Susitna-Watana Hydro Project

Technical WorkGroup Meeting
Fisheries and Aquatics

River Productivity

Interim DRAFT Revised Study Plans

25 October 2012

Prepared by R2 Resource Consultants

River Productivity Study

Participant	Comment	Response
USFWS	Discussion regarding Objective 4 (Section 7.8.4.4), inquired about the rationale for not having surrogate sites in Alaska.	During the River Productivity Subgroup meeting it was discussed that surrogate systems likely do not exist in Alaska; there are no regulated glacial rivers with reservoirs of similar size and potential operations. Thus is was determined that adding a literature review of glacial rivers affected by water regulation to Objective 1 of the River Productivity Study was an acceptable alternative. This was agreed to by the Subgroup participants including representatives from AEA, USFWS, NMFS, and ADF&G. See RSP Section 9.8.4.1.
ARRI	Discussion regarding Objective 4 (Section 7.8.4.4), expressed concerns about literature-based assessment	This subject was further discussed in the 9/27/12 agency consultation meeting. Literature review of glacial rivers affected by river regulation will be included in Objective 1, synthesis of literature reviewed, in the RSP, Section 9.8.4.1..
ARRI	Suggests that study plan should be measuring primary and secondary productivity by conducting stream respiration / metabolism studies.	This subject was further discussed in the 9/27/12 agency consultation meeting. AEA has revised the River Productivity study plan to include a more rigorous approach to measuring primary and secondary productivity that includes collecting data on organic matter, periphyton and algae, emerging aquatic invertebrates as an estimate of carbon production, benthic macroinvertebrates, and drift. This data will be used to describe existing communities of primary and secondary producers as well as will feed into two independent trophic models: one to describe the bioenergetics and a second to describe origin of food sources under current conditions. AEA thinks this is as rigorous approach and is associated with less uncertainty as compared to a stream metabolism approach. In addition, stream respiration and stream metabolism studies are do not correlate well to the communities (macroinvertebrates, fish) that potentially would be affected by Project operations. As such, this type of approach would limit our ability to predict project effects on those communities, outside of a net change in amount of GPP or ER, through sampling drift, benthos, and fish diet) best relates changes in the ecosystem to fish. See RSP Sections 9.8.4.2, 9.8.4.3, 9.8.4.5, and 9.8.4.7.

River Productivity Study

Participant	Comment	Response
ADF&G	Discussion regarding Objective 4 (Section 7.8.4.4), expressed concerns about literature-based assessment	This subject was further discussed in the 9/27/12 agency consultation meeting. Literature review of glacial rivers affected by river regulation will be included in Objective 1, synthesis of literature reviewed, in the RSP, Section 9.8.4.1.
ARRI, ADF&G	Requested sampling in deep water	Current federal protocols (specifically Angradi et al. 2006, as well as those cited in the RSP Section 9.8.4.2) recommend shoreline littoral sampling, as they are usually considered to be where much of the macroinvertebrate productivity takes place. Furthermore, shoreline areas are the locations that will be most affected by the Project. Sampling deeper benthic habitats farther out in the channel is challenging and benthic organisms are usually lower in abundance in these habitats (Angradi et al. 2006).
ADF&G	7.8.4.4 **Conduct a literature/data search to identify existing river systems that could act as surrogates in evaluating future changes to productivity in the Susitna River.** We recommend supplementing or substituting this section using a reference reach in a similar Alaska river using a BACI design monitoring program in order to assess post project impacts.	During the River Productivity Subgroup meeting it was discussed that surrogate systems likely do not exist in Alaska so that adding a review of potential project effect to Objective 1 of the River Productivity Study was an acceptable alternative. This was agreed to by the Subgroup participants including representatives from AEA, USFWS, NMFS, and ADF&G. AEA has included in the RSP a feasibility study to identify the suitability of the Talkeetna River as a reference reach. RSP Section 9.8.4.4. AEA will consider the use of a BACI design when developing a monitoring plan for post-project impacts to river productivity. Prior to developin a monitoring plan it is important first to obtain results from baseline studies and have finalized Project operation procedures.. See RSP Section 9.8.4.4.
USFWS	Marine derived nutrients are mentioned in Section 7.5.2 in association with the River Productivity Study, but are not mentioned elsewhere in the PSP	AEA has added additional detail to the RSP describing how marine derived nutrients will be addressed with a stable isotope analysis as part of the trophic analysis. See RSP Section 9.8.4.5.2.

