



BAKER RIVER PROJECT RELICENSE

Aquatic Resources Working Group Technical Sub-committee on Instream Flows

**June 30, 2003
9:00 a.m. - 3:00 p.m.
U.S. Forest Service
Conference Room A/B (425/775-9702)
21905 - 64th Avenue West, Mountlake Terrace, WA**

DRAFT AGENDA

- 1) Review Draft Agenda**
- 2) Status of Action Items from May 3, 2003 Meeting**
- 3) Brief Status Report on HYDROPS**
- 4) Review Skagit River Habitat Modeling Flow Chart**
- 5) Skagit River Hourly Flow Routing**
 - Travel time
 - Accretion
 - Stage:Q relationships
- 6) Skagit Hourly Habitat Models**
 - Relationship of wetted area to flow (critical flow level)
 - Varial zone analyses
 - Area/percent of channel area available to spawning salmonids during spawning season
 - Area/percent of spawning area remaining wetted (2-day low flow) during incubation period
 - Percent of channel spawning area susceptible to channel scour during incubation period
- 7) Skagit Daily Habitat Models**
 - PHABSIM (mainstem and secondary channels)
 - Backwater Sloughs
 - Side Channels
- 8) 4-Level HYDROPS Post-processing Analyses and Protocols**
 - Level 1 - MODEL TEST
 - Level 2 – SCENARIO TEST
 - Level 3 – SCENARIO REFINEMENT
 - Level 4 – SCENARIO CONFIRMATION
- 9) Schedule and Decision Items**



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MEETING NOTES

Meeting Purpose: *Develop a process to resolve flow-related issues for Baker River Project relicensing.*

Fish Team Leader: Arnie Aspelund, 425-462-3442, aaspel@puget.com

PRESENT: Arnie Aspelund (PSE), Stuart Beck (R2), Hal Beecher (WDFW), Brad Caldwell (Ecology), Rod Sakrison (Ecology), Cary Feldmann (PSE), Phil Hilgert (R2), Jason Shapport (Louis Berger Group), Gary Sprague (WDFW), Lorna Ellestad (Skagit County), Margaret Beilharz, by phone (USFS) and Thom Hardy (Stetson), by phone and Paul Wetherbee (PSE)

MEETING HANDOUTS

- Annotated agenda with details on associated electronic files embedded in notes (pages 1-6) [*Skagit Habitat Model Agenda and notes.062903.doc*]
- Meeting handout package (pages 1-27)
 - Draft agenda [*Skagit habitat model agenda-June 30 2003.062603.doc*]
 - Table of travel time by transect [*sample hourly output.txt*]
 - Table of example accretion flows [*Middle Skagit Accretion Flows-example.doc*]
 - Worksheets for transects T1, T3, T6, T15 and T20 bed profile [*TR 3-6-15.Adjustmts.062803.xls*]
 - Transect weighting worksheet [*transect weighting w summary.xls*]
 - Table of wetted surface width by transect [*Wetted Width TR1-24.xls*]
 - Graph of wetted surface area for entire reach with average accretion [*Wetted Surface Area.xls*]
 - June 11, 2003 memo describing analyses of Baker River at Concrete under unregulated flows during salmon spawning and incubation periods [*Spawning-Incubation hydrologic analyses.061203.doc*]

- Graph of Chinook HSI curve used for Lower Skagit River PHABSIM with overlay of 2002 middle Skagit River redd data [*ChinookSpawningHSIvsDATAfigure.062703.doc*]

REVIEW MEETING OBJECTIVES AND AGENDA

MEETING OBJECTIVES

- Report on progress towards development of middle Skagit River habitat models.
- Respond to action items identified at the May 2, 2003 technical subgroup meeting.

1) Draft Agenda

- 1) Review Draft Agenda
- 2) Status of Action Items from May 2, 2003 Meeting
- 3) Brief Status Report on HYDROPS
- 4) Middle Skagit River Hourly Flow Routing
- 5) Middle Skagit Hourly Habitat Models
- 6) Middle Skagit Daily Habitat Models
- 7) Post Processing Analysis and Protocols of HYDROPS
- 8) Schedule and Summarize Action/Decision Items

2) Status of May 2nd Action Items

- May 2 meeting record (completed and distributed)
- Adult and juvenile salmonid periodicity, (in progress, additional data received from Stan Walsh) proposed periodicity will be incorporated into A09c and A09d reports
- Overlay field data with Lower Skagit HSI curves (done-see Section 6)
- Assumptions from lower river PHABSIM applicable to middle Skagit River PHABSIM (in progress)
- Stage:Discharge relationships for 24 transects (done-see Section 4)
- Varial zone analysis and spawning/incubation analysis for fall 2002 (in progress)
- Baker incubation/spawning flows under unregulated conditions (done-see section 5)

