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April 4, 2006

Catherine Kuhlman, Executive Officer
North Coast Regional Water Quality Control Board
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403

Dear Ms. Kuhlman,

The Quartz Valley Indian Community of Quartz Valley Indian Reservation (QVIR), with the assistance of our consultants Kier Associates, have reviewed the public draft version of the North Coast Regional Water Quality Control Board's (RWB) Staff Report for the *Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads* (Shasta TMDL).

The Tribe hopes that the Shasta TMDL will result in measurable and timely improvements in the water quality of the Shasta River watershed. Please realize that QVIR is the only federally recognized, sovereign tribal government in Siskiyou County. The consideration that the Board gives to our comments should be representative of this fact.

We appreciate the efforts of your staff in the creation of this document. The Board and its Staff should be well aware of QVIRs position on the Shasta River TMDL.   Please find attached the official comments of the Quartz Valley Indian Reservation regarding the Shasta River TMDL and Implementation Plan.

The QVIR supports the concept of the TMDL. The Tribe would like to see the Shasta River Watershed restored to historical healthy and sustainable conditions. We do have some concerns with the draft document and question some of the implementation approaches, however, we feel overall that the Shasta TMDL is a good place to begin with action towards restoring the historic water quality of the Shasta River Watershed.

We understand the Regional Board has limited staff and funding, therefore we would like to provide assistance by being involved in the implementation of the Shasta TMDL and working on a government to government basis with monitoring and restoration. Additionally, the Tribe would like to be a party in the suggested Memorandums of Understanding between federal agencies and the Regional Board.

I would like to stress the Tribe's sentiment that the state of the Shasta Watershed needs immediate attention and action. We have seen populations of coho, Chinook, steelhead, and lamprey severely decline in the Shasta Watershed. To us, water is life. We are concerned about the future of our lives and call upon the North Coast and State Water Boards to protect and heal this watershed.

Attached, you will find technical comments and recommendations. Please contact myself or my environmental staff at 530-468-5907 for further information or clarification on the issues discussed.

Thank you,

Harold Bennett
Vice Chairman

Quartz Valley Indian Reservation has reviewed the public draft version of the North Coast Regional Water Quality Control Board's (RWB) Staff Report for the *Staff Report for the Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads* (Shasta TMDL).

Following the summary immediately below, detailed comments which correspond to the particular Scott TMDL subjects are provided (some of the comments are applicable to several sections of the TMDL). Where subjects were not addressed by the RWB staff we have inserted discussion where such matters would fit, had they been addressed. Insignificant issues such as typographic/grammar errors are included as Appendix A.

SUMMARY OF COMMENTS

Overall, the technical analysis in the Shasta Dissolved Oxygen (D.O.) and Temperature TMDL uses sound logic, has good supporting graphics, and uses standard models that have been previously used in the basin. The models are transparent and their assumptions are clearly stated and for the most part well supported. The Shasta TMDL recognizes that increasing flows is an important action needed to remediate water temperature problems, which is both scientifically accurate and commendable.

There are several ways in which the technical portion of the TMDL could be improved. First, there is no discussion of pH in the TMDL, despite the fact that pH values in the mainstem often exceed *Basin Plan* objectives (NCRWCB 2001), are high enough to be stressful to salmonids, and have similar causes as the dissolved oxygen issue. Second, the TMDL repeatedly refers to nutrient sources (such as from tailwater returns and Dwinnell Reservoir) as problems because of contributions to nitrogenous biological oxygen demand (NBOD), when NBOD is in fact only a small part of the oxygen demand in the Shasta River. The real problem with those nutrient sources, which the TMDL repeatedly overlooks, is the total amount of nitrogen (in all forms) contained in those nutrients sources and its stimulation of aquatic plant growth. This occurs throughout the Staff Report and the *Basin Plan* amendment language, and should be corrected.

A more holistic watershed focus is another way in which the TMDL could be improved. Partially due to the model-centric focus of the TMDL, the Shasta River is treated as a 40 mile trunk without functional tributaries. Flow data from the *Appropriation of Water Rights in the Shasta Basin* (CADPW, 1932) contained in the TMDL show that all tributaries had surface flow and were functional parts of the Shasta River, but there is no mention of restoring connectivity. Pollution from reaches of streams like upper Parks Creek are not recognize because they are not part of the model, although Parks Creek is connected to the Shasta River during major storms. Water quality issues within Lake Shastina (aka Dwinnell Reservoir) are described, but the benefit of removing the dam for abating temperature and nutrient pollution is not discussed. It should be noted here that NRC (2004) recommends consideration of removal of Dwinnell Dam.

A summary of our comments regarding implementation is included below as Table 1 (patterned after Table 4 of the Basin Plan amendment language). The water quality compliance scenario in temperature TMDL includes a 50% increase in flow from Big Springs Creek. We strongly support that decision; however the TMDL implementation does not lay out a clear path for how such a substantial increase in flow could be achieved. The RWB proposes to take no action to increase flows to improve water quality for five years, which seems like a long wait given the stock status of Klamath River salmon (Kier Associates, 2006); we think two years would be a more reasonable amount of time. Implementation relies heavily on voluntary measures, although adjacent language stressing the Regional Water Board's (RWB) ability to follow up with enforcement is reassuring. The implementation plan proposes good ideas for how to manage tailwater return flows, riparian areas, and rangelands. The discussion of urban and suburban runoff does not contain any language regarding planning or design, an oversight that should be corrected.

The Shasta TMDL does not set a clear monitoring program, leaving it until a year after TMDL approval. It would seem wise to encourage continuation of specific on-going monitoring efforts of relevant parameters before the more comprehensive plan is drafted.

DETAILED COMMENTS

Chapter 1: Introduction

On the whole, the introductory chapter is visually appealing and highly informative.

<u>1.4 Watershed Overview</u>
The Watershed Overview section (1.4) has maps that give the reader excellent geographic reference, but also convey rainfall patterns, geology, vegetation and location of modeling reaches. Hydrology and flow (1.4.5) are also clearly laid out in this section, including powerful summary charts. Discussion of riparian (1.4.7.1) reveals interesting information specific to the Shasta River that is useful for understanding model parameters in later chapters. Sections on historic and current land use (1.4.8) help frame the problem in a longer term continuum.

<u>1.4.10 Anadromous Fish of the Shasta River Watershed</u>
The section on fisheries (1.4.10) is thorough and there are useful charts that summarize data on fall chinook, coho and steelhead trout. Although data on steelhead and coho are sparse, the Shasta TMDL should state explicitly that life history requirements of these species make them more vulnerable to water quality problems. Consequently, coho and steelhead populations are likely to have declined more than fall Chinook salmon, which do not require extended freshwater rearing.

Although the TMDL makes no mention of it, Pacific salmon populations are effected changing ocean productivity and patterns of precipitation. The Pacific Decadal Oscillation (PDO) cycle causes major shifts in ocean productivity and conditions seem to shift from favorable for salmon to unfavorable approximately every 25 years. Good ocean conditions for salmon off the California and Oregon Coast prevailed from 1900-1925 and 1950-1975 and switched to favorable again in 1995 (Hare et al., 1999). The good ocean cycle is usually associated with increased rain and snow fall. Poor ocean cycles from 1925-1950 and 1976-1995 were associated with dry on-land cycles.

The Chinook salmon population of the Shasta River is showing a long term decline (Figure 1) that does not bode well for long term survival. The population is failing to rebound despite recent average and above average rainfall years and mostly favorable ocean conditions. Collison et al. (2003) point out that PDO conditions will switch back to negative ocean and dry on land sometime between 2015 and 2025 and that, if freshwater habitat conditions have not improved by that time, stock losses are likely to occur. Shasta stocks ranged from 533-726 from 1990-1992 during the last dry climatic cycle, a critically low level (Gilpin and Soule, 1990). The final Shasta TMDL should cite the findings of Hare et al. (1999) and use it as a reason for urgency of to move forward on a TMDL Implementation Plan.

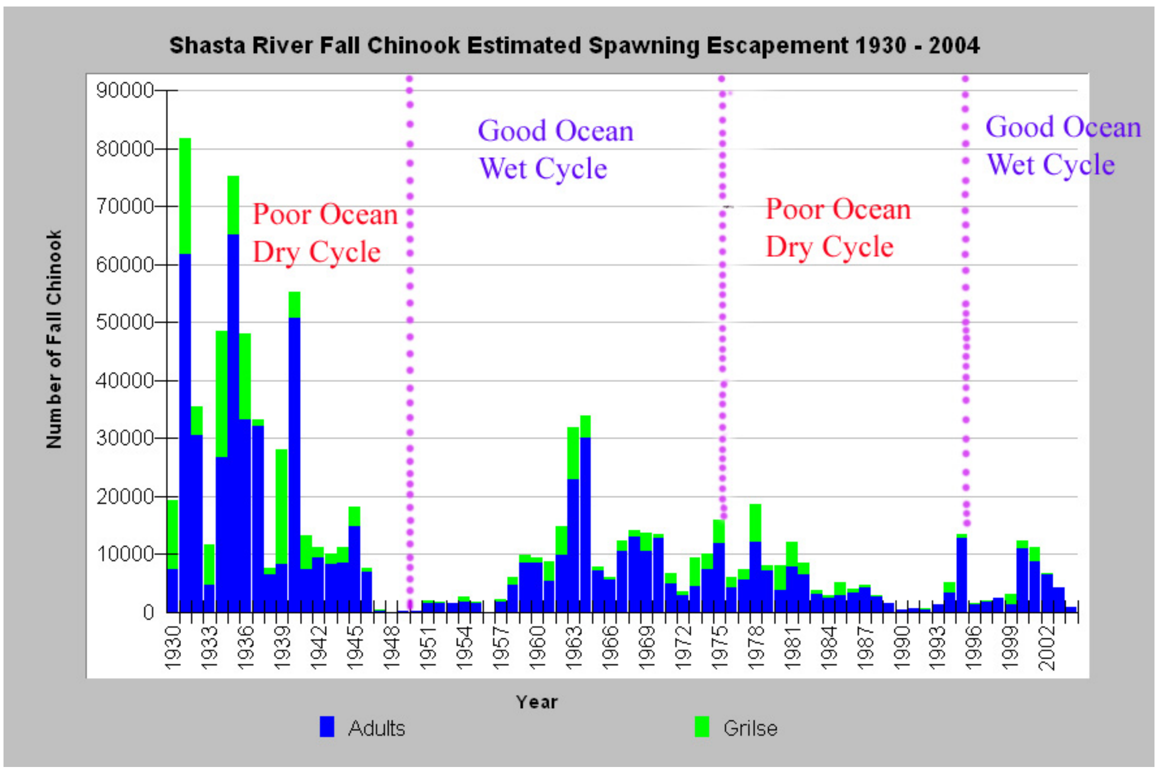

Figure 1. Shasta River Chinook salmon returns from1930 to 2005 are displayed in this chart along with known Pacific Decadal Oscillation cycles (Hare et al., 1999).

