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Matt St. John
Lead, TMDL Unit
California Regional Water Quality Control Board
North Coast Region
mstjohn@waterboards.ca.gov

Dear Mr. St. John:

Thank you for the opportunity to review the staff report and Basin Plan Amendment for the proposed temperature, dissolved oxygen, organic matter, and nutrient TMDL of the Klamath River. I understand that this TMDL addresses water quality impairment in the California portion of the basin for multiple beneficial uses. I have reviewed the staff report and appendices, and have a number of comments regarding the analysis, in addition to the four issues you asked that peer-reviewers consider.

It is my belief that the basis for this TMDL is an acceptable use of scientific information. This is clearly a very complicated and challenging analysis and I appreciate the effort that went into developing this document. However, I do have some concerns about the study, particularly regarding the modeling efforts to establish the "natural" conditions, the relationship of this TMDL to the proposed removal of Klamath River dams, and the implementation and monitoring of this TMDL. Those concerns are documented below, as well as direct responses to nutrient, chlorophyll-a, *Microcystis*, and microcystin targets, load allocations for temperature and dissolved oxygen in Copco and Iron Gate reservoirs, assessment of tributary flow rates on stream temperatures, and conceptual model linking water quality impairment to fish disease.

1.0 Nutrient, chlorophyll-a, *Microcystis*, and microcystin targets for Copco I and II, and Iron Gate reservoirs

I understand that these allocations and numeric targets were designed to control blue-green algae blooms and reduce the public health risks associated with algal toxins. I have summarized comments on the protective provided by proposed TMDL for each constituent in the table below, and include specific issues that should be addressed or clarified in revisions to this Staff Report. It is my belief that, if fully implemented, this TMDL would be protective of beneficial uses, with the exception of the Microcystis aeruginosa cell density, which I understand will allow for a 50% exceedance probability.

Type	Water Quality constituent	Recommended regulation	Comments on beneficial use protection
Load allocation	Nutrient loading from reservoir sediments	0 load	This will certainly protect beneficial uses, but it is unclear how this could actually be successfully implemented.
Numeric target	Suspended algae chlorophyll-a	10 μg/L	I have some lingering questions. The "sharp increase in Microcystis aeruginosa cell density above 10mg/L Chl a" (Section 2, pages 19-21) is not as clear of a threshold as document implies. Please see comments below.
Numeric target	Microcystis aeruginosa cell density	20,000 cells/mL	Based on WHO criteria for low risk exposure. Appears to be protective of human health and beneficial uses, however, is 50% probability of exceeding low effects threshold (Section 2, page 23) good enough?
Numeric target	Microcystin	4 μg/L	Based on WHO criteria for low risk exposure. Protective of human health and beneficial uses.

Issues/Questions:

- Section 2, page 21 and 22 (Figures 2.3 and 2.4). Why were the Chl a – Exceedance probabilities not modeled for the numeric target (10μg/L)? If I am reading Figure 2.3 correctly, it appears that the transition actually occurs under 10μg/L for 20K and 40K cells/ml MSAE. Further, for 100K cells/ml MSAE and 20 μg/L, why were these not modeled for the higher Chl a concentrations, as the lower values were?
- Also, the document references that monitoring targets are provide in Chapter 7, though this was not included in the document I received. Further, no implementation plan was provided, and thus, it is hard for me to evaluate these TMDL regulations without some sense of how they might be implemented (and

monitored), especially given the dependence of these water quality conditions on flow modification (see section below) in the river.

2.0 Load allocations for temperature and dissolved oxygen in Copco and Iron Gate reservoirs to support salmonid beneficial uses.

I understand that these load allocations are intended to protect the beneficial uses associated with cold freshwater habitat, spawning, migration, and early development, migration for redband/rainbow trout.

My understanding is that the TMDL is a load allocation for DO and temperature during the months of May to October for 85% DO at a temperature of 18.7^{o}C. I also understand that the Regional Water Quality Board staff are proposing revisions to DO objectives, however, I do want to note my concern that the current DO background conditions are based on inappropriate data for this purpose. The proposed alternatives (Section 2, page 7) should protect these beneficial uses, if adopted and implemented. I believe the targets for overlapping temperature and DO "lens" is valid and should protect beneficial uses.

Issues/Questions:

- Please clarify how core vs. non-core designations will be established.

- Estimated natural temperatures plotted in Figure 2.12 (Section 2, page 47) are questionable due to model limitations (see comments on model below). Using such a coarse level of bathymetry (estimated from USGS topos) can introduce substantial error into the models. While I understand that detailed bathymetry may not be available, some analysis of uncertainty in temperature estimates is warranted as part of this analysis since this is such a fundamental part of the TMDL.

- I have some concern regarding the monthly average target for the reservoir tailraces, while the TMDL document acknowledges the influence of reservoirs on daily temperatures and the biological implications of those shifts (Section 2, pages 38 and 39). Might a seven-day moving average be applied to the tailrace temperature target as well? I believe this would be more protective of the beneficial uses this TMDL is trying to address.

- Again, implementation is a major concern for these targets. It is my understanding that implementation would require substantial reoperation of the dams and/or new inlet structures to achieve these targets. Given the nonbinding agreement to decommission the dams in 2020, it is unclear to me whether such investment would occur in the interim. Thus, it is relevant to ask whether these targets will protect beneficial uses if not implemented until a decommissioning occurs. Throughout the anticipated delays in decisionmaking about and implementation of the decommissioning or alternatives, it is critical that these targets be implemented in the interim to protect beneficial uses.