3) Brief Status Report on HYDROPS

Paul Wetherbee reported that PSE received the latest beta version of HYDROPS on June 26, and that they are satisfied with the changes made to date. Minor cosmetic changes remain. The Technical Scenario Teamlet (TST) meets July 11th. The TST anticipates having a complete draft analysis package for the recent conditions and draft proposal. The July 11th meeting will be a chance to go through initial results and ramp up for scenario discussions so the 11th will be an important meeting to attend.

Review Skagit River Habitat Modeling Flow Chart

Rather than backtrack through the habitat modeling flow chart that has been discussed at prior instream flow and aquatic resource working group meetings, new attendees (Jason and Lorna) were given a hardcopy of the flow chart and asked to review prior meeting notes.

4) Middle Skagit River Hourly Flow Routing

The HYDROPS output will include 52-week energy year (August 1 through July 31) data sets of hourly flows at the Baker River gage at Concrete and the Skagit River gage near Concrete. The objective of the hourly flow routing effort will be to quantify flow and stage at each of the instream flow transects in the middle Skagit River as the flow passes downstream through the middle Skagit River. The flow routing model will incorporate accretion, travel time and attenuation between each transect. Accretion flows were identified using changes in flow recorded at the Skagit River USGS gages near Concrete, Sedro Woolley and Mount Vernon. The change in flow was then distributed between transects based on drainage area [*Middle Skagit Accretion Flows-example.doc*]. Since accretion was based on actual flow changes between gage sites, any effects of municipal water withdrawals from tributaries will already be incorporated into analyses of recent historic and future scenarios. Travel time and attenuation was identified based on changes in stage and flow between USGS gage sites, and fine-tuned using 3-minute stage readings recorded at three sites within the middle Skagit River during the fall 2002 through early spring 2003 as part of this study [*sample hourly output.txt*].

The next step will be to develop stage:discharge relationships for the instream flow transects and route the HYDROPS hourly flow output through each of the transects. Data on channel profiles, velocities and water surface elevations were collected at 24 transects at low (4-4.7 kcfs), middle (11-12.5 kcfs), and high flow (23.5-29 kcfs). Ten of the 24 transects had significant divided flow (mainstem and secondary channels) and bed profiles, velocities and water surface elevations were measured and recorded separately at secondary channels. Additional water surface measurements were collected at transects 11-24 at a flow of 14.3 to 17.6 kcfs. These data will be used to develop stage:discharge relationships for each mainstem transect. In some cases, separate stage:discharge relationships will be developed for mainstem and secondary transects where there is a difference between mainstem and secondary channel response.

Before the stage:discharge relationships could be developed, the raw field data were entered onto worksheets and in the process, some trouble spots were identified. Phil referred to instream flow data worksheets for Transect 1 as an example worksheet, and Transects T3, T6, T15 and T20 as trouble spots [*TR 3-6-15.Adjustmts.062803.xls*]. Velocity and depth measurements of the shallow, bank verticals were collected by wading using a top-set rod and Price AA current meter, and middle transect verticals that were too deep to measure by wading were measured by boat by Pacific International Engineering staff using an Acoustic Doppler Channel Profiler (ADCP) and GPS positioning. In some cases, it appears that questionable ADCP data were collected for a portion of one transect at each flow condition. Phil proposed adjustments at T3–high flow

(original data is shaded), T6 mid flow (page 9), and T15 low flow (page 11-13). We spent time reviewing these adjustments to allow everyone to understand the proposed adjustments. Transects in the middle Skagit River were intentionally selected in areas that contained representative habitat conditions and those habitats were often difficult to measure. Large boulder distributions in fast water areas and complex log jams in deep water made both boat and wading measurements a challenge. High banks and mature streamside canopy sometimes caused interruptions in GPS positioning. In addition to the proposed transect adjustments, R2 staff proposed dropping T20 completely due to channel change caused by local channel change and bank erosion associated with movement of streamside large woody debris.

Phil elicited comments/suggestions regarding R2's proposals to address these transect issues. Everyone agreed that what is being proposed seems rational and reasonable, and the modeling should proceed. Lorna commented that transect 20 shows the complexity, changes and challenges of the Skagit River- from that point the data are important, however we do have nine other divided channel transects that adequately describe the channel complexity. Everyone agreed that the original decision to measure 24 transects within the reach and ensure that major habitat types were described by multiple transects is proving fortuitous.

