

March 28, 2008

MEMORANDUM FOR: Robert Steed, Idaho Department of Environmental Quality  
Paul Picket / Karin Baldwin, Washington Department of Ecology  
Don Martin, Environmental Protection Agency  
Michele Wingert, Kalispel Tribe of Indians

SUBJECT: COE Comments on DEQ Analysis of the Idaho Pend Oreille River Model

The following memorandum contains comments from the Seattle District Corps of Engineers (Seattle District) regarding the February 24, 2008 *DEQ Analyses of the Idaho Pend Oreille River Model, Model Scenario Simulations, Revised Technical Report, October 2007* prepared by Idaho Department of Environmental Quality. Comments were provided by Kent Easthouse and Ed Zapel, Seattle District Corps of Engineers.

## 1. Idaho Water Quality Criteria and Their Application

**Comment 1:** IDEQ states that the water quality “*standard does not allow for manipulation of water temperature data, such as the calculation of volume-weighted temperature (IDAPA 58.01.02.250.02).*” The Seattle District cannot find a specific reference or guideline in IDAPA 58.01.02.250.02 that states how to apply the temperature data calculated by a 2-dimensional water quality model to state standards. IDEQ approved the use of volume/flow weighted CE-QUAL-W2 and Mike 11 temperature data for the Snake River-Hells Canyon Complex TMDL. Also, IDEQ compared volume weighted Total Dissolved Gas data to water quality standards for the King Hill-CJ Strike reservoir TMDL. Moreover, any IDEQ temperature TMDL or 401 Certification using 1-D models such as Qual 2k, Mike 11, or Heat Source are inherently based on volume or flow weighted data. Models such as Mike 11 or Qual 2k are 1-dimensional and model an average water column temperature.

**Comment 2:** The Seattle District agrees that the 10% exceedance provision is not to be used to determine compliance with IDEQ temperature standards and only applies for determination of beneficial use support status. However, the Seattle District believes that the 303d/305b integrated report states that the 10% exceedance policy applies to 303d listing and de-listing, not just listing, as shown below:

### *Temperature*

*DEQ has a weight of evidence policy for pH, dissolved oxygen, temperature, and turbidity. In part, this policy allows deference to biological health in judging whether a water supports cold water aquatic life use when exceedance of numeric temperature criteria is infrequent (<10%). This policy applies to 303(d) listing and de-listing decisions only, and is not for determining compliance with the WQS for other purposes. While necessary to target the current water quality criteria in drafting a TMDL, if the frequency of exceedance of the temperature criteria is less*

*than 10%, and there is no other evidence of thermal impairment, then it is possible to propose de-listing. If a temperature TMDL is established, then, during implementation of the TMDL, the water will be reassessed. In that reassessment, the goal for temperature would be considered met if frequency of criteria exceedances falls below 10% for a 90 percentile air temperature of a yearly series of the maximum weekly maximum air temperature (MWMT) calculated over the historic record measured at the nearest weather reporting station (WQS §058.01.02.80.04).*

**Comment 3:** Please provide a reference for the statement that “*The beneficial use support status for the Pend Oreille River has been previously determined, and listed. There are no biological parameters indicating full support*”. The Seattle District can find little biological and aquatic evaluation information or studies used to determine the biological health of the Pend Oreille River and would appreciate references to any known studies. The Seattle District recommends that any evaluations of the beneficial use support status and biological health of the Pend Oreille River should include the CE-QUAL-W2 temperature modeling data that predicts temperatures for the natural river to be very warm and similar to existing condition temperatures. The warm river temperatures predicted by CE-QUAL-W2 for the natural condition suggest that any changes/reductions in population strengths of cold water fisheries or aquatic insects in the Pend Oreille River may not be due to increased water temperatures resulting from Albeni Falls Dam but may instead be due to changes in river flow and elevation. Temperature, flow, and elevation should be evaluated and assessed in regards to the biological health of the river.

