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

April 16, 2010

Reply To
Attn Of: OEA-095

MEMORANDUM

To: File

From: Ben Cope, Environmental Engineer
Office of Environmental Assessment

Re: Response to Limnotech Comments on Spokane TMDL Model Stability

EPA, in consultation with Portland State University, has reviewed the March 11, 2010 Limnotech memo to Sid Frederickson[1]; as well as the three excel spreadsheets subsequently sent to the Washington Department of Ecology, at Ecology's request, by Dave Dilks of Limnotech on April 14, 2010. The Limnotech memo claims that there are flow inconsistencies in the model, and the resulting "instability" leads to inconsistent dissolved oxygen (DO) predictions. The model is the central analytical tool of the TMDL, so it is important to investigate concerns of this kind.

We see no evidence of a "stability problem" in the Spokane River model. The following flow plot in the Limnotech memo was presented as evidence of a problem:

[1] Attachment 9 to the March 11, 2010, letter from Clay Larkin, City of Post Falls and Ronald McIntire, Chairman of Hayden Area Regional Sewer Board, to Ted Sturdevant, Director of the Washington Department of Ecology.

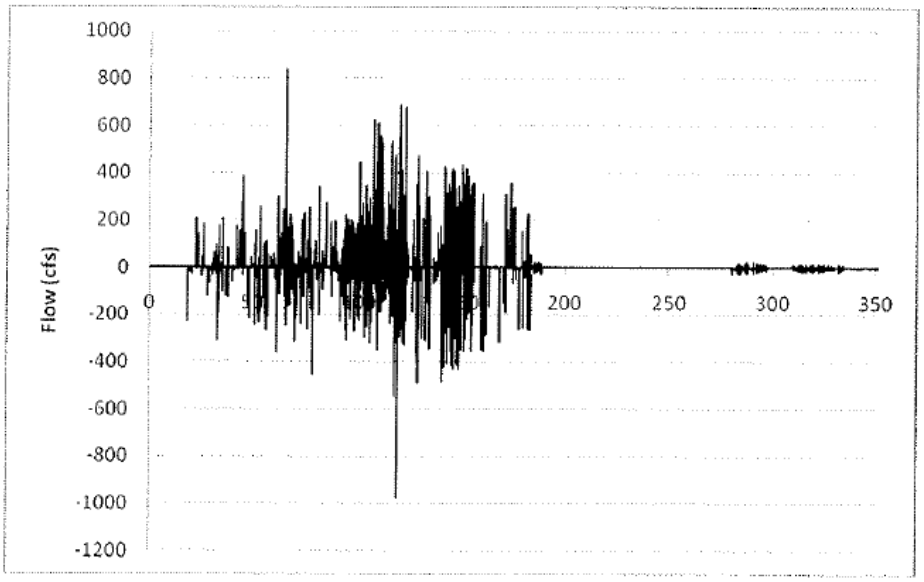


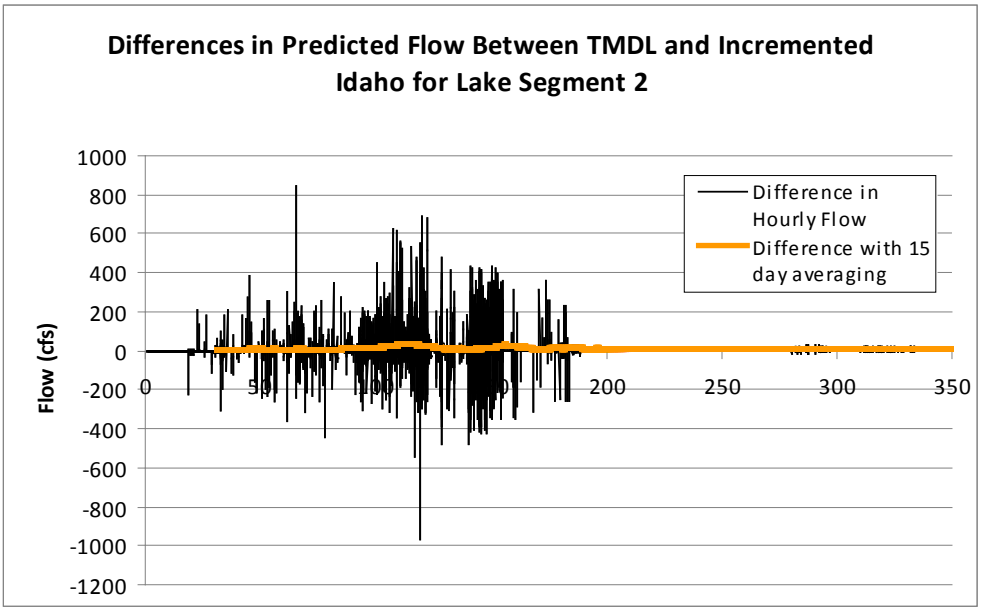
Figure 4.