The Shasta TMDL does not address the October 1 deadline for shutting off stock water and increasing stream flows for fish passage. Snyder (1931) noted that fall Chinook salmon entered the Shasta River in September. Fish now delay their migration until after October 1 because of lack of sufficient flow and associated warm water temperatures (Figure 2). This delayed pattern of entry into the Shasta River is manifest in both wet and dry years (Figure 3). Fall chinook forced to sit for weeks in stressful Klamath River conditions likely have reduced fecundity. This intensive selection pressure likely selects for later run timing. For discussion of similar impacts caused by Iron Gate Dam on mainstem spawning Klamath River fall chinook, see Kier Associates (2006).

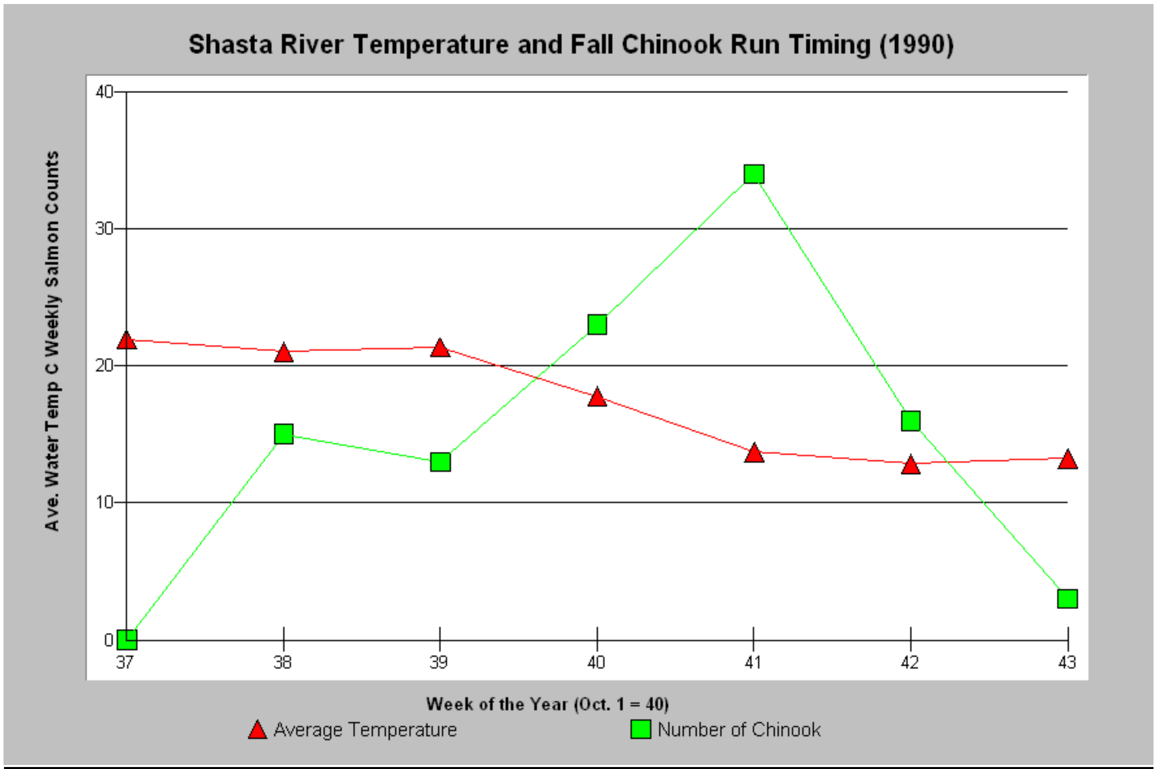

Figure 2. Increased flows with the end of stock water season decreased water temperature and triggered increased fall Chinook salmon migration into the Shasta River.

1.4.10.5 Habitat and Fish Distribution

The distribution map (Figure 1.16) showing very limited range for steelhead likely is conservative, with steelhead very likely occurring in Parks Creek at least during high flow years. A map showing gradient would be useful to judge the former range of coho salmon, spring chinook and steelhead. Expanding habitat toward historical range under TMDL Implementation would substantially improve prospects of long term Pacific salmon species population viability and stability.

The fish distribution map indicates that Big Springs is not currently salmonid habitat yet the California Department of Water Resources (1981) *Klamath and Shasta River Spawning Gravel Enhancement Study* showed a huge concentration of fall chinook spawning Big Springs Creek. This is a tangible indication that Big Springs Creek was a major refugia for Pacific salmon in the early 1980's before reduction of flows due to ground water pumping. Figure 4 shows riparian destruction in lower Big Springs Creek and the adjacent reaches of the Shasta River that would also degrade fish habitat and lead to thermal pollution (Kier Associates, 1999).

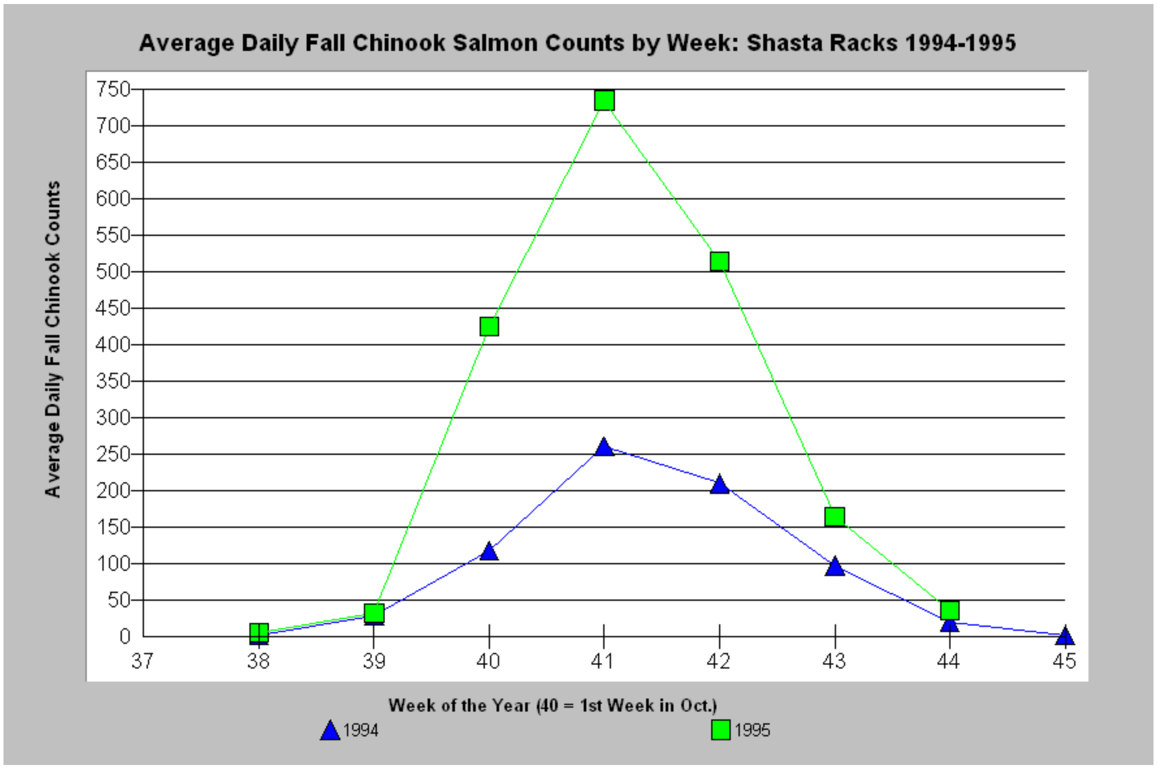

Figure 3. Fall chinook in 1994 and 1995 waited until the first week in October to move into the Shasta River because of increased flows at the end of the stock water season.

Figure 4. This photograph shows heavy equipment and excavation in the riparian zone of the Shasta River above Louie Road just upstream of the convergence with Big Springs Creek in January 1995. From Klamath Resource Information System V 3.0 (TCRCD, 2003).

Chapter 2: Problem Statement

2.2.2 Water Quality Objectives:
Table 2.2 "Narrative and Numeric Water Quality Objectives applicable to the Shasta River basin TMDLs" should also include the *Basin Plan* water quality objectives for pH in the Shasta River. While the Shasta River is not officially listed as pH impaired, summer pH values in mainstem Shasta River are extremely high (>9.5), and are unequivocally related to nutrients and D.O.

The lack of analysis of pH in TMDL is troubling, and deserves correction, for several reasons. First, pH directly affects salmonids, with pH levels above 8.5 being stressful and pH 9.6 being lethal (Wilkie and Wood 1995). For a more complete review of the effects of pH on salmonids, see Kier Associates (2005a). Second, ammonia toxicity increases with pH (U.S. EPA 1999). Third, high maximum pH and high diurnal ranges of pH are often symptomatic of nutrient enrichment and excessive growth of aquatic plants, which makes pH a highly useful index of photosynthesis. As described in Chapter 4, the primary cause of the low dissolved oxygen problems in the Shasta River is excessive respiration by aquatic plants. Analysis of pH data is a valuable tool to help understand the spatial and temporal dynamics of D.O. and nutrient impairment.

The mouth of the Shasta River has been monitored with automated water quality probes since 2000. Data from 2000-2004 show that maximum pH typically exceeds the *Basin Plan* objective of 8.5 for most days from June through September (Figure 5). TMDL Appendices A and C contains continuous pH data from other sites in the Shasta River. Goldman and Horne (1983) note that at pH of over 9.5 that all ammonium ions would be converted to dissolved ammonia, which is highly toxic to salmonids. These pulses of extreme pH occurred in seasons of downstream juvenile migration (June 2002) and during periods when adult Chinook salmon may be holding (September 2001) downstream of the mouth of the Shasta in the Klamath River.

2.3.1 Temperature Requirements of Salmonids
It is our opinion that this section presents the best available science, including from U.S. Environmental Protection Agency (2003).

2.3.2 Temperature Conditions of the Mainstem Shasta River
This section presents colorful and useful graphics (i.e. Figure 2.1) that show the seasonal variability versus life history requirements, duration of stressful conditions and the temperature profile of the river from Dwinnell Dam to the convergence with the Klamath River.

The TMDL states on page 2-12 that "Weekly maximum temperatures exceed the spawning, incubation, and emergence threshold (i.e. MWMT of 13°C) at all Shasta River reaches from April through June, and during the second half of September." An examination of Figure 2.1 shows that to be incorrect because temperatures are above 13°C until mid-October, not September. This should be corrected.

