
WR-S2: DOCUMENTATION OF SUSITNA RIVER ICE BREAKUP AND FORMATION – DRAFT FINAL

INTRODUCTION

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project) using the Integrated Licensing Process (ILP). The Project is located on the Susitna River, an approximately 300 mile long river in the Southcentral region of Alaska. The Project's dam site (Watana Dam) will be located at River Mile (RM) 184. The results of this study and of other proposed studies will provide information needed to support the FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

Project construction and operation as described in the Pre-application Document (PAD, AEA 2011) will modify the flow and water temperature regimes of the Susitna River downstream of Watana Dam. The reservoir will also result in the removal the upstream source of ice from the downstream river reaches. The Project will affect ice processes below the Watana Dam site as well as within the reservoir inundation zone. The current ice processes that occur in the river (e.g., freeze and breakup) likely have an effect on river geomorphology, fish and aquatic habitat, riparian vegetation, and potentially other resources (e.g., wildlife). This study plan outlines the objectives and methods for characterizing the existing ice processes that will provide a foundation for future ice studies. This study will initiate a multi-year effort, which will include data collection activities beginning in 2012.

STUDY OBJECTIVE

The overall objective of the 2012 study is to document baseline ice conditions and initiate assessment of potential Project effects on downstream river ice processes. The specific objectives are as follows:

- Document the timing and progression of breakup and ice cover formation on the Susitna River between RM 0 and RM 250.
- Document open leads between RM 0 and RM 250 throughout the winter.
- Measure ice cover, elevation, and thickness.
- Document the interaction between river ice processes and channel morphology, vegetation, and aquatic habitats.
- Provide baseline data to help identify the river reaches most likely to experience changes in river ice formation as a result of Project construction and operation.

EXISTING INFORMATION

Several references are provided in the References Section related to the 1980s studies regarding ice processes and the potential effect of the Project proposed in the 1980s on temperature, aquatic habitat and ice processes. An initial review of two ice studies conducted in the 1980s indicated that ice cover formation originates in the Lower River during November and

progresses upstream. The rate of progression is influenced by meteorological conditions and flow rate. The Middle Susitna River (three rivers confluence at approximately RM 99 to proposed Watana Dam site at RM 184) is usually ice covered by mid-December.

Harza-Ebasco modeled ice cover formation under a variety of proposed operations of the 1980s Project. The 1980s model results for the “Watana Dam only project scenario” indicated little change in the timing of ice cover formation downstream of RM 99. Upstream of RM 99, the model results indicated that ice cover formation would be delayed, and of shorter duration. In addition, an ice cover was not expected to form between Gold Creek and Watana Dam.

STUDY AREA

The study area includes the Susitna River from Cook Inlet upstream to RM 250, beyond the upper extent of the proposed reservoir.

METHODS

Existing Information Review

- The 1980s river ice studies are to be thoroughly reviewed and synthesized, as appropriate, for application to developing the 2013-2014 study plans. In particular, observations of the timing and location of ice formation and break up, ice thickness, ice elevation with respect to discharge, and ice process effects on geomorphology, riparian vegetation, and aquatic habitat will be synthesized. The observational information will be compiled in a geospatial format for comparison with present day observations.
- Existing information (e.g., recent studies) regarding the river ice effects associated with existing hydroelectric projects in arctic and sub-arctic climates (where it is applicable to the Project) will also be reviewed and synthesized.

Open Lead Mapping (March, 2012)

In March, 2012, open leads from RM 0 to RM 250 will be mapped aerially and documented using GPS-enabled cameras. Leads will be classified by location (main channel, side channel, slough, tributary mouth) and type (thermal or velocity, where identifiable). The upstream and downstream limits of each open lead will be located using an Archer handheld mapping GPS, and the width of each lead will be estimated visually as a percentage of river width. Open leads in the Middle River will be compared with the location of open leads documented in 1984-1985 in the Middle River.

Ice Thickness Measurements (March and April, 2012)

In late March and early April, 2012, ice thickness and top-of-ice elevations will be measured at 7 locations corresponding to likely flow routing model transect locations, and 3 locations in the Lower River downstream of the flow routing model transects. The locations in the Lower River include the upper tidal limit at RM 9, Susitna Station at RM 25, and the head of Rustic Wilderness Side Channel at RM 59.5. Ice thickness will be measured at 10 locations across each transect in order to capture variability across the river and any side channels. For each transect, a larger auger hole will be drilled to assess gross ice composition (i.e., thermal ice, snow-overflow ice, slush ice). Ice cover elevations will be tied into temporary benchmarks

(likely located in trees above the snow cover) that can be recovered by the flow routing model transect surveyors in June, 2012.

Locations for ice thickness measurements in the Middle River will be coordinated in the field with the flow routing transect study leads. Ice surface elevations will be correlated with stream flow estimates.

