UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

December 1, 2006

Reply To
Attn Of: ETPA-088 Ref: 04-032-DOE

Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Dear Ms. Salas:

The U.S. Environmental Protection Agency (EPA) has reviewed the draft Environmental Impact Statement (EIS) for the **Klamath Hydroelectric Project** (CEQ No. 20060395) (Project) located principally on the Klamath River in Klamath County, Oregon and Siskiyou County, California, between Klamath Falls, Oregon and Yreka, California. Our review has been conducted in accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act.

The scope of the draft EIS spans a diverse geographic domain and addresses an exceedingly complex array of issues. These issues involve multiple and layered jurisdictions, statutes and regulations, and scientific and technical dimensions. The Federal Energy Regulatory Commission (FERC) staff are to be commended for their effort in this ambitious and difficult undertaking.

The Project domain is the Klamath River Basin, encompassing the Klamath and Trinity River watersheds and their major tributaries. The analysis presented in the draft EIS indicates that waters within the project area do not currently meet the States of California or Oregon water quality standards for temperature, dissolved oxygen, pH, and ammonia toxicity (pages 3-93, 3-96, 3-102 and 3-105). The draft EIS further indicates that Project facilities cause or contribute to water quality impacts such as temperature water quality standard exceedences observed at the Iron Gate Dam. The States of Oregon and California have listed their portions of the Klamath River in the project area on their respective lists of impaired waters (Clean Water Act Section 303(d)) based on these water quality standards exceedences. EPA has previously reviewed the analyses supporting these state listings and approved the lists.

We have assigned a rating of EO- 2 (Environmental Objections - Insufficient Information) to the draft EIS (a copy of the rating system used in conducting our review is enclosed for your reference). Without additional information, EPA believes that relicensing the Project under the terms of the FERC Staff Alternative may result in a Project that continues to cause or contribute to water quality criteria exceedences and related adverse impacts on designated uses. Moreover, it appears that the proposed relicensing under that alternative may not be consistent with Total Maximum Daily Loads (TMDLs) currently being developed by the two states for the Klamath River. We are also concerned that the draft EIS does not analyze tribal water quality standards, including both Hoopa Valley Tribal Standards approved under Section 303(c) of the Clean Water Act, and the Karuk, Yurok and Resighini Tribes' water quality standards approved under tribal law.

In addition, we are concerned that the draft EIS does not evaluate an alternative that would fully address the Project's contribution to water quality standard exceedences. The final EIS should evaluate an alternative that demonstrates that the Project's contribution to water quality standard exceedances would be addressed throughout the Project area or discuss why such an alternative was not considered "reasonable" (40 CFR 1502.14a) and carried forward for detailed consideration.

There are questions regarding the ability of the proposed mitigation measures to address adverse water quality impacts. We recommend that the final EIS fully analyze the extent to which the Project, with proposed relicensing, would contribute to exceedences of water quality standards in the Klamath Project area, as well as downstream. In that regard, we recommend that the final EIS analyze, as appropriate, mitigation measures such as selective withdrawal and other mechanical and engineering design options, that would help meet applicable water quality standards.

We do not fully understand why the preferred alternative in the draft EIS excludes the Keno Dam and development from a detailed analysis of impacts in the draft EIS. The Keno reservoir has been shown to contribute to water quality degradation, both in the reservoir and for many miles downstream (pages 3-102 and 3-132). We recommend that, if the Keno Dam and development facility is part of the Project, its associated water quality impacts be analyzed as direct impacts, otherwise its associated impacts should be considered as part of the cumulative impact analysis in the final EIS.

Thank you for the opportunity to review and comment on this draft EIS. We have discussed our comments in detail in the enclosed attachment. If you have any questions regarding EPA's comments, please contact Christine Reichgott, Manager, NEPA Review Unit at (206) 553-1601 in our Region 10 office or Laura Fujii, Environmental Review Office at (415) 972-3852 in our Region 9 office. Please send any correspondence in response to our comments to EPA Region 10, Attention of Michelle Pirzadeh, 1200 Sixth Avenue, Seattle, WA 98101.

Sincerely,

/s/

Michelle Pirzadeh, Director
Office of Ecosystems, Tribal and Public Affairs
Region 10 EPA

/s/

Enrique Manzanilla, Director
Communities and Ecosystems Division
Region 9 EPA

Enclosures 1) EPA Rating System for Draft EISs
2) Detailed Comments

cc: ODEQ
CNCB
Klamath Tribe
Karuk Tribe
Hoopa Valley Tribe
Yurok Tribe
Reseghini Tribe
Quartz Valley Tribe
NOAA
Bureau of Reclamation
Department of Interior
USF&W
Cal-EPA
CA Resources Agency
State Water Quality Control Board
North Coast Regional Water Quality Control Board

Klamath Hydroelectric Project
Draft Environmental Impact Statement
EPA Detailed Comments

A. Analysis for Relevant State and Tribal Water Quality Standards

The analysis presented in the document indicates that waters within the Project do not meet the States of California or Oregon water quality criteria for temperature, dissolved oxygen, pH, and ammonia toxicity (pages 3-93, 96, 102, 105, 108, 113, 118). Accordingly, the States of Oregon and California have listed their portions of the Klamath River on their respective Section 303(d) lists of impaired waters. The draft EIS presents data showing the specific contribution of the Project to the exceedence of several water quality criteria.