Stuart discussed initial development of the stage:discharge relationships and the process used to extrapolate and interpolate stage for each transect. A standard IFG4 process is being used to interpolate stage values and a hydraulic model using Manning's equation is being used to extrapolate above the highest measured flow. Although the lowest measured flow (4.0 to 4.7 kcfs) is near the lowest expected range of Skagit River flows, extrapolation to flows below 4 kcfs incorporated stage-of-zero flow calculations. Once the stage: discharge relationships are developed, R2 will send the data to Thom Hardy and Stetson Engineers (USFS contractors) for their review. Thom Hardy indicated that his review should only require a day or so, and he does not expect the stage:discharge review process to delay model development. R2 is planning to release the hourly flow routing model and stage:discharge relationships on July 18. Stuart cautioned that in order to get the data out as quickly as possible, the hourly flow routing model is intended to be used by experienced modelers and at this point does not include a custom user-friendly interface. Completed data worksheets for all transects will be provided by the end of July when substrate/cover has been coded.

Stuart discussed transect weighting and showed the summary of channel type composition linking channel type with transects and river miles assigned to each transect [*transect weighting w summary.xls*]. The table distributed showed the total length per channel type, percent of study reach by channel types, and proposed transect weighting. Everyone agreed that Transect 20 would be dropped and the weighting assigned to Transect 19.

5) Middle Skagit Hourly Habitat Models

Once the hourly HYDROPS output for alternative scenarios are available, the flow will be routed through the study reach, and stage and flow at each of the 23 transects will be calculated adjusting for travel time, accretion and attenuation and influence of Sauk and Upper Skagit River flow fluctuations. One of the first model outputs will be a calculation of wetted surface area over a range of flows to identify a critical ramping flow level. An example table displaying the wetted surface width of each transect from 2 kcfs to 50 kcfs was presented [*Wetted Width TR1-24.xls*]; however, this table is an example output and did not include adjustments for accretion. A weighted compilation for entire study reach was also presented [*Wetted Surface Area.xls*], and again the group was cautioned that the table does not account for accretion. Brad requested that graphs be developed displaying total wetted width versus flow for each transect, and R2 responded that they would present graphs of individual transects when they presented the results that include accretion.

Cary asked whether the wetted surface area analyses would address non-salmonids. Phil responded that a critical ramping flow is typically developed without regard to specific species, and the analyses assume that channel bed exposure affects both salmonid and non-salmonids. Trade-offs between salmonids and non-salmonids may occur if a flow scenario is designed to minimize channel bed exposure during salmonid emergence while allowing increased channel bed exposure during a critical non-salmonid life stage. The hourly habitat models will allow periodicities to be adjusted to target any particular period, species or guild and R2 can respond to specific requests as they are raised.

Once agreement is reached on the stage discharge relationships (e.g. they are ‘anchored’), R2 will begin conducting the varial zone analyses, followed by analyses of the percent of spawning area that remains wetted through incubation and transect-specific scour analyses. Once the models are developed, R2 will be looking for a rapid review and response from the technical subgroup.

In preparation to begin the spawning and incubation analyses, discussion shifted to a memo that was distributed at the June ARWG meeting [*Spawning-Incubation hydrologic analyses.061203.doc*]. Phil asked the group to consider which hydrologic parameter might best describe spawning and incubation flow conditions for various salmonid species and what time period describes spawning and incubation activity. After walking through the June 11 memo, Phil noted that no decision was expected at this meeting. R2 will propose spawning and incubation periodicities as part of the A-09c and A-09d reports and a response will be expected when the reports are distributed for review. The initial draft of A-09c was already distributed, but a revised version will be sent out when the percent redd dewatering charts are recalculated using the stage:discharge relationships for the middle Skagit River transects (before the August ARWG meeting). R2 would like to reach agreement on periodicities within 10 days after these reports are sent out so that the periodicities can be incorporated into the hourly habitat models.

The group discussed the pros and cons of using a 1-day or 2-day low flow to describe incubation conditions. During the discussion, Thom Hardy suggested looking at the meteorological record to see how long, and how often freezing conditions occur in the middle Skagit. At this point, the group was leaning towards the 2-day low flow (i.e. 48 hour) as indicating incubation conditions, but they will revisit the topic. Phil indicated he personally was leaning to the 10 per cent exceedence flow to describe spawning conditions, but was not looking for a group decision until Stan Walsh-SSC has a chance to provide input. R2 will be proposing hydrologic statistics as part of the A-09c and A-09d reports.