**Comment 4:** The temperature threshold is calculated wrong for Fahrenheit and should be 93.0°F (33.9°C) and not 97.0°F (33.9°C). The Seattle District reviewed the temperature data from 2004 collected at the Sandpoint Experiment Station of the National Climatic Data Center and noted that temperatures for August 14<sup>th</sup> and 15<sup>th</sup>, 2004 are missing from the data set. Temperatures from surrounding weather stations in the Idaho Panhandle indicate that the 14<sup>th</sup> and 15<sup>th</sup> of August were very hot. For example, the temperature at the Priest River Experiment Station of the National Climatic Data Center on August 14<sup>th</sup> was 98°F and on August 15<sup>th</sup> was 94°F, while the temperature at the Newport Station of the National Climatic Data Center on August 14<sup>th</sup> was 99°F and on August 15<sup>th</sup> was 97°F. Temperature at the Sandpoint Airport (Station KSZT) for August 14<sup>th</sup> was 96.8 °F and for August 15<sup>th</sup> was 91.4°F. The Seattle District requests clarification on the IDEQ protocol to deal with missing air temperature data.

## 2. Beneficial Use Support Status

**Comment 5:** This section needs to clearly state that there is little biological data to assess the beneficial use support status and biological health of cold water organisms in the Pend Oreille River.

**Comment 6:** The statement “*While the majority of cold-water organisms (esp. aquatic insects) have not been evaluated in this water body, three salmonid fish species in the Pend Oreille River are likely to have reduced population strength as a result of excess water temperatures...*” implies that the existing water temperatures are warmer than natural water temperatures to such a degree as to have reduced the population strength of three salmonid fish species. The results of

the CE-QUAL-W2 model do not justify such a statement as there are only slight differences (both warmer and cooler) between modeled natural and existing temperatures. Recommend this section be revised to more clearly state that studies are needed to determine the impacts, if any, of existing vs. natural temperatures on cold water organisms in the Pend Oreille River.

**Comment 7:** The Seattle District agrees that studies to evaluate possible temperature impacts to cold water organisms should be conducted for the Pend Oreille River in Idaho to quantify and determine the extent of beneficial use impairment. This evaluation must consider the most recent model temperature data for the natural condition and assess if predicted temperature differences between the natural condition and the existing condition would have a negative, positive, or no impact on cold water organisms. It is recommended that this study also evaluate the impacts of altered river flow and elevation on cold water organisms to determine the overall beneficial use support status and biological health of the Pend Oreille River.

### **3. Evaluation of Temperature Model Results and Idaho Water Quality Criteria**

**Comment 8:** The Seattle District has commented previously on the use of bottom cells and surface cells as compliance areas. In summary, the Seattle District strongly recommends that bottom cells not be used for compliance. Specifically, the bottom cells at the 10 km and 35km compliance locations are isolated cells with little flow. Diffusion is the main transport mechanism available in the model for water quality constituents of interest in these isolated cells. Model results show that these compliance points represent isolated bottom cells that have unreliable data and can produce erroneous temperatures. The Pend Oreille River Temperature TMDL is setting precedents and the use of an isolated bottom cell as a compliance location, even if it is given a lower priority, would be poor scientific judgment. The Seattle District recommends that IDEQ remove the bottom cell compliance locations and requests that this issue be brought up to the WAG for discussion.

Similarly, the Seattle District recommends that surface cells not be used for compliance areas because of the greater uncertainty and model error associated with surface cells exposed to input parameters such as wind, wind sheltering coefficients, solar radiation, air temperature etc. Please see Appendix B of the November 9, 2007 comments for a review of surface cell uncertainty and error.

### **4. Assumption and Modeling Error**

**Comment 9:** The Seattle District has commented previously on model error. In summary, the Seattle District maintains that model errors between the “existing” and “natural” scenarios will not cancel each other out because of (1) the difference in travel time between the two scenarios, and (2) the difference in model structure between the two scenarios. The Seattle District clearly showed in the November 9, 2007 comments that an error in temperature introduced at the boundary condition in late April 2004 for both the “natural” and “existing” scenarios propagated down river at different rates resulting in an erroneous violation of Washington water quality standards at the state line in early May 2004. Moreover, the “natural” scenario model and the

“existing” scenario model are not identical as they have different boundary conditions, channel configurations, model mesh set ups, hydrologic forcing functions and other differences in order to simulate the Pend Oreille River with and without Albeni Falls Dam. Consequently, comparison of model data from a single cell at an instant in time from two model runs with different travel times without accounting for model uncertainty and error is not valid because errors introduced into the model will not be the same at that instant in time for the two scenarios.

