

Initial Study Report Meeting

Study 9.8 River Productivity

October 15, 2014

Prepared by

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Wildlife Research Unit,
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Study 9.8 Objectives

- Synthesize existing literature on the impacts of hydropower development and operations on benthic communities
- **Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River**
- **Estimate drift of benthic macroinvertebrates in selected habitats within the Middle and Lower Susitna River to assess food availability to juvenile and resident fishes**
- Conduct a feasibility study in 2013 to evaluate the suitability of using reference sites on the Talkeetna River to monitor long-term Project-related change in benthic productivity
- **Conduct a trophic analysis to describe the food web relationships within the current riverine community within the Middle and Lower Susitna River**
- Develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats to predict potential change in these habitats downstream of the proposed dam site
- **Characterize the invertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component)**
- Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including coarse particulate organic matter, fine particulate organic matter, and suspended organic matter in the Middle and Lower Susitna River
- **Estimate benthic macroinvertebrate colonization rates in the Middle Susitna Segment under pre-Project baseline conditions to assist in evaluating future post-Project changes to productivity in the Middle Susitna River**

Study 9.8 Components

- Synthesize existing information on the impact of hydropower development and operations (ISR Part A, Section 4.3; pg 8)
- Characterize the pre-Project benthic macroinvertebrate and algal communities in the Middle and Lower Susitna River (ISR Part A, Section 4.4; pg 9)
- Estimate drift in selected habitats within the Middle and Lower Susitna River (ISR Part A, Section 4.5; pg 15)
- Conduct a feasibility study in 2013 to evaluate the suitability of using reference sites on the Talkeetna River (ISR Part A, Section 4.6; pg 17)
- Conduct a trophic analysis to describe the food web relationships within the Middle and Lower Susitna River (ISR Part A, Section 4.7; pg 18)

Study 9.8 Components

- Generate habitat suitability criteria for Susitna benthic macroinvertebrate and algal (ISR Part A, Section 4.8; pg 23)
- Characterize the invertebrate compositions in the diets of representative fish species (ISR Part A, Section 4.9; pg 23)
- Characterize organic matter in the Middle and Lower Susitna River (ISR Part A, Section 4.10; pg 25)
- Estimate benthic macroinvertebrate colonization rates in the Middle River under pre-Project baseline conditions (ISR Part A, Section 4.11; pg 26)

Study 9.8 Variances

- Lower River site was moved from Trapper Creek to Montana Creek (IP Section 2.1.3). See ISR Section 4.2.4.1.
- Sampling at the FA-173 (Stephan Lake Complex) upland slough replaced by small unnamed tributary mouth (FERC SPD, B-181). See ISR Section 4.2.4.2.
- Storm event sampling at side slough at FA-173 (Stephan Lake Complex) instead of FA-144 (Slough 21); upper and lower end sites not established (RSP Section 9.8.4.3; IP Section 2.1.2). See ISR Sections 4.2.4.3 and 4.4.3.2.
- Frequent and rapid river stage changes limited sampling sites available with 30-day periods of continuous inundation (RSP Section 9.8.4.3; IP Section 2.2.1). See ISR Section 4.4.3.1.
- Number of depth and velocity measures intended to evaluate shoreline bathymetry reduced for each Hess sample (RSP Section 9.8.4.3; IP Section 2.2.1). See ISR Section 4.4.3.1.
- Algae samples were taken from stones and woody debris as opposed to fine sediment in grab samples (FERC SPD, B-187). See ISR Section 4.4.3.3.
- Plankton tows were conducted at 5 still water sites instead the potential total of 11 recommended by FERC (FERC SPD, B-188). See ISR Section 4.5.1.1.