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Participant	Comment	Response
USFWS	"Trophic ecology needs to be clearly spelled out in a study plan identifying any aspects that will and will not be addressed explained and with appropriate rationale."	This subject was further discussed in the 9/27/12 agency consultation meeting. AEA has added additional detail to RSP by describing a more rigorous approach in defining trophic relationships. Options discussed included bioenergetics, stable isotope analysis, and adult insect emergence traps. See RSP Section 9.8.4.5.2.
ADF&G	Recommends identifying a reference reach in a similar Alaska river for using a BACI design monitoring program to assess post project impacts.	RSP will address reference sites in Objective 4 (Section 9.8.4.4), with a feasibility study on the Talkeetna River in 2013, conducting sampling efforts on multiple sites to assess community similarities with middle Susitna River sites.
USFWS	Study Request = Develop a white paper on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities in cold climates. *PSP = Synthesize existing literature on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities;* Comment = Any difference in developing a white paper versus synthesizing existing literature?	"Developing a whitepaper" and "synthesizing existing literature" may be considered synonymous. However, stating "develop a white paper" may hold different meaning or expectations for different parties, and would require a definition of what a whitepaper is. Therefore, the PSP refers to the action of synthesizing existing literature, in descriptive terms, to clarify the proposed task. RSP Section 9.8.4.1.
USFWS	Study Request = Characterize the pre-project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the lower, middle and upper Susitna River. *PSP = Characterize the pre-Project benthic macroinvertebrate and algal communities with* *regard to species composition and abundance in the middle and upper Susitna River;* Comment = Omission of lower reach is an apparent typo.	AEA has considered the inclusion of sampling for macroinvertebrates and algae in the Lower Susitna River and has determined that, at this time, sampling in the Lower River is not warranted. Given the dramatic change is discharge, turbidity and temperature in the Susitna River associated with the inflows from the Talkeetna and the Chulitna River we do not anticipate Project related affects that will be translated to primary and secondary producers. Our approach for river productivity is to establish a rigorous sampling program for the locations with the greatest potential for change, the river upstream and directly downstream of the proposed Project dam site.

River Productivity Study

Participant	Comment	Response
USFWS	Study Request = 3. Estimate drift of benthic macroinvertebrates in habitats within the lower, middle and upper Susitna River to assess food availability to juvenile and resident fishes. *PSP = Estimate drift of benthic macroinvertebrates in selected habitats within the middle and upper Susitna River to assess food availability to juvenile and resident fishes;* Comment = Omission of lower reach is an apparent typo.	AEA has considered the inclusion of sampling for macroinvertebrates and algae in the Lower Susitna River and has determined that, at this time, sampling in the Lower River is not warranted. Given the dramatic change is discharge, turbidity and temperature in the Susitna River associated with the inflows from the Talkeetna and the Chulitna River we do not anticipate Project related affects that will be translated to primary and secondary producers. Our approach for river productivity is to establish a rigorous sampling program for the locations with the greatest potential for change, the river upstream and directly downstream of the proposed Project dam site.
USFWS	Study Request = Conduct a trophic analysis to describe potential changes in the primary and secondary productivity of the riverine community following post-project construction and operation *PSP = Conduct a review on the feasibility of a trophic analysis to describe potential changes in the primary and secondary productivity of the riverine community following Project construction and operation;* Comment = Shouldn't this read: Conduct a trophic analysis, if feasible, to describe…? Also, why would it not be feasible? Explain.	This subject was further discussed in the 9/27/12 agency consultation meeting. AEA has added additional detail n the RSP describing a more rigorous empirical approach to define trophic relationships. See RSP Section 9.8.4.5.
USFWS	Study Request = Characterize the **benthic** macroinvertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component). *PSP = Characterize the macroinvertebrate compositions in the diets of representative fish* *species in relationship to their source (benthic or drift component);* Comment = I assume this should include term "benthic". If not, explain difference.	Analysis of fish diets of target species will include both benthic and terrestrial invertebrates. RSP will mention the terrestrial component in this objective, as well as the drift objective, Section 9.8.4.3. and 9.8.4.7.