The statement that the accuracy of the model is not important when comparing scenarios because error in the model results would be similar between scenarios is not applicable in the current investigation of Pend Oreille River temperature particularly where much of the analysis is based on the properties of surface warming with and without Albeni Falls Dam. IDEQ has agreed that modeling errors introduced at the upstream boundary propagate at different rates and thus do not cancel out when comparing thermal conditions at specific points in space and time. The COE identified this source of error as being responsible for the apparent thermal impairments identified by the State of Washington at the border with Idaho in April/May of 2004. As a result, Washington has removed this thermal event as evidence of impairment. The model error in predicting surface temperatures has been identified to be very large relative to the 0.3 C threshold that is being used to determine temperature impairment. Surface temperature data collected in the Pend Oreille River near Riley Creek during the summer of 2004 shows that the IDEQ model predicted estimates of daily maximum surface temperatures for the existing condition overestimate actual observed conditions by an average of 1 °C.

## 5. Evaluation Areas

**General Comment:** The Seattle District prepared a draft report titled *Frequency analysis of CE-QUAL-W2 modeled “existing” and “natural” surface daily maximum, average, and volume weighted temperatures in the Idaho section of the Pend Oreille River* which was sent to IDEQ, WDOE, EPA, and the Kalispell Tribe on February 21, 2008. It is recommended that the frequency analysis results presented in the above document be included in the evaluation of the compliance areas.

## 6. Evaluation Area 1-Surface Cell Daily Average at 10km

**Comment 10:** Recommend that the combined comparison analysis analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. These evaluations would provide valuable data to the reader on the nature and extent of the water quality standard exceedance. It is recommended that frequency analysis be used to better assess the overall change in modeled temperatures for a selected time period. Assessing the overall systemic temperature change instead of the instantaneous daily temperature change can account for the natural variability in water temperatures represented by modeled scenarios where travel time differences and lag times between model runs influence the timing and location of daily maximum and minimum temperatures. In this manner, the frequency of “existing” and “natural” model scenarios exceeding the Idaho daily average standard (19 °C) and daily maximum standard (22 °C) can be compared to determine impacts to the Pend Oreille River rather than looking solely at the daily temperature difference between the two model scenarios which will

not account for any travel time differences in model scenarios. The Seattle District prepared a draft report titled *Frequency analysis of CE-QUAL-W2 modeled “existing” and “natural” surface daily maximum, average, and volume weighted temperatures in the Idaho section of the Pend Oreille River* that should be used to better assess each evaluation area.

**Comment 11:** Recommend calculating the number of days and percent of time exceeding IDEQ standards for the critical 93 day time period June 21 to September 21 in order to make site to site comparisons and to follow WBAG II guideline examples. It is recommended that IDEQ analyze and discuss the time series, frequency analysis, and duration data for each Evaluation Area.

**Comment 12:** Time series analysis shows that during periods when the Pend Oreille River is cooling during the summer (due to summer cold fronts), the existing condition daily average temperature cools slower than the natural condition by about 1 or 2 days, resulting in nearly all of the noted exceedances of water quality standards. In general, temperature exceedances do not occur during the warmest periods. The Seattle District generated frequency analysis curves for this compliance area that clearly show that Albeni Falls Dam has both had a warming and cooling influence on the river at this location. Existing conditions tend to be warmer than natural conditions for temperatures below about 22°C and cooler than natural conditions for temperatures greater than 22 °C.

## **7. Evaluation Area 2-Bottom Cell Daily Average at 10km**

**Comment 13:** The Seattle District recommends that the analysis explain the extremely cool temperatures in the bottom cell at this location. The analysis should note that the bottom cell temperatures at this location during the June 21 to September 21 time period are far cooler than the boundary condition temperatures and likely represent cold water that has become “stuck” in the cell and cannot mix with other water due to the isolated nature of the cell.

## **8. Evaluation Area 3-Volume Weighted Daily Average at 10km**

**Comment 14:** Volume weighted data accounted for 3 out of 13 compliance areas presented to the WAG at the March 20, 2007 meeting. In addition, the July 23, 2007 IDEQ assessment of the modeling results concluded that the 3 compliance areas’ volume weighted temperature data were meeting Idaho Water Quality Standards. The Seattle District does not understand how in the most recent February 24, 2008 assessment that IDEQ states that *Idaho does not have temperature criteria for volume-weighted water temperature*. Please provide an explanation for the initial inclusion of a volume-weighted compliance area and the subsequent exclusion of same.