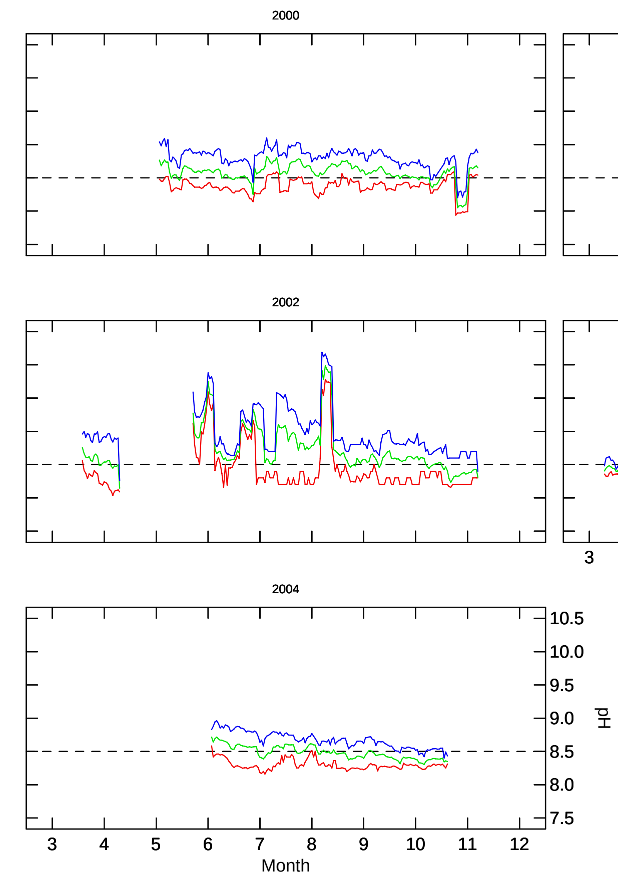

Figure 5. Daily minimum (red), average (green) and maximum (blue) pH for the Shasta River near its mouth (site SH00) for the years 2000-2004 with a reference values showing the NCRWQCB (2001) maximum pH standard of 8.5. Data are from the *Klamath TMDL* database, with data originally collected by the U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and USGS. [2002 is actually a collection of two datasets].

2.5 Biostimulatory Substances:

pH should also be specifically mentioned in this sentence on page 2-24, "In this context for the Shasta River TMDL, Regional Board staff define nuisance aquatic growth as that which contributes to violation of numeric water quality objectives (particularly dissolved oxygen) or adversely affects beneficial uses."

2.5.1 Nutrient Criteria and Trophic State Thresholds

This section of the TMDL should mention that site-specific data analyses are required to set meaningful nutrient criteria (Tetra Tech, 2004).

We recommend that this section start with this paragraph:

> "Nutrients do not directly affect salmonids, but impact them indirectly by stimulating the growth of algae and aquatic macrophytes to nuisance levels that can adversely impact dissolved oxygen and pH levels in streams. The concentration of nutrients required to cause nuisance levels of periphyton

varies widely from one stream to another. Detailed data analysis is required to determine relationships. U.S. EPA (2000) and Tetra Tech (2004) provide excellent summaries of the literature on these analytical methods and will not be repeated here. Such analyses have not yet been conducted on the Shasta River, so in this section we discuss national (USEPA 1986), regional (USEPA 2002), and international (Dodds et al. 1998) literature."

The Dodds et al. (1998) reference is relied upon far too heavily, perhaps even misapplied, in this section of the TMDL. The trophic categories in Dodds et al. (1998) were derived from looking at the distribution of nutrient concentrations in many streams and then arbitrarily dividing them up into three statistically equal categories; they are not based on any type of ecological functionality.

EPA (2000) provides the following cautionary note about Dodds et al. (1998):

> "It should be stressed that this approach proposes trophic state categories based on the current distribution of algal biomass and nutrient concentrations which may be greatly changed from pre-human settlement levels."

In other words, it is likely that the population of streams used by Dodds et al. (1998) are skewed towards more impaired streams, thus the nutrient concentrations for the trophic boundaries are skewed high. In particular, the 0.7 mg/L total nitrogen value presented by Dodds et al (1998) as the oligotrophic-mesotrophic boundary is highly suspect. Note that USEPA's (2002) recommended ecoregional nutrient criteria for total nitrogen is 0.12 mg/L, more than 5 times lower than the 0.7 mg/L from Dodds et al. (1998). Based on analysis of nutrient, pH, D.O., and periphyton data in the Klamath, Trinity, and Salmon Rivers, Kier Associates (2005a) recommended a total nitrogen criteria of 0.2 mg/L for the lower Klamath River.

As noted above, the nutrient concentration required to cause impairment in a stream varies widely according to many factors, thus the more specific the analysis the better. Thus, we cannot see any justification for the TMDL to use the numbers presented Dodds et al. (1998) derived from across North America and New Zealand, rather than the USEPA (2002) criteria derived from data in Nutrient Ecoregion II (Western Forested Mountains) of the western United States. We recommend that both Dodds et al. (1998) and USEPA (2002) remain in the literature review presented in 2.5.1, but that when analyzing Shasta River nutrient data in section 2.5.2 (Shasta River Watershed Nutrient Conditions), the USEPA (2002) recommended criteria should be used instead.

<u>2.5.2 Shasta River Watershed Nutrient Conditions</u>
<u>2.5.2.1 Total Phosphorus</u>
On page 2-28, the following statement is made:

> "Downstream of the headwaters, Beaughton and Boles Creeks enter the Shasta River from the west and flow through the phosphorus rich volcanic soils flanking Mount Shasta. This is reflected in the high total phosphorous values in these creeks with averages of 0.192 and 0.119 mg/L respectively."

The land use map (Figure 1.12) clearly indicates that the watersheds of Beaughton and Boles Creek contain an urbanized area around Weed that may also be a substantial contributor to phosphorus concentrations. Development is widely recognized to increase nutrient concentrations in streams (U.S. EPA, 2000). While we agree that the high phosphorus concentrations in Beaughton and Boles Creek are likely due in part to natural geology, they are also likely exacerbated by land use, and this should be acknowledged in the TMDL.

<u>2.5.2.2 Total Nitrogen</u>
As noted above in comments on Section 2.5.1, Shasta River nutrient data should not be compared to Dodds et al. (1998), but to USEPA (2002).

In regard to Beaughton and Boles Creek, page 2-29 of the TMDL states "Although total phosphorus levels are high in these tributaries, total nitrogen levels are generally low." We disagree with this assertion; nitrogen concentrations in Boles Creek are high. The TMDL should also recognize that the form of nitrogen is also important (as inorganic forms of nitrogen such as ammonia and nitrate are available to immediately stimulate plant growth). While total nitrogen at Boles does lie slightly below Dodds et al.'s oligotrophic-mesotrophic boundary, nitrate plus nitrite concentrations are very high. We suggest the following revision. Replace "Data from Boles creek generally reflect oligotrophic conditions, with average total nitrogen measuring 0.69 mg/L." with "Data from Boles creek indicate that total nitrogen there are higher than Beaughton Creek, with average total nitrogen measuring 0.69 mg/L, far above USEPA (2002) recommended nutrient criteria of 0.12 mg/L. Additionally, inorganic forms of nitrogen were high, with nitrate plus nitrite nitrogen ranging from 0.360 to 0.560 and an average of 0.493."

The statement "Total nitrogen values in springs are generally within the mesotrophic boundary" (p 2-30) is inconsistent with the rest of the nutrient discussion. The statement should be changed to "Total nitrogen values in springs are several times higher than the USEPA (2002) recommended ecoregional criteria."

Little evidence is provided to support the statement that "Maximum total nitrogen levels in the mainstem Shasta River increase in a downstream direction." Table 2.8 provides total nitrogen data on the Shasta River near the headwaters, Shasta River above Dwinnell, and then lumps all mainstem sites below that as "Shasta River below Dwinnell Dam." To support that statement, the sites below Dwinnell Dam should be analyzed individually. Appendix B of the TMDL contains USGS and RWB data from 2002-2003 indicating that the patterns at sites below Dwinnell Dam are complex and that analysis of the data is confounded due to the use of a laboratory with inadequate detection limits for Kjeldahl nitrogen.

<u>2.6.3 Potential Municipal and Domestic Water Supply and Contact Recreation Impairment</u>
Discussions of Dwinnell Reservoir in Section 2.5.2 note increased nutrients as compared to reaches of the Shasta River above, but do not mention the role of the nitrogen-fixing blue green algae *Anabaena flos-aquae* as one of the sources of nutrient pollution (though it is later

in the document in Chapter 4). *Anabaena flos-aquae* is correctly noted in the text to be a producer of anatoxins.

Chapter 3: Temperature Source and Linkage Analysis

3.1.1 Stream Heating Processes
This section presents a good description of how the Shasta River warms.

3.3 Stream Heating Processes Affected by Human Activities in the Shasta River Watershed
3.3.2 Shade
On page 3-6, there is discussion of a reach at river mile 37.3 shown in Figure 3.2 where the riparian vegetation noticeably changes from sparsely vegetated to densely vegetated, coincident with a 4 degree drop in temperature. It seems unlikely that riparian vegetation would rapidly cool temperatures by 4 degrees C. As Dr. Coutant points out in the peer-review (Appendix I) another possibility is that hyporheic exchange cooled the water. For details, see our comments under 3.3.7, a new section that we request be added to the TMDL.

3.3.3 Tailwater Return Flows
The attribution of warming in Big Springs Creek to diversion and agricultural return water is correct, although less than optimally illustrated by the TIR image presented (Figure 3.6). Page 3-8 states that "…Big Springs Creek, where a tailwater return flow was 9.2°C warmer than the creek and caused a plume of hot water that extended for hundreds of meters (Figure 3.6)." We have examined this figure closely, and do not see the effect described. We are unable to determine if the effect does not exist, or if it is problem with image quality.

3.3.4 Flow and Surface Water Diversions
The Shasta TMDL does not present the thermal evidence (Watershed Sciences 2004) that flow depletion is causing stream warming in tributaries Parks Creek and the Little Shasta River. Data and TIR images show temperature oscillations in Parks Creek and the Little Shasta River that indicate these streams warm as their flows are depleted (Figure 6). Kier Associates (2005b) described a similar effect on Shackleford Creek in the Scott River. Diversion also completely dries up reaches that would otherwise be suitable habitat for salmonids (Figure 7). Changing patterns of diversion on lower Parks Creek would provide a cold water reach connected to the mainstem Shasta River that could serve as a refugia for juvenile salmonids.

U.S. EPA (2003) points out the need to protect and restore well distributed refugia when other factors confound meeting temperature requirements of salmonids in mainstem environments. Hydrologic connectivity of Parks Creek is also needed for spawning gravel recruitment in the Shasta River below Dwinnell Dam. Kier Associates (1999) noted that: "Without a change in winter flow regimes to allow increased gravel supply from Parks Creek to enter the Shasta River, long-term depletion of spawning gravels for salmon and steelhead is inevitable."

