Susitna-Watana Hydroelectric Project Document
ARLIS Uniform Cover Page

Title: Proposed study plan : Susitna-Watana Hydroelectric Project, FERC No. 14241	**SuWa 82**
Author(s) – Personal:	
Author(s) – Corporate: Alaska Energy Authority	
AEA-identified category, if specified: Proposed Study Plan	
AEA-identified series, if specified:	
Series (ARLIS-assigned report number): Susitna-Watana Hydroelectric Project document number 82	**Existing numbers on document:**
Published by: [Anchorage, Alaska : Alaska Energy Authority, 2012]	**Date published:** July 2012
Published for: Submitted to Federal Energy Regulatory Commission	**Date or date range of report:**
Volume and/or Part numbers:	**Final or Draft status, as indicated:**
Document type:	**Pagination:** 1261 p. in various pagings
Related work(s): Revised as: Alaska Energy Authority. Revised study plan (SuWa 76-81)	**Pages added/changed by ARLIS:**
Notes: Includes cover letter with distribution list attachment.	

All reports in the Susitna-Watana Hydroelectric Project Document series include an ARLIS-produced cover page and an ARLIS-assigned number for uniformity and citability. All reports are posted online at http://www.arlis.org/resources/susitna-watana/

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SUSITNA-WATANA HYDRO

Proposed Study Plan

Susitna-Watana Hydroelectric Project

FERC No. 14241

ALASKA
ENERGY AUTHORITY

July 2012

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Abbreviation	Definition
AAC	Alaska Administrative Code
ACHP	Advisory Council on Historic Preservation
ac-ft	acre-feet
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADOTPFCR	ADOT Central Region Planning
ADOTPFNR	ADOT Northern Region Planning
AEA	Alaska Energy Authority
AEIDC	Arctic Environmental Information and Data Center
AFB	air force base
AFFI	Alaska Freshwater Fish Inventory
AHRS	Alaska Heritage Resources Survey
AHMG	Alaska Habitat Management Guides
Ahtna	Ahtna, Inc.
AKNHP	Alaska Natural Heritage Program
AMP	Airport Master Plan
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act of 1980
APA	Alaska Power Authority
APA Project	APA Susitna Hydroelectric Project
APE	area of potential effect
APLICs	Alaska Public Lands Information Centers
ARRC	Alaska Railroad Corporation
AS	Alaska Statutes
ASCP	Alaska Shorebird Conservation Plan
ASFDB	Alaska Subsistence Fisheries Database
ASG	Alaska Shorebird Group
ASTM	American Society for Testing and Materials
ATV	all-terrain vehicle
AVC	Alaska Vegetation Classification
AWC	Anadromous Waters Catalogue
BCC	birds of conservation concern
BDPs	Best development practices
BIA	DOI, Bureau of Indian Affairs
BLM	DOI, Bureau of Land Management

Abbreviation	Definition
BLM-S	BLM sensitive species
BLM-W	BLM watch list species
BMC	birds of management concern
BMPs	best management practices
BOD	biochemical oxygen demand
BOF	Alaska Board of Fisheries
BP	before present
BPIFWG	Boreal Partners in Flight Working Group
CATC	CIRI Alaska Tourism
CDP	census-designated place
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIBW	Cook Inlet Beluga Whales
CIRI	Cook Inlet Region, Inc.
cm	centimeter
CNIPM	Alaska Committee for Noxious and Invasive Plants Management
COY	cubs of the year
CPOM	course particulate organic matter, particle size larger than 1 mm in size
CSIS	ADF&G Community Subsistence Information System
DBSD	Denali Borough School District
DCCED	Alaska Department of Commerce, Community, and Economic Development
DHSS	Alaska Department of Health and Social Services
DIDSON	Dual Frequency Identification Sonar
DO	dissolved oxygen
DOI	U.S. Department of the Interior
Doyon	Doyon, Ltd.
DPOR	ADNR Division of Parks and Outdoor Recreation
DSM	Demand Side Management
EARMP	East Alaska Resource Management Plan
EE	energy efficiency
EFH	essential fish habitat
EIM	Environmental Information Management
EIS	environmental impact statement
El.	elevation
EMS	emergency medical services
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

Abbreviation	Definition
et al.	"*et alia*"; and the rest
FAA	Federal Aviation Administration
ft	feet
ft MSL	feet mean sea level
FBOM	fine benthic organic matter
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHA	USDOT Federal Highway Administration
FMP	Fishery Management Plan
FPOM	fine benthic organic matter
fps	feet per second
FR	Federal Register
FS	featured species
FY	fiscal year
g	gram
GIS	Geographic Information System
GMP	General Management Plan
GMU	Game Management Unit
GPS	global positioning system
GU	globally unrankable
GVEA	Golden Valley Electric Association
GWh	gigawatt-hours
HEA	Homer Electric Association
IFRR	Instream Flow Relationships Report
ILP	Integrated Licensing Process
in	Inch
IPCC	Intergovernmental Panel on Climate Change
ISER	University of Alaska Anchorage Institute for Social and Economic Research
ISR	Initial Study Report
kcmil	circular mils
kg	kilogram
km	kilometer
km^2	kilometer(s) squared
kV	kilovolt
L	liter(s)
licensing participants; Participants	Agencies, ANSCA corporations, Alaska Native entities and other licensing participants
LRTP	Long Range Transportation Plan
LOEL	Lowest Observable Effect Level

Abbreviation	Definition
LWCF	Land and Water Conservation Fund
m	meter(s)
M	million
m^2	square meter(s)
MAPS	Monitoring Avian Productivity and Survivorship
Mat-Su	Matanuska Susitna
MBTA	Migratory Bird Treaty Act
MEA	Matanuska Electric Association
mg	milligram
mg/L	milligrams per liter
mi^2; sq.mi.	square mile(s)
mi	mile(s)
ml	milliliter(s)
ML&P	Anchorage Municipal Light and Power
mm	millimeter(s)
MON	Museum of the North
MP	mile post
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSB	Matanuska-Susitna Borough
MSL	mean sea level
MVA	megavolt-Ampere
MW	megawatts (one million watts)
MWh	megawatt hour
n/a	not applicable *or* not available
NAAQS	National Ambient Air Quality Standards
NAWCP	North American Waterfowl Conservation Plan
NAWMP	North American Waterfowl Management Plan
NCI	Northern Cook Inlet
NCIMA	Northern Cook Inlet Management Area (sport fish harvest)
n.d.	no date
NCM	Newton centimeter
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NLCD	National Land Cover Dataset
NLUR	Northern Land Use Research
NMFS	NOAA National Marine Fisheries Service
No.	number

Abbreviation	Definition
NO2; NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOEL	No Observed Effects Level
NOI	Notice of Intent
NPS	DOI, National Park Service
NRCS	USDA Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	nephelometric turbidity unit
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O_3	ozone
O&M	operations and maintenance
OHV	off-highway vehicle
OPMP	Office of Project Management and Permitting
ORV	off-road vehicle
PAD	Pre-Application Document
Pb	lead
PCE	primary constituent elements
PDD	Preliminary Decision Document
PHABSIM	Physical Habitat Simulation
PhD	Doctor of Philosophy
PIT	passive integrated transponder
PL	Public Law
PLC	programmable logic controller
PLP	Preliminary Licensing Proposal
PM	particulate matter
$PM_{2.5}$; PM2.5	particulate matter up to 2.5 microns in diameter
PM_{10}; PM10	particulate matter up to 10 microns in diameter
PM&E	protection, mitigation and enhancement
PMF	probable maximum flood
lb	pound
POW	palustrine open water (ponds under 20 ac)
ppb	parts per billion
Project	Susitna-Watana Hydroelectric Project
PSD	Prevention of Significant Deterioration
PSP	Proposed Study Plan
RASP	Regional Aviation System Plan
RCC	roller compacted concrete
Rd	recreation-dispersed

Abbreviation	Definition
RIRP	Railbelt Integrated Resources Plan
RM	river mile
ROS	recreational opportunity spectrum
RS	revised statute
RSP	Revised Study Plan
RTE	rare, threatened and endangered
s	second
SANPCC	Southcentral Alaska Northern Pike Control Committee
SaSI	Salmonid Stock Inventory
SB	Senate bill
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SCRO	ADNR South Central Regional Office
SD1	Scoping Document 1
SD2	Scoping Document 2
SDVCSC	South Denali Visitor Center Steering Committee
SES	City of Seward Electric System
sf; ft^2	Square foot (feet)
SHPO	State Historic Preservation Officer
SMAP	Susitna Matanuska Area Plan
SMP	Shoreline Management Plan
SO2; SO_2	Sulfur dioxide
SpUD	Special use district
SQL	Standard query language
SRMAs	Special Recreation Management Areas
STB	Surface Transportation Board
SVO	Successor Village Organizations
SWHS	Statewide Harvest Survey
TCP	traditional cultural property
TCW	Talkeetna Mountains and Chulitna-Watana Hills
TDG	total dissolved gas
TDS	total dissolved solids
TEK	Traditional Environmental Knowledge
TOC	total organic carbon
TSP	total suspended particulate
TWG	Technical Workgroup
UAAES	University of Alaska Agriculture Experiment Station
UAFAFES	University of Alaska Fairbanks Agricultural and Forestry Experiment Station
UCG	underground coal gasification
UCIMA	Upper Cook Inlet Management Area (commercial fish harvest)

Abbreviation	Definition
U.S., US	United States
USACE	U.S. Army Corps of Engineers
U.S.C.; USC	U.S. Code
USCB	U.S. Department of Commerce, Census Bureau
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFS	USDA, Forest Service
USFWS	DOI, Fish and Wildlife Service
USGS	DOI, Geological Survey
USR	Updated Study Report
USSCP	U.S. Shorebird Conservation Plan
VFD	Volunteer Fire Department
VHF	very high frequency
VOC	volatile organic compound
VRM	Visual Resource Management system
WSR	Wild and Scenic River
yd	Yard
^{14}C	Carbon 14
ºC	degrees Celsius
ºF	degrees Fahrenheit
µg	microgram
µg/L	micrograms per liter
µg/m^3	microgram per cubic meter
µL	microliter(s)

Proposed Study Plan (PSP)

1. INTRODUCTION TO PSP

This document provides the Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) for licensing, which includes individual study descriptions for the licensing of the Project. The Federal Energy Regulatory Commission (FERC or Commission) regulations at 18 CFR §5.11 require the applicant to file a study plan with FERC after consultation with parties interested in the licensing.

On December 29, 2011 AEA filed with the FERC its Notice of Intent (NOI) and Pre-Application Document (PAD) to start formal licensing for the proposed Susitna-Watana Hydroelectric Project (Project), FERC No. 14241. The PAD provides licensing participants summaries of existing relevant, and reasonably available information related to the Project. Section 5 of the PAD identified issues and preliminary study concepts AEA believed were important to address the identified issues.

On February 24, 2012, FERC issued a public notice acknowledging the filing of AEA's NOI and PAD, officially commencing the licensing proceeding, and soliciting public comment on the PAD and study requests from licensing participants. In addition, FERC issued a Scoping Document to outline the subject areas to be addressed in its environmental analysis of the Project pursuant to

the National Environmental Policy Act (NEPA). FERC held six Scoping Meetings for the Project. The meetings were held the week of March 26, 2012 in Anchorage, Wasilla, Glennallen, Sunshine, Cantwell, and Fairbanks and focused on obtaining comments and input on resource issues related to Project operations from resource agencies, Alaska Natives, local governments, non-governmental organizations (NGOs), and members of the general public. The purpose of the meetings was for FERC to initiate scoping of the issues, review and discuss existing Project information, identify information and study needs; and discuss the process plan and schedule for licensing activities required under the ILP regulations.

Also since the filing of the PAD, AEA has held a series of monthly Technical Workgroup (TWG) Meetings with Federal and State agencies, Alaska Native entities, Non-governmental Organizations (NGOs), and other licensing participants (licensing participants) to present and discuss AEA's proposed study plans and study planning process. A listing of the meetings and topics covered is provided in Table 1-1. Documentation of the TWG meetings since filing of the PAD is found in Attachment 1-1 where the summary notes from 14 separate TWG meetings are provided and referred to in many of the ensuing sections. In addition, AEA and its consultant team have had many individual and small group meetings and follow-up discussions with resource agencies, Alaska Native entities and other licensing participants to discuss issues, existing information and information needs.

On May 18, 2012, AEA filed 46 preliminary draft study requests with the Commission. The AEA-filed study requests were not required by the ILP regulations, but were provided in order to facilitate the agencies' and other licensing participants' preparation of their formal study requests.

A total of 52 individual formal study requests, including those of the FERC staff, were made by nine Agency, Alaska Native entities and other licensing participant groups during the PAD and Scoping comment period that ended on May 31, 2012. Many of these study requests were similar in purpose and scope to AEA's proposed studies outlined in Chapter 5 of the PAD and further modified and updated in collaboration with interested parties as discussed and presented at technical workgroup meetings and shared with licensing participants throughout the first 5 months of 2012. In response to these 52 study requests, AEA is proposing to undertake all but one of these requested resource studies, with some alternations and adjustments. Most of the AEA proposed studies essentially consolidate the various study requests by specific resource areas. In this fashion, the overwhelming majority of the study requests have been incorporated into this PSP Document. These studies will provide information needed to investigate potential effects to environmental resources resulting from Project construction and operation.

This PSP contains a total of 58 individual study plans that have been prepared in consultation with licensing participants. The study plans are organized by corresponding natural resource topical areas and contained within each respective resource section of the PSP. For each proposed study within a resource area, the PSP provides all information specified under FERC's Integrated Licensing Process (ILP) requirements (18 CFR §5.11) along with additional information about the proposed study including specific documentation of consultation relevant to the study plan development. Prior to descriptions of AEA's proposed studies, in Section 3 of the PSP, AEA addresses a study that was requested by Natural Heritage Institute and American Whitewater that AEA has not adopted in the PSP. As noted above, for the remaining 51 study requests, AEA has substantially adopted these proposals, however we have not completely adopted each request (please refer to individual study plans for specific details).

The proposed study descriptions in this document have been developed to supplement the existing information summarized in the PAD and address issues associated with construction and operation of the proposed Project. Information obtained through these studies, when combined with existing information, will also be used to develop any necessary protection, mitigation, and enhancement measures (PM&E) to be included in the new Project license.

1.1. Process and Schedule Overview

From the filing of the NOI and PAD through May 2012, many interested parties including TWG participants filed comments on the PAD, on FERC's Scoping Document 1, and in some cases on AEA's proposed studies. In addition many parties have provided their own study requests or comments relating to the need for additional studies. AEA has taken these comments into account in developing its PSP. In addition, consistent with 18 CFR § 5.11(e), AEA will hold an initial study plan meeting within 30 days of filing of the PSP for the purpose of clarifying the PSP and any initial information gathering or study requests, and resolving any outstanding issues with interested licensing participants regarding the PSP. The initial study plan meeting will consist of five separate meetings organized by major resource topical area, in Anchorage at AEA's Susitna-Watana Hydroelectric Project offices, on August 8, 9, 15, 16 and 17, 2012. AEA is intending to work closely with all interested licensing participants on reviewing and updating the proposed study plans during the period leading up to filing of the revised study plan.

The ILP regulations allow 90 days for interested parties to comment on the PSP which will culminate in all comments being filed with FERC by October 15, 2012. In addition to the initial study plan meeting, AEA will engage in further efforts, as needed, to attempt to resolve study issues through a series of TWG meetings scheduled for October 16, 17, 23, 24 and 25, 2012. By November 14, 2012, within 30 days of the due date from comments on the PSP, AEA will file its Revised Study Plan (RSP) containing all revised study descriptions and an explanation of all efforts made to resolve any remaining differences over study requests. Comments on the RSP will be due from interested parties by November 29, 2012.

FERC is scheduled to issue its study plan determination by December 14, 2012, within 30 days from filing of the RSP (18 CFR §5.13 (c)). A federal agency with FPA Section 4 (e) or Section 18 mandatory conditioning authority, or the agency with authority to issue Clean Water Act Section 401 water quality certification for the Project, may file a formal notice of dispute if its disagrees with an element of the Study Plan Determination directly applicable to its mandatory conditioning authority. If so, the formal dispute resolution process will be initiated, as provided for under 18 CFR §5.14. In that case, FERC will issue a final study plan dispute determination for the disputed study plan components no later than March 2013. Interim updates for all studies being conducted by AEA will be made through periodic technical workgroup meetings scheduled at least quarterly through 2013 and 2015. The intent of the meetings is to update interested parties with information on study progress, initial results, and changes to anticipated conditions or study methodologies. AEA will provide up to 30 days review on materials presented at workgroup meetings. All studies other than ice processes are expected to be completed by the end of 2014 and final results presented in updated study reports and the ensuing documentation included in AEA's license application. The ice processes study is expected to be completed by end of March 2015, with updated results also included in the license application. The updated process, plan, and schedule for the Project is provided in Table 1.1-1, which includes additional detail regarding specific study dispute resolution steps and milestones. AEA has included timeframes for Formal Dispute Resolution, highlighted in yellow [18 CFR 5.14] even though AEA hopes to resolve any study disputes informally by working directly with interested parties to reach consensus.

1.2. Project Facilities and Operations

This section provides a brief overview of the Project location, facilities and proposed operational characteristics. At this time there are no new updates from the descriptions in the PAD, other than the study area boundaries for the transmission and road corridors have been slightly revised, but those revisions have not changed the basic alignment or orientation of the study corridors. For more detail regarding the Project facilities and operational characteristics, please refer to the PAD (AEA 2011; available on the Susitna-Watana Hydroelectric Project website, http://www.susitna-watanahydro.org. The proposed Project is located in the Southcentral region of Alaska, approximately 120 miles (mi) north-northeast of Anchorage and 110 mi south-southwest of Fairbanks. As proposed, the Project would include construction of a dam, reservoir and power plant on the Susitna River starting at river mile (RM) 184, approximately 34 mi upstream of Devils Canyon. Transmission lines connecting into the existing Railbelt transmission system and an access road would also be constructed. Because engineering and environmental studies are helping define the locations and configurations of the Project components, the current study area for the Project is larger than that which will be proposed as the Project Boundary and includes alternative transmission and road corridors that may eventually be narrowed down to one or two proposed corridors (Figure 1.2-1).

Dam and Reservoir

As currently envisioned, the Project would include a large dam with a 20,000-acre (ac) reservoir. The type and height of dam construction are still being evaluated as part of ongoing engineering feasibility studies, but early comparisons have demonstrated that it will most likely be a roller-compacted concrete structure. The dam has a nominal crest elevation at elevation (El.) 2,025 ft mean sea level (msl) corresponding with a maximum height of approximately 700 ft above the foundation and a crest length of approximately 2,700 ft. Following completion of the feasibility studies, a nominal crest elevation up to El. 2,125 ft msl may be proposed in the license application; this would correspond to a maximum dam height of up to 800 ft above the foundation.

The Watana Reservoir, at normal operating level of El. 2,000 ft msl, will be approximately 39 mi long with a maximum width of approximately 2 mi. The total water surface area at normal operating level is approximately 20,000 ac. The minimum reservoir level will be 1,850 ft msl during normal operation, resulting in a maximum drawdown of 150 ft. However, a maximum drawdown of up to 200 feet is still being considered. The reservoir will have a total capacity of 4.3 million ac-ft, of which 2.4 million ac-ft will be active storage.

Construction materials for the dam and appurtenant structures will utilize, as far as possible, rock from the structure excavations to minimize the quarry development. Stable excavations and rock cuts will be designed with suitable rock reinforcement and berms.

Thick alluvial deposits will be removed from the river bed in order to found the dam on sound bedrock.

Hydroelectric Facilities

The powerhouse will be located immediately downstream of the dam, and will house three generating units, each with a nominal capability of 200 MW unit output under average net head (which will be close to the design head) for a total plant capacity of 600 MW under average head. However, based on discussions with Railbelt utilities regarding electrical system reliability, AEA may propose up to four units with a nominal capacity of 150 MW and a total capacity of 600 MW. The capacity of the Project eventually proposed for licensing could extend up to 800 MW. The exact sizing and number of units may change as a result of further transmission system studies.

The average annual energy of the project will be 2,500,000 megawatt hours. If only three units are proposed, the powerhouse will be designed and constructed with an extra empty generating unit bay for the potential installation of a fourth unit at a future time. There would be two outlet works facility structures and four power intake structures (one corresponding to the extra unused powerhouse bay if three units are proposed). The outlet works facility in conjunction with the three powerhouse units will be sized to allow discharge of a 50-year flood before flow would be discharged over the spillway.

Ancillary Facilities

Construction of the Watana Dam site development will require various facilities to support the construction activities throughout the entire construction period. Following construction, the operation of the Project will require a small permanent staff and facilities to support the permanent operation and maintenance (O&M) program.

The most significant item among the temporary site facilities will be a construction camp. The construction camp will be a largely self-sufficient community normally housing approximately 800 persons, but with a peak capacity of up to 1,000 people. After construction, AEA plans to remove most of the camp facility, leaving only those aspects that are to be used to support the smaller permanent residential and operation and maintenance facilities.

Other site facilities include contractor work areas, site power, services, and communications. Site power and fiber optic cabling will be brought either on the transmission line route, or along the side of the access road. Items such as power and communications will be required for construction operations, independent of camp operations.

Permanent facilities will include community facilities for O&M staff members and any families. Other permanent facilities will include maintenance buildings for use during operation of the power plant.

The airstrip and helicopter/airplane hard standing will be left in place after construction.

Transportation Access

There would be both temporary and permanent site access facilities to provide a transportation system to support construction activities, and to facilitate orderly development and maintenance of the Project. The current planning assumes restricted public access during construction for safety considerations. Another goal is to co-locate access roads and transmission facilities, to the extent possible, in the same corridor to minimize environmental impacts

Three possible alternatives for access roads and transmission lines have been identified for the Project (Figure 1.2-1). Two of the alternatives would accommodate east-west running transmission lines in combination with a new site access road connecting to the Anchorage-Fairbanks Intertie Transmission line and the Alaska Railroad. One of these corridors, designated as the Chulitna Corridor, would run north of the Susitna River, and extend to the Chulitna siding area. The other alternative, designated as the Gold Creek Corridor, would run south of the Susitna River, and extend to the Gold Creek area. A third corridor, designated as the Denali Corridor, would run due north, connecting the Project site to the Denali Highway by road over a distance of about 44 mi. If a transmission line is constructed along this corridor, it would be extended westward along the existing Denali Highway and connect to the Alaska Intertie near Cantwell.

If the Denali Corridor is selected the affected sections of the Denali Highway will be upgraded in order to facilitate safe construction of the Project. The Denali Highway would not be a part of the Project.

Regardless of which road is chosen, the majority of the new road will follow terrain and soil types that allow construction using side borrow techniques, resulting in a minimum of disturbance to areas away from the alignment. A berm type cross section will be formed, with the crown of the road being approximately 2 to 3 ft above the elevation of adjacent ground. To reduce the visual impact, the side slopes will be flattened and covered with excavated peat and other naturally occurring materials. A 200-foot right-of-way will be sufficient for this type of construction.

Permanent access to the Watana Dam site will connect with the existing Alaska Railroad either at Chulitna, Cantwell or Gold Creek, where at the chosen location a railhead and storage facility occupying up to 40 ac will be constructed alongside the existing passing bays. New sidings of a length up to 5,000 ft will be constructed so that off-loading and transfer of goods and materials can take place without interrupting the operations of the Alaska Railroad Corporation (ARRC). This facility will act as the transfer point from rail to road transport and as a backup or interim storage area for materials and equipment, and as an inspection and maintenance facility for trucks and their loads. Within the 40 ac would be a small residential camp for drivers trucking equipment to the construction site, for laborers and staff operating the transfer, and for support staff such as cooks and maintenance workers.

If the Denali Corridor is chosen for road access, in the community of Cantwell the pavement on the first section of the Denali Highway will be extended for a distance of approximately 4 mi to eliminate any problem with dust and flying stones. In addition, the following measures will be taken:

- Speed restrictions will be imposed along appropriate segments;
- Improvements will be made to the intersections including pavement markings and traffic signals.

Electric Transmission Facilities

The transmission lines will begin at Watana Dam and consist of three 230-kV lines, in either single or double-circuit configuration The same three corridors under consideration for the access road are also those under consideration to connect the Project primary transmission lines to the Alaska Intertie. One or two corridors may be chosen. Depending on which corridor is, or corridors are, chosen, the transmission system will include a switching station in the point of tie in (at Chulitna, Gold Creek or Cantwell). From the Watana substation, the transmission corridors are essentially co-located with the corridors for the access roads except for two specific areas:

1) For the northern westward route (Chulitna Corridor), only the first five mi of the double circuit 230-kV transmission lines will not follow the coincident road corridor. The two lines will cross the river from the switchyard (together with the line destined for the northern route) in a northerly direction for two mi, after which the two lines will turn northwesterly to cross Tsusena Creek and three mi later will intersect the Chulitna road corridor. At the extreme westerly end of the corridor, it will widen to facilitate the divergence of the road and the transmission line which will continue to a switching station on the Alaska Intertie.
2) For the southern westward route (Gold Creek Corridor) the transmission lines would not follow the planned road corridor, rather the transmission lines can span the rough topography running more parallel to the Susitna River. Near the westerly end of the corridor, both the transmission lines and road can be co-located into one single corridor all the way to Gold Creek where the transmission lines would terminate in a new switching station on the existing Alaska Intertie.

For the northern route, the only divergence between the road and transmission line corridor will occur at Deadman Lake, at which location the road will be aligned west of Deadman Hill, while the transmission will follow a lower elevation corridor on the east of the hill. Both corridors will rejoin some 9 mi later on the north side of the Deadman Hill. At the Denali Highway, the northern transmission corridor will turn west and continue along the Denali Highway to the Cantwell switching station.

The right-of-way for the transmission lines within the corridors will consist of a linear strip of land. The width will depend on the number of lines. The transmission rights-of-way will be 200, 300, or 400 feet, depending on whether one, two, or three lines run in parallel.

The switching and substations will occupy a total of approximately 16 ac.

Rights-of-way for permanent access to switchyard and substations will be required linking back to the permanent site access road. These rights-of-way will be 100 ft wide.

Access to the transmission line corridors will be:

a) Via unpaved vehicle access track from the permanent access roads at intermittent points along the corridor. The exact location of these tracks will be established in the final design phase.
b) By helicopter, where there is no access road projected.

Within the transmission corridor itself an unpaved vehicle access track 25 ft wide will run along the entire length of the corridor, except at areas such as major river crossings and deep ravines where an access track would not be utilized for the movement of equipment and materials.

Project Operations

Project flexibility is important to Railbelt utilities. AEA proposes to operate the Project in a load-following mode such that firm energy is maximized during the critical winter months of November through April each year to meet Railbelt utility load requirements. To accomplish load following, the reservoir would be drafted annually by an average of about 120 ft to 150 ft, but a maximum drawdown of 200 feet is still under consideration. Minimum instream flow releases would be made through either the powerhouse or low level outlet works. Flow discharges through the powerhouse under this operating plan would range from the minimum required instream flow release (yet to be determined) to a high of about 14,500 cfs (based on 600 MW nominal installed capacity) during times of maximum power generation. On rare occasions when the power plant is off line during emergency outages, instream flow releases would be made through the low-level outlet works in Watana Dam. Daily power generation during the peak winter months would average about 6,000 MWh and powerhouse discharges would average approximately 6,700 cfs during that time.

For load following purposes, powerhouse discharges are expected to vary over a 24-hour period during the peak winter months, typically ranging from a low of 3,000 cfs to a high of 10,000 cfs. They could be as high as 14,500 cfs (at maximum plant output based on a 600 MW project) for short periods of time during the day to meet load spikes or emergency conditions. The daily flow variation may be constrained because of environmental needs. For a Base Case preliminary test case operating plan, initial model runs have been made using the Case E-VI minimum instream flow criteria developed during the 1980s project studies. Those criteria specified a minimum wintertime flow release of 2,000 cfs and a minimum summertime flow release of varying amounts at or above about 9,000 cfs. At this time, for planning purposes, AEA is considering a minimum winter flow of not less than 3,000 cfs. During the winter the average daily flow would be gradually increased to reflect colder conditions in January and February. The average daily flows would be gradually reduced during March and April.

The average annual generation from the Project is estimated to be about 2,500,000 MWh. This amount is equivalent to about half of the current annual Railbelt generation.

Construction Schedule

The current Project schedule allows 12 years for Project development including: FERC licensing, license implementation, design and contracting, construction, demobilization, and site restoration. Several assumptions have been made regarding the times required for the various activities.

The following are the time periods for major components of Project Development:

- Total schedule – 12 years, 2012-2023
- Pre-Application studies and related activities 3.5 years
- FERC and Cooperating agencies post-filing activities – approximately 1.5 years.
- Project Construction – 6.5 years
- Reservoir filling – one to two years
- Site Restoration – throughout construction.

Design work would be initiated or completed prior to issuance of the license, so that contracts critical to the schedule (such as access roads and construction support facilities) will be ready to be awarded shortly after issuance of the license and subsequent approvals.

Study Area

As show in Figure 1.2-1, the whole study area under evaluation consists of 186,275 acres. The reservoir study area includes all lands and waters up to elevation 2,200 feet that encompass approximately 45,321 acres. The transmission and road corridor study areas encompass the following acreages (approximate):

Gold Creek Corridor – 59,750 acres

Denali Corridor – 45,097 acres

Chulitna Corridor – 36,107 acres

1.3. 2012 Early Study Efforts

AEA is currently undertaking initial studies during 2012 in order to inform the study planning process and provide updated information that supplements existing information. In some cases, updating information consists of taking information developed in the 1980s and converting it into modern digital datasets for use in comparative analysis with the new information being obtained in the FERC formal studies. The following list identifies the specific 2012 studies; please refer to Attachment 1-2 for a summary of each study effort.

<u>Water Resources</u>

- Review of Existing Water Temperature Model Results and Data Collection
- Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography
- Reconnaissance-Level Geomorphic and Aquatic Habitat Assessment of Project Effects on Lower River Channel
- Documentation of Susitna River Ice Breakup and Formation

Instream Flow

- Instream Flow Planning Study
- River Flow Routing Model Data Collection

Fish and Aquatic Resources

- Synthesis of Existing Fish Population Data
- Adult Salmon Distribution Habitat Utilization Study
- Upper Susitna River Fish Distribution and Habitat Study
- Cook Inlet Beluga Whale Anadromous Prey Analysis

Botanical Resources

- Vegetation and Wildlife Habitat Mapping Study
- Wetland Mapping Study
- Riparian Study

Wildlife Resources

- Eagle and Raptor Nest Study
- Past and Current Big Game Harvest Study
- Wildlife Habitat Use and Movement Study

Recreation and Aesthetic Resources

- Aesthetic and Recreation Resources Study

Cultural Resources

- Cultural Resources Study

1.4. Tables

Table 1-1. Summary of TWG meetings since development of the PAD.

Comment Format	Date	Licensing participant	Affiliation	Subject
Technical Workgroup Meeting Notes	01/24/2012	USFWS, NMFS BLM, NPS, ADF&G, ADNR, FERC, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Chugach Electric Association, Nuvista Light & Power, and other interested parties	Variety	• PAD Project Description • Formal Study Planning Process
Technical Workgroup Meeting Notes	01/24/2012	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Chugach Electric Association, Nuvista Light & Power, and other interested parties	Variety	• Instream Flow Studies
Technical Workgroup Meeting Notes	1/25/2012	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Knikatnu Inc, , Nuvista Light & Power, and other interested parties	Variety	• Flow Routing Model Transect Data Collection • Water Temperature Data Models • Geomorphology, Bedload/Suspended Sediment Studies • Ice Processes Study
Technical Workgroup Meeting Notes	1/25/2012	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Knikatnu Inc, Nuvista Light & Power, , and other interested parties	Variety	• Fisheries studies
Technical Workgroup Meeting Notes	1/26/2012	AEA,USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute, Knikatnu Inc, Knik Tribe, Nuvista, and other interested parties	Variety	• Terrestrial Resources Studies
Technical Workgroup Meeting Notes	02/27/2012	AEA, ADF&G, ADNR, BLM, DHSS, DOWL HKM, EPA-ADO, FERC, Knikatnu Inc., Natural Heritage Institute, NPS, USFWS, and other interested parties	Variety	• Recreation • Aesthetics • Socioeconomics • Transportation • Health Impact Assessment
Technical Workgroup Meeting Notes	02/28/2012	AEA, ADF&G, ADHSS-HIA, ADNR, BLM, EPA, FERC, USFWS, NPS, Chuck Akers, Ahtna Inc., Natural Heritage Institute, and other interested parties	Variety	• Cultural & Paleontological Resources • Subsistence Resources

Comment Format	Date	Licensing participant	Affiliation	Subject
Technical Workgroup Meeting Notes	03/01/2012	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute, Hydropower Reform Coalition, Susitna River Advisory Committee, Alaska Ratepayers, and other interested parties	Variety	• Water Resources, River Routing Study • Geomorphology • Ice Processes Studies • Fish and Aquatic Resources Studies • Beluga Whale Studies
Technical Workgroup Meeting Notes	03/02/2012	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, and other interested parties	Variety	• Instream Flow Studies • Water Quality Studies
Technical Workgroup Meeting Notes	04/02/2012	ADF&G, USFWS, BLM, NPS, AEA,FERC, and other interested parties	Variety	• Wildlife Studies • Botanical Studies
Technical Workgroup Meeting Notes	04/03/2012	AEA, ADF&G, ADNR, BLM, FERC, Natural Heritage Institute, NPS, and other interested parties	Variety	• Socioeconomics • Transportation • Air Quality • Recreation & Aesthetics • Subsistence • Cultural & Paleontological Resources
Technical Workgroup Meeting Notes	04/04/2012	AEA, USFWS, NMFS, BLM, ADF&G, ADEC, ADNR, Natural heritage Institute/Hydropower Reform Coalition, Coalition for Susitna Dam Alternatives, Alaska Ratepayers, Mike Wood, and other interested parties	Variety	• Water Quality Study • HecRES/Hydrology
Technical Workgroup Meeting Notes	04/05/2012	ADNR, ADF&G, BLM-Glennallen, FERC, NMFS, USFWS,USGS, Mike Wood, Natural Heritage Institute, The Nature Conservancy, and other interested parties	Variety	• Cook Inlet Beluga Whale Studies • USGS Susitna Basin Hydrological Study Plan • Fish and Aquatic Resources Studies
Technical Workgroup Meeting Notes	04/06/2012	AA, USFWS, NMFS, BLM, USGS, ADF&G, ADNR, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, Mike Wood, and other interested parties	Variety	• Fluvial Geomorphology Modeling below Watana Dam • Geomorphology Study • Ice Processes

Comment Format	Date	Licensing participant	Affiliation	Subject
Technical Workgroup Meeting Notes	06/06/2012	ADF&G, AHTNA, BLM, DNR OPMP, EPA, Natural Heritage Institute, NPS, USFWS, and other interested parties	Variety	• Mammals (not marine) • Avian & Amphibian Species • Other Wildlife Studies (Habitat Evaluation, Harvest Data, Mercury Risk Assessment) • Wetland & Riparian Studies • Vegetation Mapping, Invasive & Rare Plant Studies
Technical Workgroup Meeting Notes	06/07/2012	AEA, ADF&G/DOS, ADNR-OPMP, AHTNA, BLM, EPA, FERC, HDR Alaska, MSB, Natural Heritage Institute, NOAA Fisheries, NPS, , USFWS, Knik Inc., and other interested parties	Variety	• Socioeconomics (Including Regional Economics) • Transportation • Air Quality • Recreation & Aesthetic Resources • Subsistence • Cultural & Paleontological Resources
Technical Workgroup Meeting Notes	06/12/2012	AEA, USFWS, NMFS, BLM, Coalition for Susitna River Dam Alternatives, EPA, ADF&G, FERC, Natural Heritage Institute/Hydropower Reform Coalition, MSB Fish and Wildlife, Susitna River Advisory Committee, Alaska Ratepayers	Variety	Fish and Aquatic Resources Study Plan Development • Cook Inlet Beluga Whale Study • Fish and Aquatic Resources Studies
Technical Workgroup Meeting Notes	06/13/2012	AEA, USFWS, NMFS, ADF&G, ADEC, ADNR, BLM, EPA, USGS, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, Coalition for Susitna Dam Alternatives and other interested parties	Variety	• Baseline Water Quality Study • Water Quality Modeling Study • Instream Flow and Groundwater-related Aquatic Habitat Studies • Riparian Instream Flow Study
Technical Workgroup Meeting Notes	06/14/2012	AEA, USFWS, BLM, NMFS, Coalition for Susitna River Dam Alternatives, EPA, ADF&G, ADNR, NPS, USGS, Natural Heritage Institute/Hydropower Reform Coalition, FERC, and other interested parties	Variety	• Geomorphology and Fluvial • Geomorphology Modeling Studies • Ice Processes Study

Notes
ADEC – Alaska Department of Environmental Conservation
ADF&G – Alaska Department of Fish and Game
ADHSS (DHSS) – Alaska Department of Health and Social Services
HIA – Health Impact Assessment Program
ADNR – Alaska Department of Natural Resources
OPMP-Office of Project Management/Permitting
BLM – United States Department of Interior, Bureau of Land Management
EPA – United States Environmental Protection Agency
AOO – Alaska Operations Office
FERC – Federal Energy Regulatory Commission
NMFS – NOAA National Marine Fisheries Service
NPS – United States Department of Interior, National Park Service
USFWS – United States Department of Interior, Fish and Wildlife Service
USGS – United States Department of Interior, Geological Survey

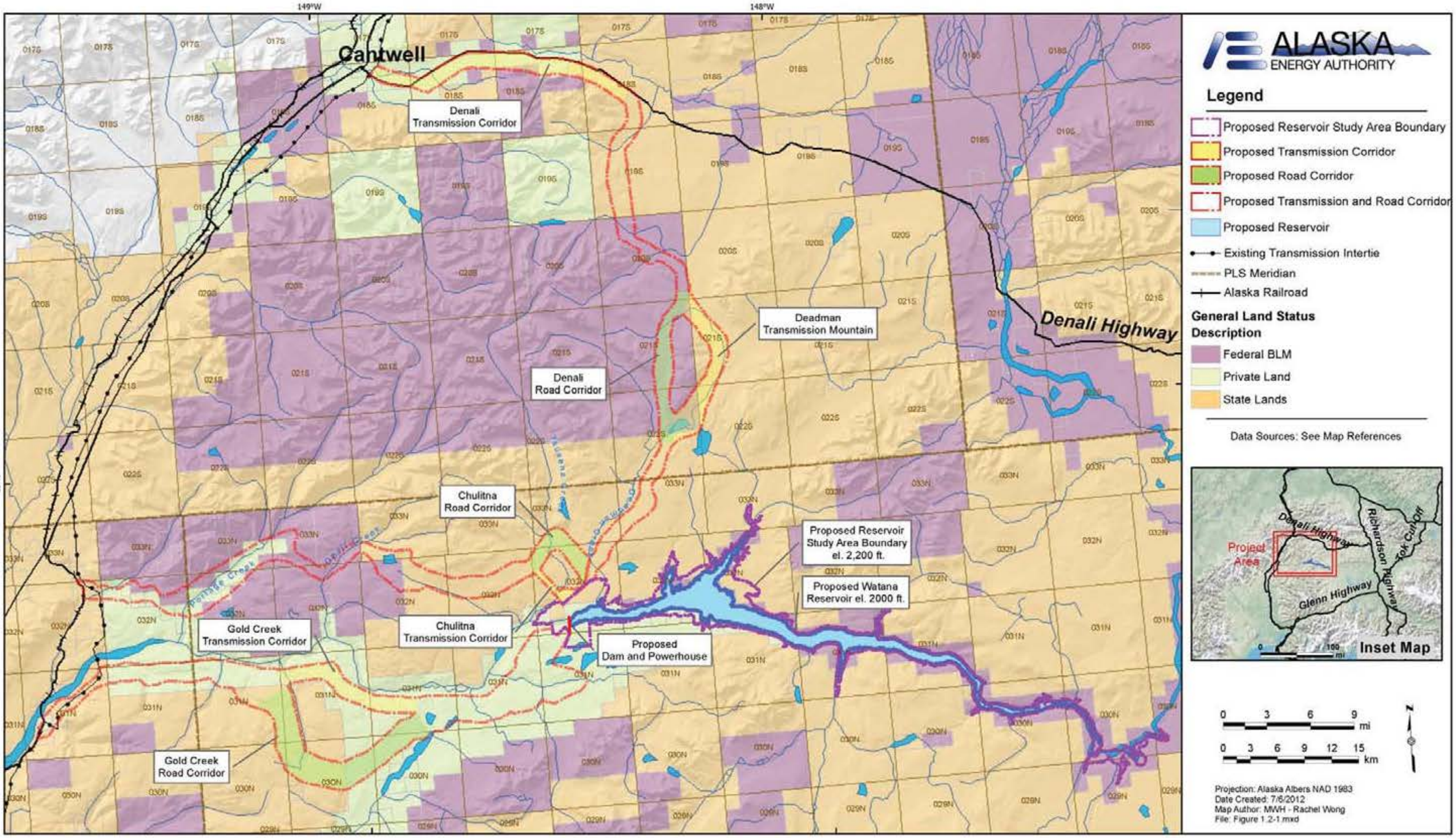
Table 1.1-1. Project Process Plan and Schedule (dispute process highlighted in yellow).

Responsible Party	Pre-Filing Milestone	Date	FERC Regulation
AEA	Issue Public Notice for NOI/PAD	12/29/11	5.3(d)(2)
AEA	File NOI/PAD with FERC	12/29/11	5.5, 5.6
FERC	Tribal Meetings	1/30/12	5.7
FERC	Issue Notice of Commencement of Proceeding and Scoping Document 1	2/23/12	5.8
FERC	Scoping Meetings	3/26-29/12	5.8(b)(viii)
All licensing participants	PAD/SD1 Comments and Study Requests Due	5/31/12	5.9
FERC	Issue Scoping Document 2 (if needed)	7/16/12	5.1
AEA	File Proposed Study Plan (PSP)	7/16/12	5.11(a)
All licensing participants	Proposed Study Plan Initial Meeting	8/8-17/12	5.11(e)
All licensing participants	Proposed Study Plan Comments Due	10/15/12	5.12
All Licensing participants	Proposed Study Plan TWG Meetings	10/16-25/12	N/A
AEA	File Revised Study Plan	11/14/12	5.13(a)
All licensing participants	Revised Study Plan Comments Due	11/29/12	5.13(b)
FERC	Director's Study Plan Determination	12/14/12	5.13(c)
Mandatory Conditioning Agencies only	Any Study Disputes Due	1/3/13	5.14(a)
Dispute Panel	Third Dispute Panel Member Selected	1/18/13	5.14(d)
Dispute Panel	Dispute Resolution Panel Convenes	1/23/13	5.14(d)(3)

AEA	Applicant Comments on Study Disputes Due	1/28/13	5.14(j)
Dispute Panel	Dispute Resolution Panel Technical Conference	2/4/13	5.14(j)
Dispute Panel	Dispute Resolution Panel Findings Issued	2/22/13	5.14(k)
FERC	Director's Study Dispute Determination	3/14/13	5.14(l)
AEA	First Study Season	March-November 2013	5.15(a)
AEA	Initial Study Report	12/16/13	5.15(c)(1)
All licensing participants	Initial Study Report Meeting	1/6/14	5.15(c)(2)
AEA	Initial Study Report Meeting Summary	1/21/14	5.15(c)(3)
All licensing participants	Any Disputes/Requests to Amend Study Plan Due	2/20/14	5.15(c)(4)
All licensing participants	Responses to Disputes/Amendment Requests Due	3/24/14	5.15(c)(5)
FERC	Director's Determination on Disputes/Amendments	4/23/14	5.15(c)(6)
AEA	Second Study Season	January – October 2014	5.15(a)
AEA	Updated Study Report due	12/15/14	5.15(f)
All licensing participants	Updated Study Report Meeting	1/5/15	5.15(f)
AEA	Updated Study Report Meeting Summary	1/20/15	5.15(f)
All licensing participants	Any Disputes/Requests to Amend Study Plan Due	2/19/15	5.15(f)
All licensing participants	Responses to Disputes/Amendment Requests Due	3/24/15	5.15(f)
FERC	Director's Determination on Disputes/Amendments	4/23/15	5.15(f)
AEA	File Preliminary Licensing Proposal	4/14/15	5.16(a)
All licensing participants	Preliminary Licensing Proposal Comments Due	7/13/15	5.16(e)
AEA	File Final License Application	9/11/15	5.17
AEA	Issue Public Notice of License Application Filing	9/11/15	5.17(d)(2)

1.5. Figures

Figure 1.2-1. Susitna-Watana Project Area.



1.6. Attachments

ATTACHMENT 1-1. TECHNICAL WORKGROUP MEETING NOTES

ATTACHMENT 1-2. LIST OF 2012 EARLY STUDY EFFORTS

ATTACHMENT 1-1

TECHNICAL WORKGROUP MEETING NOTES

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Aquatic and Terrestrial Resources Study Planning Meetings
January 24, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

PAD and 2012 ILP Activities Overview Meeting, January 24, 2012, 8:30 a.m. - Noon

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Bryan Carey
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Jennifer Spegen
USFWS	Bill Rice
NMFS	Susan Walker (by phone)
NMFS	Eric Rothwell
NMFS	Tom Meyer (by phone)
BLM	Ben Kennedy
BLM	Tim Sundlov
BLM	Mike Sondergaard
BLM	John Jangala (by phone)
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Mark Burch
ADF&G	Joe Giefer
ADF&G	Ron Benkert
ADF&G	Jack Erickson
ADNR	Courtney Smith
FERC	David Turner (by phone)
FERC	Ken Wilcox (by phone)
The Nature Conservancy	Corrine Smith
Natural Heritage Institute	Jan Konigsburg
Alaska Conservation Alliance	Kate McKeoun
Knik Tribe	Theo Garcia
MWH	Kirby Gilbert
Long View Associates	Steve Padula
Long View Associates	Randall Filbert

Organization	Name
Cardno-ENTRIX	Craig Addley
Cardno-ENTRIX	Woody Trihey (by phone)
Northern Ecological Services	John Morsell (by phone)
R2 Resource Consultants	Dudley Reiser
ABR/GW Scientific	Dave Brailey
URS	Stephen Trimble
URS	Paul Dworian
HDR	James Brady
HDR	Michael Barclay
HDR	Laurie Cummings
HDR	Tracie Krauthoefer
HDR	Mark Dalton
Tetra Tech	Rob Plotnikoff
Tetra Tech	Christy Miller
DOWL HKM	Lana Davis
DOWL HKM	Hillary Lindh (by phone)
Northern Land Use	Richard Stern
E-Terra	Lars Gleitsmann
ARRI	Jeff Davis
Northwest Hydraulic Consultants	Dave Andres (by phone)
Crowther	Scott Crowther
Van Ness Feldman	Matt Love (by phone)
Chugach Electric Association	Ron Vecern
Nuvista Light & Power	Chuck Casper

Presentations

- Kirby Gilbert (MWH): Overview of PAD and List of Chapter 5 Study Plan Activities
- Kirby Gilbert (MWH): Overview of PAD Project Description and 2012 Engineering Activities
- Steve Padula (LVA): 2012 Formal Study Planning Process

PAD Project Description and 2012 Engineering Activities

Referring to the graph shown in Slide 12 of AEA's Susitna-Watana Project description presentation, Eric Rothwell (NMFS) noted that daily load following was presented only in terms of energy production (megawatts [MW]) and not flow. Eric asked for an estimate of the flow range corresponding to the range of energy production shown in the graph. Bryan Carey (AEA) stated that the minimum and maximum energy production values of 175 MW and 375 MW corresponded to flows of about 3,000 cfs and 10,000 cfs, respectively.

Eric stated that the impacts on aquatic resources due to daily and seasonal load following could be significant and expressed concern regarding AEA's proposed daily Project operations. Wayne Dyok (AEA) stated that AEA's final proposed daily and seasonal load following operations would be predicated to some extent on the nature and extent of resource impacts, including projected impacts on water temperature, ice dynamics, and fish habitat, among others, and that energy production would not be the sole driving force behind the Proposed Action. Mike Buntjer (USFWS) and Eric Rothwell (NMFS) requested that all graphs depicting potential Project operations show not only megawatts but flow (cfs) on their vertical axes. AEA agreed to provide both units on all future plots.

Eric Rothwell (NMFS) noted that AEA had identified potential alternatives that involved a larger dam than that proposed in the PAD and asked whether consideration had been given to alternatives involving a smaller dam. Bryan Carey (AEA) stated that AEA was currently making plans based on a dam with a nominal height of 700 feet but that the dam could be as low as 650 feet. Wayne Dyok (AEA) stated that the height of the proposed dam would be confirmed in 2012, adding that the Project would need to be integrated into the overall railbelt utility system and that railbelt system demand and potential environmental impacts would both be factored into the cost-benefit ratio that would ultimately dictate Project size. Bryan Carey added that developing a hydroelectric Project in a remote and severe environment such as the upper Susitna River would involve large fixed costs and that as a result too small a Project would not be cost effective.

Betsy McCracken (USFWS) noted that the effects of Project operation on river stage would vary with distance below the dam and asked how such attenuation would be addressed. Bryan Carey (AEA) stated that AEA was developing a hydraulic routing model that would be used to estimate flow-stage relationships along the river corridor.

Betsy McCracken (USFWS) noted that full build-out for the proposed Project would include four turbines and asked if natural resource studies would be based on the capacity of the Project with all four turbines in operation. Bryan Carey (AEA) stated that the Proposed Action involved building the Project with three generating units and a single empty penstock. Bryan stated that if AEA decided to install a fourth turbine in the future, such a modification would necessitate the filing of a license amendment for the proposed increase in Project capacity. At that time, said Bryan, environmental studies needed to assess operational changes would be undertaken.

Tom Meyer (NMFS) asked if the current timeline for the Project was based on the assumption that the proposed dam would be a roller-compacted concrete (RCC) structure. Bryan Carey (AEA) replied that a RCC dam would take less time to complete than a concrete rockfill dam and that the current schedule was based on construction of an RCC facility. Tom Meyer recommended that AEA make a final decision soon regarding construction methods, so that an accurate schedule, including potentially longer duration studies, could be established. Wayne Dyok (AEA) stated that the current plan was for 2013 and 2014 to be the main study seasons (with dam construction beginning in 2017), but studies would continue as needed, depending on the results of the 2013-2014 studies and any unanticipated issues discovered during that time. Wayne added that a variety of monitoring programs would be established that would continue over the long term. Mike Buntjer (USFWS) asked how much longer a concrete rockfill dam would take to complete than a RCC dam. Bryan Carey replied that a concrete rockfill structure would take about two additional years to complete.

Mike Sondergaard (BLM) asked if a RCC dam would differ from a concrete rockfill structure in strength or other attributes. Bryan Carey (AEA) replied that the structures would be functionally equivalent; the primary difference would be duration of construction.

Jan Konigsburg (NHI) asked if the estimated cost of the Project included costs associated with transmission. Wayne Dyok (AEA) replied that estimates for the Project include the cost of establishing a transmission system from the powerhouse to the existing intertie, but did not include costs associated with any upgrades to the intertie. Wayne stated that AEA would coordinate with the railbelt utilities to apportion costs for upgrades to the intertie.

Betsy McCracken (USFWS) asked if there would be a railroad spur to the Project site. Bryan Carey (AEA) stated that there would not be a spur to the Project site. Materials would be shipped via the existing railroad to a siding constructed for the Project's use and then shipped by truck to the Project site.

2012 Formal Study Planning Process

Eric Rothwell (NMFS) asked if there was still time for stakeholders to comment on 2012 study plans. Kirby Gilbert (MWH) replied that 2012 study plans were still being developed and that agencies could comment on them through February 7, 2012. Kirby added that draft study plans would be posted on AEA's website during or immediately following the study planning meetings.

Betsy McCracken (USFWS) asked which of the 2012 aquatic and water resources studies would have lower river components. Kirby Gilbert (MWH) replied that many of the 2012 aquatic and water resources studies would have a lower river component and that AEA and its consultants would review the objectives of the studies during the upcoming meeting sessions.

Jenny Spegen (USFWS) asked if the impacts of proposed transmission lines would be addressed as part of a transportation resources study. Kirby Gilbert (MWH) replied that the impacts of the transmission lines would be assessed over a range of natural resources study areas, including, but not necessarily limited to, botanical, wildlife, cultural, and aquatic resources. Kirby Gilbert stated that the results of resource analyses would be used to refine the routes of transmission lines and access roads. Kirby explained that access roads and transmission lines would be co-located but that routes would diverge based on environmental conditions. Specifically, transmission line routes would be located at low elevations to avoid impacts to the lines from excess ice. However, low-elevation routes would be avoided for access roads in an attempt to minimize impacts to wetlands.

Tom Meyer (NMFS) asked what alternatives to the Proposed Action would be evaluated as part of FERC's National Environmental Policy Act (NEPA) analysis. David Turner (FERC) replied that FERC would evaluate a No Action alternative, the Proposed Alternative, and potentially a third alternative involving measures recommended by FERC staff.

Jan Konigsburg (NHI) asked how much information was needed by FERC in an ILP study request submitted by a stakeholder, specifically how much detail would be needed regarding proposed study methods. David Turner (FERC) replied that stakeholder study requests need not include detailed descriptions of study methods. What is needed is a clear description of objectives and the type and extent of information desired, i.e., sufficient detail to allow the applicant to develop a satisfactory study plan.

Tom Meyer (NMFS) stated that in other ILPs resource agencies had initiated dispute resolution because FERC had failed to clearly articulate the bases of its study determinations. David Turner (FERC) stated that FERC's ILP effectiveness study had shown that at times determinations based on project nexus and other criteria had not been adequately defined. However, FERC was now making a concerted effort to explain how all study criteria are factored into its study determinations. David added that he was aware of no instances in which necessary studies had been overlooked or omitted as part of an ILP process.

Steve Padula (LVA) explained that AEA was currently developing outlines of 2013-2014 studies and that AEA was willing to convert these into study requests that could be adopted by stakeholders and filed with FERC. In this way, stakeholders could avoid spending time writing requests for studies that AEA is planning to conduct and could instead focus their efforts on additional studies, if any, not identified by AEA. Stakeholders agreed that AEA's provision of study requests, as described by Steve, would be helpful and confirmed their acceptance of the proposed approach. Jan Konigsburg (NHI) noted that resource agencies have statutory authorities that make it possible that their study requests will identify needs beyond those addressed by AEA's study plans.

Joe Klein (ADF&G) expressed concern with the potential level of detail that would be included in study requests, i.e., to be filed by April 27, 2012. Steve Padula (LVA) acknowledged that implementation details would need to be worked out collaboratively following the filing of the study requests. Steve stated that the requests are meant to make sure that all information needs are being addressed, adding that AEA would work with stakeholders to finalize study implementation details during 2012. The process would culminate in the filing of the Revised Study Plan (RSP) with FERC in October 2012.

Jenny Spegen (USFWS) asked how the results of the 2012 studies would be factored into the 2013-2014 study planning. Steve Padula (LVA) replied that the completion dates of the 2012 studies would be staggered, that is, studies would be completed as soon as possible so that results could be used to refine the scopes of the 2013-2014 studies. Betsy McGregor (AEA) stated that the 2012 study plans included descriptions of the links between 2012 study efforts/results and 2013-2014 studies.

Jan Konigsburg (NHI) asked how study costs factor into FERC's determination of whether a study is warranted. David Turner (FERC) replied that FERC does not have specific criteria for evaluating the cost-benefit ratio of a proposed study. Rather, FERC evaluates whether the requested level of precision is commensurate with the stated information needs and makes a determination as to whether the cost is reasonable relative to the information that will be obtained. Steve Padula (LVA) stated that the FERC process also allows for the applicant to propose a less costly approach to a requested study, provided that the alternative approach would generate the information requested by the stakeholder.

Jan Konigsburg (NHI) asked if AEA had made progress on providing funding support to the federal agencies. Wayne Dyok (AEA) stated that AEA was still attempting to identify a means of providing support to some of the federal agencies involved in the licensing process, perhaps through the ADNR's Alaska Office of Project Management & Permitting (OPMP). Sue Walker (NMFS) said that NMFS had submitted a detailed letter to AEA in December 2011 that explained how AEA could provide support to NMFS. Sue said that as of January 24, NMFS had received no response from AEA regarding the letter.

Steve Padula (LVA) reviewed calendars showing proposed meeting dates and process milestones for February through May 2012. Betsy McCracken (USFWS) asked that the calendars be posted on AEA's website, and AEA stated that they would be posted following the meetings.

Cassie Thomas (NPS) stated that the National Park Service's primary areas of concern are recreation and aesthetic resources. Cassie noted that effects on these resources would be identified as the result of studies conducted in other resource areas, for example, instream flow analyses would shed light on potential Project impacts on recreational boating. Cassie stressed that it would be critical for stakeholders to be updated regularly on the comprehensive licensing program, i.e., the activities of all workgroups and subgroups, so that each stakeholder could be kept apprised of relevant issues and understand the links between resource areas. Cassie stated that stakeholders would require such updates in order to allocate their time effectively to the various licensing meetings and other activities. Steve Padula (LVA) stated that meeting summaries would contain details of workgroup/subgroup discussions, as well as lists of decisions and action items. Betsy McGregor (AEA) stated that meeting agendas would contain items to be addressed in meetings, as well as the time slots allocated to those issues. Betsy stated that between the agendas and the meeting summaries, stakeholder would have the information they need to make choices regarding how to direct their efforts. Sue Walker (NMFS) stated that AEA should appoint a dedicated note taker for all meetings and that meeting summaries should identify the individuals (and their affiliations) asking questions and making comments and clearly describe AEA's responses to the questions/comments. AEA agreed that meeting summaries would be structured in the manner requested.

John Jangala (BLM) noted that the data gap analysis report for cultural resources was not available on AEA's website. Steve Padula (AEA) explained that AEA could not post many cultural resources documents to the public website because they contain privileged information. AEA agreed to send John Jangala (BLM) a copy of the cultural resources data gap analysis report.

Action Items

- AEA agreed to produce all future Project operations graphs so that they include both generation (MW) and flow (cfs).
- AEA agreed to post on its licensing website calendars showing proposed meeting dates and process milestones for February through May 2012, as well as all PowerPoint presentations given at the study planning meetings.
- AEA, with stakeholders' consent, agreed to provide draft 2013-2014 study requests that could be adopted by stakeholders and filed with FERC on April 27, 2012.
- AEA agreed to appoint a dedicated note taker for all licensing meetings and agreed that meeting summaries would identify the individuals (and their affiliations) asking questions and making comments and clearly describe AEA's responses to those questions/comments.
- AEA agreed to send John Jangala (BLM) a copy of the cultural resources data gap analysis report.

Instream Flow 2012 Study Planning Meeting, January 24, 2012, 1 – 4 p.m.

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Bryan Carey
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Jennifer Spegen
USFWS	Bill Rice
NMFS	Susan Walker (by phone)
NMFS	Eric Rothwell
NMFS	Tom Meyer (by phone)
BLM	Ben Kennedy
BLM	Tim Sundlov
BLM	Mike Sondergaard
BLM	John Jangala (by phone)
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Mark Burch
ADF&G	Joe Giefer
ADF&G	Ron Benkert
ADF&G	Jack Erickson
ADNR	Courtney Smith
FERC	David Turner (by phone)
FERC	Ken Wilcox (by phone)
The Nature Conservancy	Corrine Smith
Natural Heritage Institute	Jan Konigsburg
Alaska Conservation Alliance	Kate McKeoun
Knik Tribe	Theo Garcia
MWH	Kirby Gilbert
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Cardno-ENTRIX	Craig Addley
Cardno-ENTRIX	Woody Trihey (by phone)
Northern Ecological Services	John Morsell (by phone)
R2 Resource Consultants	Dudley Reiser
ABR/GW Scientific	Dave Brailey
URS	Stephen Trimble
URS	Paul Dworian

Organization	Name
HDR	James Brady
HDR	Michael Barclay
HDR	Laurie Cummings
HDR	Tracie Krauthoefer
HDR	Mark Dalton
Tetra Tech	Rob Plotnikoff
Tetra Tech	Christy Miller
DOWL HKM	Lana Davis
DOWL HKM	Hillary Lindh (by phone)
Northern Land Use	Richard Stern
E-Terra	Lars Gleitsmann
ARRI	Jeff Davis
Northwest Hydraulic Consultants	Dave Andres (by phone)
Crowther	Scott Crowther
Van Ness Feldman	Matt Love (by phone)
Chugach Electric Association	Ron Vecern
Nuvista Light & Power	Chuck Casper

Presentations

- Craig Addley (Cardno-ENTRIX): 2012 Instream Flow Study

2012 Instream Flow Study

Joe Klein (ADF&G) stated that activities in 2012 would be critical to formulating a sound instream flow study that would address all pertinent resource issues. Joe stated that the 2012 study plan should make clear how the 2012 work will be incorporated into the larger multi-year instream flow study. Joe stated that it would be critical to properly delineate study reaches and identify the appropriate placement of representative transects. Joe stated that ADF&G would require a map showing the locations of all existing instream flow study transects. Betsy McGregor (AEA) stated that ADNR was currently developing a baseline map for the Project that would show transect locations from the 1980s studies. Corrine Smith (TNC) asked for clarification regarding ADNR's digitizing of 1980s data. Betsy McGregor replied that ADNR has assisted AEA in producing GIS products and has recently been tasked with producing a transect map. Betsy stated that historic data used in current analyses and data collected during 2012 and beyond, as applicable, would be incorporated into a geospatially-referenced relational database.

Referring to the proposed schedule in the 2012 Instream Flow Study Plan, Michael Barclay (HDR) suggested that November 2012 might be too late for a final technical memorandum, given that the schedule called for a final 2013-2014 Instream Flow Study Plan by the end of September. Betsy McGregor (AEA) acknowledged that the schedule was not ideal but stated that the November deadline for the memo was selected to allow enough time to assimilate information gathered during the fall site visit and that interim materials would be prepared to inform the 2013-2014 study plan.

Steve Padula (LVA) stated that much of the results of the 2012 studies would be available to inform the scopes of the 2013-2014 study plans, but emphasized that implementation details would be refined by the workgroup into the beginning of 2013. Craig Addley (Cardno-ENTRIX) stated that any uncertainties would be addressed in the 2013-2014 study plans by identifying contingencies, i.e., explanations of how AEA would proceed depending on what is learned prior to the onset of the 2013 fieldwork. David Turner (FERC) stated that FERC's determination would function mainly to resolve potential disagreements, and conditional statements in the RSP would be acceptable, provided that there is a clear and defensible rationale for how to resolve any issues so that data quality and reliability are not compromised.

Joe Klein (ADF&G) stated that an important issue would be the proposed reservoir's impacts on fish access to tributaries flowing into the reservoir, including seasonal changes in tributary access resulting from variation in water surface elevation. Craig Addley (Cardno-ENTRIX) replied that the issue of tributary access in the reservoir reach would be addressed as part of the 2013-2014 studies.

Joe Klein (ADF&G) stated that researchers currently have a much better understanding of ice formation and breakup than they did in the 1980s and asked if AEA planned to employ new techniques to model ice dynamics. Wayne Dyok (AEA) stated that AEA intended to use state-of-the-art techniques to evaluate the effect of the proposed Project on ice dynamics downstream of the Project, adding that the faculty at the University of Alberta, which has expertise in this area, had employed the CRISSP model on the Peace River to assess the effects of hydropower projects on ice dynamics.

Joe Klein (ADF&G) stated that another important flow-related aspect of the river that required thorough analysis was the distribution and magnitude of groundwater upwelling. Betsy McGregor (AEA) stated that AEA could use thermal imaging to identify locations of groundwater upwelling. Joe Klein noted that the US Geological Survey (USGS) had floated portions of the Susitna River to map groundwater upwelling locations. Joe suggested that the USGS results could be used to ground-truth thermal imaging results. Craig Addley (Cardno-Entrix) stated that AEA could conduct a pilot study to assess the effectiveness of thermal imaging relative to the USGS data and if the results were favorable, apply the thermal imaging technique more widely.

Jenny Spegen (USFWS) noted that much of the 2012 Instream Flow Study Plan involved review, synthesis, and evaluation of 1980s data and asked what field data would be collected in 2012. Craig Addley (Cardno-ENTRIX) stated that preliminary study site selection would be initiated where appropriate data exist, and field visits would be conducted in September and October to refine potential study sites and assess modeling approaches. Craig stated that instream flow efforts would be coordinated with fieldwork conducted as part of the 2012

Middle River Habitat Utilization Study to select spawning sites for modeling where possible so that transect measurements could be collected over a range of flows starting in spring of 2013.

Eric Rothwell (NMFS) and Bill Rice (USFWS) stressed that all the aquatic and water resource evaluations were interrelated and that understanding the proposed Project's effects on fish and other aquatic biota would involve integrating the results of multiple efforts, including ice dynamics and geomorphology studies and modeling. Wayne Dyok (AEA) replied that AEA was aware of the interrelated nature of the analysis techniques and planned for its contractors to coordinate with each other and with the technical workgroups to ensure that Project effects are adequately assessed. Craig Addley (Cardno-ENTRIX) stated that the instream flow study would be the central element of the impact assessment for aquatic resources, with all other study and modeling elements providing input to the instream flow assessment. Craig acknowledged that ideally most of the fish studies would be conducted first to provide the input needed for modeling; however, the ILP schedule is such that efforts must be conducted in parallel. Craig stated that although the integration of studies and modeling would be challenging, it could be done.

Michael Barclay (HDR) asked what instream flow study methods were likely to be used. Craig Addley (Cardno-ENTRIX) stated that it was likely that a mix of methods would be applied, depending on the habitat being analyzed. For example, one-dimensional modeling would likely be most appropriate for the mainstem, whereas two-dimensional modeling or expert habitat mapping over a range of flows might be the best approach in smaller and potentially more complex habitats, such as sloughs or side channels. Joe Klein (ADF&G) noted that it would be critical to decide soon not only what methods would be used in which habitats but also to identify measurement locations and intensities, as well as the flows at which data collection would occur.