**Comment 15:** The combined comparison analysis should analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. Recommendations for these analysis were given in the **Evaluation Area 1 Comment 10 and Comment 11**.

Time series analysis shows that during periods when the Pend Oreille River is cooling during late August and early September (due to near record cold temperatures from August 23-29) the

existing condition volume-weighted temperatures cool more slowly than the natural condition by about 3 or 4 days, resulting in all of the exceedances of water quality standards. No volume-weighted temperature exceedances occurred during warming periods. The Seattle District generated frequency analysis curves for this compliance area that clearly show that Albeni Falls Dam has had cooling influence on volume-weighted temperatures at this location. It is recommended that IDEQ analyze and discuss the time series, frequency, and duration data.

## 9. Evaluation Area 4-Surface Daily Average at 35km

**Comment 16:** The combined comparison analysis should analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. Recommendations for these analysis were given in the **Evaluation Area 1 Comment 10 and Comment 11**.

Time series analysis shows that during periods when the Pend Oreille River is cooling during the summer, the existing condition surface daily average temperatures at this location cools more slowly than the natural condition by about 1 to 4 days resulting in a majority of the exceedances of water quality standards. No surface daily average temperature exceedances occurred during the warmest periods. The Seattle District generated frequency analysis curves for this compliance area that suggest that Albeni Falls Dam has both had a warming and cooling influence on the daily average temperature at this location. Existing conditions tend to be warmer than natural for temperatures below about 22 °C and cooler than natural for temperatures greater than 22 °C. It is recommended that IDEQ analyze and discuss the time series, frequency, and duration data.

## 10. Evaluation Area 5-Bottom Cell Daily Average at 35km

**Comment 17:** The combined comparison analysis should analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. Recommendations for these analysis were given in the **Evaluation Area 1 Comment 10 and Comment 11**.

Analysis of the existing condition bottom cell temperatures at the 35km location reveal that temperatures change by more than 2°C in one day on July 9<sup>th</sup> and then remain nearly constant from about July 10<sup>th</sup> to September 1<sup>st</sup>, when they abruptly increase by about 1°C and then gradually decrease in September. These abrupt 1 to 2°C changes in temperature in a single day, and the 1.5 month of constant temperatures in the middle of the summer are likely due to water being ‘stuck’ in isolated bottom cells and abruptly being mixed out of the cell when flow conditions allow mixing to occur. It is the Seattle District’s opinion that these bottom cell temperatures do not represent an accurate thermal response of the bottom of the river but merely reflect the inability of the model to accurately move water in and out of isolated bottom cells. The Seattle District recommends that IDEQ analyze the 35 km bottom cell temperatures to determine if predicted temperatures make physical sense.

## 11. Evaluation Area 6-Volume Weighted Daily Average at 35km

**Comment 18:** See comments provided for **Evaluation Area 3**.

**Comment 19:** Evaluation of time series data show that existing condition volume-weighted daily average data cool more slowly than natural conditions by 1 to 4 days. All temperature exceedances are during these cooling periods and no exceedances occurred when the Pend Oreille River is warmest. The Seattle District generated frequency analysis curves for this compliance area that show that Albeni Falls Dam has a cooling influence on the volume weighted daily temperatures in the Pend Oreille River. Existing conditions are cooler than natural for all temperatures at this evaluation area. It is recommended that IDEQ analyze and discuss the time series, frequency, and duration data.

## 12. Evaluation Area 7-Albeni Falls Outflow

**Comment 20:** The combined comparison analysis should analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. Recommendations for these analysis were given in the **Evaluation Area 1 Comment 10 and Comment 11**.

## 13. Evaluation Area 8-Surface Daily Maximum at 10km

**Comment 21:** The combined comparison analysis should analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. Recommendations for these analysis were given in the **Evaluation Area 1 Comment 10 and Comment 11**.

**Comment 22:** Evaluation of time series data show that existing condition surface daily maximum data warm and cool similar to natural conditions. All temperature exceedances except for July 24<sup>th</sup> were during cooling periods. The Seattle District generated frequency analysis curves for this compliance area that show that existing conditions at this location results in cooler surface daily maximum temperatures than natural conditions except for a slight warming of the water in the 22 °C to 23 °C range. It is recommended that IDEQ analyze and discuss the time series, frequency, and duration data.

