

***Evaluation of Effects of Project Operation on Kenai
River Fish Habitat:
Final 2003 Study Plan***

Cooper Lake Project (FERC No. 2170)

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Introduction

A series of environmental study plans are being developed to support the relicensing process for the Cooper Lake Hydroelectric Project (Project). This study plan specifically addresses the need to obtain additional information regarding the fish utilization, habitat sensitivity, and impacts of Project-related flow and temperature changes within a portion of the upper Kenai River. Other studies being conducted for the Project relicensing will provide related information for the upper Kenai River study program: collection of water quality and discharge data for the Kenai River will be accomplished as part of the Stream Flow and Water Quality Study; modeling of potential temperature regimes in Cooper Creek will be accomplished through the Cooper Creek instream flow study; and analysis of Project effects on flows from Kenai Lake into the Kenai River will be conducted as part of the Hydrology Study. The information from these other studies will be integrated with aquatic habitat data and hydraulic modeling from this study to describe current conditions in the upper Kenai River and analyze the potential effects of various potential Project operational scenarios.

The relatively simple hydraulic model described below will provide an initial indication of Project effects on Kenai River fish resources. If the analysis indicates the potential for substantial effects on critical life history stages, then a more detailed hydraulic model may be implemented to increase the precision of the results.

Background

Operation of the Project takes water from Cooper Lake, routes it through a power generating facility on the shore of Kenai Lake, and releases an average of about 100 cfs into Kenai Lake. Prior to the Project, all flow from Cooper Lake exited via Cooper Creek, which flows into the Kenai River about 2.5 miles downstream from the outlet of Kenai Lake. Diversion of Cooper Lake outflow through the powerhouse increases flow in the Kenai River upstream from Cooper Creek by an average of 100 cfs over flow that would exist in this reach without the Project. The additional flow probably only comprises a significant portion of total flow in this reach in the late winter under low flow conditions. Diversion of Cooper Lake outflow also has reduced the temperature of water entering the Kenai River from Cooper Creek, because most flow in Cooper Creek now originates from a tributary, Stetson Creek, which has very cold water, rather than from the warmer surface waters of Cooper Lake.

Potential future changes to Project operation that are being evaluated through the relicensing process could alter flow into Cooper Creek and/or flow through the powerhouse. These potential changes, in turn, could affect fish resources in the Kenai River, either positively or negatively. Changes to the powerhouse flow regime could cause significant changes to the flow of the upper Kenai River in late winter with possible impacts to fish. Salmon eggs and/or alevins (recently hatched, pre-emergent fry) are present in the river gravels throughout the winter, and alterations to river flow could affect incubation conditions. Salmon egg incubation is considered to be the most critical issue relative to winter flow in the Kenai River. Additionally, restoration of flow to Cooper Creek from Cooper Lake could raise water temperature in Cooper Creek, thus potentially

also affecting the temperature regime of the Kenai River downstream from the Cooper Creek confluence.

Fish Utilization of the Upper Kenai River

Study Need

Analysis of Project effects on the upper Kenai River requires knowledge of the existing fish resources as well as the value and seasonal sensitivity of various kinds of fish habitat in this reach. Because of the likelihood that Project effects would be greatest during winter low flow periods, emphasis will be placed on winter fish use and sensitivity of winter habitats.

Study Area

The study area will include the Kenai River from the Sterling Highway bridge at the outlet of Kenai Lake downstream to the confluence with the Russian River, a distance of about 7 miles. Potential flow and/or temperature related effects resulting from the Project would be most significant within this reach.

Methods

A thorough review of existing information will be conducted regarding fish presence and habitat use within the study area. Sources of information will include scientific literature, gray literature, resource agency reports, resource agency files, interviews with resource agency personnel, and interviews with fishing guides. Special emphasis will be given to documentation of known or suspected spawning areas for salmon because of the potential sensitivity of the winter incubation period. Shallow spawning sockeye salmon and late run coho salmon may be most vulnerable to dewatering effects and will receive special attention.

Habitat suitability criteria (including considerations of depth, velocity, substrate composition, and temperature) for the habitat types most likely to be affected by existing or potential future Project effects on the flow regime in the upper Kenai River will be defined using existing information. Habitat types most likely to require definition of suitability criteria for the purposes of this study include sockeye and coho salmon spawning and incubation habitat.

Tables will be prepared that display the values, seasonal sensitivity, and required physical attributes of various habitat types. Known fish utilization and presumed habitat values will be graphically illustrated on a map of the Kenai River study reach.

Schedule and Deliverables

The existing information review will be conducted during the winter of 2002–2003. A report summarizing existing information regarding fish resources and habitat use will be prepared by May 30, 2003.

Kenai River Hydraulic Modeling

Study Need

To assess potential effects on fish habitats related to flow, it is desirable to be able to predict essential stream characteristics, such as wetted perimeter and depth at varying stream flows within selected important habitat areas.

