C. shasta* are abundant below Iron Gate Dam as chinook salmon carcasses accumulate because access to upstream spawning areas is blocked, and
- At some times during the year, KHP reservoirs contribute to nutrient pollution in the lower Klamath River that stresses juvenile salmonids and decreases their resistance to disease.

Klamath River salmonids have co-evolved with *C. shasta*, but epidemics are killing hundreds of thousands of juvenile salmonids annually (Nichols and Foott, 2005). The removal of KHP reservoirs could reduce nutrient pollution, permit scour that would reduce *Manayunkia* habitat, enable spawner disbursement, reducing the present concentrated supply of *C. shasta* spores, and allow access to cold water spring areas above the current dam sites.

The *Klamath TMDL* implementation outline (NCRWQCB, 2007) discusses manipulating flows to increase scour, to decrease water temperatures and thereby to reduce disease incidence. The currently available science suggests, however, that it may not be possible to abate the conditions which exacerbate Klamath River salmon disease epidemics without dam removal, and the *Klamath TMDL* make this point clear.

Algae Blooms

(See, also, "PacifiCorp Relicensing", above) KHP reservoirs harbor *Aphanizomenon flos-aquae*, a nitrogen-fixing blue-green algae. The toxic algae *Microcystis Aeruginosa* proliferates in Copco and Iron Gate reservoirs. These reservoirs produce the high concentrations of *Microcystis* observed in the lower river in recent years (Kann and Corum, 2006). The Yurok Tribe Environmental Program (2006) measured microcystin toxins in Klamath River samples all the way to the estuary and even found trace amounts in the liver of steelhead half-pounders.

Recommendations for limits of toxic algae and toxin levels (NCRWQCB, 2007) are appropriate, but control of the problem is not likely feasible without KHP dam removal.

County and State Roads

Counties in northwestern California have been working cooperatively to reduce erosion from their road systems and to improve fish passage at road-stream crossings (Trinity County Public Works, 2003). The *Klamath TMDL* should acknowledge county efforts and specifically recommend funding for defined erosion control efforts consistent with TMDL implementation objectives. The NCRWQCB has already started cooperative efforts with Siskiyou County to reduce erosion from its road network as part of the *Scott River TMDL* (NCRWQCB, 2005a). These efforts should be expanded to include Humboldt County.

Highway 96 parallels the Klamath River and has been a major source of sediment over the years. The TMDL should acknowledge improved practices by CalTrans with regard to hauling sediment from landslides to stable areas, as opposed to the old practice of side-casting debris into the river.

In recognition of the importance of fish access to Middle Klamath River tributary refugia (MKWC, 2007), the *Klamath TMDL* should recommend that CalTrans fix barriers associated with Highway 96, on a priority basis.

Chapter 589, State Statutes of 2005 requires CalTrans to provide CDFG an accounting of fish barriers at State highway crossings throughout the state and an annual update on measure being taken to remediate them. NCRWQCB staff should pursue that initial report (the Tribes have inquired as to its status) and, working with DFG, Tribal biologists and others knowledgeable about Klamath River basin fish barriers, assure that the CalTrans accounting in the Klamath basin is complete and that remediation of Klamath basin barriers is given high priority by CalTrans.

Recovery of Endangered Fishes

The NCRWQCB work plan (2007) identifies coho salmon recovery measures, but does not appear to address other at-risk Pacific salmon species, such as spring chinook salmon. We expect that the final *Klamath TMDL* will adequately address recovery of all Pacific salmon (QVIC, 2006) and sucker species (NRC, 2004). The prospect for full recovery of Pacific salmon to fishable levels that meet Tribal needs are much better if actions are taken swiftly before the Pacific Decadal Oscillation switches to unfavorable ocean conditions and a drier climatic regime (Hare et al., 1999) some time between 2015 and 2025 (Collison et al., 2003).

Salmon stocks may not be recoverable if freshwater habitat restoration is not well advanced before the next switch of the PDO (Collison et al., 2003). TMDL implementation timelines, however, can stretch over four or five decades.