The draft EIS indicates that, by causing a shift in the seasonal thermal regime, Copco No.1 and Iron Gate Dams directly impact the temperatures of the downstream Klamath River (see Figure 1 below). Temperature increases in the Fall are of particular concern because they would exceed the 2.8° C (5° F) allowable increase in California water quality criteria (Table 3-24). The draft EIS does not clearly explain how these increases are consistent with the California narrative criteria that state "At no time shall temperature be increased by more than 5º F above natural receiving water temperature." While the full impact of the dams on the applicable California water quality standards has not yet been fully analyzed in a TMDL, information presented by Bartholow, et al, 2003 (see Figures 2, 3, 4 and 5 below) indicates that significant reductions in Fall outflow temperatures would be needed to achieve California's applicable water quality criteria for temperature (no greater than 2.8° C increase).

Although the draft EIS does not analyze whether the dams can be modified to achieve California temperature standard, it does contain some analysis of the potential improvements achievable using a selective withdrawal system. From this analysis, the draft EIS concludes: "Sustained temperature relief of more than 2 weeks to the Klamath River via releases from Iron Gate Dam is not feasible. However, the cold water pool in Iron Gate has the potential to cool downstream temperatures on a short-term basis, and could be considered for extreme circumstances should environmental conditions trigger such a need (e.g., when large numbers of juvenile salmonids are present in the river under extreme temperature stress) (page 3-138)." Given that the Fall temperature impact of the Copco No.1 and Iron Gate Dams exceeds the 2.8° C water quality criteria for a period of months, it is not clear whether any of the alternatives would achieve water quality standards.

The draft EIS presents an analysis of temperature and dissolved oxygen criteria exceedences below Iron Gate Dam; temperature above and below J.C. Boyle; and, temperature within Copco No.1 and Iron Gate reservoirs, but similar analyses are not presented for all Project structures or for waters between the structures. Similarly, the draft EIS does not include a complete analysis of the Project's compliance with pH and ammonia water quality criteria. Data developed by Oregon and California in the course of their TMDL analysis indicates that there would be exceedences of temperature, dissolved oxygen, pH, and ammonia water quality criteria throughout the Project area at various times of the year (see attached model calibration results prepared by Tetra Tech (Figures 6, 7 and 8 below)).

Scoping comments provided by EPA for this Project, as well as EPA comments on the Notice of Application Ready for Environmental Analysis, recommended that the environmental analysis evaluate how the Project would meet standards of the Hoopa Valley Tribe. On October 18, 2006, the Hoopa Valley Tribe adopted numeric criteria specific to the Klamath River, including numeric criteria for nutrients, periphytin, dissolved oxygen, pH, and *Microcystis aeruginosa* and its toxin microcystin. In addition, the Karuk, Yurok, and Resighini Rancheria Tribes have adopted water quality standards under tribal law that are applicable to the Project area.

Recommendation:
We recommend that the final EIS include a more thorough analysis of all relevant water quality parameters for each Project structure and the waters between the structures and discuss the impacts the Project has on applicable state and tribal water quality standards. Such an evaluation would provide important information regarding whether a proposed alternative is consistent with all applicable state and tribal water quality standards.

Effects of J.C. Boyle Peaking on Maximum Temperatures

The draft EIS does not include an analysis of the impacts of peaking operations at the J.C. Boyle powerhouse on exceedences of the Oregon water quality temperature standard downstream from the dam. While the document discusses how the powerhouse increases the diel range of temperatures observed in the bypass reach, Oregon water quality standards include requirements to restrict human-caused increases to maximum temperatures. EPA performed a screening calculation on information in the draft EIS based on river flows and temperatures. Our calculation indicates that peaking may increase the maximum daily temperature downstream of the powerhouse compared to temperatures under steady powerhouse flows (see Figure 9 below).

Recommendation:
EPA recommends that the final EIS include a more thorough evaluation of the effects of peaking at the J.C. Boyle Dam on temperature and the implications for achieving Oregon water quality standards.

Ammonia Toxicity

High nutrient levels trigger ammonia toxicity criteria exceedences within the Project area. The draft EIS does not provide an adequate analysis of these exceedences; neither does it present adequate analysis of potential mitigation measures that could be implemented to achieve ammonia water quality standards.

Recommendation:
EPA recommends that the final EIS include an analysis of the potential contribution of the Project to ammonia toxicity and potential mitigation measures to address the Project's contributions if such exist.

Water Quality Within Reservoirs

The draft EIS does not fully evaluate water quality impacts within reservoirs. The analyses in the draft EIS focus on water quality conditions in the downstream reaches of the Project area (i.e., Iron Gate Dam), but do not fully evaluate Project impacts on water quality throughout the entire geographic scope of the Project. We believe Copco No.1 and Iron Gate reservoirs may experience prolonged water quality standard exceedences that are not addressed in the draft EIS.

Much of the discussions on alternatives to improve dissolved oxygen levels address the need to improve levels immediately below or downstream of the Project. Section 3.3.2.1.2 (Affected Environment – Water Quality) presents limited data on dissolved oxygen exceedences within the reservoirs, and the information that is presented only addresses exceeding the monthly mean threshold.

Recommendation:

We recommend that the final EIS include information on the length of time the 7.0 mg/l dissolved oxygen criteria (absolute minimum) in both Copco No.1 and Iron Gate Reservoirs are not met.

Measure 3P (on page 5-1) states that a reservoir oxygenation system at Iron Gate is needed to "prevent adverse downstream effects caused by seasonally low levels of DO in hypolimnetic generation flows." We recommend that the final EIS discuss potential adverse impacts this system would have on dissolved oxygen conditions within the reservoir, as well as potential mitigation.

Measure 4P (page 5-2), which describes the components of a single, comprehensive water quality management plan for all Project waters, appears to primarily focus on improving the dissolved oxygen conditions in the discharge of waters from its downstream boundary at Iron Gate Dam.

