

**Susitna-Watana Hydroelectric Project
(FERC No. 14241)**

**Water Quality Modeling Study
Study Plan Section 5.6**

**Part D: Supplemental Information to
June 2014 Initial Study Report**

Prepared for

Alaska Energy Authority



SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

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1. INTRODUCTION

Section 1 (Part A) of the ISR for this Water Quality Modeling Study (Study Plan 5.6) details the development of this study from the Revised Study Plan (RSP) in 2012, through the end of the 2013 study season. Section 7 of the ISR (Part C), filed in June 2014, sets forth AEA's plan and schedule, at that time, for completing this study and meeting the objectives of the RSP.

As detailed in Section 2.2 of the ISR Part D Overview, various circumstances have required AEA to extend the original timeframe for completing the Commission-approved Study Plan. However, AEA has made meaningful progress with this Study 5.6 since the filing of the ISR in June 2014. As detailed below, AEA's recent activities for Study 5.6 have consisted of the following:

- Completion of the final model spatial configuration for the river and reservoir models.
- Configured separate Focus Area model of FA-128 (Slough 8A).
- Conducted multi-year Proof of Concept (POC) hydrodynamic and temperature simulations within the reservoir model and full river model.
- Calibrated river model using high frequency temperature monitoring data from 2012 and 2013.

The primary purpose of this Part D Supplemental Information to the ISR is to report on the implementation of the Study Plan from the filing of the ISR in June 2014, through the end of calendar year 2014. In light of this additional implementation, this Part D also identifies AEA's plans for completing Study 5.6 in a manner that meets the objectives of the Commission-approved Study Plan.

2. BACKGROUND

2.1. Purpose of Study

Predicting the potential impacts of the dam and its proposed operations on water quality requires the development of a water quality model. The goal of the Water Quality Modeling Study (Study 5.6) is to utilize the extensive information collected from the Baseline Water Quality Study to develop a model(s) that evaluates the potential impacts of the proposed Project and operations on the Susitna River watershed.

The study objectives as established in the Study Plan (Section 5.6.1) are as follows:

- Implement (with input from licensing participants) an appropriate reservoir and river water temperature model for use with past and current monitoring data.
- Using the data developed as part of the Baseline Water Quality Study (Study 5.5), model water quality conditions in the proposed Watana Reservoir, including (but not necessarily limited to) temperature, DO, fine suspended sediment and turbidity, chlorophyll-a, nutrients, ice, and metals.

- Model water quality conditions in the Susitna River from the proposed site of the Watana Dam downstream, including (but not necessarily limited to) temperature, DO, fine suspended sediment and turbidity, chlorophyll-a, nutrients, and ice processes (in coordination with the Ice Processes Study 7.6).

2.2. Study Components

Study 5.6 consists of the following components:

- Model Selection (Evaluation of several candidate models and selection of one that meets study objectives)
- Reservoir and River Modeling (Development, parameterization, configuration, and calibration of each model)
- Focus Area Modeling (Development, parameterization, configuration, and calibration of a model with enhanced spatial resolution)
- Consideration of Modeling Scale and Resolution of Output (Determine the appropriate scale for evaluating post-Project water quality conditions)
- Modeling of Operational Scenarios (Existing conditions and operational scenarios and distribution of results to other studies)

3. STATUS, HIGHLIGHTED RESULTS, AND ACHIEVEMENTS

In 2013, the reservoir and riverine models were configured for hydrodynamics, temperature, and fine suspended sediment. The models were tested with 1984 historical flow data and proposed Project flow scenarios. Model parameterization was completed for both the large-scale riverine model and for the enhancement of the internally-coupled Focus Area riverine model. Data sets for water temperature from 2012 and 2013 were used to verify calibration of river model temperature, and 2012 water surface elevation and velocity data were used to calibrate river model hydrodynamics. Historical data was compared with current monitoring results to inform calibration.

Significant items accomplished since the completion of the June 2014 ISR:

- Completed final model spatial configuration for river model and reservoir model.
- Configured separate Focus Area model of FA-128 (Slough 8A).
- Conducted multi-year Proof of Concept (POC) hydrodynamic and temperature simulations within the reservoir model and full river model.
- Calibrated river model using high frequency temperature monitoring data from 2012 and 2013.

4. SUMMARY OF STUDY 5.6 DOCUMENTS

Since filing of the RSP in 2012, AEA and FERC have prepared several documents pertaining to this study. To aid review by FERC staff and licensing participants, each of these documents is listed below. Each of these documents is accessible on AEA's Project licensing website (<http://www.susitna-watanahydro.org/type/documents/>) by clicking on the entry in the "Link" column in the table. In addition, these documents are available on FERC's eLibrary system (<http://www.ferc.gov/docs-filing/elibrary.asp>), in Docket No. P-14241.