Study 9.8 Variances

- Dry weights for macroinvertebrate taxa will be estimated using length-weight relationship data from UAF (RSP Section 9.8.4.3; IP Section 2.2.2.). (ISR Part A, Section 4.4.3.4)
- The Talkeetna reference station features a side channel, side slough, and upland slough, and does not include a main channel macrohabitat type (IP Section 2.1.4). (ISR Part A, Section 4.6.1)
- **Stable isotope site selection was increased from the original two stations (3 sites each) to four stations, sampling 16 sites total** (IP Section 2.11.1; FERC SPD, B-201). (ISR Part A, Section 4.7.3.1)
- Macrohabitat-specific subcutaneous dye marking was not used to track movements of juvenile chinook, coho or rainbow trout less than 60 mm long (FERC SPD, B-199). (ISR Part A, Section 4.7.3.2)
- Fish stomach content samples were not assessed in the field as to whether the stomach was empty or not (IP Section 2.8.1.). (ISR Part A, Section 4.9.1.1)
- Dry weights for prey items in stomach contents will be estimated using length-weight relationship data from UAF (IP Section 2.8.2.). (ISR Part A, Section 4.9.1.2)
- Hester-Dendy Samplers were not pre-conditioned before deployment (IP Section 2.9.1). (ISR Part A Section 4.11.1)

Study 9.8 Summary of Results in ISR (ISR Study 9.8, Part A – Section 5)

- Benthic samples collected from 20 study sites on the Lower and Middle Susitna River, plus 3 Talkeetna River sites, during three 2013 seasonal events and processed by taxonomic laboratory:
 - 940 benthic samples (Hess, algae, LWD, and petite Ponar samples)
 - 221 seston samples (drift samples and plankton tows)
 - 45 adult emergence traps
 - 105 Hester-Dendy samples for colonization study
- For benthic algae, chlorophyll-a and AFDM (biomass) levels were lower in mainstem macrohabitats than off-channel habitats. Some side channels with lower flow also had increased algal levels
- Trophic Analysis efforts collected a total of 1,242 sample components, in support of trophic modeling and stable isotope analyses
 - 261 juvenile Chinook and coho salmon, juvenile and adult rainbow trout collected for fish stomach content, scale aging analyses, and stable isotopes from fin clips
 - Benthic macroinvertebrates, benthic algae, benthic organic matter
 - Invertebrates and organic matter in drift samples
 - Salmon carcasses