Joe Klein (ADF&G) noted that habitat suitability criteria (HSC) for certain resident fish species represented a data gap that would need to be filled before instream flow modeling could be conducted. Craig Addley (Cardno-ENTRIX) agreed, noting that upstream of Devils Canyon instream flow modeling would be focused primarily on select resident fish species. Craig stated that data would be needed to confirm which mesohabitats these fish species use and what their microhabitat preferences are within those habitats. Joe Klein added that HSC information for some of the resident species had been developed for use in Canada and that these HSC curves might be suitable for the Susitna River, pending their verification against some level of site-specific data. Joe Klein stated that ADF&G had documented the longitudinal distribution of nonnative northern pike in the Susitna River, but HSC curves would need to be developed/agreed upon to model pike habitat use.

Jan Konigsburg (NHI) stated that Project effects on anadromous fish species other than salmon, eulachon in particular, would need to be properly assessed. Betsy McCracken (USFWS) added that Pacific lamprey and humpback whitefish habitat use is not well understood, particularly that of lamprey ammocoetes. Betsy McGregor (AEA) stated that eulachon would be assessed not only as part of the instream flow analysis but also as part of the beluga whale prey availability and access evaluation.

Tim Sundlov (BLM) asked if AEA had or planned to develop aerial imagery of the upper Susitna River. Betsy McGregor (AEA) replied that AEA had partnered with Matanuska-Susitna Borough to gather LiDAR data and associated imagery of the Susitna River in 2011. The imagery and data is being processed and would be made available to stakeholders when comnpleted, which is expected to be May 2012.

Dudley Reiser (R2) stated that for the next set of aquatic/water resource workgroup meetings it would be advantageous to have the technical contractors–the entities who would conduct the 2012 studies and refine the 2013-2014 study plans–hired. Betsy McGregor (AEA) agreed, stating that AEA hoped to hire the contractors by mid February 2012. Betsy McGregor (AEA) stated that AEA expected that an Instream Flow Subgroup would be formed and would meet frequently–at times as often as biweekly–in 2012 to develop the scope of the 2013-2014 analyses.

Woody Trihey (Cardno-ENTRIX) asked if he should prepare a summary of the 1980s instream flow studies and findings for the February/March workgroup meetings, and Betsy McGregor (AEA) agreed that he should.

Action Items

- AEA agreed to provide stakeholders with a map showing the locations of all instream flow study transects once they have been defined.
- AEA stated that it hoped to hire the technical contractors–the entities who would conduct the 2012 studies and develop the 2013-2014 study plans–by mid February 2012, so that they could participate more actively in the February/March resource workgroup meetings.
- Woody Trihey (Cardno-ENTRIX) agreed to prepare a summary of instream flow study results from the 1980s for use at the March workgroup meetings.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Aquatic and Terrestrial Resources Study Planning Meetings
January 25, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Water Resources Study Planning Meeting, January 25, 2012, 9 a.m. – Noon

Attendees:

Organization	Name
AEA	Betsy McGregor
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Jennifer Spegen
USFWS	Bill Rice
NMFS	Susan Walker
NMFS	Eric Rothwell
BLM	Ben Kennedy
BLM	Tim Sundlov
BLM	Mike Sondergaard
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Joe Giefer
ADF&G	Ron Benkert
ADF&G	Jack Erickson
ADF&G	Richard Yanusz
ADF&G	Lowell Fair
ADNR	Courtney Smith
ADNR	Gary Prokosch
ADNR	Kim Sager
FERC	David Turner (by phone)
The Nature Conservancy	Corrine Smith
Natural Heritage Institute	Jan Konigsburg
Alaska Conservation Alliance	Kate McKeoun
Knik Tribe	Theo Garcia
Knikatnu, Inc	Tom Harris
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Northern Ecological Services	John Morsell (by phone)
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	MaryLou Keefe (by phone)

Organization	Name
Craig Addley	Cardno ENTRIX
Lynn Noel	Cardno ENTRIX
ABR/GW Scientific	Dave Brailey
URS	Paul Dworian
HDR	James Brady
HDR	Michael Barclay
HDR	Bob Butera
HDR	Erin Cunningham
Tetra Tech	Rob Plotnikoff
Tetra Tech	Christy Miller
DOWL HKM	Jessica Christianson
LGL Alaska	Michael Link
Normandeau Associates	Robert McDonald
E-Terra	Lars Gleitsmann
ARRI	Jeff Davis
Northwest Hydraulic Consultants	Dave Andres (by phone)
Northwest Hydraulic Consultants	Darren Ham (by phone)
Crowther	Scott Crowther
Van Ness Feldman	Matt Love (by phone)
Nuvista Light & Power	Chuck Casper

Presentations

- John Haapala (MWH): Reservoir and Flow Routing Model Transect Data Collection
- Craig Addley (Cardno-ENTRIX): WQ-S1 Review of Existing Water Temperature Data and Models
- Craig Addley (Cardno-ENTRIX): Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations
- Craig Addley (Cardno-ENTRIX): Geomorphic Assessment of Middle River Reach Using Aerial Photography
- Craig Addley (Cardno-ENTRIX): Document the Breakup and Formation of River Ice on the Susitna River
- Craig Addley and Woody Trihey (Cardno-ENTRIX): Geomorphic Assessment of Project Effects on Lower River Reach

Flow Routing Model Transect Data Collection

Eric Rothwell (NMFS) stated that channel roughness values used in the routing model should be based on independently verified and current site-specific information and potentially vary longitudinally in the system. Bill Rice (USFWS) agreed, noting that site-specific substrate/geological characteristics should be used to develop values of Manning's roughness coefficient. Eric Rothwell, Bill Rice, and Joe Klein (ADF&G) emphasized the need to account for accretion flow and the effects of ice dynamics when developing the routing model, noting that the model must be well calibrated to be useful. John Haapala (MWH) stated that MWH would apply appropriate roughness values and would account for accretion flow, likely by using spot measurements to verify accretion estimates developed during the 1980s. Craig Addley (Cardno-ENTRIX) agreed, stating that an evaluation of the effects of load following on habitat downstream of the Project could only be accomplished with an accurate routing model. Dave Andres (Northwest Hydraulic Consultants) stated that it would be useful to install pressure transducers (i.e., to measure water surface elevation) as soon as possible in 2012 so that stage-flow relationships throughout the river could be developed. Dave stated that these instruments, because they would produce continuous data and could be operated during the winter when ice is present in the river, would be superior to staff gages.

Dave Andres (Northwest Hydraulic Consultants) also expressed concern with the use of a HEC-RAS model, stating that a HEC-RAS model would suffice in summer but would not properly account for flow routing when there is ice in the river. Dave stated that the CRISSP model would function under winter conditions and would also work in summer when the river is free of ice. Craig Addley (Cardno-ENTRIX) reminded the workgroup that John Haapala was reviewing the 2012 efforts related to flow routing and that as 2013-2014 study plans are developed, there would be an opportunity to incorporate other modeling options.

Eric Rothwell (NMFS) stated that it would be important for AEA to explain in its study planning documents how studies would dovetail and input from one study or modeling effort would supply input to other studies or models. Eric stated that in addition to identifying linkages, it would be necessary to ensure that assumptions made at one level of study or modeling would remain valid when results or input are used in a subsequent phase of analysis or modeling. Craig Addley (Cardno-ENTRIX) replied that AEA was aware of the importance of the integration identified by NMFS and that AEA's contractors would identify and describe all such linkages as part of their development of the 2013-2014 study plans.

Betsy McCracken (USFWS) asked if the transects used for the development of the hydraulic routing model corresponded to those used for habitat modeling. Craig Addley (Cardno-ENTRIX) replied that transects for the two efforts were not equivalent. Craig explained that routing model transects would be used to provide continuous stage-flow relationships, via interpolation, for the entire river corridor. Transects for other purposes, e.g., fish habitat, would be established separately to address specific objectives. However, the stage-flow relationships provided by the routing model at a given location would serve as an input in the development of time-series analyses for other modeling efforts, for example fish habitat.

Water Temperature Data and Models

Joe Klein (ADF&G) stated that temperature modeling would need to account for Project effects not only in the mainstem but also in sloughs and side channels. Joe asked if AEA could specify the locations/habitat types of proposed monitoring locations. Betsy McGregor (AEA) and Woody Trihey (Cardno-ENTRIX) replied that Table 2 of the WQ-S1 study plan identified the proposed mainstem temperature monitoring sites to be used for the 1980s SNTEMP model evaluation, but noted that temperature monitoring locations for the larger study program had yet to be identified and would be addressed in the 2013-2014 study plan. Joe Klein added that the temperature model would need to be capable of estimating the proposed Project's effects on groundwater upwelling, which in turn would affect conditions in sloughs and potentially in salmonid spawning areas.

Geomorphology, Bedload/Suspended Sediment, and Ice Processes

Darren Ham (Northwest Hydraulic Consultants) stated that it would be infeasible for field crews to measure bedload at high flows and asked how AEA planned to account for high-flow bedload dynamics. Craig Addley (Cardno-ENTRIX) stated that the technical contractors would assess logistics associated with field measurements of bedload, and if safety becomes an issue, modeling would be used to extrapolate high-flow bedload based on measurements made at lower flows and what is known about the relationships of coarse sediment movement generally. Craig stated that the technical contractors would gather as much information as possible to calibrate the sediment routing model. Woody Trihey (Cardno-ENTRIX) stated that bedload measurements could be made at some stations, e.g., Gold Creek, and that the sediment rating curves from these stations could be used to extrapolate the upper portions of curves at other stations. Darren Ham (Northwest Hydraulic Consultants) suggested sampling gravel bars for sediment size distribution as a surrogate to using bedload measurements to estimate transport. Dudley Reiser (R2) added that it would be important to measure sediment transport in areas used by salmonids for spawning.

Michael Barclay (HDR) stated that a primary assumption of instream flow analysis is that the channel remains the same under changing flow conditions and stated that potential changes in channel morphology would need to be factored into instream flow modeling. Craig Addley (Cardno-ENTRIX) agreed and said that AEA would use the results of its geomorphology modeling to account for any potential channel changes when modeling the relationship between flow and habitat for aquatic biota.

Michael Barclay (HDR) asked if the purpose of the geomorphic assessment of middle river reach was to assess whether the channel was in a state of equilibrium. Craig Addley (Cardno-ENTRIX) confirmed that comparing existing and 1980s geomorphic data would allow AEA to characterize the stability of the reach under unregulated flow conditions and added that the study may also provide insight into what other data from the 1980s studies might still be applicable under current conditions.

Joe Klein (ADF&G) stated that AEA should assemble a list of floods that have occurred since the 1980s data were collected to help interpret any channel changes that are observed when comparing aerial imagery of current and historic channel conditions.

Referring to the G-S4: Geomorphic Assessment of Project Effects on the Lower River Channel study, Eric Rothwell (NMFS) noted that aerial photography of the lower river would be used to assess pre- and post-Project flow effects in summer, when the reservoir would be filling, which is expected to be when the proposed Project would have the greatest effect on flows. Eric cautioned that Project impacts on winter flows and flow-related variables in the lower river should not be overlooked. Woody Trihey (Cardno-ENTRIX) stated that the 2012 study was only a screening exercise and that geomorphic assessments conducted in 2013-2014 would be aimed at assessing Project effects over a wide range of flows during all four seasons.

Joe Klein (ADF&G) asked what effect daily Project operations are expected to have on flows in the lower river. Woody Trihey (Cardno-ENTRIX) replied that flow effects in the lower river due to daily Project operations would be muted relative to those in the middle river, and perhaps undetectable, noting that winter flows downstream of the confluence with the Chulitna and Talkeetna rivers ("three rivers confluence") are 2.0-2.5 times greater than those upstream of the confluence. Woody added that the presence of ice in the lower river would likely further obscure the effects of flow changes related to daily Project operations in winter. Sue Walker (NMFS) noted that the PAD indicates that daily winter releases at the dam could vary between 3,000 cfs and 10,000 cfs. Sue stated that this represented significant variability and AEA would need to document the effect of such flow changes throughout the river system.

Bill Rice (USFWS) asked how many lower river geomorphology transects had been established and evaluated during the 1980s studies. Woody Trihey (Cardno-ENTRIX) replied that four transects had been established in the area of the three rivers confluence because it was (and is) a highly dynamic area. Woody stated that given the dynamic nature of the area, conditions at these transects would need to be resurveyed as part of the current study program. Woody said that no geomorphology transects were established downstream of the three rivers confluence.

Dave Andres (Northwest Hydraulic Consultants) stated that it would be essential to fully document freeze-up and ice break up processes to set the stage for the collection of data to be used to develop and calibrate an ice dynamics model. Dave added that comparing ice dynamics to flow gage records would greatly enhance AEA's ability to interpret observed ice dynamics in 2012. Woody Trihey (Cardno-ENTRIX) stated that it would beneficial for specialists with a variety of backgrounds to be involved in the documentation of ice formation and breakup, including fisheries and riparian vegetation specialists in addition to physical scientists.

Aquatic Resources Study Planning Meeting, January 25, 2012, 1 – 4 p.m.

Attendees:

Organization	Name
AEA	Betsy McGregor
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Jennifer Spegen
USFWS	Bill Rice
NMFS	Susan Walker
NMFS	Eric Rothwell
BLM	Ben Kennedy
BLM	Tim Sundlov
BLM	Mike Sondergaard
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Joe Giefer
ADF&G	Ron Benkert
ADF&G	Jack Erickson
ADF&G	Richard Yanusz
ADF&G	Lowell Fair
ADNR	Courtney Smith
ADNR	Gary Prokosch
ADNR	Kim Sager
FERC	David Turner (by phone)
The Nature Conservancy	Corrine Smith
Natural Heritage Institute	Jan Konigsburg
Alaska Conservation Alliance	Kate McKeoun
Knik Tribe	Theo Garcia
Knikatnu, Inc	Tom Harris
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Northern Ecological Services	John Morsell (by phone)
R2 Resource Consultants	Dudley Reiser
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Craig Addley	Cardno ENTRIX
Lynn Noel	Cardno ENTRIX
ABR/GW Scientific	Dave Brailey
URS	Paul Dworian
HDR	James Brady
HDR	Michael Barclay

Organization	Name
HDR	Bob Butera
HDR	Erin Cunningham
Tetra Tech	Rob Plotnikoff
Tetra Tech	Christy Miller
DOWL HKM	Jessica Christianson
LGL Alaska	Michael Link
Normandeau Associates	Robert McDonald
E-Terra	Lars Gleitsmann
ARRI	Jeff Davis
Northwest Hydraulic Consultants	Dave Andres (by phone)
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Crowther	Scott Crowther
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Presentations

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- Craig Addley (Cardno-ENTRIX): WQ-S1 Review of Existing Water Temperature Data and Models
- Craig Addley (Cardno-ENTRIX): Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations
- Craig Addley (Cardno-ENTRIX): Geomorphic Assessment of Middle River Reach Using Aerial Photography
- Craig Addley (Cardno-ENTRIX): Document the Breakup and Formation of River Ice on the Susitna River
- Craig Addley and Woody Trihey (Cardno-ENTRIX): Geomorphic Assessment of Project Effects on Lower River Reach
- Jack Erikson: (ADF&G) ADF&G Conceptual Plan for 2012
- Craig Addley (Cardno-ENTRIX): Distribution and Middle River Habitat Utilization

ADF&G Conceptual Plan for 2012 and Fish Distribution and Middle River Habitat Utilization

Woody Trihey (Cardno-ENTRIX) noted that based on ADF&G's 2010 data, the percentages of coho and chum salmon upstream of the three rivers confluence were similar to what was observed in the 1980s. Jack Erickson (ADF&G) replied that ADF&G had not yet compared data from the two periods, but it would not be surprising if current run apportionment of coho and chum salmon was similar to what had been observed in the 1980s.

James Brady (HDR) asked how ADF&G had arrived at a sample size of 50 tagged chum/coho for supporting the middle river habitat use study. Betsy McGregor (AEA) replied that 50 radio-tagged fish was not a recommended sample size, but only a number selected to illustrate how many fish ADF&G would need to radio tag in the lower river to provide 50 fish for tracking in the middle river (i.e., upstream of the three rivers confluence) and to illustrate the incremental cost of tagging those fish. Gary Prokosch (ADNR) asked if ADF&G would be tagging fish in the middle river reach for AEA. Jack Erickson (ADF&G) replied that any fish tagged upstream of the three rivers confluence would be tagged by AEA's consultants, because ADF&G will already be operating at capacity in conducting its own programs in the lower river.

Sue Walker (NMFS) asked if ADF&G could mobilize early enough in 2012 to tag Chinook for a basin-wide distribution study. Jack Erickson (ADF&G) replied that it would be possible but challenging given environmental conditions early in the season. Sue Walker asked if ADF&G planned to use sonar for assessing Chinook movements, and Jack Erickson stated that ADF&G's 2012 efforts would neither assess movement per se nor apportionment/abundance but would be aimed at documenting Chinook distribution. DIDSON would be employed, however, to identify potential recapture locations.

Michael Barclay (HDR) asked to what degree ADF&G would be attempting to document spawning locations of Chinook. Jack Erickson (ADF&G) stated that identifying spawning locations was not one of ADF&G's 2012 objectives. Betsy McGregor (AEA) stated that in 2012, AEA would track Chinook radio tagged by ADF&G in the lower river through the mainstem Susitna River to identify mainstem spawning locations and potentially collect HSC data. Betsy stated that in 2013-2014 AEA would continue to track Chinook tagged by ADF&G as well as Chinook tagged above three rivers by AEA.

Michael Link (LGL) stated that gear selectivity of fish wheels would bias the sample of radio-tagged Chinook toward fish of a certain size range. Mike also questioned whether it would be possible to obtain 400 Chinook from the existing recapture wheels. Jack Erickson (ADF&G) stated that he thought ADF&G would be able to obtain and tag the target sample size of Chinook and that size variability would be sufficient to provide for a representative sample. Betsy McGregor (AEA) stated that AEA's collection of Chinook for radio tagging in 2013-2014 may not rely solely on fish wheels and that AEA intended to capture and track enough fish to be confident that study results accurately represent Chinook distribution and activity in the middle river and above.

MaryLou Keefe (R2) questioned whether the number of fish tagged would be representative of the overall population. Craig Addley (Cardno-ENTRIX) replied that tracking of radio-tagged Chinook was a first step and that other means would be evaluated to locate Chinook spawning sites, both within side sloughs and the mainstem, to provide information needed to conduct instream flow modeling.

Joe Klein (ADF&G) stated that in areas where side-scan sonar data suggest Chinook are spawning but turbidity precludes positive identification during spawning, it would be necessary to excavate the substrate to verify that Chinook eggs/alevins are in the gravels.

MaryLou Keefe (R2) asked for confirmation that AEA intended to model habitat-flow relationships of all salmon life stages in the mainstem, sloughs, and side channels. Craig stated that all relevant fish species, lifestages, and habitats would be addressed as part of the instream flow analysis.

Jan Konigsburg (NHI) questioned whether handling and tagging of Chinook in the lower river could result in individuals that are less able to ascend Devils Canyon and thereby underestimate the extent to which Chinook use the river upstream of the canyon. Woody Trihey (Cardno-ENTRIX) stated that during the 1980s, many fish had received disk and Floy tags (which involved minimal tag-related stress) and that few of these tagged fish passed through Devils Canyon. Most of the tagged fish entered tributaries downstream of Devils Canyon.

Jack Erickson (ADF&G) stated that an alternative approach to estimating the number of adult Chinook passing upstream through Devils Canyon would be to conduct genetic analyses of juvenile Chinook collected upstream of the canyon reach. Results of the genetics sampling could be used to back-calculate the number of adult spawners that produced the juveniles. Tom Harris (Knikatnu, Inc) asked if otolith analysis might be used to assess the origins of Chinook juveniles found upstream of Devils Canyon. Craig Addley (Cardno-Entrix) replied that genetics analyses would likely be more effective for this purpose. Betsy McGregor (AEA) stated that otoliths from Dolly Varden and humpback whitefish would be analyzed in coordination with ADF&G to assess whether individuals in the middle and upper river have an anadromous or resident life history.

Tim Sundlov (BLM) noted that jetboat operators routinely observe adult Chinook in eddies in Devils Canyon, confirming that some level of upstream migration into the bottom of the reach is occurring regularly.

Michael Barclay (HDR) asked if AEA planned to track radio-tagged Chinook in tributaries to the middle river. Betsy McGregor (AEA) said that some of the Chinook tagged by ADF&G might be tracked in middle river tributaries by AEA's contractors, but there would be no attempt to document habitat use in below Devils Canyon tributaries except in the tributary mouths immediately adjacent to the mainstem.

Jack Erickson (ADF&G) cautioned that the tracking of radio-tagged fish with fixed and mobile receivers throughout the licensing study period would generate an enormous dataset, which would require much time to process. Michael Link (LGL) stated that AEA would likely benefit from hiring an information management specialist and that software is available to allow for efficient QA/QC and interpretation of such large datasets.

James Brady (HDR) asked how technical contractors would arrive at final sample sizes for radio-telemetry studies, questioning whether numbers of fish would be determined collectively by the Aquatic Resources Workgroup. Betsy McGregor (AEA) stated that the first step would be for AEA to consult with ADF&G to determine how many fish could reasonably be tracked, given the limitations of the number of unique codes per frequency then to coordinate with the workgroup before arriving at a final number.

Sue Walker (NMFS) acknowledged that studies related to adult Chinook would be logistically complicated but stressed that sample sizes and methods would need to be sufficient to address the main objective, which is characterizing the range of flows under which adult Chinook can migrate through Devils Canyon.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Aquatic and Terrestrial Resources Study Planning Meetings
January 26, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Terrestrial Resources Study Planning Meeting, January 26, 2012, 1-4 p.m.

Attendees:

Organization	Name
AEA	Betsy McGregor
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Jennifer Spegen (by phone)
NMFS	Susan Walker
NMFS	Eric Rothwell
BLM	Cara Staab
BLM	Ben Seifert
BLM	John Jangala (by phone)
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Mark Burch
ADF&G	Ron Benkert (by phone)
ADNR	Courtney Smith
FERC	David Turner (by phone)
Natural Heritage Institute	Jan Konigsburg
Knikatnu, Inc.	Tom Harris
Knik Tribe	Theo Garcia
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
MWH	Heather Williams
3PPI	Sally Morsell (by phone)
ABR	Brian Lawhead
ABR	Terry Schick
HDR	Anne Leggett
DOWL HKM	Jessica Christianson
DOWL HKM	Hillary Lindh
LGL Alaska	Tamara McGuire
Normandeau Associates	Robert McDonald
E-Terra	Lars Gleitsmann
Van Ness Feldman	Matt Love (by phone)
Nuvista	Chuck Casper

Presentations

- Mark Burch (ADF&G): Susitna-Watana Dam Hydroelectric Project Terrestrial Wildlife Resources
- Lynn Noel (Cardno ENTRIX): 2012 Botanical Studies
- Lynn Noel (Cardno ENTRIX): 2012 Wildlife Studies
- Lynn Noel (Cardno ENTRIX): 2012 Beluga Whale Study

Meeting Summary

1. Steve Padula (Long View Associates) initiated attendee introductions.
2. Betsy McGregor (AEA) provided an agenda overview and highlighted the recent addition of a beluga whale study plan. She verified that all meeting materials, including those most recently added, are available on the project website (http://susitna-watanahydro.org).
3. Lynn Noel (Cardno ENTRIX) presented the study plan "F-S6: Cook Inlet Beluga Whale Anadromous Prey Analysis – DRAFT" dated 25 January 2012. Presentation slides and the study plan itself are available at the project website.
    a. Betsy McCracken (USFWS) noted that eulachon is a state species of concern and that there is a 2006 document containing relevant information.
    b. Lynn Noel (Cardno ENTRIX) indicated that the team is aware of the 2006 study and additional studies that were not mentioned in the presentation due to time limitations.
    c. Jan Konigsberg (NHI) indicated that the use of "FERC Study Area" in the F-S6 Figure 1 legend is confusing since that term in this study would refer to a larger study area extending to Cook Inlet. Betsy McGregor (AEA) indicated that she would have it changed for clarity.
    d. Steve Padula (Long View Associates) commented that the dates shown in F-S6 and other study plans are deadlines for contractor submittals to AEA and are therefore several weeks earlier than the corresponding target dates for AEA submittals to FERC. Betsy McGregor (AEA) added that this will give AEA and other stakeholders time to review. She stated that the study plan process is iterative with multiple opportunities for stakeholder input and revisions.
4. Mark Burch (ADF&G) presented three proposed ADF&G studies. Presentation slides and the project funding proposals themselves are available at the project website.
    a. <u>Caribou</u>: "Distribution, productivity, and timing of movements of Nelchina and Delta caribou in the vicinity of the proposed Susitna-Watana Hydroelectric Project in Game Management Unit 13E." 12 January 2012
        i. What is the range of the Delta herd?
            1. Mark Burch (ADF&G) suggested contacting the area biologists who manage it for further information.

ii. Is the population truly growing, or could it simply be appearing to grow based on changes in population estimating techniques (i.e. telemetry, etc).
    1. Mark Burch (ADF&G) indicated that caribou populations are cyclical, but that these are believed to be actually growing.
iii. Betsy McGregor (AEA) indicated that it would be very helpful for stakeholders to provide written comments to ADF&G on technical proposal details such as numbers of collars, frequencies, etc. in order to ensure the data gathered will be adequate for project needs.
iv. Question was asked regarding collar specifications.
    1. Mark Burch (ADF&G) relayed information he obtained from area biologist and Principal Investigator Becky Schwanke (ADF&G) indicating that collars are on 5 hrs/day and are rotated in order to cover daily variations. He referred the questioner to the funding proposal for additional detailed collar specifications.

b. <u>Moose</u>: "Abundance, distribution, productivity, and survival of moose in the vicinity of the proposed Susitna-Watana Hydroelectric project in Game Management Unit 13E." 18 January 2012
  i. What is the proposed method of determining calf survival?
    1. Mark Burch (ADF&G) referred the questioner to the funding proposal and/or Becky Schwanke (ADF&G).

c. <u>Ptarmigan</u>: "Population ecology of willow ptarmigan *Lagopus lagopus* in game management unit 13, south-central Alaska." (undated)
  i. Cara Staab (BLM) said that proposed sample size of 30 seems small for such a small animal in a large area.
    1. Mark Burch (ADF&G) clarified that sample size is 30 per year, per subunit, for a total of 90 per year. The collared birds will also be moved frequently. Increasing sample size is cost-limited due to both collar costs, and costs of moving collared birds.
  ii. Who is the Principal Investigator?
    1. Mark Burch (ADF&G) indicated that it is a cooperative project with UAF, and that Rick Merizon (ADF&G) is the PI.

d. Questions following all three presentations:
  i. Betsy McCracken (USFWS) asked how long are the three proposed studies?
    1. Mark Burch (ADF&G) indicated that there are tables showing schedule dates in the funding proposals themselves, though he didn't include that information in the presentation slides.
  ii. Will bears be studied?
    1. No field studies are proposed at this time. Literature and existing data study only.
  iii. One big data gap from earlier studies is use of the proposed reservoir area during winter, especially severe winters, since the 1980s study years were relatively mild. Is there enumeration planned specific to this

need? Given that this winter is proving to be severe, can we accelerate the field work to take advantage?
    1. Mark Burch (ADF&G) said that GPS collars and flights are thought to be sufficient to address the reservoir area use question. He will look into feasibility of accelerating the field work to capture the current severe conditions.

iv. Lynn Noel (Cardno ENTRIX) asked whether remote monitoring stations could be used in addition to the proposed telemetry?
    1. Mark Burch (ADF&G) said that the limited range of remote monitoring stations makes them cost-prohibitive and that flights are probably more valuable.

v. Will GPS data be sufficient to determine where animals are crossing the river given small sample sizes?
    1. Confidence of obtaining a definitive answer is higher with moose than caribou since caribou tend to roam significantly. ADF&G will attempt to identify and collar caribou that are using the study area, but this is acknowledged to be a risk item. Sample size is limited by collar expense.

vi. Lars Gleitsmann (E-Terra) asked how hunting effort and harvests have trended over the decades in the area for all species.
    1. Mark Burch (ADF&G) said that caribou are migratory and relatively easy to manage. Caribou hunting success tends to fluctuate with the population itself. He believes that the moose population has improved recently, though he is not personally familiar with variables such as predator control, winter severity, etc.
    2. State and federal agencies have management reports that would contain relevant information.

vii. Will bears and wolves also be counted? Will comparisons be made to new and/or existing bear and wolf population data?
    1. Mark Burch (ADF&G) said that there are existing bear population estimates and that wolves are also tracked. General trend comparisons may be possible.

viii. Will study area be increased per earlier discussions?
    1. Mark Burch (ADF&G) confirmed that trend counts will be added back in to one particular area.

ix. What studies are planned beyond these three near-term studies?
    1. Outyear studies have not yet been planned. Generally would get enough information from periodic spot checks.

x. Is there any existing data on annual caribou crossings?
    1. No movement studies have been conducted to date. Currently only radio collars have been implemented, which require flyovers to locate and are not frequent enough to determine movement.

xi. Is it possible to determine caribou movement from satellite imagery?
    1. Lars Gleitsmann (E-Terra) said that satellite coverage is available daily, and of sufficient resolution to see caribou-sized objects, so theoretically yes. Limitations include cost and time involved to obtain and analyze sufficient imagery and likelihood that caribou would be visually camouflaged against surroundings and therefore invisible.

xii. Tom Harris (Knikatnu, Inc.) asked a question regarding overall impacts to the study area.
    1. Betsy McGregor (AEA) answered that additional studies are planned. The three ADF&G studies are components of the overall study plan that will be presented later in this meeting by Lynn Noel (Cardno ENTRIX).

5. Lynn Noel (Cardno ENTRIX) presented three wildlife study plans. Presentation slides and the study plans themselves are available at the project website.
    a. "W-S1: Wildlife Habitat Use and Movement Study - DRAFT" dated 26 January 2012.
        i. What location defined "upstream" and "downstream" in the historical APA moose studies?
            1. The proposed Devils Canyon dam site
        ii. What census methods were employed in the historical APA moose studies?
            1. Gasaway-type aerial survey in addition to telemetry
        iii. Is presentation information listing existence of recent caribou data accurate?
            1. Mark Burch (ADF&G) is not familiar with caribou data. Brian Lawhead (ABR) confirmed that he has seen relatively recent caribou data, from the 2000s.
        iv. Dave Turner (FERC) requested clarification on what additional work will be done between the current 2012 DRAFT study plan, and the next study plan deliverable. His understanding was that the bulk of the historical data gathering should have been completed prior to the PAD. Concerned about length of historical data gathering process and whether it can be accelerated to better inform stakeholders and study plan development.
            1. Lynn Noel (Cardno ENTRIX) said that the level of detail relative to the usability of the historical data will be greater in the next study plan deliverable.
            2. Brian Lawhead (ABR) responded that the historical data is in fairly rough shape, and that ongoing historical "data rescue" is being attempted in order to determine usability.
            3. Betsy McGregor (AEA) indicated that the information was summarized in the data gap analysis as well as the PAD. The data gathering referred to in the study plan was to collect specific

data sets and put them in a current digital format for the further analysis. She added that the current schedule for these tasks is very aggressive, with only about a 6 week turnaround time.

4. Brian Lawhead (ABR) said that modern telemetry data analysis techniques may be performed on historical data to yield new information, such as range use for example. Need more work to determine if this is possible.
5. Dave Turner (FERC) concurred that performing and incorporating new analyses of historical data and documenting in the next study plan deliverable would be useful, but re-summarizing available data would not be as useful.
6. Betsy McGregor (AEA) said that 13 April 2012 is deadline for identifying what historical data is usable and useful. She has been working with ADF&G to develop a process for data transfer and sharing so that this can be done efficiently.

v. Brian Lawhead (ABR) asked about Becky Strauch's (ADF&G GIS) availablity, since much of the GIS analysis would presumably be tasked to her as the historical data holder.
   1. Betsy McGregor (AEA) said that she and Lynn Noel had met in December with Becky, but does not know her current availability.
   2. Several attendees indicated that Becky has a long waiting list.
   3. Mark Burch (ADF&G) said that availability is a matter of prioritization and those are set by others.

b. "W-S2: Past and Current Big Game and Furbearer Harvest Study - DRAFT" dated 26 January 2012.

c. "W-S3: Eagle and Raptor Nest Study - DRAFT" dated 26 January 2012.
   i. Brian Lawhead (ABR) is concerned that the proposed survey period may be too late in the season for eagles, but he would need to check with his raptor expert.
      1. Lynn Noel (Cardno ENTRIX) said that the dates were taken from the original surveys and may need to be adjusted.
   ii. Is a historical vegetation map available?
      1. There is one, but it may not be available in a usable format in time to support 2012 field work. Looking into other alternatives.
   iii. Betsy McCracken (USFWS) requested that all proposed project features be shown on nest maps rather than just the reservoir.
      1. Lynn Noel (Cardno ENTRIX) replied that the nest data will be delivered in GIS format, which can be overlayed with other data layers (including project features) for future map production.
   iv. Betsy McCracken (USFWS) has information on recommended clearing times that should be considered.
   v. Have there been any indications of a need for additional types of information such as raptor foraging based on new regulations?

1. Lynn Noel (Cardno ENTRIX) said that the 2012 study goal is to identify nests so that other 2012 field investigations can avoid them as appropriate. The nest data will need to be communicated to other field teams almost real-time due to schedule constraints. More comprehensive regulatory compliance reviews will be conducted during 2013-2014 study plan development. Requirements may include electrocution analysis/mitigation for transmission line corridors.
2. Betsy McCracken (USFWS) has pertinent regulatory compliance information in rough format that she is compiling for Lynn.

vi. Terry Schick (ABR) indicated that some raptor habitat data can be obtained from the proposed habitat studies that will be discussed later in the meeting.
   1. Lynn Noel (Cardno ENTRIX) added that some of the NWI mapping has been digitized and may be available soon to help inform study plans.

6. Lynn Noel (Cardno ENTRIX) presented three botanical study plans. Presentation slides and the study plans themselves are available at the project website.
   a. "B-S1: Vegetation and Wildlife Habitat Mapping Study - DRAFT" dated 26 January 2012.
   b. "B-S2: Riparian Study - DRAFT" dated 26 January 2012.
   c. "B-S3: Wetland Mapping Study - DRAFT" dated 26 January 2012.
   d. Discussion following presentation of all botanical study plans:
      i. Did 1985 vegetation map incorporate 1982 data?
         1. Lynn Noel (Cardno ENTRIX) said yes, for the overlapping portions. The 1982 data is not available digitally.
      ii. Advantages and limitations of imagery datasets shown on B-S2 Figure 2 and in the presentation slides were outlined.
         1. SPOT5 data is not useful for direct impact level analyses, might be useful for basin-wide analyses.
         2. Lars Gleitsmann (E-Terra) explained the three datasets his firm has procured for the project: Upper/Lower/Middle Susitna, primarily leaf-off for elevation contour generation, not as useful for vegetation mapping.
         3. Brian Lawhead (ABR) asked if AeroMetric is going to fly additional aerial imagery?
            a. Betsy McGregor (AEA) said that they will and that exact needs are being defined now. Geomorph needs multiple flights at different river flows, so trying to ascertain if other needs can be piggy-backed on one of those flights for efficiency.
            b. Lars Gleitsmann (E-Terra) cautioned that geomorph flights at specific river flows may yield narrower corridor than would be required for other purposes such as flood

zones, and that the specific flow requirements might fall on poor weather days when vegetation would not be visible. Studies of riparian corridor might be compatible use, depends on required corridor width.

4. Mat-Su LIDAR is thought to be generally the best dataset, but it is not processed yet and has some limitations since it was flown on multiple dates at different leaf-out stages, etc.
5. 2004 imagery is thought to have very limited value.
6. Lars Gleitsmann (E-Terra) said that as far as he knows, the 1980s aerial imagery is in the form of contact prints and that the calibration sheet has been lost, making ortho-rectification impossible. It is still useful for visual comparisons, change studies, etc.
7. Anne Leggett (HDR) raised the issue that imagery availability can impact study schedules significantly.

iii. Betsy McCracken (USFWS) suggested that the Corps of Engineers and the EPA should be contacted to determine 404 permitting requirements.
   1. Betsy McGregor (AEA) and Lynn Noel (Cardno ENTRIX) believe that this is addressed already in the study plan.

iv. Anne Leggett (HDR) asked if sensitive plant studies would be conducted.

v. Betsy McGregor (AEA) stated that an RFP will come out with details of study scopes including rare plants, invasive weeds, and revegetation plans for impacted areas.

vi. Ben Seifert (BLM) asked if there will be a study to quantify forest resources within the reservoir inundation zone and whether the plan is to clear prior to reservoir inundation?
   1. No decision has been made whether to clear prior to inundation and therefore no quantification is planned at this time.
   2. Ben indicated that quantification will likely be needed to determine fair market value of the public resource, whether or not clearing occurs prior to inundation. Also need to discuss resource salvage options if clearing is selected.
   3. Lars Gleitsmann (E-Terra) mentioned that some quantification may be possible using the recent imagery obtained by his firm as one option.

vii. Anne Leggett (HDR) asked when the Mat-Su LIDAR will be available.
   1. Betsy McGregor (AEA) said that the North Susitna block is last, around May or June 2012. The aerial imagery may be available earlier than the LIDAR.

viii. Anne Leggett (HDR) asked if there will be field verifications this year?
   1. Betsy McGregor (AEA) responded that there would be field verification of the aerial imagery interpretation these are iterative, multi-year studies that will require coordination

between contractors to determination appropriation sampling strategy to meet the data collection needs for multiple resources. She used riparian modeling component as an example.

ix. Lynn Noel (Cardno ENTRIX) commented that the reservoir operations modeling needs to be considered as well vs. botanical life cycle timing (wet/dry riverbed conditions during seed germination times, etc).

x. Relationships between wildlife habitat mapping and vegetation mapping were discussed. Betsy McGregor (AEA) said that responsibility for coordinating that effort will fall into the wildlife habitat mapping task. Tom Schick (ABR) confirmed that it is appropriate for wildlife biologists to verify that vegetation mappers are using appropriate scales for study species.

xi. Anne Leggett (HDR) asked when the RFP will be made public?
   1. Betsy McGregor (AEA) said botanical resources RFP will hopefully be out next week. There are likely to be multiple awards since it is a large amount of work. The RFP will include a task for a contractor to compile the individual Technical Memos that result into a comprehensive FERC license application section.

xii. Anne Leggett (HDR) asked if decisions have been made on how to coordinate field logistics?
   1. Betsy McGregor (AEA) said that AEA will provide helicopter support and AEA is looking into lodging options and boat access logistics for some areas also. AEA will also provide a site logistics coordinator.

xiii. Lars Gleitsmann (E-Terra) asked if it might be feasible and cost-efficient to use the existing trail/road off the Denali Highway that was used by military contractors recently to remediate a jet crash site relatively close to the proposed dam site.
   1. Betsy McGregor (AEA) said that AEA is working on lodging options and hasn't fully considered travel logistics yet. Jim Gill is looking into the other logistics at this time.
   2. Ben Seifert (BLM) said that he helped permit that access route for the Air Force and could speak to the question. The route is road-like for some distance from the Denali Highway intersection and then becomes more and more trail-like as you approach the Watana Canyon area. The remediation camp is shut down and will be fully removed this spring. The trail/road mostly follows an older trail used by placer miners. Ben thinks that there is potential for this project to use the trail/road.

xiv. Anne Leggett (HDR) asked if ADNR is still coordinating GIS data sharing.

1. Betsy McGregor (AEA) said yes and introduced Courtney Smith (ADNR GIS) who will be compiling and serving GIS data for the project.

7. General Questions and Next Steps
   a. Will the calendar showing FERC deadlines be posted?
      i. Betsy McGregor (AEA) said that yes, there is already an action item from another session to do so. Also working to get a Sharepoint site set up that would include a calendar function.
   b. Betsy McGregor (AEA) said that AEA is trying to post meeting notes and conclude action items within two weeks of meetings.
   c. AEA would appreciate written comments on all documents and study plans within two weeks of meetings to help support the overall project schedule.
   d. Next meeting series is tentatively 27 to 29 February 2012. Terrestrial resource meeting will likely be 29 February 2012.

Action Items

1. AEA will re-label the orange boundary depicted on F-S6 Figure 1 for clarity since the beluga whale study area extends to Susitna River confluence with Cook Inlet.
2. Betsy McCracken (USFWS) to provide data on recommended clearing times, and recent raptor regulation compliance requirements.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Social Science Resources Planning Meeting
February 27, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Subject
- ILP Study Request Outlines and Study Plan Development for Social Sciences.

Attendees:

Organization	Name
AEA	Wayne Dyok
AEA	Betsy McGregor
ADF&G	Mark Fink
ADF&G	Joe Giefer
ADNR	Courtney Smith
BLM	Denton Hamby
BLM	Elijah Waters
DHSS	Paul Anderson
DHSS	Sarah Yoder
DOWL HKM	Tom Middendorf
DOWL HKM	Maryellen Tuttell
EPA-ADO	Jennifer Curtis
FERC	Jesse Fernandes (by phone)
FERC	David Turner
FERC	Ken Wilcox
HDR Alaska	Laurie Cummings
Kleinschmidt	Marty Phillips (by phone)
Knikatnu, Inc.	Tom Harris (by phone)
Louis Berger Group	Lisa McDonald (by phone)
MWH	Sarah Callaway
MWH	Kirby Gilbert
Natural Heritage Institute	Jan Konigsburg
NPS	Cassie Thomas
NPS consultant	Harry Williamson (by phone)
Northern Economics	Patrick Burden
URS	Paul Dworian
URS	Bridget Easley
USFWS	Mike Buntjer

Presentations

- Kirby Gilbert (MWH): Overview of near-term project calendar through November 2012
- Kirby Gilbert (MWH): Overview formal Study Request template
- Kirby Gilbert (MWH): Overview project licensing calendar through 2015
- Kirby Gilbert (MWH): Review of Table of Preliminary 2013-2014 Formal ILP Studies – Social Sciences
- Dr. Paul Anderson (DHHS): State of Alaska Health Impact Assessment Program

Recreation

1. Kirby Gilbert (MWH) – Stated that the overall goal of the Recreation Resources Study is to develop a project recreation plan that incorporates findings from the resources assessment and anticipated project impacts.
    a. Cassie Thomas (NPS) – Stated that some impacts will not be known until the results from other resource studies are known. What is the timing going to be for developing the recreation plan, since other study results should really drive some of the plan?
    b. Wayne Dyok (AEA) – Stated that comparing the issues identified for the historic (1980s project), the current project, and those already identified by FERC, they are nearly one to one. A lot of things (resource- and impact-wise) have not changed, and will not change much. It is important to continue moving forward on parallel paths, not necessarily waiting for all the resource studies to be completed, before progressing on the recreation plan.
    c. Cassie Thomas (NPS) – Noted that things have changed since the 1980s. Impacts will likely be different than those anticipated in the original project. She noted that ECPA now requires equal consideration of environment and development, and preparing a recreation management plan too soon, before some of the resource impacts are fully understood would not be helpful. As public agencies, how can we help the public understand the different mitigation options and alternatives, if they don't know what the impacts will be or what they are losing?
    d. Kirby – Stated that the recreation plan won't be written this year, rather for 2013-14 timeframe; the 2012 work is mostly for information gathering.
2. Kirby Gilbert (MWH) – Stated that with the Recreation Resources Assessment, we want to understand the current state of the recreational framework (hunting, fishing, etc.), as well as ensure that we have an appropriate study area. What are the recreation use patterns now? And how might the project (road corridors, transmission corridors, etc.) impact those patterns? How might this project impact the recreation opportunities? Surveys might be one method of gathering information. The study plan needs to help us understand all the impact mechanisms.
    a. Cassie Thomas (NPS) – Asked if there is a plan for field staff, who might be at the site for other purposes (resource studies), to be provided with some type of form on which they could keep track of sightings of and/or encounters with

recreationists. She stated that it didn't need to be a survey itself, or a study proper, but simply a way of observing recreation opportunities.

b. Wayne Dyok (AEA) & Kirby Gilbert (MWH) – Stated that this is a great idea, but we need to be selective of the locations or how it gets applied, or it could be overwhelming (e.g. Montana Creek during high fishing season). How we use the information would still need to be determined, but something informal would definitely be useful.
c. Elijah Waters (BLM) – Stated that some dispersed recreation site information is available from BLM, as well as the Recreation Information Management System.
d. Cassie Thomas (NPS) – Stated that information may be available from boating clubs (Anchorage and Fairbanks), online forums, and air taxi operators.
e. Patrick Burden, (Northern Economics) – Stated that there will have to be cooperation between socioeconomic contractor and recreation contractor, since the topics have significant overlap.

3. Wayne – Asked the group if there were any general, big picture recreation considerations to be raised right now?
    a. Tom Harris (Knikatnu, Inc.) – Stated that it makes no sense, and native communities could not support, increasing access to a diminished resource, without taking actions to enhance the resources. Increasing access without increasing management is destructive.
    b. Mark Fink (ADF&G) – Stated that ADF&G is trying to maintain public access to a common resource (fish and wildlife); from a management perspective, they look at project components in terms of access to the resource. They also look at how increased access might change management strategies. However, they'd like to establish a good baseline first, before impacts can be assessed.
    c. Joe Giefer (ADF&G) – Stated that the use information that they have may show locations of where animals were ultimately taken, but the routes to those locations might not be known. Data gaps exist; trails are in place and used, sometimes regularly, that aren't mapped. GPS data points of unmapped trails would be useful, if observed during overflights for other resource studies.
    d. Wayne Dyok (AEA) – Stated that they are talking with ADF&G about possibly accelerating some of the moose studies. Since it's been a high snow year, ADF&G is planning a flyover of the reservoir area to determine how many moose use it.
    e. Tom Harris (Knikatnu, Inc.) – Stated that we should also consider not only what is lost (moose) but also a potential predator "explosion" if there is high moose mortality this year. Also, consider the potential user conflicts, if urban families begin hunting in more remote areas (as access increases); this competes with rural families.
    f. It was noted that the Project area is within an area managed by ADF&G for predator control.
    g. Cassie Thomas (NPS) – Stated that although important, subsistence is not recreation, so should be considered separately.

h. Wayne Dyok (AEA) – Stated that consultants will be required to provide schedules for study activities, so that all of the disciplines can be put into a big-picture schedule. Until we get the detailed schedules of the different study plans, we won't be able to articulate how they will fit together.
i. Harry Williamson (NPS consultant) – Asked if the gap analysis for recreation was posted. Betsy McGregor (AEA) replied that it will be posted.
j. Tom Harris (Knikatnu, Inc.) – Asked that a recreation trends analysis be included in the analysis.

Aesthetics

1. Kirby Gilbert (MWH) – Stated that the goal was to assess aesthetic conditions as they exist now, how they are used, and how the project (development and operation) might affect those resources. The 'night sky' is included under this topic, as an example of aesthetic resources. The project is in a fairly remote area, where not many people tend to recreate. However, aircraft overflights should be considered, and the impact to aesthetics from that standpoint. In 2012, we will start identifying key viewing areas, to establish where those locations might be. We know the project interfaces with public infrastructure at certain points (railheads, transmission corridors, etc.). We want to identify all these locations as well, so we can understand how to fully assess the current state of the resource.
2. Cassie Thomas (NPS) – Stated that in assessing the key viewpoints, trail identification will be important, particularly those that are unmapped (including winter trails).
3. Jennifer Curtis (EPA) – Stated that aesthetics/visual resources is a topic that often gets overlooked. It is encouraging to have this as a focus; however, it often can become contentious with regard to methodology. Point Thomson Draft EIS might be a good project to look at, in terms of how they approached this topic.

Socioeconomics

1. Kirby Gilbert (MWH) – Stated that there will be one contract team to do socioeconomic and transportation studies. The topic is broken into three components (social conditions & public goods and services, regional economics, air quality), but will likely need to be further broken down.
2. Kirby Gilbert (MWH) – Stated that air quality is a physical science, but has worked well under socioeconomics in other projects.
3. Kirby Gilbert (MWH) – Stated that with regard to the regional component, how does the project change the regional economy? The price of power, tourism, and multiplier effects of construction, etc.
4. Pat Burden (Northern Economics) – Inquired as to how the DCCED consultation process would move forward. Also, the benefit/cost analysis wasn't in the RFP that went out – is it going to be required? Kirby Gilbert (MWH) replied that DCCED would like to help contribute to the study, so it might look more like a partnership. They may be able to perform some tasks or subtasks. This is a potentially big study topic. Scopes

of work will be refined after contractor selection including the need for things like a benefit-cost analysis.

5. Kirby Gilbert (MWH) – Stated that the potential air quality impacts needs to be addressed. We may be looking at displaced fossil fuel emissions. What is the affected environment, what are the conditions now, and how might those conditions be impacted by the project? This topic is needed to help complete a FERC license application, and also for NEPA and for the health impact assessment. There is no specific work defined for 2012 for air quality, but information gathering activities may be appropriate.
6. Kirby Gilbert (MWH) – Stated that there will be crossover from other resources (e.g. subsistence). We are going to need some agreement on the methodologies and who is doing what pieces of work for socioeconomic information gathering activities.

Transportation

1. Kirby Gilbert (MWH) – Stated that transportation includes road, rail, and air transport systems. It is a cross over with recreation analyses, and will require integration with access management considerations. The final road corridor has not been determined yet, hopefully by the end of 2012 more information will be available.
2. Cassie Thomas (NPS) – Asked if the roads be maintained in the winter, during construction. If so, that would open the Denali Highway to the public during the winter, increasing access and recreation opportunities. Betsy McGregor (AEA) and Kirby Gilbert (MWH) answered. Betsy stated that the highway would likely be maintained during the winter if the Denali corridor is selected, but that has not been determined.
3. Transport considerations include construction in regards to how the physically large project components such as the turbine generators; will be brought to the site.
4. There will likely be some spur roads built during construction – how will this affect transportation for area users. Construction timing itself could be part of the mitigation.
5. Tom Mittendorf (DOWL HKM) – Asked whether the transmission line itself is being addressed in another resource study; is transmission access being looked at yet?
6. Kirby Gilbert (MWH) – Stated that the transmission line can be thought of as a project itself. It will need to be assessed for all resources and impacts. Transmission and transportation corridors would be co-located where practicable, but not always. If not co-located then some spur roads may be needed to access transmission towers. Some of the initial results of these studies will help to define some of the alignments, for both transmission and transportation.

Health Impact Assessment

Presentation by Dr. Paul Anderson
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1. Kirby Gilbert (MWH) – Stated that for this project, AEA would like to dovetail the HIA with preparation of the FERC license application, rather than just have it as an appendix to the EIS. Also there is a need to start considering the HIA at an earlier point (ILP study plans), rather than waiting until the NEPA process.
2. Kirby Gilbert (MWH) – Stated that some of the HIA components will be collected during other resource studies (e.g. socioeconomics). These things would fit together with and for the HIA studies.
3. Cassie Thomas (NPS) – Asked to what extent an HIA informs some of the project decisions? Construction crews, small, fixed-wing aircraft workers, etc. It would be wonderful if investment in analysis and research could help make things safer for people who will be directly exposed to construction risks.
    a. Dr. Paul Anderson (DHSS) – HIA focuses on "outside the fence" of construction. Those things related to occupational safety for construction crews are generally covered under OSHA programs. They are not typically considered in the HIA. Where there is overlap with the people within a community is where the HIA will come into play.

Meeting Summary

1. Attendee introductions, meeting agenda and calendar overview by Kirby Gilbert (MWH).
    a. April 27, 2012 – important date; comments due on PAD and study requests. Study request template is available.
    b. June 11, 2012 – AEA to submit the formal study plan. Comments due by September 10, 2012.
    c. October 10, 2012 – AEA to file revised study plan.
    d. November 30, 2012 – FERC to issue study plan determination.
2. Overview of the template for formal study requests.
3. Overview of the licensing schedule through 2015.
    a. Harry Williamson – asked for clarification on the dates of study plan submittals (drafts, revised, proposed final, etc.).
    b. Jenny Seagon (USFWS) – asked for clarification on the relationship between the "Table of Preliminary 2013-2014 Formal ILP Studies – Social Sciences" and the study plan templates. Kirby clarified – on the table, each "Study Title" will essentially be a filled out in the template form.
4. Recreation
5. Aesthetics
6. Socioeconomics
7. Transportation
8. Health Impact Assessment – Presentation by Dr. Paul Anderson

Action Items

1. AEA to post recreation data gap analysis.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Cultural and Subsistence Resources Workgroup Meeting
February 28, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Subject

- ILP Study Request Outlines and Study Plan Development for Cultural Resources.

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Bruce Tiedeman
ADF&G	Mark Burch
ADF&G	James Van Lanen
ADHSS-HIA	Sarah Yoder
ADNR	Courtney Smith
ADNR-OHA	Richard VanderHoek
BLM	Elijah Waters
BLM	Dan Sharp
EPA	Jennifer Curtis
FERC	David Turner (by phone)
USFWS	Mike Buntjer
NPS	Cassie Thomas (by phone)
ABMC and AVI	Chuck Akers
Ahtna, Inc.	Gloria Stickwan (by phone)
CardnoENTRIX	Lynn Noel
DOWL HKM	Jessica Christianson
E-Terra	Frank McQueary
E-Terra	Lars Gleitsmann
HDR	Jeff Schively
HDR	Anne Leggett
HDR	Adinda Demske
HDR	Tracie Krauthoefer
MWH	Kirby Gilbert
MWH	Heather Williams
Natural Heritage Institute (NHI) / HRC	Jan Konigsburg
Northern Land Use Research (NLUR)	Pete Bowers
Northern Land Use Research (NLUR)	Richard Stern (by phone)
URS	Paul Dworian
URS	Pat Athey

Organization	Name
Van Ness Feldman	Jonathan Simons (by phone)

Presentations

- Kirby Gilbert (MWH): Overview of project licensing calendar through Draft EIS July 2016 (http://www.susitna-watanahydro.org/Schedule.html)
- Kirby Gilbert (MWH): Overview of Study Request Template (http://www.susitna-watanahydro.org/Docs/StudyRequestTemplate_draft_021612.docx)
- Kirby Gilbert (MWH): Review of Table of Preliminary 2013-2014 Formal ILP Studies – Cultural and Subsistence Resources (http://www.susitna-watanahydro.org/Docs/CulturalandSubsistenceResources_02162012.pdf)
- James Van Lanen (ADF&G): Overview of Susitna-Watana Hydroelectric Project: Subsistence Gap Analysis and Scope of Work (meeting handout)

Cultural Resources

1. Kirby Gilbert (MWH) – Stated that 2012 will likely be focused on setting the stage for data collection and not impact analysis. Need to identify linkages between studies, overlaps with other areas such as recreation and wildlife. Some historic property information exists from the 1980s work, but more is needed, and existing data needs to be put in GIS format.
2. Kirby Gilbert (MWH) – Stated that defining the Area of Potential Effect (APE) can be a typical challenge point for projects like this. Sometimes we can end up with two APEs, one for direct effects (ground disturbance) and a larger one including a buffer zone for indirect effects. Currently the reservoir area is better defined than the road and transmission corridors due to ongoing facility siting optimization studies. Engineering feature siting optimization would ideally incorporate cultural and resource study input. Avoidance is first desired option for mitigation. Design process needs to be somewhat iterative.
    a. Richard VanderHoek (ADNR-OHA) – Agreed that defining APE is a challenge, will have to look at all three proposed road and transmission corridors. The indirect APE will become significant later. 10 years of experience on Denali Highway and other projects indicates that foot traffic, OHV traffic will be significant. Need to do an assessment to determine where the attractive hikes, boat destinations, etc. are going to be.
    b. Kirby Gilbert (MWH) – Noted the study area is currently @ 2200'corresponding to the 2000' potential maximum pool elevation reservoir. Is that sufficiently large to serve as an APE for the inundation zone.
    c. Richard VanderHoek (ADNR-OHA) – Probably this is ok for now, but may need a larger APE later.
    d. Kirby Gilbert (MWH) – Timing of APE definition is tricky. He believes that Wayne Dyok's (AEA Susitna-Watana Program Manager) goal is to have preferred access & transmission routes selected by end of 2012.

e. Betsy McGregor (AEA) – There is an ADOT&PF report due out at the end of March 2012 evaluating the three road corridors. This report does not address transmission; that is in a separate report.
f. David Turner (FERC) – How might SHPO and agencies go about identifying or defining a visual impact area for purposes of establishing an indirect effects APE?
g. Richard VanderHoek (ADNR-OHA) – Agrees it is difficult to do; but it might be a matter of looking for easy access features (gravel ridges) that intersect proposed access routes that would likely become 4-wheeler trails. There are existing 4-wheeler routes almost to the reservoir.
h. David Turner (FERC) – Noted we need to define an APE reasonably.
i. Cassie Thomas (NPS) – During yesterday's recreation discussion, it was identified that there is a trail map data gap (including foot, 4-wheeler and snowmachine trails). That data gap will likely also need to be filled to help inform the cultural resources indirect effects APE definition.
j. Betsy McGregor (AEA) – ADF&G harvest location data may help inform as well.
k. Kirby Gilbert (MWH) – Indicated the value in adding trail mapping to the 2012 recreation study.
l. Anne Leggett (HDR) – Aerial imagery may help as well.
m. Elijah Waters (BLM) – BLM does have some trail inventory data in GIS format, known to be incomplete, but may still be helpful.
n. Lars Gleitsmann (E-Terra) – Archived satellite imagery also shows trails (summer).
o. Kirby Gilbert (MWH) – Would a predictive model be useful in the cultural resources investigations?
p. Pete Bowers (NLUR) – Predictive modeling extrapolates from known sites to help stratify the survey area in order to focus the field work. Area is too large to do 100% survey so the predictive model could help limit the need to do ground surveys in all locations.
q. Richard VanderHoek (ADNR-OHA) – Predictive modeling needs to make use of all available data layers (historic sites, caribou, etc).
r. Pete Bowers (NLUR) – Is there a plan to create/enhance some trails as part of the project?
s. Betsy McGregor (AEA) – Not yet. This will be determined later in the process (collect data, assess, plan, manage). Will write a recreation management plan later.
t. Kirby Gilbert (MWH) – Public access is a contentious issue. Some stakeholders want it, others do not.
u. Chuck Akers (ABMC and AVI) – Objected to "or" statement on criteria 1.3.6 of Formal Study Plan Template. Thinks it should be an "and" conversation between the scientific community and landowners. Existing trails and proposed features likely cross native lands, and landowners need to be included in all discussions about use of their properties.

v. Bruce Tiedeman (AEA) – Introduced himself as the native liaison for AEA. Noted that the southern route is predominantly native land. The middle route is mixed native and non-native land. The northern route is mostly state and federal land. It is important to note that native stakeholders are likely to give comment on indirect effects to non-native lands. Important to remember that we do not want to dictate to other landowners what to do with their land.

3. Kirby Gilbert (MWH) – Stated that Traditional Cultural Properties (TCPs) were not something researched during the 1980s work. AEA is responsible to advance this work, and would be studying TCPs on APE lands of all ownership categories. Typically this is done by ethnographers.
    a. Pete Bowers (NLUR) – Might want to consider tying in TCP research with subsistence studies since likely interviewing many of the same people.
    b. Betsy McGregor (AEA) – TCPs seem to be useful as inputs for predictive modeling.
    c. Pete Bowers (NLUR) – Yes, but may be a "cart before the horse" situation. Modeling is iterative.
    d. Tracie Krauthoefer (HDR) – If subsistence studies being done by ADF&G consist of household surveys, there may not be time for interviewers to ask TCP questions. If it is a Traditional Ecological Knowledge (TEK) setting, then would be more appropriate to ask TCP questions.
    e. Pete Bowers (NLUR) – Agreed that it needs careful thought and planning, would at least be a starting point.
4. Tracie Krauthoefer (HDR) – Experience shows that having a plan in place for dealing with human remains (Unanticipated Discoveries Plan [UDP]) is key.
    a. Pete Bowers (NLUR) – Agreed that having contacts identified ahead of time for clear and fast communications is critical.
    b. Kirby Gilbert (MWH) – On federal lands, the Native American Graves Protection and Repatriation Act (NAGPRA) comes into consideration. FERC requires that a Historic Properties Management Plan (HPMP) be written for the project, it will be folded into the license application. Also a paleontological screening/study/sensitivity analysis will need to be done, particularly on Federal lands.
    c. Richard VanderHoek (ADNR-OHA) – They are currently working with John Jangala of BLM and paleontological resources are of interest across all BLM lands in the area.
5. Bruce Tiedeman (AEA) – Will AEA's proposed fieldwork be accepted by the agencies? Does the group feel some agreement is being reached?
    a. Kirby Gilbert (MWH) – Agreement by all stakeholders is what the study plan development and submittal process is intended to achieve. Asked if everyone thinks AEA is on track at this time? Realizes there will be more discussions and deliberations once more specifics are put into Study Plan Request format for April workgroup meetings.
    b. Richard VanderHoek (ADNR-OHA) – Yes [planning process seems to be on track].

c. Kirby Gilbert (MWH) – AEA has been given permission by FERC to initiate Section 106 consultation and it will be needed not just for FERC but also for Army Corps of Engineers 404 permitting process and any BLM decisions granting use of their lands.
d. Tracie Krauthoefer (HDR) – Encourages broad thinking with respect to the APE. It is easier to narrow an APE that started too large than to add to one later. Cited an example of another hydro project that is having to widen their corridor.
e. Pete Bowers (NLUR) – They used a 5 mile boundary around the corridors in their initial search for historic properties during recent gap analysis work. Predictive model will help identify likely areas of interest.
f. Betsy McGregor (AEA) – Indicated that the alternative corridors have been changed since gap analysis was done and some have been further refined.
g. Tracie Krauthoefer (HDR) – It would be good to do some survey work soon to help validate the predictive model(s).
h. Pete Bowers (NLUR) – Maybe start by surveying the approximately 50 identified sites in the reservoir area, and extrapolate from there.
i. Richard VanderHoek (ADNR-OHA) – When thinking about multi-year collection, want to do soils first year (volcanic for markers, etc). This will give framework for 2^{nd} and 3^{rd} year studies.
j. Betsy McGregor (AEA) – Intent is for environmental contractors to put studies from outline into FERC Study Plan Request format.
k. Kirby Gilbert (MWH) – Goal is to get the updated Study Plan Request outlines posted by March 23, 2012.
l. Pete Bowers (NLUR) – It could be useful to take a “low-hanging-fruit” approach to 2012 work. Get the non-controversial and unlikely to change work out of the way (i.e. reservoir area).
m. Betsy McGregor (AEA) – Also preparing an unanticipated discoveries plan would be good to have in place in 2012.
n. Kirby Gilbert (MWH) – Corridors as defined in the PAD are the current direct impacts or “default” APE and should be considered so at this time, however these areas would be narrowed down to the proposed ground disturbing areas later, once those areas are known.
o. Tracie Krauthoefer (HDR) – May need to make sure an Unanticipated Discoveries Plan includes a curation plan as well.

Subsistence Resources

1. James Van Lanen (ADF&G) – Presented scope of work document for ADF&G subsistence work. Indicated that the Principal Investigator (Davin Holen) was unable to be here today due to Board of Fish meeting conflict. Discussed general study objectives, survey sample techniques, community involvement, local hire and training, limitations of 1-yr-data snapshot, harvest mapping process, interview process typically including traditional knowledge interviews (TKI), etc.

a. Kirby Gilbert (MWH) – Indicated that ADF&G scope of work document will be folded into the ILP study plans.
b. Kirby Gilbert (MWH) –Noted that EIS is not expected until 2016, so we may need to include additional communities whose data validity will expire before then.
c. Betsy McGregor (AEA) – Asked what criteria define a "community" for ADF&G subsistence survey purposes.
d. James Van Lanen (ADF&G) – Indicated that only census-designated communities are surveyed. There is no population size threshold. Talkeetna is outside the ADF&G subsistence management area, so is not included as a survey community per the ADF&G guidelines.
e. Lars Gleitsmann (E-Terra) – Why isn't Lake Louise included?
f. James Van Lanen (ADF&G) – Lake Louise is likely included with Tolsona, but he would have to check.
g. Elijah Waters (BLM) – Is the Copper Center survey, the NPS survey that was done recently?
h. James Van Lanen (ADF&G) – NPS was a partner, but ADF&G did the survey.
i. (Unknown)– Chase is a trainstop, why is it singled out from all similar small Railbelt communities in that area?
j. James Van Lanen (ADF&G) – Can't cover everything. Household lists are generated upon arrival in the community for the surveys; not before arrival. This helps get people that may be missed otherwise. Local researchers add people to the list. Davin Holen (ADF&G) would have more specifics.
k. Tracie Krauthoefer (HDR) – Working with community liaisons helps get clues for outlying households.
l. Betsy McGregor (AEA) – The schedule for the surveys takes into account other Projects that may require subsistence surveys in the same community. Interim reports will roll into the ILP study report each fall.
m. Kirby Gilbert (MWH) – This plan covers baseline data collection. Need to also think about the next step and how that might proceed – that is impact analyses based on the data collected.
n. James Van Lanen (ADF&G) – Impact analysis is not my specialty, but expect that it will be fairly subjective. Method of access questions are asked, and may help get at trail location/use to help inform the impact assessment.
o. Kirby Gilbert (MWH) – Public access during construction is an open question. Winter construction could mean that the Denali Highway would be open longer than normal, to the intersection with the project road.
p. James Van Lanen (ADF&G) – On recent surveys for other projects, ADF&G typically hears that opening up access to the areas is desired.
q. Sarah Yoder (ADHSS-HIA) – Did hear some "too much access" feedback on recent surveys for other projects.
r. Chuck Akers (ABMC and AVI) – General population might want more access, but landowners might not agree. CIRI villages have 12b selection lands in the area. Ahtna has land as well, may have traditional use also. Landowners need to be engaged in the discussion.

s. James Van Lanen (ADF&G) – During Copper Basin study, heard two basic commentaries. Non-natives were complaining about Ahtna restrictions and fees, natives were complaining about not being able to keep trespassers out.
t. David Turner (FERC) – Those on the phone don't have the handout. Please describe the ADF&G Subsistence Study implementation schedule.
u. Betsy McGregor (AEA) – First four communities are scheduled for survey January through March 2013, next set January through March 2014. Lots of work leading up to the actual surveys (local hire and training, etc). Timing of surveys is based on seasonality of subsistence lifestyle.
v. Gloria Stickwan (Ahtna) – Just joined the meeting and heard reference to Copper River study. Please describe.
w. James Van Lanen (ADF&G) provided overview for Gloria and others.
x. Tracie Krauthoefer (HDR) – Are there other resources or studies that could be utilized? Concerned that one year of data might not be enough.
y. James Van Lanen (ADF&G) – Not aware of any other information sources. ADF&G recognizes limitations of 1-yr-data surveys, but that is the standard. Concerns include survey burnout and limited survey resources. They try to get at trends and cycles with historical use mapping that is part of the interview process.
z. Kirby Gilbert (MWH) – Baseline descriptions of resources should not be static by definition. Baseline resource depictions should discuss trends and cycles to help all understand declining or improving conditions with regard to resource abundance, quality or utilization, etc.
aa. James Van Lanen (ADF&G) – Cited an example where a hunting moratorium in a particular drainage would have been missed by a 1-yr look. But historical use mapping helped illuminate the longer-term situation. Need to keep 1-yr-data separate from historical data for method clarity.
bb. Additional schedule questions and clarifications based on handout.
cc. Betsy McGregor (ADF&G) – Subsistence workgroup will typically be scheduled with social sciences in future. Cultural will usually follow that meeting. Room conflicts necessitated scheduling with terrestrial resources with cultural and subsistence resources this time.