River Productivity Study

Participant	Comment	Response
USFWS	Study Request = Evaluate the feasibility of reference sites on the Talkeetna and Chulitna Rivers to monitor baseline productivity, pre- and post-construction. (deleted in PSP; and not addressed) *PSP = AEA replaced this objective (with #4 below), but based on discussion at August 15, 2012, TWG meeting it was suggested to do both or keep the original Study Request objective. We recommend and support that suggestion.* Comment = Conduct a literature/data search to identify existing river systems that could act as surrogates in evaluating future changes to productivity in the Susitna River. (added in PSP)	This subject was further discussed in the 9/27/12 agency consultation meeting. Literature review of glacial rivers affected by river regulation will be included in Objective 1, synthesis of literature reviewed, in the RSP. See RSP Section 9.8.4.1. RSP will address reference sites in Objective 4 (Section 9.8.4.4), with a feasibility study on the Talkeetna River in 2013, conducting sampling efforts on multiple sites to assess community similarities with middle Susitna River sites.
USFWS	Study Request = 9. Estimate benthic macroinvertebrate colonization rates in the middle and lower reaches to monitor baseline conditions and evaluate future changes to productivity in the Susitna River *PSP = Estimate benthic macroinvertebrate colonization rates in the middle and lower reaches to monitor baseline conditions and evaluate future changes to productivity in the Susitna River.* Comment = Note: Page 7-12 of PSP states that marine derived nutrients are included in River Productivity Study, but there is no mention of it in Chapter 7; i.e., is not addressed.	AEA has added additional detail in the RSP including an analysis of fish food sources including freshwater and marine derived nutrients as part of the trophic analysis. See RSP Section 9.8.4.5.2.
ARRI	Regarding Section 7.8.4.2.1, request for additional details of site-specific sample locations and sampling methodology	The RSP will include additional details regarding sampling methodology, which will be based on accepted federal agency standardized methods, such as the USGS NAQWA protocols, which sample in “richest-targeted habitat”, typically riffle-like habtat and woody snags. See RSP Section 9.8.4.2.1. Sampling locations will follow this standardized sampling approach and availability within sampling focus areas; details will be addressed in the implementation plan.

