# Memorandum

**To:** Steve Hirschey, Margaret Duncan, David St. John

**From:** Stillaguamish Flow Assessment Team

**Date:** January 5, 2006

**Re**: Follow-up to Peer-Review Comments on the Stillaguamish Instream Flow Assessment Pilot Project Report

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The Review Team provided extensive and comprehensive comments on the Flow Assessment project report. Their comments primarily focused on the Ecosystem Diagnosis Treatment (EDT) model used in the Pilot Project for the modeling of focal species response to flow and flow-related parameters. EDT-related comments included the identification of the need for continuing sensitivity analysis and winnowing of ineffective parameters to avoid unnecessary work, and the identification of the need to increase transparency of the EDT model to facilitate model validation and peer-review. These comments are better and more appropriately addressed by Mobrand-Jones & Stokes, the proprietors of the EDT model.

It is noted that some of the review comments are unclear, potentially misleading, or reflect miscalculations or misinterpretation on the part of the Review Team. This is to be understood as the project report is very long, being the result of many months work by several project staff. Specific reasons for the above referenced review comments include 1) insufficient clarity on the part of the project report, 2) the lack of review team familiarity with study area, 3) the lack of review team familiarity with one or both models in an operational sense, and 4) the lack of familiarity on the part of one or more members of the review team with the life histories and/or local populations of the focal species. A few of these comments are addressed below followed by suggestions as to how to improve the project report and/or the pilot project effort.

<u>Best Available Science</u>
It was requested of the Review Team at the 11/14/05 meeting that they be explicit about how the model and/or report was not Best Available Science (BAS). The final draft of the review quoted the RCW, but did not explain how the model or our effort was not BAS. The Review Team stated that their problem with the model was "…the ***<u>almost</u>*** complete absence of peer review, a consequence of the proprietary nature of the model" (emphasis added). This appears to be a matter of personal comfort with the amount of peer review, which is to be respected. The issue is obviously much larger than the pilot project given that regional salmon recovery targets and ranges rely on EDT estimates of historic, current and potential future productivity and abundance.

False Precision

A potentially misleading statement was found in the discussion of "false precision" of the EDT model. The model does not have "…tens of thousands of parameters, all of which must be estimated…" (Peer review p. 3, last para). Each reach has 40 parameters or variables to enter. Many of these are easy to measure, such as stream length and reach gradient, particularly in GIS. Others simply help identify whether there are withdrawals for irrigation or domestic supply, whether there are obstructions to fish passage, and whether the runoff regime is driven by snowmelt, groundwater, etc. Others can be easily categorized because of watershed specific knowledge on the number of fish species extant in the watershed, hatchery influences, salmon carcasses, etc. This leaves 11 physical habitat characteristics, seven water chemistry characteristics and macroinvertebrates to glean from available data sources or estimate- 19 per reach, not tens of thousands. It is possible that the review team is referring to parameters that are not subject to estimation *by the user*, but rather parameters found in rules or benchmarks that process and cap focal species survival in time and space.

The team acknowledges that uncertainty is an important topic that is worthy of additional discussion and study. As we see it, the key question regarding uncertainty for any model or procedure used to guide watershed management decisions is whether overall uncertainty is so large that the model is unable to distinguish outcomes among the range of management alternatives contemplated by managers. From this practical viewpoint, model precision can be judged by the ability of the model to credibly distinguish among alternatives and at least qualitatively, the model could be judged to be "highly precise" if it credibly distinguishes the difference between similar management alternatives that produce small but real differences in outcomes. On the other hand, if the model is only capable of distinguishing strongly contrasting dramatically different management alternatives and their outcomes, then

A rigorous uncertainty analysis of the linked model procedure (HSPF-EDT) applied in the pilot study would track the propagation of uncertainty of all input data (meteorology, channel geometry, physical habitat measurements, etc.) and all model parameter value assignments to model outputs or more importantly the differences or ratios of model outputs among scenarios. This would likely require application of Monte-Carlo methods and a vast number of HSPF and EDT runs- clearly beyond the scope, budget, and schedule of the project.

A less rigorous, but more practical approach would be to address overall uncertainty more qualitatively by examining and discussing uncertainty in a few selected key inputs and parameter values and how they propagate through the model to final results. This approach was actually implemented in the report through a limited sensitivity analysis and discussion. Our recommendation would be to expand this aspect of the study, enhance discussion of uncertainty, and more forcefully integrate uncertainty into discussion of model results and study conclusions.

Accuracy and Validation of Model Results

The peer reviews suggests that Church Creek could not possibly support the level of smolt production necessary to return the reported number of spawners. This appears to be based either on the miscalculation by the review team of stream length in Church Creek used for spawning in the model or a lack of familiarity with the life history of the focal species in Church Creek. This can easily be remedied by clearly producing a table of spawning reach lengths, summing them, doing the math as in the review and arriving at the answer we did.