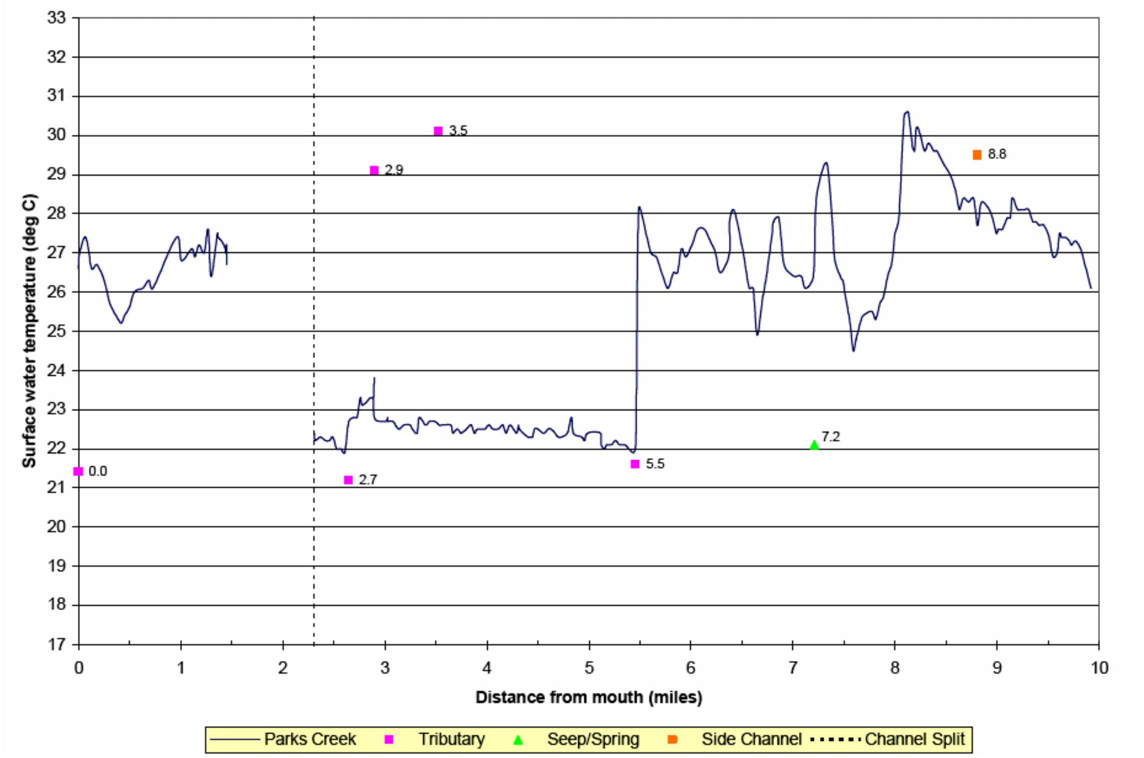

Figure 6. This temperature profile of Parks Creek from Watershed Sciences (2004) shows that at the top of the monitoring reach, water temperatures are already elevated by upstream diversions. Spring flows feed the stream above river mile 5 (RM 5) and cool it, but diversions dry the channel just above river mile 2 (RM 2.3).

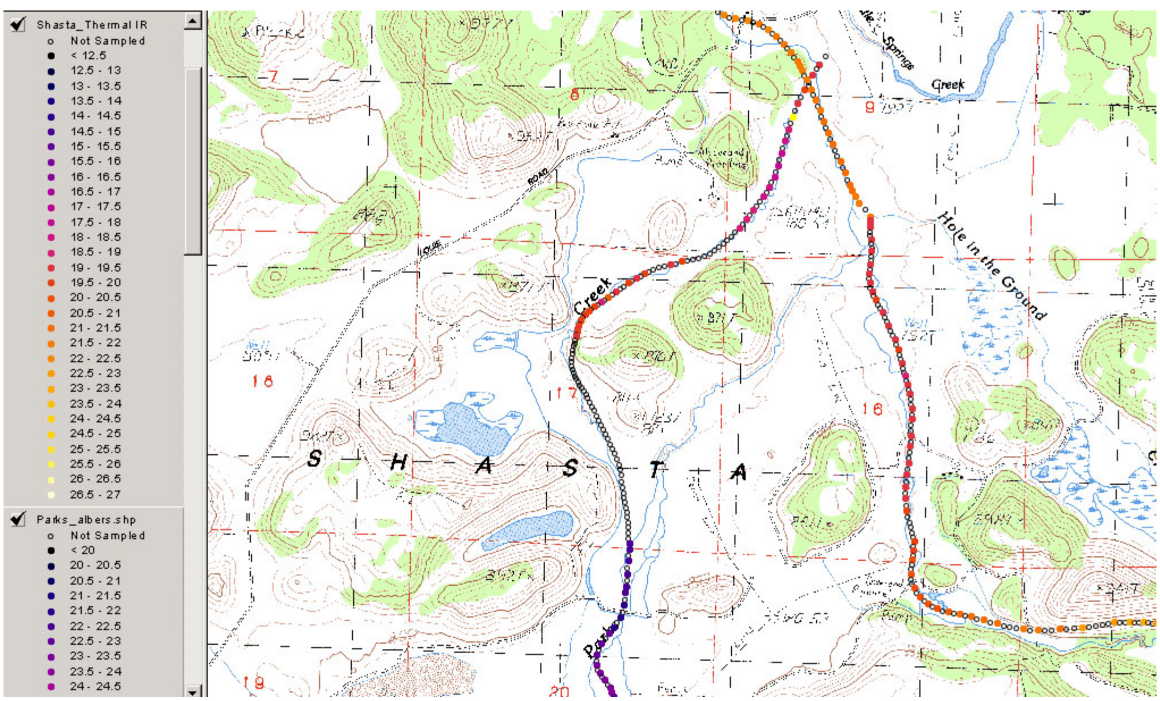

Figure 7. Thermal Infrared radar (Watershed Sciences, 2004) of lower Parks Creek. Stream is cold enough for salmonids but drained by diversion before reaching the Shasta River.

3.3.5 Groundwater Accretion / Spring Inflows
This section of the TMDL contains good discussions of why groundwater accretions and spring inflows are important to water temperatures in the Shasta River; however, it does not note that groundwater accretions and spring inflows are not included in the TMDL's water quality model.

Table 6 in Appendix D shows the "Hydrodynamic input locations and types" (e.g. the locations of types of inflows and outflows included in the models). The only specific inputs included were Parks Creek (rm 34.94), Big Springs (rm 33.71), and Yreka Creek (rm 7.88). Other inflows are included as distributed inflows. As noted in Appendix D, temperatures for "all accretions between GID and Anderson Grade" (that reach covers most of the mainstem Shasta below Dwinnell Dam) were assigned the temperature of the Shasta River at Anderson Grade. In other words, it appears as though all springs and groundwater accretions, such as the spring shown in figure 3.9, were assigned Shasta River water temperatures. This seems problematic as the springs are much cooler than the Shasta River water.

3.3.7 Hyporheic function
We propose that a short section on hyporheic function be added here.

Connection of surface water to these sub-surface waters is recognized as having a potential cooling influence (Poole and Berman, 2001; U.S. EPA 2003). It is important to note that this is a different mechanism than springs or groundwater accretion. It is not "new" cool water that dilutes the warm river water, but rather that warm river water enters the sand/gravels of the hyporheic zone and then re-emerges cooler, with no net effect on the amount of water in the stream. While magnitude and distribution of this effect in the Shasta River is unknown, it may be significant (and likely the cause of the cooling described in section 3.3.2 and shown in Figure 3.2). As Dr. Coutant mentioned in his review, the model could potentially simulate this effect:

> "For hyporheic flow, if you have some idea of the rate of flux in and out of the gravel, you could treat the flux into the gravel as withdrawal from the stream (water of ambient quality) and replace it downstream with distributed inflow representing the flux out of gravel (with water quality of the hyporheic flow)"

As noted by Dr. Coutant, failing to include this mechanism in the model may result in an over-estimation of the effect of shade. We recognize that the Regional Water Board will be reticent to conduct additional modeling work at this stage of TMDL development, but as research in the Shasta River continues this should be conducted in the future.

A major problem in the Shasta River that may have disrupted hyporheic function is the mining of hundreds of thousands of yards of gravel from the Shasta River when highway Interstate 5 was built (Kier Associates 1991). Virtually all alluvium was removed and replenishment is blocked by Dwinnell Dam and by de-watering of tributaries that formerly contributed both water and gravel to the mainstem (Kier Associates, 1999). Restoring connectivity of tributaries with the mainstem could increase spawning gravel supply and ultimately recreate some hyporheic function as well.

3.3.8 Timber harvest

We propose that a short section on timber harvest be added here.

Timber harvest activity in upper Parks Creek (Figure 7) is likely having similar effects as in the Scott River, described by Kier Associates (2005b). Logging in rain-on-snow prone watersheds leads to increased sediment yield and peak discharge that in turn widen stream channels and contribute to increased water temperature. Although the introduction of the *Shasta TMDL* mentions logging as an historic activity, it appears active in upper Parks Creek. Lingering cumulative effects, such as high road densities, skid roads and early seral forests, are likely triggering increase sediment yield, increased flood flows and decreased summer base flows. Kier Associates (2005b) pointed out that dry upland forest sites may require decades for recovery due to slow tree regeneration, causing an extended window of cumulative watershed effects related to flow.