Title	Date	Description	Link
Revised Study Plan Section 5.6, Water Quality Modeling Study	12/14/2012	This document presents the plan for this study, including goals, objectives, the study area, and proposed study methods to construct reservoir and riverine models that predict potential changes to water quality in post-Project conditions.	RSP for Study 05.06
FERC Study Plan Determination for Study 5.6	4/1/2013	This document presents FERC approval of Study 5.6, which approved AEA's Revised Study Plan with recommended adjustments.	FERC SPD for Study 05.06
Draft Initial Study Report for Study 5.6	2/3/2014	This draft of the ISR summarized the study methods and variances during the 2013 study season, and presented preliminary data collected for Study 5.6. This draft ISR was later republished as Part A of the final ISR.	Draft ISR for Study 05.06
Riverine Modeling Proof of Concept Meeting: Reservoir and Riverine Water Quality Modeling	4/15/2014 - 4/17/2015	These presentations demonstrate preliminary parameterization and configuration of the reservoir and water quality models. Draft model output for temperature and dissolved oxygen are presented for from each of the models. Seasonal changes in these water quality parameters are demonstrated for the standard model calibration 50 year data set representing wet, dry, and average past climate periods.	April 2014 Presentations for Study 05.06 (File 1) April 2014 Presentations for Study 05.06 (File 2)
Initial Study Report for Study 5.6	6/3/2014	This document is the Initial Study Report (Parts A, B and C) for Study 5.6. Part A republishes the Draft ISR. Part B identifies supplemental information and errata in Part A. Part C presents study modifications and plans for completing the study.	ISR Part A for Study 05.06 ISR Part B for Study 05.06 ISR Part C for Study 05.06
Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6) Water Quality and Lower	9/30/2014	The riverine model currently extends from the dam site downstream to PRM 29.9. Study 5.6, Part C of the Initial Study Report (ISR) explained that AEA would assess in 2014 whether to extend the water quality modeling downstream of PRM 29.9 (AEA 2014).	Sept. 2014 TM for Study 5.6

Title	Date	Description	Link
River Modeling Technical Memorandum			
Initial Study Report Meetings, Water Quality Modeling Study (5.6)	11/15/2014	Transcripts and AEA's agenda and PowerPoint presentations for the ISR meeting for the Water Quality Modeling Study	Transcripts from ISR Meeting Materials from ISR Meeting
2014 to 2015 Study Implementation Report, Study 5.6, Water Quality Modeling Study	11/2015	AEA's Study Implementation Report describing current progress on construction and testing of the reservoir and riverine water quality models.	2014-2015 SIR for Study 05.06 (File 1) 2014-2015 SIR for Study 05.06 (File 2)

5. NEW STUDY DOCUMENTATION SUPPLEMENTING THE ISR

The following table identifies and describes additional reports and other documents that update, refine, or otherwise supplement certain sections of the ISR pertaining to this Study 5.6, during AEA's continued implementation of the Study Plan through calendar year 2014.

ISR Reference	Description
Part A, Section 4	This Section is updated and supplemented by the Study Implementation Report for Study 5.6 (Section 4), which described the study methods and variances in 2014.
Part A, Section 5	This section is updated and supplemented by the Study Implementation Report for Study 5.6 (Section 5), which described the study results in 2014.
Part A, Section 6	This section is updated and supplemented by the Study Implementation Report for Study 5.6 (Section 6), which discusses the study results in 2014.
Part C, Section 7	The decision points and modifications in this section are updated and supplemented by the Study Implementation Report for Study 5.6 (Section 7), which presents the decision points from 2014 and proposed modification after conducting studies in 2014.
Part C, Section 7	The Steps to Complete the Study 5.6 in Part C Section 7 of the ISR are superseded by Section 8 in this document (Part D).

6. VARIANCES

6.1. 2013 Study Season

As noted in Section 4 of the ISR (Parts A and B) for this study, AEA encountered no variances when implementing this study in 2013.

6.2. 2014 Study Season

As noted in Section 4 of the 2014 Study Implementation Report (SIR), AEA encountered no variances when implementing this study in 2014.

7. STUDY PLAN MODIFICATIONS

7.1. Modifications Identified in ISR

As detailed in Section 7 of the ISR (Part C), AEA planned no modifications of the methods for this study.

7.2. Modifications Identified since the June 2014 ISR

As detailed in the 2014 Study Implementation Report, AEA plans no modifications of the methods for this study.

8. STEPS TO COMPLETE THE STUDY

In light of the variances described above, the steps necessary for AEA to complete this study are reported in the Study 5.6 SIR and are summarized below. As necessary and appropriate, these steps have been updated from those appearing in Section 7 of the ISR (Part C).

- Implement procedure for importing ice cover and thickness from ice processes model into river, Focus Area, and reservoir models. Conduct river temperature simulations for temperature calibration to ice-free post-Project observational data. Evaluate annual time scale predictions for temperature, ice cover and thickness for reasonableness by comparison with other high latitude or high altitude reservoir observations determined from literature review (RSP Section 5.6.4.8). Provide output for development of the River1D Ice Processes Model (Study 7.6).
- Conduct scenario simulations within river model and incorporate alternate operational scenario outputs for the 60 year hydrologic period from the reservoir model.
- Refine Focus Area modeling techniques to represent mechanisms responsible of lateral variability in Focus Areas. Conduct scenario simulations in Focus Areas. Incorporate alternate operational scenario outputs from river model. Implement procedure to transfer Focus Area model results to habitat modeling studies.
- Complete reservoir model simulation of suspended solids transport to evaluate reservoir trapping and provide downstream river loading. Coordinate study of reservoir trap efficiency and sediment accumulation with the Geomorphology Study (Study 6.6).
- Conduct sensitivity analysis of temperature and solids response within all models.

- Configure water quality model, using organic matter and nutrient loads determined from monitoring data. Configure river water quality model for pre- and post-Project conditions. Calibrate nutrient cycling model using 2014 nutrient data and adjusted 2012 and 2013 nutrient observations and derived turbidity-TSS relationships.
- Configure toxics and mercury model following calibration of the nutrient cycling model.
- After water quality and toxics models are configured, conduct simulations in reservoir and riverine models to evaluate water quality and sediment transport impacts under various alternative operational scenarios. Use the pre-Project river model to simulate corresponding natural hydrologic conditions necessary for evaluation of the impact of the reservoir on the downstream river (Study Plan 5.6, ISR Section 6). Evaluate simulation results for reasonableness of predictions (RSP Section 5.6.4.8, ISR Section 5.2).