Time Lapse Camera Installation (March and April, 2012)

Time lapse-cameras will be installed in 10 locations between RM 9 and RM 184 for the purpose of observing ice breakup and ice-cover formation. Some of these cameras will be co-located with pressure transducer locations. In 2012, cameras will be placed near the upper tidal limit (RM 9-11), at Susitna Station (RM 25), Rustic Wilderness Side Channel (RM 59.5), and 7 other locations within the flow routing study. The cameras will be programmed to record one still image per hour. Where jams are anticipated, an attempt will be made to place the relative elevation marker within the view of the camera in order to estimate the maximum jam stages after the fact. Excessive snow depths may limit the ability to place meaningful markers, however. A subset of cameras will have telemetry capabilities.

On all cameras, data cards will be retrieved following ice-out (anticipated mid-late May) and photos downloaded. Break-up progression as documented by the time-lapse photos will be summarized in text and video form.

Breakup Observations (April 2012 – May 2012)

General breakup progression will be documented between RM 0 and RM 250 from April 2012 through May 2012 using repetitive aerial observations. The frequency of observations will need to be determined in coordination with AEA and licensing participants. It is anticipated that 8 flights will be undertaken on regular intervals starting in mid-April. Conditions that will be documented each flight include the following:

- Location and width of open leads
- Locations and floe size in ice runs
- Locations and general observations of ice jams
- General observations of condition of remaining ice cover, including overflow, and evidence of deterioration

Observations will be documented using GPS-enabled still cameras and a helicopter-mounted video camera, when conditions allow.

In addition to these routine observations, observations will be made regarding geomorphology, including documentation of how channel form (braided, single-thread, cascade, slough) and ice processes interact; fisheries, including which ice processes affect different habitat types; and vegetation, including how ice interacts with soils and vegetation, and any observations on the recruitment of LWD by ice. The documentation approach for each of these types of observations will be coordinated with the Geomorphology Study Lead, the In-stream Flow Study Lead, and the Riparian Study Lead.

Meteorological, Snow Depth, and Stream Temperature Data Compilation (April 2012 - May 2012)

- Meteorological data will be obtained daily starting April 1st from the National Weather Service station in Talkeetna. A tabulation of freezing degree-days and thawing degree days will be kept, along with water temperature data from Willow Creek, Talkeetna River, and Montana Creek, which are the only current real-time water temperature monitoring stations in the Susitna Basin.
- River stage data from the National Weather Service observer at Sunshine Station (Parks Highway Bridge), and the Gold Creek gage (USGS) will be obtained daily, along with any pilot reports or other observations taken for the Susitna River. These data will be tabulated.
- Snow data for Tokositna Valley, Bentalit Lodge, Point Mackenzie, and Susitna Valley High (Talkeetna) will be downloaded daily. Snow course data for the Susitna Basin will be downloaded monthly, as it is updated.
- USGS gaging records that identify ice thickness, presence of frazil ice, and discharge will be obtained and included in the documentation.

Observations and Documentation of Freeze-up Progression (October, 2012 – December 31, 2012)

It is anticipated that 6 reconnaissance flights will take place between the onset of frazil accumulation and December 31, 2012. The following routine observations will be documented with GPS, and GPS-enabled still photographs and video:

- Presence of frazil by location (main channel, side channel, slough, tributary) and type (slush ice, anchor ice, pans)
- Ice bridges, including approximate upstream-downstream length
- Ice cover, including type (rubble accumulation, shore ice)
- Snow cover

In addition to aerial observations, the progression of freeze-up at 10 sites will be documented using the time-lapse cameras described above. Where elevation markers can be placed in the view of the camera, or pressure transducers are co-located, the staging elevations associated with ice-front progression will be estimated.

On both aerial missions and time-lapse records, observers will also document interaction between ice processes and geomorphology, fish habitat (especially slough/side channels) and riparian vegetation.

Meteorological and Stream Temperature Data Compilation (October 2012 - December 2012)

- Meteorological data will be obtained daily starting October 1st from the National Weather Service station in Talkeetna. A tabulation of freezing degree-days and thawing degree days will be kept, along with water temperature data from Willow Creek, Talkeetna River, and Montana Creek, which are the only current real-time water temperature monitoring stations in the Susitna Basin.
- River stage data from the National Weather Service observer at Sunshine Station (Parks Highway Bridge), and the Gold Creek gage (USGS) will be obtained daily, along with any pilot reports or other observations taken for the Susitna River. These data will be tabulated.
- Telemetered stage and camera installation from the 2012 flow routing and transect study will be observed daily for signs of ice formation.

Ice Process Modeling / Approach

It is anticipated that one or more physical ice processes model will be used to predict effects of Project construction and operation on river ice processes. That model and/or modeling approach will be selected in consultation with the Army Corps of Engineers Cold Regions Research Engineering Laboratory (CRREL), AEA, other technical experts, and licensing participants during the 2012 study year so that the model can be included in the FERC-approved 2013-2014 Ice Processes Study Plan.