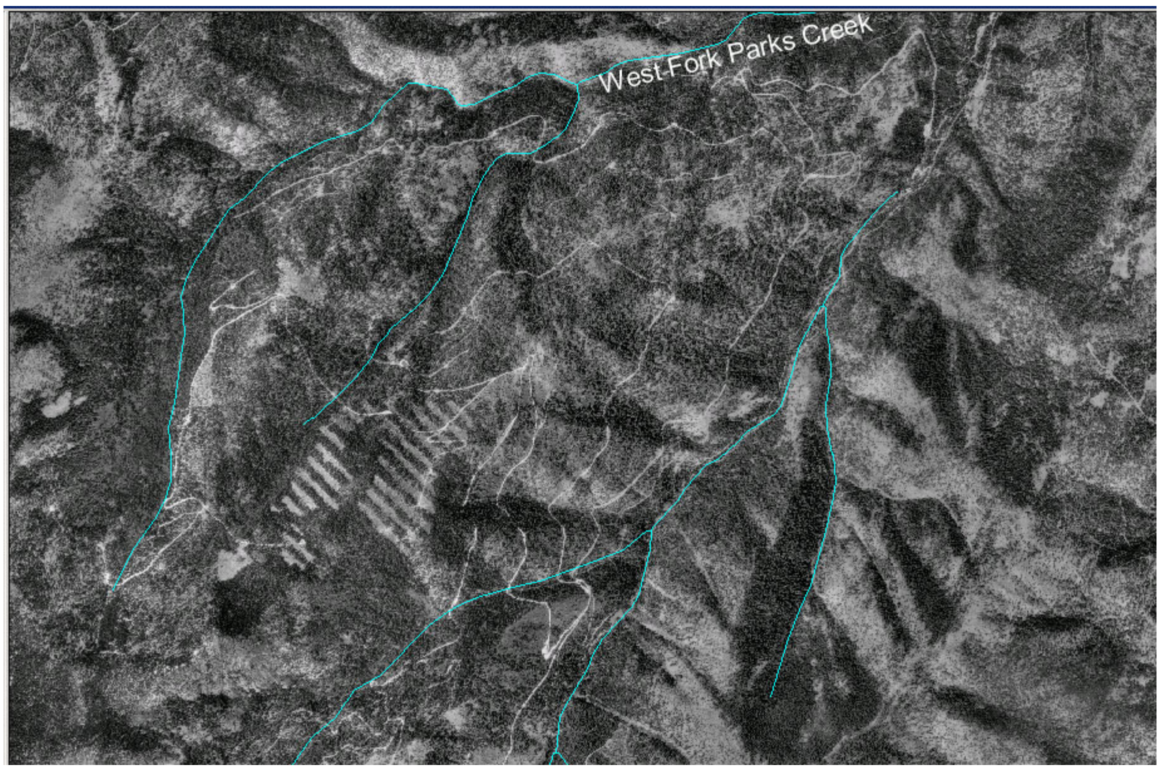

Figure 7. An orthophoto quad image of upper Parks Creek shows high road densities, numerous skid trains and clearcuts.

Chapter 4: Dissolved Oxygen Source and Linkage Analysis

4.3 Processes Affecting Dissolved Oxygen Concentrations in the Shasta River Watershed

The third paragraph of section 4.3 on page 4-3 (beginning with "Though…") should be revised. Characterizing Shasta River biological oxygen demand (BOD_5) as "relatively low" in comparison to raw sewage and hyper-eutrophic Upper Klamath Lake is not at all appropriate. As coldwater salmonid habitat they are much higher than optimal. We do agree that Shasta BOD_5 concentrations are low in the sense that they are not the major factor driving D.O. dynamics in the Shasta River. We suggest that paragraph should be replaced with the following revision:

> "Though the data are limited, BOD_5 concentrations (a measure of carbonaceous deoxygenation in the water column) in the Shasta River indicate that carbonaceous oxygen demand exerted in the water column is only a minor component of the total oxygen demand in the Shasta River. BOD_5 concentrations in the Shasta River range from 1.0 to 15.0 mg/L, with an average of 2.1 mg/L. For comparison, biochemical oxygen demand concentrations in the Klamath River near the outlet of hyper-eutrophic Upper Klamath Lake range from approximately 5 to 25 mg/L. Also for comparison, a typical biochemical oxygen demand concentration of untreated domestic sewage in the United States is 220 mg/L (Chapra 1997, p. 358)."

<u>4.3.3.2 Factors Affecting Aquatic Vegetation Productivity in the Shasta River</u>
Biggs (2000) is the best reference regarding periphyton growth, and should be cited in this section. The following sentence should be added to the end of the first paragraph of this section on page 4-11: "Biggs (2000) provides a comprehensive review of the factors affecting periphyton growth."

Flow and Current Velocity
The statement on page 4-12 "In addition, when a scour-event washes the vegetative material out of the Shasta system, there is a decrease in the oxygen demand exerted on the river" should be followed by a mention of how this might affect the Klamath River. We suggest the following: "However; it should be noted that this material could potentially have negative consequences downstream in the mainstem Klamath River, depending upon the time of year and if it settled out or kept moving out to the Pacific Ocean."

Nutrient Concentrations
The last paragraph in this section (beginning with "Section 2.5 provides an overview of trophic status boundaries associated with nutrients…") contains numerous references to trophic boundaries based (apparently) on the Dodds et al. (1998) reference. As explained above in comments on section 2.5.1s, the trophic boundaries presented in Dodds et al. are arbitrary and do not have much relevance to the Shasta River, so this section should be revised to reference ecoregional criteria from USEPA (2002) instead of Dodds et al.

<u>4.4 Anthropogenic Effects on Shasta River Dissolved Oxygen Conditions</u>
<u>4.4.1 Tailwater Return Flow Quality</u>
The most important mechanism by which tailwater returns affect D.O. is not included in the bullets on page 4-15, an omission which deserves correction. Tailwater returns are increasing nitrogen levels in the Shasta River, which can increase growth of aquatic plants.

As shown in Chapter 7, respiration of aquatic plants, stimulated by high nutrient levels, is by far the largest contributor to dissolved oxygen demand in the Shasta River. While it is worthwhile to mention that tailwater returns do increase nitrogenous oxygen demand of the Shasta River, the most significant effect of tailwater on oxygen demand is to increase total nitrogen levels and stimulate aquatic plant growth. We recommend that a new second bullet be added:

> "The average total nitrogen concentration of tailwater return flows is over two times that of the average Shasta River concentration during the irrigation season (*XX and XX [fill in the appropriate values]* mg/L, respectively). This increase in nitrogen stimulates the growth of aquatic plants, substantially contributing to oxygen demand by increasing respiration."

Also, table 4.3 should also include total nitrogen calculated from individual samples as NO3+NO2 + TKN.

<u>4.4.3 Lake Shastina and Minor Impoundments</u>

This section does not mention two of Lake Shastina's most important effects on oxygen demand in the Shasta River:

> 1. Shastina reduces peak flows, allowing organic matter and fine sediments to accumulate in the channel, contributing to oxygen demand via macrophyte respiration, and
> 2. Shastina increases nitrogen concentrations, stimulating aquatic plant growth and hence contributing to oxygen demand via macrophyte respiration.

We recommend the following text be added in a new paragraph at the bottom of page 4-19 (after "…may occur in the Reservoir"):

> "As discussed above in section 4.3.3.2, Lake Shastina substantially reduces scouring peak flows. This allows organic matter and fine sediments to accumulate in the channel. These are the preferred substrates for aquatic macrophytes, so this effect expands the area of suitable habitat for macrophytes, increasing the amount of macrophyte photosynthesis and respiration in the Shasta River."

We recommend the following text be added in a new paragraph near the bottom of page 4-19 (above "The regular occurrence of algal blooms…"):

> This increase in total nitrogen concentrations fuels the growth of aquatic plants, which in turn contributes to oxygen demand by increasing aquatic plant photosynthesis and respiration.

Also, because not all blue green algae can fix nitrogen (i.e. *Microcystis aeruginosa* cannot), the statement "Blue green algae are capable of sequestering atmospheric nitrogen." should be changed to "Like many blue green algae, *Anabaena flos-aquae* is capable of sequestering atmospheric nitrogen, resulting in the potential for additional nutrient pollution."

4.4.5 Flow

This section does not mention a third important way in which flow affects dissolved oxygen. We recommend that the following text be added to the last sentence in this section (after "…caused by photosynthesis and respiration.") on page 4-21:

> Third, flow can affect dissolved oxygen through its effects on water temperature. For instance, larger volumes of water have a higher thermal mass are more resistant to heating and cooling. So if a large volume of water is cool (i.e. from a spring-fed creek such as Big Springs) it can travel downstream and retain its low temperature. Low temperatures allow water to water hold more dissolved oxygen. Through this mechanism, flow can affect dissolved oxygen.

Chapter 5: Analytical Approach and Methods

5.2 Analytic Approach and Model Selection

For reasons discussed above in our comments on section 4.4.5, the following sentence should have "water temperature, " inserted after "sediment oxygen demand rates, ":

> Further, as outlined in Chapter 4, dissolved oxygen concentrations of the Shasta River depend on photosynthetic and respiration rates of aquatic vegetation, sediment oxygen demand rates, consumption of oxygen via nitrification and biochemical oxygen demand, and flow.

5.6 RMS Sensitivity Analysis

We recommend the following addition to the section (extracted from Appendix D, with some edits):

> With respect to dissolved oxygen, CBOD, and NBOD decay rates were largely insensitive (meaning they had little effect on model outputs), as was the SOD rate. The driving factor for dissolved oxygen was maximum photosynthetic and respiration rate. These values were adjusted during calibration to fit the model to measured data. Reaeration rate, a calculated term within the model, played a pivotal role, particularly in the steep canyon reach where mechanical reaeration would be expected to occur.

Chapter 6: Temperature TMDL

Overall, this chapter appears to be based on sound analyses. We applaud the Regional Water Board for including flow increases from Big Springs in its Water Quality Compliance Scenario, as flow depletion is a long recognized problem in the Shasta River Basin, and good evidence is provided as to how this flow increase would affect water quality.

6.2 Water Quality Compliance Scenario Conditions

6.2.3 Tributary Temperatures

6.2.3.1 Big Springs Creek

The discussion of how $4^{O}C$ lower than baseline was chosen for the Water Quality Compliance Scenario should be explained more clearly (we cannot make sense of it in its current form).

6.6 Margin of Safety

On page 6-19, the following statement is made:

> Some improvements in stream temperature that may result from reduced sedimentation are not quantified. Reduced sediment loads could lead to increased frequency and depth of pools, independent of changes in solar radiation input. These changes tend to result in lower stream temperatures overall and tends to increase the amount of lower-temperature pool habitat. These expected changes are not directly accounted for in the TMDL.

While it is true that reducing sediment loads would likely decrease stream temperatures (and it should be noted that increased rates of hyporheic exchange are another mechanism by which this would occur), it is not clear what basis the Regional Water Board has for stating that sediment load are going to decrease. If this statement is to remain in the TMDL, it should be specified *why* sediment loads are going to decrease, otherwise this is not a margin of safety, it is theoretical statement.

Chapter 7: Dissolved Oxygen TMDL

7.2 Algae Box Model Application and Results

7.2.2 Summary and Conclusions

We agree with the statement on page 7-4 that "If TIN concentrations in the Shasta River were maintained at levels comparable to those concentrations measured in the headwaters of the Shasta River, aquatic vegetation biomass would likely be reduced."

7.3 RMS Model Application

7.3.2 Photosynthetic and Respiration Rates

On page 7-5, the TMDL states:

> The photosynthetic and respiration rates assigned for the water quality compliance scenario were 50% of those for the existing (baseline) condition, as shown in Table 7.3. These reductions in photosynthetic and respiration rates assume a 50% reduction in aquatic vegetation standing crop during the simulation periods. Regional Water Board staff believe that such reductions in aquatic vegetation standing crop, and associated reductions in photosynthetic and respiration rates, are achievable in the Shasta River.