Once the periodicities are identified, and assuming agreement can be reached on a hydrologic statistic to describe spawning and incubation conditions, R2 was asked how they intend to identify the lateral and vertical distribution of redds associated with a given flow. Phil discussed how R2 will recalculate vertical redd distribution using the new stage:discharge relationships and the 2002 redd measurement data. The percent of redds dewatered at a given flow will be calculated – but Phil acknowledged that it would be based on one year of data. Assuming middle Skagit River redd surveys are continued, additional data will be collected, and confidence in flow management decisions should increase as a longer-term data set is developed. Thom Hardy noted that he is a bit nervous tying spawning and incubation flows into a single year of information. The group will reconsider this issue when we have the initial results of the 2002 data recalculated using the stage:discharge relationships. Phil agreed that additional data are desired, and noted that we will have the initial results of fall 2003 spawning to provide some indication of year-to-year variability. No decision is needed at this time.

The June 11 memo [*Spawning-Incubation hydrologic analyses.061203.doc*] presents an analysis of synthesized daily flows under unregulated conditions-without the Baker Project (calculated using the updated reservoir storage information). Phil suggested that most of the statistics examined indicated that 4 kcfs flows were typically present during the salmon spawning period under unregulated conditions. Under regulated conditions, the fall spawning flows will be even higher since the reservoir pool must be evacuated to make flood control storage available. Cary suggested that an overlay be presented displaying what reregulation does to shift the hydrograph. Phil said that such a graph is presented in the A24 Part 1-Hydrology study, and he will incorporate into future presentations.

Looking at incubation flows, Phil suggested that under unregulated conditions, 1-day or 2-day low flows were typically about 20 percent of the spawning flow, rather than the 50 percent value that would be desired to protect redds. Phil suggested that even without the results of HYDROPS runs, it appears unlikely that future Baker project operations will be able to meet an incubation flow target that is 50 or 60 percent of the spawning flow. The relicensing issue of spawning versus incubation flows may end up being an issue of maintaining high incubation flows with less emphasis on reducing flows during the spawning season.

Phil noted that precipitation events drive flows during the fall and early winter incubation and that snowpack runoff primarily influences flows during May and early June. There is little correlation between flows during the fall spawning season and flows during the incubation period. Under flow regulation, there is some opportunity to shape low flows and provide limited low flow augmentation. The Corps flood control requirements force PSE to keep the Upper Baker reservoir drawn down, which limits the volume of water available for low flow augmentation. If PSE attempts to maintain high incubation flows, or maintain incubation flows for an extended period through the spring, there is a greater risk of running out of flow augmentation water. In addition, if the reservoir is drawn down to augment flows, there is a greater risk that the reservoir may not refill during the spring. Future HYDROPS runs will allow the development of a risk analysis where the benefits of higher incubation flows are compared to the risk of running out of water. Cary noted that any future operational scenario should incorporate a procedure that will allow PSE to demonstrate 100 percent compliance.

Lorna requested that some statistic or description be provided that characterizes the type of water year for each year within the period of record. Phil said he would take another look at this as a HYDROPS Level-4 post-processing task which will be discussed as part of the Technical Scenario Team (TST).

6) Middle Skagit Daily Habitat Models

Phil noted that the input to the daily habitat models would consist of hourly HYDROPS output, routed through the middle Skagit River transects to adjust for accretion, travel time, accretion, incorporating the influence of upstream inflow from the Sauk and Upper Skagit River and presented as average daily flows for each transect. The average daily flow record would then be used to calculate the following habitat indices:

- PHABSIM (Physical habitat Simulation) is an index of potential fish habitat over a range of flows within mainstem and secondary channels for target species and life stages. Model output will consist of tables of weighted usable area (WUA-ft²) for various species and life stages at Skagit River flows of 3.5 kcfs to 50 kcfs cfs⁽¹⁾.
- Backwater sloughs are middle Skagit River habitat features with typically deep, open channels at the downstream end. There is little or no velocity and any inflow is from off-channel sources. Wetted surface area within these habitats is increased by being backwatered from increasing mainstem river stage. The model output will consist of tables of wetted surface area of individual study sites from 3,000 cfs to 50,000⁽¹⁾ cfs⁽¹⁾; a table of wetted surface area extrapolated to all backwater sloughs between RM 56.5 to RM 24.5; and tables of wetted surface area by 1.0-ft depth increments for individual study sites.
- Side Channels are off-channel habitat features containing surface inflow from the mainstem channel within the range of modeled mainstem river flows. They do not include tributary channels - unless lower tributary channels are supplemented by mainstem inflow. Output will consist of tables of wetted surface area of individual study sites from 3,000 cfs to

50,000 ⁽¹⁾cfs; a table of wetted surface area extrapolated to all side channels between RM 56.5 to RM 24.5; and a table of wetted surface area and where inflow occurs within the range of modeled mainstem flow, WUA calculations using PHABSIM models.