## 14. Evaluation Area 9-Surface Daily Maximum at 35km

**Comment 23:** The combined comparison analysis should analyze the temporal pattern, frequency and duration of the exceedances of Idaho water quality standard. Recommendations for these analysis were given in the **Evaluation Area 1 Comment 10 and Comment 11**.

**Comment 24:** The Seattle District model results do not show an exceedance on July 9<sup>th</sup>. Please re-check evaluation.

**Comment 25:** Evaluation of time series data show that existing condition surface daily maximum data warm and cool similar to natural conditions. All temperature exceedances except

for July 24<sup>th</sup> were during cooling periods. The Seattle District generated frequency analysis curves for this compliance area that show that existing condition has both cooler and warmer conditions, but is generally warmer at temperatures greater than 24 °C. It is recommended that IDEQ analyze and discuss the time series, frequency, and duration data.

**Comment 26:** The Seattle District conducted a sensitivity analysis using a corrected lake elevation rating curve based on actual and readily available historical lake elevation records collected prior to the construction of Albeni Falls Dam. The results show that using the more realistic and accurate higher lake elevation in the summer has the greatest impact on surface daily maximum temperatures at the 35km location. Existing surface daily maximum temperatures are up to 1°C cooler using the corrected lake elevation. Please see the February 21, 2008 Draft Frequency Analysis conducted by the Seattle District for additional details and results.

## 15. Evaluation Area 13-Longitudinal Cross Section, August 8, 2004

**Comment 27:** Please state that the longitudinal cross section is for August 8, 2004 at 17:58. It does not represent the entire day, only a specific point in time at 17:58.

**Comment 28:** IDEQ states that the August 8<sup>th</sup> date represents *a hot day when maximum entrainment of the hypolimnion is occurring*. This statement is incorrect, as August 8<sup>th</sup> represented a relatively cold summer day with a maximum air temperature of 72°F and was at the end of a cool and windy period that started on August 6<sup>th</sup>. Maximum air temperatures recorded in Sandpoint were:

▪	August 1	88
▪	August 2	94
▪	August 3	93
▪	August 4	Missing
▪	August 5	84
▪	August 6	76
▪	August 7	72
▪	<b>August 8</b>	<b>72</b>
▪	August 9	79
▪	August 10	85

The weather played a critical role in the development of the longitudinal profile on August 8<sup>th</sup>. Cool water started to enter the Pend Oreille River from Lake Pend Oreille on August 6<sup>th</sup> not August 8<sup>th</sup>, likely due to a combination of windy conditions creating seiching activity bringing cool water to the surface, and cool air temperatures/wind cooling down the river. This abrupt change in weather resulted in cool water entering the Pend Oreille River between August 6<sup>th</sup> and August 8<sup>th</sup>. This cold water traveled down the river at different rates between the existing and natural scenarios because of the difference in travel time between the two scenarios. The Seattle District maintains that the instantaneous temperature comparisons at any cell in the longitudinal cross section on August 8, 2004 at 17:58 is not valid because it is comparing a pulse of cold water traveling down two systems that have different travel times. The shallower faster moving

natural system will transport the colder water at a different rate than the deeper slower moving existing condition. To compare two systems with different travel times at an instant in time at any location when a pulse of cold water is moving through the system is not a valid comparison. IDEQ's contractor that developed the model (Portland State University) stated in the model results report that for the longitudinal profiles "*there is a time lag of 71.4 hours between the two scenarios for August 8<sup>th</sup> ... This indicates that during this time period it takes over 70 hours (more) for water travel through the Long Bridge to Albeni Falls Dam in Scenario 1 (existing) than in Scenario 8(natural). The difference in travel times between the scenarios will influence the location of daily peak temperatures in each scenario*".

**Comment 29:** The Seattle District maintains that such a compliance metric has no precedent in Idaho TMDL work or 401 Certifications and questions why this metric is being applied on the Pend Oreille River TMDL. The temperature difference between conditions at a point in space and time is primarily a function of the different flow conditions and not an indication of a change in the thermal load to the Pend Oreille River. The thermal comparison in this case simply identifies differences between two different parcels of water with different initial conditions when introduced to the Pend Oreille River and different exposure histories to atmospheric heat exchange processes. Use of the daily maximum and daily average compliance metrics are available to IDEQ and have been used for all other TMDLs and 401 Certifications.