No reason is stated for why a 50% reduction in photosynthetic and respiration rates was chosen. With no reason provided, the decisions seems arbitrary. The TMDL then states: "In practice, the mechanisms that would result in these reductions include:

• Decreased light availability to aquatic vegetation via increased riparian shade, as outlined in Section 6.2.1;
• Reduced concentrations of biostimulatory nutrients in the Shasta River achieved via controls targeting NBOD reductions from Lake Shastina outflow, irrigation return flows, and Yreka Creek, as outlined in Section 7.3.3;
• Reduced fine sediment inputs from irrigation return flows that can be achieved via controls targeting NBOD reductions, as outlined in Section 7.3.3; and
• Increased flushing flows to scour the channel of accumulated fine sediments that promote the establishment and proliferation of rooted aquatic macrophytes.
• Reduced stream temperatures, as outlined in Chapter 6."

While we agree that these mechanisms would indeed reduce the photosynthetic/respiration rates, it is unknown how much each of these factors would need to change in order to result in a 50% reduction in the photosynthetic/respiration rates. The quantitative relationships between each of these factors and the photosynthetic/respiration rates is not known. This uncertainty should be acknowledged in the text.

Furthermore, as we have stated above several times, it is not NBOD that causes dissolved oxygen problems in the Shasta River, it is total nitrogen. As shown in table 7.7, NBOD is only 7.9% of the oxygen load for the baseline condition; respiration of aquatic plants is 73.9%. Therefore, "NBOD" in the bullet points above should be replaced with "NBOD and total nitrogen"

While it is important to acknowledge scientific uncertainty, we also believe that since the factors causing D.O. problems are known, there is no need to wait until we have 100% certainty on the magnitude of land/water use changes that are required to bring the Shasta River into compliance with the water quality objectives. The best strategy is to continue with restoration efforts, and then evaluate progress along the way.

Chapter 8: Implementation

The RWB has an obligation to make sure that the water quality objectives are met, and beneficial uses restored and protected, particularly because the final *Shasta TMDL Action Plan* will be amended to the *Basin Plan* (NCRWQCB, 2001). If there are multiple ways to meet the objectives, we support giving landowners the flexibility to decide how they want to meet those objectives. For example, if other regulatory and policy processes such as the *Shasta Incidental Take Permit* (SRCD, In Draft), *Coho Recovery Plan* (CDFG, 2004), and Timber Harvest Plans will result in the attainment of water quality objectives, then further regulation by the RWB is not necessary.

Duplicative and overlapping regulation benefits no one. Unfortunately, these other processes often rely on voluntary measures that neither guarantee that water quality problems will be remedied nor that TMDL objectives will be achieved. When other policy approaches and voluntary landowner actions fail to achieve the TMDL objectives, then the RWB must use its considerable regulatory and enforcement authority to take necessary actions to ensure results.

The implementation actions requested in these comments are summarized below as Table 1 (a revised version of Table 4 from the proposed Shasta TMDL Basin Plan amendment language).

8.1.1 Prioritization of Implementation Actions

Page 8-6 states "Where reaches of the Shasta River and its tributaries are providing suitable freshwater salmonid habitat, protection of these areas should be a priority for restoration efforts." While this is a step in the right direction, it could be improved by specifically mentioning coho salmon, coldwater refugia needs and connectivity.

The Shasta TMDL should follow the approach of Bradbury et al. (1995), which is to identify the most intact habitat patches and to begin restoration by making sure that these areas are protected and enhanced as a top priority. In the Shasta River basin, these would be the stream reaches with coho salmon or those that provide coldwater refugia for other Pacific salmon species. The *Shasta TMDL* needs to add specific reference to lower Parks Creek and the need to restore riparian there and change diversion to provide a refugia and to improve spawning gravel supply to the mainstem Shasta River.

8.3 Tailwater

We recognize that tailwater returns are a substantial contributor to water quality problems, and we support the recommendations in this section.

8.4 Water Use and Flow

The water quality compliance scenario in Chapter 6 includes a 50% increase in flow from Big Springs Creek. We strongly support that decision; however the TMDL implementation does not lay out a clear path for how such a substantial increase in flow could be achieved. To be realistic, it will also have associated cost factors for assisting water conservation to offset the current demand for groundwater. Some language should likely be added to reflect this long term need.

The RWB proposes to take no firm action to increase flows to improve water quality for five years, which seems like a long wait given the stock status of Klamath River salmon (Kier Associates, 2006). We support the RWB in taking action, and think that two years would be a more reasonable amount of time to wait. A quote from the *Long Range Plan for Klamath River Basin Fishery Restoration Program* (Kier Associates, 1991) gives a sense of long term perspective:

> "In the year 2000, if adequate progress towards improving flow conditions for salmonids has not been made …. then investigate the option of reallocation of water rights under the public trust doctrine for protection of fish habitat."

While many of the ideas proposed in the *Coho Recovery Plan* are positive, they are also voluntary. It is important for the Regional Water Board to remember that it has a responsibility to protect public trust resources and ensure results. If voluntary measures work, that would be great, but they are often insufficient and further action is required.

Chapter 8 states that: "Other management measures recommend the leasing, purchasing, or donations of water rights from willing water rights holders in the Shasta River watershed." While purchasing or donations could provide long-term benefits to fish and water quality, leases would be unwise because they provide no long-term benefits. A major hurdle for success, if water rights are acquired, is that riparian water users are likely to exploit any water not used by those contributing water. The original Shasta River adjudication (CDPW, 1932) recognized that problem and it still has not been remedied. today. Before water rights are purchased, restrictions on water withdrawal under riparian rights must be disallowed, which likely requires another adjudication. Legality of some water rights also needs to be explored because ground water diversions that are linked to surface flow depletion require an Appropriative Water Right and diversions from the underflow of Big Springs have not obtained such rights (Kier Associates, 1999). The TMDL should also note that water rights holders may designate temporarily their water right to instream flow under California law SB-301, without penalty of losing that right at a future date (Kier Associates, 1999).

<u>8.5 Irrigation Control Structures and Impoundments</u>
<u>8.5.1 Implementation Actions for Irrigation Control Structures and Minor Impoundments</u>
The reference "(Great Northern Corp. 2001)" should be added after "1996" to the statement "The Shasta CRMP, working with cooperative landowners, has removed one impoundment in 1996, the farthest downstream…"

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<u>8.6 Lake Shastina</u>
This statement on page 8-25 has several problems and needs correction:

> "Additionally, nutrient inflows (Chapter 4) from natural sources to the reservoir appear to be significant, but nutrient loads from the outflow of Shastina exceed inflow loads, on an annual basis, suggesting that Lake Shastina is an additional source capable of generating its own nitrogenous oxygen demanding substances."

First, the TMDL does not contain any data/analysis regarding Lake Shastina nutrients loads (loads are mass per time, e.g. kg/year), only concentrations (e.g. mg/L). The sentence should be corrected by replacing "loads" with "concentration" (or if the Regional Water Board does have information about loads, it should be presented). Second, as we have stated above several times, <u>it is not NBOD that causes dissolved oxygen problems in the Shasta River, it is total nitrogen.</u> Therefore, "nitrogenous oxygen demanding substances" in the sentence above should be replaced with "nitrogen, affecting dissolved oxygen conditions downstream by increasing nitrogenous oxygen demanding substances and stimulating growth of aquatic plants."

The statement on page 8-25 that "10) appropriate actions, based on the investigation's results, to reduce nitrogenous oxygen demand, thereby, increasing dissolved oxygen concentrations in Lake Shastina and, thus, discharges from Dwinnell Dam to the Shasta

River." we recommend that "nitrogenous oxygen demand," should be replaced by "total nitrogen and nitrogenous oxygen demand"

Two other statements on the same page should be similarly revised by replacing "nitrogenous oxygen demand" with "total nitrogen and nitrogenous oxygen demand":

> "Initiate, complete, and submit to the Regional Water Board the results of an investigation characterizing, quantifying, and analyzing the sources of nitrogenous oxygen demanding substances contributing to low dissolved oxygen levels affecting the beneficial uses of water in Lake Shastina and to waters of the Shasta River downstream from Dwinnell Dam.
>
> Based on the results of the investigation, the Regional Water Board shall determine appropriate implementation actions necessary to reduce the nitrogenous oxygen demand that is lowering dissolved oxygen concentrations in Lake Shastina and affected areas downstream from Dwinnell Dam."

Lake Shastina has substantially changed the hydrology of the Shasta River, decreasing peak stormflows and reducing the frequency of high flows that can scour fine sediments and aquatic plants. For this reason, we request that the following language be added to this section "The Regional Water Board shall study the possibility of using pulse flows from Lake Shastina to clean out accumulated organic matter and macrophytes from the Shasta River. The study will also consider the effects of such pulse flows on the Klamath River downstream."

<u>8.8 Urban and Suburban Runoff</u>
This section neglects to mention planning and design as important means to manage urban and suburban runoff. Runoff pollution is much easier to minimize and manage if stormwater is considered during the design phase. We recommended the addition of the following language:

> "New developments should be designed to minimize stormwater runoff and maximum infiltration by minimizing impervious surface area, minimizing hydrologic connection between impervious surfaces and watercourses, and constructing stormwater retention basins. Existing developments should be retrofitted to minimize stormwater runoff."

<u>8.10 United States Bureau of Land Management</u>
This section should specifically reference staff for enforcement. BLM lands in the Shasta River canyon include extremely important Chinook salmon spawning habitat and juvenile salmon and steelhead rearing habitat. Grazing in violation of BLM policies has taken place illegally in the past and may recur if occasional enforcement presence is not in evidence. Illegal residences on BLM land off Hudson Road have not been removed and residents are harvesting firewood from the riparian zone on public land.

Chapter 9: Monitoring

If the RWB staff are not prepared to present a monitoring plan with the *Shasta River TMDL*, they should at least specifically mention on-going monitoring that should be continued for long term trend monitoring. The CRMP gauge at Montague-Grenada Road, USFWS multi-channel data recorder, USGS flow monitoring and annual deployment of automated temperature sensing probes. The TMDL should specifically reference need to store and share data in a way that supports TMDL implementation and adaptive management. The Klamath Resource Information System (TCRCD, 2003) is available for use by the community and the major expense of populating the database has been paid by previous grants. Cooperative efforts between the RWB, Tribes, agencies and stakeholders would not cost much if each partner dedicated a few days of staff time a year.