Meeting Summary

1. Attendee introductions, meeting agenda and draft calendar overview by Kirby Gilbert (MWH).
    a. Last week of March 2012 – scoping meetings throughout the state.
    b. First week of April 2012 – next set of workgroup meetings.
    c. April 27, 2012 – important date; agency & licensing participants' comments due on PAD, FERC Scoping Document (issued 2/23/12), and study requests.
    d. May 2012 – workgroup meetings.
    e. June 11, 2012 – AEA to submit the formal Proposed Study Plan. Comments due by September 10, 2012.

   f. July 2012 – possible site visit and formal FERC study plan workgroup meetings.
   g. October 10, 2012 – AEA to file Revised Study Plan with FERC.
   h. November 30, 2012 – FERC to issue study plan determination.
   i. September 2015 – submit license application to FERC.
   j. July 2016 – FERC to release Draft EIS.
2. Overview of the template for formal study requests by Kirby Gilbert (MWH).
   a. Environmental contractors who will be hired next week will be asked to draft formal study plan requests for each item in the study plan outline (and any other studies identified during the workgroup process or other comment avenues) for project efficiency.
   b. Stakeholders wishing to make additional study requests must use the study plan template. Goal is to identify study needs as early as possible so that the contractors can draft the requests and minimize need for stakeholders to do so on their own.
3. Cultural Resources discussion led by Kirby Gilbert (MWH)
4. Subsistence Resources overview discussion introduced by Kirby Gilbert (MWH)
   a. Subsistence presentation by James Van Lanen (ADF&G)

Action Items

1. AEA to post ADF&G's Subsistence Gap Analysis and Scope of Work that was handed out during the meeting.
2. AEA to consider doing some trail mapping in 2012, to inform definition of APE.
3. AEA to investigate what GIS trail inventory data is available from BLM.
4. Workgroup to consider including TCP research with subsistence research, if feasible.
5. Make sure UDP includes a curation plan.
6. Consider adding TKIs to ADF&G subsistence scope, if not already there.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Aquatic and Water Resources Workgroup Meetings
March 1, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Bruce Tiedeman
USFWS	Mike Buntjer
USFWS	Betsy McCracken (by phone)
USFWS	Bob Henszey
USFWS	Jennifer Spegun
NMFS	Susan Walker
NMFS	Eric Rothwell
NMFS	Mandy Migura
NMFS/University of Alaska	Kate Wynne (by phone)
BLM	Tim Sundlov
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADF&G	Jack Erickson
ADF&G	Richard Yanusz
ADF&G	Kimberley Sager
ADNR	Courtney Smith
ADNR	Krissy Plett
ADNR	Kim Sager
FERC	David Turner (by phone)
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsberg
MWH	John Haapala (by phone)
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Cardno-ENTRIX	Craig Addley
Cardno-ENTRIX	Woody Trihey
Cardno-ENTRIX	Lynn Noel
HDR	James Brady
HDR	Robin Beebee
HDR	Heidi Weigner
HDR	Keri Lestyk
HDR	Scott Prevatte

MWH

Organization	Name
HDR	Erin Cunningham
URS	Paul Dworian
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	MaryLouise Keefe (by phone)
R2 Resource Consultants	Stuart Beck (by phone)
Tetra Tech	Bill Fullerton (by phone)
Tetra Tech	Rob Plotnikoff (by phone)
E-Terra	Lars Gleitsmann
GW Scientific	Michael Lilly
Brailey Hydro	David Brailey
LGL	Michael Link
LGL	Sean Burril
Aquacoustics	Don Degan
ARRI	Jeff Davis (by phone)
Susitna River Advisory Committee	Bruce Knowles
Alaska Ratepayers	Scott Crowther
Citizen	Jim Ferguson

Presentations

- Lynn Noel (Cardno-ENTRIX): Table of Preliminary 2013 - 2014 Formal ILP Studies – Beluga Whale
- Craig Addley (Cardno-ENTRIX): Table of Preliminary 2013 - 2014 Formal ILP Studies – Water Resources
- Craig Addley (Cardno-ENTRIX): Table of Preliminary 2013 - 2014 Formal ILP Studies – Geomorphology
- Craig Addley (Cardno-ENTRIX): Table of Preliminary 2013 - 2014 Formal ILP Studies – Fish and Aquatic Resources

Introduction

Steve Padula (LVA) began by summarizing licensing progress to date. Steve (LVA) noted that FERC had issued its Scoping Document 1 (SD1) on February 23, 2012 and that scoping meetings would be held by FERC March 27-30, 2012.

Betsy McGregor (AEA) explained that AEA had hired its technical consultants for the period ending March 2013. Steve (LVA) stated that the technical consultants would be assisting AEA in finalizing 2012 study plans and preparing formal 2013-2014 study plans. The consultants would also be assisting AEA in preparing 2013-2014 study request documents and that it was AEA's intent that stakeholders could adopt these study requests as their own, revising or augmenting them as necessary. Steve (LVA) stated that this would result in a less onerous task for stakeholders, who could focus their effort on any study elements they thought to be missing, rather than having to invest energy writing requests for studies AEA is already planning to conduct. Betsy (AEA) stated that both the final 2012 study plans and the draft study request documents would be provided to stakeholders by March 23, 2012. Betsy (AEA) then identified the study areas awarded to each of the technical consultant teams. Steve (LVA) stated that if stakeholders had comments on the content of the day's presentations (i.e., study summary tables); AEA would appreciate receiving that input soon.

Steve (LVA) stated that the goal of the April 2012 meetings would be to discuss revised 2012 study plans and 2013-2014 study tables. Craig Addley (Cardno-ENTRIX) explained that the 2013-2014 study tables would be revised to further clarify study objectives, refine general methods descriptions, and delineate approximate study areas. Craig (Cardno-ENTRIX) noted that specific study sites, sample sizes, and more detailed method descriptions would be defined later in the licensing process, prior to the filing of AEA's Proposed Study Proposal (PSP) with FERC.

Joe Klein (ADF&G) asked if 2012 study plans submitted to stakeholders on March 23 would identify specific tasks and include details related to methods, timing, study site locations, equipment to be used, QA/QC and procedures. Betsy (AEA) replied that the 2012 plans released on March 23 would include the elements identified by Joe (ADF&G).

Eric Rothwell (NMFS) expressed concern that stakeholders would be submitting 2013-2014 study requests to FERC on April 27, 2012, well before the results of 2012 studies would be available. Eric (NMFS) suggested that this arrangement could result in a situation where new information may warrant additional studies or study objectives and there would be no mechanism by which agencies could request them. Betsy (AEA) replied that the ILP process is iterative, with study objectives being refined and expanded as needed through the filing of the Revised Study Plan (in September 2012). Craig (Cardno-ENTRIX) added that FERC requires the assessment of findings after the first field season's results become available to determine whether studies need to be revised for the second year's fieldwork. Craig (Cardno-ENTRIX) noted that wherever there are uncertainties, study plans would be developed with contingencies, providing alternative paths forward depending on what is learned as study results become available.

Sue Walker (NMFS) stated that not enough information was available yet to preclude the need for fish passage at the proposed Project, so NMFS would likely file a request for a fish passage study.

Joe (ADF&G) stated that the agencies would benefit from a table or Gantt chart showing the major Project milestones, including a timeline depicting schedules for fieldwork, technical memoranda, reports, FERC filings, and interaction with stakeholders. Joe (ADF&G) added that the timeline should show approximately when output from various studies and modeling efforts would be integrated into other studies and modeling so that tools are ready on time to conduct impact analysis. AEA agreed to produce a Gantt chart showing the timeline showing Project licensing milestones and scheduling.

Sue (NMFS) stated that being notified by AEA regarding the availability of materials was helpful but would prefer if AEA could attach materials to email messages. Betsy (AEA) stated that AEA was working on a more efficient system to communicate and share materials with stakeholders.

Ron Benkert (ADF&G) stated that if AEA and its technical contractors planned to install any structures in the Susitna River or its tributaries, it would be necessary to secure permits from ADNR to do so. Ron (ADF&G) encouraged filing for permits as soon as possible, as ADNR was receiving a high volume of permit requests. Craig Addley (Cardno-ENTRIX) suggested that it might be most efficient for AEA to consolidate its permitting needs, to the extent possible, into a single application. Ron (ADF&G) agreed that a more programmatic approach would streamline the process.

2013 - 2014 Formal ILP Studies – Cook Inlet Beluga Whale Study

Lynn Noel (Cardno-ENTRIX) noted that one of the objectives of the Cook Inlet beluga whale study was to summarize the life history, run timing, abundance, distribution, and habitat of beluga whale prey species, i.e. eulachon and salmon, in the Susitna River. Concern had previously been expressed regarding whether lamprey should also be considered a beluga whale prey species. Mandy Migura (NMFS) replied that she was aware of no information indicating that beluga prey on lamprey. She added that although Cook Inlet beluga occur in the Susitna River delta area year round, NMFS has not collected whale stomach contents data during winter. Stomach contents have not shown that beluga consume lamprey, although without winter data, it is impossible to be certain. Mandy (NMFS) said AEA should direct its initial efforts toward assessing impacts on salmon and eulachon. If information arises to indicate that lamprey may be important as prey, study goals could be reassessed at that time.

Betsy McCracken (USFWS) stated that Pacific lamprey is a prey buffer species in the lower river, and USFWS considers them important. Betsy (AEA) stated that AEA would be studying lamprey as part of its Non-Salmon Anadromous Fish Study, so the species would not be overlooked. Stakeholders asked what the uppermost extent of lamprey distribution is in the Susitna River. Jeff Davis (ARRI) stated that the northernmost tributaries in which lamprey have been found are Trapper, Clear, and Whiskers creeks.

Mike Buntjer (USFWS) noted that one of the study's objectives was to summarize the distribution of Cook Inlet beluga whales relative to the availability of four of the five salmon species and asked why pink salmon had not been included. Betsy (AEA) stated that NMFS had only identified Chinook, coho, chum, and sockeye salmon as primary constituent elements (PCEs) for belugas.

Mandy (NMFS) noted that beluga require high prey densities to feed effectively and that study objectives should be revised to explicitly call for assessment of potential Project effects on the densities of salmon and eulachon in the section of river used by the whales. AEA agreed to revise the objectives of the Cook Inlet Beluga Whale Study to explicitly state that salmon and eulachon densities would be estimated in the section of river used by the whales, so that potential effects of the Project could be assessed.

Mandy (NMFS) stated that in addition to evaluating run timing of salmon and eulachon, the study would need to address run duration. AEA agreed to revise the objectives of the Cook Inlet Beluga Whale Study to include run duration as well as run timing for salmon and eulachon. She also asked if fieldwork was included in the Cook Inlet Beluga Whale Study and Betsy (AEA) confirmed that fieldwork in 2013-14 and modeling would be conducted to assess the proposed Project's impacts on Cook Inlet beluga whale foraging and habitat.

The workgroup discussed the availability and value of acoustics data used to document whale use of the Susitna River delta. Workgroup members agreed that May through June was the period when whale use of the delta area is greatest and that additional tracking of whales would be unlikely to provide any information beyond what is known from existing studies.

2013 - 2014 Formal ILP Studies – Water Resources, River Routing Study

Craig (Cardno-ENTRIX) reviewed the objectives and potential study methods for the proposed River Routing Study, noting that an existing hydraulic routing model was being used to inform Project planning, but that the approach to routing used in the overall study program might need to be refined to provide the basis for the suite of models used to assess Project impacts. Craig (Cardno-ENTRIX) stated that it was possible that two routing models could be used, i.e., one for the ice-free period and one to simulate hydraulics when ice is present in the river.

Joe (ADF&G) noted that the routing model would be used to simulate stage-flow relationships longitudinally in the mainstem but asked how Project effects would be simulated in sloughs and side channels. Craig (Cardno-ENTRIX) replied that empirical data would be used to establish relationships between mainstem and slough/side channel conditions, i.e., associating side channel flows, breaching of side sloughs, etc. along the river with stage estimates provided by the routing model. This would allow for assessment of habitat effects and side-channel/slough access over a range of flows.

Joe (ADF&G) asked what time-step would be selected for output from the routing model. Craig (Cardno-ENTRIX) replied that typically a 1-hour time-step is considered sufficient, but a shorter interval could be selected if there is justification to do so. He noted, however, that a shorter time-step would result in a shorter simulation period.

Joe (ADF&G) asked how long the period of record would be for modeling. Craig (Cardno-ENTRIX) replied that modeling would be based on a 48-year period of record based on basin flow data obtained from the US Geological Survey (USGS).

Joe (ADF&G) asked where routing model transects would be located, and Craig (Cardno-ENTRIX) replied that the 2012 study plan included a map of potential transect locations, adding that the routing model would be based to some extent on transect locations established as part of the 1980s studies but that some additional/different transects would also be established. Michael Lilly (GW Scientific) stated that coordination with other technical consultants and stakeholders regarding transect locations would be conducted prior to distribution of the revised 2012 study plan on March 23. Michael (GWS) stated that some new transect locations would be needed to account for channel changes that have occurred over the past 30 years. David Brailey (Brailey Hydro) added that velocities and depths at each routing model transect would be measured using acoustic Doppler current profiling (ADCP), which would provide a highly accurate basis for developing simulations.

Bob Henszey (USFWS) asked what had been the basis for selecting transects used in the 1980s studies. Craig (Cardno-ENTRIX) replied that transects had been established to account for variability in channel conditions and to represent the overall channel throughout the river downstream of the proposed Project, so that simulations produced by the routing model were accurate.

Eric (NMFS) stated that rating curves for specific locations could change seasonally, particularly given the role played by ice in the Susitna River. Eric (NMFS) stated that channel roughness could vary as a function of flow, especially in winter, over the potential range of daily discharges proposed for the Project (i.e., 3,000 - 10,000 cfs). He noted that flow models are predicated on the assumption that channel conditions are static over the range of conditions being simulated. However, channel conditions following construction of the Project would change relative to existing conditions, which could compromise the reliability of model output.

Craig (Cardno-ENTRIX) replied that AEA's technical consultants would use all available information, including what has been learned during studies of other similar river systems, to validate the assumptions of models being used, and would be aware of any potential violations of assumptions as well as the implications of those violations. Robin Beebee (HDR) stated that potential effects of ice on the routing model would be assessed to some degree by empirical observation of ice dynamics beginning in 2012. Robin (HDR) added that the underside of surface ice tends to smooth out over the winter so that roughness can be greater early in the season and then decline.

2013 - 2014 Formal ILP Studies – Geomorphology and Ice Processes Studies

Ice Processes Study

Robin (HDR) stated that HDR planned to measure ice thickness prior to breakup in 2012, noting that breakup could occur as early as April so it would be important to initiate fieldwork as soon as possible. Robin (HDR) would coordinate with AEA, its other technical consultants, and stakeholders to select representative measurement locations that would produce results useful as input to other study efforts, for example, locations such as entrances to side sloughs where ice dynamics could affect fish habitat. HDR would also seek input regarding the placement of cameras, which would be used to detect the onset of ice breakup in a number of key locations.

Eric (NMFS) asked how many flights would be undertaken in 2012 to observe ice breakup, adding that whatever is done in 2012 should be repeated in subsequent years to develop a more complete account of what occurs. Robin (HDR) replied that it was difficult to specify the number of flights that would be conducted, given that weather conditions will dictate whether and when flights are possible.

Eric (NMFS) asked if breakup conditions vary among tributaries at the three rivers confluence (i.e., among the Susitna, Chulitna, and Talkeetna rivers). Jeff Davis (ARRI) replied that breakup conditions in the three rivers vary a great deal among years, adding that in some years, sections of river open up and are then frozen over again following the formation of ice jams.

Joe (ADF&G) asked what the diameter of ice borings used to measure ice thickness would be, and Robin (HDR) replied a 4-inch-diameter auger would be used. Ice thickness will be measured along a transect of the channel at each measurement location to account for lateral variability in thickness.

Krissy Plett (ADNR) stated that at some parcels along the lower river, land owners are issued permits by ADNR to thicken ice bridges over which they transfer heavy equipment, such as agricultural machinery. Krissy (ADNR) said that the ice bridges are often the only way in which landowners can access the opposite side of the river and that AEA would need to evaluate the Project's potential effects on the ability of these landowners to use these ice bridges.

Geomorphology Studies

Joe (ADF&G) stated that when sampling sediment and bedload, it would be desirable to obtain as long-term a data series as possible. Joe (ADF&G) stated that the USGS had recommended the use of hydrophones to measure bedload, where feasible. Craig (Cardno-ENTRIX) stated that hydrophones are useful for identifying the flows at which bedload movement is initiated but questioned whether they could be used to develop bedload estimates. Joe (ADF&G) stated that based on his interaction with USGS personnel, hydrophones can be used to assess particle sizes being transported.

Eric (NMFS) stated that geomorphology work conducted in 2012 must be sound to set the stage for an accurate assessment of Project effects. Paul Dworian (URS) stated that an initial task would be the analysis of aerial photos to detect the extent of channel changes that have occurred over recent decades, which would help focus assessment on those areas where Project operations are most likely to affect channel structure and processes. Craig (Cardno-ENTRIX) added that AEA intended to assess the entire river downstream of the Project and that potential Project effects would be based on data and modeling, not speculation as to whether a certain reach, e.g., the lower river, is likely to be affected by the Project. Bill Fullerton (Tetra Tech) emphasized that work conducted in 2012 would not be aimed at trying to determine which reaches would or would not be affected by Project operations, but rather to develop the tools necessary to assess potential Project effects in 2014 and 2015.

Bob Henszey (USFWS) stated that it would not only be important to assess Project effects on lateral changes in channel morphology but also vertical changes. Bill (Tetra Tech) agreed, noting that modeling would be designed to estimate potential Project-related channel aggradation and degradation.

Jan Konigsberg (NHI/HRC) asked if the objectives of the geomorphology study included assessing the Project's effects on long-term channel degradation. Bill (Tetra Tech) stated that assessing long-term effects would be critical, because not all changes would occur rapidly. Craig (Cardno-ENTRIX) reiterated that AEA would be using a 46-year flow record to simulate potential Project impacts.

Tim Sundlov (BLM) asked how AEA intended to assess potential impacts at locations where planned access roads cross would cross tributaries. Craig (Cardno-ENTRIX) replied that assessing existing conditions along proposed access road corridors, as well as estimated impacts, would be an element of the study program, adding that geomorphology, water quality, and fish habitat impacts would all be addressed. Bill (Tetra Tech) added that study results would not only be used to assess impacts but also to make decisions about the siting and design of road crossings, to minimize or prevent impacts where possible.

Paul (URS) and Bill (Tetra Tech) stated that the team studying geomorphology would benefit from observations made by other crews while they are conducting fieldwork and asked that leads for other study efforts request that their field crews record incidental observations of geomorphic phenomena, such as large wood transport, locations of mass wasting, etc.

Betsy (AEA) instructed Bill (Tetra Tech) to coordinate with Lars Gleitsmann (E-Terra) to obtain all available aerial images useful for assessing channel conditions in the Susitna River. It was noted that Dave Meyer (USGS, Alaska Science Center) would be the appropriate contact at USGS. Betsy (AEA) added that AEA would provide technical contractors with a list of Project-related contacts during the week of March 5, 2012.

2013 - 2014 Formal ILP Studies – Fish and Aquatic Resources Studies

Craig (Cardno-ENTRIX) reviewed examples of historic aquatic resources study results from the 1980s, explaining the potential applicability of these data to the current study effort. Sue (NMFS) asked whether relevant historic data were available to stakeholders. Workgroup meeting materials are available online at Susitna-watanahydro.org. Although current information includes only a small sample of the overall dataset, a more comprehensive and targeted review and synthesis of useful historical data will be conducted by the technical contractors as a preliminary element of their respective studies.

Craig (Cardno-ENTRIX) and Dudley Reiser (R2 Resource Consultants) stated that development of habitat suitability criteria (HSC) for some fish species and life stages represented a good example of where historic data could be used, i.e., conducting limited fieldwork to validate the previously developed HSC curves, which would improve the efficiency of the current instream flow modeling effort.

Jack Erikson (ADF&G) reminded the technical contractors that Alaska regulations preclude the use of felt-soled waders and that all members of field crews should be alerted to this before any fieldwork is conducted.

River Productivity Study

Referring to Objective 4 of the River Productivity Study (see Table of Preliminary 2013 - 2014 Formal ILP Studies – Fish and Aquatic Resources), MaryLou Keefe (R2 Resource Consultants) noted that the intent was to select for a river with physical conditions similar to those expected for the Susitna River with the proposed Project/operating regime in place. MaryLou (R2) asked if the river selected for the basis of any inferences was to be a system affected by a hydropower project. Craig (Cardno-ENTRIX) said that the intent was to find a river located at comparable latitude with physical conditions–mostly turbidity and temperature, but also flow–similar to those expected for the Susitna River under the with-Project alternative. If a regulated analog could be found, it could be used as the basis of comparison, but if not, an unregulated system would likely suffice for providing an idea of how productivity might change in the Susitna River. Craig (Cardno-ENTRIX) noted that if a suitable analog river could not be found, then Objective 4 would not go forward.

MaryLou (R2) stated that it would be important to control for other variables before assuming that turbidity was the primary factor accounting for any potential differences in productivity between the existing and with-Project conditions. Rob Plotnikoff (Tetra Tech) stated that it should be possible to model benthic macroinvertebrate and periphyton production, or at least abundance, against a turbidity gradient. Jack (ADF&G) stated that a number of recent studies had been conducted to document the relationship between turbidity and the ability of fish to feed on invertebrate drift, and results from these studies could be useful when assessing potential Project effects.

Betsy McCracken (USFWS) asked if the study would focus on tributary mouths, which are likely to be productivity hotspots. MaryLou (R2) replied that it would be important to select study sites to address all habitats likely to be affected by the Project, adding that areas to be studied would be determined collaboratively with stakeholders during the development of the study plans.

Jan (NHI/HRC) acknowledged that increased light penetration due to decreases in turbidity could increase productivity but questioned whether potential reductions in nutrient input resulting from a dampening of high flows could offset such increases. Craig (Cardno-ENTRIX) stated that baseline nutrient level would be measured as part of the water quality study, and based on this information, nutrient levels under a range of potential with-Project operational scenarios would be modeled.

Referring to Objective 5 in the studies table, Sue (NMFS) asked if the bioenergetics model used to estimate with-Project juvenile salmonid growth would be calibrated based on actual site-specific fish growth data measured in the field. Craig (Carndo-ENTRIX) replied that empirical fish growth data from the Susitna River would be collected (or derived from existing information) for calibration of the model.

Reservoir Fish Habitat and Entrainment Risk Study

Referring to Objective 5, i.e., characterizing the reservoir fishery, Jack (ADF&G) stated that it would also be important to characterize the potential tailwater fishery. Mike (USFWS) asked if AEA intended to propose a management strategy for the reservoir. Wayne Dyok (AEA) stated that AEA would work with ADF&G and other relevant agencies to develop information needed to make decisions about the future management of the reservoir fishery but that the agencies were the only entities with the authority to propose a management strategy.

Mike (USFWS) noted that Objective 6 involved conducting a desktop analysis to evaluate entrainment risk for resident fish in the reservoir and asked if AEA would also be proposing measures to reduce the potential for entrainment. Wayne (AEA) stated that as part of Project engineering, AEA's engineering contractor would assess measures for reducing fish entrainment into the powerhouse intakes.

Fish Passage Study

Mike (USFWS) asked if the Fish Passage Study involved assessment of fish habitat in tributaries to the middle Susitna River or potential barriers to tributary access following construction of the proposed Project. Craig (Cardno-ENTRIX) replied that the passage study would address potential passage barriers in tributaries in and above the Devils Canyon reach. Craig noted that the Upper River Fish and Habitat Study would involve mapping tributary habitat in the proposed inundation zone below elevation 2,000 feet.

Upper River Fish and Habitat Study

Sue (NMFS) asked why identification of fish passage barriers would be conducted up to an elevation of 3,000 feet. Betsy (AEA) replied that 3,000 feet is the highest elevation at which Chinook have been observed in the Susitna River basin.

Referring to Objective 6, Jack (ADF&G) noted that AEA proposed to collect genetic samples from juvenile Chinook salmon to back-calculate the number of Chinook spawners that produced the juveniles. Jack (ADF&G) asked which technical consultant would be tasked with collecting the genetic samples. Craig (Cardno-ENTRIX) replied that HDR would be collecting the samples. Jack (ADF&G) stated that HDR would need to coordinate with ADF&G to ensure that sample sizes and methods are appropriate and consistent with ADF&G's overall Chinook genetics study program. The genetics lab might be capable of identifying tributary-specific lineages, depending on how fish samples are collected.

Adult Salmon Distribution and Habitat Utilization Study

Craig (Cardno-ENTRIX) pointed out that in the Relevant 2012 Components Column of the proposed studies table, the text stated, "ADF&G anticipates radio tagging and monitoring approximately 400 coho, 400 chum, 400 pink, 100 sockeye, and 500 Chinook adult salmon at Flathorn in 2012." Craig (Cardno-ENTRIX) stated that this was inaccurate, and the text would be changed to reflect the actual numbers to be tagged by ADF&G, i.e., 200 coho, 200 chum, 200 pink, 200 sockeye, and 400 Chinook.

Referring to Objective 4, Craig (Cardno-ENTRIX) stated that those managing field crews would need to coordinate with Dudley (R2) to ensure that fish habitat use data are properly collected for the development of HSC for spawning salmon. Dudley (R2) stated that it would also be necessary to develop HSC for adult salmon holding habitat.

MaryLou (R2) said that it would be necessary to ensure that data are collected to develop salmonid incubation HSC, or to verify existing incubation criteria. Wayne (AEA) stated that NMFS conducted a salmonid incubation study in the 1980s, which would provide valuable information, and Woody Trihey (Cardno-ENTRIX) noted that in the 1980s he had installed Vibert boxes in redds and fyke nets at the downstream ends of sloughs in an attempt to document chum and coho salmon fry emergence; fyke nets placed in sloughs with similar habitat characteristics, including groundwater upwelling, had shown that fry emergence varied among habitats with apparently similar conditions. Wayne (AEA) stated that these results underline the need to understand the mechanisms driving fish habitat use in the Susitna River basin so that Project effects could be predicted.

Tim Sundlov (BLM) stated that juvenile salmonids associate strongly with the interface of clear water and turbid water and that these areas of interface vary spatially as a function of flow. It’s important to model, or estimate in some other way, the relationship between Project flows and the availability and locations of areas where clear water and turbid water come in contact.

Mike (USFWS) stated that it would be critical to estimate fry stranding under proposed Project operations. Dudley (R2) agreed that fry stranding was a critical issue and stated that potential stranding under different operational scenarios would be estimated using a combination of data including bank slope, magnitude of flow change, and ramp rates, particularly downramping rates. Wayne (AEA) added that it would be important to develop a Project flow regime that would prevent or minimize redd construction in areas that would later be dewatered, thereby preventing desiccation of redds.

Juvenile Salmon Study

Eric (NMFS) asked whether HSC for juvenile salmonids were to be based on existing habitat use information or if field data were to be collected during 2012-14. Dudley (R2) replied that AEA would begin with the available data, determine where data may be lacking, and augment the data as needed to ensure that representative, site-specific HSC are available for modeling. Eric added that when developing and/or validating macrohabitat and microhabitat HSC for juvenile salmon, it would be critical to develop criteria that represent habitat use throughout the year, especially during winter.

Mike (USFWS) noted that Study Objective 2 involved characterizing juvenile salmon relative abundance in the middle and lower river reaches and asked if the intent was to measure fish densities in various habitats. Craig (Cardno-ENTRIX) confirmed that fish densities would be measured by field crews, wherever possible, given site-specific conditions and sampling methods. MaryLou (R2) stated that density estimates would only be possible in open-water environments, adding that during winter, when ice is present, relative abundance estimates may be all that is feasible.

Jan (NHI/HRC) stated that when conducting fieldwork, especially in the lower river, it would be important to differentiate between fish produced in the Susitna River and its major tributaries. In this way AEA could account for potential Project effects not only on fish production within the Susitna River but also on production in larger tributaries, for example the Yentna River. Jan (NHI/HRC) stated that without this differentiation, there would be no ability to detect whether the Project is affecting fish production in important tributaries.

Resident and Invasive Fish Study

Jack (ADF&G) stated that ADF&G would evaluate this study's objectives and make recommendations to AEA as to which species should be addressed and how they should be studied. Woody (Cardno-ENTRIX) stated that arctic grayling and rainbow trout had been the two primary resident species studied during the 1980s.

Wayne (AEA) asked whether ADF&G thought the Project could be operated to reduce the suitability of the river for northern pike. Jack (ADF&G) replied that there is no way to know what the future distribution and abundance of pike will be without the Project in place, making it difficult to speculate as to how the Project might affect pike.

Joe (ADF&G) asked if AEA planned to develop HSC for northern pike and use them to simulate potential Project-related changes in pike abundance and distribution. Craig (Cardno-ENTRIX) stated that Objective 5 of the study involved review of existing information and collection of limited new data to assess Project effects on northern pike distribution and abundance, but the plan was not to model northern pike habitat suitability.

Jack (ADF&G) stated that a new technique being used to detect invasive species involved collecting water samples and analyzing them to detect the presence of invasive species' DNA. He suggested that this approach could be useful in the Susitna River.

Non-Salmon Anadromous Fish Study

Betsy McCracken (USFWS) noted that Pacific lamprey ammocoetes remain in the river's substrate for up to six years, and because very little is known about their distribution in the Susitna River basin, it would be necessary to sample adequately to predict the Project's effects on this species. Craig (Cardno-ENTRIX) stated that AEA was aware of the work needed to formulate study methods and acknowledged that in some cases it would likely be necessary to develop species-specific approaches to study objectives. MaryLou (R2) noted that sampling approaches would vary not only by species but also by life stage, adding that unlike many other fish species, lamprey are not susceptible to electrofishing, so other sampling methods would be required.

Sue (NMFS) noted that the study called for sampling using a variety of methods in the middle and lower river mainstem, side channels, sloughs, and tributary mouths and questioned whether the spatial scope was too ambitious for the time allotted for study. Craig (Cardno-ENTRIX) replied that spatial and temporal scopes had not yet been defined and MaryLou (R2) added that AEA and its contractors would work with the resource agencies to collectively determine what information needs are critical and what constitutes an achievable scope. MaryLouise stated that an outline would be available soon, which would include a proposed approach to assessing the fish assemblage and the distribution, population structure, and abundance of the species of interest, noting that estimating abundance would be the most difficult objective to address.

Access Alignment, Construction Area, and Transmission Alignment Aquatic Investigation Study

Wayne (AEA) stated that AEA would work with the Alaska Department of Transportation (ADOT) to identify the best access road alignments and bridge crossings from the standpoint of structural longevity, transportation efficiency and safety. Following identification of a corridor based on these considerations, AEA would make adjustments in an iterative fashion, modifying the alignment based on the results of natural resource studies to minimize road-related impacts and then reevaluate the new alignment to assess its impacts. Wayne (AEA) noted that the US Army Corps of Engineers would require AEA to develop and evaluate at least two corridor alignment alternatives. Betsy (AEA) stated that the eventual goal would be to construct two transmission line corridors and one access road, with one transmission line co-located with the access road.

Action Items

- AEA requested that stakeholders provide comments on the 2013-14 study summary tables (presented at the March 1 and 2, 2012 workgroup meetings) as soon as possible (i.e., by March 19).
- AEA agreed to revise the objectives of the Cook Inlet Beluga Whale Study to explicitly state that salmon and eulachon densities would be estimated in the section of river used by the whales, so that potential effects of the Project could be assessed.
- AEA agreed to revise the objectives of the Cook Inlet Beluga Whale Study to include run duration as well as run timing for salmon and eulachon.
- AEA instructed Bill Fullerton (Tetra Tech) to coordinate with Lars Gleitsmann (E-Terra) to obtain all available aerial images useful for assessing channel conditions in the Susitna River.
- AEA agreed to provide technical contractors with a list of Project-related contacts by March 9, 2012.
- AEA agreed to produce a Gantt chart showing the major Project milestones, including a timeline outlining the schedule for fieldwork, technical memoranda, reports, FERC filings, and interaction with stakeholders.

Agreement and Decisions

- Aquatic Resources Workgroup members agreed that May through June was the period when beluga whale use was heaviest in the Susitna River delta and that additional tracking of whales would be unlikely to provide any information beyond what is already known from existing studies.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Instream Flow and Water Quality Workgroup Meetings
March 2, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
USFWS	Mike Buntjer
USFWS	Betsy McCracken (by phone)
USFWS	Bob Henszey
USFWS	Jennifer Spegun
NMFS	Susan Walker
NMFS	Eric Rothwell
BLM	Tim Sundlov
NPS	Cassie Thomas (by phone)
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADNR	Courtney Smith
ADNR	Krissy Plett
ADNR	Kim Sager
NPS	Cassie Thomas
FERC	David Turner (by phone)
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsburg
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Cardno-ENTRIX	Craig Addley
Cardno-ENTRIX	Woody Trihey
HDR	James Brady
HDR	Robin Beebee
HDR	Keri Lestyk
HDR	Scott Prevatte
URS	Paul Dworian
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	MaryLouise Keefe (by phone)
Tetra Tech	Harry Gibbons
Tetra Tech	Rob Plotnikoff (by phone)
Tetra Tech	Andrew Parker
E-Terra	Lars Gleitsmann
GW Scientific	Michael Lilly

MWH

Organization	Name
Brailey Hydro	David Brailey
LGL	Michael Link
Alaska Ratepayers	Scott Crowther
Citizen	Jim Ferguson

Presentations

- Craig Addley and Woody Trihey (Cardno-ENTRIX): Table of Preliminary 2013-2014 Formal ILP Studies – Instream Flow, and select tables and figures from 1980s study program
- Craig Addley (Cardno-ENTRIX): Table of Preliminary 2013 - 2014 Formal ILP Studies – Water Quality

Introduction

Wayne Dyok (AEA) stated that AEA had been discussing the proposed Project with Railbelt utilities, including the extent to which the Project may be operated in a load-following capacity. AEA has also been in ongoing discussions with resource agencies and recognizes that resource constraints will limit the timing and extent of any load-following operations and that at times, load following might be precluded completely. Wayne (AEA) emphasized that determining the extent to which load following can-or cannot- be conducted would be based on the results of technical resource studies and modeling. The integrated suite of models developed and applied in 2012-15 will be used to identify a suitable operating regime that minimizes impacts to natural resources.

2013 - 2014 Formal ILP Studies – Instream Flow

Dudley Reiser (R2 Resource Consultants) outlined the approach the technical team, in coordination with AEA, would take to develop the 2013-14 Instream Flow Study plan outline for the March 23 delivery date to stakeholders: (1) describe main study components, (2) identify Project nexus, (3) identify general modeling approaches, e.g., one- and two-dimensional modeling, expert habitat mapping over a range of flows, etc., tentatively identifying which approach will be applied to which reaches/macrohabitat types, (4) describe steps for developing baseline data and HSC, including, where possible, use of 1980s data, (5) explain how modeling of flow and other physical processes will be incorporated into instream flow analyses, and (6) discuss general approach to assessing Project impacts. Dudley (R2) noted that the content of the plan would remain provisional for some time, as more is learned and AEA and stakeholders consult on study details, but that the general framework of the study would be provided on March 23.

Dudley (R2) asked if it would be permissible to conduct informal coordination with various stakeholders, individually or in small groups, while developing the plan. Betsy McGregor (AEA) said that so-called offline communications between technical consultants and stakeholders would be appropriate but that all substantive interchange would need to be documented in writing. Betsy (AEA) emphasized that she should be kept apprised of all such activity and that it would be necessary to hold instream flow subgroup meetings during the development of the study plan, either in person or by teleconference/web-based conference. Wayne (AEA) stated that for all such coordination events the lead technical consultant would need to draft a brief summary, i.e., a bulleted list of agreements, decisions, and action items, which would then become part of the record and be distributed to relevant individuals.

Regarding the use of historic data to help develop HSC for fish, Mike Buntjer (USFWS) asked whether the 1980s studies provided a reliable quantitative record of habitat conditions in locations that were not used by fish. Woody Trihey (Cardno-Entrix) replied that documentation of microhabitat variables at sites with no fish was not a priority during the 1980s studies. Instead, the emphasis was on identifying sites where fish were present and then attempting to determine what effect the proposed Project would have had on those sites.

Mike (USFWS) noted that there are coho salmon in the Susitna River that complete their life cycles in the mainstem and do not enter tributaries. Woody (Cardno-ENTRIX) stated that researchers in the 1980s had not been aware of this and so no attempt was made to document the habitat use of these individuals.

Eric Rothwell (NMFS) stated that juvenile fish are selecting habitats for a reason and that for the proposed modeling to be useful it would be essential to identify where fish are, and why they are there. Eric (NMFS) stated that characterizing winter habitat use would be critical, emphasizing the importance of having a full understanding of environmental variables that will be affected by the Project, for example the seasonal dynamics of source water in side sloughs.

Following Woody's (Cardno-ENTRIX) presentation of select 1980s fish abundance and habitat use results (available at Susitna-watanahydro.org) Dudley (R2) asked Woody (Cardno-ENTRIX) if 1980s IFG4 data decks were available. Woody (Cardno-ENTRIX) replied that he possessed hardcopy versions of much of the fisheries information from the middle river but did not have any data in electronic format.

Michael Lilly (GW Scientific) noted that depth, velocity, substrate, and channel geometry data would be collected at many of the 1980s transects. He added that the locations of historic transects would need to be approximated because transect markers placed in the 1980s would be difficult or impossible to relocate and in some locations the channel will have changed since those transects were established.

The group discussed the availability of aerial imagery of the Susitna River, digitizing of information, and maps to be produced. Betsy (AEA) instructed technical consultants to coordinate with Lars Gleitsmann (E-Terra) to obtain relevant aerial images for use in instream flow study planning and execution.

2013 - 2014 Formal ILP Studies – Water Quality

Upper Susitna River Basin Glacier and Hydrologic Runoff Model Study

Wayne (AEA) stated that AEA would develop a glacier/hydrologic runoff model for the Susitna River basin above river mile 184 and use it to simulate the effects of climate change on the quantity and seasonality of runoff in the upper basin through the year 2100. Wayne (AEA) stated that AEA was coordinating with Gabriel Wölken (ADNR-DGGS) to develop the model and that the goal was to begin fieldwork to assess existing glacier conditions in summer of 2012.

Sue Walker (NMFS) stated that climate change will affect a wide range of environmental variables beyond temperature and precipitation, including evapotranspiration and permafrost dynamics, among others. It's critical to consult NMFS climate change experts, who have some of the most in-depth and broad expertise in the field. Sue (NMFS) stated that using NMFS experts would not only help to provide a better simulation of the proposed Project's effects but would also be useful in refining potential operations and assessing the long-term viability of the Project, both of which would have practical applications for AEA.

Wayne (AEA) stated that AEA would schedule a teleconference in March 2012 to discuss the approach to glacier and hydrologic runoff modeling; the call would include, among others, Bryan Carey (AEA), Michael (GWS), John Haapala (MWH) and representatives from NMFS. Wayne stated that John (MWH) would be tasked with drafting a 2013 -14 glacier and hydrologic runoff modeling study request for submittal to stakeholders on March 23, 2012.

Water Quality

Paul Dworian (URS) stated that useful water quality data had been collected during the 1980s in the Susitna River, as documented in AEA's Pre-Application (PAD) document. These data would be augmented with data collected during 2013-14, and a water quality model would be developed to simulate existing and with-Project conditions over the range of flows measured during the period of record. Paul (URS) stated that some parameters would be measured continuously, e.g., temperature, dissolved oxygen, pH, and specific conductance, and others, such as metals, would be sampled discretely.

Paul (URS) stated that it would be important to measure water quality throughout the year to detect any factors that could be limiting fish use, e.g., possible anoxic conditions in some sloughs during winter. Wayne (AEA) stated that water quality sampling would need to be conducted in habitats where fish are present and where fish are absent for results to yield valuable information about fish habitat use.

The workgroup discussed the timing of the pilot thermal imaging assessment, which would be undertaken to identify areas of groundwater upwelling. Michael (GWS) stated that the pilot study, and likely any subsequent thermal imaging studies, should be conducted in early fall. Temperature differences would be difficult to detect during summer because water is well mixed during high flows. In the early fall, flows would be low and the differences between groundwater and surface water temperatures would be pronounced. Michael (GWS) added that when conducting thermal imagery it would be important to have an understanding of geologic controls in the system, i.e., locations where bedrock is likely to be forcing groundwater to the surface. Paul (URS) agreed that it would be useful to develop a set of predictors regarding the potential locations of upwelling.

Joe (ADF&G) stated that from a fish habitat suitability perspective, it would be important to differentiate between areas of true groundwater upwelling and areas where subterranean flow from the river channel is reemerging, the former being more important for providing year-round thermal refugia. Michael (GWS) stated that it should be relatively straightforward to differentiate between the two, because temperature and conductivity differentials between true groundwater and surface water will make it apparent where groundwater is emerging.

Craig Addley (Cardno-ENTRIX) said that temperature data from the 1980s could be evaluated in an attempt to fine tune the timing of the pilot study. Wayne (AEA) stated that it would be critical to document changes in thermal baseline since the 1980s data were collected, given that some degree of channel change has occurred.

Rob Plotnikoff (Tetra Tech) stated that it would be important to document mercury sources under existing conditions, adding that a single tributary could be the major source of mercury levels in the proposed Project area. Rob (Tetra Tech) recommended that multiple media (e.g., surface water and pore water) be sampled to assess metals concentrations, and that a pathways model be developed to identify potential bioaccumulation mechanisms and the Project's potential effects on those mechanisms.

Referring to the analysis of mercury levels in fish tissue, Harry Gibbons (Tetra Tech) asked whether AEA envisioned evaluating whole body burden or muscle tissue only. Craig (Cardno-ENTRIX) replied that the agencies' primary concern was human health, and as such, documenting muscle tissue concentrations would be most relevant.

Jan Konigsburg (NHI/HRC) questioned whether metals data from the 1980s were still valid, given that analytical methods have improved since that time. Paul (URS) replied that some analytical methods for metals detection are similar to what they were in the 1980s, but in instances where detection methods have improved significantly, additional data would need to be collected. In addition, metals concentrations will have likely changed, making it important to sample adequately to characterize existing conditions.

Sue (NMFS) stated that fires are ecologically important in the upper Susitna River basin and that AEA would need to evaluate the relationship between fire and water quality under baseline conditions and address any potential Project effects on that relationship.

Bob Henszey (USFWS) stated that it would be useful to establish observation wells along the river corridor to understand how groundwater influences the extent and species composition of the riparian zone. Craig (Cardno-ENTRIX) replied that the relationship between groundwater and riparian vegetation would be addressed as part of the Instream Flow Riparian Study.

Betsy (AEA) stated that the water quality program lead would need to coordinate with Michal (GWS) and David Brailey (Brailey Hydro) regarding the placement of pressure transducers, which would also measure temperature, at transects surveyed for use in the hydraulic routing model.

Betsy (AEA) and Craig (Cardno-ENTRIX) noted that it would be important for AEA and its water quality consultants to coordinate soon with the Alaska Department of Conservation (ADEC) to ensure that the proposed water quality sampling design and parameters selected for measurement are adequate. Rob (Tetra Tech) added that it would be important to coordinate with ADEC regarding the content of the Quality Assurance Project Plan (QAPP). Craig (Cardno-ENTRIX) added that it would also be important to contact the USGS to determine what water quality data are being collected at the Tsusena, Gold, and Sunshine gaging stations.

Wayne (AEA) requested that URS/Tetra Tech develop a recommendation regarding the approach to water quality modeling, including which model to use and what variables to model and why. Craig (Cardno-ENTRIX) added that whatever water quality model is selected, it must have flow routing capability, interface with the other models being applied as part of the study program, and be capable of accounting for the effects of ice. Effects of tributary inflows on mainstem water quality would also need to be accounted for in the model. Andrew Parker (Tetra Tech) stated that CE-QUAL-W2, as modified by Alberta Environment and Water, would likely be the best choice. Craig (Cardno-ENTRIX) stated that Tetra Tech should recommend a few models, comparing and contrasting their capabilities and limitations. Based on this, AEA and the stakeholders would decide which model best addressed the needs of the study program. Craig (Cardno-ENTRIX) reminded the group that the output from the reservoir water quality model would serve as the upstream boundary condition for the riverine water quality model, so that approaches used in the two environments would need to be compatible.

Mike (USFWS) noted that in its PAD, AEA had proposed a multi-level Project intake to enable withdrawal of water from different depths within the reservoir to manage the downstream water temperature regime. However, if the low-level outlet were to be used discharges to the river would reflect temperature and other water quality conditions near the reservoir's bottom, which could have adverse effects on aquatic biota in the river. Wayne (AEA) replied that the low-level intake represented an approach to flow release that would only be used under extreme, very rare circumstances, perhaps in the event of a transmission system outage. However, it might be necessary to engineer the low-level intake so that water can be withdrawn from higher in the water column, to prevent adverse effects on riverine biota in the event of an emergency. Craig (Cardno-ENTRIX) stated that it would likely be a good idea to design the multi-level intake so that it could supply water to the bypass.

Action Items

- AEA agreed to schedule a teleconference with NMFS in March 2012 to discuss the approach to glacier and hydrologic runoff modeling.
- AEA stated that John Haapala (MWH) would be tasked with drafting a 2013 -2014 glacier and hydrologic runoff modeling study request for submittal to stakeholders on March 23, 2012.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Terrestrial Resources 2012/2013-2014 Study Plan Development,
April 2, 2012, 9 a.m. – 1 p.m.
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
ADF&G Wildlife Conservation	Lem Butler
USFWS	Mike Buntjer
USFWS	Maureen de Zeeuw
USFWS	Bob Henszey (by phone)
BLM	Sarah Bullock (by phone)
NPS	Cassie Thomas (by phone)
AEA	Betsy McGregor
AEA	Wayne Dyok
FERC	David Turner (by phone)
ABR, Inc.	Brian Lawhead
ABR, Inc.	Terry Schick
ABR, Inc.	Wendy Davis
ABR, Inc.	Janet Kidd (by phone)
ABR, Inc.	Alex Prichard (by phone)
ABR, Inc.	John Shook (by phone)
MWH	Kirby Gilbert
Solstice AK	Robin Reich

Presentations

Terry Schick (ABR, Inc.):

- Botanical 2012 Study Plans
  - Vegetation and Wildlife Habitat Mapping
  - Riparian Study
  - Wetland Mapping
- Botanical Resources 2013/2014 Study Plans (Requests)

Brian Lawhead (ABR, Inc.):

- Wildlife 2012 Study Plans
  - Wildlife Habitat Use & Movement
  - Big Game and Furbearer Harvest Study
  - Eagle and Raptor Nest Study
- Wildlife Resources 2013/2014 Study Plans (Requests)

General Questions/Discussion

Timelines

Kirby Gilbert (MWH) discussed that the team would like comments on the 2012 Study Plans in the next two weeks, since field work is beginning very soon. He said that there has been a request to extend the comment period on the PAD, Scoping Document 1 and Study Plans. Once AEA receives official word from FERC, the schedule will shift about one calendar month. David Turner (FERC) stated that FERC has acted on the request for time extension. Comments on the PAD, Scoping Document 1, and requests for studies are now due May 31, 2012. The FERC approval is now in FERC e-library.

Recent FERC Scoping Meetings

Wayne Dyok (AEA) indicated that there were a lot of all new issues raised during the FERC scoping meetings held the week of March 26, 2012, but AEA did get valuable input to help move the process forward. Comments will be available to the Project team and may influence study plan development. FERC transcripts will be available in a few weeks. People are interested in socioeconomic regional impacts. People in Talkeetna were interested in an analysis of tourism impacts. Although many of the comments received might not directly relate to the studies that we are discussing at this meeting, AEA still needs to account for public comments. Kirby Gilbert (MWH) mentioned that the team learned more details about the importance of issues to people, including: project access, road accessibility, access to the rail corridor, the importance of subsistence, socioeconomics and the need to analyze air quality.

David Turner (FERC) said that they did hear during the Wasilla scoping meeting about a large mining operation north of the Talkeetna Mountains. The commenter expressed concern that the mine may be influencing caribou migration behavior or use of habitat, but that the specific location was not described. Brian Lawhead (ABR) speculated that it may have been the current gold-mining operation at Valdez Creek, located adjacent to the upper Susitna River. Later in the discussion, Sarah Bullock (BLM) said that the mining development in question may be in the Tangle Lakes area on State of Alaska land. She said that Pure Nickel is now doing exploratory drilling for nickel, platinum, and copper. Wayne Dyok (AEA) said we'll need to carefully consider which projects will be including in the scope of the cumulative impacts analysis.

General Information on 2012 Study Plans and 2013/14 Study Requests

Kirby Gilbert (MWH) noted that the 2012 study plans are posted on the project website and are near final, but AEA is open to further comments within the next two weeks. Comments should be emailed to Betsy McGregor (BMcGregor@aidea.org or 771-3957).

Kirby Gilbert (MWH) also noted that draft 2013/14 study requests are posted (in MS Word format) on the project website for agencies to use to develop their study requests. He said that if agencies want more information about the study request, they can contact Betsy McGregor at AEA (BMcGregor@aidea.org or 771-3957). The project team is focused on developing the 2013/14 study plans, which should be filed by July 16, 2012. Kirby said that the agencies are welcome to edit and submit the draft study requests that were provided. Betsy McGregor (AEA) said that AEA would like comments in writing, but if an agency doesn't have time to send comments, there would be meeting notes that agencies could accept in writing.

Kirby Gilbert (MWH) noted that some of the posted study requests don't have information regarding study cost. David Turner (FERC) said that cost is an element that the team should include in the study plans. He said that it is good to understand what any additional level of effort would cost. If there is no difference in cost with additional tasks, than cost information is not as important.

Vegetation Study Plans Questions/Discussion

Terry Schick (ABR) presented the Botanical 2012 Study Plans and Botanical Resources 2013/2014 Study Plans (Requests) following a PowerPoint presentation.

Wayne Dyok (AEA) discussed that the project facilities are currently sited based on the previous wetlands and vegetation data. He said that feedback to the locations for project components would be good, if there are important vegetation or wetland issues.

Terry Schick (ABR) highlighted that for developing wetlands delineation methods, ABR will organize a separate set of meetings to include USFWS, USACE, ADEC and EPA, with the goal being that everyone agrees before ABR begins field studies this summer. He said that the group needs to come to consensus on methodology for delineation and for determining wetland functions and values.

In reference to the riparian study, Betsy McGregor (AEA) said to make sure to coordinate with Kathy Dube who is doing the large woody debris study. Betsy said that they would have a consultant coordination chart that will be available on the website.

Bob Henszey (USFWS) asked what vegetation classification would be used. Terry Schick (ABR) said that they would use the Viereck (Alaska Vegetation Classification) Level 4 for vegetation types for the riparian study and for the habitat study; however, it is up for discussion. Bob Henszey (USFWS) said that the Viereck classification worked for him. Terry said another system might be needed for more intensive studies. Bob Henszey (USFWS) said that he was not opposed to modifying the Viereck types or creating new types if existing Viereck classes don't apply.

Kirby Gilbert (MWH) asked the extent of the previous work down the river. Brian Lawhead (ABR) said that previous (1980s) study went as far down as Willow. Brian said the active floodplain was mapped from Talkeetna upstream to Devils Canyon and then went basin-wide above Devils Canyon. Terry Schick (ABR) said that they will follow the same study boundaries unless they hear that they need to go south of Willow.

Terry Schick (ABR) said that the team needs comments in the next two weeks to incorporate into this year's study. Betsy McGregor (AEA) said that it is important to get comments. She said that since these are multi-year studies, which will be brought into the FERC process, agencies need to accept the methods and the study area.

Terry Schick (ABR) confirmed that the same crews would be doing the vegetation, wetlands, and rare and invasive species surveys.

Betsy McGregor (AEA) said that AEA would be obtaining aerial imagery once they determine the holes in the existing imagery. Janet Kidd (ABR) confirmed that the team is determining the holes right now. Terry Schick (ABR) said that much of the imagery, as long as it is fine-scale and acquired during the summer months, should be suitable for botanical mapping studies.

Betsy McGregor (AEA) said that there may be LiDAR-quality issues in the North Susitna block, like shadows and smearing, and that reprocessing but could take longer. Janet Kidd (ABR) said that LiDAR sometimes is flown when the canopy is minimized. Betsy McGregor (AEA) said that they are waiting for the Mat-Su Borough data and will need to work on it once it is obtained. Kirby Gilbert (MWH) said that the imagery may not cover all areas of interest and there may be need to be different sources of imagery used for different areas.

Betsy McGregor (AEA) said that Kirby Gilbert and Jim Gill are working on narrowing the study corridors. Kirby Gilbert (MWH) said that the project area won't change much from what is in the PAD. He said that the study area will shift a bit as they move forward and learn more about the area in terms of the feasibility of placing new facilities in those locations. Betsy McGregor (AEA) said that the ADOT&PF access study results, expected in April, will have a nominal centerlines for the road options, which will help determine the study corridors.

Kirby Gilbert (MWH) said that sometimes there is an inclination to assume that we will be summing up results across the total project area; however, the current effort needs to compare and contrast the corridors as only one or two corridors will ultimately be chosen. As a result, the summary of information across all corridors is not going to be useful. He said that then the corridors will be compared and contrasted to help AEA decide which corridor is most favorable. He said that AEA is carrying all corridors forward at this point. The 2012 field study information will help to make corridor decisions if one is to be eliminated. Betsy McGregor (AEA) said that AEA will have to carry several corridors forward for the U.S. Corps of Engineers permitting effort. The Project team needs mapping and groundtruthing in all three corridors to help them determine the least environmentally damaging practicable alternative. Kirby Gilbert (MWH) said that they could drop a corridor if it is found to be not feasible or unreasonable, but right now can't assume any corridors will be dismissed from further consideration.

Kirby Gilbert (MWH) asked about the use of the National Wetland Inventory mapping. Terry Schick (ABR) said that NWI typically underestimates the area of wetlands.

Bob Henszey (USFWS) asked about the minimum mapping unit. Janet Kidd (ABR) said that for these studies, ABR normally maps to 0.5 acre. She said that the team would use 0.1 acre for waterbodies and aquatic habitats of interest. She said that NWI maps are based on vegetation and tend to miss small drainages that this work would catch.

Kirby Gilbert (MWH) mentioned that the corridors are generally about 1-mile wide so as to be able to accommodate a road and possibly transmission line together across varying terrain. Terry Schick (ABR) said that the team would map at a finer scale in the area of the Project footprint for the purpose of permitting and determining compensatory mitigation requirements. He said that for comparative and impact assessment purposes, the team would complete wetland mapping at a broader scale in areas surrounding the localized mapping in the project footprint area.

Janet Kidd (ABR) said that they want to hit the ground running once they have good imagery that they can use. The team would use a HGM (hydrogomorphic) approach for each wetland polygon, similar to the method developed by Mike Gracz.

Betsy McGregor (AEA) said that we need to set up a meeting with USACE, EPA, USFWS, and ADEC for next week. She said the Corps has provided some comments during a meeting and agreed with the methods. She said that the team needs to include William Aston at ADEC, Mary Leykom the Corps' project manager, and Matt LaCroix at EPA.

Janet Kidd (ABR) said that there may be some issues with the Cook Inlet (Gracz's) Method and the team needs to work with the agencies to come to a consensus on the approach. Bob Henszey (USFWS) said that he supports this approach even though his agency recommended using Gracz's method.

Betsy McGregor (AEA) said that it will be important for each team to remember other teams' work. She said that all teams need to be collecting information in the same way, and take notes and share the information. She said to remember to share information with Kathy Dube who is doing the large woody debris study and Kevin Fetherston (R2) who is doing the instream flow riparian study.

Mike Buntjer (USFWS) said that the team should contact Betsy McCracken at USFWS for more information on the wetland methods recommendations prepared by USFWS. David Henszey (USFWS) asked to be invited to the wetland focus group meeting. Kirby Gilbert (WMH) said that it will be important to have meeting notes from these meetings for the record of consultation.

David Henszey (USFWS) asked whether the group discussed the study area or the extent of study for the 2013/14 studies. Terry Schick (ABR) said that it is going to be a large area. He said that right now, ABR will is planning on looking at all three proposed transmission corridors.

Kirby Gilbert (MWH) asked if the riparian study area extended as far as Willow. He said that the current study area shown on the slide is the extent of the vegetation mapping, which AEA thinks is adequate for the Project. Terry Schick (ABR) said that the wetlands study area is a broader for making project decisions. It is assumed that the study area would be narrowed into areas where there is decent imagery for 2012. Betsy McGregor (AEA) said that the finer scale mapping would be needed within the corridors. David Henszey (USFW) agreed that wildlife habitat would need to be understood outside the general study area.

Brian Lawhead (ABR) said that the 1980s mapping for wildlife habitat covered the entire upper basin. Kirby Gilbert (MWH) said that the study plans need to include maps if possible.

Bob Henszey (USFWS) asked how far downstream the river corridor would be mapped. Terry Schick (ABR) said they would map pretty close to just south of the Deshka River confluence. Betsy McGregor (AEA) said that the instream flow study would look at the entire river or at least to where there is tidal influence. She said that there would be less study downstream away from the project impacts and that pressure transducers would help to understand the limits of the riparian study.

David Turner (FERC) said that it is important to maintain the characterization for habitat for wildlife in the downstream area, but this may only be needed at a higher scale. He said that the project needs to have consistent study areas in order to relate and compare the information.

Wildlife Study Plans Questions/Discussion

Brian Lawhead (ABR) presented the Wildlife 2012 Study Plans and Wildlife Resources 2013/2014 Study Plans (Requests) following a PowerPoint presentation.

Kirby Gilbert (MWH) asked whether ABR did a previous bald eagle nest survey in the project area. Brian Lawhead (ABR) said that ABR looked a small area in 2011 in a limited survey around drilling borehole sites and found a previously undiscovered nest. They have a good map and physical descriptions for historical sites from the 1980s studies.

Maureen de Zeeuw (USFWS) said that she wasn’t prepared to provide specific comments on the study plans, since she had an older version. She said that for delineating suitable nesting habitat for eagles, it isn’t necessary to map a 10 mile area from the corridors. She said that the USFWS is interested in nest locations. Maureen said that AEA would have to apply for eagle take permits. She said that the USFWS hasn’t issued permits for take of golden eagles. The project studies should concentrate on information need for a permit, including information like inter-nest distance, breeding territory size, and how many breeding territories would be taken by the project.

Brian Lawhead (ABR) said they would set up a meeting with Maureen and Jordan (Muir) to discuss study methods. Maureen de Zeeuw (USFWS) said that bald eagle permitting requires many years of preconstruction surveys. She said it would be good to look at maps together during the meeting. She said the maps should show the corridor locations, and that aerial photography would be helpful.

Betsy McGregor (AEA) said that it would be good to understand where nests have been found in the past. Maureen de Zeeuw (USFWS) said it would be good to know where the null data is, that is, where they surveyed in the past and did not find nests.

Lem Butler (ADF&G) said that ADF&G completed a preliminary survey (geospatial population estimator) for moose last week. Brian Lawhead (ABR) said that this was a good time to do this, since this winter had a heavy snowfall and concerns had been expressed during the original project studies regarding the use of the inundation zone by moose in severe winters.

Lem Butler (ADF&G) said that he didn't think that an aerial survey was needed for brown bears and black bears. He said that he didn't think it would change the agency's understanding of the population.

Brian Lawhead (ABR) asked the group their thoughts on whether wolverines were a big study concern. Lem Butler (ADF&G) said that he missed the discussion on it and that ADF&G may have dropped their interest.

Brian Lawhead (ABR) said that additional data on wildlife harvest would be added to the studies, as they become available from ADF&G's ongoing analysis of harvest patterns, including the newly instituted small-game harvest monitoring project. He said that the project's recreation analysis may be interested in these data. Betsy McGregor (AEA) said that Bridget Easley, URS' program lead for recreation and aesthetics, should be consulted to determine what they information they need.

Betsy McGregor (AEA) asked whether it would be possible to have a list of bird species expected in the upper river so other people in the field could document their presence.

Maureen de Zeeuw (USFWS) asked why the team wasn't conducting bird surveys (beside raptors) in 2012. She said that from the point counts, the team would be getting primarily presence/absence information, depending on the specific method used. She said in 2013, perhaps the team could look at determining bird densities. She said that to figure out project impacts, it would be helpful to have to bird densities.

Terry Schick (ABR) said that the team would use variable-radius circular plots for point count surveys. He said that with enough data, they could get densities. Maureen de Zeeuw (USFWS) said that it will be important to understand impacts to sensitive species, including rusty blackbirds and olive-sided flycatchers. Terry Schick (ABR) said that given enough data, they could calculate densities by habitat and could relate that information back to project impacts. He said that the analysis would be relative to habitats used by each species.

Brian Lawhead (ABR) asked whether transmission-line collision mortality was an issue to USFWS. Maureen de Zeeuw (USFWS) asked whether there was a plan to look at bird migration corridors. She asked whether migration corridors were studied in the past. Brian Lawhead (ABR) said that water bird migration corridors were mostly studied, but that studies of nocturnal migration had not been conducted in the project area, although they have been done farther east near Gakona and farther north on the Tanana Flats.

Sarah Bullock (BLM) asked whether there had been any thought given to how the provision of more raptor perches on transmission towers would affect ground-nesting bird populations and small mammals. Brian Lawhead (ABR) said the he expected that the implementation of BMPs, that is keeping the project from adding perches, would cut down on impacts to these animals.

John Shook (ABR) said that they did have data from the Eva Creek Wind project. He said that if poles are in a windy area, nests would not be sustainable, but perches could be available. He said more ravens could be attracted to the area, which could result in more small birds and mammal predation.

Maureen de Zeeuw (USFWS) said that the project still needs to understand bird migration corridors. She asked whether this issue was brought up in the past and dismissed. Brian Lawhead (ABR) said that previously the project examined migration of waterbirds only, and that the conclusion was that it was not an important migratory corridor, compared with other high-volume migration corridors such as the upper Tanana valley. Maureen de Zeeuw (USFWS) said that she would like to know the locations of bird migration corridors in relation to the transmission line corridors. She said understanding their location would help with project design. Wayne Dyok (AEA) challenged ABR to investigate what could be gleaned about bird migration corridors in the project area. John Shook (ABR) said that there is a pretty strong east-west bird migration in the Eva Creek area. Brian Lawhead (ABR) said that information collected near Tok and Gakona also shows east-west bird migration corridors.

Maureen de Zeeuw (USFWS) said that the bird migration corridors are important for locating the transmission line. She encouraged the team to think about where migration corridors might be an issue for locating the transmission line. She said that impacts to migration corridors might only be in specific locations where the elevation of the line might conflict with migration.

Terry Schick (ABR) said that there had been discussions of the level of detail needed for wildlife habitat mapping products. He said that ABR usually prepares one wildlife habitat map that shows 30 to 40 habitat types on it. Brian Lawhead (ABR) said that ABR can prepare different maps for birds and mammals, and could prepare specific maps for high-profile species (e.g., moose, bears, and species of concern). He said that if they are mapping to Viereck Level 4, the habitat types would indicate dominate species, such as willows, which are important for moose browse. Kirby Gilbert (MWH) mentioned that it might be better to have an ecosystem approach, unless there are questions about specific species.

Brian Lawhead (ABR) asked whether BLM has questions or whether there were particular mandates that the agency has for particular species or areas. Sarah Bullock (BLM) said that she don't know if she knew enough about the issue since she was new. She confirmed that the availability of game for subsistence harvests was important to BLM.

Lem Butler (ADF&G) said that ADF&G's work would extend below the proposed dam or the confluence near Talkeetna, but not down to Willow.

Wayne Dyok (AEA) asked that, assuming that there is some big game usage of the reservoir, would ABR be looking at the impacts of other hydroelectric projects in northern latitudes where fluctuations of reservoir levels was a concern for wildlife movements. Brian Lawhead (ABR) confirmed that they would be focusing on caribou movements and reservoir fluctuations.

Action Items

1. AEA agreed to begin investigating the potential for bird collisions with project infrastructure, and requested that ABR investigate what might be gleaned from other studies to help understand what broad-scale bird movements might be like in the project area.
2. ABR will organize and conduct a wetlands focus group agency meeting. AEA will provide updated transmission line corridor data for ABR to use in preparing more accurate study area maps for the wetland methods consultation meetings.
3. ABR will send copies of historical references describing LGL's eagle studies (in the 1980s) to Maureen de Zeeuw (USFWS).
4. ABR will contact Bridget Easley, URS's recreation and aesthetics program lead, to determine information needs related to wildlife harvest data from ADF&G.
5. ABR will prepare and share a list of bird species expected in the upper river with other field teams, so that other teams can document their presence.
6. ABR will organize and conduct a meeting with Maureen de Zeeuw (USFWS) and Jordan Muir (USFWS) to discuss bald and golden eagle study methods.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Social Sciences 2012/2013-2014 Study Plan Development,
April 3, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
AEA	Wayne Dyok
AEA	Betsy McGregor
AEA	Bruce Tiedeman
ADF&G	Joe Giefer
ADF&G/DOS	James Van Lanen
ADNR/OHA (SHPO office)	Richard Vanderhoek
BLM	Elijah Waters
DOWL HKM	Tom Middendorf
DOWL HKM	Maryellen Tuttell
McDowell Group	Donna Logan
FERC	Jesse Fernandes (by phone)
FERC	David Turner (by phone)
HDR Alaska	Tracie Krauthoefer
HDR Alaska	Alyse Roberts
Louis Berger Group	Lisa McDonald (by phone)
MWH	Kirby Gilbert
Charles Mobley & Associates	Chuck Mobley
NLUR	Pete Bowers
Natural Heritage Institute	Jan Konigsberg
NPS	Cassie Thomas
NPS consultant	Harry Williamson (by phone)
Northern Economics	Patrick Burden
Stephen Braund & Associates	Paul Lawrence
URS	Bridget Easley

A housekeeping discussion followed introductions. Kirby Gilbert (MWH) introduced the purpose of the meeting, to discuss both AEA-prepared 2012 study plans and ILP study requests.