Recommendation:

EPA recommends that the plan include consideration of measures to improve dissolved oxygen levels throughout all layers of both Copco No.1 and Iron Gate Reservoirs, in order to attain water quality standards. In addition, we recommend that the plan address the other significant water quality concerns in the reservoirs such as elevated temperatures, nutrient levels, and pH, as well as potential mitigation.

Downstream Water Quality

The draft EIS does not discuss in sufficient detail the Project-related impacts downstream of the Project. The draft EIS states that the geographic scope of the analysis for water quality issues includes "the mainstem Klamath River to its confluence with the Pacific Ocean (page 3-3)." However, most of the analysis focuses on the area immediately downstream of Iron Gate Dam and the majority of the data presented in the draft EIS for temperature, dissolved oxygen, and nutrients is for the mainstem Klamath River to just above the confluence of the Shasta River.

Recommendation:
We recommend that the final EIS describe, in greater detail, project related impacts downstream of Shasta River such as an analysis of water quality impairments due to Project operations.

B. Proposed Mitigation Measures Regarding Water Quality Standards

Some of the potential mitigation measures analyzed in the draft EIS, such as selective withdrawal (temperature control structures) at Iron Gate Dam and aeration at discharge points and within reservoirs to address dissolved oxygen impacts, do not appear to be fully analyzed. The draft EIS considers some measures ineffective or their effects negligible based on limited analysis. On this basis, the draft EIS removes from consideration mitigation measures that could improve or meet water quality standards within and below the Project structures. As discussed below, we recommend additional analyses and information be included in the final EIS.

Reservoir Aeration

Water quality falls below the Oregon water quality criteria for dissolved oxygen in the deepest part of J.C. Boyle Reservoir and, based on preliminary modeling estimates, may not achieve the criteria immediately downstream of the powerhouse. One of the key water quality issues and impacts for this Project is low dissolved oxygen in the deepest parts of each reservoir. The draft EIS proposes the use of aeration of the reservoirs to mitigate this impact. Similarly, the draft EIS raises the concern for potential breakdown of the thermocline (area of rapid temperature change) and reduction in volume of cold water in hypolimnion (layer of water below the thermocline), due to the proposed in-reservoir aeration. EPA notes that the draft EIS does not provide examples in this region or elsewhere where such dissolved oxygen impacts were successfully mitigated by reservoir aeration and where thermocline breakdown due to aeration has occurred.

Recommendation
We recommend that the final EIS include examples of, and citations to, literature describing successful implementation of this technology to improve hypolimnetic oxygen concentrations and where aeration has led to the breakdown of the thermocline.

Supporting Information

The draft EIS states that dissolved oxygen concentrations measured at flows that range from 370 cfs to 2,400 cfs in the J.C. Boyle peaking reach meet applicable state water quality criteria without describing the basis for this statement. The draft EIS also states, without presenting supporting information, that there is no evidence that Run-of-River operation would result in increased dissolved oxygen levels (page 3-140).

Recommendation:
We recommend that the final EIS include documentation (e.g., measurement plots, model output plots, specific citations) to support these statements.

Use of Selective Withdrawal Systems for Iron Gate Dam

The draft EIS indicates that the use of temperature control structures (TCSs) would have negligible benefits to mitigating temperature impacts. In the part of the evaluation discussing the effectiveness of TCSs, the draft EIS assumes that all the cold water in the hypolimnion would be released as part of temperature mitigation with TCSs (page 3-137). We believe that the use of the cold water reservoir, managed and mixed with warmer waters to lower water temperatures, could more closely match natural conditions. Such an approach would not involve draining the entirety of the cold reservoir in the manner discussed in the draft EIS.

The draft EIS evaluation of selective withdrawal is limited to information about two model scenarios (page 3-138) and does not evaluate the capability of a multi-port selective withdrawal structure. We believe that the reduction of water temperatures by 0.5° C or 1.0° C, through mixing of these waters over several weeks or a month during critical periods, may mitigate water quality impacts and be an improvement for fisheries.

Recommendations:

EPA recommends that the following additional analysis and information be included in the final EIS:

(1) Consideration of capabilities of a multi-port, selective withdrawal structure per the recommendation of National Marine Fisheries Service.
(2) Additional scenarios (of varying duration) devised in consultation with agencies with fisheries expertise.
(3) Longitudinal graphs of model output showing temperature improvements of each scenario downstream to the ocean.
(4) Presentation of comparable information on average impacts of each cold water release scenario.
(5) Solicitation of fishery agency judgment on significance of estimated improvements.

Cyanobacterial or Blue-Green Algae Blooms

During the summer of 2005 and 2006, significant and sustained blooms of *Microcystis aeruginosa* (MSAE), a toxic producing cyanobacterium, occurred in both Copco No.1 and Iron Gate Reservoirs, producing high levels of microcystin, a liver toxin. These blooms lasted for several months (May through October), severely impacting recreational opportunities within the reservoirs and downstream, and representing an exceedence of several of California's water quality criteria. While there are no federal or state standards with regard to acceptable recreational exposures to MSAE and its toxins, the Water Quality Control Plan for the California North Coast Regional Water Quality Control Board (commonly referred to as the Basin Plan) contains several standards that are applicable to cyanobacterial (or blue-green algae) blooms. The Basin Plan designates beneficial uses of waters as well as the water quality criteria necessary to protect those uses. Relevant California water quality criteria include those for toxicity, biostimulatory substances, and tastes and odors. The extended summer blooms of blue-green algae in both Copco No.1 and Iron Gate Reservoirs represent exceedences of the Basin Plan criteria.