Differences in Predicted Flow between TMDL and Incremented Idaho for Lake Segment 2

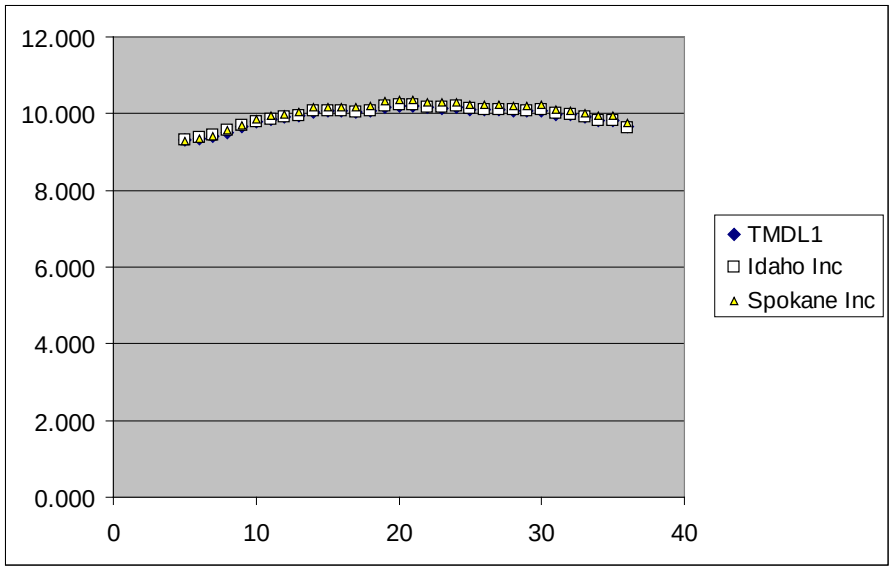
In fact, this plot represents a known feature of the water balance in the model. In order to allow for ease in running scenarios with varying boundary inflows, the model includes a "pump" feature at Nine Mile Dam. The pump turns on and off during the model run to maintain the correct flows and water elevations (based on 2001 data) behind the dam. Small changes in water constituents and density can make the pump switch on at slightly different times, creating slight phase shifts. At a given hour (the model outputs hourly information), the pump may have turned on in one simulation and not in another. The above plot is an hourly data comparison.

These small phase differences are not a problematic "stability issue" provided (1) the overall flow balance is equal between scenarios at a longer time frame, e.g., 2 week averages per the TMDL assessment of the lake, and (2) model simulations for DO are generally consistent between scenarios.

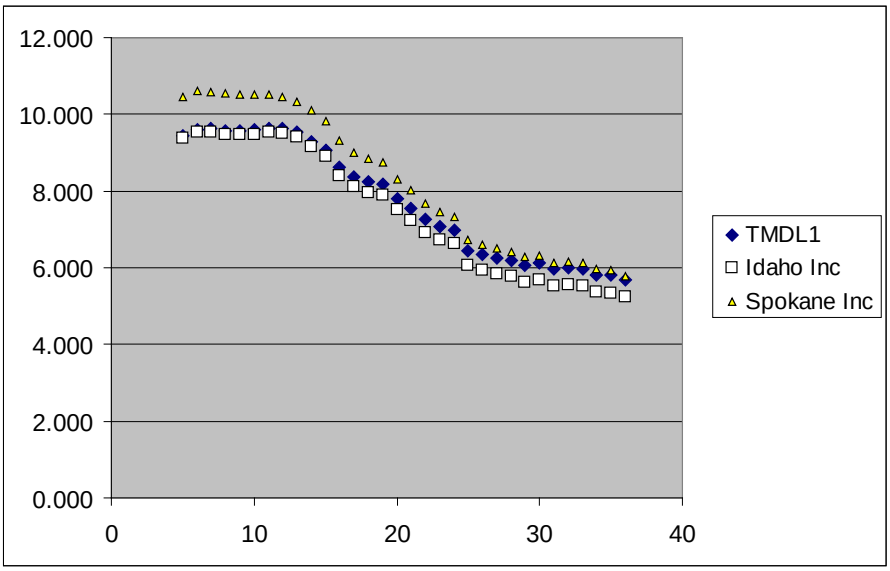
On the first point, we have plotted the 2-week average flows for the same information plotted by Limnotech, and this shows that the flow balance is virtually identical for each scenario at time scales of importance to the TMDL:



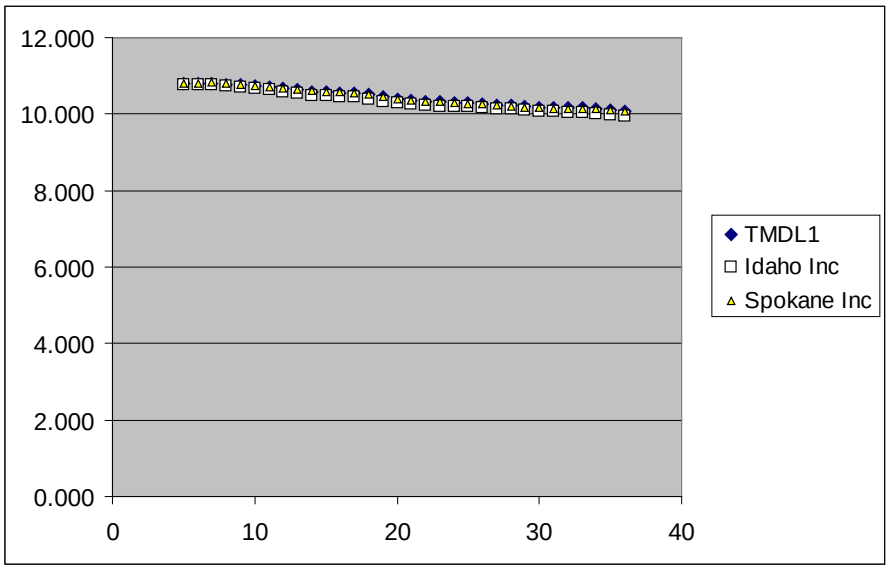
As an additional line of evidence that the model is performing reasonably, we requested Limnotech's dissolved oxygen outputs and assessed the "stability" of the predictions during periods when there is no difference between the scenarios, i.e., early and late in the year. The following three plots show DO conditions (y axis) by segment (x axis) in Lake Spokane. The plot show predictions for two-week average DO in early May (prior to the scenario differences), late-July (during a period when the scenarios differ), and late-November (after the scenario differences). As is clear in this comparison, the model provides consistent results when the scenario conditions are consistent:



Early May



Late July

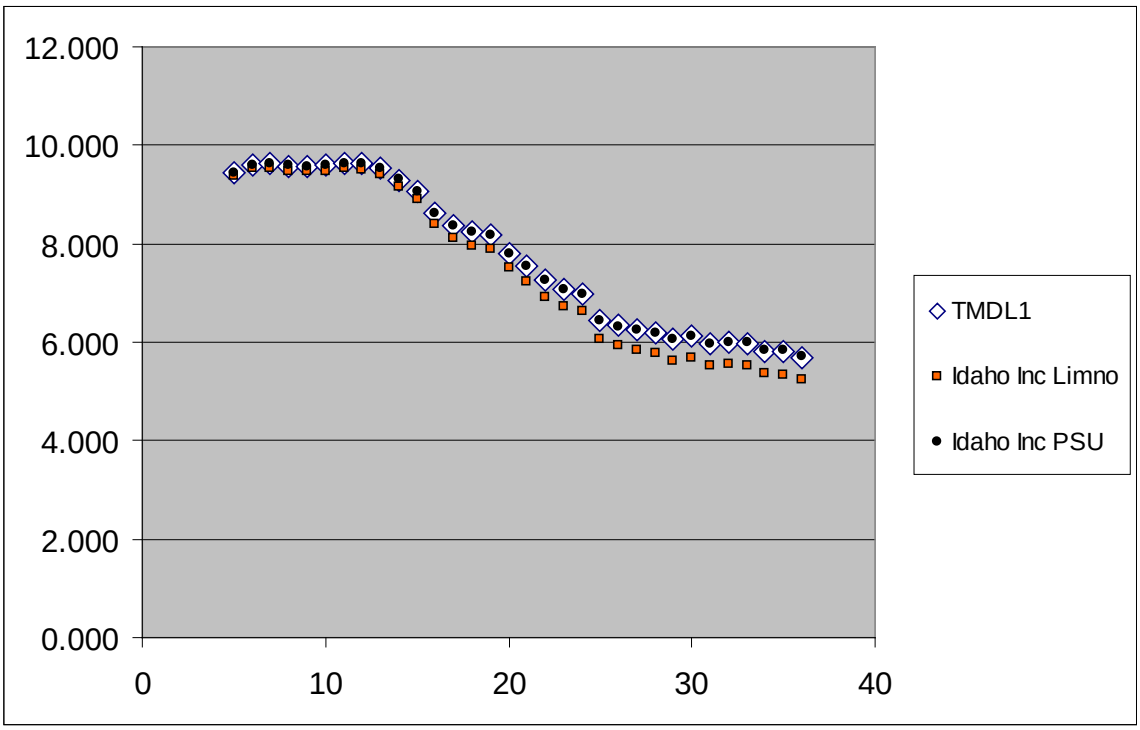


Late November

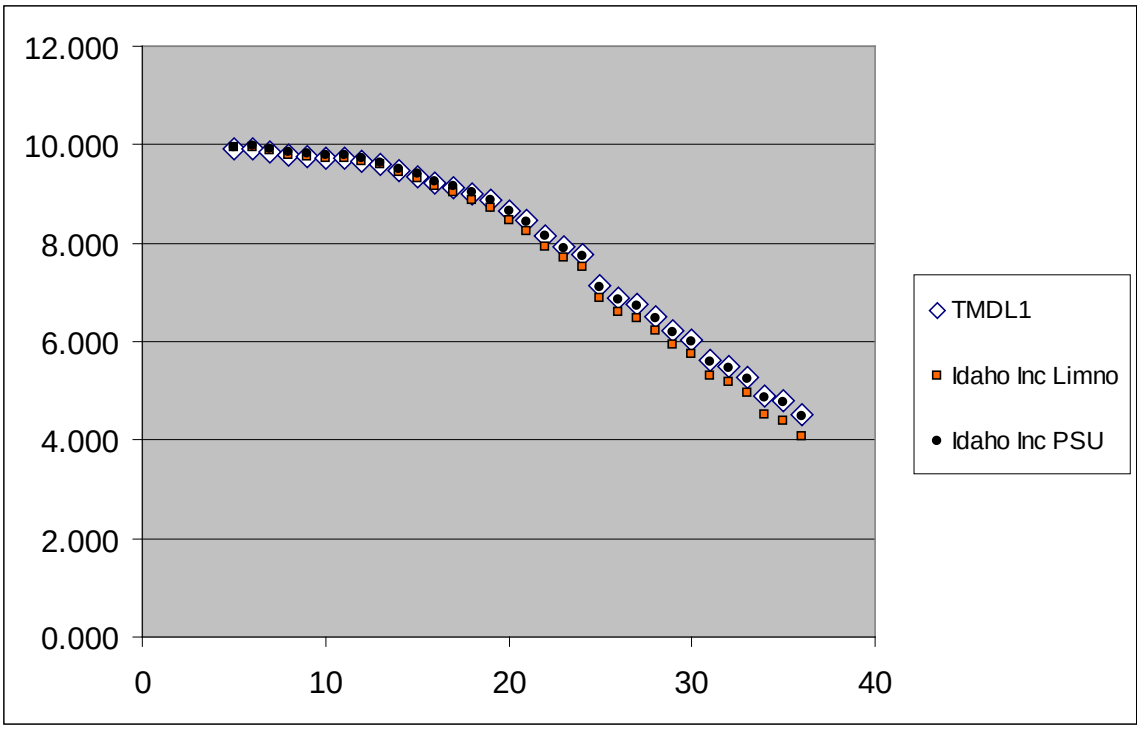
The model documentation and TMDL record clearly acknowledge that there are uncertainties in the model and its predictions, but the Limnotech memo and model output provides no evidence of a stability issue in the model.

The key parameter for the TMDL is DO, and Limnotech states that they investigated the stability issues because their DO predictions for the Incremented Idaho scenario were "completely inconsistent" with other scenarios by approximately 0.5 mg/l. Limnotech's memo provides no documentation of the details of the scenarios run by the firm, nor did the firm request that PSU peer review their modeling work. PSU has run its own Incremented Idaho scenario (doubling the total phosphorus for Idaho discharges by

doubling both the ortho-phosphate and organic phosphorus compartments). The results for DO in the reservoir differ significantly from Limnotech's results. Comparative model outputs for July and September are shown below.



Late July



Late September

PSU's simulation results do not show a 0.5 mg/l inconsistency and align closely with the TMDL scenario as expected. Based on these results, EPA believes Limnotech may have made an error in its model setup for this scenario.

In conclusion, EPA, in consultation with Portland State University, find no evidence of stability problems or inconsistent DO predictions in the Lake Spokane model.