Cassie Thomas (National Park Service) asked AEA to consider several housekeeping measures that she felt would allow the agencies to be more efficient in their participation in the study development process and their review of proposed study plans. Suggestions included:

- Making sure that all of the agencies and consultants are on the project list serve for updates and announcements.

- Having the Go-To Meeting link available on the website and listed on agendas.
- Send out an e-mail letting people know any time new material is posted on the website.
- Come up with a more consistent protocol for where things, such as study plans, are posted on the website so they are easier to find.
- Come up with a better protocol for file naming including either a version number or date so that agencies don't download materials thinking they are new if they are not.

Jan Konigsberg (Natural Heritage Institute) asked whether a list of all contractors for each study were listed on the website. Betsy McGregor (AEA) responded that a list is being prepared and will be available.

Kirby Gilbert (MWH) informed the group that FERC would release transcripts of the scoping meetings so that everyone could see what was said at each meeting. He also noted that there would be another site visit in July.

Socioeconomics

Maryellen Tuttell, AICP (DOWL HKM) introduced herself as the program manager for these studies. She introduced Pat Burden (Northern Economics) who will lead the socioeconomic studies. Maryellen (DOWL HKM) noted that she will be supported on the transportation studies by DOWL HKM staff: Tom Middendorf, aviation; Steve Noble, P.E., highways; and Dave McCourtney, P.E., railroad. Maryellen (DOWL HKM) noted that support for air quality studies would be from Harris Miller Miller and Hanson, a firm that specialized in noise and air analysis.

Pat (Northern Economics) introduced the two main components of the socioeconomic studies: Social Conditions and Public Goods & Services, and Regional Economics. Pat (Northern Economics) reviewed the goals of the study and noted that the Social Conditions and Public Goods & Services study will be focused more on communities and boroughs in proximity to the project site. He noted that any local, borough or state-adopted plans for standards of public services will be used. However in many cases no such standards have been adopted and in these cases the existing situation will be used as the standard. So, for example, if there are currently 10 police officers for every 1,000 people, the analysis will use that as the standard for police protection.

Pat (Northern Economics) discussed how the REMI model, developed by Regional Economic Models, Inc. and calibrated by Northern Economics to Alaska's economy, is proposed to be used to evaluate impacts to populations and public goods and services. Pat (Northern Economics) noted that some basic data collection would begin in 2012, but most activity in 2012 would be associated with coordinating with the Project design team and other consultants, and developing the socioeconomic study plans.

Pat (Northern Economics) then reviewed the regional economic evaluation and noted that the focus on this study will be on the communities within the Railbelt. Other communities may need to be added if the transmission lines are extended into areas outside the Railbelt. He noted that one of the standards that would be used is the state's adopted policy for providing 50 percent of energy from renewable sources. Existing levels would be used where no standards have been adopted, such as existing income levels, employment levels, etc.

Pat (Northern Economics) described how the future scenario would be created through development of major assumptions about the Alaska economy and how it is likely to change over time. The assumptions are based on research and interviews with key industries and have been used in several economic studies, including the one for the Alaska Gas Pipeline Project. The REMI model would again be used to evaluate the economic effects of the project, including effects from stable energy prices in the Railbelt and how that might affect business opportunities and impacts on tourism businesses. The regional economic analysis would also evaluate how stable energy costs would change disposable income in the Railbelt and what effects that would have on purchased of other goods and services. He noted that, again, most of the work on this study in 2012 would be limited to coordinating with the project design team and other consultants.

Cassie (NPS) asked whether the evaluation of public goods and services would look at the services provided by green infrastructure, as well as built infrastructure. She noted in particular the Susitna River system provides public benefits associated with flood retention and other services. Pat responded that green infrastructure was not specifically in the scope of the study but that this was an interesting concept.

Jan Konigsberg (Natural Heritage Institute) asked David Turner (Federal Energy Regulatory Commission) how FERC would use the socioeconomic information to inform the licensing process. He indicated that it seemed easier to understand how biological and other resource studies would result in license conditions, but could the license requirements also address social and economics?

David (FERC) said that FERC does look at impacts to social and economic resources and could potentially have license conditions to address these.

Cassie (NPS) asked whether the regional economic evaluation will look at multiple potential future scenarios, instead of just one.

Pat (Northern Economics) answered that the proposed study would look at two future scenarios: one that includes construction of the project and one that assumes the project is not constructed. The study would develop Reasonably Foreseeable Future Actions (RFFAs) based on interviews with key industries and others. This is how the analysis was done for Highway-2-Highway and the Knik Arm Bridge projects. The scenario without the project would be based on the Railbelt Integrated Resource Plan (RIRP) that outlines future potential power sources.

There was also discussion of the timeframe for the project. Wayne Dyok (Alaska Energy Authority) stated that if the license was issued in 2017 construction would start then and the project could be online in 2023. Pat (Northern Economics) noted that the REMI model will look out 50 years. Once you get beyond 50 years, it is hard to confidently model effects.

Jan (NHI) asked whether the analysis would consider changes in power generation in other areas and/or changes in industries. Pat (Northern Economics) answered that it would look at both. There was discussion of the potential for attracting companies that currently aren't in Alaska and have high energy demands. They may be more interested in locating in Alaska if they have a low or more reliable source/cost of power.

Cassie (NPS) asked whether a project of this magnitude could result in changes to construction material prices, such as steel, gravel, etc. This could make other construction projects in Alaska more expensive if this project drives those prices up. There was discussion of the various types of equipment and materials, and how material supplies and costs from markets in the Lower 48, such as steel, would not be impacted by this project, but that local goods and materials (such as labor and gravel) could be affected and these impacts would be evaluated.

Jan (NHI) asked that the economic analysis look at the impact on state credit and potential indirect impacts to the state's ability to fund other needed projects if they commit to funding this project. Pat (Northern Economics) noted that the modeling effort does include a fiscal model to look at fiscal impacts on the state and boroughs.

Wayne (AEA) noted that AEA is hiring a financial consultant that will develop a financial plan for how the project would be funded.

Bruce Tiedeman (AEA) stated that the Alaska Native land owners and communities are very interested in the long-term effects on them from this project. Not all the Alaska Native entities will be affected the same and not all of them have the same interests, so they can't be lumped into one group. They are very interested in coordinating on the economic studies.

Kirby (MWH) noted that he heard comments from Alaska Native groups at the Glennallen meeting and concerns about the outmigration from rural communities and its impact on school enrollment and community stability. Some people commented that the price of energy was driving the outmigration. Changes in population profiles need to be addressed.

Jan (NHI) asked why Glennallen would be affected since there was no proposed transmission connection to Glennallen in the proposed Project. There was discussion about recreation and subsistence use and other indirect cumulative effects on the Glennallen area. Ahtna Inc. owns property adjacent to the Project area. Any area that could be impacted should be in some manner, evaluated in the study.

There was discussion of social survey efforts that would be underway in various resource areas. Betsy (AEA) noted that the Susitna area communities would be surveyed in 2013 and the Copper River communities would be surveyed in 2014 for subsistence. Tracie Krauthoefer (HDR) said that the Institute of Social and Economic Research (ISER) has had Alaska Department of Fish & Game (ADF&G) add some socioeconomic questions to the subsistence survey. Joe Giefer (ADF&G) noted that it is hard to get participation if the survey gets too long, so he wouldn't recommend adding a lot of questions to it.

There was clarification that there will be some baseline information collected and informal interviews conducted in 2012, but no actual surveys for subsistence or recreation. There was a question about why the Copper River communities were surveyed in 2014. ADF&G has recent surveys for that area; the ADF&G survey data on Susitna communities is older and needs to be updated.

Jan (NHI) asked Pat (Northern Economics) if part of the socioeconomic study was to hold public meetings to get information from the public. Pat (Northern Economics) noted that typically for this type of study there are meetings with elected officials, industry officials and others. No public meetings would be held specifically for this study, but information gathered from the scoping meetings would be incorporated. Jan (NHI) asked if Pat (Northern Economics) thought that the results would differ with or without public input. Pat (Northern Economics) did not think the results of the analysis would change.

Mike Wood (Chase resident) asked whether the transportation use of the Susitna River in winter would be evaluated. He noted that Chase is the closest community council to the project site and that most of the communities in the area are unincorporated. He has concerns about how an influx of people could affect these unincorporated areas.

Jan (NHI) noted that if the Project decreases rates, new industries could develop potentially leading to increasing energy demand. Jan (NHI) continued that increased demand would require more power, or could raise rates again. Pat (Northern Economics) said that the average price will depend on the load generated. Wayne (AEA) also noted that the study would look at how energy needs would be addressed using different resources if the power demand increases. Jan (NHI) added that as an applicant, the State needs to be straight-forward about potential power prices. The proposed Project may produce lower cost energy if demand stays the same, but not if demand increases.

Cassie (NPS) asked about where other resource economics are addressed, such as the value of recreation. She was not referring to changes in income to recreation businesses, but the value of non-cash goods, such as the enjoyment of the river. Some of these things are not as easily monetized but would likely be addressed in the recreation and aesthetic studies. Tracie (HDR) noted that ISER does have information on the value of the fisheries resource.

Bridget Easley (URS) noted that the recreation study will collect information on recreation spending.

Mike (Chase resident) added that in six weeks the river will be inundated with bear hunters. In December the Denali Highway is crowded with people getting caribou. He noted that Dallas Seavey, Jeff King and other mushers use the Denali Highway area for training.

Transportation

Maryellen (DOWL HKM) went over the goals of the transportation study, the standards that would be used for evaluating transportation and the standard methodologies for forecasting traffic levels. She again noted that transportation studies would not start in 2012, but that the team would be coordinating with the design team and the other consultants and preparing the study plans.

Cassie (NPS) noted that she had heard concerns from residents that have cabins in the Gold Creek area about whether the studies would evaluate the potential for more trespass on their lands if a new western access road is constructed. Betsy (AEA) responded that if a link to the Parks Highway is identified as a reasonably foreseeable action, it could be addressed in cumulative effects. Cassie (NPS) noted that access from the railroad could also be an issue. Maryellen (DOWL HKM) responded that the study will evaluate the effects of possible change in access and proximity to road and rail corridors.

Mike (Chase resident) stated that winter is a major travel time on the Susitna River and changes in ice conditions could impact the ability to travel and travel safety on the river.

Ron Benkert (ADF&G) stated that ADF&G would like Tier 1 fish passage culverts on any new roads. For the Denali Highway, an analysis of fish passage through the existing culverts would be needed.

Kirby (MWH) noted that the DOT&PF is evaluating road corridors. Becky Long (Coalition for Susitna Dam Alternatives) asked when the DOT&PF study would be completed. Wayne (AEA) noted that it would likely be released near the end of April.

Air Quality

Maryellen (DOWL HKM) reviewed the purpose of the air quality study, the standards that would be used and the standard methodologies for evaluating emissions. She noted the lack of existing data for the project area.

Wayne (AEA) recommended that the air analysis study plan consider the analysis conducted on the recent Eagle Mountain Pumped Storage EIS. He asked David (FERC) whether the study can use the emissions information already developed in the RIRP, or whether emissions had to be modeled all over again. David (FERC) said that he would look into this question and get back to Wayne (AEA).

Jan (NHI) asked whether the power generated by the project would replace relatively inefficient peaking units. Wayne (AEA) responded indicating that the project could do a combination two approaches, load following or base loading, but that the two approaches provide the bookends (range) of emissions reduction for the Project.

Betsy (AEA) noted that people in Fairbanks were interested in whether this Project would change air emissions in Fairbanks where they are in non-attainment for some air pollutants. Maryellen (DOWL HKM) noted that the analysis would have to look at what the various contributors to the non-attainment pollutant levels were and whether they were related to power production or to other sources, such as wood stoves or vehicles.

Cassie (NPS) asked whether the study proposed to collect baseline data for air quality. She noted that without a baseline it is hard to determine the effect on visual and aesthetics at the project site and for road construction and operation (dust). There are currently issues with dust on the Denali Highway and localized effects from wood stove smoke in the winter. Maryellen (DOWL HKM) noted that the study team will meet with EPA and DEC to determine what level of analysis they want to see for the study and to see if there is other information or other studies that might have been done in the study area.

Wayne (AEA) added that there will be discussions with the Railbelt utilities to see which units would be displaced by the Project to help in determining any Project-related emissions reduction.

Recreation & Aesthetics

Cassie (NPS) asked if the landscape characterization process and quantification of aesthetic values would include the river downstream of the proposed dam as well as changes in downstream flow patterns. Cassie (NPS) emphasized the importance of having a baseline noise assessment and the potential for impacts on the region's soundscape by increased overhead flights and helicopter usage. Further discussion about potential impacts of noise on wildlife populations and the need for a different model to assess impacts on wildlife. Tracie (HDR) asked if it would be possible to coordinate URS's noise modeling efforts with efforts to determine the impact of noise on wildlife populations, potentially expanding the noise analysis and modeling efforts.

Betsy (AEA) emphasized that the region was not a noise free environment and that a significant amount of hunting, fishing, and snow machine activities occurred in the Project area. Betsy (AEA) brought up the possibility of coordination between the aesthetic group and the river and ice processes group to the match KOPs with river monitoring sample points. This would allow for river flow data to be used to be matched with the quantification of aesthetic values of the river, especially in relation to changes in river flow patterns.

The river and ice processes group will be collecting several types of data at multiple points along the river from the reservoir to River Mile 9. This data includes river transects to determine bathymetry, audio and video to monitor changes in river flow, LiDAR data for the project area, pressure transducers, monitoring ice formation and break up, in stream flow and ice modeling.

Cassie (NPS) asked if the road would be open to public use. If it is not open to the public, then it may be better to select a road alignment that would conceal the road and reduce aesthetic impacts to the landscape. In particular, Cassie (NPS) suggested hiding the road from hikers on Krusig Ridge. Wayne (AEA) provided insight into the steps and timeline for determine if the access road would be open to the public. He emphasized that currently there is no easy answer and that it is essentially a policy question which will require a significant amount of dialog with all stakeholders (including landowners) and an assessment of all potential alternatives (road alignments). However, he highlighted that this would be a public-use project. In addition, the road will not be open to the public during the construction period.

There was discussion on how many Key Observation Points (KOPs) will be designated and where they will be located. Louise Kling emphasized that the designation of KOPs is an evolving process and the input from all groups was welcomed. The initial list of KOPs would be based on the 1985 FERC application KOP list, but that list would be adjusted as required. Wayne (AEA) brought up the July site visit and suggested that stops at the initial KOPs could be incorporated into the visit to help everyone coordinate efforts.

Wayne (AEA) discussed the ongoing assessment of the potential configuration of transmission lines (one line verses two lines), emphasizing that it would be based on reliability, but that a two-line configuration was likely. A decision would likely be made by the end of the year with potential routes becoming more defined.

Harry Williamson (NPS) asked if there would be a less formal coordination process that would allow agency input/vetting of 2012 survey questions. Donna Logan (McDowell Group) clarified that the 2012 interviews would be informal and would be conducted in a way to allow people to express their views and perspectives, rather than a series of questions normal associated with a survey. Donna (McDowell Group) emphasized that the interviews were not aimed at collecting “data”, but rather designed to acquire impressions of the project and to gather information about who should be contacted and surveyed (prominent individuals, lodge owners, user groups, etc.) for the 2013-14 survey.

Cassie (NPS) asked how the informal trail network would be assessed and mapped and in particular, what would be the threshold for determining what the designation of “trail” versus “route” would be used. It was highlighted that current ADNR GIS layers may be inadequate and would need to be ground-truthed. They may be very out of date with many trails not shown or shown but currently abandoned. Betsy (AEA) brought up that AEA would be able to provide updated aerial photos and GIS layers showing rights of access and ownership.

Cassie (NPS) asked to ensure that trail’s official designations and numbering systems are used.

Betsy (AEA) and Kirby (MWH) discussed the ADNR and BLM data sources that would be available for general land ownership designation and how they would be used to determine the specific owners of lands within the region. Betsy (AEA) confirmed that URS was not responsible for determining land ownership within the region.

John Gangemi (ERM) discussed the flow-dependent recreation assessment that could be conducted and the need for input from the hydrology group and the need to determine what information is used by locals to determine flow rates. Cassie (NPS) asked for clarification on the unique situation in Alaska where rivers freeze over in the winter and transition from flow-dependent recreational uses to ice-dependent recreational uses. John (ERM) said that this has not been done before and that ice-dependent recreation would likely be excluded from his portion of the study.

Wayne (AEA) pointed out that for winter recreational uses it will be important to determine how the river is used and how flow patterns will influence these recreational uses. The recreation group will need to coordination with the river flow and ice modeling group and the transportation group to determine these interactions.

Mike (Chase resident) emphasized that river flow will directly affect the ice formation and how local residents will be able to use the river in the winter (moving along and across the river) and that most out-of-state recreational users come from the railroad and professional boat charters.

Cassie (NPS) brought up that records of access might exist for private landowners within the region; however, it was likely that this is a very small portion of the actual usage of the lands. There was discussion about combining recreation and subsistence surveys; however, Tracy (HDR) and Donna (McDowell Group) both agreed that this would not be the appropriate methodology. Paul Lawrence (Stephan Braund & Associates) pointed out that discussions on sport uses during subsistence interviews are generally not productive or well-received.

Cassie (NPS) said that it is important to identify river access points for recreational users and that it will be necessary to determine how sensitive each of these points are to changes in river flow regimes, vegetation and geomorphology. Amy Rosenthal (URS) suggested that an initial site-condition analysis form could be developed to record vegetation, ground cover and general conditions.

Betsy (AEA) emphasized the need to coordinate field efforts and the recreational sites should be designated at key points for flow studies. Donna (McDowell Group) also suggested that a study group be established to coordinate public contact efforts in order to minimize the number of times that individuals in the public are contacted.

Subsistence

Tracie (HDR) provided an overview of the ADF&G Division of Subsistence survey and how certain communities were selected as they are in need of updated information whereas other communities already had been surveyed recently. In addition to the ADF&G work, the HDR team would also conduct subsistence surveys in "non-subsistence" communities as defined by ADF&G Division of Subsistence that included Talkeetna. Tracy (HDR) noted her group would also be attempting to gather Traditional Environmental Knowledge (TEK) which would include information useful to help identify Traditional Cultural Properties (TCPs) in the Alaska Native communities. The discussion then transitioned into cultural resources

Cultural Resources

Pete Bowers (Northern Land Use Research) presented an overview of the cultural resource studies proposed. He noted that the current effort has been to bring data into Geographic Information System (GIS) databases from the older paper resource studies relevant to the area. He noted that the 2012 scope is limited to developing a GIS predictive model to identify areas which would need further evaluation in field studies in 2013 and 2014. He also discussed ice patch studies which evaluate resources that are found as ice melts and reveals areas that have been undisturbed for long periods of time.

Wayne (AEA) asked when a protocol for handling resources found in the field would be available. It would be nice to have it in early June so that crews in the field this summer can be trained on it. Chuck Mobley (Charles M. Mobley & Associates) asked about the best way to brief field teams and whether there is a Project Health & Safety Plan for all field staff. Wayne (AEA) indicated that this would be a good topic for the consultant coordination meeting coming up next week. Betsy (AEA) added that there will be a site logistics coordinator that will ensure field crews are aware of important information. She noted that all field crews will be staying in one location and will be coordinated through her.

Pete (NLUR) noted that more data on Alaska Native place names and on Traditional Cultural Properties (TCPs) will still need to be gathered. Jim Kari at the UAF Alaska Native Language Center has gathered a lot of information and his studies will need to be incorporated into the GIS system along with new information gathered.

Betsy (AEA) mentioned that Alaska Native entities had indicated an interest in being intricately involved during the development of the study plans for cultural resources. Bruce (AEA) confirmed this and said that holding meetings out in their regions would help illustrate that we are aware of their importance in this study process. They take a long-term view on access and use of their lands and want to be sure that long-term effects are adequately addressed.

Pete (NLUR) mentioned that there would be testing of the predictive modeling with limited field reconnaissance in 2012.

Richard Vanderhoek (Department of Natural Resources, Office of History and Archaeology) expressed concerns about timing during multi-year studies. Key information needs to be identified up front. Richard (SHPO) suggested that field reconnaissance should be broad. He also asked if the predictive model was going to be based on biological data and noted that it couldn't wait for 2-3 years to get the fish and wildlife studies. Pete (NLUR) agreed and noted that existing data would be used initially and that later modifications would incorporate any new information available.

David (FERC) asked when the Area of Potential Effect (APE) would be identified. Pete (NLUR) responded that the model will start by looking at a very broad area, but then the study area would become more refined through field surveys. Kirby (MWH) noted that the direct effects APE could be identified fairly easily based on Project information, but defining the indirect APE will require more time and could be an iterative process as more information is developed. Wayne (AEA) asked if FERC had recent guidance on the direct-impact APE versus the indirect-impact APE. David (FERC) agreed that the direct-impact APE is easy to define based on areas that would be disturbed by project activities but that the indirect APE gets much more site specific and difficult to discern. He noted that the identification of these areas would have to be coordinated with the State Historic Preservation Office (SHPO).

There was a question about whether a Programmatic Agreement (PA) could accelerate the process. Wayne (AEA) indicated that Ann Miles (FERC) would consider a PA and David (FERC) said he would follow-up. However, David (FERC) said the PA would provide agreement on how to do the studies, but wouldn't necessarily affect the level of effort to identify the APE. He is unsure how a PA would help, as compared to the normal cultural consultation process in the ILP.

Mike (Chase resident) asked what Alaska Native groups would be contacted downriver. Bruce (AEA) suggested that these would include Knik, Chickaloon, Tyonek, CIRI, and others.

Pete (NLUR) discussed survey strategies being considered for the FERC study plans; most would begin with helicopter surveys and then more intensive ground surveys in key areas to test the predictive model results.

Wayne (AEA) questioned the process for archaeological sites that may be part of the inundation zone. If an Alaska Native group does not want the area disturbed, does the site need to be surveyed and tested? Pete (NLUR) and Richard (SHPO) explained that all sites would have to be tested and evaluated because the State needs to identify what types of sites there are. Some may be preserved after flooding, others may lose their value. Wayne (AEA) noted that he wanted to be able to respect the wishes of the Alaska Native communities to the extent possible.

Betsy (AEA) asked how disagreements would be handled if land was owned by a village or regional corporation who had a different perspective on impacts than the tribal government. Pete (NLUR) noted that this is why consultation with all affected parties is critical.

Bruce (AEA) added that Alaska Native groups have their own criteria to determine cultural importance. He noted that the Project team must have respect for the sites that the tribal groups feel are important. Richard (SHPO) responded that consultation is critical to try to not disturb sites with human remains or spiritual significant. It was agreed that consultation is key. The Section 106 requirements are not just about preservation of historic resources but also include consultation, consideration, and respect for Alaska Native sensitivities.

Bruce (AEA) noted that most regional corporations have now identified cultural sites. Villages are now working to identify these sites, including TCPs, but they may not want to share this data. This information would need to be kept confidential. Richard (SHPO) noted that the SHPO has a database with confidential cultural data in it. But, people with legitimate research needs have access to the data. People need to know where resources are so that they don't damage resources accidently. The SHPO works hard to get this information so that it can be used to review projects and prevent damage.

Kirby (MWH) noted that Pete (NLUR) should get Betsy (AEA) information on what dates access to different Alaska Native owned lands would be needed. Betsy (AEA) added that AEA has agreed to do programmatic permits for access to Alaska Native-owned lands for the Project studies. She needs dates from all groups that need access.

Pete (NLUR) talked about collection and curation. There is an agreement with the University of Alaska Fairbanks for resources found on state or federal lands. There would need to be coordination with landowners for curation of resources found on non-public lands. UAF may want an agreement with individual landowners for curation of artifacts from Alaska Native lands.

Tracie (HDR) asked about the GIS protocols and metadata standards. Betsy (AEA) responded that there were standards identified and Courtney Smith (DNR) added that there is a GIS coordination group across all disciplines that has started meeting on a weekly basis to ensure everyone is using the same protocol. Joetta Zablotney (R2) is coordinating the list of data sets and who is collecting what so that there are not multiple parties collecting the same information. Betsy (AEA) noted that the GIS data access will be set up so that people will have access to the data they need but that access to other data, such as cultural data, can be restricted.

Pete (NLUR) asked Richard (SHPO) if SHPO will want a separate data agreement with each contractor working on this project, or whether there would be a project-specific data sharing agreement with AEA and the technical team. Richard (SHPO) responded that there will have to be control over the sharing of data so he would give this more consideration.

Betsy (AEA) noted that she was looking at disseminating confidential data to a limited number of people. There would be a data-sharing agreement that would likely include ADF&G, NLUR, HDR, Stephen Braund, DNR, etc.

Pete (NLUR) noted that it was important to have a thorough understanding ahead of time of the geographic reference levels. He noted that the volcanic ash layers and other specific layers could be used as a framework for the cultural chronology to evaluate sties. He and Richard (SHPO) agreed that it was important to be sure to identify these references early in the study and not be encountering a new soil reference type two or three years into the study. Richard (SHPO) added that a lot of data is gathered in the first season and takes all winter before it begins to mean something. Betsy (AEA) asked whether this level of information gathering was in the current scope. Pete (NLUR) said that it would be in the 2012 cost estimate. Chuck Mobley (Charles Mobley & Associates) noted that stratigraphic information that is broadly applicable is needed in several areas. Richard (SHPO) explained that areas with thicker sediments would have more data layers. The samples need to be spatially complete across the region. After discussion about the timing of re-examining site locations, this action was moved to 2012. Richard (SHPO) did not anticipate it would be labor intensive.

Wayne (AEA) asked whether stratigraphic information was already collected for the region in the 1980s. Pete (NLUR) responded that radiocarbon dating technology has advanced from what was available in the 1980s and that some of the laboratories that used to do radiocarbon dating have been discredited. Richard (SHPO) added that crews only dug to 50 cm or to certain stratigraphic layers and then stopped. Our assumptions about when humans were first present have changed since then. Pete (NLUR) noted that we now know that people have been in Alaska for more than 11,000 years. Richard (SHPO) added that some of the new technologies allow radiocarbon dating of the actual soils.

ACTION ITEMS:

- Develop protocol for handling historic resources encountered by field crews – MOBLEY/NLUR.
- Disseminate protocol for handling historic resources to field crews. – AEA
- Check with Ann Miles regarding use of a Programmatic Agreement for the project. – Wayne.
- Get Betsy information on what dates access is needed on Alaska Native lands. – ALL TECH TEAM.
- Disseminate standards on GIS – AEA.
- Determine if there will be a project data sharing agreement between AEA and OHA. – DNR OHA – AEA.
- Set up SharePoint Site with access to sensitive data limited. – AEA.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Water Resources Study Development Workgroup Meeting
April 4, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	**Name**
AEA	Betsy McGregor
AEA	Wayne Dyok
USFWS	Mike Buntjer
USFWS	Betsy McCracken (by phone)
USFWS	Lori Verbrugge
NMFS	Susan Walker
NMFS	Eric Rothwell
BLM	Tim Sundlov
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADF&G	Mike Bethe
ADEC	William Ashton
ADNR	Terry Schwartz
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsberg
MWH	Kirby Gilbert (by phone)
MWH	John Haapala (by phone)
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Cardno ENTRIX	Craig Addley
Cardno ENTRIX	Jim Gill (by phone)
HDR	Robin Beebee
URS	Paul Dworian
R2 Resource Consultants	Dudley Reiser
Tetra Tech	Bill Fullerton
Tetra Tech	Rob Plotnikoff (by phone)
GW Scientific	Michael Lilly
Brailey Hydro	David Brailey
Coalition for Susitna Dam Alternatives	Becky Long (by phone)
Alaska Ratepayers	Scott Crowther
Chase Resident	Mike Wood (by phone)

MWH

Presentations

- Review of Existing Water Temperature Model Results and Data Collection – Draft Final (2012 study plan)
- Baseline Water Quality Study (2013-14 study request)
- Water Quality Modeling Study (2013-14 study request)
- River Flow Routing Model Data Collection – Draft Final (2012 study plan)

Introduction

Steve Padula (LVA) stated that FERC had granted a deadline extension to May 31, 2012, for stakeholders to provide comments on the Pre-Application Document (PAD), Scoping Document 1 and formal study requests as part of the ILP process. Steve (LVA) noted that FERC had adjusted subsequent ILP milestones commensurate with the PAD comment extension and AEA would soon post a revised Project licensing schedule on its website. The previously scheduled May 2012 workgroup meetings have been rescheduled to be held during the second week of June 2012.

Steve (LVA) said that during the next several months AEA intends to begin scheduling subgroup meetings, which would involve greater focus on the details of study planning and execution. Wayne Dyok (AEA) added that these meetings would be open to anyone who wished to participate but that the focus of the meetings would shift to more technically oriented topics.

Steve (LVA) stated that 2012 study plans were nearing completion and AEA requests stakeholders provide final input on the 2012 plans by the week of April 16, 2012. AEA will be finalizing and distributing the 2013-2014 formal study request documents during the next several weeks. In order to make the requests as comprehensive as possible, stakeholders are encouraged to provide input as early as possible. By submitting comprehensive study requests, AEA intends to reduce the amount of work required by stakeholders who would otherwise need to submit requests of their own.

Sue Walker (NMFS) stated that stakeholders needed contact information for AEA's technical consultants, particularly study program leads. Betsy McGregor (AEA) replied that AEA would provide the requested contact information. Although it would be acceptable for stakeholders to contact AEA's consultants, AEA would need to be kept apprised of all substantive dialogue. Betsy (AEA) noted that technical consultants were not authorized to make decisions regarding stakeholder requests; all study-related decisions will be made by AEA's Project managers.

Water Quality Study

Review of Existing Water Temperature Model Results and Data Collection (2012)

Eric Rothwell (NMFS) stated that stream temperature and meteorological data collection identified in the 2012 study plan represented a good initial step toward establishing a baseline, but noted that it would be necessary to soon begin identifying areas where groundwater upwelling was providing thermal refugia for fish. Paul Dworian (URS) acknowledged the need for this information and noted that thermal imaging and ground surveys planned for 2013-14 would be used to identify these areas. Eric (NMFS) added that thermal refugia needed to be mapped and integrated into AEA's analysis of groundwater dynamics so that the proposed Project's effects on fish habitat, especially spawning and overwintering habitat, could be assessed. Eric (NMFS) stated that it would be necessary to understand and document the relationship between river stage and groundwater upwelling to evaluate the effects of proposed alteration of the river's flow regime. This information is most critical for the middle Susitna River where Project effects would be most pronounced.

Craig Addley (Cardno ENTRIX) stated that the effects of the proposed Project on groundwater upwelling would be evaluated through synthesis of results derived from multiple study efforts, including instream flow modeling and geomorphology, ice processes, and riparian vegetation studies. Eric (NMFS) stated that AEA's study plans to date did not explain specifically how results of the aforementioned study efforts would be used to document groundwater dynamics and assess potential Project impacts. The plans need to clearly identify the links between the studies and various modeling efforts.

Dudley Reiser (R2 Resource Consultants) stated that AEA and its consultants acknowledged the importance of groundwater upwelling and that study details would be refined over the next several months as formal 2013-14 study plans are finalized. Eric (NMFS) proposed that AEA develop a stand-alone document to explicitly identify how groundwater dynamics would be addressed over a range of scales, with a description of detailed analyses at the mesohabitat level and an explanation of how small-scale results would be extrapolated to document reach-wide dynamics. The document would not need to be a study plan, per se, but rather an explanation of how results of the various study efforts would be brought together to address groundwater.

Terry Schwartz (ADNR) asked if wells had been established to assess groundwater in the vicinity of the proposed dam site. Wayne Dyok (AEA) replied that groundwater wells had been established by AEA's engineering team to document groundwater at the dam site. Terry (ADNR) said that it might be necessary to establish similar wells longitudinally downstream of the proposed dam site to establish baseline groundwater patterns. Terry indicated that AEA should conduct detailed, two dimensional modeling of groundwater and its link to river stage at several representative sloughs and side channels and then use an agreed-upon method to extrapolate results to the reach level. Terry (ADNR) added that the presence of the reservoir would have large-scale effects on groundwater beyond those associated with changes in flow regime resulting from Project operations.

Mike Bethe (ADF&G) stated that the importance of groundwater upwelling was not restricted to sloughs and side channels, noting that the suitability of mainstem habitat for salmonid spawning was also dependent on groundwater. However, evaluating groundwater upwelling in the mainstem is complicated by the fact that it often occurs in turbid areas where fish use is difficult to document, unlike in many of the sloughs. Mike (ADF&G) stated that upwelling areas in the mainstem also provide winter rearing habitat for juvenile salmonids by moderating temperatures and maintaining areas of liquid water beneath the ice cover. Betsy (AEA) stated that tracking radio-tagged salmon would help AEA locate areas of mainstem spawning, which would in turn aid in locating areas of groundwater upwelling.

Betsy (AEA) stated that AEA would schedule a meeting to discuss groundwater issues and assessment methods in greater detail and that based on the meeting make a determination as to whether a stand-alone groundwater document is needed.

Baseline Water Quality Study (2013-2014)

Wayne (AEA) asked how many sites had been identified for collection of baseline water quality data. Craig (Cardno ENTRIX) stated that the study plan identified 38 temperature monitoring sites but that other water quality parameters would likely be sampled at fewer sites, although the specific number of sampling/measurement locations was still being determined.

Eric (NMFS) asked if the water quality parameters identified for in-situ measurement (see Table 3 of the study request document) would be monitored continuously. Paul (URS) replied that plan was to take the measurements at discrete intervals, not continuously. Eric (NMFS) asked whether discrete sampling would be sufficient for calibrating a turbidity model. Rob Plotnikoff (Tetra Tech) replied that discrete sampling should be sufficient for calibration of a turbidity model at a level of resolution needed to evaluate the response of biota to Project-induced changes in turbidity. Mike Wood (Chase resident) stated that turbidity levels around the three rivers (Susitna, Talkeetna, and Chulitna) confluence increase dramatically following break up of surface ice in the spring.

Tim Sundlov (BLM) stated that it would be necessary to establish a reliable baseline time series for turbidity in the river to accurately assess the impacts of Project construction. Wayne (AEA) acknowledged that there would be a short-term increase in turbidity during the Project's construction, but construction activities would be timed and best management practices (BMPs) would be employed to minimize any impacts. Craig (Cardno-ENTRIX) noted that turbidity would be measured above and below the dam site during the construction period. Jan Konigsberg (NHI/HRC) stated that increases in turbidity would not only result from construction activities but also from the initial filling of the reservoir, when soils from the inundated slopes would be released into the water column.

Lori Verbrugge (USFWS) stated that fish tissue samples should be evaluated for heavy metals generally, not only mercury. In addition to the fish species identified in the study request document, tissue samples should be collected from burbot, lake trout, and northern pike. Lori

(USDWS) continued that liver tissue, in addition to muscle tissue, should be collected from larger fish, particularly burbot, because liver from this species constitutes a subsistence delicacy for Alaska Natives.

Lori (USFWS) acknowledged that bioaccumulation of metals would be detected in larger, long-lived species but stated that it would be important to sample muscle tissue from fish of early life-stages to assess the extent to which metals might be conveyed upward through trophic levels, e.g., from small fish to birds and furbearers. MaryLou Keefe (R2 Resource Consultants) stated that sculpin, one of the fish taxa identified in the study request document for tissue sampling, would be difficult to sample and would not likely provide useful information regarding metals accumulation because they would not use the reservoir habitat. Stakeholders agreed that no sculpin tissue would be collected for heavy metals analysis.

Ron Benkert (ADF&G) stated that tissue samples should be taken from Dolly Varden between 90 and 125 millimeters in length, to avoid inclusion of anadromous Dolly Varden in the metals assessment; because anadromous individuals have spent a portion of their lives in the ocean and farther downstream in the river, their tissues would not accurately reflect exposure to ambient conditions at the site of their collection.

Lori (USFWS) stated that it would be important to account for the effects of ambient water quality on the toxicity and bioavailability of metals, both under existing conditions and with the Project in place. Rob (Tetra Tech) stated that a pathways model would be an effective means of identifying potential bioaccumulation mechanisms, accounting for the effects of ambient water quality (e.g., pH, redox potential, hardness), as well as the Project's potential effects on those mechanisms.

Lori (USFWS) stated that there is often an increase in the potential for formation of methyl mercury (a bioavailable form) in newly-formed reservoirs, due in part to the inundation and breakdown of organic matter; this phenomenon is particularly common in reservoirs at high latitudes. Removal of vegetation prior to reservoir filling would be one way to reduce the potential for mercury methylation. Craig (Cardno-ENTRIX) agreed and stated that a reservoir's operational regime can also affect rates of methylation.

Terry (ADNR) asked when the pilot thermal imaging assessment would be conducted, adding that the best time might be just prior to ice-over because at that time differences between surface and groundwater temperatures would be significant. Michael Lilly (GW Scientific) said that the best time would likely be just after ice breakup, before runoff; at this time groundwater is likely to be about 2 ˚C warmer than surface water. MaryLou (R2) stated that the timing of breakup would be more predictable than ice-over, which would be advantageous in trying to schedule an over-flight.

Lori (USFWS) asked how thermal refugia would be identified and mapped if thermal imaging proved to be unsuccessful in the Susitna River. Craig (Cardno-ENTRIX) replied that a combination of ground surveys and aerial photographs of open leads in winter would be used to identify areas of groundwater upwelling. Michael (GWS) stated that at best thermal imaging would only provide a partial representation of upwelling areas and that a variety of techniques, including tracking of radio-tagged salmon, would need to be used to complete a proper assessment.

Wayne (AEA) stated that dye injections can be used to track groundwater and Michael (GWS) agreed that dye injections can be successful in some environments. Paul (URS) stated that isotopic methods, i.e., the use of stable isotopes of hydrogen and oxygen as markers of water source, might also be useful for groundwater investigations. Mike W. (Chase resident) stated that observations of groundwater elevation in his well had revealed that dramatic changes can occur over very short intervals following ice-over, i.e., he has observed as much as a 4-foot change in the well's water level within 24 hours.

Betsy (AEA) stated that it would be useful to know soon to what extent thermal imaging would provide valuable information. If possible, the pilot study should be undertaken in 2012; if not in spring of 2013. Craig (Cardno-ENTRIX) stated that much of the expense of conducting thermal imaging would be associated with the fixed cost of the over-flight. The incremental cost of conducting additional imaging would be relatively small and recommended that imaging be conducted for the entire river rather than for a small segment, as indicated in the study request document.

Water Quality Modeling Study (2013-2014)

Wayne (AEA) asked which water quality models were being considered for use. Rob (Tetra Tech) replied that a model with capabilities similar to the Environmental Fluid Dynamics Code (EFDC) would be used for the reservoir and river modeling. Rob (Tetra Tech) confirmed that the EFDC model is approved for use by the Environmental Protection Agency (EPA). Wayne (AEA) requested that Rob (Tetra Tech) provide a technical memo, including a description of the pros and cons of available water quality models and a recommendation as to which model would be most suitable for use in the Susitna River basin.

Eric (NMFS) stated that it would not only be important to identify the pros and cons associated with the available water quality models but also to explain how the water-quality model would interface with the suite of other models that will be used to assess Project impacts. Eric (NMFS) asked specifically how the water-quality model would be linked to the flow-routing model. Craig (Cardno ENTRIX) replied that ideally there would be a single flow-routing model that would provide input to all the other models. Craig noted that the water-quality model, like the ice-dynamics model, might require the use of its own routing component. The EFDC model has its own routing function, but use of different routing tools should not represent a problem as long as steps are taken to ensure that the responses of the various routing models are consistent with one another.

Tim Sundlov (BLM) noted that inflow chlorophyll *a* concentrations were identified as a data need in the modeling study request document but not in the baseline water quality document.

Rob (Tetra Tech) stated that chlorophyll *a* concentrations would be small in a glacially-fed system such as the upper Susitna River and questioned the need for collection of chlorophyll *a* data. Wayne (AEA) requested that Rob (Tetra Tech) provide a rationale for why chlorophyll *a* data should or should not be collected as part of the baseline water quality study and be prepared to discuss it at the next water quality meeting.

HecRES/Hydrology

River Flow Routing Model Data Collection (2012)

Wayne (AEA) noted that no routing model cross sections were proposed for the Devils Canyon reach. Michael (GWS) stated that no cross sections had been proposed for Devils Canyon, an approximately 15-mile reach, because collecting data there would be too dangerous.

Craig (Cardno ENTRIX) said that as part of study planning it would be necessary to develop an alternative approach to surveying cross sections in this reach, which could consist of "fabricating" transects based on aerial photos and comparisons to cross sections in other reaches of the river. John Haapala (MWH) stated that one of the primary purposes of a routing model is to account for attenuation of flow. Because of the physical characteristics of the Devils Canyon reach, there would be little attenuation, so it was less important to have empirical data for this reach than for other reaches downstream of the Project. Michael (GWS added that the bedrock channel in Devils Canyon is typified by complex hydraulics, so obtaining representative data would be difficult even if cross sections could be established and surveyed. It will be most important to accurately model the flows that enter and exit Devils Canyon.

Craig (Cardno-ENTRIX) asked how many cross sections would be surveyed downstream of the three rivers confluence. Dave Brailey (Brailey Hydro) stated that 19 cross sections would be surveyed and based on MWH's analysis of these 19 transects, a determination would be made as to whether additional transects should be established and surveyed downstream of the confluence.

Eric (NMFS) stated that winter data would be needed to accurately calibrate the routing model. Eric noted that the USGS would be collecting limited winter flow data at select gage locations and asked what other winter flow data might be gathered to supplement those collected by the USGS. Craig (Cardno-ENTRIX) replied that the approach to assessing winter flow routing was still under development but that it would be addressed in the context of the ice processes modeling, which would be discussed at the April 6, 2012 workgroup meeting. Craig (Cardno-ENTRIC) stated that Robin Beebee (HDR) and her team would be collecting ice thickness data along transects and that it might be possible to measure flow by accessing the river through the holes drilled to document ice thickness.

Eric (NMFS) asked if cross-section measurements would be depth-limited in the channel margins and whether there were plans to measure depths and velocities by wading in the margins. David (Brailey Hydro) replied that there was no plan to conduct measurements via wading, although a wading rod and current meter would be taken on the 2012 field trip in case they are needed. The Acoustic Doppler Current Profiler (ADCP) is capable of recording conditions at depths as shallow as one foot, and that it would therefore be possible to estimate flows from bank to bank. Dudley (R2) asked if the ADCP would be limited by water velocities. David (Brailey Hydro) stated that measurements could not be made at velocities exceeding 10 feet/second due to safety concerns.

Terry (ADNR) asked if roughness values for each transect would represent an integrated value for channel or if there would be multiple roughness coefficients for individual transects based on lateral variation in substrate. Stuart Beck (R2 Resource Consultants) stated that use of ADCP involves solving for a single roughness value for each cross section based on channel slope and substrate and that the roughness value would be adjusted for each transect as a function of river stage.

The workgroup discussed proposed winter Project operations, and John (MWH) stated that a maximum winter flow release of 8,000 cfs from the Project would be very large relative to winter accretion flows immediately downstream of the dam site. Wayne (AEA) stated that AEA understands that proposed winter load-following operations at the Project will be shaped based on potential effects on downstream resources. Wayne (AEA) reemphasized that understanding potential Project effects would require an accurate understanding of physical processes in the river basin, which makes it critical that a reliable set of simulation models be developed.

Eric (NMFS) stated concerned about the degree of uncertainty regarding how winter flow routing would be addressed, and as a result how all other modeling would be conducted. NMFS's comments on the study plans will reflect this ongoing concern.

Action Items

- AEA agreed to provide stakeholders with contact information for its technical consultants, particularly the study program leads.
- AEA agreed to schedule technical resource subgroup meetings in April and May 2012.
- AEA agreed to schedule a meeting to discuss groundwater issues and assessment methods in greater detail to make a determination as to whether a stand-alone groundwater document is needed.
- AEA agreed to add burbot, lake trout, and northern pike to the list of fish species from which tissue samples would be collected for metals analysis.
- AEA agreed to collect and analyze burbot liver tissue, in addition to muscle tissue, for mercury concentrations.
- AEA requested that Rob Plotnikoff (Tetra Tech) provide a technical memo describing the pros and cons of available water quality models and a recommendation as to which model would be most suitable for use in the Susitna River basin.
- AEA requested that Rob Plotnikoff (Tetra Tech) provide a rationale for why chlorophyll *a* data should or should not be collected as part of the baseline water quality study.

- URS/Tetra Tech will account for in-reservoir biomass (i.e., vegetation to be inundated by the proposed reservoir) in the reservoir modeling section (i.e., data needs) of the 2013-2014 Water Quality Modeling Study request document.

Decisions

- Stakeholders agreed that no sculpin tissue would be collected for heavy metals analysis.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Aquatic and Water Resources 2012/2013-2014
Study Plan Development
April 5, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	**Name**
ADNR	Kim Sager
ADF&G	Joe Klein
ADF&G	Jack Erickson
ADF&G	Ron Benkert
ADNR	Terry Schwartz
BLM-Glennallen	Tim Sundlov
BLM-Glennallen	Mike Sundergaard
FERC	David Turner
NMFS	Mandy Migura
NMFS	Eric Rothwell
NMFS	Sue Walker
USFWS	Mike Buntjer
USFWS	Bob Henszey (on phone)
USFWS	Betsy McCracken
USGS	Dave Meyer
Citizen	Mike Wood
Natural Heritage Institute	Jan Konigsberg
The Nature Conservancy	Corrine Smith
Ratepayers	Scott Crowther
AEA	Wayne Dyok
AEA	Betsy McGregor
AEA	Bryan Carey
Cardno ENTRIX	Craig Addley
Cardno ENTRIX	Jim Gill (on phone)
E-Terra	Lars Gleitsmann
GW Scientific	Michael Lily
HDR	James Brady
HDR	Keri Lestyk
LGL Alaska	Michael Link
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
MWH	Kirby Gilbert
MWH	John Haapala
R2 Resource Consultants	Dudley Reiser

R2 Resource Consultants	MaryLou Keefe
R2 Resource Consultants	Kevin Featherston
Solstice AK	Robin Reich

Presentations

Keri Lestyk (HDR)
- Beluga Whale Prey Analysis

Dave Meyer (USGS)
- USGS Flow Data

Alan Olson (R2)
- Existing Fisheries Data Synthesis

James Brady (HDR)
- Upper Susitna River Fish Distribution and Habitat Study

Michael Link (LGL)
- Distribution and Middle River Habitat Utilizations

MaryLou Keefe (R2)
- Timing Distribution and Relative Abundance of Juvenile Salmon in the Middle River
- Habitat Characterization for Off Channel Habitats
- River Productivity—Macroinvertebrate and Periphyton
- Reservoir Operations Fish Community and Risk Entrainment Study
- Non Anadromous/Invasive Species Study
- Access/Transmission Corridor Characterization Study

Dudley Reiser (R2)
- Instream Flow Study

Kevin Featherston (R2)
- Riparian Instream Flow Study

General Questions/Discussion

Steve Padula (LVA) stated that FERC had granted a deadline extension, to May 31, 2012, for stakeholders to provide comments on the Pre-Application Document (PAD), scoping document 1 and formal study requests as part of the ILP process. Steve (LVA) noted that FERC had adjusted subsequent ILP milestones commensurate with the comment extension. AEA will post a revised Project licensing schedule on its website. The previously scheduled May 2012 workgroup meetings are canceled and will be held during the second week of June 2012.

Steve (LVA) said that during the next several months AEA intends to begin scheduling subgroup meetings, which would involve greater focus on the details of study planning and execution. Wayne Dyok (AEA) added that these meetings would be open to anyone who wished to participate but that the focus of the meetings would shift to more technically-oriented topics.

Steve (LVA) stated that 2012 study plans were nearing completion and AEA was requesting that stakeholders provide final input on the 2012 plans by the week of April 16, 2012. Steve (LVA) stated that AEA would be finalizing and distributing the 2013-2014 formal study request documents over the next several weeks and asked that stakeholders provide any input as soon as possible, so that by the time the requests are filed they are as comprehensive as possible, which would reduce the amount of work required by stakeholders.

Cook Inlet Beluga Whale Prey Study Plan

Keri Lestyk (HDR) presented the Cook Inlet Beluga Whale Prey Analysis. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Mandy Migura (MNMFS) said that the draft Cook Inlet Beluga Whale Recovery Plan would be completed in the next year.

Wayne (AEA) asked when the synthesis of existing data would occur. Keri (HDR) said that the team is beginning now and should be completed in the next two months.

Mandy (NMFS) said that the National Marine Mammal Laboratory (NMML) has an opportunistic database based on sightings of beluga whales. Mandy (NMFS) said these data might not be as accurate as those produced by systematic studies, but the database is still a good source of data. Mandy (NMFS) said that ADF&G had an acoustic recorder near the Susitna River delta that was collecting year-round data, which is important because there may be year-round use of the delta by Cook Inlet belugas.

Mandy (NMFS) said that other marine mammals' prey and habitat should be considered. She said that harbor seals, killer whales and harbor porpoise are seen in the area, and they are managed under the Marine Mammal Protection Act (MMPA). Mandy (NMFS) said that if there is the potential for harassment or take of these species as the result of Project activities, a permit would be required.

Wayne (AEA) said that AEA had scheduled a July field visit planned for interested agencies, during which agencies could visit the mouth of the Susitna River. Mandy (NMFS) said that June is the period of peak Cook Inlet beluga presence in the delta.

Keri (HDR) said that AEA will develop a no-impact protocol for the 2012 field studies. Mandy (NMFS) said that AEA should initiate informal consultation under the Endangered Species Act

(ESA) as soon as possible. Wayne (AEA) said that FERC would do formal consultation until it specifies that AEA is the designee for ESA consultation.

Wayne (AEA) asked how NOAA Fisheries studies belugas in riverine systems. Mandy (NMFS) said that NOAA Fisheries does in-house aerial surveys, which are conducted when whales are congregated and during low tides to increase success of findings. She said that June aerial surveys are lacking in temporal scope, which is needed for the Project. There are some satellite tagging data, which may show upriver movement of whales. Mandy (NMFS) said that the Alaska Sealife Center had a camera that showed how far Cook Inlet belugas travelled up the Little Susitna River, which could help understand how far upstream Cook Inlet belugas may go in the Susitna River. Keri (HDR) said that the Sealife Center is on the HDR team for installing cameras for this study.

Mandy (NMFS) said that there are critical habitat species that are not listed in the study plan, including gadus and yellowfin sole. During ESA consultation, all the critical-habitat species and the Project's effects on these species will need to be addressed. Mandy (NMFS) said that her comments at the meeting were informal and she would likely provide additional comments later. Keri (HDR) said that the beluga team would coordinate with other Project studies. Mandy (NMFS) said that NMFS has evidence that topography and bathymetry might be equally or more important elements of beluga whale habitat than prey species. Project changes to bathymetry could impact beluga predation success.

Mandy (NMFS) said that NMFS is interested in changes in habitat and how the Cook Inlet belugas might be affected. NMFS is also interested in changes in prey density, timing of prey species runs, and which prey species beluga feed on during winter. The Susitna River delta is the first place newborn Cook Inlet belugas are seen, so it is an important area to understand.

Wayne (AEA) asked whether winter studies of belugas can be successful and whether belugas will use iced-over areas. Mandy (NMFS) said that based on satellite data, belugas can be present in areas with 100 percent ice cover. There is a NMML report that might have in-depth beluga dive data from the satellite tags; however, the data needs to be fine-tuned. Mandy (NMFS) said that NMFS does not know how far belugas can travel or how long they can remain under the ice.

Mike Wood (Chase resident) asked whether eulachon studies would be conducted. Keri (HDR) said that the Cook Inlet beluga study will be a year-round study, but would focus on eulachon only when Cook Inlet belugas would be feeding on them. Mike W. (Chase resident) said that he had previously seen eulachon as far upstream as Willow, whereas currently they appear travel no farther upstream than Yentna. MaryLou Keefe (R2) said that the eulachon study area is focused on where they are preyed upon by belugas.

USGS Susitna Basin Hydrological Study Plan

Dave Meyer (USGS) presented the USGS Susitna Basin Hydrological Study. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Dave Meyer (USGS) said that USGS would be using pressure transducers and that sensors would be placed in the best locations to collect good temperature and sediment data. Dave (USGS) said that USGS would collect data at cross sections to relate continuous water temperatures of the whole stream channel. Michael Lily (GWS) said that AEA will need to know where data are collected. Dave (USGS) said that no temperature or turbidity data would be collected in the winter, but that the thermistors would be left in place. The thermistors would not be in the deep areas that would remain ice free, so that records from these thermistors would not reflect ambient winter water temperatures.

Eric Rothwell (NMFS) asked for a description of the winter gauging. Dave (USGS) said that two to three discharge measurements are taken along a transect by boring holes through the ice, as soon as the ice is strong enough to safely support field crews. Dave (USGS) said that USGS estimates discharge between the initiation of freeze up and the time when field crews can safely work on the ice, i.e. no measurements are made during that period. USGS tries to take early, mid, and late winter discharge measurements. In cases where the USGS has collected winter data consistently, it has been shown that linear estimations between sampling points are reliable, characterized by about ±12 percent error.

Eric (NMFS) said that understanding winter flows would be critical for characterizing fish overwintering habitat. Dave (USGS) said that assessing winter hydrology is challenging because the relative amount of groundwater-surface water interchange is greater during winter. There is a need for more frequent sampling at more locations to more accurately characterize winter flows.

Joe Klein (ADF&G) asked whether hydroacoustics could be used to estimate bedload. Dave (USGS) replied that daily access to instruments and use of a permanent platform, such as a bridge or bridge pier, would be required to apply hydroacoustics. The use of hydroacoustics for measuring bedload is still an experimental technology and might not be a reliable means of developing daily load calculations.

Wayne (AEA) asked whether bedload measurements could be taken during a flood flows. Dave (USGS) said that USGS used heavy-duty bedload samplers that weigh between 150 and 300 pounds that would be capable of withstanding high-flow conditions. During high flows, routine discharge measurements are done with acoustic measurements from a boat. During floods, collecting load materials could be dangerous because of trees moving down the river. Dave (USGS) said that in 1980s, bedload transport rates varied each day. Total load estimates tend to be inaccurate without continuously collecting bedload data over a long period of time because the natural bedload rates are very variable. USGS would likely assume that bedload accounts for about 5 to 20 percent of the total sediment load and focus its efforts on measuring suspended sediment.

Dave (USGS) said USGS performs QA/QC on winter stage data and only publishes data considered to be representative. USGS measures ice thickness and provides data to the National Weather Service. He said these data could be made available to AEA.

Bryan Carey (AEA) asked which of the upstream gaging sites would be most useful for calibrating the hydraulic routing model and whether flow records could be synthesized based on rating curves from locations farther downstream. Dave (USGS) replied that the most reliable data would come from the MacLaren River at the Denali Highway (near Paxson) and Susitna River near the Denali Highway (near Denali) sites, but a synthesized flow record would be inadequate for calibrating the model upstream of Denali Highway, and it would be better to calibrate the model based on data from the Gold Creek or Tsusena gages.

Dave Terry Schwartz (ADNR) asked whether the same methods employed in 1985 to measure bedload would be used for the current study. Dave (USGS) said that there are slight differences in gear but that techniques were basically the same.

Fish and Aquatic Resources Study Plans Questions/Discussion

Existing Fisheries Data Synthesis Study Plan

Alan Olson (R2) presented Existing Fisheries Data Synthesis Study Plan. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

ADF&G requested that the study include an assessment of historical data related to *Elodea* and lake trout distribution and abundance.

Mike Buntjer (USFWS) asked how the study would assess fish-habitat selection (i.e., use relative to abundance of a given habitat), as opposed to simply habitat use. Craig Addley (Cardno ENTRIX) said that habitat suitability criteria (HSC) developed in the 1980s might be used.

Sue Walker (NMFS) said that the Aquatic Resources Data Gap Analysis does not document all the data needs. Betsy McGregor (AEA) said that all of the reference documents are available through ARLIS, but not all are linked and available on line. Betsy (AEA) said that AEA will be checking with ARLIS to get these documents linked, but that AEA is not finding additional or previously undiscovered materials, but there are some low-quality or missed pages in some of the reference materials.

MaryLou Keefe (R2) said that historical data may need to be extracted from written reports, which could require a lot of time. MaryLou (R2) said that R2 is doing an assessment of whether such data are could be used in current analyses. Sue Walker (NMFS) asked about the schedule. Betsy (AEA) said that the analysis should be completed by mid-summer 2012. Sue (NMFS) said that in discussions earlier, NMFS had asked for null data, i.e., where sampling had revealed habitats that were not used by fish. Dudley Reiser (R2) said that R2 would check with Woody Trihey (Cardno ENTRIX) to see what data he might have. Alan Olson (R2) said that ideally the synthesis of existing data would be done as quickly as possible to make it useful for implementing the 2012 studies and for developing 2013/14 study plans.

Mike B. (USFWS) asked about nomenclature and labeling areas as river segments versus reaches. Betsy (AEA) said that the workgroup would have one system-wide classification based on reach and subreach designations. MaryLou (R2) said that everyone on the project will use the same system. Betsy (AEA) said that a map of reaches and subreaches would likely be available at the June 2012 workgroup meeting. MaryLou (R2) stated that there would be some refinement of the nomenclature during the summer 2012 field effort. Betsy (AEA) said that the Project will have one GIS layer, by river mile, which will include a naming convention for all streams that are unnamed.

Upper Susitna River Fish Distribution and Habitat Study

James Brady (HDR) presented the Upper Susitna River Fish Distribution and Habitat Study. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Joe Klein (ADF&G) asked if resident-fish habitat lost as the result of reservoir construction would be documented. James (HDR) said that Objective 3 of the study would evaluate the quality of the habitat in the inundation zone. Betsy (AEA) said that the study would include an assessment of all barriers to fish migration in tributaries that exist now and would cease to exist after the reservoir is in place.

Ron Benkert (ADF&G) said that there is observer bias associated with collecting habitat data which could be compounded by different groups collecting information. Integration across disciplines is needed and training could be conducted to reduce bias. MaryLou (R2) said that AEA was developing habitat survey protocol and would be coordinating with the workgroup. There would be QC field checks by experienced scientists throughout the season.

Betsy McCracken (USFWS) said that the USFWS might recommend a different classification system than that developed by AEA. Joe (ADF&G) said that protocol would need to be consistent with the Montgomery Buffington System. MaryLou (R2) said that it would be. Joe (ADF&G) said that the AEA needs to make available all references used in the development of habitat survey protocol. Sue (NMFS) said that it would be helpful if AEA could provide draft protocol for review before the next workgroup meeting. Betsy (AEA) said that AEA would provide protocol, references, and a map at the June next meetings. Sue (NMFS) said that the team should look at NOAA Shorezone (mapping) Program (http://www.fakr.noaa.gov/shorezone/default.htm) as an example product.

Ron (ADF&G) said that he was concerned that some habitat types, for example undercut banks, could be overlooked because aerial photography is being used to select sampling locations. Sue (NMFS) said that the mapping would need to be groundtruthed. MaryLou (R2) said that the team would be doing ground surveys where there is poor imagery.

Mike Sundergaard (BLM) said that a separate smaller group needs to meet to develop habitat survey protocols. Betsy (AEA) said that it would be important to remember the objectives of the study when considering methods.

Mike B. (USFWS) asked whether there was any corresponding shift in the peak Chinook runs since the 1980s based on ADF&G findings. Betsy (AEA) said that they haven't observed any changes in timing based on recent work. Ron (ADF&G) said that there needs to be more attention directed toward assessing mainstem salmon spawning. Betsy (AEA) said that the team would fly the mainstem to do aerial surveys. Joe (ADF&G) asked whether carcass surveys would be conducted. Betsy (AEA) said that AEA would do carcass and redds surveys.

Wayne (AEA) asked whether upstream work would be done above fish migration barriers. Betsy (AEA) said that work would continue upstream to the first fish barrier that would remain intact after reservoir filling or to 3,000 feet, whichever is encountered first. Mike B. (USFWS) said that it would be useful to document resident fish habitat upstream of the inundation zone in the mainstem of the Susitna River. Betsy (AEA) said that AEA needed to better understand the extent to which Chinook pass through Devils Canyon to assess the Project's effect on habitat in the inundation zone.

Sue (NMFS) asked for the biological basis for limiting surveys to 1 mile above a barrier. Sue (NMFS) said that AEA should document habitat in tributaries upstream to the point where it is no longer suitable. MaryLou (R2) said that the team could sample for fish at 3,000 feet, and if fish are present then they could keep looking until the habitat suitable for Chinook is no longer available. Sue (NMFS) confirmed that that would be a good strategy. Jack Erickson (ADF&G) said that radio-tagged Chinook would be tracked, which would help define the upstream extent of the species' distribution.

Mike B. (USFWS) asked why no genetic information would be collected for adult salmon. MaryLou (R2) said that tissue samples would be collected from radiotagged (i.e., adult) salmon and could be used for genetic analysis. Jack Erickson (ADF&G) said that any adult salmon that are handled should be sampled for genetic analysis. Genetic samples should only be collected if the fish is living and still fresh and six or more individuals per tributary would be best. Jack (ADF&G) confirmed that the collections could be made over the next few years. ADF&G would like samples of all salmon species, if possible.

Betsy McCracken (USFWS) asked how far upstream the distribution of northern pike extends. James (HDR) said that pike have not been found above Devils Canyon.

Distribution and Middle River Habitat Utilizations

Michael Link (LGL) presented the Distribution and Middle River Fish Habitat Utilizations Study. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Mike B. (USFWS) asked why there was not plan to locate a radio telemetry receiver station at the proposed dam site. Michael (LGL) said that they would be flying every five days to figure out whether the tagged fish would be going up tributaries. Any fish that make it above Devils Canyon would be tracked to their spawning locations. Mike B. (USFWS) said that the study plan should be revised to make that clear. Michael (LGL) said that there had been changes to the study plan since it had been provided to stakeholders.

Mike B. (USFWS) asked whether genetic differences would be expected between fish migrating to different areas in the watershed, mainly between those occupying the lower river and those above Devils Canyon. Jack (ADF&G) said that there would be.

Michael (LGL) asked whether it be better to collect Chinook genetic samples at the time of radio-tagging or from individuals on their spawning grounds. Jack (ADF&G) said collecting samples from fish on the spawning grounds would provide a better characterization of the genetic baseline and differences between upper basin fish and those elsewhere in the system. Michael (LGL) said that it would be best to avoid taking tissue samples from fish during radio tagging to minimize handling and, as a result, the risk of affecting the behavior of tagged fish. If many Chinook pass Devils Canyon, additional work would be recommended for 2013-2014.Sue (NMFS) asked whether eggs could be used for genetic analysis. Jack (ADF&G) said that it would be necessary to consult appropriate experts to make that determination.

Mike B. (USFWS) asked whether AEA was planning to do secondary tagging as was proposed in the original study plan. Sue (NMFS) asked what range of tag loss was expected. Michael (LGL) said that 5 to 10 percent tag loss was typical. Sue (NMFS) asked what risk was involved in ancillary tagging. Jack (ADF&G) said that any puncturing of a fish's body would increase the risk of altering its behavior.

MaryLou R2) said that the HDR team would be sampling in the upper watershed and could take genetic samples. Jack (ADF&G) said that whatever can be done to get accurate baseline genetic samples in 2012 would be best. Mike B. (USFWS) asked whether the team was planning on taking genetic samples from other fish that are found with the tagged fish. Michael (LGL) confirmed that samples would be collected from any aggregation of fish above Devils Canyon. Mike B. (USFWS) said that samples from tagged fish should be segregated from untagged fish.

Craig (Cardno ENTRIX) said that collecting genetic fish information is a secondary goal and that the main goal of the study is to figure out whether mainstem spawning is occurring and where the fish are going above Devils Canyon.

Jack (ADF&G) said that these are multi-year studies, which will be continued next year. When genetics samples are collected, sampling on the spawning grounds is needed to get a clean baseline.

Sue (NMFS) said that she still questions whether a secondary tag isn't useful and suggests that a teleconference is needed to discuss the subject more. Michael (NMFS) said that the results of

2012 will help understand whether there is a need for secondary tagging. Betsy (AEA) said that ADF&G will be doing another tagging study.

Eric (NMFS) said that the methods for studying groundwater were discussed at the April 4 meeting, but that there was no ILP study request directed specifically at groundwater assessment. Betsy (AEA) said that AEA would set up a meeting with agencies to discuss groundwater study in April and requested that agencies send an email to her that includes specifically what the agencies would like to discuss.

Timing Distribution and Relative Abundance of Juvenile Salmon in the Middle River

MaryLou (R2) presented the Timing Distribution and Relative Abundance of Juvenile Salmon in the Middle River Distribution. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Mike B. (USFWS) asked how the middle river was defined. MaryLou (R2) said the middle river extended from the confluence of Chulitna River to Devils Canyon. MaryLou (R2) said that AEA was not studying at juvenile salmon in the lower river.

Joe (ADF&G) asked how the juveniles would be marked. MaryLou (R2) said PIT tags and PIT tag arrays would be used to detect fish. Joe (ADF&G) said that it would be important to sample at the right time because the juveniles could be missed.

Mike B. (USFWS) asked why Whiskers Creek was selected. MaryLou (R2) said it was selected because it is at the lower end of the run. Mike B. (USFWS) said that the team might want to meet to go through the protocols in more detail. Mike B. questions why the lower reach wasn't being studied. Eric (NMFS) said that the Project needs to get the results of modeling to determine lower river impacts. Betsy (AEA) said that the team will be looking at the lower river for beluga prey species and that there would be other lower river work occurring.