The Preferred Alternative in the draft EIS includes a measure to develop and implement a monitoring plan for MSAE and its toxin in Project reservoirs and immediately downstream of

Iron Gate Dam (Measure 6S). Monitoring data from 2005 and 2006 has demonstrated that the algae blooms from the reservoirs move downstream in the river and can produce both algae cell counts and toxin levels of concern much farther downstream than Iron Gate Dam. Based on this monitoring data from the past two summers, it is clear that the algae can migrate downstream and potentially exist at levels of concern, and potentially produce toxins at levels of concern. In addition, the Klamath River experiences multiple recreation uses in both the open water and reservoir sections of the river and provides important cultural and dietary benefits to the Native Americans (Yurok, Hoopa, Klamath and Karuk) who rely on the River. Potentially toxic levels of blue-green algae in the Klamath River can create health concerns for both Native Americans and the public in general, who recreate in and harvest migrating salmon from the River. While we support this monitoring requirement, it is unclear whether this measure would fully address the Project's impact on conditions in the River that enable or promote these cyanobacterial blooms. The draft EIS does not appear to analyze provisions to address conditions created by the Project that are conducive to the formation and duration of these blooms.

Recommendation:
We recommend expanding Measure 6S to include the development of a Cyanobacterial Management Plan that includes monitoring and management measures to address these blooms, such as: (1) monitoring for MSAE and its toxins in Iron Gate and Copco 1 Reservoirs; (2) monitoring for other species of blue-green algae or cyanobacteria, that are also likely to occur in these reservoirs, and their toxins; (3) analysis and implementation of measures (in conjunction with those developed under Measure 4P as part of a comprehensive water quality management plan) for preventing or minimizing occurrence of blooms, specifically by managing controllable factors that may enable or promote bloom conditions such as increased nutrient loadings, increased temperatures, greater water residence time, increased turbidity, and reduced vertical mixing; (4) analysis and implementation of options for controlling blooms, and minimizing public health exposures, when they do occur; and (5) monitoring for MSAE and other related species downstream of Iron Gate Dam to the mouth of the Pacific Ocean.

We further recommend the final EIS consider how PacifiCorp could work with the appropriate entities to provide public health advisory postings at project reservoir public access sites when algae cell counts or toxin levels exceed a pre-identified threshold level (such as the recreational guidance values developed by the World Health Organization). These posting measures could be integrated into measure 32P which discusses a "recreational resource management plan".

Evaluation of Algaecide Benefits and Adverse Impacts

The draft EIS discusses the need to evaluate both potential benefits as well as adverse impacts of potential management measures, citing use of algaecides to control blue-green algae blooms as an example (pages 3-148 and 3-149).

Recommendation:
We recommend that the final EIS consider that microcystis releases its toxin during cell death and, thus, use of algaecides such as copper sulfate could <u>increase</u> public health risks by increasing microcystin levels.

Limiting Nutrient for the Klamath System

The draft EIS indicates that the Klamath system is nitrogen-limited based on evaluation of nitrogen to phosphorus (N:P ratios). While the N:P ratio is a good screening metric for the evaluation of nutrient problems, other metrics should be considered when determining the limiting nutrient for a particular system. The nutrient analysis presented in the DEIS does not appear to consider the actual concentrations of nitrogen and phosphorus in the system.

In addition, the draft EIS indicates concludes that nitrogen is the limiting nutrient throughout the River and, thus, focuses on management measures to control nitrogen inputs. Literature on managing cyanobacterial blooms states that dual controls of both nitrogen and phosphorus are often required to effectively control bloom size, duration and spatial extent in the long-term (Paerl, HW, Fulton RS, Moisander PH, Dyble J (2001) Harmful Freshwater Algal Blooms, With an Emphasis on Cyanobacteria. The Scientific World 1:76-113).

Recommendation:

We recommend that the final EIS take into consideration that portions of the system may not be limited for nutrients and that phosphorus may be the limiting nutrient in some areas.

We also recommend that the final EIS include consideration and analysis of measures to reduce both nitrogen and phosphorus inputs, where appropriate, as a means to effectively control cyanobacterial blooms.

Inclusion of Keno Dam and Development in Project Analysis

The Preferred Alternative would decommission the Eastside and Westside developments, which are upstream of the Keno development. However, the draft EIS does not include the Keno Dam and development in the detailed analysis of the Project's impacts. Waters in the Keno development area currently do not meet water quality standards for pH, ammonia, nutrients, temperature, chlorophyll a, and dissolved oxygen (pages 3-102 and 3-132). Page 3-134 of the draft EIS states that the water quality at Keno Reservoir influences water quality at all downstream Project developments. In order to fully understand what opportunities are available for mitigation, additional analysis would be helpful to show specific contributions of the Keno system to exceedences of water quality standards. We agree with the draft EIS (page 3-134) that development of a water quality management plan that encompasses all project waters, not just Keno Reservoir, could be considered when specific remedial measures are developed. The development of this management plan could include consultation with all appropriate agencies and tribes.

Recommendation:

If the Keno Dam and development are considered part of the Project, we recommend that its associated water quality impacts be analyzed as direct impacts in the final EIS. If not included as part of the Project, its associated impacts should be analyzed as cumulative impacts in the final EIS.

CIP Process

The draft EIS refers to the Bureau of Reclamation's Conservation Implementation Program (CIP) as the forum in which water quality management plans should be developed (pages 3-133, 3-49, and 3-156). The Bureau's CIP process, as currently drafted, is focused on endangered species and does not include improving water quality as a primary objective. The CIP process does not specifically address Oregon or California water quality standards or TMDLs as part of its objectives and the States do not consider the CIP process as a means of implementing water quality mitigation measures. For this reason, we believe that the CIP process may not be an appropriate mechanism for the development of water quality management plans.