3.0 Assessment of tributary streamflow rates on stream temperatures.

While projections of streamflows from the tributaries are problematic due to lack of data, particularly for the Scott River, my concerns regarding stream temperatures are more focused on cumulative effects and the ecological relevance of 5°F temperature increase. Related to implementation and its outcomes on cumulative effects, the narrative objective states that temperature cannot be altered unless demonstrated not to adversely affect beneficial uses. How will adverse effects be determined? That is, how will multiple actions be evaluated that could create adverse effects cumulatively? My second concern regarding the ecological relevance of 5°F temperature increase may simply be addressed with some clarification of how the 5°F limit was established. Also, please clarify that this is 5°F basinwide, as opposed to 5°F per action. My concerns related to establishing "natural receiving water temperatures" apply here as well.

4.0 Linkages between water quality and fish disease

I understand that improving the overall status of fish populations is the key end point to restoring beneficial uses of the Klamath River. To this end, I do believe the analysis presented in the TMDL staff report on linkages between water quality impairment and impacts on fish disease is based upon sound scientific knowledge, methods, and practices. The conceptual models and well-supported text provide a solid and commendable overview of current science.

5.0 Additional concerns

As indicated in the discussion above, I have some additional concerns regarding the development and implementation of this TMDL. I also found that the document needs substantial editing, with numerous typos throughout, syntax errors (watch missing commas and affects vs. effects), superfluous and duplicative text, and figure axes without units. In addition, a figure with the location of the Copco and Iron Gate reservoirs would be very helpful. Finally, numbering pages continuously throughout the document, as opposed to section by section, would be helpful for providing comments.

- **Modeling efforts to establish the "natural" conditions.** As noted previously, I have concerns regarding the resolution of bathymetric inputs to the models and the calibration of the model components with limited data from different years (estuary calibrated for 2004, while Segments 1-5 for 2000 and 2002, and Segments 6-9 for year 2000). Because the model integrated results from CE-QUAL-W2, RMA I and II, and EFDC were used as inputs to each other, this calibration scheme seems particularly dubious. Additionally, calibration of the model during using data from a low flow when beneficial uses are particularly susceptible to impairment would greatly strengthen the analysis.

Related to this, I disagree with the statement (Section 5, page 9) that an implicit margin of safety is appropriate "because uncertainty was greatly reduced in the analysis by applying a comprehensive, dynamic numerical model…representing conditions in great detail spatially and temporally." The model is not based on great spatial and temporal detail, and an analysis of model uncertainty is absolutely warranted.

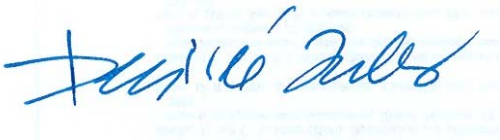
- **Relationship of this TMDL to the proposed decommissioning of Klamath River dams**. While I realize that this TMDL document is to be kept clearly distinct from the FERC reclicensing procedure for the Klamath Hydropower project (Section 2, page 2), it is relevant and critical to consider the relationship between the proposed TMDL and potential decommissioning. I suggest adding a discussion on how this TMDL might restrict or otherwise effect plans for removal of the 4 dams (Copco I and II, JC Boyle, and Iron Gate) on the Klamath River. Conversely, the Staff Report should establish a strategy for reconsidering the TMDL following the decommissioning. In addition, the Staff Report should consider how the TMDL targets can be met during the interim period between approval of the targets and decommissioning, which may extend well beyond the proposed plans for decommissioning in 2020. In this sense, it is hard to evaluate the TMDL's ability to protect beneficial uses without an analysis of the relationships between the proposed targets and decisionmaking about the Klamath Hydropower project.

- **Implementation and monitoring of this TMDL.** It is difficult to provide an informed review of and meaningful feedback on this staff report without the accompanying monitoring and implementation plans. It is not appropriate for reviewers to project how the targets will be implemented, and yet, it is impossible to truly understand the impacts of the targets without some sense of how they will be applied. For example, are the secondary targets (e.g. "0 miles of excess sediment impact") even feasible? If these targets are unrealistic, what is the outcome of not meeting them? Similarly, it is clear that flow modifications to the river play a large role in the water quality of the river. Related to implementation, if the dams are reducing peak flow from 20-25% in May, and increasing minimum summer flows (Section 1, page 22), then some flow modifications are needed, which influence a number of water quality impairments addressed within this TMDL, including:
    - Flushing flows to prevent periphyton as substrate for C. Shasta (page 31)
    - Summer low flows for dessication of polycheates (page 32)
    - Exposure of juveniles to C. Shasta (page 42)
    - Flushing sediment (page 70)

The relationships between flow, temperature, DO, salmon, and C. Shasta could be further developed in this TMDL. While I understand that altered flow that affects habitat conditions is not directly addressed in this TMDL (Section 2, page 2), it is impossible to consider whether this TMDL is achievable given the extensive modifications, particularly Lewiston and Trinity flow diversions and Copco and Iron Gate regulation of flow, in the Klamath River system.

In summary, taken as a whole, the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. However, my concerns, described above, limit my confidence in the ability of the TMDL to protect the beneficial uses of the Klamath River. Please feel free to contact me with any questions or requests for additional information.

Sincerely,



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