Habitat Characterization for Off Channel Habitats

Joe (ADF&G) said that if the study only focuses on the physical aspects it would miss biological aspects, like macroinvertebrates and other parameters. Joe (ADF&G) said that he would like to see the ability to classify categories of off-channel habitat types; the team could modify and expand the data collected so that he could understand the range and variables that the habitats may have. MaryLou (R2) said that the goal of the work is to have consistent standards that can be used across studies. Dudley Reiser (R2) said that the instream flow studies will be consistent with the 1980s work and that some of the additional parameters that were brought up by Joe (ADF&G) might be covered.

Eric (NMFS) said he knew the studies are linked, but the Project should be able to tie habitat types and functions. The team needs to make sure that habitat type information can link back to the entire river system. The plans needed to clearly identify the links between the studies and various modeling efforts.

River Productivity—Macroinvertebrate and Periphyton

Betsy (AEA) said that maps including historic data and 2012 information would be sent out soon.

Mike B. (USFWS) said that work was proposed in the lower reach in the 1980s and that work in the lower reach could be warranted.

Mike S. (BLM) said that currently the top predator is lake trout. Lake trout are in Sally Lake and would definitely have an impact on the resident fish. MaryLou (R2) said that "transitional" in reference to sloughs a temporal definition, not a geographic area. MaryLou (R2) said that the review of the 1980s data would give more information on where the transitional sloughs areas are located. Jan Konigsberg (NHI) said that transitional slough areas were mapped in the 1984 studies, assuming that the baseline hasn't changed. MaryLou (R2) said that AEA wants a minimum of three transitional slough sample sites.

Craig (Cardno ENTRIX) said that they found that during turbid water, there was a lot of drift, and during clear water, the available drift was down. MaryLou (R2) said that they would have to look at this type of habitat type two times-once when the water was turbid and again when the water was clear. Joe (ADF&G) said that APA documents from 1980s studies show 13 sites. MaryLou (R2) said that the team would repeat sampling at those sites with the goal to make the information consistent with the 1980s as much as possible and still maintain quality work and new, more informative methods.

Dudley (R2) said that the invertebrate sampling issue often comes up with instream flow. This piece will help us understand how habitat could change with the project. Dudley (R2) said that smaller workgroup meetings would help determine sampling sites and a classification system.

Reservoir Operations Fish Community and Risk Entrainment Study

Joe (ADF&G) said that it was important to look at primary productivity and how it would be affected. Jack (ADF&G) said that ADF&G manages the fisheries in the area; however, he didn't know what would happen if there was no fishery. Betsy (AEA) said that the team would be looking at sport harvest potential based on access to the reservoir in the recreation studies. Joe (ADF&G) said that whether the road is public is an important question. Betsy (AEA) said that this would be determined by looking at safety and the socioeconomics results.

Non anadromous/Invasive Species Study

Alan Olson (R2) asked whether agencies thought that burbot should be included in the study plan. Alan (R2) said that burbot may be important because have a different timing than other species. Mike W. (Chase resident) said that he sees grayling, long nose sucker, Dolly Varden, hooligan, burbot, grayling and rainbow trout year round. Mike W. (Chase resident) said that he had not seen eulachon up river, but that he once got them in Talkeetna. He once could get them at Deshka Landing, but now he sees them at Yentna. MaryLou (R2) said that they could be checking for blackfish.

Access/Transmission Corridor Characterization Study

Ron (ADF&G) said that this study is important to ADF&G because they are looking at the structures. Ron (ADF&G) requested that if fish are not collected at a certain time to return to the area at another time of year.

Jan (NHI) asked why there was no juvenile salmon study planned for the lower river and said that during the last project effort (1980s), winter flow was load following and possible stranding of fish was a possible Project impact. Jan (NHI) said that he was interested in what juveniles are in the river and when. Craig (Cardno ENTRIX) said that AEA understands that this issue needs to be addressed. Steve Padula (LVA) said that AEA will want to continue this coordination and by November 2012, there should be agreement on studies to conduct.

Instream Flow Study

Dudley (R2) presented the Instream Flow Study. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Joe (ADF&G) said that for the reconnaissance visit, it would be good to have the1980s data and a map to understand and plan the trip to see where to go and to observe habitats. Dudley (R2) said that they should be able to develop a selection of photo plates of locations to revisit to see whether the sites have changed since the 1980s. Michael (GWS) said that the cross-section studies would look at this. Dudley (R2) said that intensively modeled areas should be reexamined. Joe (ADF&G) said that there is a lot of complexity at locations and that the Project might need a two-dimensional model. Joe (ADF&G) said that this type of depiction as well as overall reach, the proportions of upland sloughs compared to side channels, will be important to plan the trip.

Betsy (AEA) said that the team was obtaining 1980s aerial imagery to use in comparing sites over time. Joe (ADF&G) said that he might have a box of old photos available. Betsy (AEA) said that the LiDAR photography would be available before the end of May 2012 and that other imagery would be available in reservoir area. A three-dimensional model will be built in GIS. Bob Henzley (USFWS) said that the LiDAR data could be used to do a three-dimensional model of the watershed and that it is better than a longitudinal profile. He added that the team should be looking for major breaks in gradient. Betsy (AEA) said that it would be tough to get water surface because it has changed.

Michael (GWS) said that a survey control for the mainstem would be tied to the LiDAR survey control and series of points that would help to show water level. Craig (Cardno ENTRIX) said that 100 transects would be taken down the river plus more with geomorphology and riparian data.

Eric (NMFS) asked what the mechanism was for model selection and how the model decision would be made. Dudley (R2) said that there are times when you can use multiple methods, but is it necessary to address question. There might be some situations where habitat value and complexity needs to be more detailed in the modeling approach. Dudley (R2) said that part of the rational is site selection and part is what model is most suited for the habitat type. Eric (NMFS) said that there might be a need for an extra model for defensiveness. An agreement on what is important is needed, and that depends on what information is known. Eric (NMFS) asks how the dominate variables that control the habitat quality would be determined. Dudley (R2) said that he was confident that from review of 1980s data, the team would get an idea of where groundwater influence was a factor or where other physical features are controlling the system. The ice study may provide a better understanding of upwelling.

Betsy McCracken (USFWS) asked whether Google Earth could be used to identify areas based on a geomorphology concerns. Lars Gleitsmann (E-Terra) said that Google Earth would not work, since the data is too course, only covers a portion of the project area, and has ice and snow cover.

Joe (ADF&G) said that he didn’t see when 2012 results would be available. Dudley (R2) said that the draft study plan technical memorandum would be available in June 2012 at the earliest and that the final tech memos would be completed by November 2012. Joe (ADF&G) said that the information is needed to review before go out in the field. Dudley (R2) said that they could prepare a tech memo to plan the agency field trip to focus the effort. Joe (ADF&G) said that it would be nice to visit a representative sample and biological hot spots as determined in the 1980s. Betsy (AEA) said that there would be interim deliverables given out prior to workgroup meetings like map products.

Michael (GWS) asked if the trip was planned in August 2012, there would be more information from earlier summer efforts. Dudley (R2) said that they want to plan the field visit around when the water is going down, so we can see what is going on in sloughs, for example. Joe (ADF&G) said that when the water is receding depends where you are at in the river, or when. Michael (GWS) said that late August or September will be the best time to go if targeting before ice and around 10,000 to 12,000 cfs.

Sue (NMFS) said that all the models seem to assume a before-project baseline and an after-project baseline; however, project effects would happen over a long time-frame, and it is difficult to predict over time. Eric (NMFS) said that although there would be an additive effect over the long term, with the geomorphological model it can be carried forward to the long term. Dudley (R2) said that they would be looking at a 50-year time frame and that flow, sediment transport, and other features would be used to understand what would happen to other features.

Joe (ADF&G) said that he would like to see the slow succession over the 50-year license. The habitat models concept is good to see what process is driving the fish species. Joe (ADF&G) said that the project needs to add fish behavior and response, when juveniles seek out cover, and feeding behavior and shelter. Turbidity needs to be understood and modeled, and groundwater needs to be understood. Sue (NMFS) said that temperature is important. Joe (ADF&G) said that when adult salmon like to hold in deep waters need to be added to the modeling.

Mike S. (BLM) asked how confident the team would be with the temperature modeling, Craig (Cardno ENTRIX) said that it would be harder because it is a new project, but the water temperature will be pretty good. Joe (ADFF&G) said that as he understands, the project would be a multi intake system, so it could control water temperatures. Craig (Cardno ENTRIX) said that they would have feedback loop in the modeling for operations and impact categories. Betsy (AEA) said that they may have flushing flows and maintenance or load following scenarios and that there would have to be a balance of the energy demand and economics, bracketed by environmental needs.

Terry Schwartz (ADNR) asked how groundwater would be addressed in the modeling. Dudley (R2) said that in terms of instream flow, there was a lot of work in the 1980s data where groundwater and stage connections were identified that will be tested. Dudley (R2) said that there may be sites where temperature intensively studied. Craig (Cardno ENTRIX) said that the team understands that how groundwater studies would be integrated needs to be integrated. Terry (ADNR) said that the geotechnical bores might give some information, like bedrock fractioning. Joe (ADF&G) said that there might be other processes that drive groundwater and he was interested in what influences upstream development might have on those processes.

Betsy (AEA) said that small meetings would be set up for the next two to three weeks to address and get help with developing study plans for the groundwater issue, routing, and fisheries studies protocols. Sue (NMFS) requested that AEA send out protocols to the group prior to the fisheries meeting, so that they can be reviewed.

Riparian Instream Flow Study

Kevin Featherston (R2) presented the Riparian Instream Flow Study. See the corresponding PowerPoint presentation (Susitna-watanahydro.org).

Joe (ADF&G) asked for a definition of domain. Kevin (R2) said that in terms of where there are similar geomorphic river processes. Kevin (R2) said that it is where there are difference disturbance process occurring for example, areas where only alluvial process are happening.

Kevin (R2) said that their group would work with the geomorphology group and the ice processes group to figure out where to do intensive studies. Bob (USFWS) said that the area right below the dam was not shown for study. Kevin (R2) said that they were planning on studying there and immediately below the three rivers confluence.

Kevin (R2) said that it is likely every 10 years that peak flow would occur, but this information would be determined by looking at the age of the forest, the plant community age, distribution, and the hydrograph. Wayne (AEA) said that this type of work has been done in other places and this study is the key to understanding the system.

Bob (USFWS) asked whether the team would measure the valley-wall to valley-wall. Kevin (R2) said that they would just look at riparian areas with their target being to look at the entire active valley that is the region which is flooded by a 100 or 200-year event. Kevin (R2) confirmed that the study would help to understand the effects of changes to water flow on plant communities.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Water Resources Study Development Workgroup Meeting
April 6, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	**Name**
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Bryan Carey
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Bob Henszey (by phone)
NMFS	Susan Walker
NMFS	Eric Rothwell
BLM	Tim Sundlov
BLM	Mike Sundergaard
USGS	Dave Meyer
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADNR	Terry Schwartz
FERC	David Turner
FERC	Paul Makowski
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsberg (by phone)
Long View Associates	Steve Padula
Long View Associates	Randall Filbert
Cardno ENTRIX	Craig Addley
Cardno ENTRIX	Jim Gill (by phone)
HDR	Robin Beebee
URS	Paul Dworian
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	Kevin Featherston
Tetra Tech	Bill Fullerton
GW Scientific	Michael Lilly
Watershed GeoDynamics	Kathy Dubé
E-Terra	Lars Gleitsmann
Solstice Alaska	Robin Reich
Alaska Ratepayers	Scott Crowther
Chase Resident	Mike Wood (by phone)

MWH

Presentations

- Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography – Draft Final (2012 study plan)
- Reconnaissance Level Geomorphic and Aquatic Habitat Assessment of Project Effects On Lower River Channel – Draft Final (2012 study plan)
- Geomorphology Study (2013-2014 study request)
- Fluvial Geomorphology Modeling below Watana Dam Study (2013-2014 study request)
- Documentation of Susitna River Ice Breakup and Formation – Draft Final (2012 study plan)
- Ice Processes in the Susitna River (2013-2014 study request)

Fluvial Geomorphology Modeling below Watana Dam

Wayne Dyok (AEA) stated that Bill Fullerton's (Tetra Tech) extensive experience with fluvial geomorphology would be augmented by the participation of Mike Harvey (Tetra Tech), an internationally recognized expert in the dynamics of glacially fed river systems.

Eric Rothwell (NMFS) questioned that given the one-dimensional (1D) sediment transport model for the Susitna River would be run using input from the flow routing model, would the number of routing model cross sections would be sufficient to adequately simulate sediment transport at the reach and sub-reach level.

Eric (NMFS) stated that flow routing transects, selected for simulating flow attenuation, are typically located in areas where the channel's cross section is simple, and that data from these locations might not be appropriate for modeling sediment transport. Bill (Tetra Tech) replied that more flow routing cross sections could be necessary for 1D sediment transport modeling, but that field reconnaissance would be needed to make decisions about whether- and where- additional cross sections may be needed. He encouraged the workgroup to be careful and patient when making decisions about the placement of additional cross sections to avoid wasting time and funds by establishing additional cross sections in inappropriate locations.

Wayne (AEA) asked how bathymetry would be developed for sections of river where two-dimensional (2D) geomorphic modeling is to be applied. Craig Addley (Cardno ENTRIX) replied that LiDAR would be used to map the terrain above the water-line, multi-beam sonar would be used to develop bathymetry within the wetted channel, and photogrammetry would be applied to characterize those areas not accounted for in the overlap of the previous two methods.

Jan Konigsberg (NHI/HRC) asked how 1D sediment transport modeling would be applied to account for geomorphic dynamics in tributaries. Bill (Tetra Tech) replied that the 1D model would account for flows and sediment input from significant tributaries. Bill (Tetra Tech) emphasized that 1D sediment transport models simulate large-scale dynamics longitudinally within a river basin and as such they respond to large sediment and flow inputs. Addressing smaller-scale geomorphic phenomena, such as sediment dynamics at tributary mouths, would require 2D modeling or delta evolution analysis. Bill (Tetra Tech) again cautioned that the small-scale methods would be labor intensive and time consuming, so analysis locations would have to be carefully selected to make results as useful as possible for assessing potential Project impacts.

Wayne (AEA) asked if 2D modeling could be applied at the mouth of the Chulitna River, which is a major source of sediment input to the Susitna River. Bill (Tetra Tech) stated that the confluence of the Chulitna and Susitna rivers is a large and complex area and that applying 2D techniques there would be a very involved undertaking. The workgroup should be certain that this level of analysis is necessary before planning such a large-scale effort.

Craig (Cardno-ENTRIX) noted that USGS records would provide good estimates of the volume of flow and suspended sediment entering the Susitna River from the Chulitna River and asked Dave Meyer (USGS) if similar data were available for Indian and Portage creeks. Dave (USGS) replied that no data were available for these streams. Bill (Tetra Tech) stated that it would be necessary to estimate suspended sediment input from many of the tributaries using transport equations and to develop bedload estimates based on sediment deposition at tributary mouths.

Betsy McCracken (USFWS) stated that tributary mouths are often biological "hotspots" and locations where adult fish stage prior to entering tributaries for spawning, so it would be important to model these locations to understand potential Project impacts. Bill (Tetra Tech) asked if members of the workgroup could identify specific tributary confluences of high biological importance. Mike Buntjer (USFWS) and Joe Klein (ADF&G) replied that it would be easier to identify key tributary mouths after the 2012 fisheries studies, especially telemetry studies, are completed.

Terry Schwartz (ADNR) asked if output from the 1D model would be helpful in identifying locations for 2D modeling. Bill (Tetra Tech) replied that the 1D model is a gross tool for assessing large-scale sediment transport and deposition, and as such would not be that useful for identifying potential 2D sites. It would be more effective for 2D sites to be selected by experts, and vetted by the workgroup, based on empirical observations made during 2012.

Bob Henszey (USFWS) noted that during FERC's scoping meetings William Harrison, Professor Emeritus, Geophysical Institute, University of Alaska had stressed the importance of sediment pulses released by glaciers in the upper Susitna basin. Bob (USFWS) noted that these pulses are an important geomorphologic phenomenon, affecting island building and the distribution and persistence of riparian vegetation. He asked if the 1D model would be capable of accounting for these glacially induced sediment pulses. Bill (Tetra Tech) stated that the pulses could be accounted for in the 1D model at a gross level by modeling a range of sediment loading scenarios. However, the 1D model would not be capable of tracking the effect of a sediment pulse at specific downstream locations. Wayne (AEA) stated that Mike Harvey (Fluvial Geomorphology task lead, Tetra Tech) would contact William Harrison to discuss the effects of glaciers on sediment dynamics in the Susitna River basin.

Betsy McCracken (USFWS) asked if the 1D model could be used to assess differences in sediment transport associated with a variety of Project load-following scenarios. Bill (Tetra Tech) explained that the model would not be capable of modeling at such a fine scale and that other techniques would be required to address such questions. Craig (Cardno-ENTRIX) stated that geomorphic changes would result from effects on bedload movement and that bedload is moved by high flows. The magnitude of difference in flows among various load-following scenarios would be small and not sufficient to produce differences in bedload movement, i.e., bedload movement would not vary among load-following scenarios.

Bill (Tetra Tech) reemphasized that the 1D model would be insensitive to small-scale phenomena and would not be capable of identifying locations of erosion, deposition, shoreline sloughing, etc. The purpose of the model will be to understand baseline sediment transport generally and identify large-scale changes to sediment transport associated with Project construction and operation. The Project would dramatically alter sediment supply immediately downstream of the proposed dam site and that this level of effect would be accounted for by the model.

Joe (ADF&G) asked what the time step would likely be for the 1D sediment transport model, and Bill (Tetra Tech) replied that a daily time step would be appropriate given the purpose and capabilities of the model. Joe (ADF&G) asked what the proposed time step would be for 2D modeling. Bill (Tetra Tech) stated that 2D modeling would be conducted at a much finer resolution, not only spatially but temporally. However, the time step for 2D modeling was yet to be determined. Terry (ADNR) asked if the one-day time step proposed for 1D modeling would suffice for evaluating flushing flows. Bill (Tetra Tech) replied that assessing flushing flows with the 1D model would require use of a smaller time step than the overall sediment transport modeling, perhaps at a 1-hour interval rather than the 1-day interval.

Betsy McCracken (USFWS) asked what the first sediment transport model runs would be. Bill (Tetra Tech) replied that initially the model would be calibrated against existing conditions and then used to model the 56-year period of record (or some other agreed-upon period) without the Project in place, to establish baseline conditions. Results of model runs associated with various with-Project scenarios would then be compared to the modeled baseline.

Joe (ADF&G) asked how AEA would address potential indirect effects on salmonid spawning habitat resulting from Project-induced effects on fluvial geomorphology. Bill (Tetra Tech) and Craig Addley replied that 2D geomorphic modeling at representative sites would be needed to assess potential channel changes at this level of resolution, and based on the results of the 2D modeling, indirect effects on fish habitat, riparian vegetation, side channel access, and other resources could be evaluated.

Joe (ADF&G) referred to examples of sediment transport modeling presented by Bill (Tetra Tech) (presentation available at Susitna-watanahydro.org) and asked if sediment data for the Susitna River basin are less comprehensive than what are available for systems in the contiguous United States. Bill (Tetra Tech) replied that data availability varied widely among the river systems he had modeled. Having access to the studies conducted on the Susitna River in the 1980s provided a significant advantage and that without the 1980s information the sediment transport modeling effort would more time consuming and difficult.

Joe (ADF&G) emphasized that it would be critical to identify and track the consequences of all modeling assumptions, across all tiers of modeling. Betsy McCracken (USFWS) stated that AEA would need to provide stakeholders with an account of the assumptions, uncertainties, and limits associated with the proposed geomorphic modeling approach.

Wayne (AEA) stated that Bill (Tetra Tech) would draft a technical memo (1) summarizing the geomorphic model selection process, (2) describing how geomorphic models will interact with other models, (3) describing the proposed schedule for completion of modeling, and (4) identifying the preferred geomorphic 1D and 2D modeling approaches for use on the Susitna River. The memo would discuss the assumptions, uncertainties, and limits associated with the proposed modeling approach. Wayne (AEA) stated that AEA wanted to avoid use of a proprietary model to provide maximum transparency regarding how model runs are conducted.

Geomorphology Study

Tim Sundlov (BLM) stated that the extent of clear-water habitat in the Susitna River, and its interface with turbid water, varies as a function of mainstem flow and that it would be important to understand how the relative amounts of turbid and clear water would change as the result of the proposed Project and how this might affect fish.

Eric (NMFS) noted that the 2013-14 study request document called for developing the mass balance of sediment above (Gold Creek data) and below (Sunshine data) the three rivers confluence to estimate current sediment contributions from the Chulitna and Talkeetna rivers. Eric (NMFS) asked if the large potential error associated with USGS measurements would potentially affect the accuracy of such an approach. Bill (Tetra Tech) stated that the goal of analysis will be to assess the overall effect on sediment balance brought about by the construction of the reservoir, so what is needed is an estimate of the relative contributions of the tributaries. Bill (Tetra Tech) emphasized that the resolution of the basin-level geomorphic studies will be low; it will not be possible to identify, for example, specific locations of channel aggradation or degradation.

Terry (ADNR) asked what proportion of the suspended sediment originating upstream of the Project would be expected to settle in the reservoir. Bill (Tetra Tech) replied that the extent of settling depends on reservoir retention time, surface area, and depth, as well as the particle sizes of the suspended sediment. He noted that the proposed reservoir would be large and that most of the suspended sediment would be expected to precipitate.

Jan (NHI/HRC) asked if suspended sediment in the reservoir would affect water temperature. Craig (Cardno ENTRIX) stated that reflection/absorption of solar energy by suspended sediment affects water temperature and that the influence of suspended sediment on water temperatures in the reservoir would be accounted for by the reservoir water quality model.

Betsy McCracken (USFWS) asked what effect the Project was expected to have on geomorphic conditions, and as a result other resources, in the lower river. Bill (Tetra Tech) and Craig (Cardno-ENTRIX) stated that most sediment transport occurs during the high flow periods; the Project would only affect a small portion of the total flow during that time. This, coupled with the fact that a large proportion of the sediment supply to the lower Susitna River originates downstream of the proposed dam site, means the Project will likely have a small effect on channel morphology in the lower river.

Referring to the reservoir geomorphology component of the study, Wayne (AEA) asked if existing high-latitude reservoirs would be examined to gage the nature and extent of impacts that might occur in the Project reservoir. Kathy Dubé (Watershed GeoDynamics) stated that she would investigate other existing reservoirs with characteristics similar to the proposed reservoir to help shape general conclusions.

Tim (BLM) emphasized the importance of accurately characterizing delta formations associated with the upper Susitna River and other tributary inflows to the reservoir to estimate potential Project effects on fish access to riverine habitat upstream of the reservoir.

Mike Sundergaard (BLM) noted that removal of vegetation in the zone of inundation could increase soil erosion during and following the filling of the reservoir. Kathy (Watershed GeoDynamics) agreed, however noting that removal of the above-ground portion of vegetation while allowing the roots to remain in the soil can reduce erosion potential. Depending on plant species and soil conditions, roots can remain in the inundated soil for 5 to 10 years. Mike (BLM) noted that ice formation and thawing in the reservoir fluctuation zone would also have significant effects on shoreline erosion.

Terry (ADNR) asked how the effects on erosion associated with the melting of permafrost would be addressed. Kathy (Watershed GeoDynamics) stated that she had not worked on reservoirs with permafrost and would need to coordinate with others who had, likely in British Columbia or other Canadian provinces, to develop methods to address potential effects. Michael Lilly (GW Scientific) stated that useful information regarding effects of high-latitude reservoirs on permafrost and associated erosion might also be derived from studies of reservoirs in northern Europe.

Referring to the large woody debris (LWD) component of the study, Michael (GWS) stated that Jason Mouw (ADF&G) had conducted his PhD research on the effects of LWD on large braided rivers and recommended that Bill (Tetra Tech) and Kathy (Watershed GeoDynamics) coordinate with Jason (ADF&G) regarding potential methods during the refinement of the 2013-14 study plan. Michael (GWS) also recommended contacting the faculty of the Forestry Department at the University of Alaska, Fairbanks. Wayne (AEA) stated that Dudley Reiser (R2 Resource

Consultants) or Alan Olson (R2) would coordinate with Woody Trihey (Cardno-ENTRIX) to ascertain what, if any, LWD data are available from the 1980s studies of the Susitna River basin.

Craig (Cardno-ENTRIX) asked if AEA had aerial photos of the alternative access road and transmission line alignments. Bryan Carey (AEA) replied that AEA had identified alternative routes on aerial photographs but that the photographs were of low resolution.

Wayne (AEA) stated that the selection of alignments would be an iterative process, with the alignments refined based on information gained during field reconnaissance, with the goal of minimizing resource impacts. Wayne (AEA) stated that AEA's plan was to select preferred access/transmission line routes by the end of 2012 and then refine the alignments in 2013-2014. AEA's consultants would conduct studies, as described in the study request document, of all three corridors until the final routes are established.

Ice Processes

Robin Beebee (HDR) presented a series of aerial photographs taken during the March 2012 open lead mapping exercise (PowerPoint presentation available at Susitna-Watanahydro.org). Mike Wood (Chase resident) stated that ice breakup in the middle Susitna River has dramatic effects on stream geomorphology, including the cutting of new channels and the scouring riparian vegetation from islands. Robin (HDR) stated that beginning with the 2012 reconnaissance, AEA would produce a photographic record of breakup conditions, including channel changes and effects on riparian vegetation. A fish biologist and geomorphologist will accompany HDR's ice processes specialists on over-flights to help document the effects of breakup on a variety of resources. Betsy (AEA) asked if the mouths of Indian and Portage creeks were open during HDR's over-flight, and Robin (HDR) replied that they were.

Robin (HDR) stated that time lapse-cameras were being installed at 10 locations between river mile (RM) 9 and RM 184 to document ice breakup and ice-cover formation. Michael (GWS) stated that for a small incremental cost, additional cameras could be installed at the Tsusena Creek, Gold Creek, and Sunshine USGS gaging stations. If the cameras were mounted on the existing gage houses no permits would be needed from the state for their installation. Betsy (AEA) stated that cameras could also be mounted on the radiotelemetry tower at Portage Creek. Wayne (AEA) stated that a time-lapse camera should be placed at Slough 8a to monitor ice breakup and freeze-up at this location that was shown to be important fish habitat during the 1980s studies. Mike W. (Chase resident) said that another good location for a time-lapse camera would be Whiskers Slough, which could be accessed from his property adjacent to the Susitna River. Mike W. (Chase resident) stated that he would provide AEA with access if desired.

Joe (ADF&G) asked if single cameras were being installed at each location, and Robin (HDR) replied that there would be up to three cameras at a given location to capture a variety of views. Dudley (R2) asked if the cameras were motion-activated, and Robin (HDR) replied that they were not but were set to take photographs at timed intervals.

Photos of ice processes taken at the upstream end of Devils Canyon during the 1980s are available from the Alaska Resources Library & Information Services (ARLIS) but Robin (HDR) indicated they are poor quality. Craig (Cardno ENTRIX) stated that ARLIS had upgraded its scanner and replaced many of the old photos with new ones of better quality so it would be worthwhile to access the newly scanned photos for possible use in the current ice processes study. Lars Gleitsmann (E-Terra) stated that R&M Consultants (in Anchorage) possessed a large collection of historical photos from the Susitna River that could be useful in comparing existing to historic conditions.

Kevin Featherston (R2) stated that it would be useful to coordinate with those conducting the ice processes study to establish protocol to be used to develop photo documentation of ice-vegetation interactions during breakup. During the 2012 riparian vegetation reconnaissance, field crews could re-photograph the locations documented during breakup to characterize the vegetation and assess the effects of ice.

Dudley (R2) asked how frequently ice thickness measurements would be made in 2012. Robin (HDR) replied that one set of thickness measurements was being made in winter/spring 2012, with a possible second set in fall/winter 2012. Bill (Tetra Tech) asked if the transects where ice thickness was being measured were tied to benchmarks. Robin (HDR) replied that the transects were currently linked to temporary benchmarks but that they would eventually be tied to routing model transects.

Wayne (AEA) stated that ice on the Susitna River can be as thick as 10 feet. Robin (HDR) confirmed that the augers used by HDR were capable of drilling through the thickest ice on the river. Wayne (AEA) asked how many ice thickness measurements were being made at each transect. Robin (HDR) replied that ice thickness was being measured at approximately 10 locations at each transect to account for variability across the river and any side channels, but the actual number of locations would vary depending on conditions.

Eric (NMFS) suggested that AEA make flow measurements using the holes drilled to measure ice thickness, which would yield both a spatial and temporal expansion of the winter flow data available from the USGS gages. Wayne (AEA) stated that it would not be feasible to add this to the 2012 study but that it could be added to the protocol for the 2013-2014 ice thickness measurements.

Eric (NMFS) asked if there were existing projects at high latitudes that operated in a manner similar to that proposed for the Susitna-Watana Hydroelectric Project. Robin (HDR) replied that the Peace Canyon Dam on the Peace River in northern British Columbia operated in a similar fashion, with stage fluctuation taking place beneath the ice cover.

Betsy (AEA) asked if the ice processes study would extend upstream to the Oshetna River. Robin (HDR) replied that the study area would extend from RM 0 to RM 250. Betsy (AEA) stated that it would be important to document any open leads in the area immediately upstream of the proposed reservoir.

Craig (Cardno-ENTRIX) asked how various ice features, open leads in particular, will be documented. Robin (HDR) replied that GPS data collected during aerial reconnaissance will be used to produce GIS maps for each reconnaissance trip, showing the locations and basic dimensions of the leads and other key features, such as ice jams, ice bridges, etc. Betsy (AEA) emphasized that aerial photos should be provided to ADNR as soon as possible for digitizing.

Dudley (R2) asked how ice process modeling would be conducted. Robin (HDR) replied that ice-process routines would be developed and calibrated to augment the riverine water quality model, and if that approach proved to be infeasible it would be necessary to employ a separate ice processes model. Craig (Cardno-ENTRIX) reiterated that it would be preferable to use a single model for simulating both water quality and ice processes, but if two models must be used it would be essential that they are applied in a consistent manner. He added that the EFDC model does not have an ice routine, whereas the CRISSP model, for example, can model ice processes. Craig stated that AEA plans to schedule a technical subgroup meeting to discuss ice modeling approaches once technical consultants had more fully developed their study outlines. Wayne (AEA) stated that the model selected would need to have been tested and validated under conditions similar to those occurring in the Susitna River basin. David Turner (FERC) asked if the list of potential ice processes models would be finalized when AEA files its Proposed Study Plan (PSP). Robin (HDR) stated that the list of possible models would be finalized by the time the PSP is filed, although it might require longer to determine which one is most suitable for application.

Jan (NHI/HRC) asked how the ice model would be calibrated. Robin (HDR) replied that the model would be calibrated using a range of field data at multiple locations. If the model accurately simulates existing conditions along the longitudinal profile of the river, it will be considered calibrated and suitable for use in simulating ice processes under a range of with-Project scenarios. Mike W. (Chase resident) stated that he has recorded the timing of freeze up and breakup on the middle Susitna River for a number of years and would be willing to provide his records to AEA.

Mike Buntjer (USFWS) stated that in addition to documenting ice dynamics at sloughs that are known to be important to fish, it would be beneficial to conduct observations at sloughs that are not heavily used by fish to develop a better understanding of what is driving fish habitat selection. Craig (Cardno-ENTRIX) stated that the following side sloughs provide important fish habitat: 8, 9, 10a, 11, 22, and Whiskers. Robin (HDR) stated that HDR had documented conditions at sloughs 1, 9, and 21 in 2012.

Action Items

- AEA stated that Mike Harvey, Fluvial Geomorphology task lead, Tetra Tech, would contact William Harrison, Professor Emeritus, Geophysical Institute, University of Alaska, to discuss the effects of glaciers on sediment dynamics in the Susitna River basin.

- AEA requested that Bill Fullerton (Tetra Tech) draft a technical memo (1) summarizing the geomorphic model selection process, (2) describing how geomorphic models will interact with other models, (3) describing the proposed schedule for completion of modeling, and (4) identifying the preferred geomorphic 1D and 2D modeling approaches for use on the Susitna River. The memo will discuss the assumptions, uncertainties, and limits associated with the proposed modeling approach.
- AEA stated that Dudley Reiser/Alan Olson (R2) would coordinate with Woody Trihey (Cardno-ENTRIX) to ascertain what, if any, large woody debris data are available from the 1980s studies of the Susitna River basin.
- AEA stated that a time-lapse camera would be placed at Slough 8a to monitor ice breakup and freeze-up.
- AEA stated that its technical contractors would add "anticipated level of effort and cost" information to all 2013-2014 study request documents.
- AEA stated that it would issue a revised Project licensing schedule in April 2012.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Terrestrial Resources 2012/2013-2014 Study Plan Development
June 6, 2012, 9:00 a.m. – 1:00 p.m.
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
ADF&G Wildlife Conservation	Lem Butler
ADF&G Habitat Division	Stormy Haught
ADF&G Habitat Division	Mark Burch
AHTNA	Joe Bovee
AHTNA	Bill Simeone
AHTNA	Katherine Martin
BLM	Dave Mushovic
BLM	Sarah Bullock (by phone)
BLM	Ben Seifert
DNR OPMP	Marie Steele
EPA	Matt LaCroix
EPA	Lisa McLaughlin
EPA	Jennifer Curtis (by phone)
Natural Heritage Institute	Jan Konigsberg
NPS	Cassie Thomas (by phone)
USFWS	Jenny Spegon (by phone)
USFWS	Mike Buntjer
USFWS	Maureen de Zeeuw
USFWS	Bob Henszey (by phone)
USFWS	Lori Verbrugge
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Emily Ford
AEA	Bruce Tiedeman
ABR, Inc.	Brian Lawhead
ABR, Inc.	Terry Schick
ABR, Inc.	Wendy Davis (by phone)
ABR, Inc.	Janet Kidd (by phone)
ABR, Inc.	Alex Prichard (by phone)
ABR, Inc.	John Shook (by phone)
Cardno ENTRIX	Lynn Noel
E-Terra	Steve Colligan
MWH	Kirby Gilbert
Solstice AK	Robin Reich
TetraTech	Christy Miller

Presentations

Brian Lawhead (ABR, Inc.)

- Wildlife 2013 Proposed Study Plans

Terry Schick (ABR, Inc.)

- Botanical 2013 Proposed Study Plans

General Questions/Discussion

After introductions, Kirby Gilbert (MWH) gave an overview of all of the comments and study plan requests received from stakeholders, regulatory agencies, and other entities. Kirby said that the team is now reviewing the comments that have been received and trying to address them in the study plans. Kirby said that this meeting was to help clarify agencies comments on the study plans. Kirby encouraged an interactive dialog about the comments and stakeholder input on the study plans.

Wayne Dyok (AEA) said that some agencies submitted formal study request and some just embedded study requests within comment letters. Wayne said that all types of comments on study plans would be considered and addressed. He said that the team would compare what was being developed in study plans with the agency and stakeholder requests.

Lori Verbrugge (USFWS) said that USFWS listed a point of contact for each study that should be consulted regarding questions.

Kirby said that there were a few new studies requested that had not been previously identified. He said that the team was trying to capture all the study requests into the study plans.

Wildlife Study Plans Questions/Discussion

General discussion regarding large mammal, furbearer, and bat study plans

Brian Lawhead (ABR) said that the study requests are currently being developed into 16 wildlife study plans. Brian said that ABR is incorporating an internal review and evaluating all the comments received to modify the study plans. He said that there are a few contradictions among agency comment that need to be resolved.

Brian said that moose and caribou study plans are being developed from the Alaska Department of Fish and Game (ADF&G) proposal. The plan is to collar moose and caribou in the study area. He said that late winter surveys were conducted this year. He said that Alaska Department of Fish and Game (ADF&G) Division of Wildlife Conservation stated that they supported the moose and caribou studies.

Brian said that the bear study plan will be a retrospective analysis of how the existing data affects bears' home ranges and would involve working with ADF&G to get previous telemetry data. Brian confirmed that ADF&G said that existing information is enough to do the analysis. Brian said that an investigation of bears' use of anadromous streams in the downstream Project area has been suggested to determine the minimum number of bears using the streams. Brian said that ADF&G supported the concept of looking at spawning in streams and an evaluation of berry resources in the inundation zone to understand bears' downstream use areas.

Brian said that one study will focus on estimating wolf and wolverine population density using tracks and aerial survey methods. Brain said that the Project area is in a wolf control area.

Brian said that Dr. Laura Prugh at University of Alaska Fairbanks is developing a study plan for terrestrial furbearers including coyotes, lynx, red fox, and martin using fecal and hair sampling to get density estimates. Brian said that ADF&G supports this methodology. Brian said that a prey abundance study by UAF graduate student is beginning this summer. He said that ADF&G did have comments for improvements to this study.

Brian said that ADF&G commented that they were not certain that an aquatic fur bearers study was necessary for use of the mainsteam river. Brian said that U.S. Fish and Wildlife Service (USFWS) commented that they wanted to see detailed methods for studying aquatic furbearers on the mainsteam. BLM commented that they would be interested in the over-winter survival of beavers in the area with changes in the flow regime after the Project was constructed.

Brian said that the small-mammal community is pretty well understood. He said that more sampling is planned to get information on populations in habitat that might be directly impacted by the project. Brian said that he had not seen any comments on the small-mammal study plan.

Brian said that there were several comments from ADF&G and BLM which supported the general approach for studying bats and included improvements to the study plan, which will be addressed. Brian said that aspects of the study plan that require work are related to passive acoustic monitoring arrays to understand bat occurrences and the habitat investigation planned for the second year. He said that ADF&G commented on the need understanding potential habitat for bat roosting and hibernation. Brian said that the ABR Team is looking at a desktop study of geologic information with the potential for some field survey work to determine bat roosting and hibernation.

Brian said that the moose browse survey that ADF&G requested is similar to what has been used in the rest of the State. He said that the question is whether it gets lumped into the overall moose plan or is a separate plan. Brian said that the BLM requested a study to understand the carrying capacity in the inundation zone and road corridors.

Matt LaCroix (EPA) said that he needed more details on the moose-browse study. Brian said that the study looks at removal of current annual growth to quantify browse within the inundation zone. Mark Burch (ADF&G) said that the study should be broader to understand what would be available to moose after the inundation zone is filled. He said that this would also help to guide mitigation for impacts to moose. Betsy McGregor (AEA) asked whether the study should extend to the riparian area below the inundation zone. Mark said that he didn't recall the ADF&G comment but thought that it might be in the immediate area around the inundation zone.

Matt said that operations of the reservoir will have impacts on the riparian zone and icing. He said that the floodplain is important to moose and other species, and changes in flow might change access and availability of that type of habitat, including moose and other species' browse. Matt said that the Project needs to understand these changes.

Terry Schick (ABR) said that the riparian study should provide information on baseline moose habitat availability downstream of the inundation zone. He said that the riparian study is focused on mapping successional vegetation. In that study, ABR will map riparian ecotypes and wildlife habitat types. He said that the riparian study does not focus specifically on moose, but that a specific moose habitat map for the downstream areas could be made if desired.

Matt asked whether there would there be an analysis that ties the riparian study together with questions regarding browse. Wayne Dyok (AEA) said that how all the information fits together would be included in the entire study plan. Matt said that the EPA's comments state that the agency expects to see the National Environmental Policy Act (NEPA) document quantify the effects of the Project. Matt said that maps and numbers are great, but the EPA is interested in what this means in terms of likely effects. Terry said that the ultimate goal (in the riparian study) is to link information on geomorphology, icing, flow, and other downstream effects to wildlife habitat use and to predict the potential changes in wildlife habitat availability.

Kirby said that the Federal Regulatory Energy Commission (FERC) also asked to see study linkage information. Kirby said the front of the study plan will call out the early linkages, and the linkages will be listed in multiple places. He said that showing linkages is complicated but would be done.

Dave Mushovic (BLM) asked where the moose-browse survey would occur. Mark Burch said that ADF&G is interested in looking at the road corridor areas. Dave said that this is a particular interest to the BLM. Kirby said that it should include the downstream area and Betsy agreed. Mark said that it might be easier to combine the moose-browse study with the moose study. Wayne said that the moose browse information would help create habitat mitigation measures. Wayne said that the study plan goal is to inform the creation of protection, mitigation, and enhancement (PME) measures. Wayne said that the measures would be included in the hydroelectric project license application. Wayne said that the study plans will help to determine how to develop to the PME measures.

Bruce Tiedeman (AEA) asked whether there are agreements with Native landowners on how studies would be conducted on their lands. Mark Burch said that much of the work will be conducted by planes or helicopters that will not land. Mark said that ADF&G did understand that the landowner has to be involved. Bruce said that as AEA's native liaison for the project, it was his job to encourage involvement by Native landowners. Betsy said that AEA has been working with all the Native corporations that own land in the area to obtain land-use permits.

Dave Mushovic said that many of the studies would be conducted on Federal Native-selected lands. Dave said that most activities would be defined as casual use according to BLM. Dave said that more intrusive work could require a permit from BLM, which is a timely process. Kirby said that the study plan should have enough information to determine whether a land-use permit would be needed, and permitting requirements would be listed in the study plan.

Aquatic furbearers and mercury study plan discussion

Brian Lawhead said that the ADF&G and USFWS have differing comments on the aquatic furbearer study. Brian said that the USFWS has requested a population estimate of mink and river otter, and ADF&G didn't think that these species needed more study. Lori Verbrugge said that they had no time to discuss their comments with ADF&G prior to submitting their comments. Lori said that the impacts of mercury on aquatic furbearers are a concern and that the study request is extensively referenced. Lori said that maybe after ADF&G reads the USFWS' request, they might agree the Service's study request. Brian asked whether there were ADF&G river otters and mink experts. Mark Birch said that Howard Golden is in a different region but he is knowledgeable about these species.

Mark said that he did not think that direct population effects needed work, but he did not integrate the mercury concern. Lori said that maybe the ADF&G contaminate expert should review the study request. Mark said that ADF&G would take a look at the USFWS study request and see how it fits with their study requests. Brian requested that Lori and Mark meet with him to work through the differences.

Brian asked what the risk to otter and mink would be if the mainstem river is not important habit for the species (more foraging by these species occurs in clearwater habitats). Lori said that the information is references in the study request and that there have been otter and mink documented with higher mercury levels. Matt LaCroix asked whether there was baseline information that shows that these species use tributaries more than they use the mainstem. Matt asked whether AEA was planning on completing a baseline survey of the mainstem to understand how otter and mink might be impacted. Matt said that a survey might not be needed, but prior to saying that the study is not important, we should figure out whether it is an important issue.

Lori said that the impact of mercury depends on the project design, and it is not the same for all projects. Lori said that the methods recommended for getting a population estimate are similar to Dr. Prugh's methods for the terrestrial mammal surveys. Lori questioned why the Project was more interested in completing a terrestrial mammal study when aquatic species might be at more risk.

Brian said that he did not know whether the survey method for terrestrial furbearers would work for aquatic furbearers. He said that pelts from hunters might be able to be used and that the focus of the efforts would be along long stretches of stream. Brian said that the work would have to be conducted in the winter, and snow machine access would be difficult. Lori said that Dr. Prugh should be consulted or used for the field effort.

Betsy asked whether a mark/recapture study could be conducted in the middle Susitna River to understand terrestrial furbearers. Lori said that her study request did not go into that detail, but that the study area is probably larger than needed. Lori said that her office does not have river otter and mink experts and that the team needed to work together to develop the best study. Kirby said that the study area could be established from another study going on to see whether mercury bioaccumulation would be important. Lori said that the literature already indicates that mercury will be a problem. Lori said that a population assessment needs to be done to see whether otter and mink would be impacted by the bioaccumulation. Mark Burch asked whether determining presence or absence would be enough. Brian asked whether a population estimate could be done from existing roads. Matt said that agencies need to understand numbers, where the species are, what the accumulation of mercury levels would be, and whether mercury could affect a species to completely understand the issue. Matt said that this is a “trigger” model.

Betsy asked how the team would determine how far downstream to study. Matt said that the Project will need to understand fish moving downstream of the reservoir to determine the study area size. Matt said that bioaccumulation delivery methods need to be determined. Lori said that it is different for different species and their diet. Lori said that some of the papers referenced in USFWS’ study request have models, which could be used. Wayne said that most of the impacts would be immediately downstream of the dam because with the reservoir’s elevation change and 500 feet of head, it would be difficult for fish to survive and because surviving fish would be stunned and could be eaten right away (e.g., by predatory fish, birds, and/or mammals).

Kirby asked whether there was an established study methodology and trigger mechanism that could be used. Brian asked whether they could use a phased approach and do a portion of the study during year 1 and the next steps during year 2. Lori said that with such a short time period for studies to be conducted, a phased approach would be difficult. Betsy said that the fish study is looking at background levels of mercury this year. Lori said that in addition, her agency is interested in how mercury would bioaccumulate. Matt said that the EPA has experts that can discuss this with USFWS.

General discussion regarding bird study plans

Brian said that the USFWS developed study requests for eagles, raptors, and landbirds/shorebirds. The requests mostly revised the AEA study plans, but there were some modifications.

Brian said that BLM requested that their agency be involved in the eagle and raptor consultations and stated that an avian production plan would be needed on BLM lands. Brian said that BLM had comments on the ptarmigan study design, which will be directed to Richard Merizon at ADF&G, since they are conducting the study.

Brian said that since the last terrestrial group meeting, the Project Team had additional consultation with USFWS. He said that ABR had conducted raptor nest surveys and that more nests were found than in the 1980s. Brian said that the study team is considering what would be needed to determine eagle take to determine study area size. He said that right now they are surveying a 2-mile buffer around the project components. Brian said that the USFWS requested a 10-mile buffer study area for next year around the reservoir in order to understand golden eagles and habitat take by the Project.

Brian said that a 15-mile buffer around the reservoir was requested for understanding other species. Lori said that part of the concern with the reservoir is that it would be an attractive nuisance and would collect water birds that currently use lakes and ponds nearby. Maureen de Zeeuw (USFWS) said that she would get back with Brian about the basis for the study area size.

Brian said that the use of the reservoir shoreline by nesting waterbirds would not be an issue since the area would not be vegetated and because the reservoir would be filling during nesting season. Wayne added that the shoreline would have steep slopes. Matt LaCroix said that there might be nest losses if shorebirds ground nests are inundated. Brian said that it is more likely that the reservoir would be used as a staging area for migrating birds. Wayne said that the upstream ends of the reservoir are usually more important bird habitat because there is less water level modulation in these areas. Kirby said that combining GIS data with the topographic information could help understand the lakeshore and its potential for providing nesting habitat. Brian said that they would plan a meeting with USFWS to address this issue.

Brian said that USFWS was interested in determining the relative importance of the area as a migration corridor related to power line placement. Maureen said that there could be about 100 miles of new power lines and collisions could be avoided if it is understood where potential collision areas exist. Kirby said that the transmission line could be placed in a different location based on the bird study. Wayne said he understood that baseline information was needed to determine the best location for the lines.

Maureen said that bird collisions with lighting at the dam site could also be an issue; however, the Project could plan ahead for bird safe lighting and a study would not be needed. Wayne said that lighting mitigation could be incorporated as long as human safety is protected. Maureen said that the USFWS would need to know details of the lighting. She said that two years of bird studies might not be enough to understand migration routes and that there could be a tragic event years after the Project is constructed.

Wayne said that lighting could be more of an issue during construction, especially in the spring and fall. He said that once the Project is constructed, lighting would be less likely to attract migrant birds. Maureen said that the Project should investigate construction lighting options, since many construction lights are not suited to protect migrating birds. Wayne said that the Project would work with USFWS on this issue. Kirby said that they might be able to time construction activities to avoid peak periods of bird migration.

Maureen said that she was more concerned with habitat fragmentation than with bird strikes. She said that the cuts of vegetation for the power lines would end up being used recreationally, which could affect birds. Maureen said that creating openings will increase the spread of wildlife that like habitat edges. Maureen said that these birds could outcompete other birds and change the local assemblage of breeding bird species.

Maureen said that there should be more emphasis in the study plan on "oddball" birds that might not be captured during the proposed bird surveys (especially point counts for breeding landbirds and shorebirds). She said that examples of those birds are wintering dippers, mergansers, kingfishers, and tree-nesting ducks. She said that USFWS was particularly interested in those birds that would be affected in the inundation zone. Lori said that based on other studies, mercury might affect kingfishers the most. Brian said that these birds might be captured in the existing studies. Maureen confirmed that USFWS would probably be satisfied with brood-rearing surveys for tree-nesting ducks instead of searching every tree for nests, but that some effort should be spent on surveys for the riverine-specific species, at least in the inundation zone.

Maureen said that Rock Sandpipers feed on *Macoma* clams during the winter in the Susitna River flats area. Maureen said that understanding how *Macoma* clams would be affected by changes in flow is important. Terry said that nearly the entire population of the Bering Sea subspecies of Rock Sandpiper winters in Cook Inlet and that they use the mouths of several rivers in upper Cook Inlet when feeding on ice-scoured gouges in the mud. Maureen said that we already know that the sandpipers use the area and a bird survey isn't needed; the question is how a new flow regime would impact the clams that are important to their diet. Betsy said that answers to this question would come from modeling hydrology and the invertebrate study. Betsy said that this topic needs to be included in the macroinvertebrate study plan.

Maureen said that the study plans need to propose methods to get density information for breeding birds. Terry said that ADF&G has valid concerns over the statistical issues with determining reliable density estimates, especially if sample sizes are small. Brian said that regardless of these questions, we need to use existing study methodology and that ABR would like to use the Alaska Landbird Monitoring Survey. Maureen said that there are issues with that methodology, but she was willing to accept its use because it is a standard. Maureen said that she was open to discussing other methodologies.

Maureen said that the productivity estimates for water and landbirds were downplayed in the study requests and that productivity needs to be a focus in the study plans. Maureen said that the permanent loss of bird habitat and its long term effects needs to be addressed. Maureen said that additional surveys (e.g., brood-rearing surveys) may be needed for lake-nesting birds. Brian said that we need to determine what question we are trying to answer and more discussion was needed with USFWS. Maureen said that she was interested primarily with loons and grebes.

Brian said that BLM had concerns with the Ptarmigan study plan that ABR is addressing.

Wood frog study plan discussion

Brian said that ADF&G had some comments related to using waterbody habitat modeling to determine survey areas for wood frogs. Brian said that ADF&G was interested in sampling waterbodies for a fungus that might be affecting amphibian populations. Betsy said that this could be an incidental sampling effort. Lori said that Meg Perdue is an expert at USFWS (Anchorage Field Office) and that she might know more about the fungus. Wayne asked whether understanding the fungus was really important to understanding the impacts of the Project. Kirby said that the Team would consult literature and talk with experts to determine how to move forward.

Brian said that ADF&G suggested putting the landbird/shorebird, bat, and frog surveys into one study plan; however, this may not be feasible because of seasonal and diurnal differences. Marie Steele (ADNR-OPMP) asked whether there might be linkages between the species and their survey methods. Brian said that the bird, bat, and frog study teams would be out in the field at the same time (roughly), but that there are few things that in common with the study methods.

Brian said that the wildlife habitat evaluation and developing the habitat map is vital to the wildlife impact assessment. Brian said that ABR would be creating the mapping for multiple species and would build a matrix of the mapped habitats and categorized habitat values for the species of concern. He said that by doing this assessment in the context of GIS, the Project Team will be able to quantify project impacts on wildlife habitats.

Brian said that ADF&G requested using the statewide Gap Analysis model outputs as a framework for data collection and reporting; however, he believes that a more detailed and project-specific (local-scale) assessment would be better than using the broad-scale statewide model. Terry said that ABR was not sure that the statewide model would apply specifically and accurately to the project area. Matt LaCroix said it is likely that the ADF&G is interested in having the Project baseline data incorporated into the Gap Analysis program. Betsy said that the Project should be able to share the data. Matt said that EPA would support integrating data with the statewide effort where this is possible. Terry said that the ADF&G actually was recommending that the Project use the statewide Gap Analysis model outputs to predict which waterbodies could support wood frogs because they thought the sampling, as proposed, would result in insufficient data to evaluate wood frog habitat use in the area. Matt said that the EPA is also interested in the statewide Gap Analysis program. Terry said that they needed to discuss this comment with ADF&G because there appear to be differing opinions at ADF&G. Brian said that using the statewide Gap Analysis framework may not change the way the teams would collect the data. Kirby said that the data could be delivered differently to ADF&G. Terry said that ABR would discuss the comment with Dave Tessler at ADF&G. Wayne said that this is a good action item to follow up with ADF&G, but that the study team might not be able to get resolution.

Botanical Resources Study Plans Questions/Discussion

Terry Schick said that the botanical resources work involves five study plans. He said that ABR prepared study requests and is currently working to incorporate comments on the requests into the study plans. He said that two study plans have been completed and that ABR would like to revise them with the additional comments received.

Wetlands study plan discussion

Terry said that most of the focus has been on the wetland mapping study. He said that there have been smaller meetings with EPA, the U.S. Army Corps of Engineers (USACE), and USFWS. He said that there has been considerable interest in using the Cook Inlet (Wetland) Classification System, which is a methodology primarily focused on lowland wetland types in the Matanuska-Susitna Borough (MSB) and on the Kenai Peninsula. He said that ABR is proposing a hybrid classification system, which would be “cross-walkable” with the Cook Inlet Classification. The MSB is interested in the Project using the Cook Inlet Classification and being able to incorporate the data collected for this Project into their existing GIS system. Terry said that ABR developed a system that is similar to the Cook Inlet Classification, but will allow the flexibility to address the different wetland types that will be encountered at higher elevations in the upper Susitna basin. Matt LaCroix said that EPA is very comfortable with what ABR is developing and appreciates that the Project is involving Mike Gracz in the methods discussion.

Terry said that the wetlands functional assessment methodology is being refined. Terry said that there are a number of approaches, most of which focus on habitats that have been significantly altered (e.g., developed for applications in the lower 48 states), and that many of those methods are not ideally suited to work in the remote and primarily undisturbed Project area. He said that ABR was planning on one more meeting to go through the final list of wetland functions and proposed field measurements before starting the field effort. He said that the goal was to send out a list of wetland functions and get responses in advance of the meeting.

Janet Kidd (ABR) said that ABR received good feedback on the functional assessment at the last (wetland-focused) agency group meeting and that ABR started to develop a list of parameters following the Hollands-Magee Method. Janet said that there are no cultural or social parameters in the Hollands-Magee approach. She said that ABR proposes examining data collected by other field efforts for the Project and incorporating those data into the wetlands functional assessment product.

Matt said that EPA would like to see the list of proposed wetland functions. Matt said that part of the reason that the EPA and USACE have funded the wetlands work in the MSB is because they believe that there is a lot that can be done with GIS. Matt said that cultural and aesthetic functions are something that do not need to be measured in the field; instead this information could be incorporated into the assessment as a GIS layer (i.e., after the field surveys).

Bob Henszley (USFWS) asked to see the wetland functions list.

Riparian vegetation study plan discussion

Terry said that questions arose as to whether jurisdictional wetlands need to be mapped as a part of the riparian vegetation study. Betsy said that the USACE has said that the wetlands below the dam do not need to be delineated because they will not be filled. Matt said that the wetlands below the dam do not need to be assessed using the three-parameter wetland assessment. He said that the EPA, however, does want to see wetland maps generated to identify wetlands using the same classification system as the rest of the Project area. Matt said that it is not necessary to complete a preliminary jurisdictional determination; instead EPA is interested in baseline mapping with some field data points that ground-truth the vegetation work. Janet confirmed that the entire vegetation map of the study area would be seamlessly integrated.

Bob Henszey asked whether the areas would by identified as wetlands and whether there would be formal data on the sites. Matt said that the EPA is assuming that there would be some wetlands ground-truthing, but the majority of the area would not be field checked. Terry said that the ABR team could map wetlands throughout the Project area, but that they would prefer not to conduct USACE-approved wetland determination plots (because they are very time consuming and doing so would reduce the number of sites that can be visited). Terry said that for the riparian effort, they would produce fine-scale mapping of the riparian area in order to predict changes due to altered flow, icing, and geomorphology. Betsy added that the mapping would also be good enough to model vegetation changes due to groundwater changes.

Bob said that he was trying to figure out the riparian study outcomes. Terry said that the riparian vegetation study would be examining vegetation age structure and size to add to the understanding of vegetation succession. He said that the team would spend a lot more time at each plot to collect the data to conduct both fine-scale mapping of successional vegetation and broad-scale mapping of wildlife habitats. Terry noted that the riparian study will occur in 2 phases. First, they will map riparian ecotypes and wildlife habitats, then, in phase 2, they will work with the instream flow, ice processes, and geomorphology researchers to predict changes in riparian habitats from development of the Project.

Matt asked the current status of developing the vegetation mapping line work. Matt said that spending time in the field without having line work done might not be helpful. Terry said that the ABR team would be using the 1987 vegetation mapping and NWI mapping lines to help with their efforts. Terry said that they had not been able to do preliminary mapping because of the limited availability of aerial imagery. Matt said that the Team needed to understand the degree of diversity of the vegetation communities. Terry said that one of the first riparian study goals is to find and visit plots that were studied in the 1980s to document changes. Terry said that they are working with the instream flow and geomorphology teams to co-locate study plots. Matt said that it will be important to see the vegetation boundaries line work this winter. Matt said that there may be specific habitat types that need to be better understood. Terry said that there are areas that were sampled well in the past (in the 1980s). He said that the team needs to determine which areas were not sampled well in the past so those areas can be adequately studied now. The riparian study report for 2012 will include recommendations for study improvements, if needed, for 2013 and 2014.

Bob said that USFWS put in study requests for riparian vegetation, wetlands, and vegetation. He said that the Service did not have any major changes from the AEA's study requests. Terry said that the ABR team would review the USFWS study requests to see the changes. Wendy Davis (ABR) said that there was the request to coordinate with the statewide Gap Analysis program. Terry said that ABR would meet with ADF&G to discuss this request, but that the Project data could be shared with the statewide effort after mapping has been completed.

Invasive and rare plants study plan discussion

Terry said that they were working on rough drafts of the invasive and rare plants study plans, but that they had not received any comments of these study plans specifically.

Matt LaCroix said that the EPA did not submit comments on the invasive species plan specifically, but that the agency did have comments that would need to be addressed in the NEPA document. Matt said that invasive species issues raised in the EPA comments are consistent with nationwide and regional EPA comments and may not be specific to the Project. He said that, for example, feral cats are a regional issue, and although they are not a high priority issue in Alaska, they would need to be addressed.

Terry said that The Nature Conservancy (TNC) brought up aquatic invasive species as an issue. Matt said that invasive terrestrial plant species could be an issue. Matt said that invasive species are found on braid points on the Matanuska and Knik Rivers, and the Palmer Soil and Water Conservation District has had weed-pull efforts. Matt said that invasive species becoming established by construction activities is an operational issue that does not need to be studied. Terry said that one of the objectives of the study is to develop a method to minimize the spread of invasive plants. Janet said that along the Parks and Denali Highways there has been documentation of invasive species, but that management practices that could limit invasive species from becoming established. Matt said that that Project would need to quantify the likely risk of establishing invasive species.

Terry said that ABR is preparing the rare plant study plan and has requested a list of rare plant species from the Alaska Natural Heritage Program. Terry said that the rare plant study would interact heavily with riparian vegetation and wildlife habitat mapping studies. Matt asked whether there was documentation of rare plants in the 1980s work. Terry said that there was a rare pond weed species recorded from Watana Lake. Terry said that ABR would focus their rare plant survey effort on appropriate habitats where rare plant species could be directly affected within the Project footprint.

Betsy said that the Project might need to look at the potential for recreation to affect rare plants. Matt said that the BLM would get the data from the studies and would need to figure out how to manage activity and species on their lands. Terry questioned the rare plants survey study area. Kirby said that the study area is pretty big and perhaps the focus of the rare plant survey should be only within the inundation zone and dam site. Terry said that ABR will first determine whether there are suitable habitats available for the set of potential rare species within the Project footprint. He said that the 2013 study plan proposes completing the rare plant survey in the dam/reservoir area. Terry said that when the access road alignment is determined, the team would complete a survey along the centerline footprint (in suitable habitats).

General comments

Wayne said that AEA had 1980s photographs of sloughs in the downstream Project area taken at different flows. He said that these sloughs could be visited to see how the conditions have changed.

Wayne said that the EPA, Rural Utilities Service (RUS), and the USACE have requested cooperating agency status on the Project. He said that BLM has not made a decision about whether they would be cooperating agency.

Matt said that by law, the EPA is required to review all Environmental Impact Statements, and is requesting cooperating status to facilitate the process. Matt said that there was some discussion about whether the EPA would become a cooperating agency because they are not issuing a permit for the project, but given the project scope and the level of controversy, it makes sense for the EPA to be a cooperating agency.

Wayne said that related to the climate-change comments, AEA has taken a more open process than the FERC usually employs. Matt said that the Council on Environmental Quality (CEQ) has information on how to incorporate the analysis of climate change into a NEPA document. Matt said that the EPA does feel that climate change is very relevant to this project, especially looking ahead in the licensing period and the potential for climate change to change the water levels. Wayne said that AEA was thinking about addressing the climate-change issue in the water resources study plan.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Social Sciences 2012/2013-2014 Study Plan Development,
June 7, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
AEA	Wayne Dyok
AEA	Betsy McGregor
AEA	Bruce Tiedeman
AEA	Emily Ford
ADF&G/DOS	James Van Lanen
ADNR – OPMP	Marie Steele
Agnew::Beck	Shanna Zuspar
AHTNA	Joe Bovee
AHTNA	Bill Simeone
AHTNA	Katherine Martin
BLM	John Jangala
BLM	Dave Mushovic
BLM	Cory Larson
Charles Mobley & Associates	Chuck Mobley
DOWL HKM	Maryellen Tuttell
EPA	Jennifer Curtis
EPA	Lisa McLaughlin
FERC	Frank Winchell (by phone)
HDR Alaska	Tracie Krauthoefer
MSB	Fran Seager-Boss
MWH	Kirby Gilbert
MWH	Sarah Callaway
Natural Heritage Institute	Jan Konigsburg
NOAA Fisheries	Scott Miller
NPS	Cassie Thomas
Northern Economics	Don Schoden
Northern Economics	Patrick Burden
Stephen Braund & Associates	Stephen Braund
Stephen Braund & Associates	Paul Lawrence
Stephen Braund & Associates	Liz Sears
URS	Bridget Easley
URS	Tim Kramer
USFWS	Mike Buntjer (by Phone)
Knik	Bob Charles

After introductions, Kirby Gilbert (MWH) gave an overview of comments and study plan requests received from stakeholders, regulatory agencies, and other entities. Not all study requests were necessarily in the formal study plan request format, but all that were received are being considered during planning as the Project moves forward.

Socioeconomics

Pat Burden (Northern Economics) outlined two study plans under preparation: social conditions and public goods and services and regional economic evaluation study and discussed how the regional economic study will address potential changes in the price of electricity might affect the regional economy. Most comments received are being addressed in the study plans, but three major items not in the study plans: 1) FERC requested a survey of residents to evaluate potential changes in quality of life; 2) request to evaluate potential effects from the extension of a transmission line into the Copper River Valley – Betsy McGregor (AEA) AEA is conducting a feasibility study for this topic, but it would not be part of this Project – and; 3) request for a study of national economic evaluation for ecosystem services – however, this isn't a normal FERC practice.

Jan Konigsberg (Natural Heritage Institute) – The natural resource evaluation was put in only as a placeholder. FERC has a duty to make a licensing decision based on national economic interest, so the national interest level should be understood. Analysis of cost/benefit at the national level, not just within the Railbelt, is required under the Federal Power Act. It appears that the methods to do this type of work are feasible; it may be the scale for which the information is generated that might be the limiting factor.

Scott Miller (NOAA Fisheries) – If it moves forward, utilities will likely bear a substantial portion of the cost of developing the Project. When that cost burden is recovered through power rates, how will that offset benefits of regional reduced power rates? If utilities are expected to bear a substantial burden, rate payers can be expected to also bear that burden. Maybe a matrix could be developed showing the cost borne by utilities, and the potential rate effect on the end user. Or develop some scenarios showing a range of rates.

Cassie Thomas (NPS) – A goal is to develop PMEs and compensate for non-power values (recreation, etc.). It will be difficult for the NPS to perform its duty to come up with PMEs unless the value of recreational uses is assessed at a national level. Comments are coming in from outside of Alaska, so there is clearly a value to users outside of the railbelt.

Bob Charles (Knik Tribe) – From a financing perspective, how might other potential energy projects be affected by this project? What is the condition of the state's energy plan – is there one? If so, how does this project fit in to that plan? This starts to get in to the alternatives analysis, which are not included in the study plans. This plays into cumulative effects, so we need to be aware of what projects may be conducted in the future – the Integrated Railbelt Energy Plan as a starting point.

Jan Konigsberg (National Heritage Institute) – As supply increases, demand will as well. At what point will demand cause rates to increase to a level where it is no longer beneficial to rate payers? There is a substantial difference between the estimated cost of construction and the total cost of the Project.

Scott Miller (NOAA Fisheries) – Cost effective analysis comparing the Project to other reasonable power alternatives will be part of the NEPA process. As for EFH responsibilities, biological study plans are going to be key in determining the linkages to fish productivity. However, there didn't seem to be analysis of the impact of reductions in surplus for harvest in a 50 year timeframe. Also need to consider the uniqueness of the watershed with respect to its Chinook salmon runs. Would like to see attention paid to subsistence and personal recreation values, and potential effects the Project may have on them. Kirby Gilbert (MWH) – that is the intention, to bring interdisciplinary linkages to the study plans and the FERC licensing process.

Transportation

Maryellen Tuttell (DOWL HKM) Most of the comments on transportation, including those relating to winter river transportation, were already incorporated into the study plan.

Katherine Martin (Ahtna) – Does the study plan include impacts to other private land owners and access routes? Land ownership maps were not sufficient in the PAD to understand the selection status. Dave Mishovik (BLM) – BLM is working with AEA to update and standardize land ownership maps. BLM is conducting an in-depth land status review (for lands under BLM administration), as well as a boundary risk assessment. A comprehensive title search GIS layer is currently being produced, and will be available on the ADNR website.

Cassie Thomas (NPS) – A recreational management plan should include plans for trespassing, a boundary risk assessment, etc. Since there is new access being created for this project, it will need to cover a large area and a large range of topics.