Recommendation:
We believe that allocations determined under the TMDL process are an effective basis for the Project-specific water quality management plans, and that management actions be directly linked to the TMDL Implementation Programs carried out by the two states.

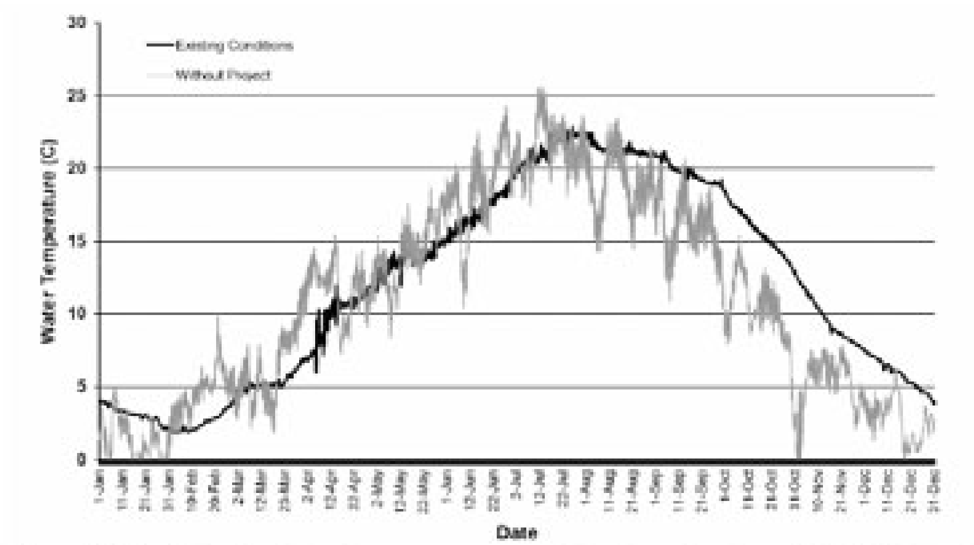


Figure 3-37. Simulated hourly water temperature below Iron Gate dam (RM 190.5) based on 2002 (considered a dry year) for existing conditions compared to hypothetical conditions without the existing Klamath Hydroelectric Project. (Source: PacifiCorp, response to AIR-AR-2, dated October 2005)

Figure 1 : Plot of Temperature Shift below Iron Gate Dam based on Pacificorp Model (draft EIS, Figure 3-37)

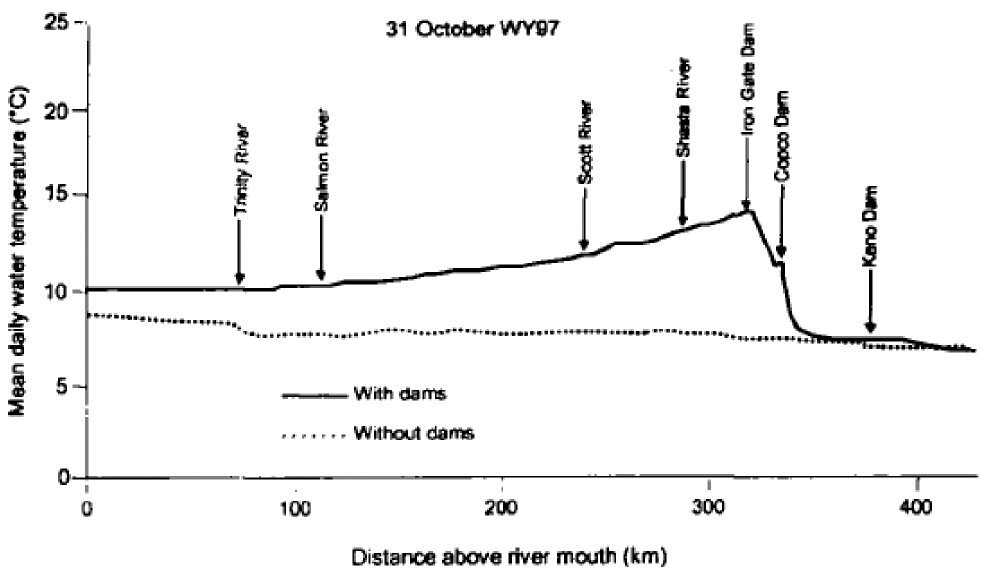


Figure 2: Longitudinal Temperature Effect of Fall Temperature Shift Based on USGS Model (Bartholow, et al, 2003)

Table 7. Recommended temperature ranges and time periods used as guidelines for biological evaluation. The upper limit of each range reflects the maximum recommended temperature for each West Coast salmon life stage (USEPA 2003). Time periods were adapted for fall Chinook salmon on the Klamath River from unpublished data (Shaw and others ND). The spawning temperature range also protects *in vivo* eggs.

Life stage	Mean daily temperature range	Time period
Spawning and egg incubation	4–14°C	1 October–15 April
Juvenile rearing	12–15°C	1 February–1 July
Adult migration	15–20°C	15 August–15 December

Figure 3 : Table of Fall Chinook Life Stage Temperature Guidelines (Bartholow, et al (2003))

Table 8. Mean annual chronic and acute degree-days (DD) at Iron Gate Dam, Seiad Valley, and near the ocean at Klamath, California for the *With* and *Without Dams* simulations for the period 1962–2001.