Conclusion

The Shasta TMDL comes at a time when Klamath River fall Chinook salmon stocks are collapsing, due to water quality problems and consequent disease epidemics (Kier Associates, 2006). Unlike other mountains throughout the West, snowpack on Mt Shasta is increasing with the onset of global warming, making the Shasta River an even more important tributary for Klamath Basin salmonids. NRC (2004) calls for restoring the Shasta River as a necessity in ensuring the salmon survival. The switch in the PDO looms. Speedy implementation is needed.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
Range and Riparian Land Management	• Parties Conducting Grazing Activities. • Parties Responsible for Vegetation that Shades Water Bodies. • Parties Responsible for Bank Stabilization Activities. • Regional Water Board.	Landowners should employ land stewardship practices and activities that minimize, control, and, preferably, prevent discharges of fine sediment, nutrients and other oxygen consuming materials, as well as elevated solar radiation loads from affecting waters of the Shasta River and tributaries. Those that oversee and manage grazing and range land activities in the Shasta River watershed should implement grazing and rangeland management practices listed in Table 8.1 of the TMDL Implementation Plan, and in the Shasta Restoration Plan. The Shasta CRMP should, (1) implement the strategic actions specified in the Strategic Action Plan, and (2) assist landowners in developing and implementing management practices that are adequate and effective at preventing, minimizing, and controlling discharges of nutrients and other oxygen consuming wastes, and elevated water temperatures. The Regional Water Board will work cooperatively with the Shasta CRMP to provide technical support and information to willing individuals, landowners, and community members in the Shasta River watershed, coordinate educational and outreach efforts, and monitor the implementation and effectiveness of the Shasta Watershed Restoration Plan.	Proposed action is sufficient.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		Should voluntary efforts fail to be implemented or effective at preventing, minimizing, and controlling discharges of sediment, nutrients and other dissolved oxygen consuming materials, and increasing solar radiation loads, the Regional Water Board's Executive Officer shall require the appropriate responsible parties to develop, submit, and implement a RRWMP on an as-needed, site-specific basis. Any landowner may be subject to this requirement if livestock grazing activities on their property are discharging, or threatening to discharge oxygen consuming materials and/or elevated solar radiation loads to a water body in the Shasta River watershed. The RRWMP shall describe in detail: Locations discharging and/or with the potential to discharge nutrients and other oxygen consuming materials, and increased solar radiation loads to watercourses which are caused by livestock grazing, How and when those sites are to be controlled and monitored, and management practices that will prevent and reduce, future discharges of nutrient and other oxygen consuming materials, and increases in solar radiation loads. Group and/or individual RRWMPs shall be implemented upon review, comment, and approval	

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		by Regional Water Board staff and their Executive Officer for compliance with Regional Board directives, the Basin Plan, and also with the management measures in the Nonpoint Source PCP. The Regional Water Board shall address the removal and suppression of vegetation that provides shade to a water body through its Wetland and Riparian Protection Policy, a comprehensive, region-wide riparian policy that will address the importance of shade on instream water temperatures and will potentially propose riparian setbacks and buffer widths. The Policy will likely propose new rules and regulations, and will therefore take the form of an amendment to the Basin Plan. Other actions under this section may be modified for consistency with this policy, once adopted. With funding already available through a grant from the U.S. EPA, Regional Water Board staff are scheduled to develop this Policy by the end of 2007. Permitting and Enforcement: The Regional Water Board shall take appropriate permitting and enforcement actions if necessary to address the removal and suppression of vegetation that provides shade to a water body in the Shasta River watershed. Such actions may include, but are not limited to, general waste discharge requirements (WDRs) or waivers of WDRs for grazing and rangeland activities, farming activities near water bodies, stream bank stabilization activities, and other	

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		land uses that may remove and/or suppress vegetation that provides shade to a water body. Should prohibitions or general WDRs be developed, they may apply to the entire North Coast Region or just to the Shasta River watershed. If necessary, Regional Water Board staff shall propose to the Board appropriate enforcement actions for human activities that result in the removal or suppression of vegetation that provides shade to a water body in the Shasta River watershed. Such actions may include, but are not limited to, cleanup and abatement orders, cease and desist orders, and administrative civil liabilities (fines) in accordance with California Water Code sections 13304, 13301, and 3350, respectively. Enforcement actions for violations of the California Water Code shall be taken when and where appropriate. Enforcement activities should be consistent with the State Water Board's *Water Quality Enforcement Policy* (SWRCB Resolution No. 2002-0040), adopted February 19, 2002, and as it may be amended from time to time. This enforcement policy promotes a fair, firm, and consistent enforcement approach appropriate to the nature and severity of a violation. Within two years of the date that the TMDL Action Plan takes effect the Regional Water Board's Executive Officer shall report to the Board on the	

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		status of the preparation and development of appropriate permitting actions. Enforcement implementation is ongoing and effective the date that the TMDL Action Plan is adopted.	
Tailwater Return Flows	• Parties Responsible for Tailwater Management and Use • Shasta CRMP • Shasta RCD • CDFG • Regional Water Board	Parties responsible for tailwater discharges from irrigated lands, which may include landowners, lessees, and land managers, should implement the management practices presented in the CDF&G's Coho Recovery Strategy, the Shasta CRMP's Shasta Watershed Restoration Plan and the Shasta RCD's Incidental Take Permit Application. Regional Water Board staff will evaluate the effectiveness of these voluntary actions and develop	Proposed action is sufficient.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		recommendations for the most effective regulatory vehicle to bring tailwater discharges into compliance with the TMDL and the Basin Plan. Information gathered during the evaluation phase will be used to formulate final recommendation(s) to the Regional Water Board. This evaluation phase shall be completed within 12 months after the TMDL is approved by the U.S. EPA. Based on Regional Water Board staff recommendation(s) derived from the evaluation phase for tailwater management, the Regional Water Board shall adopt prohibitions, Waste Discharge Requirements, Waivers of Waste Discharge Requirements, or any combination, thereof, as appropriate. To assure compliance if prohibitions, WDRs, Waivers of WDRs, or any combination of the latter are adopted, a tiered tailwater management program may be instituted for tailwater management that may include various elements such as discharge and receiving water sampling, monitoring, and reassessment. Additional management practices to assure that tailwater discharges to receiving waters comply with the TMDL and the Basin Plan may also be based on results from the tailwater management program.	

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
Water Use and Flow	• Water Rights Holders and other Stakeholders • Shasta Coordinated Resource Management and Planning Committee (Shasta CRMP) • Shasta Valley Resource Conservation District (Shasta RCD) • California Department of Fish and Game (CDFG) • Regional Water Board	Water diverters should participate in the CDFG's Coho Recovery Strategy (CDFG 2004a) and Incidental Take Permit Program (CDFG 2004b). The Regional Board shall work with DFG to establish monitoring and reporting elements of these programs in order to gage their effectiveness. Water diverters should participate in and implement flow-related measures outlined in the Shasta CRMP's Shasta Watershed Restoration Plan. The Regional Board shall work with the Shasta CRMP to establish monitoring and reporting elements in order to gage the Plan's implementation and effectiveness. If after five years, the Regional Board Executive Officer finds that the above-measures have failed to be implemented or are otherwise ineffective, the Regional Board may recommend that the SWRCB consider seeking modifications to the decree, conducting proceedings under the public trust doctrine, and/or conducting proceedings under the waste and unreasonable use provisions of the California Constitution and the California Water Code.	Water diverters should participate in the CDFG's Coho Recovery Strategy (CDFG 2004a) and Incidental Take Permit Program (CDFG 2004b). The Regional Board shall work with DFG to establish monitoring and reporting elements of these programs in order to gage their effectiveness. Water diverters should participate in and implement flow-related measures outlined in the Shasta CRMP's Shasta Watershed Restoration Plan. The Regional Board shall work with the Shasta CRMP to establish monitoring and reporting elements in order to gage the Plan's implementation and effectiveness. **The Regional Water Board shall actively encourage the purchase of water rights for the purpose of maintaining adequate streamflows.** **Recommend revisiting adjudication to stop riparian appropriation of water purchased for instream flows and fish.** If after **two** years, the Regional Board Executive Officer finds that the above-measures have failed to be implemented or are otherwise ineffective, the Regional Board will recommend that the SWRCB consider seeking modifications to the decree, conducting proceedings under the public trust doctrine, and/or conducting proceedings under the waste and unreasonable use provisions of the California Constitution and the California Water

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
			Code.
Irrigation Control Structures, Weirs, Flashboard Dams, and other Minor Impoundments (Collectively referred to as minor impoundments)	• Individual Irrigators • Irrigation districts • Other Stakeholders owning, operating, managing, or anticipating construction of minor impoundments	Irrigations districts, individual irrigators, and other stakeholders that own, operate, manage, or anticipate construction of instream impoundments such as flashboard dams, or other structures capable of blocking, impounding, or otherwise impeding the free flow of water in the Shasta River system shall comply with the following measure: Within one year of TMDL approval by the U.S. EPA, report to the Regional Water Board methods and management practices they shall implement that will reduce sediment oxygen demand rates by 50% from baseline behind all minor impoundments. Options may include, but are not limited to: 1) permanently removing impoundments in the Shasta River mainstem as a mechanism to provide for flushing flows capable of scouring fine sediment from the stream-river channel on which aquatic plants grow; 2) re-engineering existing impoundments to decrease their surface area; and 3) not undertaking the construction of new impoundments unless they can be shown to have positive effects to the beneficial uses of water relative to water quality compliance and the support of beneficial uses, including the salmonid fishery, in the Shasta Valley.	Proposed action is sufficient.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
Lake Shastina	• Montague Water Conservation District (NWCD) • Other Appropriate Stakeholders • Regional Water Board	The Montague Water Conservation District shall take the following actions: Initiate within two years, complete and submit to the Regional Water Board within five years, the results of an investigation characterizing, quantifying, and analyzing the sources of, and ways to reduce, nitrogenous oxygen demanding substances contributing to low dissolved oxygen levels affecting the beneficial uses of water in Lake Shastina and to waters of the Shasta River downstream from Dwinnell Dam. Based on the results of the investigation, the Regional Water Board shall determine appropriate implementation actions necessary to reduce the nitrogenous oxygen demand that is lowering dissolved oxygen concentrations in Lake Shastina and affected areas downstream from Dwinnell Dam.	The Montague Water Conservation District shall take the following actions: Initiate within two years, complete and submit to the Regional Water Board within five years, the results of an investigation characterizing, quantifying, and analyzing the sources of, and ways to reduce, **nutrients and** nitrogenous oxygen demanding substances contributing to low dissolved oxygen levels affecting the beneficial uses of water in Lake Shastina and to waters of the Shasta River downstream from Dwinnell Dam. Based on the results of the investigation, the Regional Water Board shall determine appropriate implementation actions necessary to reduce the **nutrients and** nitrogenous oxygen demand that is lowering dissolved oxygen concentrations in Lake Shastina and affected areas downstream from Dwinnell Dam. **The Regional Water Board shall study the possibility of using pulse flows from Lake Shastina to clean out accumulated organic matter and macrophytes from the Shasta River.**
City of Yreka Wastewater Treatment Facility (Yreka WWTF)	• City of Yreka • Regional Water Board	The Regional Water Board staff shall pursue aggressive compliance with Order No 96-69, and CAO No.R1-2004-0037. To ensure timely submittal of sampling and analytical results from the operators of the Yreka WWTF, the Regional Water Board staff shall also continue vigorous oversight and enforcement of Monitoring and Reporting Program	Proposed action is sufficient.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		No. R1-2003-0047.	
Urban and Suburban Runoff	• Cities of Yreka, Weed, the Lake Shastina Development • Other Stakeholders • Regional Water Board	The cities of Yreka, Weed, the Lake Shastina Development and other stakeholders should identify possible pollutants, their sources, and volumes of polluted runoff from urban and suburban sources within their spheres of influence that may discharge, directly or indirectly, to waters of the Shasta Valley watershed. Cities and other stakeholders responsible for urban and suburban runoff should implement the following measures: Seasonal scheduling of construction activities to prevent unnecessary waste loads in stormwater runoff. Seasonal scheduling for the application to lawns and gardens, municipal facilities, and agricultural areas of fertilizers, pesticides and herbicides, and other oxygen consuming materials that may contribute to dissolved oxygen impairments to watercourses in the Shasta River hydrologic system from cities, towns, developments and other concentrations of urban and suburban populations. When, and if, pollutant sources are identified that discharge, or threaten to discharge, oxygen consuming materials, fine sediment, and other	The cities of Yreka, Weed, the Lake Shastina Development and other stakeholders should identify possible pollutants, their sources, and volumes of polluted runoff from urban and suburban sources within their spheres of influence that may discharge, directly or indirectly, to waters of the Shasta Valley watershed. Cities and other stakeholders responsible for urban and suburban runoff should implement the following measures: Seasonal scheduling of construction activities to prevent unnecessary waste loads in stormwater runoff. Seasonal scheduling for the application to lawns and gardens, municipal facilities, and agricultural areas of fertilizers, pesticides and herbicides, and other oxygen consuming materials that may contribute to dissolved oxygen impairments to watercourses in the Shasta River hydrologic system from cities, towns, developments and other concentrations of urban and suburban populations. **New developments should be designed to minimize stormwater runoff and maximum infiltration by minimizing impervious surface**

