

Bypass Reach (Gorge) Flow Releases Study
– **Status Report** –
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Prepared for:
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Instream Flow Analysis

Data Collection

The transect data required for the instream flow study were collected by R2 Resource Consultants (R2) from June 15th through 18th, 1999, in Reaches 1 and 2 of the Chelan River. Bed elevations, velocities, depths, substrate composition, and water surface elevations were measured at twelve transects in Reach 1, and five transects in Reach 2, at discharges of 32, 81, and 260 cfs. The instream flow transect data for Reach 4 of the Chelan River were collected from August 17th through 24th, 1999. Bed elevations, velocities, depths, substrate composition, and water surface elevations were measured at seven transects (Transects 2 through 8) at discharges of 74, 117, 295, and 540 cfs.

As requested by the National Marine Fisheries Service (NMFS), water surface elevations were measured at instream flow transects in Reaches 1 and 4 during a high flow event. The measurement of these water surface elevations were requested in order to evaluate habitat conditions in the bypass reach under proposed Columbia River flow augmentation releases from Lake Chelan. Water surface elevations were measured at all transects in Reaches 1 and 4 on July 15th, 1999, under a flow of 4,200 cfs.

Instream flow data were obtained at two additional transects in Reach 4 (Transect 1 and Transect 9) on November 4th and 5th, 1999. Transect 1 is located immediately below where the powerhouse tailrace channel enters the Chelan River. This section of the Chelan River is influenced by backwater effects of the Columbia River, and is used as a spawning area by chinook salmon during the fall. Flows in this short section of the river are usually close to 2,200 cfs (i.e., powerhouse discharge) throughout the year. Instream flow data were collected at Transect 1 were collected during the period of peak chinook spawning during 1999. Transect 9 is located within the tailrace channel, and also possesses flows close to 2,200 cfs throughout the year. Velocity and depth measurements at each of these two transects was obtained at a single flow, which was determined to be 2,250 cfs.

Habitat utilization data, including depth, velocity, substrate composition values, were collected at a total of 21 active chinook salmon redds situated near Transect 1 on November 4th and 5th.

Chinook salmon spawner activity was monitored throughout October and November, 1999, with the greatest number of spawners was observed during the first week of November.

Hydraulic Calibration

The data obtained at each of the 26 instream flow transects in the Chelan River were entered into an Excel spreadsheet developed by R2 to evaluate instream flow data, and then analyzed by a hydraulic engineer. The field data and preliminary hydraulic analysis then underwent a quality control / quality assurance (QA/QC) review by R2's project manager. Any inconsistencies with the data were documented, and then corrected after careful examination of the survey data and photographs obtained at each transect. The data correction procedures were documented in the hydraulic calibration spreadsheets.

Upon completion of the QA/QC review and initial hydraulic calibration, an Excel spreadsheet was then used to export the transect data into the format required I4TEXT, a program used to generate the hydraulic calibration files used by the Physical Habitat Simulation System (PHABSIM). Separate hydraulic simulation files were constructed for Reaches 1, 2, and 4. Further, separate simulation files were constructed for each channel within multiple channel (islanded) sites established within Reaches 1 and 4. PHABSIM requires the independent modeling of all channels within multiple channel site because the flows occurring within each channel are different. A Excel spreadsheet was used to apportion flows among the individual channels for every calibration discharge.

The resulting hydraulic simulation files were then calibrated using the IFG4 hydraulic simulation modeling program, as well as several PHABSIM calibration programs (e.g., REVI4) and Excel spreadsheets developed for this purpose. Model calibration first involved identifying the best method to accurately predict water surface elevations at each transect as determined by discharge. The results of these calibration procedures found that a log-log stage-discharge regression relationship could be used to accurately predict water surface elevations at each measured discharge.

The results of the instream flow hydraulic calibration procedures conducted for the Chelan River were discussed during a meeting with instream flow experts with the Washington Dept. of Fish and Wildlife (WDFW), Washington Dept. of Ecology (WDOE), and NMFS on February 14, 2000. These experts recommend several calibration procedures for developing a final hydraulic model for the Chelan River. Their recommendations included:

- 1) The log-log stage-discharge regression procedure developed during initial calibration would provide the best method for simulating water surface elevations within the range of flows in which velocities were measured (i.e., 32 to 260 cfs in Reaches 1 and 2; 74 to 540 cfs in Reach 4).
- 2) Water surface elevation modeling programs (WSP and MANSQ) should be used to simulate water surface elevations between the highest measured velocity discharge set and 4,200 cfs.

- 3) The velocity-discharge regression method, which is that preferred by the WDOE and WDFW, should be used to simulate velocities in all reaches. This method was recommended because it can accurately predict velocities over a wide range of flows if properly calibrated, and because it simplifies the development of habitat versus discharge relationships.
- 4) The three-velocity (Manning's N roughness coefficient) method, which was preferred by NMFS, should also be used to predict velocities in Reach 4 and compared to the results provided by the velocity-discharge regression method.
- 5) Modifications of velocity values up to 0.2 ft/sec are allowable to calibrate velocity-discharge relationships, with modification up to 1.0 ft/sec acceptable under some conditions.
- 6) Modifications of Manning's N roughness coefficient values should be applied on a cell by cell basis within a transect to: (1) correct unusually high velocity values; and (2) edge roughness problems at higher simulation flows.
- 7) Transect 9 in Reach 4 should be dropped from instream flow analysis because habitat conditions at this transect were not considered to be suitable for salmon spawning. However, habitat conditions in the tailrace channel as measured by this transect (e.g., depths exceeding 30 ft; boulder and sand substrates) should be described in the report.

Final calibration of the Chelan River instream flow model will be completed during the week of February 14th, 2000 following these recommendations.

Barrier Analysis

The five largest barriers within Reach 2 of the Chelan River were measured using a total station surveying instrument under zero-flow conditions on June 16th, 1999 under dry channel conditions. Cross-sectional measurements were obtained at the crest of each barrier, and longitudinal profiles were surveyed from the crest to bottom (including plunge pool) of each barrier. Detailed photographs of each barrier were then obtained at flows of 74 cfs, 117 cfs, 295 cfs, and 540 cfs using a 35 mm camera mounted with a 200 mm telephoto lens. These photographs were used to document the water surface elevation at the crest and plunge pool of each barrier for each flow in relation to well-defined marks on adjacent canyon walls. These water surface elevation positions were later measured using a survey level. The vertical height and horizontal distance of each barrier, as well as the depth of the plunge pool below each barrier, were calculated at each flow. Velocities at the crest of each barrier under each flow are being calculated using the methods described in the June 11, 1999 study plan.

Limiting Factors Analysis

The limiting factors analysis conducted by this study included: (1) monitoring of water temperatures in water released from the powerhouse tailrace during the summer and fall, and at three locations in the bypass reach during summer flow releases; (2) a survey of spawning gravel

availability and rearing habitat conditions in Reach 1; (3) macroinvertebrate sampling in the Chelan River immediately below the project tailrace to evaluate the taxonomic composition and abundance of food items potentially available to fish in the bypass reach under sustained flow releases; (4) drift net sampling of zooplankton in water released from Lake Chelan into the tailrace; (5) an evaluation of nutrient concentrations which were measured by the water quality study to assess the potential productivity of water released into the bypass reach; and (6) gravel scour monitoring during high flow conditions occurring the bypass reach during the summer of 1999.

Draft Report

A preliminary draft report is scheduled to be completed during the first week of March, 2000. This report will then be reviewed by Chelan PUD staff. A revised draft report will be completed during the middle of March, 2000 for distribution to the technical review committee.