River Productivity Study

Participant	Comment	Response
ARRI	Regarding Section 7.8.4.2.1, number of sample sites per macrohabitat classification.	PSP contains details on sampling areas and number of sites within those areas in Table 7.8-1, along with Figures 7.8-1 through 7.8-3. AEA has included in RSP clarification that sampling focus areas contain 1 mainstem site and 2 off-channel sites that are associated with that mainstem site. See RSP Section 9.8.4.2.1.
ARRI	Regarding Section 7.8.4.2.1, inquired if macrophyte beds should be included as habitat to be sampled for benthic macroinvertebrates	No documentation of macrophyte beds as a major habitat area in the Susitna. No plans to further stratify for this habitat type.
ARRI	Questions on methodology of sample snags for macroinvertebrates (in Section 7.8.4.2.1)	PSP refers readers to Moulton et al. 2002 for USGS protocols on snag sampling. RSP Section 9.8.4.2.1.
ARRI	Objective 3, Section 7.8.4.3, invertebrate drift sampling methods and timing.	RSP will clarify that drift sampling will occur in spring, summer, and fall, and that 12 of the 18 sites to be sampled will be in a focus area in the Middle Reach, which include mainstem sites paired with1-2 associated off-channel sites. RSP Section 9.8.4.1, and 9.8.4.3..
ARRI	Objective 5, Section 7.8.4.5, trophic analysis.	AEA has revised the RSP to include a more rigorous approach in defining trophic relationships and addressing estimates of river productivity. See RSP Section 9.8.4.5.
ARRI	Regarding Objective 6, Section7.8.4.6, HSC criteria development. Concerned that level of sampling is insufficient.	AEA has added additional detail in the RSP regarding the HSC/HSI criteria development process. See RSP Section 9.8.4.6. In the RSP, the suitability information is literature-based, with validation by site-specific field observations, and finalization by expert panel.
ARRI	Regarding Objective 7, Section7.8.4.7, questioned what the objective is for fish diet analysis.	Fish diet analysis will provide information on what target fish species are consuming in relation to their overall abundance in community and their prevalence in drift. See RSP Section 9.8.4.7.
ARRI	Regarding Objective 7, Section7.8.4.7requested additional details about sampling efforts (locations and frequency).	AEA has added additional detail in the RSP regarding the implementation plan. RSP describes how the efforts will be coordinated with relevant fish study for timing and locations at focus areas. See RSP Section 9.8.4.7.

River Productivity Study

Participant	Comment	Response
ARRI	Regarding Objective 7, Section7.8.4.7, asked if weights and cohort info should be collected.	Detail has been added to the RSP including taxa weights (See RSP sections 9.8.4.2.1, 9.8.4.3, 9.8.4.5, and 9.8.4.7.). In addition with the inclusion of the bioenergetics and isotopic analyses AEA approach will focuses on trophic relationships not production estimates and thus, does not include cohort analysis. RSP Section 9.8.4.5.
ARRI	Regarding Objective 7, Section7.8.4.7, asked if terrestrial invertebrates and riparian vegetation cover information should be collected.	Terrestrial invertebrates will be analyzed in drift samples and fish diet analysis (RSP sections 9.8.4.3 and 9.8.4.7). Additional information on riparian vegetation will be available from Botanical or Riparian Instream Flow studies The interdependencies of the Riparian and River Productivity studies will be clarifed as baseline data is collected and we learn what proportion of the drift and fish diet is derived from terrestrial, specifically riparian, resources..
ARRI	Regarding Objective 4, Section7.8.4.4, asked how and who will determine if additional reference data collection at other sites is “feasible”.	RSP will address reference sites in Objective 4 (Section 9.8.4.4) with a feasibility study of potential sites in the Talkeetna River in 2013 which will include sampling efforts on multiple sites to assess community similarities with middle Susitna River sites.
ARRI	Regarding Objective 8, Section7.8.4.8, requested more detail on organic matter sampling methods.	AEA has added additional detail in the RSP regarding the methods of collecting and analyzing organic matter will be provided in the RSP. See RSP Section 9.8.4.8..
ARRI	Regarding Objective 8, Section7.8.4.8, asked if organic matter processing, flow transport, and floodplain interactions will be investigated.	AEA is not proposing to such investigations because such investigations would be focused on river processes, and less on the trophic community analysis that is the focus of this study. Results of such investigations would not be easily related/ correlated to the organisms of interest, i.e. macroinvertebrates and fish, and, therefore, would be difficult to use those results to predict project effects on those communities. In addition, each of these would require a specialized and extensive study involving development with or by other study plans.