Output from the daily habitat models will be available by September 19; however, the backwater habitat models may be ready by mid-August. No questions were raised from the group and R2 indicated they would proceed as described.

Since one of Rod's objectives for the middle Skagit River PHABSIM analyses was to develop data compatible with the existing lower Skagit River PHABSIM study, R2 proposed that the technical subgroup adopt the lower river habitat suitability index (HSI) criteria for the daily habitat analyses. During the fall of 2002, 25 measurements of depth and velocity were collected at chinook redds with adults in attendance in the middle Skagit study reach. The 2002 field data were plotted onto graphs of the lower Skagit criteria [*ChinookSpawningHSIvsDATAfigure.062703.doc*] to evaluate whether the lower river criteria should be adjusted. The middle Skagit measured velocities fall within the outline of the lower Skagit curves. Thom wondered if the criteria curve should be shifted a bit to the right since the 2002 field data generally are grouped towards the higher velocities. Phil responded that he did not believe an adjustment was warranted given the small dataset. After further group discussion, all parties agreed that R2 should use the lower Skagit River criteria without adjustment.

7) Post Processing Analysis and Protocols of HYDROPS

Phil described a 4-level approach to post processing HYDROPS output, but cautioned the instream flow technical subgroup that comments on the process should be directed to the Technical Scenario Teamlet (TST). The 4-level approach will be discussed at the July 11 TST meeting, but the current draft of the process was being presented at this time so that the instream flow team could understand how they might fit into the overall relicensing settlement process. The July 11 TST meeting will start getting the HYDROPS processing started with the rollout of the latest version of the HYDROPS model.

Level 1 is Model Testing to see that the scenarios do not violate physical constraints.

Level 2 is Scenario Testing where additional post processing of Baker River at Concrete flows using representative 12-month periods (energy years) to identify the strengths and weaknesses of various scenarios. Level 2 is intended to initiate cross resource evaluations and initial scenario runs will be sent back to the TST for additional tweaking of promising alternatives.

Level 3 is Scenario Refinement where hourly flow data for the five representative years will be routed through the middle Skagit River to identify scenarios effects on Skagit River resources. One issue that will be considered at the July 11th TST meeting will be the size of Level 3 output (>460 plots and >55 tables) and how we might streamline the process.

Level 4 is Scenario Validation where the most-promising scenarios are run through the 1982-2002 period of record for the Baker River at Concrete gage site and 1991-2002 for the Skagit River near Concrete gage site. This level will initiate IHA analyses and will be allow final crosschecking of scenarios beyond the five representative years.

8) Schedule and Summarize Action/Decision Items

Task	Anticipated Schedule
Hourly flow routing model	July 18
Stage: discharge relationships	July 18
Worksheets for all transects	August 1
Initial runs of hourly habitat models	August 15
Initial runs of daily habitat models	September 19

The next instream flow technical meeting is scheduled for August 15, 0900 to 1300 at the USFS Mountlake Terrace location.

New/Outstanding Action Items

- Arnie: send Rod and Lorna May 2nd meeting notes and handouts (hardcopy of handouts distributed after June 30 meeting)
- Phil: meet with Hal Beecher-WDFW on July 15 to address lower Skagit River PHABSIM protocols and assumptions
- Phil: Send out graphs of wetted width for individual transects-noting that data presented at the June 30 meeting do not incorporate accretion or travel time.
- All: Phil will be looking for comments from the group on the varial zone analysis and spawning: incubation analyses when these are distributed for review at the end of July.
- All: Phil will be looking for agreement on salmonid periodicities about 10 days after A-09c and A-09d reports are distributed for review so that the periodicities can be incorporated into the hourly habitat models.

Decisions

- 1) Adjustments proposed to Transect 3-high flow, Transect 6-mid flow and Transect 15-low flow are approved as presented.
- 2) Proposal to drop Transect 20 approved. Transect numbers 1 through 24 will not change.
- 3) Agreement reached on adopting the HSI curves used for the lower Skagit River PHABSIM study for the middle Skagit River PHABSIM study. Chinook spawning HSI curves will not

be adjusted based on the redd measurements collected by PSE and their contractors during fall 2002.

Meeting adjourned on time.