Location	*With Dams*		*Without Dams*	
	Chronic DD (>15°C)	Acute DD (>20°C)	Chronic DD (>15°C)	Acute DD (>20°C)
Iron Gate Dam	482	48	519	101
Seiad Valley	460	69	467	95
Klamath River at Klamath, California (near the Pacific Ocean)	439	55	449	64

Figure 4 : Effect of Dams on Degree Days above Temperature Thresholds (Bartholow, et al (2003))

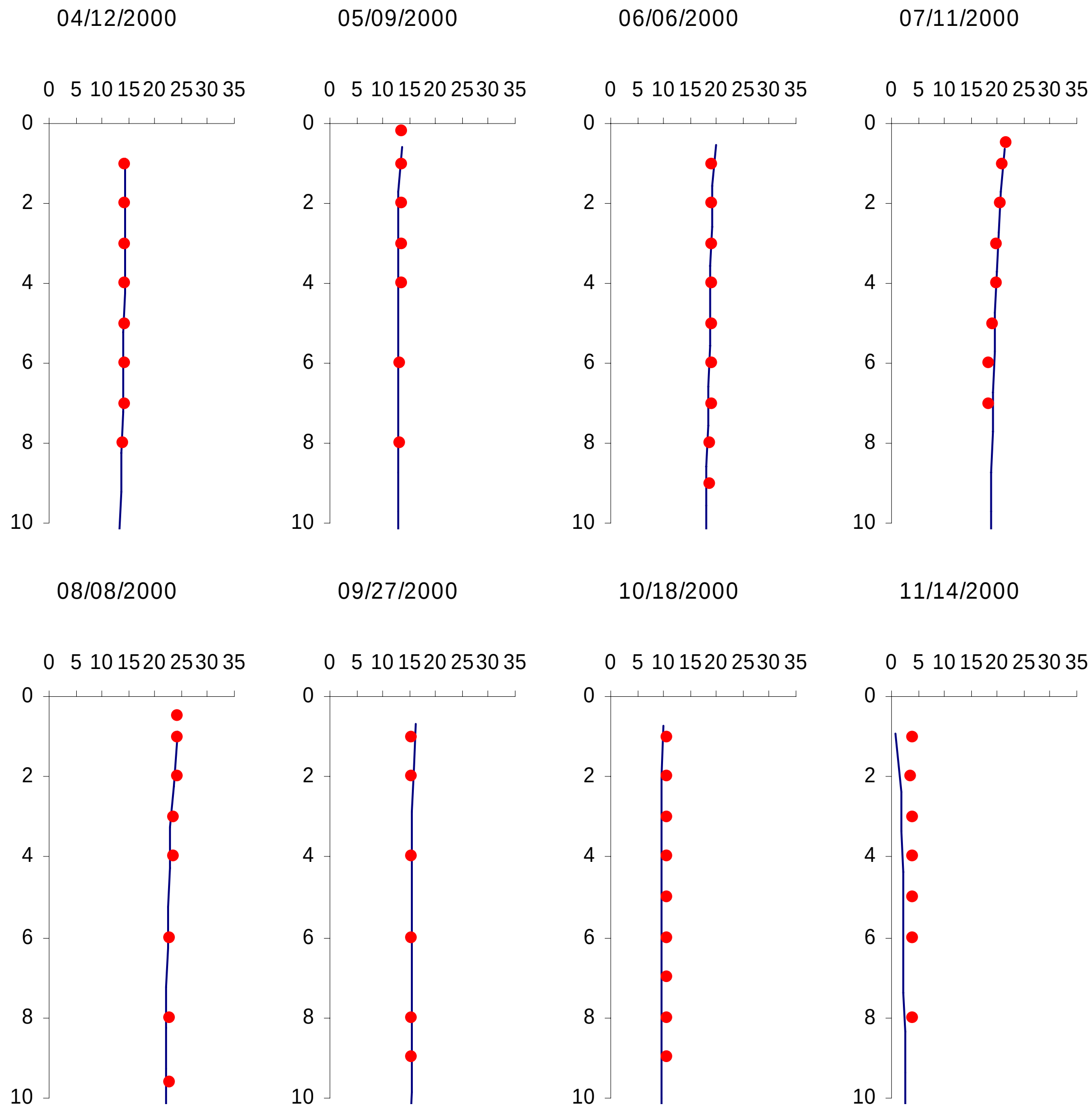
Table 9. Average annual number of days that temperatures exceed the maximum recommended temperature during time periods for three life stages of fall Chinook salmon at three locations on the Klamath River, California, for the period 1962–2001.

Lifestage (time period)	Iron Gate		Seiad Valley		Klamath, California	
	With Dams	*Without Dams*	*With Dams*	*Without Dams*	*With Dams*	*Without Dams*
Spawning and egg incubation, (1 Oct–15 Apr)	30	12	19	10	15	11
Juvenile rearing , (1 Feb–1 Jul)	49	60	48	53	53	58
Adult migration, (15 Aug–15 Dec)	33	23	28	23	21	19

Figure 5 : Effect of Dams on Number of Days above Temperature Thresholds (Bartholow, et al (2003))