Assumptions in the Model

The peer review suggests that the project team or the model misrepresented the historic (and by extension the current, because of our scenario assumptions) Pilchuck Creek Chinook salmon abundance. The reasoning appears to be that spawning surveys show that there are so few fish now, relatively speaking, that estimates of historic abundance of about 100 times as many spawners must be wrong. One or more of several things may be wrong with this reasoning.

First, spawning surveys (reference was to the 1960's) count only fish that make it to the spawning index reaches in Pilchuck Creek. They do not count Pilchuck Creek fish that are harvested in any stage of their ocean life or returning upriver. They also do not count every fish, but provide an index of the escapement. During the 1960's it was not uncommon for 70-80% of a run to be harvested. EDT estimates total run size including fish that are harvested.

Second, fall Chinook salmon in the Stillaguamish are what are termed "ocean-type" fish. While they spend little time in fresh water, they are heavily dependent on the quality and quantity of habitat in the lower Stillaguamish River, in the estuary, and in the marine environment for survival. The lower Stillaguamish River floodplain forest was gone by the turn of the 1900's; it has been diked and farmed since the 1930's; its reaches have been on the Clean Water Act 303(d) list since sufficient data was collected. Further, diking of the estuary, removing access to blind tidal channels and pocket estuaries, has reduced the quantity of estuary rearing and smoltification habitat by 90% since the early part of the 1900's. This has had a nearly overwhelming effect on all Chinook salmon stocks in the basin.

Finally, all Chinook salmon stocks on the west coast that have not been extirpated have suffered losses of 90-99% of their abundance compared to estimates based on cannery and catch records from the late 1800's and early 1900's. The 16 million Chinook salmon that once entered the Columbia River mouth have dwindled to less than 500,000 fish (~3% of historic abundance), propped up by numerous hatcheries and a Rube Goldberg transportation system. Therefore it is not unusual for current populations to be at such a relatively low abundance.

Recommended revisions to the pilot project effort and/or report:

Given the goals and objectives of the project and the constructive elements of the peer review there are several things that the project team could do to improve the effort and the report that would make it more useful to Shared Strategy and central Puget Sound watersheds. Some of these may be accomplished fairly quickly, while others would require more effort.

*Quick and easy:*
Provide the land cover citation in question (land cover report was sent to Dr. Booth as well as several NOAA Fisheries staff in 2003 when completed. Report can also be found at www.surfacewater.info).

Acknowledge uncertainty in EDT model outputs and that quantification of uncertainty is beyond the project scope. Recast all results relative to template into categories to reinforce the point- e.g. <20% loss of abundance = "moderate loss", 20% – 50%. "substantial loss", >50% "severe loss". Place all numerical results in an appendix.

*Not so quick, but not lengthy or hard:*
Run new scenarios to include current condition and that use the minimum set of attributes to reduce need for crude estimation. Run one scenario that includes current riparian conditions, marine survival, estuary conditions, to validate against recent run size estimates based on harvest and escapement counts.

Improve basis for bed scour ratings using land cover relationship reported by Booth, Hartley, Jackson relating channel stability to basin land cover. Acknowledge uncertainty with respect to redd scour depth notwithstanding this improved approach. Alternatively, apply sediment transport modeling to compute redd scour depth for changed hydrologic and hydraulic conditions. Reference scour chain data for urban streams such as Alan Johnson's work for the Des Moines Creek basin plan. Possibly cross-link turbidity and fine sediment attribute levels to bed scour

*Regarding conclusions and usefulness (relatively quick and easy):*
Acknowledge the EDT framework as potentially useful because of the specificity of diagnosis with respect to life stages and locations of survival threats as compared with other methods.

More consistently and forthrightly acknowledge the uncertainty associated with the EDT output including ratcheting back conclusions about the usefulness of the method.

More explicitly characterize EDT outputs as Mobrand intended they be used: as useful hypotheses, especially when they do not contradict our experience. In other words, do the overall conclusions and direction that the EDT output leads us in violate our collective knowledge about watershed impacts to habitat?

Reinforce the need to test key hypotheses in an adaptive management context.

*Strategic Improvements*
Follow up work needs to be done to better answer the following questions with regard to EDT's ability to quantify the affect of flow regime on habitat:

1. What are the minimum number and definition of flow regime metrics that effectively determine the impact of flow regime on salmonid habitat?
2. What are the functional relationships between these metrics and measures of habitat quality?
3. How do we modify EDT or other existing habitat models or create new ones that incorporate the minimum number of metrics as inputs and properly transform them into habitat quality outputs?

To address these questions we would recommend the following:

Convene a workshop of habitat modelers, hydrologists, and fish biologists to address these questions and develop a plan of action to improve the flow-habitat modeling nexus through 1) targeted research 2) data review 3) algorithm development.