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		polluting constituents to nearby watercourses from existing runoff control facilities, the Regional Water Board will work cooperatively with responsible parties to ascribe appropriate management measures and reasonable time schedules to control and eliminate said pollutant discharges.	**area, minimizing hydrologic connection between impervious surfaces and watercourses, and constructing stormwater retention basins. Existing developments should be retrofitted to minimize stormwater runoff.** When, and if, pollutant sources are identified that discharge, or threaten to discharge, **nutrients,** oxygen consuming materials, fine sediment, and other polluting constituents to nearby watercourses from existing runoff control facilities, the Regional Water Board will work cooperatively with responsible parties to ascribe appropriate management measures and reasonable time schedules to control and eliminate said pollutant discharges.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
Activities on Federal Lands	• U.S. Forest Service (USFS) • Regional Water Board	The USFS shall consistently implement the best management practices included in *Riparian Area Management 1997* (USDA/USDI 1997), and *Water Quality Management for Forest System Lands in California, Best Management Practices* (USFS 2000). The Regional Water Board staff will continue its involvement with the USFS to periodically reassess the mutually agreed upon goals of the Management Agency Agreement between the SWRCB and the USFS. Additionally, the Regional Water Board shall work with the USFS to draft and finalize a Memorandum of Understanding (MOU). The MOU shall be drafted and ready for consideration by the appropriate decision-making body of the USFS within two years of the date the TMDL Action Plan takes effect. The MOU shall include buffer width requirements and other management practices as detailed in the Implementation chapter of the TMDL.	Proposed action is sufficient.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
	• U.S. Bureau of Land Management • Regional Water Board	BLM shall implement best management grazing strategies that are detailed in a joint management agency document titled: *Riparian Area Management 1997* (USDA/USDI 1997). The Regional Water Board shall work with the BLM to draft and finalize a Memorandum of Understanding (MOU). The MOU shall be drafted and ready for consideration by the appropriate decision-making body of the BLM within two years of the date the Shasta River TMDL Action Plan takes effect. The MOU shall include buffer width requirements and other management practices as detailed in the Implementation chapter of the TMDL.	Proposed action is sufficient.
Timber Harvest Activities on Non-federal Lands	• **California Department of Forestry (CDF)** • **Regional Water Board**	[discussed in chapter 8 but not in Basin Plan amendment language]	**The Regional Water Board shall rely on applicable current regulations, existing permitting and enforcement tools, and other ongoing staff involvement, summarized in the listed below, associated with timber harvest activities. As such, no new regulations or actions are being proposed in association with this TMDL:** **- Z'Berg-Nejedly Forest Practice Act and the California Environmental Quality Act (CEQA)** **-Management Agency Agreement between the CDF and the State Water Resources Control Board to oversee water quality protection on timber operations on non-federal lands in California.** **- Senate Bill 810, enacted in 2003, provides that a**

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	**Responsible Parties**	**Action Proposed in Public Draft TMDL**	**Recommended Alternative Action**
			Timber Harvest Plan (THP) may not be approved if the Regional Water Board finds that the proposed timber operations will result in discharges to a water body impaired by sediment and/or is in violation of the Basin Plan. - Regional Water Board Timber Harvest General Waste Discharge Requirements (Order No. R1-2004-0030) and Categorical Waiver of Report of Waste Discharge (Order No. R1- 2004-106) for timber activities on private lands. Both the Categorical Waiver and the General Waste Discharge Requirements programs use the CDF timber harvest, functional equivalent review process for THPs and Non-industrial Timber Management Plans (NTMP) to ensure compliance with the CEQA. - Active and continuous oversight by Regional Water Board staff of the timber harvest review and inspection process. - Habitat Conservation Plans and Sustained Yield Plan review. - U.S. Forest Service activities (discussed in Section 8.1.17) and CDF and Board of Forestry meetings and review.
Caltrans Activities	• California Department of Transportation (Caltrans) • Regional Water Board.	Regional Water Board staff shall complete an initial evaluation of the Caltrans Stormwater Program within two years of the date the TMDL Action Plan takes effect. After the initial two-year evaluation is completed, the Regional Water Board staff shall continue periodic reviews of the Caltrans Storm Water Program to assure ongoing compliance with	Proposed action is sufficient.

Table 1. Proposed TMDL Implementation Actions and Recommended Alternative Actions

Source or Land Use Activity	Responsible Parties	Action Proposed in Public Draft TMDL	Recommended Alternative Action
		the Shasta River TMDL.	

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Appendix A:

Typographic/grammar errors and other less significant comments

General comment
Many of the tables and charts in this document are formatted as images, not text/lines. This makes them harder to read (fuzzy and pixilated) and makes it impossible to copy/paste data from tables into spreadsheets. If possible, the Regional Water Board should try in future TMDLs to properly format the tables and charts.

Page 2-25
This statement is based on a total of 6 data points: "Total phosphorus levels are low in the headwaters of the watershed at the North North Fork Shasta River and Shasta River near the headwaters monitoring locations, with values of 0.025 mg/L"
Hence, a qualifying statement is necessary (also note that the word North is repeated). We suggest the following: "Existing limited data (6 samples) indicate that total phosphorus levels are low in the headwaters of the watershed at the North Fork Shasta River and Shasta River near the headwaters monitoring locations, with values of 0.025 mg/L"

Page 2-28
This statement is based on a total of 6 data points: "Total phosphorus concentrations of the headwaters of the Shasta River are generally oligotrophic, with TP concentrations at levels that do not promote nuisance aquatic growth."
Hence, a qualifying statement is necessary. We suggest the following: "Existing limited data (6 samples) indicate that total phosphorus concentrations of the headwaters of the Shasta River are generally oligotrophic, with TP concentrations at levels that do not promote nuisance aquatic growth."

Page 2-29
This statement is based on a total of 6 data points: "Existing limited data (6 samples) indicate that" to the beginning of "The headwaters of the Shasta River generally have low total nitrogen levels, indicative of conditions that do not promote aquatic plant growth."
Hence, a qualifying statement is necessary. We suggest the following: "Existing limited data (6 samples) indicate that the headwaters of the Shasta River generally have low total nitrogen levels, indicative of conditions that do not promote aquatic plant growth."

Page 3-9
In Figure 3.5, the Y-scale on graph is too large. It would be more legible if scale was from +1 to -4, rather than current scale of +4 to -4. If this would be easy to do, it should be redone.

Page 3-16
There is a bunch of irrelevant words on this page (delete).

Page 4-2
The statement that "The organic matter thus produced then serves as an energy source for bacteria and animals in the reverse process of *respiration*…" should be revised to include the fact that plants also respire (could be fixed by adding "plants, " before "bacteria").

Page 4-5
The statement "At this average TKN concentration, approximately 2.3 mg/L of oxygen is consumed, representing a moderate component of the total oxygen demand exerted in the Shasta River." should be revised to read "At this average TKN concentration, approximately 2.3 mg/L of oxygen would be consumed. This 2.3 mg/L of oxygen consumption occurs spread over an unknown period that is likely at least five days long, thus representing only a moderate component of the total oxygen demand exerted in the Shasta River."

Page 4-6
This statement on page 4-6 is ambiguous as to whether the conditions occurred in the Shasta River or elsewhere: "USGS reports document cases of supersaturated conditions attributed to aquatic plant growth persisting for several days or more, with saturations as high as 250 percent (Flint et al. 2005, p. 60)." We recommend changing it to:
"USGS reports from Oregon document cases of supersaturated conditions attributed to aquatic plant growth persisting for several days or more, with saturations as high as 250 percent (Flint et al. 2005, p. 60)."

Page 8-7
On this page there are several mentions of the Scott River that should instead be the Shasta River. It appears as though this language was ported over from the Scott TMDL. Also, there is mention of the "Strategic Action Plan", another relic from the Scott River TMDL.

Page 8-8
Change "timewith" to "time with"

Page 8-9
"Grazing on federal land is addressed separately in sections 8.8 (Forest Service) and 8.9 (BLM) of the Staff Report." This apparently references an outdated numbering system; it should be sections 8.9 and 8.10.

Page 8-11
This language is contained twice in the same paragraph. One should be deleted.

> "Irrigation water would be applied uniformly based on an accurate measurement of cropwater needs and the volume of irrigation water applied, considering limitations raised by such issues as water rights, pollutant concentrations, water delivery restrictions, salt control, wetland, water supply and frost/freeze temperature management. Additional precautions would apply when chemicals are applied through irrigation."

Page 8-13

This statement is out of place, and it is unclear what the point is:

> "The Dissolved Oxygen TMDL (Chapter 7), using the water quality compliance scenario of the RMS model, shows that photosynthetic and respiration rates approaches 50% of existing baseline conditions when assuming a 50% reduction in the standing crop of aquatic plants."

This does not make any sense. The photosynthetic/respiration rates are essentially the same things (just different units) as the standing crop.

Page 8-18
Change "dry wet water plan" to "dry year water plan"
Change "dissolver" to "dissolved"

Page 8-34
Change "Contol" to "Control"
Change "Dsicharge" to "Discharge"
Change "nd" to "nd"