Although not listed under the ESA, the last viable population of spring chinook salmon is in the Salmon River and is at risk of extinction due to extremely low adult returns (Kier Associates, 1999). The original Klamath River meta-population of spring chinook salmon included the upper Klamath, Scott, Shasta and Salmon river sub-populations. Rieman et al. (1993) point out that "the diversity of local populations in variable environments conveys stability to the larger meta-population."

Long term viability of Klamath River spring chinook relies on restoring populations in the upper Klamath, Shasta and Scott rivers in the event that the Salmon River population is lost due to stochastic events or genetic drift (Rieman et al., 1993). KHP dam removal would enable spring chinook access to important thermal refugia in the springs below the current site of J.C. Boyle Dam.

Although the at-risk status of Lost River and short-nosed suckers has been recognized since 1988 (USFWS, 1993), according to NRC (2004) "USFWS and the Ecosystem Restoration Office do not appear to have an operational recovery plan for the two sucker species." The final *Klamath TMDL* should recognize sucker species as water quality indicators in upper basin reaches and provide an expected time-frame for recovery.

Implementation Must Have Wetland Restoration Emphasis

Mayer's (2005) research on nutrient retention in the Lower Klamath Lake Wildlife Refuge suggests that wetland restoration could play a major role in improving Klamath River water quality. The *Klamath TMDL* should endorse the recommendations of Deas and Vaughn (2006):

> "Consider implementing a pilot project to assess organic matter removal potential of treatment wetlands with a small scale project adjacent to the Klamath River or in neighboring areas. Such projects would be invaluable investigations not only into the ability of wetlands to process organic matter, but also to determine the best methods to implement, maintain, and operate such a system."

Deas and Vaughn (2006) focused their analyses on the use of wetlands for organic matter removal, with the primary goal of improving dissolved oxygen conditions in Keno Reservoir. Consistent with their stated goals, Deas and Vaughn (2006) recommended wetlands with a relatively short residence time (i.e., the amount of time that incoming water remains in the wetland before exiting) of approximately four days.

This approach would reduce total nutrient concentrations by removing (settling) nutrients contained in particulate organic matter; however, the use of larger wetlands with longer residence times offers significantly more potential for removing dissolved inorganic forms of nitrogen (e.g. ammonia and nitrate). To achieve these longer residence times, wetlands would have to be larger to treat the same quantity of flow, but their effluent would have greatly reduced nitrogen concentrations. Additional design elements such as open water (not completely vegetated) zones are also necessary to maximize nitrogen removal through denitrification (U.S. EPA 1993; 1999; 2000).

Because wetlands are rich living systems that generate their own internal nutrient loads, relative (i.e. percentage) removal efficiencies of treatment wetlands are most effective when influent concentrations are highest. To illustrate with a hypothetical example, in a municipal wastewater treatment system where influent total nitrogen concentrations are 50 mg/L a properly designed wetland could remove 90 percent of the incoming nitrogen, i.e., resulting in effluent concentrations of 5 mg/L. If influent concentrations were 4 mg/L (typical concentrations at Link Dam in mid-summer), however, then a wetland may only be able to reduce concentrations to 50 percent, i.e, down to 2 mg/L.

For this reason, some people may say that nutrient concentrations are too low in the Klamath River for treatment wetlands to be able to effectively remove nutrients. This may be a concern; however, evidence from other rivers with similar or even lower nutrient concentrations than the Klamath shows that wetlands can, in fact, be effective.

For example, constructed wetlands have been used successfully to reduce nutrient concentrations in the Des Plaines River in Illinois, where nitrogen concentrations are similar to those in the upper Klamath River. Water is diverted from the Des Plaines, routed through constructed wetlands, and then returned to the river (U.S. EPA, 1993). On an annual basis, the wetlands removed 78-95 percent of the nitrate and 54-75 percent of the total nitrogen received (Phipps and Crumpton, 1994).