Legend

- Project River Mile
- ← Flow Arrow

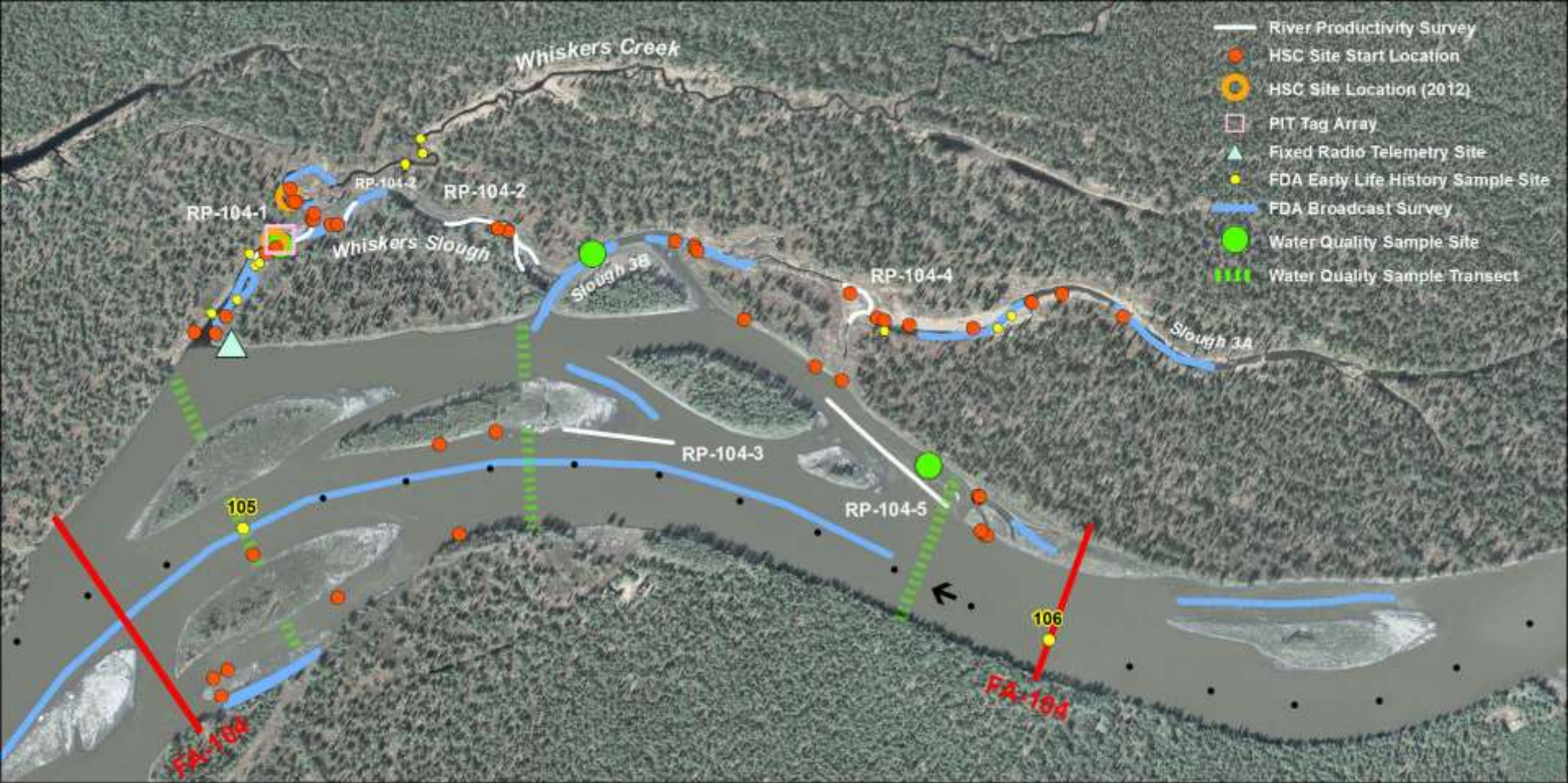


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Feet



Projection: AK SP Zone 4 NAD 1983
 Date Created: 9/25/2014
 Map Author: R2 - Joetta Zabolney
 File: Map_TWG_RIVPRO_SurveyOverlap_LR.mxd

Note: 2013 survey locations, unless otherwise noted.
 Orthophoto Source: 2011 Matanuska-Susitna Borough LIDAR & Imagery Project



- River Productivity Survey
- HSC Site Start Location
- HSC Site Location (2012)
- PIT Tag Array
- Fixed Radio Telemetry Site
- FDA Early Life History Sample Site
- FDA Broadcast Survey
- Water Quality Sample Site
- Water Quality Sample Transect

- Legend**
- Instream Flow Focus Area (Upper and Lower Extent)
 - Project River Mile
 - Flow Arrow



Projection: AK SP Zone 4 NAD 1983
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 Orthophoto Source: 2011 Matanuska-Susitna Borough LIDAR & Imagery Project



- River Productivity Survey
- HSC Site Start Location
- HSC Site Location (2012)
- Rotary Screw Trap
- PIT Tag Array
- ▲ Fixed Radio Telemetry Site
- FDA Early Life History Sample Site
- Water Quality Sample Site
- Water Quality Sample Transect

Legend

- Instream Flow Focus Area (Upper and Lower Extent)
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Study 9.8 Summary of Results since ISR

September 2014 Technical Memo

- Suite of metrics generated for benthic and seston (drift) data analysis
 - Density, taxa richness, community compositions, feeding habits
- 2013 benthic macroinvertebrate density and taxa richness measures appeared lower in mainstem macrohabitats than off-channel habitats
- 2013 drift net samples showed higher drift density and taxa richness in tributary mouths, lower in off-channel habitats
 - Drift density averaged 0.14 individuals/ft³ (0.007 – 1.25 individuals/ft³)
- Plankton tows showed high densities per ft³
 - Plankton tows averaged 3.13 individuals/ft³ (0.03 – 18.48 individuals/ft³)
 - Higher zooplankton densities
 - Low taxa richness
- Sampling with Hester-Dendy multiplates suggests that a period of 6 weeks is sufficient for colonization.
 - Higher densities and taxa richness under clear and warm conditions.

