

## Susitna-Watana Hydroelectric Project Document ARLIS Uniform Cover Page

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## **2012 DOCUMENTATION OF SUSITNA RIVER ICE BREAKUP AND FORMATION**

### **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 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 eliminate the upstream source of ice that currently moves downstream to the lower 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-up 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 spring of 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 234 (Oshetna River confluence).
- Document open leads between RM 0 and RM 234 throughout the winter.
- 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 (see References) to 1980s studies of 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

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(three rivers [Susitna, Talkeetna, and Chulitna rivers] confluence at approximately RM 99 to the 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 scenarios for 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, model results indicated that ice formation would be delayed and ice cover would be 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 234, beyond the upper extent of the proposed reservoir.

## **METHODS**

### ***Existing Information Review***

- The 1980s river ice studies will 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 breakup, 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 effects of hydroelectric projects on river ice 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 234 will be mapped aerially and documented using Global Positioning System (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.

### ***Time Lapse Camera Installation (March and April 2012)***

Time lapse-cameras will be installed at 11 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), at Susitna Station (RM 26), Rustic Wilderness Side Channel (RM 59.5), Birch Creek Slough (RM 88), Slough #1 (RM 99), Old Talkeetna Station (RM 103), Curry Slough (RM 121), Slough 9 (RM 129), Slough 21 (RM 141), Portage Creek Confluence (RM 148), and the

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proposed Watana Dam site (RM 184). The cameras will be programmed to record one still image per hour.

For all cameras, data cards will be retrieved following ice-out (anticipated to occur in mid to late May) and photos will be downloaded. Breakup 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 234 from April 2012 through May 2012 using repetitive aerial observations. The frequency of observations will be determined in coordination with AEA and licensing participants. It is anticipated that 6-8 flights will be undertaken on regular intervals starting in mid-April. Conditions that will be documented during 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 large woody debris (LWD) by ice. The documentation approach for each of these types of observations will be coordinated with the Geomorphology Study Lead, the Instream 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 1 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 River 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.

- SNOTEL data for Tokositna Valley, Bentalit Lodge, Point Mackenzie, and Susitna Valley High (Talkeetna) will be downloaded daily. Snow course data for the Susitna River 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 six reconnaissance flights will take place between the onset of frazil ice accumulation and December 31, 2012. The following routine observations will be documented with GPS and GPS-enabled still photographs and video:

- Presence of frazil ice 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 11 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 1 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.

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### ***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**

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

- WR2: 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.

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:

- Hampering the formation of a stable ice cover on the reservoir.
- 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.

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.

### **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.

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**Draft Technical Memoranda.** Draft technical memoranda will be prepared after each period of survey (i.e., spring breakup 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 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. 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.

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

**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.

## 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 for spring breakup - June 29, 2012.
- Draft Technical Memorandum, relational database, ArcGIS spatial products for fall river ice formation - December 21, 2012.
- Original QC'd Data - December 21, 2012.
- QC'd Geospatially-referenced relational database - December 21, 2012.
- Final Technical Memorandum on 2012 Activity - December 21, 2012.

Observation of breakup and river ice formation will commence in 2012 and is anticipated to continue through 2014. Determination of the need for additional spring breakup and fall river ice formation observations will be made as part of the 2013-2014 study planning process.

Acquisition and review of 1980s study results will be completed in 2012, along with selection of an ice model / modeling approach. Analytic assessment of Project effects on ice processes will commence in 2013 and continue through 2014.

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## REFERENCES

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