River Productivity Study

Participant	Comment	Response
ARRI	Regarding Objective 9, Section7.8.4.9, request for additional details on the sample design, materials, and deployment.	Decisions on specific artificial substrates to be used will depend on location of the site, flows the devices will be subjected to, accessibility to the site, vandalism risks, and comparability to other studies in Alaska. This decision will be made after consideration of all focus areas and site-specific information required to select sampling stations for the study. .. See RSP Section 9.8.4.9.
Various agencies	Discussion regarding Objective 4 (Section 7.8.4.4), concerning surrogate sites and a literature-based assessment.	Literature review of glacial rivers affected by river regulation will be included in Objective 1, synthesis of literature reviewed, in the RSP. See RSP Section 9.8.4.1.
Various agencies	Discussion regarding reference sites in a similar Alaska river for using a BACI type design monitoring program to assess post project impacts.	RSP will address reference sites in Objective 4 (Section 9.8.4.4) with a feasibility study of potential sites in the Talkeetna River in 2013 which will include sampling efforts on multiple sites to assess community similarities with middle Susitna River sites.
Various agencies	Discussion regarding the BACI design for use in monitoring program to assess post project impacts.	A BACI type design can be attempted, but there are concerns about the power of analysis due to the level of sampling efforts (study plan is only 2 years). Possible that only large differences will be detectable. Multivariate analyses could be attempted. Additional details would be included in an implementation plan.
Various agencies	Discussion regarding Objective 5, Section 7.8.4.5, trophic analysis and formal productivity measures	RSP will include a more rigorous approach in defining trophic relationships and addressing estimates of river productivity. RSP Section 9.8.4.5.
Various agencies	Question about recent flooding and the possible negative effect it would have upon sampling next year	Sampling requires multiple years in order to account for the annual variability; high, low, and average years all need to be sampled. Study plan has the limitation of 2 years of data.
Various agencies	Regarding Objective 5, Section7.8.4.5, discussion about options for trophic analysis, productivity measures	Several approaches were discussed, including bioenergetics, stable isotope analysis, and adult emergence sampling. Regarding bioenergetics, target species may include all 3 salmon species fry/juveniles, and possibly stickleback. RSP Section 9.8.4.5.

River Productivity Study

- ADF&G Request for reference sites on the Talkeetna River
- ARRI Request to establish 5 – 6 reference sites on the Talkeetna River
- Various agencies request for additional sampling programs as part of the reference sites on the Talkeetna River.

River Productivity Study

- **Objective 4, RSP Section 9.8.4.4.**

Reference Site Feasibility Study

- One station on Talkeetna River in 2013
  - 1 mainstem site
  - 2 off-channel habitat sites associated with mainstem site
- Benthic macroinvertebrates and algae sampling
- Drift sampling
- Three seasonal collections

River Productivity Study

- USFWS Request for more detailed Trophic Analysis component
- USFWS Request for marine-derived nutrient measures
- ARRI Request for primary and secondary productivity measures (stream metabolism, stream respiration)

River Productivity Study

- **Objective 5, RSP Section 9.8.4.5.**
- Growth Rate Potential (GRP) Model
  - Couples foraging model with bioenergetics model
  - Focus on 3 fish species
    - Coho (fry/juveniles)
    - Rainbow trout (juveniles and adults)
    - Northern pike (juveniles and adults)
  - Couples Foraging Model with Bioenergetics Model
  - Predicts consumption rates and growth rates for fish species
  - Preliminary models for 2013 data, refined in 2014

River Productivity Study

- Stable isotope analysis (SIA)
  - Can be used to trace sources of productivity within aquatic food webs and trophic positions of consumers
  - Will be used to identify contribution of marine-derived nutrients (MDN) in the system
  - Focused SIA testing on samples from 2 stations
- Adult emergence traps
  - included as part of **Objective 2, RSP Section 9.8.4.2.1**
  - Collected at each site
  - Surrogate for carbon production from the river

River Productivity Study

- Sampling reduced from 9 Stations (27 sites) to 6 Stations (18 sites).
- Lower Reach Stations removed from plan.
- Middle Reach stations to be located at 4 of the 8 proposed focus areas .

Sampling Reach	Reach Description	Number of Mainstem Sites	Number of Associated Off-channel Sites[1]
Upper Reach			
UR-1, -2, -3	Reference upstream of reservoir	2	4
Middle Reach			
MR-1	Immediately below dam site	1	2
MR-2	Upstream of Devils Canyon	1	2
MR-6	Downstream of Devils Canyon	2	4
Susitna River Totals		**6**	**12**