Study 9.8 Summary of Results since ISR

September 2014 Technical Memo

Fish Diet Analysis

- 196 non-empty fish stomachs analyzed
- 4,375 diet items identified and measured
- Stable Isotope Analysis: 3 fish species ate substantial amounts of marine-derived food, in addition to freshwater and terrestrial invertebrates
- Stomach contents: strong reliance on fish (including newly emerged salmon fry) during June and on salmon eggs during August-October

Trophic Modeling

- 2013 growth patterns of age-0 Chinook salmon; age-0 and 1 coho salmon similar to 1980s
- More age-2 Chinook salmon present in age samples than during 1980s
- From bioenergetics model: feeding rate was the primary factor limiting the growth of while temperature and food quality were secondary
- Salmon that fed heavily on eggs had higher growth efficiency (consumed less energy per unit of growth)

AEA Proposed Modifications to Study 9.8 in ISR (ISR Study 9.8, Part C – Section 7.1.2)

7.1.2.1. Characterizing Pre-Project Benthic Macroinvertebrate and Algal Communities (RSP Sections 9.8.4.2, 9.8.4.3, 9.8.4.4.)

- Moving the Lower River site from Trapper Creek to Montana Creek, which has no effect on any of the study objectives, as it establishes one study station within the Lower River Segment (ISR Section 4.2.4.1)
- Replacing the upland slough sites at FA-173 (Stephan Lake Complex) with a small unnamed tributary mouth (ISR Section 4.2.4.2), which has no effect on accomplishing the study objectives
- Conducting storm event sampling at side slough at FA-173 (Stephan Lake Complex) instead of FA-144 (Slough 21), which made it possible to accomplish the required sampling for the purpose of evaluating the effects of the storm event in 2013, and benefits the study by providing a second post-flood event sampling during the Fall Index period, which may give further information on recovery times (Section 4.2.4.3)
- Sampling at sites that could have potentially been inundated for less than the 30-day periods of continuous inundation, due to frequent and rapid river stage changes, which allows for sample collection during all seasonal events as opposed to postponements or cancellations (ISR Section 4.4.3.1)
- The reduction in the number of depth and velocity measures intended to evaluate shoreline bathymetry, which enables the completion of each seasonal event within a 14-day period, allowing for better comparability among sites sampled within each seasonal event, and sample-specific depth and velocity measurements were able to be made to satisfy the requirements for both the trophic modeling effort (ISR Section 4.7), and the HSC/HSI development effort (ISR Section 4.8). (ISR Section 4.4.3.1)

AEA Proposed Modifications to Study 9.8 in ISR (ISR Study 9.8, Part C – Section 7.1.2)

- Taking algae samples from stones and woody debris as opposed to fine sediment in grab samples, which allows for algae samples to be consistently collected in slow-water habitats, as required for the study objective (ISR Section 4.4.3.3)
- Estimating dry weights for macroinvertebrate taxa using length-weight relationship data from UAF as opposed to direct oven-dried biomass weights
- **Emergence trap modifications include:**
 - **Increased floatation to prevent sinking and/or capsizing**
 - **Improved anchoring and deployment**

7.1.2.2. Estimating Drift of Invertebrates (RSP Section 9.8.4.5.)

- Collecting plankton tows at 5 still water sites instead the potential total of 11 recommended by FERC, which provides a standardized approach for sampling the water column for invertebrates, depending upon the velocity, allowing the study team to achieve the study objective (ISR Section 4.5.1.1)
- Estimating dry weights for macroinvertebrate taxa using length-weight relationship data from UAF as opposed to direct oven-dried biomass weights, which increases accuracy, reduces sampling bias, and provides a standard methodology for estimating biomass and energy density while achieving the study objective (ISR Section 4.5.1.2)

7.1.2.3. Feasibility of Talkeetna River Reference Sites

- Main channel macrohabitat type would be replaced with an upland slough site within the Talkeetna reference station (would add second off-channel habitat type to compare to the Middle River Segment sites)

AEA Proposed Modifications to Study 9.8 in ISR (ISR Study 9.8, Part C – Section 7.1.2)