Reference

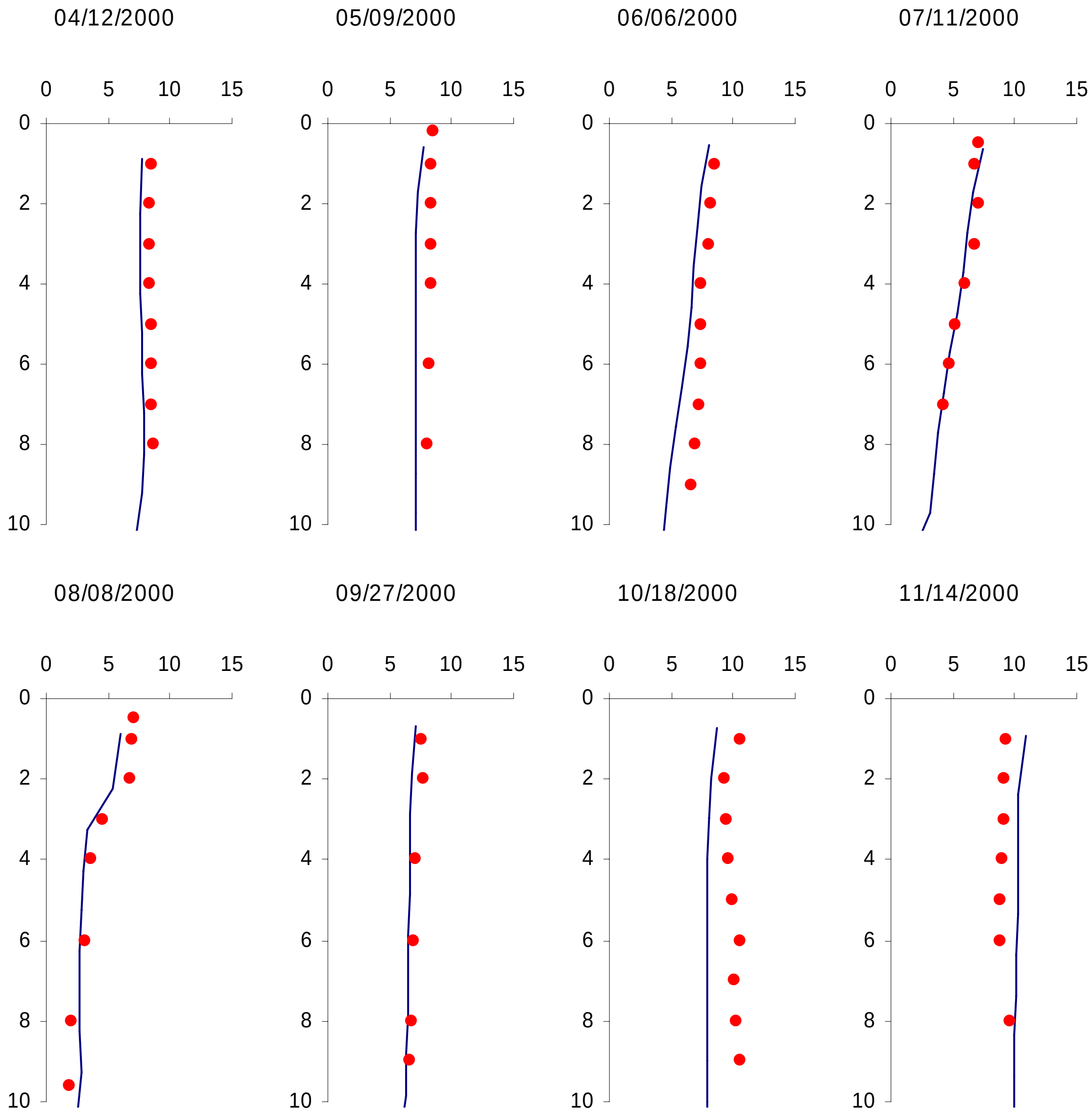
Bartholow, J., Campbell, S., and Flug, M. Predicting the Thermal Effects of Dam Removal on the Klamath River. USGS. In Press, Environmental Management. Attachment to Transmittal Letter from Department of Interior to FERC regarding Relicensing of Klamath River Hydroelectric . September 2004.



KR22505 - JC Boyle Reservoir at Deepest Point – **Temperature (° C)**

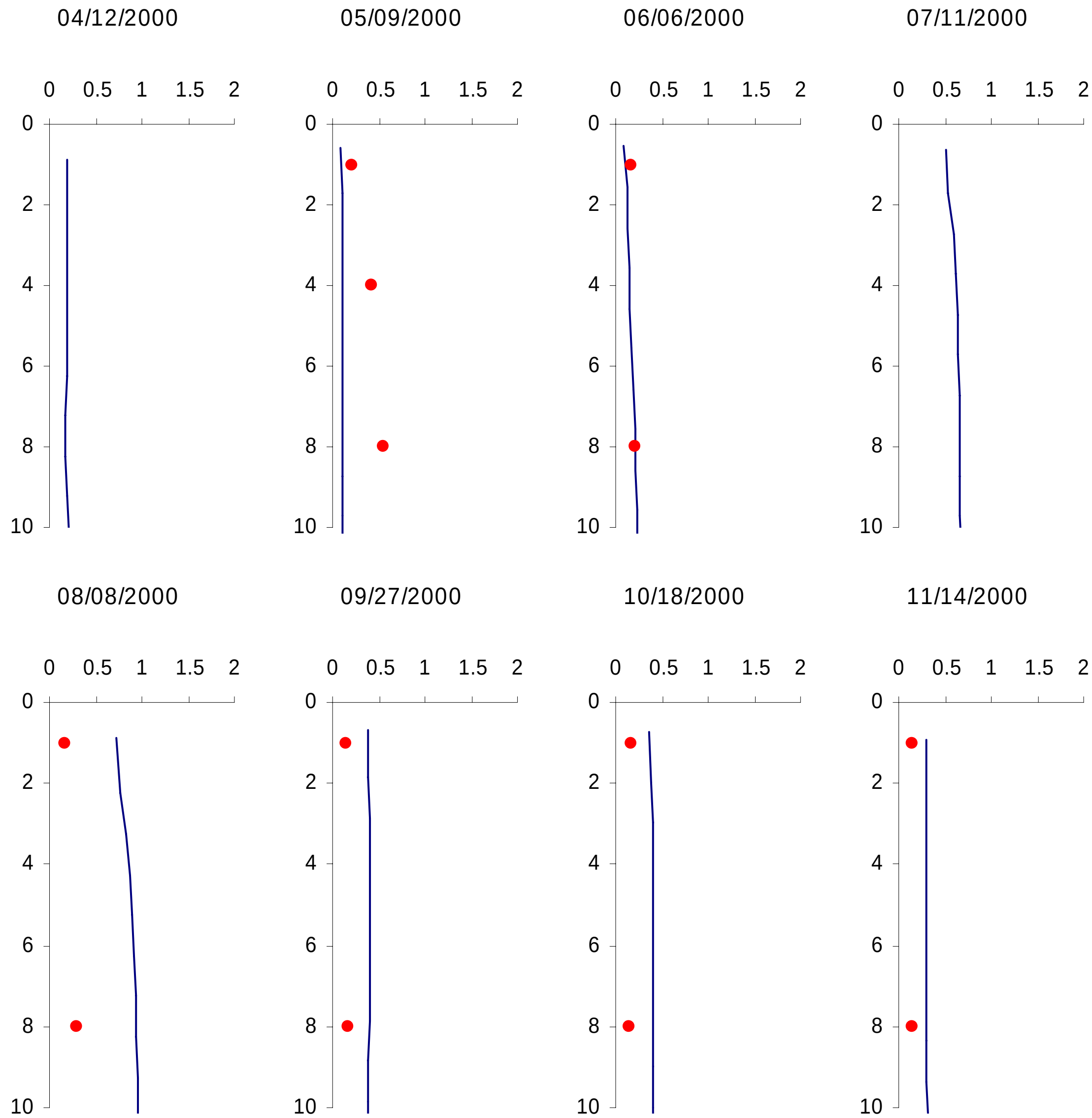
Note: Vertical profiles with X-axis Temperature (° C) and Y-axis Depth (m)