It is also important to note that due to seasonal climate differences, nutrient removal efficiencies vary at Des Plaines and other wetland systems. Nitrate reductions are highest in summer because de-nitrification (the conversion of nitrate to inert amospheric nitrogen) rates are temperature-driven. In many wetlands, nutrients can be released in the fall when plants senesce, or in spring when decomposition rates increase as temperatures begin to rise (U.S. EPA 2000); however, nutrient release during these periods may not be detrimental because water quality in the Klamath River is less impaired during those times of the year

Monitoring Should Support Adaptive Management

The NRC (2004) pointed out that, despite huge expenditures and numerous restoration programs and restoration groups, that there is no effort toward adaptive management. The final *Klamath TMDL* should explicitly define monitoring activities needed to gauge the success of water pollution abatement efforts, the methods of data storage, and defined time periods for evaluation.

Work Group member Tribes are ready to engage in discussions about long-term monitoring needs.

Deas and Vaughn (2006) recommend monitoring to assess the efficacy of wetland restoration in reducing nutrient pollution, which the *Klamath TMDL* should explicitly endorse.

Work Group member Tribes see the need for a coordinated information system of reliable scientific data to facilitate participatory co-management with state and federal agencies. Member Tribes unsuccessfully sought Prop 50 funds to provide equipment and technical support (Hoopa Tribe, 2005) to provide a hub for updating the Klamath Resource Information System (KRIS). KRIS was created, with SWRCB/NCRWQCB funding, by the Klamath River Basin Fisheries Task Force to gauge restoration success. Likewise, KRIS has been supported by the Trinity River Restoration Program. It would make an ideal mechanism with which to support the tracking of TMDL implementation success.

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Appendix 1

Table 1. Responses to specific components of the Draft Workplan (NCRWQCB). Table derived from NCRWQWCB (2007) with added column for response.

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
Interstate Water Quality	Temperature Nutrients Dissolved Oxygen	State of Oregon Regional Board USEPA 9 and 10 Klamath Tribes SWRCB	• Work with ODEQ to develop MOU to ensure that TMDL loading capacity and load allocations will lead to delivery of water across the OR/CA boundary that meets CA water quality objectives. • Work with Oregon agencies to monitor effectiveness of MOU measures and implementation. • Work with EPA 9 and 10 to coordinate implementation including the Lower Lost River Action Plan.	• ODEQ MOU needs to require specific steps to remediate acute water quality problems in Keno Reach, Lost River, and Upper Klamath Lake and specify monitoring requirements and a time line for meeting WQ standards. • Need full funding for Hatfield Working Group, including science panel monitoring priorities. • Draft Lower Lost River TMDL is anadequate. Needs to be remedied by: 1) restoring ecosystem function by restorating riparian wetlands, channel sinuousity, increasing wetland/lake size by flooding more of Tule and Lower Klamath Lakes, and 2) Use of constructed wetlands to treat Straits Drain effluent.
Point Source Discharges	Nutrients Dissolved Oxygen	Iron Gate Hatchery Tule Lake WWTP Oregon Point Sources Oregon DEQ	• If appropriate, assure numeric effluent limits are incorporated into the NPDES permits to comply with TMDL implementation. • Investigate Oregon Point Sources permits to incorporate needed effluent reductions into the MOU with ODEQ or appropriate agency.	• Should the Straits Drain be treated as a point source?