Joe Bovee (AHTNA) – Perhaps an integrated plan could be developed, to incorporate subsistence, cultural, etc. since they are interrelated.

Air Quality

Dave Mushovi (BLM) – Dust is the biggest issue to be addressed in the study plan, and the methodology is being decided upon. Reliable information is really only available for the upper basin. How do we quantify project emissions for 50 years from now?

With respect to dust, the study plans should clarify the intention to consider how materials will be used; not only where they are coming from, but where they will be going as well.

Recreation & Aesthetics

Bridget Easley (URS) – Most comments were already incorporated into the draft study plan. Topics that FERC recommended to split out included recreation, aesthetics, and noise. A more robust noise analysis was requested than was previously planned. There was also a study request for river flow and access, which will be conducted. There were several comments on how recreation and tourism users could be displaced. At this point, the questions moving forward include: how to present the study plans; how will they be split out, and; how to identify the timing of information flow between the different resource studies.

Cassie Thomas (NPS) – Perhaps call it a "soundscape" analysis, rather than "noise." Noise implies 'unwanted sound.' Kirby Gilbert (MWH) – the analysis is on the aesthetic experience, which includes the soundscape. Separating construction impacts, impacts to recreation specifically, and long-term impacts to recreationists should be addressed. A major task for URS is to break these study plans apart.

Cory Larson (BLM) – BLM will do the suitability determination for Wild and Scenic Rivers.

Bridget Easley (URS) – A future workgroup meeting to discuss the surveys might be necessary, since there are going to be so many potential subject areas, and since they are going to be a big part of the recreation study. There is not necessarily enough information yet to give the full methodology description in the initial Study Plan; that will come from 2012 efforts.

Bob Charles (Knik Tribe) – The cumulative impacts assessment will be very important, as Knik Tribe is commenting on multiple projects, many of which have overlapping impact areas.

Cassie Thomas (NPS) – Some survey respondents to a future survey may need more information on the impacts to natural resources in order to fully answer questions about the future in a survey. Kirby Gilbert (MWH) – baseline surveys can be conducted first as the surveys are trying to help us understand current use, use patterns and experiences. Maybe the survey instrument might not be ready by July study plan, but *how* the survey results will be utilized, and/or the goal of a survey can be described in the study plan.

Scott Miller (NOAA fisheries) – Comprehensive recreational demand model; will the survey include an angler survey for recreational demand that would allow this type of modeling to be done? And will that be available for review? Bridget Easley (URS) – Yes, we want to get at demand, but we are not at that point of knowing the survey questions, and won't probably be there by July.

Subsistence

Tracie Krauthoefer (HDR) – Not many comments were received. Many of the comments were addressing the fact that people use subsistence resources and that those resources are important. Caribou, and hoofed animals in general, appear to be of particular concern. Steve Braund (Stephen Braund & Associates) – Need wildlife/fisheries impacts assessments in order to assess subsistence. Looking at surveying a broad range of communities.

The current ADF&G harvest survey doesn't ask whether people are hunting under sport regulations or subsistence regulations, or federal versus state subsistence regulations.

Typically, respondents are hesitant to divulge information on hunting out of fear that the data will be used for law enforcement.

Betsy McGregor, (AEA) noted that ABR is doing a harvest survey. HDR should coordinate with them to ensure that the state-versus-federal subsistence question is being addressed.

Kirby Gilbert (MWH) – Study plan interim reports can be important for delivering data and coordination between the resource study groups.

Dave Mushovic (BLM) – With subsistence, we are thinking about the EIS. BLM also has to do an ANICLA 810 evaluation, and then make a determination on whether or not public hearings will need to be held (which are likely). We need to be sure that there is enough information for the 810 evaluation. BLM would like to have the preliminary 810 evaluation done before the draft EIS. This goes into 2014-15 timeframe.

Tracie Krauthoefer (HDR) noted that subsistence includes not only fish, waterfowl, mammals, etc. but also berries, trees, (traditional knowledge) etc. The study plan includes the list of communities and also will include a traditional knowledge survey.

Bob Charles (Knik Tribe) - Can the information be specified/organized by other stakeholders, entities, and tribes? Tracie Krauthoefer (HDR) – surveys are designed by community.

Cultural Resources

Kirby – TCP (traditional cultural properties) program needs to be included in the cultural resources study plan.

Chuck Mobley (Charles Mobley & Associates) – TCP study will incorporate information from other areas (e.g. subsistence).

Many comments were received. In 2012, field work to investigate geotech boreholes at the site was initiated. The inventory effort for 2012 is modest, four people for about four weeks. A curation agreement is in place that addresses what happens to any artifacts collected in 2012 (but collection is not anticipated). More extensive curation agreements are likely for 2013-14. Development of an ‘unanticipated discoveries’ document was done – for human remains in the study area. A second track, for inadvertent discovery of cultural resources, has also been developed. This document will be circulated to native groups and other entities. There are 200 already-recorded sites, so a way to discriminate from those sites was necessary. Cultural sites are handled differently from human remains. Cultural resources finds can have a few days lag, and allows for verification of whether or not it is a new or previously-recorded site. Human remains require immediate reporting. A one-page field sheet was developed for crews in the field.

Comments on the 2013-14 plan primarily addressed details of the cultural resource investigations. Some resource study approaches were lacking in the original study plan.

Another noted element was about where the study area itself is – better definition of the APE. More specificity on methods was also requested. Also to include ANCSA 14-H (1) sites. A comprehensive document of all sites was requested. Paleontological studies were deemed insufficient, and will be included, but kept as a separate section. The Traditional Cultural Properties (TCP) study will be somewhat delayed probably, because the place name study (to be done by Dr. Jim Carrey and AHTNA) needs to be completed first.

Bill Simeone (AHTNA) – Ethnographic interviews and also analysis of existing tapes and linguistic information will be conducted.

Chuck Mobley (Charles Mobley & Associates) – Regarding the question of study area, FERC requested a complete APE for both direct and indirect effects. The direction from AEA has been to focus on the direct impact area (Watana) and the three potential transmission/access corridors. Definition of an APE for indirect impacts may need to wait until some of the work is done. APEs will be resource specific.

Wayne Dyok (AEA) – Indirect impacts (or APE) may be different, depending on the access plans for the impact corridor. If public access is restricted, the indirect impact area may be smaller.

Kirby Gilbert (MWH) – Based on other recent hydroelectric projects, the indirect effects assessment will likely happen later after some impacts are assessed for some of the other resource areas. Additionally, there is more information currently available for some areas over others.

Dave Mushovic (BLM) – How much impact does dispersed recreational use have on cultural sites, and what is the risk to the resource? What is the high risk area? Talkeetna has an historic district (some buildings and the airstrip) which may be an indirect impact area, even though it is located well away from any corridors.

Frank Winchell (FERC) – For indirect effects, FERC is looking for auditory and visual effects.
Kirby Gilbert (MWH) – This encourages a direct impact APE that includes areas of likely induced recreation use.

Chuck Mobley (Charles Mobley & Associates) – A number of native groups commented with three points of emphasis: 1) concern for preservation of cultural resources; 2) desire to participate in studies, and; 3) desire for government-to-government relationship as the project moves forward.

Bruce Tiedeman (AEA) – Definitions of all the resources, particularly when it comes to "cultural resources" and "subsistence" should be very clearly defined. "Resources" can mean different things to different people.

ADDITIONAL DISCUSSION – SITE VISIT

Two site visits have been proposed. July 23/24th were the originally proposed dates, but may be moved closer to the 27th. Planning is underway, input is being solicited, and information to be forthcoming. Email Betsy McGregor and/or Emily Ford. Contractors should look at the SharePoint site, the helicopter site is posted there.

ACTION ITEMS:

- Betsy McGregor – timeline for the AEA feasibility study regarding possible transmission line to the Copper River Valley
- Workgroup meeting(s) for survey instrument discussion – multi disciplinary discussion to be scheduled for mid-August with workgroup participants. Need to propose date in study plan.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Fish and Aquatics Resource Workgroup Meetings
June 12, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Stakeholder PAD Comments/Study Requests and Study Plan Development for Fish and Aquatic Resources, June 12, 2012, 9:00 am - 1:00 pm

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Brian Carey
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Danielle Thompson
USFWS	Brittany Williams
NMFS	Susan Walker (by phone)
NMFS	Eric Rothwell
BLM	Tim Sundlov (by phone)
BLM	Dave Mushovic
Coalition for Susitna River Dam Alternatives	Becky Long
EPA	Matthew LaCroix
EPA	Jennifer Curtis (by phone)
EPA	Lisa McLaughlin
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADF&G	Jack Erickson
ADF&G	Stormy Haught
ADF&G	Kimberley Sager
FERC	David Turner (by phone)
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsburg
Long View Associates	Steve Padula
Long View Associates	Bao Le
HDR	James Brady
HDR	Keri Lestyk
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	MaryLouise Keefe
R2 Resource Consultants	Phil Hilgert
GW Scientific	Michael Lilly

MWH

Organization	Name
LGL	Michael Link
MSB Fish and Wildlife	Larry Engel
ARRI	Jeff Davis (by phone)
Susitna River Advisory Committee	Bruce Knowles
Alaska Ratepayers	Scott Crowther
Alaska Ratepayers	Frank Mielke

Introduction

Steve Padula (Long View Associates) acknowledged the receipt, by AEA, of stakeholder comments and study requests that were received by the FERC prior to the May 31st deadline. Steve briefly summarized the extent of comments noting receipt from non-governmental organizations (NGOs), Alaska Native Entities, citizen's groups, utilities and individual comments from the public. Wayne Dyok (AEA) stated that AEA had reviewed the comments and that many of them were consistent with the study requests developed by AEA. Steve Padula stated that the goal of this week's set of meetings was to seek clarification regarding any stakeholder comments that would require the development of new studies, additional study tasks or differing approaches to existing study methods. Discussions from meetings will inform the revision of study plans for the development of the Preliminary Study Plan (PSP) document due to the FERC on July 16th, 2012. Steve noted that the meetings would be led by program leads and organized by studies where stakeholder comments received met the above criteria.

Cook Inlet Beluga Whale Study - discussion

Keri Lestyk (HDR), the Beluga Whale Study lead, stated that after reviewing comments, the only additional stakeholder issue was to ensure that the study be a systematic survey and assessment of impacts for all marine mammals, not just beluga whales. Keri also noted that surveying marine mammal prey species was also included in the request and that as a result of the study plan development process, this additional component has now been included as part of the Lower Susitna River Fish and Aquatic studies.

For the Beluga Whale Study, Keri stated that two technologies will be implemented; remote cameras and still cameras. Still cameras will be used to assess beluga whale presence at the furthest upstream extent. The camera work will be supported by staff from the Alaska Sea Life Center, which successfully used this camera technology in the Little Susitna River last year. Wayne Dyok (AEA) stated that it is important to note that information collected must support an evaluation of potential Project effects. Keri agreed and stated that it will be critical that the results of the beluga whale study be integrated with the other pertinent lower river studies to provide a holistic picture of the resource and potential impacts of the proposed Project (e.g., habitat, prey species, whale distribution and relative abundance, etc.). Wayne asked participants if there were any additional comments regarding this study while acknowledging that NMFS' marine mammal lead was not present at the meeting. There were no additional comments, however, Eric Rothwell (NMFS) encouraged participants to engage appropriate NMFS staff if there were any additional questions regarding the study.

Fish and Aquatic Resource Studies - discussion

MaryLou Keefe (R2 Resource Consultants), the Fish and Aquatic Resource Studies Program lead, stated that she had reviewed the pertinent stakeholder comments and had attempted to isolate a subset of comments that 1) were not already addressed in existing AEA study plans and 2) could impact the continued development of fish and aquatic resource study planning. She encouraged stakeholders to introduce additional comments, if any, that she may not have identified, as comments for each of the studies, are discussed.

River Productivity Study

MaryLou stated that with regard to the River Productivity Study, there were five comments that required additional discussion.

A comment was received to conduct a trophic analysis of primary and secondary productivity; MaryLou expressed some concerns about how valid a trophic analysis would be given the number of variables and associated uncertainty inherent to this analysis. As an alternative, MaryLou proposed that a feasibility assessment be conducted first to determine the appropriate next steps. Mike Buntjer (USFWS) stated that this was his requests which he worked with in collaboration with experts from his agency. He continued by stating that this may not be an issue of concern but did encourage some follow up with the USFWS to resolve any potential issues.

A comment was received to characterize coarse particulate organic matter in the upper, middle, and lower Susitna River. MaryLou stated that this was appropriate and would be included in the study plan.

A comment was received to estimate benthic macroinvertebrate colonization rates toward evaluating future changes to productivity. Mary Lou stated her concerns about the accuracy of the information that would be collected using artificial substrate samplers (the preferred sampling technology). Mike Buntjer (USFWS) agreed with MaryLou on the shortcomings of artificial substrate samplers toward providing representative results. Mike Buntjer stated that similar work was conducted during the 1980s and that the results of this work were unclear. Mike supports further evaluation of the 1980s work to determine the value of collecting this information and that such an exercise would be the appropriate first step to determining whether any additional work is needed.

A comment was received to quantify large wood and characterize its use by macroinvertebrates. Mike Buntjer stated that the intent of this request was to better understand the importance of large wood. MaryLou asked Mike if his interest was to sample macroinvertebrates on large wood. Mike stated that this was his interest. MaryLou thought that this issue was being addressed within the Large Wood Study and believed that a stratified sampling design would be most appropriate to addressing this issue. Mike agreed with this assessment.

A comment was received to document the presence and locations of invasive macroinvertebrates and algae. MaryLou noted that all studies will document the presence of invasive species, if any are observed.

MaryLou and Mike agreed that a follow up discussion would be valuable to resolve any outstanding issues related to the River Productivity Study.

Fish Passage Study

MaryLou Keefe (R2 Resource Consultants) stated that these fish passage comments should be considered a new study request since AEA had not yet developed a study plan to address these issues. Wayne Dyok (AEA) stated that a study plan describing a feasibility level analysis would be appropriate but that within this plan, it would be critical to develop triggers for future evaluation and/or next steps that might be needed. Sue Walker (NMFS) asked that triggers be defined. Wayne defined triggers as the criteria for implementing additional steps as it relates to technological feasibility of passage structures in the context of a cost/benefit analysis. Wayne also stated that AEA will consider these types of criteria. Sue stated and Wayne agreed that the evaluation of fish passage feasibility should be conducted within the conceptual design phase of the Project engineering process. Sue also noted that she had additional fish passage engineering issues that she would like to discuss with the appropriate AEA staff and consultant leads outside of this meeting. MaryLou will follow up with Sue to identify a time for a conference call to follow up.

Betsy McCracken (USFWS) asked if AEA had considered alternatives to fish passage such as mitigation. Wayne stated that currently, no alternatives are being considered but that the fish passage feasibility assessment should be the first step before any alternatives can be identified. Dudley Reiser (R2) noted that although mitigation should be a consideration, it is too early to begin discussing this as there is not enough information at this point in time to properly inform the development of alternatives.

Early Life History and Juvenile Fish Distribution and Abundance

MaryLou Keefe (R2 Resource Consultants) stated that many of the study comments were being addressed under different studies but that this confusion may have been the result of a past reorganization of study elements into different study plans. MaryLou noted the following comments that had been received that required further clarification as follows:

A comment was received to determine the timing of downstream movement of all anadromous salmon species and outmigration. MaryLou noted that this would be a very large task with various challenging components such as during ice conditions and for the fry life history stage. MaryLou stated that outmigration timing would be best captured through the use of technologies such as migrant traps and that such traps may not work well to capture certain life history stages such as fry under ice. Mike Buntjer (USFWS) agrees and stated that when writing these requests, he tried to use existing information to develop his study objectives. Both MaryLou and Mike agreed that capturing sufficient information about downstream migration will be important.

MaryLou inquired whether Mike Buntjer had given any thought to sampling sites. Mike stated that he had not thought about the study at this level of detail but noted that Portage Creek was a selected site. MaryLou and Michael Link (LGL) believe this site would be effective for capturing and marking fish. Mike Buntjer also stated that trapping activities could be beneficial at different locations to examine reach scale outmigration metrics. MaryLou stated that there has been discussion about developing the concept of intensive study sites that would support the objectives of various resource studies and that this design would address Mike Buntjer's concerns. Mike stated that he is receptive to continuing discussions regarding study design details.

A comment was received to estimate juvenile salmon production. MaryLou asked Mike Buntjer (USFWS), if productivity, in this instance, was defined as CPUE or true total production and whether he thought that migrant traps could be used to address this. Mike stated that estimating true total productivity was not his intent but rather an index of abundance so that stakeholders can assess relative status both pre- and post-Project.

Sue Walker (NMFS) stated that having these comments provided in advance of the meeting would have been helpful to allow participants to prepare for discussions. Wayne Dyok stated that the objective of these discussions is to not force stakeholders to make decisions but to try and get clarification on the rationale used to develop specific requests. The feedback would be used to inform the PSP which is a preliminary step in the overall development of the study program. Betsy McCracken (USFWS) agreed with Sue Walker about having the questions in advanced.

A comment was received to evaluate salmon incubation in mainstem habitats with and without upwelling. MaryLou stated that her primary concern with this type of evaluation is the high level of uncertainty given the complexities around the drivers of hatching success. MaryLou referenced a study conducted in the Mid-Columbia River where results indicated that modifying alevin emergence timing using flow releases had high variability between individual redds. Mike Buntjer (USFWS) agreed that there would likely be a lot of natural variability but is most interested in the groundwater component (areas with and without). Dudley stated that given his past experience with this type of work, it would be difficult to control the large number of interactions between existing variables although it could be viable in a controlled area. Dudley presented another option which would be to monitor the parameters that drive incubation and emergence timing such as temperature and dissolved oxygen. He stated that there is a considerable amount of literature on how specific parameters affect emergence timing. Mike stated that he was receptive to pursuing this approach.

MaryLou asked the group for further clarification on the overall objective of the study request. Mike stated that his primary interest is emergence timing and success under pre- and post-Project conditions. To support this, Mike believes an overall characterization of natural mortality of various species of interest versus what the system would look like post-Project, would be useful. Wayne Dyok (AEA) noted that such information might also support the development of operational regimes to minimize impacts to emergence timing and success. MaryLou stated that to address this issue, integration of information from multiple study areas will be critical. Phil Hilgert (R2 Resource Consultants) noted that a topic of discussion tomorrow will be the integration of biological information and instream flow/operational scenarios. Such an integration will allow for the development of approaches such as tracking the fate of a redd through time (via flow releases/water level) to assess the probability of survival (assumptions included). Betsy McCracken (USFWS) asked how would this be done for multiple redds and multiple species. Phil stated that one way would be to identify an area using transects and 2D modeling to identify potential spawning habitat by species. Once areas were identified, one could then model the area's spawning, incubation, and emergence success through the entire spawning and incubation period under proposed operational scenarios. Betsy McCracken asked if this approach could also address the function of groundwater. MaryLou reiterated the importance of integration over many studies to acquire the appropriate information including the groundwater study. Michael Lilly (GW Scientific) stated that the groundwater study was never intended to be an independent study but rather its function is to provide critical information to other studies to better understand the processes and how they may impact potential resources. Michael Lilly noted that understanding the processes first toward informing next steps and solutions will be critical. Joe Klein (ADF&G) agreed and stated that marrying adequate physical data with fish distribution data would be a critical component to an integrated approach. Michael Lilly also noted the importance of knowing why fish may not be distributed in particular areas in order to better isolate the differences between presence and absence. Both Mike Buntjer and Sue Walker agreed. Mike Buntjer noted that there is some confusion around the conclusions that can be drawn from the 1980s studies given the incomplete reporting. Wayne Dyok (AEA) stated that R2 Resource Consultants is currently synthesizing the information collected from the 1980s studies and hopes to share this information, when available.

A comment was received to evaluate diel behavior and fry stranding. MaryLou (R2 Resource Consultants) requested more input regarding the expected scale of this request. Mike Buntjer (USFWS) referenced the 1980s studies and noted the work provided little in the way of conclusions. Mike would like to know when fish are most active and whether they can avoid being stranded by fluctuating water elevation. MaryLou stated that the video/DIDSON component of the fish proposal might suffice in addressing this concern. Dudley Reiser (R2 Resource Consultants) added that this issue relates to the varial zone and could also be addressed, in part, via modeling. Dudley also noted that stranding is only one component and that trapping would also need to be considered. Joe Klein (ADF&G) added that a year-round timeframe for study/analysis is important due to other species such as burbot that spawn in the winter and may be susceptible. Wayne Dyok (AEA) stated that future Project operations are not yet defined and that this type of information will be important to informing how the Project may operate to protect aquatic resources.

Eric Rothwell (NMFS) asked whether the methods identified in the study plan were adequate for characterization of seasonal distribution and relative abundance in the winter months and whether other methods could be used. MaryLou stated that the methods identified in the study plan were not intended to be all inclusive. Various methods will be used including radio-telemetry (RT) and passive integrated transponder (PIT) tags. MaryLou noted that the first year of study would employ a broad array of methods and this would help to refine the effort in subsequent years. Tim Sundlov (BLM) asked if anybody was aware of the successful data collection using PIT tags during winter ice conditions. Mike Buntjer (USFWS) stated that some USFWS work on coho salmon in the Matanuska Valley may provide some insight. Joe Klein (ADF&G) stated the importance of being able to extrapolate any information that is collected to larger spatial scales in order for it to be meaningful. MaryLou noted that the current study plan identifies a stratified random sampling design from a robust habitat classification system to address this concern.

Adult and Juvenile Non-salmon Anadromous, Resident and Invasive Fish Studies

A comment was received to characterize the synchronized life history strategies of these species and their potential behavioral response to Project-induced flow changes. MaryLou Keefe (R2 Resource Consultants) stated that the study employs RT technology and wanted to confirm that this would be appropriate to address this request. Betsy McCracken (USFWS) believed that RT would be sufficient but expressed the need to coordinate this work with other studies such as instream flow. Betsy also noted that they are primarily interested in broad migration patterns.

A comment was received to characterize trophic interactions by conducting a seasonal evaluation of the diet of all species by age class. MaryLou Keefe (R2 Resource Consultants) asked the group to confirm whether trophic interactions meant diet analysis and why it was necessary to conduct an analysis for all species, all life stages, and all seasons. Betsy McCracken (USFWS) stated that having this suite of information prior to Project construction would be important for assessing how these interactions change after construction. MaryLou asked whether there was an interest for this information above and below the proposed dam site. Betsy McCracken confirmed that there was an interest for this information above and below the dam site. MaryLou agreed that trophic interactions will likely change with Project construction but asked how this baseline information would help to assess Project impacts. Betsy McCracken stated that little information exists for many of these species and that baseline would be needed to evaluate Project impacts. Jack Erickson (ADF&G) noted that there is significant temporal variation in stomach content and that large sample sizes would be necessary. MaryLou concurred and believed that to conduct a scientifically rigorous analysis given 20 species, 3 age classes, and 4 seasons would require that approximately 60,000 stomachs be collected which is not feasible. MaryLou stated that she is not opposed to conducting some gut analysis for the study but that she would need to better understand the objective of the task. Betsy McCracken noted that she could consult with her agency and provide more information. Betsy also stated that her interest is to understand persistence in the new environment. MaryLou replied that if this was the primary objective, there different type of approach can be designed to better understand trophic dependencies.

A comment was received to quantify marine-derived nutrients input into the system by estimating biomass of anadromous lamprey, eulachon, and Bering cisco. MaryLou Keefe (R2 Resource Consultants) asked if biomass was defined as a simple abundance multiplied by mass calculation. Betsy McCracken (USFWS) stated that it was and that her primary interest was to get an idea of relative contribution of these species to the system. MaryLou stated that the wildlife component of the marine-derived nutrients question is challenging since predation does not necessarily constitute a loss of nutrients but a transfer from aquatic to terrestrial systems. Betsy McCracken stated that any biomass information and indice development would be more than is currently available. Betsy McGregor (AEA) reminded the group that the terrestrial study will evaluate aquatic inputs/relationships with bear. MaryLou believes that an evaluation at some level can be conducted to address this request.

A comment was received to determine the economic, social, recreation and aesthetic value of fish and habitat in the Susitna River. MaryLou Keefe (R2 Resource Consultants) stated that these issues will be addressed in other studies.

Adult Salmon Distribution, Abundance, Habitat Utilization, and Escapement

A comment was received to estimate salmon escapement by mainstem reaches and tributaries. MaryLou Keefe (R2 Resource Consultants) believed that this work was being conducted by ADF&G. Michael Link (LGL) noted that the 2012 Radio-telemetry work would not address this issue. MaryLou asked that Mike Buntjer (USFWS) clarify what was being proposed with this specific request. Mike stated that he would review his notes and provide feedback to MaryLou on this issue.

Additional Issues and Requests

A comment was received to address methylmercury in fish. MaryLou stated that this is a concern and it will be addressed. This issue is not in the fisheries program and is spread out over several programs including water quality, wildlife, and geology and soils.

A comment was received to evaluate the presence of sockeye in the Upper Susitna River. Betsy McGregor stated that all five species will be radio-tagged by ADF&G and that this information can be used to characterize presence in the upper basin. If sample sizes had to increase to address this issue, that could be done. Becky Long (Coalition for Susitna Dam Alternatives) noted that at a previous work group meeting, Mike Beethie had shared anecdotal accounts of species presence.

MaryLou stated that she had no more questions regarding comments received and asked if there were any other comments. Frank Mielke (Alaska Ratepayers) stated that invasive species information would be useful for developing future management objectives. Joe Klein (ADF&G)

wanted to clarify the purposes of the two types of sampling; by habitat and the intensive study sites. Joe expressed that the intensive sites are areas where the information will allow us to understand relationships at the represented scale whereas by habitat sampling would allow for information at a broader scale.

Larry Engel (MSB Fish and Wildlife) stated he is currently involved with an environmental analysis of military operations and impacts from aerial activity in the Susitna area. He stated his concerns about the potential impacts of aerial operations during critical times associated with this Project and wondered if AEA has been involved in this process. Becky Long stated that comments are due on July 9th. Wayne stated that AEA needs to work with Tom Crawford at ADNR and make them aware that this project exists and the specific concerns to ensure they are adequately reflected in the EIS process.

Brian Carey (AEA) reminded participants that the site visit has been moved the July 26-27th. He requested that those interested in participating RSVP by June 30th. He also asked that participants provide information about sites of interest and specific requirements from federal agency participants about paying for their own participation. Information can be provided to Brian via email at bcarey@aidea.org.

Wayne stated that there may be the potential need for a plenary group to evaluate the process thus far. He thought that this could occur in August. Sue Walker supported this idea and requested that a detailed agenda be provided in advanced of the meeting. Sue also asked if this was the extent of agency interaction with AEA regarding finalizing study plans. Wayne noted that the filing of the PSP does not signify the end of input for comments to study plans. There are additional opportunities via the 90-day comment period and the Revised Study Plan.
A phone participant requested that members of her community be involved with the subsistence and traditional ecological knowledge assessments. Betsy McGregor stated that this work was being conducted by ADF&G and that they have hired local people to conduct these studies.

Mike Buntjer stated that there have been several requests for multiple years of study and that there was confusion as to AEA's position with regard to this request. Wayne asked if David Turner (FERC) could clarify on feedback that "studies must be completed" prior to filing a license application. David Turner stated that he views this as a study specific question. If multiple years above the current 2-year proposal, is needed, these should be done prior to filing the license application. Wayne stated that he expects that these studies can be conducted and filed by September of 2015.

Jan Konigsburg (NHI/HRC) asked if AEA plans to develop a comment table. Steve Padula notes that in the fall when the RSP is developed, AEA will be required to account for all comments and how they were addressed. David Turner noted that this requirement should be provided in the PSP as well. Steve clarified that completely new study requests/major issues will be clearly addressed in the PSP however, if adjustments are made to existing study plans such as minor changes, these will not be explicitly accounted for in an accompanying document but only within the study plans themselves given this would be a very lengthy exercise. Dave Turner agreed that

that the disposition of major issues will need to be clearly addressed in the PSP. Matt LaCroix (EPA) stated that a general status summary of comments would be useful for many who are not participating in all parts of the process. Wayne replied that AEA will consider this but to review and consolidate 2000 pages may not be feasible, certainly not by July 16th. Matt stated that this could be a valuable tool but is not necessarily asking for anything at this time.

Larry Engel asked where more information on ongoing Project activities can be found. Betsy McGregor noted that most Project information, when available, can be found on the Project website. Wayne noted that MSI Communications has been hired to better refine the AEA-public informational interface regarding Project activities. Next week – Access Corridor Alternatives Analysis should be available (conducted by ADOT). Joe Klein requested that the USGS studies and any FERC notices be included on the website. Mike Buntjer stated that regarding rock sandpiper overwintering at the mouth of the Susitna River may be an issue. Betsy McGregor replied that she has an action item to follow up on this potential issue

Action Items

- R2 Resource Consultants (MaryLou Keefe) shall include a characterization of particulate organic matter in the Upper, Middle, and Lower Susitna River as part of the River Productivity Study.
- R2 Resource Consultants (MaryLou Keefe) to schedule a meeting with the USFWS to discuss/resolve any outstanding issues related to the River Productivity Study.
- AEA will develop a Fish Passage Feasibility Study Plan for inclusion in the PSP.
- R2 Resource Consultants (MaryLou Keefe) will identify a time for a conference call with NMFS (Sue Walker) to discuss their additional fish passage feasibility concerns.
- USFWS (Betsy McCracken) will consult with others at her agency to provide additional information to R2 Resource Consultants on the scope of the trophic interactions comment noted in the Adult and Juvenile Non-salmon Anadromous, Resident and Invasive Fish Studies.
- For the Adult and Juvenile Non-salmon Anadromous, Resident and Invasive Fish Studies, R2 Resource Consultants (MaryLou Keefe) will add a study task to describe marine-derived nutrient inputs into the system.
- With regard to the comment in the Adult Salmon Distribution, Abundance, Habitat Utilization, and Escapement Study to estimate salmon escapement by mainstem reaches and tributaries, the USFWS (Mike Buntjer) will provide clarification to R2 Resource Consultants (MaryLou Keefe) regarding the intent of the request.
- AEA (Wayne Dyok) will follow up with ADNR regarding comments on the environmental analysis of military operations and impacts from aerial activity on the Susitna River area.
- AEA will post the USGS studies and any FERC notices to the website, when available.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Water Resources Workgroup Meetings
June 13, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK
Stakeholder PAD Comments/Study Requests and Study Plan Development for Water Resources (Instream Flow and Water Quality), June 13, 2012, 9:00 am - 1:00 pm

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Brian Carey
ARRI	Jeff David (on phone)
USFWS	Mike Buntjer
USFWS	Betsy McCracken
USFWS	Bob Henszey
USFWS	Lori Verbrugge
USFWS	Lori Schtick (on phone)
NMFS	Susan Walker (on phone)
NMFS	Eric Rothwell
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADF&G	Stormy Haught
ADF&G	Mike Beethie
ADEC	William Ashton
ADEC	Jim ???
ADNR	Melissa Hill
ADNR	Kim Sager
ADNR	Walton
BLM	Alan Peck
BLM	David Mushovic
BLM	Mike Sondergard (by phone)
EPA	Matt LaCroix
EPA	Lisa McLaughlin
USGS	Dave Meyer
FERC	David Turner (by phone)
FERC	Paul Makowski (by phone)
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsburg
Long View Associates	Steve Padula
Long View Associates	Bao Le

Organization	Name
HDR	Michael Barclay (on phone)
URS	Paul Dworian
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	Stuart Beck (on phone)
R2 Resource Consultants	Phil Hilgert
R2 Resource Consultants	Kevin Featherston
Tetra Tech	Harry Gibbons
Tetra Tech	Rob Plotnikoff
Tetra Tech	Christy Miller
Tetra Tech	Bob Mussetter
Tetra Tech	Mike Harvey
Tetra Tech	Bill Fullerton
E-Terra	Lars Gleitsmann
E-Terra	Steve Colligan
GW Scientific	Michael Lilly
Alaska Ratepayers	Scott Crowther
Coalition for Susitna Dam Alternatives	Becky Long (on phone)

Presentations

- Phil Hilgert (R2 Resource Consultants): Effective Spawning Incubation Model.
- Kevin Featherston (R2 Resource Consultants): Riparian Instream Flow Studies.

Introduction

Steve Padula (Long View Associates) acknowledged the receipt, by AEA, of stakeholder comments and study requests and noted that many of them were consistent with the study requests developed by AEA. Steve Padula stated that the goal of this week's set of meetings was to seek clarification regarding any stakeholder comments that would require the development of new studies, additional study tasks or differing approaches to existing study methods.

Brian Carey (AEA) reminded participants that the site visit has been moved the July 26-27th. He requested that those interested in participating RSVP by June 30th. He also asked that participants provide information about sites of interest and specific requirements from federal agency participants about paying for their own participation. Information can be provided to Brian via email at bcarey@aidea.org.

Baseline Water Quality Study

Paul Dworian (URS) stated that in general, the study comments were consistent with what had been developed in the Baseline Water Quality Study Plan. There were, however, several water quality comments where he was seeking additional clarification as follows.

Paul stated that there were several comments related to concerns over water quality impacts during Project construction activities. Paul noted that these potential impacts are not currently known and that the intent of these studies is to establish baseline water quality information for the Project as opposed to assessing impacts to construction activities. Paul stated that as if/when construction occurs, permitting will be required but these are not activities at this point in time.

A number of comments were received regarding sampling and modeling mercury in the Susitna River. Paul believed that one potential challenge with mercury is that all of the related activities are spread out over many disciplines/studies. Paul added that there has been discussion about consolidating mercury into one interdisciplinary study where the primary objective would be to conduct basic sampling to determine the presence of mercury in the system. Lori Verbrugge (USFWS) asked if all media will be sampled. Paul noted that mercury would be sampled in a diverse set of media. Harry Gibbons (Tetra Tech) added that a pathways analysis would also be conducted. Rob Plotnikoff (Tetra Tech) expressed the need to collaboratively identify criteria for triggers that confirm pathways that support a step-wise approach.
A comment was received to conduct water quality sampling at a monthly frequency during the winter. Paul Dworian stated that this is not the current intent given the challenging field conditions in the winter and because the water quality team does not believe that the magnitude of change in water quality are not rapid enough to justify such a high level of temporal resolution. Eric Rothwell (NMFS) asked whether anything would be missed with just two winter sampling events. Harry Gibbons stated that the system is biologically constrained and not dynamic during this time period which results in little change in chemistry. Eric requested that this rationale be stated clearly in the study plan.

Betsy McCracken (USFWS) asked how all of this information will be integrated to give stakeholders a clear understanding of the system. Harry Gibbons replied that the data is collected to calibrate the predictive capability of the modeling for future scenario projections. Alan Peck (BLM) asked how many years of water quality data will be collected to calibrate the model. Rob Plotnikoff replied that it is dependent upon the situation but in this case, it may be that one year of data can calibrate the model and a second year can function as the independent data set. Matt LaCroix (EPA) stated that without a middle of winter sampling period, it would be difficult to confirm static conditions. Matt noted that the Susitna River transitions to a groundwater influenced system in the winter and wonders if the first sampling period would capture this transition. He did not know if additional sampling would detect this but believed based upon the results of the first year of study, that revisiting winter sampling frequency could be warranted. Wayne Dyok (AEA) stated that such an approach of first year informing activities in the second year seems appropriate.

Water Quality Modeling Study

A comment was received questioning the choice of selecting the EFDC model over the CE-QUAL-W2 model. Paul Dworian (URS) stated that the EFDC model was chosen due to its range. Rob Plotnikoff added that sediment transport and toxics could be addressed with EFDC in addition to the general suite of water quality parameters. Harry also believes the three-dimensional component of EFDC will be valuable for with regard to toxics modeling. Matt LaCroix clarified that (EPA) recommended the use of CE QUAL-W2 only because they were against the use of a one-dimensional model. Matt added that EPA would be happy with the EFDC model. Wayne Dyok stated that in the study plan, it would be helpful to add references about where this model has been used successfully.

A comment was received regarding the broad application of thermal imaging technology. Paul Dworian sensed that comments were generally optimistic about this technology and that he was remained cautious about its utility. Paul clarified that the first year of thermal imaging is intended to be a pilot study. Paul noted that the window of time to utilize this technology successfully in the Susitna River (late August/early Sept) is small. Differentials to support detection only exist during a small window of time. Eric Rothwell (NMFS) recognizes the small window of time to sample using thermal imagery and requested that the study plan acknowledge the constraints so that stakeholders understand that failure represents a data gap which may require alternative approaches.

A comment was received regarding the addition of meteorological stations (2 or 3) in the Upper Susitna River basin. Paul Dworian stated that he was not opposed to this. Rob Plotnikoff added that meteorological data is good for modeling but given that the terrain in this area is relatively uniform, it may not be necessary. In general, meteorological stations should be added in consideration of how much variability one would expect to see in this area. Rob Plotnikoff will provide in the study plan, a rationale for how many additional stations may be needed for the Upper Susitna River. Eric Rothwell stated that these comments were from NMFS and USFWS and that he would like to keep the discussion open to develop the best approach and get agreement from Bill Rice (USFWS) who also contributed to this comment. Bob Henszey (USFWS) has an interest in precipitation data. Kevin Featherston (R2 Resource Consultants) plans to have riparian meteorological stations where precipitation data will be collected.

A comment was received regarding the collection of additional water quality parameters at meteorological stations. Paul Dworian did not have an issue with this request however, a caveat is that existing stations need to be evaluated for feasibility of upgrades given the potential for different technologies. Michael Lilly (GW Scientific) stated that there are various meteorological stations in existence but the level of collaboration will depend upon the potential for integration. Paul noted the value in co-location of meteorological stations due to the potential for acquisition of historical data.

A comment was received regarding additional metals sampling. Paul Dworian stated that he was not opposed to this request but questioned why some metals were added and others were not with regard to the list. Lori Verbrugge (FWS) could not recall exactly why this is so. Paul asked whether it is acceptable to do a screen for all metals and then to reduce the metals sampled only to those that have significant results. Lori believed that removing analytes that are not of concern after a robust first screen would be acceptable. William Ashton (ADEC) stated that he would like to see chromium, nickel, and selenium sampled during all events regardless of results. Paul noted that these are in the 2012 study plan. Paul will update the study plan to capture discussion.

Wayne Dyok (AEA) noted that comments were received regarding expanding the glacier melt study. Wayne stated that a long term approach to addressing this issue would be to engage the University of Alaska, Fairbanks, but for now Tetra Tech would develop a study plan to address this issue.

Instream Flow and Groundwater Aquatic Habitat Related Studies

Dudley Reiser (R2 Resource Consultants) began the discussion by presenting a figure that illustrated the instream flow study program, its component parts, and the linkages to other disciplines/studies. Dudley noted that similar to other study disciplines, the instream flow and groundwater comments were generally consistent with what is currently being proposed by R2 and AEA but as a result of reviewing stakeholder comments, some additional questions were identified as follows.

Instream Flow Comments

A comment was received requesting the study to quantify changes to the aquatic and riparian ecosystem due to operations over the expected life of the project, at least 100 years. Phil Hilgert (R2 Resource Consultants) stated that with regard to FERC-licensed projects, this impact analysis would typically be conducted over a maximum license term of 50 years. Betsy would ask that a copy of comment table available. R2 will provide. Eric Rothwell (NMFS) replied that 50 years of analysis is appropriate but wanted to make the point that the Project effects will much longer than a maximum license term. Eric added that this comment reflects NMFS' concerns with longer term impacts although he understands the need to conduct it within the FERC's appropriate timeframe.

A comment was received requesting the development of habitat flow relationships over a scale of 5 years. Phil Hilgert stated that currently, the study program is 2013-2014. However, once the models are developed and linked, an operational scenario can be developed over a 5 year increment. Eric Rothwell stated that problem is that the model is calibrated over a short time (2 years) and this may not be a representative time period; especially with regard to biological information. Eric stated that his concern was that 2 years of information may not encompass the variability for all resource areas. Phil Hilgert replied that the intent of the model is to extrapolate to conditions that may not be present over the next two years. With regard to operational scenarios, it is appropriate to begin with wet, dry and average water years as the basis for operations, but this would become refined as preferred scenarios are identified and would allow AEA to refine the period of record that is appropriate. Eric stated that his concern was having sufficient information for key life history stages that may overlap with operational changes and that if assumptions were needed due to a lack of data that agencies would be forced to develop such assumptions conservatively. Dudley Reiser introduced periodicity as an example where variation can be considered conservatively within the modeling framework. Dudley stated that the modeling is intended to be a collaborative and iterative process.

A comment was received requesting that the future trend in hydrologic flow be projected for the expected life of Project. Dudley Reiser stated that this will be evaluated.

A comment was received requesting that the instream flow assessments have 2 years of data. Dudley Reiser stated that per previous comments, there are constraints to study program that currently won’t allow the request.

A comment was received requesting that new HSC/HIS curves be developed for all fish species and lifestages, by season. Dudley Reiser noted that such a request would be a daunting task. Dudley added that all species will be evaluated but not all will have site specific curves developed. Dudley stated that the current approach is to implement a gilded approach where a representative umbrella species would be identified. This approach has been implemented for other projects. Betsy McKracken (USFWS) stated that although there may be some opportunity for overlap of some lifestages, the gilded approach is typically implemented in systems where there is a high species assemblage. Regardless, Betsy stated that she is receptive to providing overlap where it is reasonable. Dudley replied that confirmation that a gilded approach is important but reiterated that development of this approach will be collaborative with continuing discussions by the group.

Matt LaCroix (EPA) stated that there is a general lack of baseline data for habitat use to conceptually identify umbrella species and that he would be interested in seeing a preliminary analysis/organization of how a gilded approach would occur, when it is available. Dudley replied that after a year of study, more information should support the collaborative development of an acceptable HSC/HSI approach.

Dudley stated that currently, the details are not in study plans at this time but much of this will be developed and integrated in a step wise manner. Matt LaCroix stated that sampling effort should be sufficient to capture episodic events. Phil Hilgert added that this summer, to be proactive, some HSC data will be collected and methods tested to inform next year.

A comment was received requesting that model selection be determined in consultation with agencies. Dudley Reiser noted that they are open to this and that subsequent discussions will require a site visit and a discussion with agencies about best models to use to address various objectives. Dudley also reiterated that this is not one model but a suite of models. Phil Hilgert provided a presentation on varial zone modeling that tracks redd disposition during spawning and incubation period on the Skagit River in response to load following activities (effective spawning incubation model). Phil stated that such a model could be used for different conditions, different operations, different locations and different species. Phil also noted that this model could be used to integrate groundwater. Eric Rothwell (NMFS) stated that for redds, a one-dimensional model would be appropriate; but for post emergence, uni-variate models are not appropriate which is why NMFS stresses the need for collaboration. Eric added that model selection must be justified in study plans. Phil Hilgert agreed that for the purposes of study plan development, concurrence on general direction/approach is the goal, however, working out the details locally with agencies/stakeholders would be preferred. Phil cautioned that a lot of specificity in study plans may reduce implementation flexibility from a FERC process perspective so it is important to have a balance between necessary detail and adaptability. David Turner (FERC) stated that he doesn't need all the study plan details worked out (i.e., transect selection) but also noted that the ILP is flexible enough to allow deviation in study approach, if needed. Dave added that FERC does not need a high level of detail but assurance is required that there is buy-in from stakeholders.

A comment was received requesting that Project alternatives should consider a two dam configuration. Dudley Reiser stated that the current analysis is only pursuing a single dam alternative. Betsy McGregor (AEA) stated, however, that the model will run a variety of flow/operational scenarios similar to a two dam configuration. Mike Buntjer (USFWS) noted that this request was not intended to replicate the 1980s analysis but to just evaluate the option of a re-regulating reservoir to lessen impacts as a component of potential mitigation. Brian Carey (AEA) noted that AEA is currently evaluating the importance of flow variation to better understand value of various flows as they relate to operational scenarios. Wayne Dyok added that this analysis will look at various conditions under various circumstances from load following/displacement to emergency conditions and that this information will be available in September. Eric Rothwell (NMFS) asked range of flows the current evaluation is considering. Brian replied that flows will be evaluated be up to 14,500 cfs. Eric noted this is the maximum flow and that the next steps could be to refine the range. Matt LaCroix (EPA) stated that the focus of EPA's similar comments were related to the need to look at the effects to alternatives for the purposes of NEPA analysis. Matt stated that this does not suggest a high level of modeling for these alternatives but that some modeling activity may be requested to inform a broader analysis required by NEPA. Wayne replied that the analysis of alternatives will be broader and could include a re-regulating structure.

A comment was received requesting that habitat studies be conducted along all affected areas between RM 0-233. Dudley reiterated that the instream flow work is being conducted in the middle reach but that there is habitat work being conducted in upper reach. Betsy McGregor added that the entire zone of influence such as tributary mouths and all reservoir inundation zone habitat, we'll be evaluated but that this would be covered under a different study. Instream flow modeling is from the proposed dam site downstream.

A comment was received requesting the characterization of the natural flow regime including magnitude, frequency, duration, timing and rate of change of hydrologic conditions. Dudley Reiser stated that the hydrologic analysis will address this request.

A comment was received to analyze tributary flow data, particularly Indian and Portage creeks is needed to understand flow inputs from major tributaries. Dudley Reiser stated that the hydrologic analysis to characterize natural flow regimes should address this issue.

A comment was received to map and type tributary habitat in the upper reach. Dudley Reiser noted that this information will be collected as part of the fish and aquatic studies in the Upper Susitna River Reach.

A comment was received requesting that the habitat typing and use information should be integrated into a GIS interface. Betsy McGregor stated that this topic is related to habitat utilization and geomorphology which Bill Fullerton (Tetra Tech) will be discussing tomorrow.

A comment was received requesting that historic salmon run return timing be correlated with available spawning area. Dudley Reiser stated that one could use historic information and information being collected by ADFG to try and address this question but that a correlation to spawning area would still be challenging, especially in the mainstem.

A comment was received that stated that habitat modeling should not be used to assess habitat availability. Dudley Reiser stated that this is the process; collect information on where they are, their utilization, and their availability to try and isolate preference.
A comment was received requesting that all modeling steps be agreed upon and signed off by all parties. Dudley Reiser agreed with this comment.

A comment was received stating that to achieve the desired level of resolution for 2-D modeling, after each field data collections step, the data should be projected in a computer topographic model to identify locations needing more data points. Phil Hilgert agreed with this comment but noted that the timing constraints may require that data is collected when the flows are opportune as opposed to the proposed process. That said, R2 will abide by this process, if possible.

A comment from the Center for Water Advocacy stated that 2-D modeling, such as SRH 2-D, by the BuRec, enable modeling many kilometers of river at fine resolution (<1 m) accurately and quickly. Dudley Reiser stated that there is no proposal to implement 2-D modeling on many kilometers of the river. The 2-D effort will be a strategic application and will be coordinated with Bill Fullerton (geomorphology) and Kevin Featherston (riparian).

A comment from the Center for Water Advocacy requested that effects be studied down to Cook Inlet and identify Project effects on the Cook Inlet ecosystem. Dudley Reiser stated that the first step is to get a sense as to how far downstream load following has effects and adjust appropriately. Phil Hilgert added that there are other water quality and biological issues that may also justify moving the analysis further downstream toward Cook Inlet.

Wayne Dyok (AEA) asked whether the model will extend down to Cook Inlet from the beginning. Michael Lilly (GW Scientific) noted that it will begin at RM 74 and if model outputs outside the range of natural variability are observed to this point, this may justify expansion further downstream but the analysis will need to be conducted first.

Michael Lilly stated that there was only one groundwater study comment inquiring about the number of years groundwater-surface water interface would be evaluated. Michael noted that up to 3 years of data will be collected depending upon needs but he noted that there is other data available from other sources such as USGS as well. Michal added that the years of data are not as important as events and that collecting data during peak events would be highly beneficial to calibrating models. Other questions may require more extrapolation out over time. Michael also stated that data collection is only one potential source of information and there are other systems that are comparable and can be used to better our understanding.

Riparian Instream Flow Studies

Kevin Featherston (R2 Resource Consultants), the lead on the Riparian Instream Flow Study, stated that he has been working with Bob Henszey (USFWS) on design and noted that there were minimal comments relative to the proposed study design. The only comment that differed between what Kevin and Bob have currently developed goes back to the duration of the study which has been addressed earlier today.

Due to the lack of substantive study comments or requests, Kevin provided a brief overview of the effort developed with Bob Henszey. The Riparian Instream Flow Studies are a modeling effort that will involve synthesis of the 1980s studies but will also sample and model surface/ground water and relationship on recruitment/establishment of riparian species on the floodplain. This study, like others, is a collaborative study that will coordinate with the ice processes study to identify areas of ice break up as it relates to vegetation and with geomorphology leads to examine dynamic areas of channel migration and rates. The study will also interface with the other biological studies. This approach will allow for the characterization of the river into "riparian process domains" which follows an intensive representative reach approach. Bob Henszey stated that the study will also develop suitability curves called "riparian vegetation flow response guilds" grouping species that recruit under similar conditions. These will be developed for vegetation via flow and sediment regimes to achieve similar analyses to the HSC development for fish. Information collected at these sites will allow such guilds to be scaled up from the reach to the river scale. Wayne Dyok asked if the model be able to run scenarios, predict riparian response, and help to identify flow regimes Kevin replied that this is the primary goal of the study.

Agreements

- All Instream Flow Study modeling steps will be agreed upon and approved by all Parties.
- The EFDC Model as the preferred water quality model.

Action Items

- Paul Dworian (URS) will update the Water Quality Study Plan to update the metals sampling list to reflect the discussion at the meeting.
- Paul Dworian will update the Water Quality Study Plan to acknowledge the limitations to using thermal imaging technology.
- Paul Dworian will update the Water Quality Study Plan to provide rationale for proposing only two winter water quality sampling events.
- Rob Plotnikoff will provide in the Water Quality Modeling Study Plan, a rationale for how many additional meteorological stations may be needed for the Upper Susitna River.
- Rob Plotnikoff will provide in the Water Quality Modeling Study Plan, references to examples of successful implementation of the EFDC Model.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Water Resources Workgroup Meetings
June 14, 2012
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Stakeholder PAD Comments/Study Requests and Study Plan Development for Ice Processes and Geomorphology, June 14, 2012, 9:00 am - 1:00 pm

Attendees:

Organization	Name
AEA	Betsy McGregor
AEA	Wayne Dyok
AEA	Brian Carey
USFWS	Bob Henszey
USFWS	Bill Rice
USFWS	Mike Buntjer
NMFS	Susan Walker (by phone)
BLM	Dave Mushovic
Coalition for Susitna River Dam Alternatives	Becky Long
EPA	Matthew LaCroix
EPA	Lisa McLaughlin
ADF&G	Joe Klein
ADF&G	Ron Benkert
ADF&G	Stormy Haught
ADNR	Terry Schwarz
NPS	Cassie Thomas
USGS	Dave Meyer
Natural Heritage Institute/Hydropower Reform Coalition	Jan Konigsburg
FERC	David Turner (by phone)
FERC	Paul Makowski (by phone)
Long View Associates	Steve Padula
Long View Associates	Bao Le
HDR	Bob Butera
HDR	Ingrid Corson
R2 Resource Consultants	Dudley Reiser
R2 Resource Consultants	Kevin Featherston
R2 Resource Consultants	Phil Hilgert
GW Scientific	Michael Lilly
ARRI	Jeff Davis (by phone)
Watershed Geodynamics	Kathy Dube

Organization	Name
Tetra Tech	Bill Fullerton
Tetra Tech	Mike Harvey
Tetra Tech	Bob Mussetter
Tetra Tech	Christy Miller
E-Terra	Lars Gleitsmann

Presentations

- None.

Introduction

Steve Padula (Long View Associates) acknowledged the receipt, by AEA, of stakeholder comments and study requests and noted that many of them were consistent with the study requests developed by AEA. Steve Padula stated that the goal of the meeting was to seek clarification regarding any stakeholder comments that would require the development of new studies, additional study tasks or differing approaches to existing study methods.

Geomorphology Studies

Kathy Dube (Watershed Geodynamics) began the discussion by addressing a NPS request for a study of dust generated in the reservoir fluctuation zone, roads, and the Lower Susitna River. Kathy stated that to calculate dust from road activity, EPA procedures would be used. For wind erosion potential, Kathy Dube noted that the study is proposing to use USDA/NRCS procedures that have been applied to calculating erosion from croplands using climate and soil properties. Cassie Thomas (NPS) stated that her concern was with the fine glacial flower that will be deposited around the reservoir and when combined with high wind events could create fine particulate suspension. Despite few people living in the immediate vicinity of the Project, this could impact recreationists and residents in other areas. Kathy Thomas added that the issue is an air quality issue and potentially a wildlife issue. Kathy Dube requested confirmation that the areas of interest relate to how much fine particulate matter could be generated, mobilized in the air, and how far it might travel. Kathy Thomas concurred and added that the season of interest is spring into summer when the reservoir is low and filling. Wayne Dyok (AEA) stated that AEA could address this issue. Kathy Dube asked who could serve as a resource if more information was needed. Kathy Thomas stated that the recreation consultants may be the best source of information. Betsy McGregor (AEA) added that Bridget Easley and Paul Dworian (URS) could provide information on meteorological stations that will have wind data.

A comment was received by FERC requesting that studies consider deep rotational and block failure as part of the mast wasting/erosion along the reservoir shoreline. Kathy Dube stated that there are two studies being conducted; a study on large failures and dam safety by MWH and a study on shallow slide components of erosion which she is conducting. Paul Makowski (FERC) asked where the MWH write-up could be found so that he could make FERC dam safety staff aware of its availability. Wayne Dyok replied that this information would be included in the PSP.

A comment was received from Trout Unlimited requesting that erosion from new road construction be evaluated. Kathy Dube stated that she would be calculating erosion and sediment delivery to streams at road crossings as part of the geomorphology work. Kathy Dube also stated that one could model erosion from entire road surface and link this to receptors of interest if those were identified. David Turner (FERC) stated that following up with Trout Unlimited would be appropriate. Kathy Dube stated that she would follow up with Trout Unlimited to identify the potential receptors of interest.

A comment was received from FERC regarding the effect of glacial surge on contribution to reservoir sediment accumulation rates. Bill Fullerton (Tetra Tech) stated that this issue was first introduced by Dr. Harrison (University of Alaska, Fairbanks) at a scoping meeting, has been included as an objective in the study plan, and will be evaluated in a stepwise manner. Mike Harvey (Tetra Tech) stated that the evaluation can only occur if Dr. Harrison can provide the necessary information. Mike Harvey added that in general, he is skeptical that glacial surge is a major contributor given that glacial systems are always in a state of transport and near their maximum. David Myers (USGS) stated that the system is energy limited and that there is sufficient river length between glaciers and the proposed reservoir to attenuate any high sediment loads. Mike Harvey reiterated the need to engage Dr. Harrison directly to assess the availability of information. Wayne Dyok stated that he would connect Dr. Harrison with appropriate Tetra Tech staff. Matt LaCroix (EPA) asked whether sediment transport models could run scenarios with large inputs from glacial events. Bob Mussetter (Tetra Tech) replied that the model could but that the critical question is whether such an event is realistic or not. Tetra Tech will consider glacial events and if appropriate, they can pursue it.

A comment was received from NMFS/USFWS to describe sediment removal procedures. Bill Fullerton stated that this is something that is not being evaluated at this point in time since previous work showed the reservoir life is hundreds of years long. Matt LaCroix (EPA) noted that there are concerns with sedimentation and tributary access from Project operations. Matt added that it is conceivable that limited dredging could be necessary. Sue Walker (NMFS) referenced the Oroville Project as an example where sediment wedges. Bill Fullerton replied that part of the reservoir geomorphology study plan is to evaluate processes in major tributaries to evaluate the potential of sediment accumulation as they relate to fish passage barriers. This component of the study will occur in coordination with the reservoir fisheries activities.

A comment was received by the USFWS to digitize river habitat types for three flows in the Middle and Lower Susitna River. Bill Fullerton (Tetra Tech) stated that the current study plan proposes to examine three flows in the Middle Susitna River (23, 12 and 5 kcfs) and one in the Lower Susitna River (36 kcfs). There would be an option to digitize river habitat at the two additional flows in the lower river but this would be dependent upon whether the geomorphology and instream flow work would need to be expanded into the lower river (below the Three Rivers Confluence). At this time, the criteria to determine expansion would be if the model shows sediment transport and bed response are outside range of the natural variability. Bob Mussetter (Tetra Tech) stated that the relative contribution from upstream is relatively small (since sediment inputs at the Three Rivers Confluence is likely significant) and this needs to be evaluated first. Bill Rice (USFWS) concurred with this is approach but asked why the lower river flow was set at 36 kcfs and not a lower flow. Bill Fullerton replied that 36 kcfs is the middle range of the flows evaluated from the historical assessment. Wayne Dyok asked if the group supported the criteria for the expansion of modeling downstream as outputs outside of the range of natural variability. Matt LaCroix asked that AEA define "natural". Bob Mussetter replied that natural variability criteria would be associated with whether changes associated with the Project create a systematic change or are more consistent with what is currently seen. Matt LaCroix noted that variation occurs at a reach scale and on a seasonal basis and requested that this be considered.

Bill Rice asked what can be expected for bank erosion during load following operations. Mike Harvey replied that in general, load following may have impacts on bank erosion but it depends on specific areas and composition. Overall, Tetra Tech is planning on addressing these issues and can examine bank stability at specific sites. Joe Klein (ADF&G) asked about whether the rate of erosion on LWD pre and post Project will be examined. Kevin Featherston (R2 Resource Consultants) replied that the LWD study will examine size and distribution which will feed into modeling of how load following will affect the changes in patterns of wood mobilization. Michael Lilly (GW Scientific) stated that in the summer time, there is a constant effect of boat wake erosion which should be considered part of the natural variability. Jan Konigsburg (NHI/NHC) asked if boat wake contributions to erosion would be evaluated. Betsy McGregor replied that this would be part of the environmental baseline. Bob Mussetter stated that if this were to be included in the study, data about boat use would be needed. Betsy McGregor noted that the recreation team will be collecting these data. Joe Klein and Michael Lilly added that other studies could also provide additional data. Bob Mussetter will coordinate with Michael/Joe about what types of information would be needed to add this task to their scope of work.

Dave Mushovic (BLM) stated that the discussion seems focused on the lower river but if a reservoir is built, this will create additional boat traffic in this area and that this should be examined as well. Wayne Dyok replied that some information to address this issue is being collected in pieces through a variety of other reservoir resource studies but is not sure if this issue is being addressed explicitly. Paul Makowski (FERC) stated that there is always the option to make adjustments, as necessary, to the study program in the second study year. It may be that after year 1, this is an issue that could be added. Wayne Dyok stated that Kathy Dube's work (erosion) and the recreation data being collected could represent the preliminary phases of a step-wise process. Dave Mushovic supports this approach.

A comment was received from NMFS/USFWS to include two-dimensional model sites to include representation of each riverine habitat type, primary tributary deltas, and an unstable reach. Bill Fullerton asked if the Three Rivers Confluence would be considered a primary tributary delta. Bill Rice stated that he believed the area would be a primary tributary delta and would require two-dimensional modeling. Bill Fullerton replied that modeling this area would be a very extensive study and believes that fisheries and other data should be collected and evaluated first to identify whether an extensive modeling approach is justified consistent with the step-wise approach being implemented for other aspects of modeling. Matt LaCroix stated that a step-wise approach would be appropriate. Bill Rice stated that this area is of high interest to the USFWS. Joe Klein and Mike Buntjer agreed noting fisheries concerns in the Three Rivers Confluence. Wayne Dyok reiterated Matt's point that an incremental approach would be most appropriate. Bill Rice stated that primary tributary deltas could be discussed further. Betsy McKracken added that she was interested in Indian River and Portage Creek as primary tributaries. Bill Fullerton stated that there are more than one primary tributary and that selection would be driven by fisheries and other environmental information. Christy Miller (Tetra Tech) stated that there has been some two-dimensional modeling done at Talkeetna but only for a specific portion. Michael Lilly added that the railroad may have had additional modeling done in this area as well.

After the break, Brian Carey (AEA) reminded participants that the site visit has been moved the July 26-27th. He requested that those interested in participating RSVP by June 30th. He also asked that participants provide information about sites of interest and specific requirements from federal agency participants about paying for their own participation. Information can be provided to Brian via email at bcarey@aidea.org.

A comment was received from NMFS/USFWS to conduct fluvial geomorphology modeling tied to warm and cold Pacific Decadal Oscillations (PDOs). Bill Fullerton stated that the study is already evaluating the wet and dry years and thought that PDOs would be nested in these years. David Myers (USGS) replied that PDO cycles wouldn't necessarily be represented consistently in wet and dry years. Wayne Dyok stated that AEA will address warm and cold PDOs but stressed the importance of integration and coordination amongst team members to address all issues. Bill Fullerton stated that they will start with the 6 scenarios (wet, dry, and average years and warm and cold PDOs) but as a group, may select a subset that is representative of everyone's concerns.

A USFWS comment was received requesting the use of tracers to assess bed material mobilization. Bill Fullerton stated that for a river this large, this would be very challenging and would likely not yield any useful results due to the inability of finding a significant number of tracers. Mike Buntjer replied that he would consult with Bill Rice on this request. Bill Fullerton stated that he would contact Bill Rice to discuss.

A NMFS/USFWS comment was received requesting a geomorphic evaluation of load following during the winter period. Bill Fullerton stated that if bed is not mobilized in the winter, that there would be no reason to run the model. However, re-suspension and increasing turbidity during a period where you'd see low turbidity could be examined. Matt LaCroix stated that tributaries are not just sediment sources but can also be areas of deposition. Bill Fullerton added that this is why two-dimensional modeling will occur; to examine the dynamics of transport or accumulation at these areas, as needed. As part of the sediment balance exercise, Bill plans to identify the major point sources. Bill Henszey asked if there is a time period where turbidity is low enough to use LIDAR (green spectrum) to collect data. Bob Mussetter stated that green spectrum LIDAR is still considered to be experimental and has been used successfully in shallow mountain streams with extreme clarity but likely not applicable for this system. Sue Walker (NMFS) stated that this technology should not be dismissed. Lars Gleitsmann (E-Terra) added that aerial photos from just before freeze up (around Oct. 1) show extreme clarity to the river bottom. Bob Henszey reiterated his interest in evaluating if green spectrum LIDAR can be used.

A comment was received by the NRDC requesting that modeling include turbidity and sediment transport. Bill Fullerton stated that sediment routing will look at sediment load and will be routed through the system as a concentration. The model does not “route turbidity.” Sediment is related to turbidity but it is not the sole factor. The Water Quality Modeling Study will model turbidity.

Betsy McGregor stated that two technical memos on one- and two-dimensional modeling were prepared by Bill Fullerton and are now available on the Project website.

Ice Processes Modeling Study

Ingrid Corson (HDR) provided an overview of recent field work related to the Ice Processes Modeling Study. Spring ice flights were conducted between March 21 and May 10. In total, 13 helicopter flights surveying RM 234 down to the mouth of the river were completed. Fourteen multigrain cameras were installed, seven flights had GPS tagged video, and 2000 GPS tagged photos were taken. Additionally, GIS data was collected for open leads and ice jams. Currently, the ice processes group is in the office geo-referencing all historical data into a database. All weather data during the surveys is being compiled in an Access database. All data including ARCGIS geodatabase containing ice jams, open leads (points and lines), ice survey hyperlinked to photos, all multigrain camera photos hyperlinked, and all flight lines hyperlinked to video will be available. Ingrid added that this year’s ice breakup appeared to be “dull” noting that the break up was so mild that there were rarely interactions with vegetation (3 total observations) and that although ice jamming occurred, nothing out of the flood channel and interacting with vegetation was observed.

Bob Butera (HDR) stated that the 2012-2014 study period will continue with observations starting with freeze up (October to freeze up in late December/early January) using the same methods as in 2012 for ice breakup surveys. One additional task will be ice thickness measurements that did not occur in the last survey due to safety issues since this was a comment from agencies. Selection of the ice processes model is also continuing with two potential models; the KRISP Model and one developed for the Peace River. Wayne Dyok stated that the goal is to have full agreement on model selection for the RSP in November.

Bob Butera presented the ice processes comments from stakeholders that required additional discussion as follows:

ADFG provided a comment to examine ice processes under alternative operation scenarios which Bob believed will be built into the scope after the model is built.

Bob noted that a comment provided by ADNR and FERC was prevalent throughout the public comments reviewed and this was the use of ice as a transportation corridor. Bob stated that currently this is not a study plan task. Betsy McGregor noted that this task is part of the transportation studies.

A NMFS comment was received regarding the need to measure ice thickness. As stated earlier, this will be addressed in the ice processes study.

A NMFS comment was received regarding extending surveys to RM 250. Bob stated that the constraints of the helicopters range preclude expansion. In addition, the need to expand the study does not appear warranted.

Bill Rice (USFWS) asked about the collection of solar radiation data and its extent. Michael Lilly (GW Scientific) replied that there will be a series of solar radiation measurements taken by AEA as well as coordination with other agency data collectors, as appropriate. Bill Rice questioned whether these measures would be sufficient. Michael replied that the 2012 activity is the preliminary step to determine if more data is needed. Currently, the solar radiation monitoring has been focused on supporting the development of the temperature modeling, however, the ice processes model selection and evaluation may also inform other data needs.

In closing, Steve Padula stated that next steps will include AEA integrating into and developing new study plans per the discussions over the past two weeks. These study plans will be integrated into the PSP which will be filed with FERC on July 16th. He also noted that there was one study request that will not be adopted; the National Economic Study. But for most all other issues, it appeared that consensus was reached.

Action Items

- As part of the erosion assessment, AEA will evaluate the mobilization of fine particulate matter by wind and its potential impacts to recreationists and residents in other areas near the Project.
- AEA will put Tetra Tech in contact with Dr. Harrison regarding the acquisition of historical information on glacial surge and sedimentation in the vicinity of the proposed Project reservoir.
- Kathy Dube (Watershed Geodynamics) will contact Trout Unlimited to identify the eceptors of interest in aquatic systems that may be impacted from erosion due to new road construction.
- Bob Mussetter (Tetra Tech) will coordinate with Michael Lilly and Joe Klein about the types of information needed to add boat wake erosion as a task to the geomorphology studies.