Methods

Because of the specific emphasis on incubation habitats during low flow periods (i.e., the time when Project-related flows would have the most pronounced effect on upper Kenai River fish habitat), a simplified modeling method has been selected that addresses the basic concerns without requiring extensive field measurement. The method described below assumes that changes to wetted perimeter (distance along the bottom and sides of a channel cross section in contact with the water) are proportional to changes in availability of incubation habitat (Collings, 1972).

Cross sectional profiles will be measured during low flow conditions at two locations on the Kenai River between Kenai Lake and Cooper Creek using standard survey techniques. The USGS gaging station at the Sterling Highway bridge will be considered to be a third cross section and will provide a continuous record of the relationship between river stage and discharge at that site. The locations of the sections will be determined based on a combination of fish habitat value (as determined from the information review described above) and representativeness of river characteristics. One of the sections will be located at a broad, shallow reach where flow changes would be expected to have the greatest effect on wetted perimeter.

Following establishment of the cross sections, right and left bank edge of water will be measured at each section referenced to the original section end stakes or other monuments. Water edge measurements will be made during at least four different flows throughout the period from November 2003 through May 2004. Staff gages will be placed at the cross sections and gage elevations will be referenced to shoreline monuments. Staff gage readings will be collected at least monthly during the low flow period. Wetted perimeter will be calculated from the section profiles and water edge data, and a graph of wetted perimeter vs. discharge will be prepared for each section. Curve-fitting techniques will be used to interpolate between data points. Frazil ice and ice cover can artificially raise water surface elevation; therefore the effects of ice will be addressed during winter observations.

The influence of powerhouse discharges into Kenai Lake on flow fluctuations in the upper Kenai River will be evaluated as part of the Hydrology Study, and these results will be translated into effects on wetted perimeter due to the powerhouse outflow. Interpretation of the biological significance of the hydraulic modeling will be accomplished as described below under “Synthesis of Biological and Physical Elements.”

Schedule and Deliverables

Transect locations and staff gages will be established in April 2003. Unusually high water conditions in 2003 will likely cause a delay in cross section profile measurements. Profiles will be surveyed at the earliest opportunity at a time when low flow coincides with ice free conditions, probably March or April 2004. A series of water edge measurements will be collected starting in April 2003 and continuing through May 2004.

A summary report including a wetted perimeter/discharge relationship will be prepared by June 30, 2004.

Kenai River Temperature Modeling

Study Need

To assess potential Project effects on fish habitats related to water temperature in the Kenai River, it is desirable to be able to predict water temperatures resulting from the mixing of water from Cooper Creek and the Kenai River under various Project operations scenarios.

Methods

Water temperatures and stream flows will be continuously recorded within the upper Kenai River above and below Cooper Creek and within Cooper Creek at several locations. The methods to be used and the monitoring locations are described in the Stream Flow and Water Quality Study Plan. Projected water temperatures within Cooper Creek will be modeled for various flow and lake outlet scenarios using the SNTMP model as described in the Cooper Creek Instream Flow Study Plan.

The above information regarding existing and potential future water temperatures and flows will be integrated, and water temperatures within the Kenai River above and below Cooper Creek will be calculated using a simple numerical model that depends on proportional mixing. Seasonal temperatures in the Kenai River will be arrayed in spreadsheet format for a variety of flow and temperature scenarios, including the existing regime and simulated potential future regimes in which flow from Cooper Lake is released into Cooper Creek. Interpretation of the biological significance of these study results will be accomplished as described below under “Synthesis of Biological and Physical Elements.”

Schedule and Deliverables

Completion of the above temperature analyses depend on the availability of projected temperature data for Cooper Creek per the instream flow analysis (SNTEMP modeling). This information is expected to be available in early 2004. Integration of temperature data and the necessary calculations will be completed as early as possible in 2004 following completion of the instream flow temperature effort. A summary of the temperature analyses will be completed by March 2004.

Synthesis of Biological and Physical Elements

Study Need

Analysis of the potential effects of various Project operation scenarios on the upper Kenai River depends on an integration of the biological requirements of fish species and the important physical characteristics that define their environment so that potential biological effects can be defined.

Methods

Key fish species and life stages will be identified based on the initial information review and on consultation with interested parties. Habitat suitability criteria for the key species will be defined with emphasis on habitats potentially affected by changes in winter flow and by changes in temperature. Habitat requirements will be compared with habitat availability at selected time periods.

In the case of winter flow considerations, wetted perimeter will serve as an indicator of habitat availability for incubation of salmon eggs. Relative changes in wetted perimeter for each of the stream reaches typified by the cross sections will provide a representation of potential effect of varying flow regimes within each reach.

Similarly, optimal temperature requirements for selected species will be compared with available temperatures under various operating scenarios in the Kenai River both above and below the Cooper Creek confluence.

Schedule and Deliverables

Information synthesis and completion of the overall Kenai River analysis depends on completion of all of the above components. The primary analysis will be conducted after the last wetted perimeter measurement in early 2004. A final report which incorporates all of the above components will be completed by August 1, 2004.

References

Collings, M. 1972. A methodology for determining instream flow requirements for fish. In: Proc. of Instream Flow Methodology Workshop, pp. 72-86, Washington Dept. of Ecology, Olympia