7.1.2.4. Trophic Modeling and Stable Isotope Analysis (RSP Section 9.8.4.7.)

- **Increasing stable isotope site selection from the original two stations (3 sites each) to four stations, sampling 16 sites total, which will better address the study objective of quantifying the relative importance of riverine, terrestrial, and marine energy sources to juvenile salmon and the broader river food web (ISR Section 4.7.3.1)**
- Not utilizing macrohabitat-specific subcutaneous dye marking to track movements of juvenile chinook salmon, coho salmon or rainbow trout less than 60 mm long, which would be much less useful for GRP model validation than the PIT tag data, and therefore allow study resources to be focused on using a robust PIT tag study to most effectively document the movements and growth of individual fish, test the GRP models, and accomplish the objectives of the study (ISR Section 4.7.3.2)
- **Addition of Arctic grayling as a target species**

7.1.2.5. Fish Diet Analysis (RSP Section 9.8.4.11.)

- Elimination of field determinations of fish stomach emptiness to reduce uncertainties in sample collection by standardizing the sampling effort and decision process, thus allowing the study crew to achieve the study objective (ISR Section 4.9.1.1)
- Estimating dry weights for prey items in stomach contents using length-weight relationship data from UAF, as opposed to direct oven-dried biomass weights, which increased accuracy, reduces sampling bias, and provides a standard methodology for estimating biomass while achieving the study objective (ISR Section 4.9.1.2)
- **Addition Arctic grayling juveniles and adults as target species/lifestages**

AEA Proposed Modifications to Study 9.8 in ISR (ISR Study 9.8, Part C – Section 7.1.2)

7.1.2.6. Benthic Macroinvertebrate Colonization Rates (RSP Section 9.8.4.13.)

- The deployment of Hester-Dendy sampler sets from sites with different turbidity/temperature conditions, to deployment in each of the macrohabitat-type sites within a River Productivity station
- Investigate the overall differences in colonization rates and compositions among the five macrohabitat types within River Productivity sites
 - Main channel site, side channel site, side slough site, upland slough site, tributary mouth/clearwater plume site
 - Adds one upland slough site to sampling efforts
- Add an extra collection of six Hester-Dendy sampler sets at a main channel site at increasing depth increments

7.1.2.7. River Productivity in Susitna River Tributaries and Lakes above Devils Canyon

- Additional effort will be added to the River Productivity Study, with the stated objective to characterize the pre-Project benthic macroinvertebrate communities, with regard to species composition and abundance, and algal production in selected Susitna River tributaries and lake systems located above Devils Canyon

Current Status Study 9.8 (ISR Study 9.8, Part C – Section 7.1)

- 2014 focus was field collections to support Trophic Modeling and Stable Isotope Analysis (SIA)
 - Fish diet and tissue sampling at 21 sites
 - Dedicated fish collection efforts for target fish species
 - Addition of adult and juvenile arctic grayling
 - Spring: collected 129 target fish species/lifestage
 - Drift sampling/plankton tows at 21 sites.
 - SIA components collected at 16 study sites.
- Continuing analysis of 2013 data received from taxonomic laboratories.

2014 Productivity in Tributaries and Lakes Above Devils Canyon

- River Productivity surveys in selected Susitna River tributaries and lakes above Devils Canyon. (July 14 - 24).
- Sampling from nine tributaries located above Devils Canyon in the Middle and Upper Susitna River basin.

Devil Creek

Fog Creek

Deadman Creek

Watana Creek

Kosina Creek

Jay Creek

Oshetna River

Tyone River

Butte Creek

- Sampling from Lake Louise, Susitna Lake, and Tyone Lake in the Upper Susitna River basin.
- Samples of benthic macroinvertebrates, algae, drift, plankton, water quality, and water nutrients



Steps to Complete Study 9.8 (ISR Study 9.8, Part C – Section 7.1)

In 2015, AEA plans to complete all remaining data collection and analysis for this study, which include the following activities:

- Collection of benthic macroinvertebrates, algae, drift, and organic matter from the 21 sites established in 2013, with modifications as detailed in the ISR.
- Evaluate the feasibility of Talkeetna River reference sites with continued sampling efforts pursuant to a decision point based on 2013 results as described in the ISR.
- Develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats as detailed in the Study Plan.
- Deploy Hester-Dendy samplers in each macrohabitat site within FA-104, with the addition of a one set that contains a collection of six sampler sets along a main channel depth transect. Supports the study of the effect of fluctuating shorelines on mainstem colonization.

Licensing Participants Proposed Modifications to Study 9.8?

- Agencies
- CIRWG members and Ahtna
- Public