- AEA will add additional scenarios to the fluvial geomorphology modeling to address warm and cold PDO cycles.
- Bill Fullerton (Tetra Tech) stated that he would contact Bill Rice (USFWS) to discuss the request to utilize tracers to assess bed material mobilization.

ATTACHMENT 1-2
LIST OF 2012 EARLY STUDY EFFORTS

Water Resources

Review of Existing Water Temperature Model Results and Data Collection

The objective of the 2012 Review of Existing Water Temperature Model Results and Data Collection Study is to provide a foundation for water temperature modeling of the Susitna River and the proposed reservoir that will be conducted in 2013-2014. Specific objectives include: (1) an evaluation of 1980s water temperature modeling (i.e., SNTEMP and DYRESM) results, (2) determination of whether past modeling results are applicable to the currently proposed Project, and (3) initiation of the collection of stream temperature and meteorological data needed for future modeling. The study area includes the Susitna River from river mile (RM) 10.1 to RM 233.4.

SNTEMP and DYRESM assumptions and predictive capabilities are being evaluated to determine if previously developed model results are appropriate for application to current conditions. The models' configurations, input parameters, and calibration/validation are being assessed. Flows and proposed release schedules from the 1980s are being analyzed and compared to recent records to determine the applicability of historic flow and release data to the proposed Project. If existing temperature models are applicable, results will be synthesized to evaluate potential effects of the proposed Project on water temperature and guide the design of 2013-2014 study plans.

Water temperature data and monitoring locations from the 1980s were evaluated to determine which historic locations should be monitored in 2012. Locations were evaluated based on (1) adequate representation throughout the Susitna River and tributaries, (2) preliminary consultation with AEA and licensing participants, and (3) understanding of other proposed studies and study sites (e.g., instream flow, ice processes). During 2012, water temperature data loggers are being installed at 39 sites, and meteorological (MET) data collection is being conducted and/or upgraded at up to eight locations between RM 25.6 and RM 224.

Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography

Understanding the extent to which current aquatic habitat and geomorphic features are similar to or different from conditions in the 1980s will provide information on the long-term equilibrium of the Susitna River channel and inform the extent to which datasets collected in the 1980s can be used to describe and supplement more recent data. Quantifying geomorphic features and aquatic habitat types will provide a basis for selecting future study sites, understanding flow-habitat relationships, and assessing geomorphic conditions. The objectives of the 2012 Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography Study are as follows: (1) identify the surface area of riverine habitat types over a range of stream flows, (2) compare existing and 1980s geomorphic feature/units and associated aquatic habitat type data to characterize the relative stability of the channel under unregulated flow conditions, and (3) delineate large-scale geomorphic river segments to stratify the river into study segments for use in 2013-2014 study design and implementation. The study area includes the Middle Susitna River from RM 98 to RM 184.

Color aerial photographs of the Middle River (RM 98 to RM 184) obtained in 2012 will be combined with existing information to create a digital, spatial representation (i.e., GIS database) of geomorphic features/units and macro- and meso-scale riverine habitat types. This information will be used to analyze and compare aquatic habitat and geomorphology under 1980s and current conditions. Based on this information, the Middle River will be delineated into large-scale geomorphic river segments with relatively homogeneous characteristics, including channel width, entrenchment ratio, sinuosity, slope, geology/bed material, single/multiple channel, braiding index, and inflow from major tributaries.

Reconnaissance-Level Geomorphic and Aquatic Habitat Assessment of Project Effects on Lower River Channel

The objective of the 2012 Reconnaissance-Level Geomorphic and Aquatic Habitat Assessment of Project Effects on Lower River Channel Study is to assess at a reconnaissance level the potential for the Project to affect aquatic habitat and channel morphology in the Lower Susitna River. Specific objectives include: (1) evaluating the relative magnitude of changes to the flow regime, with and without the Project in place, (2) assessing potential changes to channel morphology and aquatic habitat, with and without the Project in place, (3) evaluating the relative magnitude of changes to the sediment regime, potential impacts on sediment/substrate gradations, and the vertical and lateral stability of the channel, with and without the Project in place, (4) delineating large-scale geomorphic river segments with relatively homogeneous characteristics, (5) conducting a geomorphic assessment of historic channel change and its drivers and determining if changes have affected the frequency and distribution of meso-habitat units, and (6) providing information to assist AEA and licensing participants in developing 2013-2014 study plans. The study area includes the Lower Susitna River from RM 0 to RM 98.

The study will quantify the magnitude of change associated with stream flow, riverine habitat features, and sediment transport under the existing pre-Project and proposed post-Project conditions. A geomorphic assessment of channel change will also be conducted. Specific analyses being performed include a stream flow assessment, riverine habitat-flow relationship assessment, sediment transport assessment, geomorphic assessment of channel change, and delineation of large-scale geomorphic river segments with relatively homogeneous characteristics (e.g., channel width, lateral confinement by terraces, entrenchment ratio, sinuosity, slope, bed material, single/multiple channel, and hydrology). Additional studies will be planned for 2013-2014 if the results of the 2012 study identify a potential for channel adjustments and associated changes to important aquatic habitat in response to the proposed Project.

Documentation of Susitna River Ice Breakup and Formation

The overall objective of the 2012 Documentation of Susitna River Ice Breakup and Formation Study is to document baseline ice conditions and initiate assessment of potential effects on ice processes downstream of the proposed Project. Specific objectives are to: (1) document the timing and progression of breakup and ice cover formation on the Susitna River between RM 0 and RM 234, (2) document open leads between RM 0 and RM 234 throughout the winter, (3) document the interaction between river ice processes and channel morphology, vegetation, and aquatic habitats, and (4) 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.

Information on Susitna River ice studies conducted in the 1980s will be reviewed and synthesized, as appropriate, for use in developing 2013-2014 study plans. Information will be compiled in a geospatial format for comparison with present day observations. Recent studies of the effects of hydroelectric projects on river ice in arctic and sub-arctic climates will also be reviewed and synthesized.

Aerial mapping of open leads was conducted in March 2012 from RM 0 to RM 234. Open leads in the Middle River will be compared with the location of open leads documented in 1984-1985. Time-lapse cameras were installed in spring 2012 at 11 locations between RM 9 and RM 184 for observing ice breakup and ice-cover formation. Ice breakup progression was documented in spring 2012 between RM 0 and RM 234 via aerial observations. Documentation of freeze-up progression will be conducted in fall/winter 2012 and will include observations of the presence of frazil ice, ice bridges, ice cover, and snow cover. Meteorological and stream temperature data compilation will occur in fall/winter 2012, and river stage data from the National Weather Service observer at Sunshine Station and Gold Creek gage will be obtained daily. Telemetered stage and camera installations from the 2012 flow routing and transect study will be observed daily for signs of ice formation.

One or more physical ice processes models will be used to predict the effects of the proposed Project on river ice processes. The 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 approved for use in 2013-2014.

Instream Flow

Instream Flow Planning Study

The 2012 Instream Flow Planning Study outlines the objectives and methods for characterizing existing information that will provide a foundation for future flow-habitat studies. This study will initiate a multi-year effort, which will include data collection activities beginning in 2012 and carrying over into 2013-2014.

A comprehensive instream flow study plan will be developed during 2012 as part of the Project licensing process. The 2013-2014 instream flow study will describe the response of aquatic habitats to Project-induced changes in river flow, water temperature, turbidity, and other river channel/water quality parameters, as appropriate. The objective of the 2012 Instream Flow Planning Study is to provide information that will be the foundation for the 2013-2014 Instream Flow Study and will assist in its development. The specific objectives are to: (1) synthesize the 1980s instream flow study information and evaluate the applicability of the studies to the currently proposed Project, (2) identify appropriate fish species/life stages, study reaches, study sites, and instream flow modeling methods for the 2013-2014 Instream Flow Study, (3) conduct a site reconnaissance survey with agencies and stakeholders during which preliminary study sites and potential transect locations will be identified and analytical methods will be discussed, (4) commence collection of habitat suitability criteria (HSC) data at selected locations on the Susitna River, (5) coordinate instream flow study data needs across resource disciplines and studies, and (6) assist AEA in the development of the 2013-2014 Instream Flow Study Plan. The study area includes all aquatic habitats and riparian areas related to river flow in the Susitna River downstream of the proposed Watana Dam (RM 184 to RM 0).

The 2012 study methods address the following tasks: (1) review of 1980s instream flow study documents, (2) preliminary identification of fish target species, life stages, and/or guilds, (3) preliminary determination of species periodicity, (4) compilation and review of habitat utilization data by life stage/guild, (5) identification of physical habitat processes, (6) river stratification and study site selection, (7) review of existing HSC data/initiate collection of new data, (8) review and selection of habitat modeling methods/components, (9) assist in assessment of temperature modeling, and (10) develop the 2013-2014 study plan.

River Flow Routing Model Data Collection

A hydraulic flow routing model of the Susitna River downstream of Watana Dam will be required to support a variety of other models used to assess the Project's impact on river hydraulics, temperature, ice processes, sediment transport, aquatic resources, and terrestrial resources. The U.S. Army Corps of Engineers' HEC-RAS model is being considered for this purpose. The 2012 River Flow Routing Model Data Collection Study will initiate data collection required for developing a routing model.

The purpose of the 2012 field effort is to provide input, calibration, and verification data for a river flow routing model that extends from the proposed dam site (RM 184) to RM 75. Specific objectives include: (1) surveying cross sections to define channel topography and hydraulic controls between RM 75 and RM 184, excluding Devil's Canyon (for safety reasons), (2) measuring stage and discharge at each cross section during high and low flows, with the potential addition of an intermediate flow measurement, (3) measuring water surface slope during discharge measurements and documenting substrate type, groundcover, habitat type, and woody debris in the flood-prone area for the purposes of developing roughness estimates, and (4) installing and operating water-level recording stations in collaboration with other studies.

The primary study area includes the Susitna River mainstem channel between RM 75 and RM 184. Additional measurements will be made at inactive U.S. Geological Survey (USGS) stations at RM 26 (Susitna Station) and RM 223 (Susitna River near Cantwell), and in the Susitna delta, to support other studies taking place in these regions.

Up to 100 cross sections will be surveyed overall, with a minimum of 50 cross sections surveyed in 2012 and, if needed, the remaining cross sections surveyed in 2013. At each cross section, water level, surface slope, and discharge measurements will be made concurrently with bathymetric surveys. At each cross section, a survey team will record main channel and overbank locations, substrate and vegetation descriptions, water temperature, estimated D84 substrate size, and field roughness estimates following USGS guidance. Water-level monitoring will be conducted at approximately 8 to 10 stations.

Fish and Aquatic Resources

Synthesis of Existing Fish Population Data

The 2012 Synthesis of Existing Fish Population Data Study has two objectives: (1) consolidate and synthesize contemporary and historical fisheries resource data from the study area into a concise, comprehensive reference document and (2) develop a geospatially-referenced relational database of fisheries resources from which information can be obtained for use in analyses and studies to be conducted in 2013-2014 and beyond. The data synthesis will improve the understanding of baseline conditions and refine the list of potential fisheries data gaps, which together will contribute to developing well-focused aquatic resource studies for 2013-2014.

The following types of information are expected to be compiled: (1) river mile locations for geographic landmarks used in historical studies, (2) resident and anadromous fish species composition within the Upper Susitna River (upstream of RM 184), Middle Susitna River (RM

184 to RM 99), and lower Susitna River (RM 99 to RM 0), (3) distribution of resident and anadromous fish species among riverine habitat types, (4) relative abundance of fish species in river segments and riverine habitat types, (5) run timing, spawning, and incubation periods for resident and anadromous species, (6) representative indicators of fish growth, condition factor, age structure, and genetic information, (7) physical habitat attributes that appear to be beneficial to or preferred by fish species and life stages, (8) physical habitat attributes that appear to limit fish populations, (9) fish communities, benthic macroinvertebrate communities, and habitat conditions at stream crossings associated with proposed transmission line and access corridors.

Adult Salmon Distribution Habitat Utilization Study

The 2012 Adult Salmon Distribution and Habitat Utilization Study is the initial component of a multi-year data collection and interpretation effort. The goals of the 2012 study are to: (1) characterize the distribution, migration behavior, and proportional abundance of adult salmon and determine their use of mainstem, side channel, and slough habitats in the lower, middle, and upper Susitna River, (2) determine whether historical study results and conclusions are consistent with the current distribution and relative abundance of spawning adult salmon in the mainstem Susitna River, (3) provide spawning habitat data to support the selection of sites for the instream flow study, develop site-specific habitat suitability criteria, and develop habitat sampling protocol for 2013-2014, and (4) develop information to refine the scope, methods, and study sites for assessing habitat use by adult salmon during the 2013-2014 studies.

Study objectives include: (1) capturing, radio-tagging, and tracking adults of the five species of Pacific salmon in the middle Susitna River in proportion to their abundance, (2) determining the migration behavior and spawning locations of radio-tagged fish in the lower, middle, and upper Susitna River, (3) assessing the feasibility of using sonar to determine spawning locations in turbid water, (4) characterizing salmon migration behavior and run timing above Devils Canyon, (5) comparing historical and current data on relative abundance, locations of spawning and holding salmon, and use of mainstem, side-channel, slough, and tributary habitat types by adult salmon, (6) locating individual holding and spawning salmon in clear and turbid water and collecting habitat data from holding and spawning salmon in the middle and lower river mainstem consistent with developing HSC for instream flow modeling, and (7) evaluating the effectiveness of methods used in 2012 to address study goals and objectives, and assessing their suitability for future years' studies.

The study area encompasses the Susitna River from Cook Inlet (RM 0) upstream to the Oshetna River (RM 234.4), with an emphasis on river reaches between its confluence with the Chulitna River (RM 98) and Devils Canyon (RM 154). This study will be coordinated with basin-wide radiotelemetry studies that are being conducted by the Alaska Department of Fish & Game (ADF&G). This study differs from the ADF&G studies in that spatial data will be collected from radio-tagged fish on a finer scale, with the objective being to obtain locations of spawning and holding salmon at the macro- and microhabitat levels.

Upper Susitna River Fish Distribution and Habitat Study

The goal of the 2012 Upper Susitna River Fish Distribution and Habitat Study constitutes the first year of a multi-year effort aimed at characterizing the existing distribution of Chinook salmon and other fish species in the Susitna River and its tributaries above Devils Canyon. In addition, the study will begin to characterize fish communities and aquatic habitat in the proposed reservoir inundation zone. Specific objectives include: (1) determining the distribution of adult and juvenile Chinook salmon and relative abundance of juvenile Chinook salmon in the Susitna River and its tributaries above Devils Canyon, (2) characterizing aquatic habitat in the Susitna River and its tributaries/lakes from Devils Canyon upstream to, and including, the Oshetna River and determining the suitability of that habitat for Chinook salmon, (3) determining fish species composition and relative abundance in the proposed reservoir inundation zone, (4) characterizing the type and amount of aquatic habitat within the proposed reservoir inundation zone; (5) identifying the locations of potential fish barriers in tributaries between Devils Canyon and the Oshetna River, (6) collecting genetic samples of Chinook salmon, and (7) providing information for the development of plans for studies to be conducted in 2013-2014. The study area includes the mainstem Susitna River, tributaries, and several lake systems associated with the Susitna River between Devils Canyon (RM 154) and the Oshetna River RM (234.4) (including the Oshetna River).

Habitat mapping will be conducted in tributaries, the mainstem Susitna River, and in lakes. Adult Chinook salmon spawning surveys will be conducted in tributaries and the mainstem; timing of the surveys will be based on existing run-timing information and when clear water habitat conditions are anticipated. Juvenile Chinook salmon and other fish species will be sampled in tributaries, the mainstem Susitna River, and in lakes; sampling will be scheduled based on typical outmigration timing. If appropriate, a simple geomorphic and biologic model will be developed with appropriate criteria (e.g. channel gradient, confinement, sediment size, presence of barriers, fish sampling results) to identify the distribution of juvenile Chinook habitat in the mainstem river and tributary streams.

Cook Inlet Beluga Whale Anadromous Prey Analysis

Project-induced changes to discharge and stage may impact beluga whale access to the lower Susitna River and/or to available prey. Therefore, an understanding of beluga distribution (both spatially and temporally) and their prey species is necessary to evaluate potential Project impacts on whales and their critical habitat.

The Cook Inlet Beluga Whale Anadromous Prey Analysis consists of literature and data reviews of the use of the Susitna River by beluga whales and by their important anadromous prey species (eulachon and adult Chinook, sockeye, chum, and coho salmon). Study objectives include: (1) summarizing the life history, run timing, abundance, distribution, and habitat of beluga whale anadromous prey species in the Susitna River and in other Cook Inlet tributaries used by beluga whales, (2) summarizing temporal and spatial distribution of beluga whales in Cook Inlet, the Susitna River delta, and the Susitna River relative to the availability of eulachon and adult Chinook, sockeye, chum, and coho salmon, and (3) consulting with the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) permitting and requirements for the Project study program.

Existing information on pink salmon (juveniles and adults) and all life stages of Chinook, sockeye, chum, and coho salmon above RM 50 will be compiled as part of the Synthesis of Existing Fish Population Data Study, and additional data will be collected during fisheries studies conducted in 2013-2014. This study will focus on compiling and synthesizing life history and habitat use information of eulachon; adult Chinook, sockeye, chum, and coho salmon; and beluga whales. The study area includes the Susitna River within the range of anadromous fish distribution, with an emphasis on the lower river (RM 0-50), and the area of the Susitna River delta that could be affected by Project operations. Fish escapement and run timing data will also be compiled for other Cook Inlet tributaries where significant salmon and/or eulachon predation by beluga whales occurs. Results of the study will be used to begin identifying potential Project-induced impacts to beluga whales and their critical habitat and identify data needs to be addressed as part of the 2013-2014 beluga whale study.

AEA, in consultation with NMFS, will address MMPA and ESA permit requirements for the Project studies program and begin preparation of appropriate permit applications. A "No Impact" protocol will be developed for implementation in association with all studies that have the potential to affect beluga whales.

Botanical Resources

Vegetation and Wildlife Habitat Mapping Study

Project construction, facilities, and operation and maintenance will affect vegetation both upstream and downstream of the proposed dam, as well as along access and transmission line routes. Project effects will include direct, indirect, and cumulative effects to vegetation. This study will characterize and quantify direct loss of vegetation communities and wildlife habitat within the Project footprint; evaluate baseline wildlife habitat in the Project vicinity; and evaluate potential direct and indirect effects of Project maintenance and operations on vegetation communities and wildlife habitat. This is a multi-year study that will begin in 2012 for locations where aerial imagery is currently available. Upon a complete assessment of the Project area, mitigation alternatives will be developed from the data to address adverse Project-induced impacts.

The overall, multi-year objectives of the Vegetation and Wildlife Habitat Mapping Study are to:

- Characterize the vegetation communities and wildlife habitat in the Project area;
- Quantify the potential impacts due to Project construction;
- Evaluate potential changes to the vegetation communities and wildlife habitat from Project maintenance and operations and related activities; and
- Develop the 2013–2014 Vegetation and Wildlife Habitat Mapping Study Plan.

A complete assessment of the Project area vegetation and wildlife habitat will be completed as aerial imagery becomes available and the Project area is refined (e.g., preferred alternative access and transmission corridors). The study objective for 2012 is to develop a vegetation map using existing habitat delineations, current aerial imagery, and field verification.

Wetland Mapping Study

Project construction, facilities, and operation and maintenance may affect wetlands upstream and downstream from the dam site, and along access and transmission line routes. A thorough understanding of how project activities will affect wetland resources in the study area will be critical for developing best management practices, rehabilitation options for promoting recovery of wetlands exposed to short term impacts, and compensatory mitigation for permanent wetland losses. Wildlife use is related to the impact of Project activities on wetlands; therefore, the results of this study will be necessary to evaluate baseline and future wildlife use of the Project area. The results of the Wetlands Mapping Study will also be used to supplement the Vegetation and Wildlife Habitat, Riparian, Rare Plant, and Invasive Plant studies.

The overall, multi-year objectives of the Wetlands Mapping Study are to:

- Characterize wetlands in the Project area;
- Quantify the potential impact to wetlands and wetland function from Project construction;
- Evaluate potential changes to wetlands and wetland functions from Project maintenance and operations and related activities; and
- Develop the 2013–2014 Wetlands Mapping Study Plan.

The 2012 study will include the following study components:

- Determine appropriate scales and areal extents for wetland delineations in consultation with USACE and compile available wetland mapping at various scales for development of wetland delineations based on current aerial photography.
- Incorporate data from the Vegetation and Wildlife Habitat Mapping Study and available data on natural fire patterns along the reservoir reach of the Susitna River.
- Identify wetland delineation field sites and data from the 1980s studies for potential resampling, if possible.
- Identify sample locations and conduct initial field surveys.

Report study results, including reporting that is coordinated with other pertinent studies.

A complete assessment of the Project area wetlands and wetland functions will be completed as aerial imagery becomes available and the Project area is refined (e.g. preferred alternative access and transmission corridors). The study objective for 2012 is to develop a wetland map using existing habitat delineations, current aerial imagery, and field verification.

Riparian Study

Construction and operation of the Susitna-Watana Hydroelectric Project will alter the natural flow regime of the Susitna River. A thorough understanding of how project activities will affect riparian communities and hydrologic processes in the study area will be critical for developing best management practices, developing predictive models of potential changes in riparian ecosystems downstream of the proposed dam, assessing potential impacts to wildlife, and preparing environmental impact statements and FERC documentation.

This study will characterize and quantify riparian habitats and successional stages downstream from the dam site and will evaluate potential direct and indirect effects of Project operations on riparian habitats. This is a multi-year study that will begin in 2012 at locations where aerial imagery is currently available. Upon a complete assessment of the Project area, mitigation alternatives will be developed from the data to address adverse Project-induced impacts.

This study addresses the following issues:

- Losses of vegetation and wetland communities and productivity from reservoir inundation and the development of other Project facilities (direct effects).
- Changes to vegetation and wetland communities along access roads, transmission corridors, and reservoir edges due to alteration of solar radiation, temperature

moderation, erosion and dust deposition, reservoir fluctuation, pathogen dispersal and abundance.

- Potential changes in wetlands, wetland functions, riparian vegetation, and riparian succession patterns related to altered hydrologic regimes below the dam.

Wildlife Resources

Eagle and Raptor Nest Study

The Project may result in eagle nest site loss or alteration and disturbance due to increased human activity. Information on eagle and other raptor nest site locations will be necessary to develop avoidance and mitigation measures in compliance with the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and associated Executive Orders. Current nest site locations and nest activity in areas potentially affected by the Project, as well as areas that could potentially be disturbed during field study activities for other resources, will be obtained. This information will be used to develop avoidance areas for field study activities, and to estimate potential Project-related impacts.

The 2012 study will identify and compile existing nest site and habitat use information, develop survey areas, and complete multiple inventory and monitoring surveys for Bald and Golden eagles consistent with current guidelines. The 2012 study will identify potential Project-related impacts to eagles and raptors, identify critical data gaps, and develop 2013–2014 study plans in consultation with AEA, U.S. Fish and Wildlife Service (USFWS), and other licensing participants.

Inventory and monitoring methodologies will follow established aerial and ground-based protocols for eagle nest surveys, using appropriately trained observers and suitable survey platforms (helicopter, fixed-wing aircraft). Reporting of inventory and monitoring data will comply with the protocols and standards described in the Memorandum of Understanding between the FERC and the USFWS regarding implementation of Executive Order 13186. Although the primary study focus will be to evaluate the potential for the Project to affect eagles and eagle nests all nests of raptors and Common Ravens will be recorded during surveys. Recommendations for survey extent and methods will be developed in coordination with the USFWS before beginning surveys.

The data gathered in 2012 will form the basis of future studies to evaluate the potential impacts of the Project on Bald Eagles, Golden Eagles, and other raptors. Delineation and survey results of all suitable habitats within the Project area will identify occupied habitats and may be used in the future to evaluate occupied versus available habitats. Eagle nest sites and ground-based observations may be compared to determine pair territory size. Data on territory size can be used to determine whether raptors displaced from nest sites due to Project-related habitat loss, alteration, or disturbance maintain alternative nest sites within their territory that would be unaffected by the Project, or whether nesting pairs may be displaced into already occupied territories. Historical and current data may also be compared to evaluate trends in raptor populations and habitat use.

Past and Current Big Game Harvest Study

The Project would create an access road to the dam site, as well as a large water body that could be used for floatplane access to the region. These Project features, along with transmission line corridor(s), have the potential to facilitate human access to the Project area and change the pattern of human harvest of big game, furbearers, small game mammals, and upland game birds.

This study addresses the following issues:

- Potential impact of changes in predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development; and
- Potential impacts to wildlife from changes in hunting, vehicular use, noise, and other disturbances due to increased human presence resulting from Project development.

The objective of this study is to identify, acquire, and analyze available big game and furbearer harvest and population data from the Alaska Department of Fish and Game (ADF&G) for identification of past and current trends in hunter access modes, hunting locations, and harvest locations. Existing data from harvest reports will be compiled and reviewed for its adequacy to address Project-specific changes in human access. The analysis will also determine whether the watershed tributary-scale Uniform Coding Unit (UCU) data are adequate for detecting and predicting potential Project-related changes in total harvest and harvest locations due to potential changes in human access.

The wildlife data-gap analysis conducted for the Project identified the need for an updated drainage-specific compilation of subsistence, sport hunter, and trapper harvest data for all game animals and furbearers. Hunter access to this region has changed since the 1980s, but potential changes in patterns of harvest at this scale have not been evaluated or compared to movements of moose or caribou. Compilation of historic data could also be useful for identifying any potential trends in human access and harvest locations over the past decades and will provide input to ADF&G's management goals for big game and furbearers in the Project area.

Initial efforts will focus on compilation and analysis of hunter harvest and effort within harvest report units contained within the ADF&G harvest record database. Movement and aggregation patterns of game resources will be evaluated from available ADF&G telemetry databases (moose and caribou) or other available data maintained by ADF&G. The spatial resolution, adequacy, and completeness of the harvest data record for detecting potential changes in use of wildlife resources in the Project area will be evaluated. Collection of additional harvest data may be recommended if existing data are determined to be at an insufficient resolution to detect potential changes in harvest due to changes in human access. Additional information gathering may involve interviews with trappers, upon approval and in coordination with subsistence interviews that will be conducted in the affected communities in 2013–2014.

Wildlife Habitat Use and Movement Study

Construction and operation of the Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity due to construction and operation of the Project from the proposed dam site, and along access and transmission line routes. The Project may result in loss of, or displacement from, seasonally used sensitive habitats in the middle and upper Susitna River basin, such as caribou calving areas, bear foraging habitats, and Dall sheep lambing areas and mineral licks. This study plan outlines the objectives and methods for characterizing and further defining critical data gaps based on existing Project area wildlife abundance, distribution, movements and sensitive habitat data in order to evaluate potential Project-related effects and inform subsequent studies developed under the ILP. This study is the initiation of a multi-year data-synthesis effort beginning in 2012 and continuing in 2013–2014.

This study is broken into tasks by resource (species), each with specific objectives, study areas, methods, and analytical outputs. Information on the current use of critical moose and caribou calving areas, rutting areas, wintering areas, and migration or movement corridors; bear foraging and den habitats; Dall sheep lambing areas and mineral licks; and wolf den and rendezvous sites will be compiled from various sources and evaluated to determine the need for additional aerial surveys, ground-based monitoring, and/or the potential establishment of remote surveillance. This information will be used to develop 2013–2014 study plans.

Recreation and Aesthetic Resources

Aesthetic and Recreation Resources Study

Construction and operation of the Project may impact recreation resources by increasing activity, altering portions of the Susitna River and adjacent land, and/or restricting or increasing access. These impacts could result in changes in the nature of the recreation experience, changes in hunting or fishing opportunities, and/or changes in other recreation opportunities. Temporary recreation impacts could be generated by construction personnel, traffic, materials, staging areas, the worker camp, and noise. The Project is likely to also have positive recreation impacts. The proposed access roads and transmission line corridors, reservoir, and recreational facilities would provide new recreational opportunities to the public.

Construction and operation of the Project also may alter the character of aesthetic resources as a result of increased human activity, noise and development. Temporary visual and noise impacts would be generated by construction personnel, traffic, materials, staging areas, and worker camps. The dam and reservoir would become a new visual feature in the middle Susitna River basin. These structures could be viewed by various categories of persons, including Project personnel and support staff, recreationists, subsistence users, and individuals flying overhead. The Project could have positive visual impacts as a result of the access roads, reservoir, and recreational facilities providinge new recreational and viewing opportunities to the public.

The study objectives for the 2012 Recreation and Aesthetics Program focus on information gathering activities to identify relevant recreation and aesthetic resource information that will inform the formal study planning process and environmental and social effects analysis for Project construction and operation. Information will also be used to guide Project design and mitigation of construction, operation and maintenance activities to minimize impacts, and identify opportunities for design and siting refinements that maximize opportunity and access to recreation opportunities and/or important views. Coordination across social resources (i.e., cultural, subsistence, and socioeconomic) from the outset of information gathering is considered an essential component of the Aesthetics Program. Interdisciplinary coordination will focus on identifying location of sensitive aesthetic and/or recreational resources such as cultural properties, cultural vistas, and areas used by local outfitters (i.e., rafting, fishing, and hunting).

The 2012 work effort concentrates on data collection, and an evaluation of the comprehensiveness and applicability of existing data. An evaluation of further measures that may be required to collect appropriate data will also be provided for application in 2013/14. Both recreation and aesthetics resource areas include 2012 fieldwork, because early validation of recreation uses, trails, and viewpoints will be essential to other resource areas, and for gaining trust and input from the public. All tasks are in support of and in preparation of a draft and final FERC license application.

Cultural Resources

Cultural Resources Study

Construction and operation of the Project may result in damage or loss of cultural resources from construction or increased human activity in upper Susitna River basin. Documentation of currently known cultural resources sites will help to inform the 2013-2014 studies and this information along with a plan for unanticipated cultural resource discoveries will be useful to prevent inadvertent disturbance from other field studies for the Project.

Construction and operation of the Project may impact sites of cultural significance along transportation and powerline alignments, as well as in the area to be inundated by the reservoir. It is important that these resources be inventoried and evaluated, so that the Project can identify protection, mitigation and enhancement measures as appropriate. It is expected that potential impacts to many cultural resources in the Project area can be mitigated either via removal (data recovery/ archaeological excavation), or minor changes to project alignments (avoidance).

The cultural resources study objectives are designed primarily to continue laying the foundation of information to enable the applicant and lead federal agency to meet the requirements of National Historic Preservation Act (NHPA) and its accompanying regulations (36 CFR 800). The major objectives for 2012 work are as follows:

- Create GIS database to help enable development of predictive models and management of cultural resources information for 2013-2014 studies;
- Develop predictive model, identifying areas of high, medium, and low potential for the occurrence of cultural resources;
- Continue to identify and document cultural resources within the Project study area, building upon work done between 1978-1985; and
- Prepare plans and procedures addressing unanticipated discoveries of cultural resources, human remains, and paleontological resources.

2. PROPOSED 2013 AND 2014 ILP STUDIES

AEA is proposing to perform 58 individual studies in eleven resource sections listed below. Each study description follows a standard study plan template to provide a consistent presentation across disciplines. The study descriptions include: fundamental discussions of existing information and why the study is necessary to augment existing information; a description of the objectives and scope of the study; and how the information could be used to inform the development of license conditions for the Project.

Implementation of the studies will commence soon after FERC's study plan determination. Each study description has information regarding the scheduling of the work efforts but in general each study will include:

- Preparatory Phase, January–March 2013 and 2014;
- Field Phase or Deployment Phase, spanning April – October (typically September) 2013 and 2014;
- Analysis Phase, June – November 2013 and 2014; and
- Reporting Phase, November and December, 2013 and 2014.

Upon FERC's approval of the final study plan, AEA will finalize a comprehensive schedule for all studies. Because the studies are interdisciplinary in nature, most have direct input or output needs from other resource studies. Each study plan provides a description of these interrelationships for specific information needs and requirements that will be obtained via other study efforts. The general relationships, key information flow patterns, and interdependencies among studies are shown in Figure 2-1 (Riverine-based Studies) and 2-2 (Upland-based Studies).

Some general concepts that apply to each study plan implementation effort include:

- The schedule for each proposed study is reasonably flexible to accommodate unforeseen problems that may affect schedule.
- Field crews may make reasonable modifications to a study in the field to accommodate actual field conditions and unforeseen problems. When modifications are made, AEA's contractor field crews will follow accepted protocols to the extent possible. When modifications are made, AEA will work to advise licensing participants of the change, particularly for any substantial modifications.
- When a number of alternative modifications are available to the field crew and with all other things being equal, the contractor field crew will chose the low-cost alternative.
- Implementation of many studies will require access to private property. AEA is in the process of obtaining permission from land owners for access. Specifically excluded from study areas are locations where access is unsafe (very steep terrain or high water flows) or private property for which AEA has not received specific approval from the landowner to enter the property to perform the study.

The following studies are described in the PSP, as listed below.

<u>Geology and Soils (Section 4)</u>

1. Geology and Soils Characterization Study (Section 4.5)

Water Resources (Section 5)

1. Baseline Water Quality Study (Section 5.5)
2. Water Quality Modeling Study (Section 5.6)
3. Groundwater-related Aquatic Habitat Study (Section 5.7)
4. Geomorphology Study (Section 5.8)
5. Fluvial Geomorphology Modeling below Watana Dam Study (Section 5.9)
6. Ice Processes in the Susitna River Study (Section 5.10)
7. Glacial and Runoff Changes Study (Section 5.11)
8. Mercury Assessment and Potential for Bioaccumulation Study (Section 5.12)

Instream Flow (Section 6)

1. Fish and Aquatics Instream Flow Study (Section 6.5)
2. Riparian Instream Flow Study (Section 6.6)

Fish and Aquatic Resources (Section 7)

1. Study of Fish Distribution and Abundance in the Upper Susitna River (Section 7.5)
2. Study of Fish Distribution and Abundance in the Middle and Lower Susitna River (Section 7.6)
3. Salmon Escapement Study (Section 7.7)
4. River Productivity Study (Section 7.8)
5. Characterization of Aquatic Habitats in the Susitna River with Potential to be Affected by the Susitna-Watana Project (Section 7.9)
6. The Future Watana Reservoir Fish Community and Risk of Entrainment Study (Section 7.10)
7. Study of Fish Passage at Watana Dam (Section 7.11)
8. Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries (Section 7.12)
9. Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area (Section 7.13)
10. Genetic Baseline Study for Selected Fish Species (Section 7.14)
11. Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area (Section 7.15)
12. Eulachon Distribution and Abundance in the Susitna River Study (Section 7.16)
13. Cook Inlet Beluga Whale Study (Section 7.17)

Wildlife Resources (Section 8)

1. Study of Distribution, Abundance, Productivity, and Survival of Moose (Section 8.5)
2. Study of Distribution, Abundance, Movements, and Productivity of Caribou (Section 8.6)
3. Study of Distribution, Abundance, and Habitat Use of Dall's Sheep (Section 8.7)
4. Study of Distribution and Abundance, and Habitat Use by Large Carnivores (Section 8.8)
5. Study of Distribution and Abundance of Wolverines (Section 8.9)
6. Study of Terrestrial Furbearer Abundance and Habitat Use (Section 8.10)
7. Study of Aquatic Furbearer Abundance and Habitat Use (Section 8.11)
8. Study of Species Composition and Habitat Use of Small Mammals (Section 8.12)
9. Study of Distribution and Habitat Use of Little Brown Bat (Section 8.13)
10. Survey Study of Eagles and Other Raptors (Section 8.14)

11. Waterbird Migration, Breeding, and Habitat Study (Section 8.15)
12. Breeding Survey Study of Landbirds and Shorebirds (Section 8.16)
13. Study of Population Ecology of Willow Ptarmigan in Game Management Unit 13, Southcentral Alaska (Section 8.17)
14. Study of Distribution and Habitat Use of Wood Frogs (Section 8.18)
15. Evaluation of Wildlife Habitat Use Study (Section 8.19)
16. Wildlife Harvest Analysis Study (Section 8.20)

Botanical Resources (Section 9)

1. Vegetation and Wildlife Habitat Mapping Study (Section 9.5)
2. Riparian Study (Section 9.6)
3. Wetland Mapping Study (Section 9.7)
4. Rare Plant Study (Section 9.8)
5. Invasive Plant Study (Section 9.9)

Recreation and Aesthetic Resources (Section 10)

1. Recreation Resources Study (Section 10.5)
2. Recreation River Flow Study (Section 10.6)
3. Aesthetics Resources Study (Section 10.7)

Cultural and Paleontological Resources (Section 11)

1. Cultural Resources Study (Section 11.5)
2. Paleontological Resources Study (Section 11.6)

Subsistence Resources (Section 12)

1. Subsistence Baseline Documentation Study (Section 12.5)

Socioeconomic and Transportation Resources (Section 13)

1. Regional Economic Evaluation Study (Section 13.5)
2. Social Conditions and Public Goods and Services Study (Section 13.6)
3. Transportation Resources Study (Section 13.7)
4. Health Impact Assessment Study (Section 13.8)
5. Air Quality Study (Section 13.9)

Project Safety (Section 14)

1. Probable Maximum Flood Study (Section 14.5)
2. Site Specific Seismic Hazard Study (Section 14.6)

As noted in Section 1, interested parties have submitted a total of 52 formal study requests of which AEA is proposing to undertake all but one of these requested resource studies, with some alternations and adjustments. For the 51 study requests that align with studies AEA is proposing, AEA is not necessarily adopting each element or aspect of the proposed study request. Rather, AEA is incorporating many, if not most of the elements, with alterations or adjustments, or by providing similar approaches to the requested studies.

To the extent there are remaining differences between AEA's proposed studies and the study requests, AEA intends to discuss further with the interested parties during Final Study Plan development meetings.

The sections of this PSP where the 51 study requests align with studies AEA proposed studies are presented in Table 2-1. This table presents a listing of the individual study requests, identifies the study requestor(s), and identifies where in AEA's study plan the study topic is addressed.

2.1. Tables

Table 2-1. Summary of formal study requests filed with FERC.

Study Request Title	Requestor	Date filed with FERC	PSP Section Study Request is Addressed
Probable Maximum Flood	FERC	05-31-2012	Section 14 – Project Safety, 14.5
Geology and Soils Assessment	FERC	05-31-2012	Section 4 – Geology and Soils
Site-Specific Seismic Hazard Evaluation	FERC	05-31-2012	Section 14 – Project Safety, 14.6
Noise Assessment	FERC	05-31-2012	Section 10 – Recreation and Aesthetic Resources, 10.7
Recreational Boating and River Access Study	FERC	05-31-2012	Section 10 – Recreation and Aesthetic Resources, 10.5 and 10.6
Recreation Resources Study	FERC	05-31-2012	Section 10 – Recreation and Aesthetic Resources, 10.5
Study of Eagles and Other Raptors	USFWS	05-31-2012	Section 8 – Wildlife Resources, 8.14
Study of Waterbird Migration, Breeding, and Habitat	USFWS	05-31-2012	Section 8 – Wildlife Resources, 8.15
Study of Landbirds and Shorebirds	USFWS	05-31-2012	Section 8 – Wildlife Resources, 8.16
Piscivorous Wildlife and Mercury – Risk Assessment Study	USFWS	05-31-2012	Section 5 – Water Resources, 5.12
Vegetation and Wildlife Habitat Mapping Study	USFWS	05-31-2012	Section 9 – Botanical Resources, Section 9.5; Wildlife Resources, 8.19
Riparian Habitat Mapping Study	USFWS	05-31-2012	Section 9 – Botanical Resources, 9.6
Wetland Mapping and Functional Assessment Study	USFWS	05-31-2012	Section 9 – Botanical Resources, 9.7
Instream Flow for Floodplain and Riparian Vegetation Study	USFWS	05-31-2012	Section 6 – Instream Flow, 6.6
River Productivity Study	USFWS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.8
Fish Passage Study	USFWS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.11

Study Request Title	Requestor	Date filed with FERC	PSP Section Study Request is Addressed
Early Life History and Juvenile Fish Distribution and Abundance in the Susitna River	USFWS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.5, 7.6 and 7.7
Adult and Juvenile Non-Salmon Anadromous, Resident and Invasive Fish Studies in the Susitna River basin (RM0-233)	USFWS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.5 and 7.6
Adult Salmon Distribution, Abundance, Habitat Utilization and Escapement in the Susitna River	USFWS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.5
Susitna River Instream Flow and Habitat Utilization Study	USFWS	05-31-2012	Section 6 – Instream Flow, 6.5
Groundwater-Related Aquatic and Floodplain Habitat Study	USFWS	05-31-2012	Section 7 – Water Resources, 5.7
Water Quality Study	USFWS	05-31-2012	Section 5 – Water Resources, 5.5
Geomorphology Study	USFWS	05-31-2012	Section 5 – Water Resources, 5.8
Flow Routing Study	USFWS	05-31-2012	Section 5 – Water Resources, 5.6, 5.9, 5.10 and Section 6 Instream Flow, 6.5 and 6.6
Ice Processes in the Susitna River	USFWS	05-31-2012	Section 5 – Water Resources, 5.10
Project Effects Under Climate Change Condition Study	USFWS	05-31-2012	Section 5 – Water Resources, 5.11
Fish Passage Study	NOAA-NMFS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.11
Early Life History and Juvenile Fish Distribution and Abundance in the Susitna River Study	NOAA-NMFS	05-31-2012	Section 5 – Water Resources, 5.7 and Section 6 – Instream Flow, 6.6
Adult Salmon Distribution Abundance, Habitat Utilization and Escapement in the Susitna River	NOAA-NMFS	05-31-2012	Section 7 – Fish and Aquatic Resources, 7.5 and 7.6
Susitna River Instream Flow Study Request	NOAA-NMFS	05-31-2012	Section 6 – Instream Flow, 6.5
Susitna River Groundwater Study	NOAA-NMFS	05-31-2012	Section 5 – Water Resources, 5.7

Study Request Title	Requestor	Date filed with FERC	PSP Section Study Request is Addressed
Susitna River Water Quality Study	NOAA-NMFS	05-31-2012	Section 5 – Water Resources, 5.5
Susitna River Geomorphology Study Request	NOAA-NMFS	05-31-2012	Section 5 – Water Resources, 5.8
Susitna River Flow Routing Study Request	NOAA-NMFS	05-31-2012	Section 5 – Water Resources, 5.6, 5.9, 5.10 and Section 6 Instream Flow, 6.5 and 6.6
Susitna River Ice Processes Study Request	NOAA-NMFS	05-31-2012	Section 5 – Water Resources, 5.10
Susitna River project Effects Under Changing Climate Conditions Study Request	NOAA-NMFS	05-31-2012	Section 5 Water Resources, 5.11
Susitna-Watana Marine Mammal Study Request	NOAA-NMFS	05-31-2012	Section 7 – Aquatic Resources, 7.16 and 7.17
Recreation Resources Assessment	USDOI – NPS	05-24-2012	Section 10 – Recreation and Aesthetic Resources, 10.5
Aesthetic Resources, Assessment of Visual and Auditory Impacts	USDOI – NPS	05-24-2012	Section 10 – Recreation and Aesthetic Resources, 10.7
Adult Chinook and Coho Salmon Spawner Distribution and Abundance Studies	ADF&G	05-30-2012	Section 7 – Fish and Aquatic Resources, 7.5, 7.6, and 7.7
Fish Genetics	ADF&G	05-30-2012	Section 7 – Fish and Aquatic Resources, 7.14
Moose Browse survey in the Susitna-Watana Hydroelectric Project Area	ADF&G	05-30-2012	Section 8 – Wildlife Resources, 8.5
Instream Flow Study	ADF&G	05-30-2012	Section 6 – Instream Flow, 6.5
Evaluation of Surface Water and Ground Water Exchange	ADF&G	05-30-2012	Section 5 – Water Resources, 5.7
Request for Information or Study Effects of the Project and Related Activates on Hydrology for Anadromous Fish	Center for Water Advocacy	05-31-2012	Section 6 – Instream Flow, 6.5
Recreational Flow Study	American White Water	05-31-2012	Section 10 – Recreation and Aesthetic Resources, 10.6
Mineral Resources	Cook Inlet Region INC	05-31-2012	Section 4 – Geology and Soils

Study Request Title	Requestor	Date filed with FERC	PSP Section Study Request is Addressed
Assessment			
Temperature Impact on Aquatic Community	Natural Resources Defense Council	05-30-2012	Section 5 – Water Resources, 5.6; Section 6-Instream Flow, 6.5
Altered Flow, Turbidity and Sediment Transport	Natural Resources Defense Council	05-30-2012	Section 5 – Water Resources, 5.8
Salmon Viability Criteria	Natural Resources Defense Council	05-30-2012	Section 7 – Fish and Aquatic Resources, 7.7
National-Level Economic Valuation	Natural Heritage Institute	05-31-2012	Section 3 – Studies Not Proposed
National-Level Economic Valuation	American Whitewater	05-31-2012	Section 3 – Studies Not Proposed

2.2. Figures

Figure 2-1. Interrelationships amongst Riverine-based Studies.

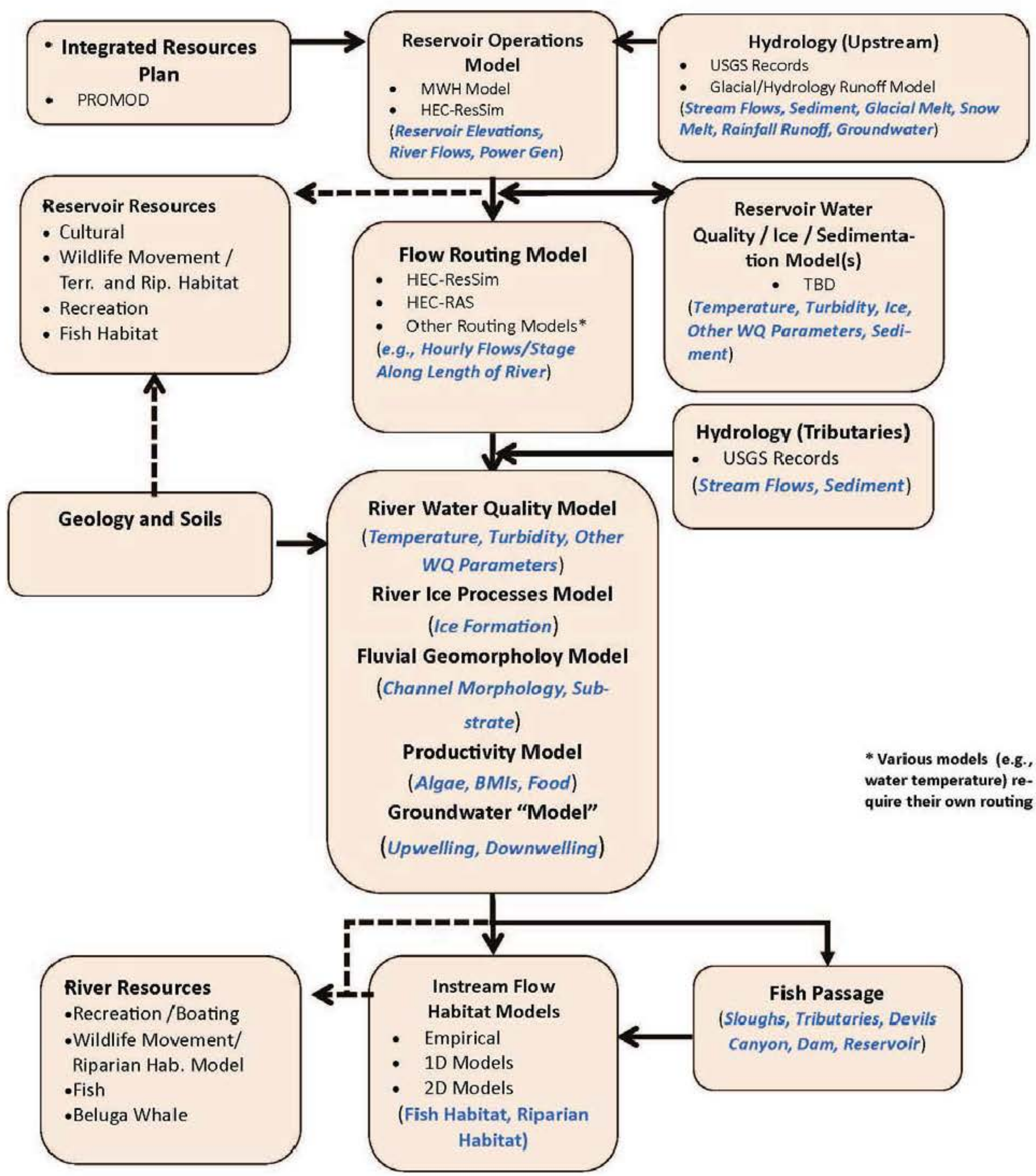
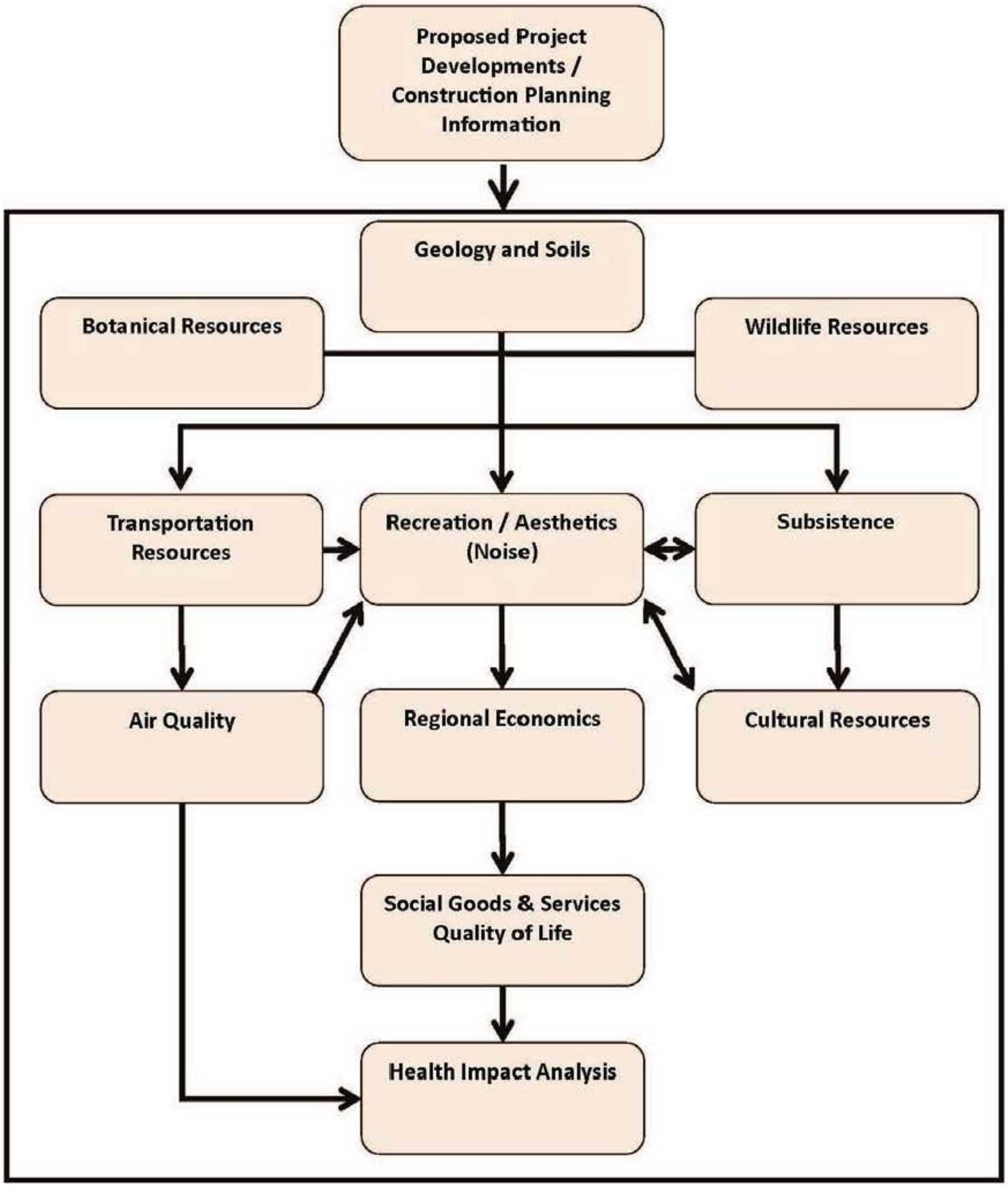


Figure 2-2. Interrelationships amongst Upland-based Studies.



3. STUDIES NOT PROPOSED

Under FERC ILP regulations, if an applicant does not adopt a requested study, the applicant must provide in its Proposed Study Plan an explanation of why the request was not adopted with reference to the criteria set forth in 18 CFR § 5.9(b). In total there were 52 study requests filed with FERC that followed the formal study request formats. As outlined in Section 2, AEA intends to perform studies relating to each of the study topics requested, except for one study request that is for a National-Level Economic Valuation Study proposed by the National Heritage Institute and American Whitewater. This section describes that study request and AEA's rationale for not adopting the study.

3.1. Requested Study Not Adopted in the PSP

3.1.1. Information Regarding Study Request

Both National Heritage Institute and American Whitewater requested the National-Level Economic Valuation Study. The following three subsections provide information directly from the study requests and these extracts are taken directly from those study requests, both filed May 31, 2012.

3.1.2. Requester's Description of Study Goals and Objectives

The National Heritage Institute and American Whitewater study objectives are stated as follows:

"*The study will identify and analyze the economic values associated with constructing and operating project compared to alternatives, including the no-action alternative, at the national scale. If it were to be licensed by the Federal Energy Regulatory Commission (FERC), the proposed 700-foot-high Susitna River dam, with an installed capacity of 600 MW, will significantly change the hydrograph of the Susitna watershed for 220 miles upstream from its mouth at Cook Inlet and transform an unregulated river into a regulated one. The construction of the project will preclude, limit, or otherwise change the existing uses of the river and other extant attributes of the river and its watershed that people value. The study will obtain information to ascertain the value of the change from the proposed project is more or less than the value of an undammed watershed the no-action alternative and in the public interest.*"

3.1.3. Relevant Resource Agency Management Goals

The National Heritage Institute and American Whitewater study relevant resource management goals are stated as follows:

"*The U.S. Fish and Wildlife Service and National Marine Fisheries Service have stewardship responsibilities for public-trust fish and wildlife resources in the basin.*

The resource management goal of the Fish and Wildlife Service is no net loss of fish and wildlife resources, to conserve the nation's existing fish and wildlife and their habitats in the Susitna River Basin, and to prescribe fishways pertaining to this project pursuant to Section 18 of the Federal Power Act.

National Marine Fisheries Service has jurisdiction over the nation's marine, estuarine and anadromous fishery resources, with the goal of maintaining native and natural aquatic communities for their intrinsic and ecological value and their benefits to people, including the authority to prescribe fishways pertaining to this project pursuant to Section 18 of the Federal Power Act.

The applicant should confer with resources agencies, tribes, nongovernmental organizations to develop this study."

3.1.4. Sponsor's Description of Existing Information and Need for Additional Information

The Natural Heritage Institute and American Whitewater study description of existing information and need for additional information is stated as follows:

"*The PAD (Section 4.12 "Socioeconomic Resources) contains no information relating to value of products and services that businesses, such as tourism and sport and commercial fisheries, extract from the existing ecosystem, which would be useful for designing the research instruments (e.g. surveys, focus groups) to ascertain the value that the broader American public (a statistically significant sample of the national population) places on the extant watershed in comparison to the changes to the watershed that would result from the proposed project.*

This information is necessary for the Commission to give equal consideration to non-power and power values."

3.1.5. AEA's Rationale for Not Adopting the Proposed Study in the PSP

Several organizations and individuals requested that the socioeconomic study plan address the economic value of environmental goods and services provided by the Susitna River system, including non-market benefits. In fact, the Social Conditions and Public Goods and Services Study as proposed by AEA includes analyses that will evaluate a number of the potential changes in the environmental goods and services derived from the river system and surrounding areas in dollar terms. That study will not, however, include a national level economic valuation study.

As described below, AEA's proposed analyses address both market (e.g. jobs, revenue) and non-market (e.g. recreation, aesthetics) values. However, economic (i.e., monetary) valuations of environmental goods and services are not required, nor may they be sufficient, in order for the positive value of the environmental assets of the Susitna River system to be given full and equal consideration in the licensing decision making process for the proposed Project.

As some commenters noted, there are significant challenges and obstacles to the quantification of environmental values of river systems in dollar terms. Consequently, the environmental review will incorporate a variety of qualitative and quantitative measures of impacts to the physical, biological, and socioeconomic environment. These multiple measures will be obtained through an array of biological, physical, socioeconomic, transportation, recreational, aesthetics, subsistence and cultural studies.

As demonstrated below, this approach does not preclude the monetization of some impacts to environmental goods and services. Rather, a combination of monetized and non-monetized measures offers the advantage of bringing a wide range of insights to the licensing decision. In accordance with FERC guidelines and practice, the environmental review will focus on reasonably foreseeable significant impacts on the human environment; remote and highly speculative consequences will not be considered.

<u>Data Collection and Analysis for Social Conditions and Public Goods and Services Study</u>

The Social Conditions and Public Goods and Services Study proposed by AEA will use a variety of methods to derive estimates of the value of affected environmental goods and services, including goods and services that are not priced in conventional markets. Methods will be used to monetize the value of some goods and service, while the value of others will be expressed in qualitative terms.

The proposed Project would not start operations until 2023 under the current schedule. The Project is anticipated to operate for more than 50 years, similar to other large hydroelectric developments around the world. Given the long time frame for construction of the Project and its operations, the Project's socioeconomic effects will be estimated by comparing future socioeconomic conditions with and without the Project.

The forecast of socioeconomic conditions with and without the Project will be based in part on estimates derived from the REMI model described for the Regional Economic Analysis. While the REMI model provides a wide range of output variables, the variables of interest in the socioeconomic impact analysis for the proposed Project are population, employment, labor income, output (sales), and housing. The REMI model extends economic and demographic forecasts through 2060, which is consistent with the temporal scope of the socioeconomic impact analysis. The REMI model can provide projections for all of the boroughs and census areas within the Railbelt, including the MOA, FNSB, KPB, MSB, and Denali Borough. The current REMI model also includes the Yukon-Koyukuk Census Area and Valdez-Cordova Census Area.

The forecast analysis performed by the REMI model will be guided by assumptions about reasonably foreseeable future actions that would have an important and measurable effect on Alaska's economy. As the Project design becomes more developed, specific requirements for the types of construction specialties (e.g., firms with roller-compacted concrete experience) will be identified and compared with current expertise of regional construction companies to see which opportunities can be filled by Alaska firms. This evaluation would improve the model estimates of future economic activity, and provide recommendations to increase the percentage of these opportunities captured by Alaska businesses.

Here is a summary description of other AEA efforts pertinent to the planned socioeconomics study that will evaluate a number of the potential changes in the environmental goods and services derived from the river system and surrounding areas in dollar terms.

- The effect of potential immigration during Project construction and operations on municipal and state services, such as police, fire protection, medical facilities and schools, will be assessed. If projected immigration would potentially burden existing municipal and state services, proposed plans to alleviate this impact will be identified.
- A fiscal impact analysis will be conducted to evaluate incremental local government expenditures in relation to incremental local government revenues that would result from construction and operation of the Project. Incremental expenditures include, but are not limited to, school operating costs, road maintenance and repair, public safety, and public

utility costs. Incremental revenues include, but are not limited to, property taxes and hotel/motel occupancy taxes.

- Transportation of construction equipment and materials through communities on the transportation routes to and from the Project could result in increased traffic volumes, and associated noise and congestion effects. Such conditions might require additional police and emergency response calls for traffic accidents and other incidents. These impacts will be assessed based on the results of the Transportation Resources Study.
- Utilizing the results of the Recreation and Aesthetics Study (Section 10), AEA will analyze the economic impact of the Project on local tourism establishments (e.g., river sport fishing, whitewater boating) and the regional economy will be estimated. Calculations will be based on information obtained from the recreation survey, including the estimated recreation-related expenditures per recreational day or trip and changes in the number of days or trips per year. Utilizing the results of the Subsistence Study (Section 12), the regional economic impact of changes in subsistence-related expenditures due to the proposed Project will be estimated. The approximate cash expenses to generate each pound of subsistence harvest will be based on information in Goldsmith (1998). Changes in spending for recreational or subsistence related goods and services will become inputs to the REMI model to calculate regional economic impacts.
- The Project, including access roads, could affect surrounding property uses and values. These effects will be described identifying the properties that are on, or in close proximity to the Project area, including the access road(s) that will be built; determining the degree to which the use of the properties would change as a result of the Project; and estimating the extent that properties' values will change as a result of the change in use.
- If Project features (i.e., reservoir and access roads) stimulate residential location, spending by new residents in the local economy will generate new economic activity, including additional jobs and labor income. Interviews will be conducted with regional businesses to identify potential opportunities for residential development and estimate the economic impacts should this development occur.

  To the extent that Project construction and operations will change the level of production of commercial farming, grazing, logging, mining, and fishing operations, these effects will be approximated by the change in production multiplied by the market price of the resource in question. Information on the quantity and value of market-based natural resources is available through state and federal resource management agencies. Changes that result in increases or decreases in commercial resource extraction will become inputs to the REMI model to calculate regional economic impacts.
- AEA will utilize the travel cost method or random utility model to estimate changes in recreational use values associated with sport fishing, sport hunting, boating, wildlife viewing, hiking, and camping in the study area. The basis of the method is the assumption that the recreational experience is enhanced by high quality sites (e.g., clean water, abundant recreational fisheries), hence the net willingness to pay for—and value of—recreational trips depends on site quality. Different model specifications can be used to value specific qualities of the resource and attributes of the recreational experience. To value these types of amenities, economists typically rely on a variant of the basic travel cost model referred to as a discrete choice or random utility model. In addition, the

benefits transfer approach will be used to supplement or compare unit values (e.g., value per-day of sport fishing) for recreational goods and services obtained from primary valuation methods. Benefits transfer involves the application of unit value estimates, functions, data, and/or models from one or more previously conducted valuation studies to estimate benefits associated with the resource under consideration (Black et al. 1998). For example, an extensive number of previously conducted studies estimated the value of sport fishing in various regions of Alaska. Similarly, several existing reports estimated the value of Alaska wildlife.

- The value of changes in subsistence activities in the study area will be estimated by applying a wage compensating differential model that examines tradeoffs between time spent on subsistence and cash employment (Duffield 1997). The advantage of latter method is that it captures the cultural and social value of participating in subsistence activities as well as the product value. It requires community-specific per capita income levels and subsistence harvest per capita data, both of which will be obtained from the subsistence survey conducted for the Subsistence study.

  Following the methodology of Braund and Lonner (1982), information on the values, attitudes, and lifestyle preferences of residents in the Talkeetna, Trapper Creek, and Cantwell areas will be collected through informal interviews with community residents, Matanuska-Susitna Borough officials, and other knowledgeable people. Interview questions will be oriented toward identifying how the Susitna River corridor and upper basin is used and valued by local residents to identify the importance of the various bio-physical aspects important to area residents. Once the types of Project-induced changes in riverine and basin resources are known, a further analysis will be undertaken to identify how such changes might alter the resources used and valued by area residents. The results of the project effects on subsistence, recreation and transportation can be used to further evaluate the overall effects on the residents of the region.

Proposed National-Level Economic Valuation

By contrast, the American Whitewater Association (AWA) requests[1] that AEA conduct a "National-Level Economic Valuation" study in order to "identify and analyze the economic values associated with constructing and operating project compared to alternatives, including the no-action alternative, at the national scale" [sic].[2] We disagree. AEA's proposed Social Conditions and Public Goods and Services Study is more than adequate and, as set out above, more closely tracks FERC's study request standards in 18 CFR § 5.9.

AWA reasons that "[t]he requirement of the Federal Power Act (FPA) that FERC give equal consideration to non-power values affirms the Commission's duty to evaluate the trade-offs that would be involved in authorizing" the Project.[3] AWA further argues that, "[t]o ensure a reliable comparison of all relevant values, the Commission should use economic valuation as a means of

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[1] AWA's proposal is supported by other advocacy groups, including the National Heritage Institute, Trout Unlimited (Alaska), the Coalition for Susitna Dam Alternatives, and the Alaska Center for the Environment.

[2] *Comments of American Whitewater on the PAD, Scoping Document 1, and Study Requests*, at 7 Docket No. P-14241-000 (filed May 31, 2012) (AWA Comments).

[3] *Id.* at 8.

evaluating the trade-offs involved in the licensing action; an assessment of benefits and costs should be part of the information-set available to FERC in deciding among alternatives."[4]

The Commission should reject this request. FERC has consistently found that the monetization of non-market goods and services is inadequate in the context of assessing non-power values under Sections 4(e) and 10(a)(1) of the FPA. As explained by the Commission in *Great Northern Paper, Inc.*[5] and *City of Tacoma, Washington*:[6]

> The public-interest balancing of environmental and economic impacts cannot be done with mathematical precision, nor do we think our statutory obligation to weigh and balance all public interest considerations is served by trying to reduce it to a mere mathematical exercise. Where the dollar cost of enhancement measures, such as diminished power production, can be reasonably ascertained, we will do so. However, for non-power resources such as aquatic habitat, fish and wildlife, recreation, and cultural and aesthetic values, to name just a few, the public interest cannot be evaluated adequately only by dollars and cents.[7]
>
> . . . .
>
> In the context of public interest balancing for long-term authorizations, it is inappropriate to rely too heavily on the accuracy of current dollar estimates of nonpower resource values, calculated using any number of reasonably disputable assumptions and methods.[8]

Specifically, AWA's request fails to meet the Commission's requirements for requesting additional information gathering and study requests under FERC's Integrated License Application Process. 18 C.F.R. 5.9(b)(6) requires that any information gathering or study requests be "consistent with generally accepted practice[s] in the scientific community . . . ." Economic valuation of nondevelopmental values, however, while obviously having some support, is not generally accepted within the scientific community.[9] Further, AWA has not

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[4] *Id.*

[5] 85 FERC ¶ 61,316 (1998), *reconsideration denied*, 86 FERC ¶ 61,184 (1999*), aff'd*, *Conservation Law Foundation v. FERC*, 216 F.3d 41 (D.C. Cir. 2000) (nothing in the FPA requires the Commission to place a dollar value on nonpower benefits; nor does the fact that the Commission assigned dollar figures to the licensee's economic costs require it to do the same for nonpower benefits.). *See also*, *Namekegon Hydro Co.*, 12 FPC 203, 206 (1953), *aff'd*, *Namekegon Hydro Co. v. FPC*, 216 F.2d 509 (7th Cir. 1954) (when unique recreational or other environmental values are present such as here, the public interest cannot be evaluated adequately only by dollars and cents); and *Eugene Water & Electric Board*, 81 FERC ¶ 61,270 (1997), *aff'd*, *American Rivers v. FERC*, 187 F.3d 1007 (9th Cir. 1999) (rejecting request for economic valuation of environmental resources that were the subject of 10(j) recommendations).