NEXUS BETWEEN PROJECT AND RESOURCE TO BE STUDIED AND HOW THE RESULTS WILL BE USED

The Project and Project operations, including the volume and temperature of the water released for winter generation from Watana Reservoir can potentially alter the natural formation of river ice by:

- Preventing or delaying in-channel and ice cover formation for several miles downstream of the reservoir.
- Increasing the elevation at which the ice cover forms downstream of this open water reach.
- Potentially, hampering the formation of a stable ice cover on the reservoir.

The results of this study will contribute to documentation of baseline conditions, understanding of existing ice formation and breakup processes, and provide insight into the relationships between river ice and channel morphology, riparian vegetation and aquatic habitat. This information will assist in identification of the potential effects of the Project on ice formation. Assessment of the effect of altered ice processes on geomorphology, vegetation, and aquatic habitat would occur within those respective studies.

Existing information is insufficient to address the following issue identified in the PAD (AEA 2011):

- WR1: Potential effects of Project operations on downstream river ice processes. Changes in ice processes may affect river morphology and water quality which can affect fish and riparian habitats.

PRODUCTS

Study products will include a summary of the 1980s information and 2012 findings in a technical memorandum and, as applicable, a workshop presentation to resource agency personnel and other licensing participants.

Study products to be delivered in 2012, at a minimum will include:

Final 2012 study plan. The final 2012 study plan will be developed in coordination with AEA, agencies and other licensing participants. The AEA-selected environmental contractor will assist AEA, the Program Lead, and licensing participants in developing the final study plan.

Draft Technical Memoranda. Draft technical memoranda will be prepared after each period of survey (i.e. spring break up and fall river ice formation). The topics for the draft memoranda will be developed in coordination with AEA and the licensing participants to meet the needs for developing the 2013-2014 Ice Processes Study Plan. Each memo will summarize progress, identify data gaps, and indicate coordination efforts with other studies.

Relational database. A geospatially-referenced relational database of historic data used in the current analysis and data collected during the 2012 field season will be prepared. This database will form the basis for additional data collection in 2013-2014. All new field data must be associated with location information collected using a Global Positioning System (GPS) receiver in unprojected geographic coordinates (latitude/longitude) and the WGS84 datum. Naming conventions of files and data fields, spatial resolution, and metadata descriptions must meet the ADNR standards established for the Susitna-Watana Hydroelectric Project.

Data. All original data collected in the field in 2012 will be QC'd and delivered to AEA after each of the two survey periods. The data will be entered into the relational database described above, QC'd and delivered to AEA.

Final 2012 Technical Memo. A technical memo summarizing all of the 2012 results will be presented to resource agency personnel and other licensing participants, along with spatial data products. All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and North American Datum of 1983 (NAD 83) horizontal datum consistent with ADNR standards.

SCHEDULE

The following schedule is for milestones of the 2012 scope of work. In addition to the schedule below, draft technical memoranda and potentially other deliverables will be required between work group meetings as necessary to facilitate work group discussions and 2013-2014 Ice Processes Study Plan development.

- Draft Technical Memorandum, relational database, ArcGIS spatial products – June 29, 2012
- Original QC'd Data - December 21, 2012
- QC'd Geospatially-referenced relational database – December 21, 2012

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- Final Technical Memorandum on 2012 Activity – December 21, 2012

Observation of breakup and river ice formation would commence in 2012 and is anticipated to continue through 2014. Acquisition and review of 1980s study results would be completed in 2012 along with selection of an ice model / modeling approach. Analytic assessment of Project effects on ice processes would commence in 2013 and continue through 2014.

REFERENCES

Alaska Energy Authority (AEA). 2011. Pre-Application Document: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2011. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska.

Acres America (1982), A Survey of Environmental Concerns Associated with River Ice.

HARZA-EBASCO Susitna Joint Venture. 1985. Survey of Experience in Operating Hydroelectric Projects in Cold Regions. June 1985. 4 Volumes. Prepared for the Alaska Power Authority by the HARZA-EBASCO Susitna Joint Venture. [APA Doc Nos. 2654, 2655, 2656, 2657]

R&M Consultants. 1985. Susitna River Ice Study 1984-85. Final Report. June 1985. Prepared for the Alaska Power Authority through HARZA-EBASCO Susitna Joint Venture by R&M Consultants, Inc., Anchorage, Alaska. 120 pp. [APA Doc. No. 2747]

Arctic Environmental Information and Data Center (AEIDC) – University of Alaska. 1984. Assessment of the Effects of the Proposed Susitna Hydroelectric Project on Instream Temperature and Fishery Resources in the Watana to Talkeetna Reach. Volume II, Appendix B. Prepared for the Alaska Power Authority through HARZA-EBASCO Susitna Joint Venture by AEIDC, Anchorage, Alaska. 266 pp. [APA Doc. No. 2331].