Figure 6: Plots from Tetra Tech Draft Modeling Report (unpublished) showing calibration runs for various water quality parameters compared to their current conditions monitoring results.



KR22505 - JC Boyle Reservoir at Deepest Point – **Dissolved Oxygen (mg/L)**
Note: Vertical profiles with X-axis Dissolved Oxygen (mg/L) and Y-axis Depth (m)

Figure 7: Plots from Tetra Tech Draft Modeling Report (unpublished) showing calibration runs for various water quality parameters compared to their current conditions monitoring results.



KR22505 - JC Boyle Reservoir at Deepest Point – **Ammonia (mg/L)**
Note: Vertical profiles with X-axis Ammonia (mg/L) and Y-axis Depth (m)

Figure 8: Plots from Tetra Tech Draft Modeling Report (unpublished) showing calibration runs for various water quality parameters compared to their current conditions monitoring results.

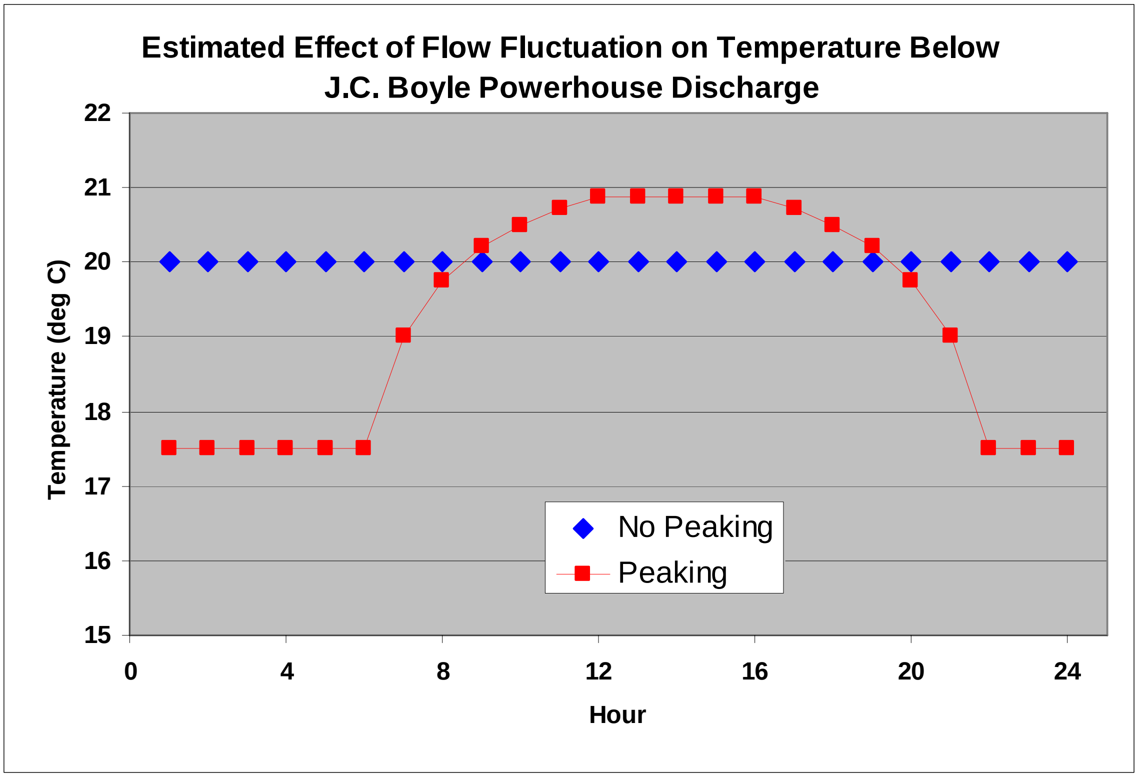


Figure 9: Estimated Effects of Flow Fluctuation on Temperature Below J.C. Boyle Powerhouse Discharge.