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
PacifiCorp Relicensing	Temperature Nutrients Dissolved Oxygen	PacifiCorp SWRCB Regional Board ODEQ Tribes BOR NOAA	• Work with SWRCB, ODEQ and other agencies to ensure that the 401 certification and relicensing conditions for the PacifiCorp hydro facilities are consistent with TMDL load allocations. • Develop monitoring plan for implementation measures. • Explore dams' influence on algae blooms and fish disease. • Incorporate flow objective in Pacificorp license.	• 401 consistency is imperative,but there is no reason to believe that KHP impacts to water quality can be fully mitigated. • If clear links to incidence of fish disease and toxic algae blooms are shown and problems cannot be remedied by other than dam removal, the TMDL should so state. • Monitoring plan for implementation related to KHP should include both with and without dam contingencies. • Flows are set by BOR, not PacifiCorp.
Range and Riparian Land Management	Temperature Nutrients Dissolved Oxygen	USFS BLM RCDs Parties responsible for grazing activities Regional Board	• Grazing, Riparian, and Water Management Plan(s) on an as-needed, site-specific basis. • Develop MOUs with USFS and BLM. • Develop/implement rangeland and land stewardship measures that are TMDL compliant • (in general, actions can be similar to Shasta).	• Direct impact to the mainstem Klamath from livestock grazing is localized (e.g. just above Horse Creek and PacifiCorp's Ranch between Copco and Stateline). • Stock water withdrawal on Middle Klamath tributaries could be major issue due to refugia or access for fall chinook. • Riparian easements should be recommended for sensitive private lands.
Flow (timing)	Temperature Nutrients Dissolved Oxygen	USBOR (DWR??) *Water Rights Holders* Irrigators Stakeholders Dam Owners/Operators	• Explore methods to increase cold water flows for the benefit of Klamath River fisheries including impacts on fish disease and toxic algae blooms.	• Protect and restore Middle Klamath watersheds to maintain healthy sediment regime and riparian conditions to protect refugia. • Remove dams to allow access to spring areas upstream of Iron Gate and Copco dams.

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
		SWRCB Water Rights Regional Board	• Ensure NMFS Biological Opinion flow RPA that BOR will implement is consistent with TMDL load allocations.	• Hardy Phase II provides "best science" basis for flow and the river should never be run lower than 1000 cfs under any circumstance.
			• Incorporate Klamath Water Banking program into TMDL where applicable.	• Marginal lands need to be retired through purchase or easements, not subsidized on an annual basis. • Flood lease lands to restore Tule Lake and Lower Klamath Lake: Increase storage, >WQ
			• Work with State Division of Water Rights to establish a flow objective that addresses thermal refugia protection, fish disease, and algae blooms.	• Need to prevent future flow depletion of MK tribs, but solution to disease, algae blooms and refugia access may require KHP removal.

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
Timber Harvest on Private Lands	Temperature	Private Parties Conducting Timber Harvest Activities Regional Board CDF Tribes	• Waste discharge requirements -general or specific, and waivers. • Explore how existing permitting and enforcement programs including Timber Harvest Plan review process (CDF) can be made consistent with TMDL • Habitat Conservation Plan coordination. • Explore ways to close gaps between federal and private timber management and water quality protections. • Explore ways to bring road density and maintenance to a level consistent with TMDL protection of thermal refugia and compliant with sediment prohibitions. • Incorporate Stream and Wetlands policies into THP process. • Explore ways that THP process can be more protective of and enhance thermal refugia and riparian function.	• Getting recognition of private timberland issues in TMDL development is very positive (limits to harvest rates, protection of riparian, limits to road density) • Getting explicit language and action on these thorny issues in the final TMDL may be problematic. • Should consider recommending easements or acquisitions of highly erodible or otherwise sensitive lands. • Enhanced stream and wetland protection is laudible, but cumulative watershed effects can cause major riparian damage and loss of stream habitat diversity. • Needs to specifically identify hydrological alteration due to timber harvest affect water quality, particularly in watersheds with high amount of area in transient snow zone.
Timber Harvest on Public Lands	Temperature	USFS BLM Regional Board Tribes	• Continue cooperatively implementing the joint Management Agency Agreement (MAA) between SWRCB and the USFS (1981). • Develop MOUs with USFS and BLM that address road maintenance and road density in addition to timber harvest BMPs that protect thermal refugia and riparian fxn. • Incorporate future Stream and Wetlands Policy into MOUs.	• Lower Scott River, Walker Creek and Elk Creek are examples of where 1981 MAA has broken down and channel scour in January 1997 flood has caused loss or degradation of refugia. • Need more management that is forest health driven and restores diverse stand age and hydrologic function. • KNF needs to reduce its road network by 2/3 to make annual maintainance feasible.

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
Irrigated Agriculture	Temperature Dissolved Oxygen Nutrients	Irrigation Districts RCDs DEQ BOR BLM Tule and Lower Lake Wildlife Refuges NRCS Private landowners US EPA 9 and 10	• Encourage development and implementation of water conservation practices that improve water quality and increase cold water flows. • Incorporate Rapid Subbasin Assessments developed by NRCS into conservation strategy for irrigated ag. • Explore ways wetlands can be used to decrease nutrient concentrations • Integrate Lower Lost River TMDL Action Plan into Klamath TMDL. • Explore funding options for conservation activities on irrigated ag land. (funding) • Explore how ag waivers fit into implementation strategy.	• Need to recommend to SWRCB that no additional permits be issued in MK tribs unless offsetting conservation measures are implemented. • Address riparian cultivation and diking of mainstem Klamath along the Keno Reservoir. • Need easements for expansion of riparian for water filtration function • Levee setbacks needed to improve filtration capacity and stop non-point source pollution, especially if Keno Dam stays. • Expansion of wetlands and riparian areas on Lost River, Tule Lake and Lower Klamath Lake would increase nutrient stripping capacity and improve Straits Drain water quality problems. It would also have major benefits for suckers, which are also a designated beneficial use.
Fish Disease	Temperature Nutrients	Pacificorp DEQ NRCS RCDs/CRMP Regional Board Tribes USFWS BOR NOAA	• Inhibit establishment of cladophora beds that provide habitat for intermediate host • Connect flows with spread and control of disease • Work with Pacificorp, BOR and NOAA to address factors affecting fish disease. • Incorporate effects on fish disease into Klamath flow objective.	• Assumes connection between scour below Iron Gate and habitat for Manayunkia, but need further data to confirm. • It is likely that lack of flushing flows in spring during years of succcessive drought contributes to fine sediment built up and reduces frequency of scour of algae beds. • Requires re-establishing free-flowing river, access to refugia, and disbursement of spawners, not increasing flow from dams. • Reducing the amount of organic matter in the river (e.g. by reducing pollution from upstream agriculture) should also reduce fish disease.

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
Algae Blooms	Temperature Dissolved Oxygen Nutrients	Pacificorp DEQ NRCS RCDs/CRMP Regional Board Tribes BOR NOAA	• Work with Pacificorp, BOR and NOAA to address factors affecting algal blooms • Incorporate effects on algal blooms into Klamath flow objective. • Explore how pulse or flushing flows contribute to controlling algal proliferation. • Include WHO, SWRCB water quality standards as trigger for health advisories and as an implementation goal.	• Factors affecting algae blooms are Upper Klamath Lake limnology, nutrient contributions from agriculture and biological activity in reservoirs themselves. Reducing nutrients would help, but removing reservoirs also needed. • Flow changes cannot likely reduce algae and nutrient problems. • Should differentiate between phytoplankton (free-flowing algae) and periphyton (attached algae), not just use generic term "algae blooms", as different solutions for each may be required.
County/State Roads	Temperature Nutrients Dissolved Oxygen	CALTRANS Siskiyou, Trinity, Humboldt and Modoc Counties Regional Board	• Evaluate and modify if needed Caltrans statewide NPDES stormwater permit. • Work with counties to ensure road maintenance and construction programs are consistent with TMDLs and grading ordinances are developed and enforced.	• The contruction of highway 96 triggered many landsides, but most have now stabilized. NCRWQCB should ensure that Caltrans continues with policy of not side-casting mterials into the river during road maintenance activities (i.e. clearing landslides). • Mitigation money should be directed at Hwy 96 barrier modification (refugia access) • Good to work with counties on roads (pro-active versus reactive to prevent failures).
Riparian Function General	Temperature Dissolved Oxygen	Parties Responsible for Vegetation that Shades Water Bodies Regional Water Board	• Preserve and restore streamside vegetation providing shade to watercourses. • Regional Water Board to develop mechanisms, e.g., Waste Discharge Requirements (general or specific) or waivers, for addressing shade-providing riparian vegetation.	• This is particularly important on tributaries that serve as refugia. • Biggest threat to riparian function is debris torrents and channel scour. • Need to include cumulative watershed effects prudent risk levels of disturbance for watershed (road densities, percent harvest, disturbance of unstable ground).

Draft Klamath River Nutrient, Dissolved Oxygen, and Temperature TMDL Implementation Plan Workplan Outline for CA				
Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
Septic Tanks	Nutrients Dissolved Oxygen	Counties River communities (e.g., Orleans, Happy Camp, Seiad Valley)	• Ensure that septic systems are not contributing nutrient load to the river.	• Likely more important as human health measure, but still needed.
Technical Support, Outreach and Funding	Temperature Nutrients Dissolved Oxygen	*NRCS* UC Cooperative Extension Regional Board Tribes Local and Regional Watershed Groups	• Increase cooperation to provide technical support, education, and outreach. • Work cooperatively with the NRCS and UCCE on technical support, educational and outreach efforts. • Ensure various funding sources give priority to TMDL implementation projects. • Funding sources: Prop 40, 50, 319(h), EQIP, DFG, NRCS, Tribes.	• Need to make sure that NRCS is mindful that ground water and surface water connections may make pumps a bad investment, if flows for fish are the objective. • Need open sharing of information of how and where NRCS restoration funds are applied. • Make sure that monitoring components are in place to insure that funds spent in the name of fisheries and water quality improvement are working. • Technical support objectives should include information and data sharing.
Coho Recovery	Temperature Dissolved Oxygen	CDFG Regional Board	• Work with CDFG to integrate Coho Recovery Strategy into TMDL. • ITP? Explore w/ CDFG feasibility (and necessity) of drafting-implementing an Incidental Take Permit for listed fish species.	• ITP drafts have substantial major flaws, which if not corrected, would make them counter-productive to TMDL objectives. • Scott and Shasta ITP drafts do not reflect TMDL findings in those basins.

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Gold Mining	Temperature	CDFG New 49ers Regional Board	• Ensure mining activities are protective of thermal refugia and riparian function. • Ensure mining activities are compliant with TMDLs and management goals. • Work with CDFG to update their mining permits to comply with TMDL.	• Protection of refugia from mining is an important issue. • Also need to protect stream banks and prevent non-point source pollution. • Most significant risk is cumulative watershed effects if price of gold continues to climb (will lead to more mining). • USFS cannot turn down mining claims due to 1872 Mining Law, but can ask for mitigation.
Bank Stabilization	Temperature Dissolved Oxygen	Parties Responsible for Bank Stabilization Activities Regional Board	• Encourage planting and restoration of flood control structures on/adjacent to stream banks • Use existing authorities and regulatory tools (401 Water Quality Certification Program, etc.), to ensure proper bank stabilization and vegetation management.	• Issue of riparian function should also address wetland restoration and pulling back dikes along Keno Reservoir to expand wetlands and promote nutrient retention. • We also recommend the use of conservation easements (e.g. to maintain/restore riparian buffers) as an inducement in additon to using a regulatory approach.

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Topic	**Impair-ment**	**Interested Parties**	**Components**	**Tribal Response**
Monitoring and Tracking	Temperature Nutrients Dissolved Oxygen	Regional Board NGOs PacifiCorp USBOR Tribes CDF Timber Harvest operations USFS, BLM CDFG	• Coordinate with tribes and other agencies • Integrate TMDL results into ongoing monitoring • Ensure TMDL implementation is resulting in trend towards meeting load allocations and water quality objectives • Fish disease – spore counts • Algae – WHO and SWRCB standards • Track MOU measures, RCD/CRMP efforts, compliance with waivers and Stream and Wetlands Policy • Include regular reporting to Regional Board • Monitor thermal refugia water quality and functionality including fish counts.	• Specific monitoring strategies expected, including methods, locations and timing. • Link to rates of pollution abatement, with expected timelines, and tiered actions, if water pollution abatement is not achieved. • Monitoring should have two contingencies, with dam removal and without dam removal. • TMDL Implementation Plan should include description of potential collaboration with Tribes and local NGOs for data acquisition. • Restate need for mechanism for data sharing mechanism for adapative management (e.g. KRIS). • Require data transparency (provision of raw data) from RCDs and CRMPs.