[6] 84 FERC ¶ 61,107 (1998), *order on reh'g*, 86 FERC ¶ 61,311 (1999), *City of Tacoma v. FERC*, 460 F.3d 53 (D.C. Cir. 2006).

[7] 85 FERC at p. 62,244-245.

[8] 84 FERC at pp. 61,571-72.

[9] *See, e.g.,* Steven Shavell, CONTINGENT VALUATION: A Critical Assessment at 372 (1993). "Contingent valuation should not now be used to attempt to measure nonuse values of natural resources, either in public decision

demonstrated why a national economic valuation study is necessary under 18 CFR 5.9(a) (7)[10] to augment or supplant FERC's NEPA evaluation of the Project's impacts on aesthetics, cultural, and socioeconomic resources, among others.[11] AWA argues that FERC's proposal is inadequate because it will only assess the regional, as opposed to the national impacts of the Project. On this point, we strongly disagree. FERC's inquiry under the FPA focuses on the waterway as a starting point and extends to reasonably connected interests in a manner consistent with the revised plan for the Social Conditions and Public Goods and Services Study. There is simply no evidence that public-interest balancing of environmental and economic impacts requires a national perspective to weigh and balance all public interest considerations consistent with FERC's statutory obligations under FPA.

Finally, the AWA proposal does not meet the 18 CFR 5.9 standards (6) and (7) respectively by failing to describe the methodology to implement their proposal[12] and by ignoring the requirement to describe either the level of effort and cost, as applicable, of the proposed AWA study[13] and not addressing how or why the proposed Social Conditions and Public Goods and Services Study would not be sufficient to meet the stated information needs.[14] It is well settled that contingent value surveys are expensive, subject to bias[15] and even "[s]tudies conducted in controlled experimental settings suggest that …contingent valuation…methods may overestimate values[16] producing "implausible" results[17] that fail by trying to reduce FERC's public interest test to a mere mathematical exercise. The proposed National-Level Economic Valuation study should not be adopted.

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making or in liability assessment. In these contexts, society is likely to be better off not seeking to estimate nonuse values with contingent valuation because of the serious problems that this would engender."

[10] 18 CFR 5.9(a)(7) provides that "[a]ny information or study request must . . . [d]escribe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs."

[11] *See Scoping Document 1 for Susitna-Watana Hydroelectric Project,* Docket No P-14241-000 at §§ 4.2.7-9 (filed Feb.2 2012).

[12] AWA Comments at 9 "We describe the necessary elements of the study . . . but do not explain how the study would be designed and implemented."

[13] AWA states only that "the level of effort is significant, as the study will likely require focus groups and survey instruments." AWA Comments at 11. American Whitewater ignores cost projections entirely.

[14] AWA does not address the revised plan for the Social Conditions and Public Goods and Services Study, but only generally states that a regional study is not appropriate for the project.

[15] Peter A. Diamond, and Jerry A. Hausman, *Contingent Valuation: Is Some Number Better than No Number?,* Journal of Economic Perspectives, Volume 8, Number 4, Fall 1994, pp 45-64 at 45,46.

[16] National Research Council, Committee on Assessing and Valuing Aquatic and Related Terrestrial Ecosystems, *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*, 2004, at 122.

[17] Kenneth Arrow et alia, *Report of the NOAA Panel on Contingent Valuation*, 1993 at 12, 13.

4. GEOLOGY AND SOILS

This study plan will review the existing information on the Susitna-Watana Project (Project) area regarding geology and soils and gather additional information in order to define the geologic, geotechnical, seismic, and foundation conditions at the sites of Project works (e.g., dam, reservoir, access road, construction camps, and materials borrow sites). This information will be used to support development of the Project design, with an emphasis on minimizing risks to dam safety. In general, the study tasks will include field investigations, laboratory testing, review of existing studies, and engineering analyses to characterize site conditions, limitations, and constraints. The study will also identify impacts of Project construction and operation, such as soil erosion along the reservoir rim, slope stability, excavation, and spoil disposal, on environmental resources (e.g., oil, gas, and minerals).

4.1. Introduction

A Susitna Hydroelectric Project was proposed by the Alaska Power Authority (now the Alaska Energy Authority [AEA]) in the early 1980s. That project was to be composed of two major dams (the Watana Dam and Devils Canyon Dam) constructed in three stages. A draft Environmental Impact Statement was prepared by the Federal Energy Regulatory Commission (FERC), but the application was subsequently withdrawn. The current proposed Project dam is located at river mile 184, the same location as that of the previously proposed Watana Dam.

The Project will most likely include a high concrete arch dam constructed using roller compacted concrete (RCC) construction methods. The Project will also include a large reservoir, a spillway, cofferdams, diversion tunnels, integrated penstocks and powerhouse, construction and permanent housing, borrow and quarry areas, transmission lines, access roads, and staging and stockpile areas. Each of these features will have an impact on, or will be impacted by, geology and soils over the course of design, construction, and operation of the Project.

4.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

The soil and geological characteristics of the Project area will affect Project design, construction, operation, and maintenance because the Project facility foundations are integral to the soil and rock features of the area and also will serve as raw materials for some project components. Also, Project design, construction, and operation, including the dam and reservoir, access road, transmission line, and construction camp/village, may affect geological resources by exposing soils and rock to new surface erosional forces and could change the stability of landscape features.

Considerations of geology and soil conditions in planning for Project construction, operation, and maintenance will include, but are not limited to:

- Proper disposal of spoils from the excavations
- Geologic features in the foundation that may require additional excavation and foundation treatment

- Identification of poor rock conditions or the presence of geologic features in the diversion tunnel excavation that may require support and/or lining (e.g., type and thickness)
- Design of rock cut-slopes on the right abutment, particularly in the downstream portal area
- Identification of seismic sources and design of structures for seismic loading
- Ice-filled discontinuities in the rock foundation beneath and in the abutments of the dam
- Design of cut-off walls in the cobble and boulder alluvium beneath the cofferdams
- Road, transmission tower footing, or camp foundation design to address subsidence due to poor soil conditions or thawing soil
- Sediment load contributions due to glacial melt and possible surging glacier event

Potential impact mechanisms for soils and geologic features include:

- Soil erosion from slope instability along the reservoir rim due to presence of fine-grained soils and thawing permafrost (discontinuous)
- Seismic activity due to the deep, large reservoir
- Changes to river channel geomorphology based on reservoir operation
- Seepage through abutments just upstream of the dam causing piping and soil erosion
- Soil erosion and slope instability along access road cuts and stream/creek crossings

4.3. Resource Management Goals and Objectives

No Alaskan Native resource management goals have been identified other than the provisions identified under the Alaskan Native Claims Settlement Act (ANCSA) dealing with provision of access to mineral resources. FERC regulations under 18 CFR 4.41 require a report on the Geological and Soil Resources in the Exhibit E along with supporting design report to help demonstrate the proposed Project structures are safe and adequate to fulfill their stated functions.

4.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Specific consultation regarding geology and soils study planning has been limited to informal discussion with Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys during 2011 as part of planning the geotechnical investigations for the Project. Soil erosion and the potential for reservoir sedimentation and other issues have been discussed in technical work group meetings, and the aquatic aspects of sediments are being addressed in the geomorphology study. In FERC's May 31, 2012 filing of requests for studies and comments on preliminary study plan, a geology and soils assessment study was requested. In addition Cook Inlet Region, Inc. (CIRI) has submitted a study request (filed May 30, 2012) for a minerals resource assessment that states that "CIRI owns or is entitled to receive conveyance of significant subsurface interests with the area that would be affected by the proposed Project". Both the FERC and CIRI study requests correspond to AEA's proposed geology and soils characterization study, and through this study plan AEA is attempting to meet the expectations and objectives of those study requests.

4.5. Geology and Soils Characterization Study

4.5.1. General Description of the Proposed Study

The overall goals of this study are to conduct a geology and soils evaluation to define the existing geological conditions at the site and to develop design criteria to ensure that the proposed project facilities and structures would be safe and adequate to fulfill their stated functions. The general objectives of the study plan are to:

- identify the existing soil and geologic features at the proposed construction site;
- determine the potential effects of project construction, operation, and maintenance activities on the geology and soil resources (including mineral resources) in the project area including identification and potential applicability of protection, mitigation and enhancement (PM&E) measures;
- identify known mineral resources and mineral potential of the Project area; and
- acquire soils and geologic information for use in the preparation of a supporting design report that demonstrates that the proposed structures are safe and adequate to fulfill their stated functions.

The field investigation activities for each season will be coordinated with resource agencies, ANCSA Corporation landowners. A Geotechnical Exploration Program Work Plan (Work Plan) will be developed which outlines the field program information that will be needed for submitting applications and obtaining land access permits from applicable agencies and ANCSA Corporation landowners. The Work Plan will identify known impacts to geology and soil resources. FERC regulations require “evaluation of unconsolidated deposits, and mineral resources at the project site” 18 CFR 5.6(d)(3)(ii)(A). For the Exhibit E, AEA must provide a report on the geological and soil resources in the proposed project area and other lands that would be directly or indirectly affected by the proposed action and the impacts of the proposed project on those resources. This study report will provide the basis of the information needed for the Exhibit E.

4.5.2. Existing Information and Need for Additional Information

Extensive field investigations and studies were undertaken during the 1970s and 1980s for the Watana Dam Site to characterize the geologic, seismic, and foundation conditions for a different type of dam (earthfill embankment) with a much larger footprint and a higher normal mean reservoir operating level.

These studies include:

- regional mapping of surficial deposits (rock and soil) using aerial photography and geologic reconnaissance (Acres 1982a);
- studies of reservoir slope stability (Acres 1982a);
- subsurface explorations through geophysics, borings, test pits, and trenches (USACE 1975, USACE 1979, Acres 1982a, Acres 1982b, Harza-Ebasco 1983, Harza-Ebasco 1984);
- preliminary evaluations of borrow and quarry sites (USACE 1978, Acres 1881, Acres 1982a);

- in-situ hydraulic testing of rock and soil (Acres 1982a, Acres 1982b, Harza-Ebasco 1983, Harza-Ebasco 1984);
- instrumentation (groundwater and thermal observations [USACE 1979, Acres 1981, Acres 1982, Harza-Ebasco 1983, Harza-Ebasco 1984]);
- laboratory testing of physical and strength properties of rock and soil (USACE 1979, Acres 1981, Acres 1982, Harza-Ebasco 1983, Harza-Ebasco 1984);
- site-specific seismic hazard evaluations (WCC 1980, WCC 1982);
- evaluation of reservoir induced seismicity (RIS) (Harza-Ebasco 2005); and
- geology and soil resources (Harza-Ebasco 1985).

In summary, the following geotechnical investigations were performed prior to 2012:

- geologic mapping
- drilling at the dam site, construction materials source areas, and in other geologic features (i.e., relict channel near dam site)
- instrumentation monitoring (groundwater and temperature)
- seismic refraction
- test trenches and pits (Borrow Areas E)
- trenching of lineaments and faults

For this study, the existing information coupled with new field investigations and mapping analyses, this study will provide specific information on the properties of Project-site-specific rock and soil units that would be affected by the newly proposed Project.

4.5.3. Study Area

The study area will include the dam site area, reservoir area, construction material sources, tailwater downstream of the dam, access road and transmission line corridors, airport facilities, and construction camp and permanent village sites (Figure 1.2-1).

4.5.4. Study Methods

The study of geology and soils resources for supporting licensing and detailed design will include a number of components:

- Develop understanding of geologic and foundation conditions for the dam site area and specifically for each of the project surface and underground components of the project;
- Evaluate the mineral resource potential in the reservoir, dam and upland facilities areas;
- Evaluate major geologic features, rock structure, weathering/alteration zones, etc.;
- Delineate and characterize construction material sources for the dam and appurtenant structures, access road, transmission line, and construction camp; and
- Evaluate the surficial geology and potential thawing of localized permafrost on reservoir slope stability.

<u>Review of Project Documentation</u>

The existing documentation from the 1970s and 1980s will be brought into a geo-referenced, geotechnical databases to build new information on the earlier studies in digital formats.

Regional Geologic Analysis and Mineral Resources Assessment

Existing published information, air photointerpretation and reconnaissance mapping, and new LiDAR survey data will be used update information about the regional geology, Quaternary geology, bedrock geology, geologic structure, seismicity and tectonics, mineral resources; determine siting of project component or structures; identify geologic features of significance; and assess potential impacts and mitigation measures to address impacts (e.g., erosion) on geology and soil resources and project construction. A survey of the mineral resources will be performed to assess mineral potential and mining activity in the impoundment area. The survey will entail mapping of known mineral deposits, identification of likely areas of mineral resources, field reconnaissance of specific areas of potential mineral potential, review of area mining claims, and analysis of mineral potential from boring and other sampling work done for the dam and other facilities undergoing geotechnical investigations. As recommended by CIRI, the BLM and USGS will be consulted in review of this study plan to determine the most appropriate methods and evaluation techniques are used for the mineral resource investigation.

Geologic and Geotechnical Investigation and Testing Program Development

The development of a geological and geotechnical exploration and testing program work plan for completion of geologic field studies for final design and ultimately for construction will be undertaken. Based on review of the existing data including previous geologic mapping, subsurface investigations and laboratory testing from the 1970s and 1980s, additional investigations and testing will be to:

- Evaluate major geologic features, rock structure, weathering/alteration zones, etc.;
- Delineate and characterize construction material sources for the dam and appurtenant structures, access road, and construction camp;
- Determine the effects of discontinuous permafrost on the dam foundation and abutments relative to foundation treatment, grouting and drainage, as well as reservoir slope stability;
- Evaluate the effect of project features on permafrost and periglacial features (thawing of permafrost), as well as the impact of these features on permanent structures, work camps, temporary construction areas, road corridors, transmission lines, etc.;
- Evaluate the need for, and potential sources of, borrow for ancillary facilities including structures, roads, and transmission lines;
- Evaluate potential waste stockpiles and storage sites including plans to help minimize the impact of these facilities on adjacent areas;
- Evaluate plans and methods for the reclamation of borrow area and quarry sites;
- Evaluate the Project's impact on geologic resources (oil, gas, and mineral claims and patents) by reviewing existing state and federal databases, as well as readily available geologic maps and surveys; and
- Conduct a preliminary evaluation of the effect of the composition of soils in the project area on the construction, operation, and maintenance of the proposed project.

Field Geologic and Geotechnical Investigations

Geologic and geotechnical field investigations will be carried out in phases with portions of that work contributing to the report on geology and soils in 2013 and updates in 2014. The geotechnical investigations and testing being undertaken as part of the Project feasibility and design effort will include geologic mapping, drilling, sampling and in situ testing, test trenches, pump tests, test adit, laboratory testing, instrumentation monitoring, etc. A geotechnical exploration and testing program is planned for the 2012 season to investigate the dam foundation and a new quarry site for concrete aggregate material, installation and monitoring of geotechnical instrumentation, and reconnaissance geologic mapping.

Reservoir Triggered Seismicity

Seismic evaluations are being undertaken for the Project under a separate study (see Section 14) and will include the installation of a long-term earthquake monitoring system. The Geology and Soils Characterization study would contribute information to that study.

Reservoir Slope Stability Study

An assessment will be made of reservoir rim stability based on the geologic conditions in the reservoir area, particularly in the reservoir drawdown zone. Geologic information from the previous study on reservoir slope stability (1982) as well as mapping, geotechnical investigations and instrumentation monitoring will be used to assess the stability concerns of the reservoir rim. Key factors in this study are the planned reservoir level and anticipated range of drawdown, soil conditions, presence of permafrost, topography and slope conditions.

Geologic and Engineering Analysis

The analysis will identify and evaluate construction material sources to provide adequate quantities for construction, suitable alignments and foundation design for the access road, construction, permanent camps, and transmission lines; and identify re-use of excavated materials and/or disposal areas. The study will also assess the soil erosion potential along the transmission and road corridors along with other effects of design and construction on geology and soils, and identify the suitability of measures to minimize and mitigate impacts.

4.5.5. Consistency with Generally Accepted Scientific Practice

Studies, field investigations, laboratory testing, engineering analysis, etc. will be performed in accordance with general industry accepted scientific and engineering practices. The methods and work efforts outlined in this study plan are the same or consistent with analyses used by applicants and licensees and relied upon by the Commission in other hydroelectric licensing proceedings.

4.5.6. Schedule

The proposed study includes a limited field investigation program in 2012 for aerial photographic interpretation, reconnaissance geologic mapping, drilling, lineament analysis, installation of a long-term earthquake monitoring system, assessment of slope stability for the reservoir rim, and reservoir triggered seismicity study. For 2013-14, comprehensive investigations will focus on the dam site, reservoir area, and access road and transmission line corridors. Initial and Updated Study Reports explaining actions taken and information collected to date will be issued in December 2013 and 2014.

4.5.7. Level of Effort and Cost

The study plan will involve a phased multiple year approach that will include field investigations from 2012 through 2014 with associated studies and engineering analysis. The estimated level of effort is estimated to be in excess of 3,500 hours plus expenses. The total costs of the study will be between an estimated $400,000 and $800,000 dollars. This work is part of a much larger geotechnical investigation program for the Project which will be undertaken through the engineering design activities.

4.5.8. Literature Cited

Acres, 1982a. Reservoir Slope Stability and Erosion Studies, Closeout Report. Final Draft. Prepared for Alaska Power Authority.

Acres. 1982b. Susitna Hydroelectric Project 1980-81 Geotechnical Report, Volumes 1 through 3. Prepared for Alaska Power Authority.

Acres. 1982c. Susitna Hydroelectric Project, 1982 Supplement to the 1980–81 Geotechnical Report. Prepared for Alaska Power Authority, Anchorage, Alaska.

Harza-Ebasco. 1983. Susitna Hydroelectric Project, Watana Development, 1983 Geotechnical Exploration Program. Volumes 1 and 2.

Harza-Ebasco. 1984. Susitna Hydroelectric Project, 1984 Geotechnical Exploration Program, Watana Dam Site. Final Report, Document 1734, Volumes 1 through 3.

Harza-Ebasco. 1985. Susitna Hydroelectric Project Draft License Application. Volume 12 Exhibit E Chapter 6. Geologic and Soil Resources.

U.S. Army Corps of Engineers (USACE). 1975. Hydroelectric Power and Related Purposes, Southcentral Railbelt Area, Alaska Upper Susitna River Basin. Department of the Army, Alaska District, Corps of Engineers. 12 December 1975.

USACE, 1979. Hydroelectric Power and Related Purposes, Supplemental Feasibility Report, Southcentral Railbelt Area, Alaska Upper Susitna River Basin. Department of the Army, Alaska District, Corps of Engineers. February 1979.

Woodward-Clyde Consultants Inc. (WCC). 1980. Interim Report on Seismic Studies for Susitna Hydroelectric Project. Prepared for Acres American Inc.

Woodward-Clyde Consultants. 1982. Final Report on Seismic Studies for Susitna Hydroelectric Project. Prepared for Acres American, Inc.

5. WATER RESOURCES

5.1. Introduction

Operation of the Susitna-Watana Project (Project) is expected to change the water quality characteristics of the riverine portion of the drainage and the mainstem Susitna River reach inundated by the Project reservoir. This will affect flow, water depth, surface water elevation, channel characteristics, and sediment regimes. The potential effects of the Project on ice formation, surface and groundwater temperature and quality, mercury bioaccumulation, and geomorphology need to be carefully evaluated as part of the licensing process, since changes to these parameters can affect aquatic and riparian habitat quality, which can in turn affect fish populations, riparian-dependent species, and roads, bridges, structures, and recreation opportunities along the river corridor.

This section of the PSP describes the water resource studies that will be conducted to characterize and evaluate these effects. These studies will be subject to revision and refinements in consultation with licensing participants as part of the continuing study planning process identified in the ILP. The impact assessments will inform development of any necessary protection, mitigation, and enhancement measures to be presented in the draft and final License Applications.

An additional study is being proposed on Glacial and Runoff Changes in the Upper Susitna basin, in response to written requests from the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), as well as other licensing participants. This study will research, describe, and quantify glacial retreat and runoff changes in the Upper Susitna Basin, and assess reasonably foreseeable impacts to the Project.

5.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

Construction and operation of the Project have the potential to alter water chemistry, temperature, river flow, sedimentation, and ice processes in the Susitna River. Changes to these processes may affect channel morphology and aquatic habitat downstream of the Project site. Understanding existing conditions provides baseline information needed for predicting the likely extent and nature of potential changes to the river that may occur due to Project construction and operations.

For any hydropower project it is important to understand the variability of the discharge. On-going retreat of the glaciers feeding the Upper Susitna drainage, along with the anticipated long-life of the project, means that glacial retreat could have significant impacts to the ecosystem, economics of the Project, and proposed mitigation measures. These impacts from natural changes to the environment may be additive to impacts from the proposed dam. The effects will be varied and could include:

- Glacial retreat can affect runoff contribution from glaciers that could result in reduced summertime stream flows.

- Decreased snowpack and glacial runoff combined with increased air temperatures could change the thermal regime of the Susitna River and affect fish and aquatic invertebrates.
- Sedimentation changes could impact Project longevity and thus cost-benefit calculations for the reservoir. The rate of sedimentation is strongly tied to erosion processes, which may change as glacial ice becomes a smaller contribution to the total run-off.
- An understanding of changes in the hydrologic regime (water timing, quantity, and quality) in combination with Project operations will inform post construction monitoring needs. This could include stream temperature measurements, assessment of fish habitat conditions under changing conditions, instream flow throughout the system to assess changes in flow contribution from tributaries, and stream temperature monitoring in the reservoir and downstream.

5.3. Resource Management Goals and Objectives

Water quality in the state is regulated by a number of state and federal regulations. This includes the Federal Clean Water Act (CWA), and the state of Alaska Title 18, Chapter 70, of the Alaska Administrative Code (18 AAC 70). Aquatic resources including fish and their habitats, and wildlife resources, are generally protected by a variety of state and federal mandates. In addition, various land management agencies, local jurisdictions, and non-governmental interest groups have specific goals related to their land management responsibilities or special interests. These goals are expressed in various statutes, plans, and directives.

In addition to providing information needed to characterize the potential Project effects, these water resources studies will inform the evaluation of possible conditions for inclusion in the Project license. These studies are designed to meet FERC licensing requirements and also to be relevant to recent, ongoing, and/or planned resource management activities by other agencies.

5.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

These study plans have been modified in response to comments from various agency reviewers, including the NMFS, the Alaska Department of Environmental Conservation, and the U.S. Fish and Wildlife Service (USFWS). Consultation on the study plan occurred during licensing participant meetings on April 6, 2012 and the June 14, 2012 Water Resources Technical Work Group (TWG). At the June TWG meeting, study requests and comments from the various licensing participants were presented, discussed and refinements determined to address agreed upon modifications to the draft study plans.

A summary of consultations relevant to water quality resources is provided in Table 5.4-1.

Table 5.4-1. Summary of consultation on Water Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Letter	12/30/2011	A. Rappoport	USFWS	Recommends monitoring flow and sediment in the Chulitna and Talkeetna Rivers and Gold Creek; Recommends monitoring mercury bioaccumulation study
Technical Workgroup Meeting Notes	01/25/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Knikatnu Inc, , Nuvista Light & Power, and other interested parties	Meeting to discuss Project and 2012 study plans: •Flow Routing Model Transect Data Collection •Water Temperature Data Models •Geomorphology, Bedload/Suspended Sediment Studies •Ice Processes Study See Attachment 1-1.
Letter	02/10/2012	A. Rappoport	USFWS	Lists recommended items to include in geomorphic studies
Letter	02/29/2012	J. Balsiger	NMFS	Letter recommending inclusion of lower Susitna River in geomorphology study and using classification scheme that includes geomorphic process and response potential (Filed with FERC.)
Technical Workgroup Meeting Notes	03/01/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute, Hydropower Reform Coalition, Susitna River Advisory Committee, Alaska Ratepayers, and other interested parties	Meeting to discuss 2012 study plans and table of 2013-14 studies, potential methods and objectives: •Water Resources, River Routing Study •Geomorphology studies •Ice Processes Study See Attachment 1-1.
Technical Workgroup Meeting Notes	03/02/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, and other interested parties	Meeting to discuss 2012 study plans and table of 2013-14 studies, potential methods and objectives: •Water Quality Studies See Attachment 1-1.
Phone Call	03/15/2012	J. Klein	ADF&G	Measurement techniques for groundwater influences on sloughs.
Technical Workgroup	04/04/2012	Various	AEA, USFWS, NMFS, BLM, ADF&G, ADEC, ADNR, Natural heritage	Meeting to discuss 2012 study plans and draft 2013-14 study requests:

Comment Format	Date	Stakeholder	Affiliation	Subject
Meeting Notes			Institute/Hydropower Reform Coalition, Coalition for Susitna Dam Alternatives, Alaska Ratepayers, Mike Wood, and other interested parties	•Water Quality Study •HecRES/Hydrology See Attachment 1-1.
Technical Workgroup Meeting Notes	04/05/2012	Various	AEA, ADNR, ADF&G, BLM-Glennallen, FERC, NMFS, USFWS,USGS, Mike Wood, Natural Heritage Institute, The Nature Conservancy, and other interested parties	Meeting to discuss 2012 study plans and draft 2013-14 study requests: •USGS Susitna Basin Hydrological Study Plan See Attachment 1-1.
Technical Workgroup Meeting Notes	04/06/2012	Various	AEA, USFWS, NMFS, BLM, USGS, ADF&G, ADNR, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, Mike Wood, and other interested parties	Meeting to discuss 2012 study plans and draft 2013-14 study requests: •Fluvial Geomorphology Modeling below Watana Dam •Geomorphology Study •Ice Processes See Attachment 1-1.
Meeting Notes	04/11/2012	W. Ashton	ADEC	Meeting with AEA team and ADEC to discuss the 2012 Temperature Monitoring Study Plan and 2013-2014 Study Requests. (Supporting material provided to attendees by AEA 04/10/2012).
E-mail	04/12/2012	J. Klein	ADF&G	J. Klein provided references for techniques for estimating water fluxes between groundwater and surface water and thermal profile method for identifying groundwater areas and preferred salmonid habitat.
Meeting Notes	04/19/2012	Various	AEA, ADF&G, ADNR, BLM, NMFS, USFWS	AEA team initiated teleconference meeting with agencies topresent an initial draft geomorphic reach delineation of the Susitna River.
Meeting Notes	04/19/2012	Various	AEA, ADEC, ADF&G, ADNR, EPA, NMFS, USFWS	The AEA team requested a meeting with the agencies to present and discuss the initial draft Groundwater Study plan that was prepared by AEA team in response to agency request.
Phone Call	04/23/2012	E. Rothwell	NMFS	Conversation regarding groundwater, groundwater-surface water interactions, and winter flow routing
E-mail	05/14/2012	J. Mouw	ADF&G	Provided input on his observations of

Comment Format	Date	Stakeholder	Affiliation	Subject
				the role of large woody debris in the Susitna River
E-mail, phone call	05/15/2012	R.Wilson	USGS	Provided information and contacts re: existing geologic mapping
Phone Call	05/17/2012	E. Rothwell	NMFS	Groundwater Study Plan Request Questions
Phone Call	05/17/2012	J. Klein	ADF&G	Groundwater Study Request Questions
Phone Call, Letter	05/18/2012, 05/23/2012	R. Henzey	USFWS	Groundwater Study Request Comments
Technical Workgroup Meeting Notes	06/13/2012	Various	AEA, USFWS, NMFS, ADF&G, ADEC, ADNR, BLM, EPA, USGS, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, Coalition for Susitna Dam Alternatives and other interested parties	Meeting to discuss draft 2013-14 study plans, licensing participant comments and licensing participant study requests: •Baseline Water Quality Study •Water Quality Modeling Study •Instream Flow and Groundwater-related Aquatic Habitat Studies •Riparian Instream Flow Study See Attachment 1-1.
Technical Workgroup Meeting Notes	06/14/2012	Various	AEA, USFWS, BLM, NMFS, Coalition for Susitna River Dam Alternatives, EPA, ADF&G, ADNR, NPS, USGS, Natural Heritage Institute/Hydropower Reform Coalition, FERC, and other interested parties	Meeting to discuss draft 2013-14 study plans, licensing participant comments and stakeholder study requests: •Geomorphology and Fluvial •Geomorphology Modeling Studies •Ice Processes Study See Attachment 1-1.
E-mail, phone call	06/21/2012	R. Gerlach	ADEC	Background data and methods for previous mercury studies
E-mails	07/02/2012, 07/10/2012	J. Labenski	ADNR	Correspondence regarding permit for water quality monitoring stations on State lands; changed a few site locations due to lack of private property access.
E-mail	07/10/2012 – 07/11/2012	D. Griffin	ADNR	Correspondence regarding permit for water quality monitoring stations on Denali State Park lands; changed access to sites from helicopter to boat to expedite permit approval.

5.5. Baseline Water Quality Study

5.5.1. General Description of the Proposed Study

The collective goal of the water quality studies is to assess the effects of the proposed Susitna-Watana Project (Project) operations on water quality in the Susitna River basin, which will inform development of any appropriate PM&E measures. Project operations are expected to change some of the water quality characteristics of the resulting riverine portion of the drainage once the dam is in place as well as the inundated area that will become the reservoir.

The objectives of the Baseline Water Quality Study are to:

- Document historical water quality data and combine with data generated from this study. The combined data set will be used in the water quality modeling study to predict Project impacts under various operations (Section 5.6).
- Add three years of current stream temperature and meteorological data to the existing data.
- Develop a monitoring program to adequately characterize surface water physical, chemical, and bacterial conditions in the Susitna River within and downstream of the proposed Project area.
- Measure baseline metals concentrations in sediment and fish tissue for comparison to state criteria.

Perform a pilot thermal imaging assessment of a portion of the Susitna River. If the pilot assessment is successful, it may be expanded to develop a detailed map of thermal refugia throughout the Project area.

5.5.2. Existing Information and Need for Additional Information

Historical water quality data available for the study area includes water temperature data, some general water quality data, and limited metals data primarily collected during the 1980s. Additional data has been recently collected at limited mainstem Susitna sites describing flow, in-situ, general, and metals parameters by United States Geological Survey (USGS). A data gap analysis was conducted for water quality and sediment transport in 2011 (URS 2011) summarizing mainstem and tributary data available.

A large-scale assessment of water quality conditions throughout the Susitna drainage has not been completed. The proposed overall assessment will be used to establish natural background water quality parameters. This need was identified in the Data Gap Analysis for Water Quality, URS 2011) that determined the spatial coverage of water quality characterizations, the time period during which water quality conditions were described, and specific data gaps that required further data collection to adequately evaluate the current status of water quality in the drainage. The following is a summary of existing water quality data:

Lower Susitna from Cook Inlet to the Susitna – Chulitna –Talkeetna confluence (River Mile 0-99)

- Large amounts of data were collected in this reach during the 1980s. Very little data are available that describe current water quality conditions.

- Metals data are not available for the mouth of the Chulitna River. The influence of major tributaries (Chulitna and Talkeetna rivers) on Susitna River water quality conditions is unknown. There are no monitoring stations in receiving water at these mainstem locations.
- Metals data are not available for the Skwentna River or the Yentna River.
- Continuous temperature data, general water quality data, and metals data are not available for the Susitna River mainstem and sloughs potentially used for spawning and rearing habitat.

Middle Susitna River and tributaries from the Susitna – Chulitna–Talkeetna confluence to the mouth of Devil's Canyon (River Mile 99-150)

- The source(s) for metals detected at high concentrations in the mainstem Susitna River are unknown.
- Current data reflects large spatial data gaps between upper river and the mid- to lower portion of the river.
- Continuous temperature data are not available for Susitna River mainstem, tributary, and sloughs potentially used for spawning and rearing.

Middle Susitna River from Devil's Canyon to the proposed Susitna-Watana Dam site (River Mile 150-184)

- Temperature data are not available above and below most tributaries on the mainstem Susitna River.
- Overall, very limited surface water data are available for this reach.
- Metals monitoring data do not exist or are limited.
- Concentrations of metals in sediment immediately below the proposed Project are unknown. Metals in these sediments may become mobile once the Project begins operation.
- Monitoring of Susitna River mainstem and sloughs (ambient conditions and metals) is needed for determining the potential for metal bioaccumulation in fishes.

Upper Susitna River including headwaters and tr ibutaries above the proposed Susitna-Watana Dam site (River Mile 184-313)

- Surface water and sediment analysis for metals are not available for the Susitna River mainstem, only for one tributary.
- Information on concentrations of metals in media and current water quality conditions is needed to predict if toxics can be released in a reservoir environment.
- Continuous temperature data are not available for Susitna River mainstem, tributary, and sloughs potentially used for spawning and rearing.

Water temperature monitoring was primarily done in the middle river portion of the Project area during the 1980s. The purpose for collection of this data was to model post-dam temperature conditions and to predict the potential for impact on thermal refugia for fish downstream of the proposed dam site. The current proposal includes expansion of the temperature monitoring effort to include the Project area from RM 10.1 to RM 233.4; encompassing both the lower end of the riverine portion of the Project area and above the proposed area of inundation by the reservoir.

An expanded network of continuous temperature monitoring data and water quality data (including sediment, surface water, potentially pore water) collection is required for this project because

- More information is needed to define existing thermal refugia throughout the Susitna drainage.
- Limited information is available on natural, background conditions for water quality.
- It is unknown if seasonal patterns exist for select water quality parameters.
- Additional information is required for calibrating the water quality model to be used in the water quality model (Section 5.6). More recent water quality data will be used for predicting reservoir conditions and predicting riverine conditions downstream of the proposed dam.

An expanded network of water quality and temperature monitoring sites is proposed from approximately RM 10 to RM 234. Monitoring sites are located at the same sites characterized during the 1980s studies, as well as additional sites. Monitoring of areas of the mainstem Susitna River or tributaries with high metals concentrations or temperature measurements (based on the Data Gap Analysis for Water Quality, URS 2011) will confirm previous observations and will describe the persistence of any water quality exceedances that might exist.

Locations in the mainstem Susitna River and tributaries where high metals concentrations were historically identified in surface water lack sediment analysis data to determine potential sources that can be mobilized. The linkage between sediment sources, mobilization into the water column (dissolved form), and the potential for bioaccumulation in fish tissue presents a human health concern with respect to mercury contamination. The consumption of mercury in fish tissue will be addressed by co-locating a limited number of surface water, sediment, and fish tissue monitoring sites (and sampling events) where there is the greatest likelihood for bioaccumulation. The proposed Project may have the potential to exacerbate bioaccumulation of toxics beyond that occurring under current conditions. The initial monitoring will identify select monitoring locations and media (e.g., surface water, pore water, and sediment) for sampling and suggest the need for more detailed, site-specific sampling if a potential risk from bioaccumulation is found.

The available historical data are not continuous over time or over spatial areas of the Susitna drainage. The discontinuities in the data record limit the opportunity for conducting a complete assessment of current water quality conditions that define natural background, the spatial extent of higher than expected concentrations of metals (and select parameters), and identification of source and timing of pollutant entry into the Susitna drainage. Expanding the data record beyond existing information will be used to develop a model of the proposed reservoir and for projecting water quality changes in the existing riverine system resulting from reservoir operations.

5.5.3. Study Area

The study area includes the Susitna River and from RM 10.1 to RM 233.4, and select tributaries within the proposed transmission lines and access corridors. Water quality and water temperature data loggers will be installed at 39 sites identified in Table 5.5-1 and Figure 5.5-1 as part of the 2012 Baseline Water Quality Study. The lowermost boundary of the monitoring activity is above the area protected for Beluga whale activity.

5.5.4. Study Methods

The Baseline Water Quality Study has several components that address needs for water quality modeling and for detecting the location and magnitude of water quality issues. This study plan has been modified in response to comments from various agency reviewers, including the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS). Consultation on the study plan occurred during licensing participant meetings on April 6, 2012 and June 14, 2012 Water Resources Technical Work Group (TWG) June 14, 2012. At the June TWG meeting, study requests and comments from the various licensing participants were presented, discussed and refinements determined to address agreed upon modifications to the study plans (Table 5.4-1).

Data will be collected from multiple aquatic media including surface water, sediment, and fish tissue. The fish tissue collection will be conducted as part of Study Plan 7.5/7.6 (Study of Fish Distribution and Abundance in the Upper Susitna River and the Middle/Lower Susitna River, respectively). Tissue or whole fish samples will be collected in the mainstem Susitna River under Study Plan 7.5 and Study Plan 7.6 for use in analysis of potential for bioaccumulation. Continuous temperature monitoring will inform the predictive model on how the mainstem river and tributaries will respond to load-following from the dam and if changes in water quality conditions could affect aquatic life use and survival in the Project area. In addition, several other requirements of the 401 Water Quality Certification Process will be addressed with collection and description of additional data including the following:

- conducting a water quality baseline assessment;
- description of how existing and designated uses are met;
- use of appropriate field methods and models;
- use of acceptable data quality assurance methods;
- scheduling of technical work to meet deadlines; and
- derivation of load calculations of potential pollutants (pre-Project conditions).

Two types of water quality monitoring activities will be implemented: 1) routine monitoring for characterizing water quality baseline conditions, and 2) a single, comprehensive survey for a larger array of parameters. Frequency of sampling water quality parameters varies by category and potential for mobilization and bioavailability. Most of the general water quality parameters and select metals will be sampled on a monthly basis since each parameter has been demonstrated to be present in one or both of surface water and sediment (URS 2011). An initial screening survey has been proposed for several other toxics that might be detected in sediment and tissue samples (Table 5.5-4). The single surveys for toxics in sediment, tissue, or water will trigger additional study for extent of contamination and potential timing of exposure if results exceed criteria or thresholds (e.g., LAETs, LC_{50}s, etc.). The general list of water quality parameters and metals will be used in calibrating the water quality model (Section 5.6) in both a riverine and reservoir environment.

Twelve mainstem Susitna River monitoring sites are located below the proposed dam site and two mainstem sites above this location. Five sloughs will be monitored that represent a combination of physical settings in the drainage and that are known to support important fish-rearing habitat. Tributaries to the Susitna River will be monitored and include those contributing large portions of the lower river flow like the Talkeetna, Chulitna, Deshka, and Yentna rivers. A partial list of the remaining tributaries that will be monitored represent important spawning and rearing habitat for anadromous and resident fisheries and include: Gold Creek, Portage Creek, Tsusena Creek, Watana Creek, and Oshetna Creek. The operation of temperature monitoring sites will continue as part of water quality monitoring activities in 2013/2014. These sites were selected based on the following rationale:

- Adequate representation of locations throughout the Susitna River and tributaries above and below the proposed dam site for the purpose of a baseline water quality characterization;
- Location on tributaries where proposed access road-crossing impacts might occur during and after construction (upstream/downstream sampling points on each crossing);
- Preliminary consultation with AEA and licensing participants including co-location with other study sites (e.g., instream flow, ice processes);
- Access and land ownership issues; and
- Eight of the sites are mainstem monitoring sites that were previously used for SNTEMP modeling in the 1980s. Thirty-one of the sites are Susitna River mainstem, tributary, or slough locations, most of which were monitored in the 1980s.

Monitoring sites are spaced at approximately 5 mile intervals so that the various factors that influence water quality conditions are captured and support the development (and calibration) of the water quality model. Frequency of sites along the length of the river is important for capturing localized effects from tributaries and from past and current human activity.

5.5.4.1. Water Temperature Data Collection

Water temperatures will be recorded in 15-minute intervals using Onset TidbiT v2 water temperature data loggers (or equivalent instrumentation). Data collection will occur between late June 2012 and the end of December 2012. Deployment and continuous temperature data logging will resume for each of the two following years (2013 and 2014) using the same apparatus and deployment strategy at all 39 sites. The TidbiT v2 (or equivalent) has a precision sensor for plus or minus 0.4 degrees Fahrenheit (°F) (0.2 degrees Celsius [°C]) accuracy over an operational range of -4 °F to 158 °F (-20 °C to 70 °C). Data readout is available in less than 30 seconds via an Optic USB interface.

To reduce the possibility of data loss, a redundant set of data loggers will be used at each site. In general, the two sets of sensors will be installed differently (depending on site characteristics). One logger will be inserted into the bottom of an 8.2-foot (2.5-meter) length of perforated steel pipe housing which is fastened to a large bank structure via clamps and rock bolts. The logger will be attached to a rope which allows it to be easily retrieved for downloads. The top pipe cap will contain a locking mechanism which can only be opened using the appropriate Allen key to prevent theft or vandalism. The second set of temperature loggers will be anchored to a concrete block and buoyed to record continuous bottom, mid, and surface temperature conditions throughout the water column (fewer temperature loggers may be deployed depending on site characteristics). The anchor block will be placed at a channel location that is accessible during routine site visits and will be attached with a steel cable to a post which is driven into the bank or to some other structure. The proposed installation procedures may require some alteration based on site specific conditions.

The sensors will be situated in the river to record water temperatures which are representative of the mainstem or slough being monitored, avoiding areas of groundwater upwelling, unmixed tributary flow, direct sun exposure, and isolated pools that may affect the quality of the data.

The 2012 Instream Flow Study will install water-level loggers with temperature recording capability at several study sites that are yet to be determined. Where these study sites overlap the water temperature monitoring study sites (Figure 5.5-1), the water-level logger temperature sensors may be used. However, a redundant TidbiT v2 would be deployed at these sites for backup temperature recording.

5.5.4.2. Meteorological Data Collection

Meteorological (MET) data collection stations will be installed and/or upgraded at up to 8 locations during 2012 between RM 224 and RM 25.6. Table 5.5-2 lists the MET station locations. The exact location will depend on access and suitability of an appropriate site for installation.

The two MET stations near the Susitna-Watana Dam site need to be established at specific locations as requested by Project design engineers. The upland MET station will record snowfall data and precipitation. The upland MET station will be established at about the 2,300 foot elevation on the north side of the river, in the area of the proposed field camp. The near river site MET station will be located on the north abutment just above river level depending on suitability of location for establishing the structure.

Existing MET stations will be fitted with additional monitoring equipment to expand data collection that meets project needs and to use historical information collected from each of these sites (Table 5.5-2). Data records from other studies will be used, wherever available, to help generate information for the required parameters needed for construction of the water quality models (Section 5.7). The linkage between historical records and continuing data records may be used in evaluating the utility of 1980s temperature data for modeling.

MET stations are spatially distributed on the Susitna River from RM 25.8 to RM 224.0 and represent a range of distinct physical settings throughout the Project area. Data from these MET stations will be combined with data from three MET stations that will be installed in the upper Susitna basin by the Glacier and Runoff Changes Study (Section 5.11). Additional MET station sites may be necessary if current site placement is inadequate to represent the needs of water quality model development. Parameters measured by each of the MET stations will be compared with the nearest down-gradient site and evaluated for adequacy of representation of weather conditions in that reach. If data recorded between successive sites are distinctly different, then additional sites will be proposed so that weather descriptions for use in the water quality model calibration phase (Section 5.6) will be improved with greater detail.

5.5.4.2.1. MET Station Parameters

MET stations will collect parameters that support the activities of the engineering design team and the development of the water quality temperature model. Snow depth will be estimated from the precipitation gage with the onset of the winter season. Evapotranspiration is measurable within deciduous canopies; however, the MET Station placement will not be under vegetation canopies so that parameters (like wind speed, etc.) necessary for establishing conditions on the reservoir can be measured. The following is a comprehensive list of parameters required for use in this Project and will be measured by each of the MET stations:

- Temperature (maximum, minimum, mean)
- Relative humidity
- Barometric pressure
- Precipitation
- Wind speed (maximum, minimum, mean)
- Wind direction
- Wind gust (maximum)
- Wind gust direction
- Solar degree days

5.5.4.2.2. MET Station Installation and Monitoring Protocol

Each MET station will consist of, at a minimum, a 10-foot (3-meter) tripod with mounted monitoring instrumentation to measure the parameters identified above (Figure 5.5-2). The station loggers will have sufficient ports and programming capacity to allow for the installation of instrumentation to collect additional MET parameters as required. Such installation and re-programming can occur at any time without disruption of the data collection program.

MET station installation is intended to provide instrumentation that will work continuously with little maintenance and produce high quality data through a telemetry system.

A Campbell Scientific CR1000 data logger will be used to record data. The archiving interval for all MET parameters will be 15 minutes, with a 2-year storage capacity. The MET station will be powered by a 12 Vdc 8 amp-hour battery and a 20-watt solar panel complete with charge regulator.

To protect the stations from wildlife intrusion and to discourage any potential vandalism, the stations will be protected by fencing as appropriate.

5.5.4.2.3. Satellite or Radio Telemetry Communications System

Real-time data will be downloaded from MET stations using satellite transmission or radio telemetry hardware. This will enable study staff to download, inspect, and archive the data as well as monitor station operational parameters for signs of problems without visiting the site. The communication will ensure that problems, if they occur, are resolved promptly to minimize data loss between service periods.

5.5.4.3. Baseline Water Quality Monitoring

The purpose of the Baseline Water Quality Study is to collect baseline water quality information that will support an assessment of the effects of the proposed Project operations on water quality in the Susitna River basin.

Baseline water quality collection can be broken into two components: in-situ water quality sampling and general water quality sampling. In-situ water quality sampling consists of on-site monthly measurements of physical parameters at fixed locations using field equipment. General water quality sampling will consist of monthly grab samples that will be sent to an off-site laboratory for analysis. The laboratory will have at a minimum, National Environmental

Laboratory Accreditation Program (NELAP) Certification in order to generate credible data for use by state, federal, and tribal regulatory programs for evaluating current and future water quality conditions. In general, these samples represent water quality components that cannot be easily measured in-situ, such as metals concentrations, nitrates, etc.

Water quality data collection will be at the locations in bold in Table 5.5-1. The initial sampling will be expanded if general water quality, metals in surface water, or metals in fish tissue exceed criteria or thresholds. Additional contiguous sample sites will be visited on this list beginning the following sampling month wherever criteria or thresholds have been exceeded by individual parameters. This proposed spacing follows accepted practice when segmenting large river systems for development of Total Maximum Daily Load (TMDL) water quality models. Sampling during winter months will be focused on locations where flow data is currently collected (or was historically collected by the USGS) and will be used for water quality modeling (Section 5.7).

5.5.4.3.1 Monitoring Parameters

Water quality samples will be analyzed for several parameters reported in Table 5.5-3. Metals monitoring for total and dissolved fractions in surface water include the full set of parameters used by ADEC in fish health consumption screening. The creation of a reservoir and potential alteration of surface water downstream of the proposed dam site may change characteristics of groundwater in the upper and middle Susitna basin. The water quality parameters identified in Table 5.5-3 will address the influence surface water may have on adjoining groundwater supplies in the vicinity of each sampling site. Changes to groundwater quality may have an effect on drinking water supplies so several parameters included on the inorganic chemical contaminants list have been included as part of this sampling program (ADEC 2003). The criteria that will be used for comparison with sampling results are the drinking water primary maximum contaminant levels.

Additional parameters will be measured from all sites in a single survey that occurs during low water conditions (e.g., August/September) in the Susitna basin. The following is a list of pollutants for which Alaska Water Quality Standards has established water quality criteria (18 ACC 70.020(b)) for protecting designated uses in freshwater:

- Continuous temperature monitoring program
  - Temperature, already included as part of the continuous temperature monitoring program.
- In-situ monitoring program
  - pH, included as part of the monthly water quality sampling routine.
  - Color, categorical observation.
  - Residues, categorical assessment (floating solids, debris, sludge, deposits, foam, or scum).
- General water quality program
  - Dissolved gas, included in the monitoring program (Dissolved Oxygen).
  - Dissolved inorganic substances (Total Dissolved Solids), included in monthly monitoring.

— Turbidity, already included as part of the monthly water quality sampling routine.

— Toxic and other deleterious organic and inorganic, already included in monitoring for metals and mercury/methyl-mercury (organometals).

- One time survey

— Fecal coliform bacteria, included in monthly monitoring.

— Sediment, already included in assessing mercury and other metals from sediments.

— Petroleum Hydrocarbons, oil, and grease, included in a one-time survey.

— Radioactivity; radionuclide concentrations to be generated from surface water samples.

— Toxic and other deleterious organic and inorganic, already included in monitoring for metals and mercury/methyl-mercury (organometals).

Water quality parameters above that do not exceed Alaska Water Quality Standards will not be collected in succeeding months; the exception are those parameters in Table 5.5-4 associated with monthly sample collection from surface water.

5.5.4.3.2 Sampling Protocol

Water quality grab samples will be collected during each site visit in a representative portion of the stream channel/water body, using methods consistent with Alaska State and EPA protocols for sampling ambient water and trace metal water quality criteria.

Mainstem areas of the river not immediately influenced by a tributary will be characterized with a single grab sample. Areas of the mainstem with an upstream tributary that may influence the nearshore zone or is well-mixed with the mainstem will be characterized by collecting samples at two locations: in the tributary and in the mainstem upstream of the tributary confluence. All samples will be collected from a well-mixed portion of the river/tributary.

These samples will be collected on approximately a monthly basis (4 samples from June to September) and used for calibrating the same model framework used for predicting temperature. The period for collecting surface water samples will begin at ice break-up and extend to beginning of ice formation on the river. Limited winter sampling (once in December, and again in March) will be conducted where existing or historic USGS sites are located. Review of existing data (URS 2011) indicated that few criteria exceedances occur with metals concentrations during the winter months. Initial assessment of this existing data suggests that samples be collected twice during the winter months for analysis of early and late season conditions. If the 2013 data sets suggest that metals and other general water quality parameters exceed criteria or thresholds then an expanded 2014 water quality monitoring program will be conducted to characterize conditions on a monthly basis throughout the winter months.

Water quality indicators like conductivity (specific conductance) has been suggested as a surrogate measure for transfer of metals from groundwater to surface water or in mobilization of metals within the river channel. Available USGS data from select continuous gaging stations will be reviewed for increases in specific conductance during monthly and seasonal intervals, and these results will be used to determine if further metals sampling is warranted during additional winter months.

Water samples will be collected using an appropriate sample container upstream of any agitated water that has been mixed either by a boat or walking.

Variation of water quality in a river cross-section is often significant and is most likely to occur because of incomplete mixing of upstream tributary inflows, point-source discharges, or variations in velocity and channel geometry. It is possible that a flow-integrated sampling technique employed by USGS known as the *equal width increment/equal transit rate* (EWI) method (Edwards and Glysson 1988, Ward and Harr 1990) will be used. In this method, an isokinetic sampling device (a sampler that allows water to enter without changing its velocity relative to the stream) is lowered and raised at a uniform transit rate through equally-spaced vertical increments in the river cross-section. This can be done either by wading with hand-held samplers or from a boat using a winch mounted sampler, depending on river stage and flow conditions. The number of vertical increments used will differ between sites depending upon site specific conditions.

Additional details of the sampling methods will be provided in the Sampling and Analysis Plan (SAP) and the Quality Assurance Project Plan (QAPP) for this study.

In-Situ Water Quality Sampling. During each site visit, *in-situ* measurements of dissolved oxygen, pH, specific conductance, redox potential, turbidity, and water temperature will be made. A Hanna Instruments HI 98703 Portable Turbidity Meter will be used to measure turbidity, while a Hydrolab® datasonde (MS5) will be used to measure the remaining field parameters during each site visit. Continuous turbidity measurement may be conducted with the Hydrolab datasonde at select locations (e.g., former/current USGS sites where turbidity data is available from the 1980s) and operated during summer and winter conditions. The following list of former and current USGS mainstem Susitna River monitoring sites will be considered for continuous turbidity monitoring: Susitna Station, Sunshine, Gold Creek, Tsusena Creek, and near Cantwell. These locations have historic and current flow data that will be used in water quality modeling (Section 5.7) of effects on turbidity from Project operations. Standard techniques for pre- and post-sampling calibration of *in-situ* instrumentation will be used to ensure quality of data generation and will follow accepted practice. If calibration failure is observed during a site visit field data will be corrected according to equipment manufacturer's instructions.

General Water Quality Sampling. Sampling will avoid eddies, pools, and deadwater. Sampling will avoid unnecessary collection of sediments in water samples, and touching the inside or lip of the sample container. Samples will be delivered to EPA approved laboratories within the holding time frame. Each batch of samples will have a separate completed chain of custody sheet. A field duplicate will be collected for 10 percent of samples (i.e., 1 for every 10 water grab samples). Laboratory quality control samples including duplicate, spiked, and blank samples will be prepared and processed by the laboratory.

Quality Assurance/Quality Control (QA/QC) samples will include field duplicates, matrix spikes, duplicate matrix spikes, and rinsate blanks for non-dedicated field sampling equipment. The results of the analyses will be used in data validation to determine the quality, bias and usability of the data generated.

Sample numbers will be recorded on field data sheets immediately after collection. Samples intended for the laboratory will be stored in coolers and kept under the custody of the field team at all times. Samples will be shipped to the laboratory in coolers with ice and cooled to approximately 4 °C. Chain of custody records and other sampling documentation will be kept in sealed plastic bags (Ziploc®) and taped inside the lid of the coolers prior to shipment. A temperature blank will accompany each cooler shipped. Packaging, marking, labeling, and shipping of samples will be in compliance with all regulations promulgated by the U. S. Department of Transportation in the Code of Federal Regulations, 49 CFR 171-177.

Water quality samples will be labeled with the date and time that the sample is collected and preserved/filtered (as appropriate), then stored and delivered to a state-certified water quality laboratory for analyses in accordance with maximum holding periods. A chain of custody record will be maintained with the samples at all times.

The state-certified laboratory will report (electronically and in hard copy) each chemical parameter analyzed with the laboratory method detection limit, reporting limit, and practical quantification limit. The laboratory will attempt to attain reporting detection limits that are at or below the applicable regulatory criteria and will provide all laboratory QA/QC documentation.

The procedures used for collection of water quality samples will follow protocols from Alaska Department of Environmental Conservation (ADEC) and the EPA Region 10 (Pacific Northwest). Water samples will be analyzed by a laboratory accredited by the ADEC or recognized under the NELAP. Water quality data will be summarized in a report with appropriate graphics and tables with respect to Alaska State Water Quality Standards (ADEC 2005) and any applicable federal standards.

Additional details of the sampling procedures and laboratory protocols will be included in the SAP and QAPP.

5.5.4.4. Sediment Samples for Mercury/Metals in the Reservoir Area

This task was designed to gather specific information on the distribution of Susitna River sediment contaminants of concern in potential source areas. In general, all sediment samples will be taken from sheltered backwater areas, downstream of islands, and in similar riverine locations in which water currents are slowed, favoring accumulation of finer sediment along the channel bottom. Samples will be analyzed for Total Metals, including aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, and zinc. In addition, sediment size and total organic carbon (TOC) will be included to evaluate whether these parameters are predictors for elevated metal concentrations. Samples will be collected just below and above the proposed dam site. Additional samples will be collected near the mouth of tributaries near the proposed dam site, including Fog, Deadman, Watana, Tsusena, Kosina, Jay, and Goose creeks, and the Oshetna River. The purpose of this sampling will be to determine where metals, if found in the water or sediment, originate in the drainage. Toxics modeling will be conducted to address potential for bioavailability in resident aquatic life. Comparison of bioaccumulation of metals in tissue analysis with results from sediment samples will inform on potential for transfer mechanisms between source and fate.

Most of the contaminants of interest are typically associated with fine sediments, rather than with coarse-grained sandy sediment or rocky substrates. Therefore, the goal of the sampling will be to obtain sediments with at least 5 percent fines (i.e., particle size less than 0.0025 inches [63 micrometers], or passing through a #230 sieve). At some locations, however, larger-sized sediment may be all that are available.

The sediment samples will be collected using an Ekman dredge or a modified Van Veen grab sampler. Sampling devices will be deployed from a boat. Samples may also be collected by wading into shallow near shore areas. To the extent possible, samples will consist of the top 6 inches (15 centimeters) of sediment. Comparison of results from the Susitna drainage will be made with other studies for Blue Lake, Eklutna Lake, and Bradley Lake when similar data are available and where physical settings are comparable.

5.5.4.5 Baseline Metals Levels in Fish Tissue

Two screening level tasks will be conducted. The first will be for methyl mercury in sport fish. Methyl mercury bioaccumulates and the highest concentrations are typically in the muscle tissue of adult predatory fish. Final determination of tissue type(s) for analysis will be coordinated with ADEC's Division of Environmental Health and guidance on fish tissue sampling. Target fish species in the vicinity of the Susitna-Watana Reservoir will be Dolly Varden, Arctic grayling, whitefish species, burbot and resident rainbow trout. If possible, filets will be sampled from 7 adult individuals from each species. Body size targeted for collection will represent the non-anadromous phase of each species life cycle (e.g., Dolly Varden will be 3.5 to 5 inches [90 to 125 millimeters] total length to represent the resident portion of the life cycle). Collection times for fish samples will occur in late August and early September. Filet samples will be analyzed for methyl and total mercury.

Liver samples will also be collected from burbot and analyzed for mercury, methyl-mercury, arsenic, cadmium, and selenium.

Field procedures will be consistent with those outlined in applicable Alaska State and/or EPA sampling protocols (USEPA 2000). Clean nylon nets and polyethylene-gloves will be used during fish tissue collection. The species, fork length, and weight of each fish will be recorded. Fish will be placed in Teflon® sheets and into zipper-closure bags and placed immediately on ice. Fish samples will be submitted to a state-certified analytical laboratory for individual fish muscle tissue analysis. Results will be reported with respect to applicable Alaska State and federal standards.

Results from fish tissue analysis will also be used as a baseline for determining how the proposed Project may increase the potential of current metals concentrations to become bioavailable. The projected water conditions in the reservoir will be estimated and current results for metals concentrations re-evaluated for determining potential toxicities to resident and anadromous fish species. Detection of mercury in fish tissue and sediment will prompt further study of naturally occurring concentrations in soils and plants and how parent geology contributes to concentrations of this toxic in both compartments of the landscape. The focused study will estimate the extent and magnitude of mercury contamination so that an estimate of increased bioavailability might be made once the reservoir inundates areas where high concentrations of mercury are sequestered. Detectable concentrations of mercury may prompt additional sampling and analysis of tissues in the benthic macroinvertebrate community. The bio-magnification of mercury contamination from sediments and plants to the fish community may be facilitated through consumption of contaminated food sources like the benthic macroinvertebrates. Contamination of this component of a trophic level may also be a conduit for mercury biomagnification in waterfowl and other wildlife that consume this food source.

5.5.4.6 Pilot Thermal Imaging Assessment of a Portion of the Susitna River

Thermal imagery of a portion of the Susitna River (e.g., 10 miles of the Middle River) will be collected in the 2012 season. Data from the thermal imaging will be ground-truthed and the applicability and resolution of the data will be determined in terms of identifying water temperatures and thermal refugia/upwelling. In coordination with the Instream Flow and fish studies, a determination will be made as to whether thermal imaging data will be applicable and whether or not additional thermal imagery will be collected during the 2013 field season to characterize river temperature conditions.

If the pilot study is successful, then a description of thermal refugia throughout the Project area can be mapped using aerial imagery calibrated with on-the-ground verification. The verification data will be collected at the same time as the aerial imagery (or nearly the same time) using the established continuous temperature monitoring network and additional grab sample temperature readings where there may be gaps, such as in select sloughs. The following elements are important considerations for data collection, specifications for data quality, and strategy for relating digital imagery and actual river surface water temperatures.

5.5.4.6.1 Radiant Temperature

Remotely sensed thermal images allow for spatially distributed measurements of radiant temperatures in the river. Radiant temperature measurements are made only on the surface layer of the water (top 4 inches [10 centimeters]). Temperature readings can vary depending on the amount of suspended sediment in the water and the turbidity of the water. Collection of data will occur near the end of October when the freeze begins and the contrast between cold surface water and warmer groundwater influence is accentuated. The suspended sediment and turbidity will be diminished during this period of the year when the glacial flour content in the water column is reduced from glacial meltwater.

5.5.4.6.2 Spatial Resolution

The key to good data quality is determining the pixel size of the thermal infra-red (TIR) sensor and how that relates to the near-bank environment. Best practice is 3 pure-water pixels (ensures that the digital image represented by any 3 contiguous pixels discriminates water from land). Very fine resolution (0.7 to 3.3 feet [0.2 to 1 meter]) imagery is best used to determine ground water springs and cold-water seeps. Larger pixels can be useful for determining characteristic patterns of latitude and longitude thermal variation in riverine landscapes.

5.5.4.6.3 Calibrating Temperature

Water temps change during the day, therefore measurements should occur near the same time each day and when water temp is most stable (early afternoon). Site selection for validation sampling will be determined by channel accessibility and where there is not known influences of tributaries, or seeps in the area. Hand-held ground imaging radiometers can provide validation as long as the precision is at least as good as that expected from airborne TIR measurements. Availability of historical satellite imagery for thermal analysis will be investigated. Historical thermal imagery may enable exploration of potential trends in water temperature both spatially and temporally.

5.5.4.7 Groundwater Quality in Selected Habitats

The purpose will be to characterize the water quality differences between a set of key productive aquatic habitat types (3 to 5 sites) and a set of non-productive habitat types (3 to 5) that are related to the absence or presence of groundwater upwelling to improve the understanding of the water quality differences and related groundwater/surface water processes.

Basic water chemistry (temperature, DO, conductivity, pH, turbidity, redox potential) that define habitat conditions will be collected at selected instream flow, fish population, and riparian study sites. These data will be used to characterize groundwater and surface water interactions.

5.5.5 Consistency with Generally Accepted Scientific Practice

Studies, field investigations, laboratory testing, engineering analysis, etc. will be performed in accordance with general industry accepted scientific and engineering practices. The methods and work efforts outlined in this study plan are the same or consistent with analyses used by applicants and licensees and relied upon by the Commission in other hydroelectric licensing proceedings.

5.5.6 Schedule

Baseline Water Quality Study elements will be completed in several stages and based on the following timeline:

Monitoring Activity	**Timeline**
Thermal Imaging (one survey)	October 2012
MET Station Installation and Data Collection	July 2012
QAPP/SAP Preparation and Review	January 2013-March 2013
Deployment of Temperature Monitoring Apparatus (if removed before winter ice-up)	June 2013 (retrieve in October 2014)
Water Quality Monitoring (monthly)	June 2013-October 2013 (one sampling event in each of December 2013 and March 2014)
Sediment Sampling (one survey)	August-September 2013
Fish Tissue Sampling (one survey)	August-September 2012/2013
Thermal Imaging (one survey)	October 2013
Data Analysis and Management	June 2013-November 2013
Initial Study Report	December 2013
Updated Study Report	December 2014

5.5.7 Level of Effort and Cost

The estimated cost for the water quality baseline monitoring in the Susitna basin in 2013 and 2014 is approximately $1,500,000, not including the cost of the thermal imaging.

5.5.8 Literature Cited

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U.S. Environmental Protection Agency (USEPA). 2000. Guidance for Assessing Chemical Contaminant Data for use in Fish Advisories: Volume 1 Fish Sampling and Analysis, 3rd Edition. EPA-823-B-00-007. United States Environmental Protection Agency, Office of Water. Washington , D.C. 485p

5.5.9 Tables

Table 5.5-1. Proposed Susitna River Basin Temperature and Water Quality Monitoring Sites.

Susitna River Mile	Description	Susitna River Slough ID	Latitude (decimal degrees)	Longitude (decimal degrees)
10.1	Susitna above Alexander Creek	NA	61.4014	-150.519
25.8[3]	**Susitna Station**	NA	61.5454	-150.516
28.0	**Yentna River**	NA	61.589	-150.468
29.5	**Susitna above Yentna**	NA	61.5752	-150.248
40.6[3]	**Deshka River**	NA	61.7098	-150.324
55.0[1]	**Susitna**	NA	61.8589	-150.18
83.8[3]	**Susitna at Parks Highway East**	NA	62.175	-150.174
83.9[3]	Susitna at Parks Highway West	NA	62.1765	-150.177
97.0	LRX 1	NA	62.3223	-150.127
97.2	**Talkeetna River**	NA	62.3418	-150.106
98.5	**Chulitna River**	NA	62.5574	-150.236
103.0[2,3]	**Talkeetna**	NA	62.3943	-150.134
113.0[2]	LRX 18	NA	62.5243	-150.112
120.7[2,3]	**Curry Fishwheel Camp**	NA	62.6178	-150.012
126.0	--	8A	62.6707	-149.903
126.1[2]	LRX 29	NA	62.6718	-149.902
129.2[3]	--	9	62.7022	-149.843
130.8[2]	LRX 35	NA	62.714	-149.81
135.3	--	11	62.7555	-149.7111
136.5	Susitna near Gold Creek	NA	62.7672	-149.694
136.8[3]	**Gold Creek**	NA	62.7676	-149.691
138.0[1]	--	16B	62.7812	-149.674
138.6[3]	**Indian River**	NA	62.8009	-149.664
138.7[2]	**Susitna above Indian River**	NA	62.7857	-149.651
140.0	--	19	62.7929	-149.615
140.1[2]	LRX 53	NA	62.7948	-149.613
142.0	--	21	62.8163	-149.576
148.0	Susitna below Portage Creek	NA	62.8316	-149.406
148.8[2]	**Susitna above Portage Creek**	NA	62.8286	-149.379
148.8	**Portage Creek**	NA	62.8317	-149.379
148.8[3]	Susitna above Portage Creek	NA	62.8279	-149.377
165.0[1]	Susitna	NA	62.7899	-148.997
180.3[1]	Susitna below Tsusena Creek	NA	62.8157	-148.652
181.3[3]	Tsusena Creek	NA	62.8224	-148.613
184.5[1]	**Susitna at Watana Dam site**	NA	62.8226	-148.533
194.1	Watana Creek	NA	62.8296	-148.259
206.8	Kosina Creek	NA	62.7822	-147.94
223.7[3]	**Susitna near Cantwell**	NA	62.7052	147.538
233.4	Oshetna Creek	NA	62.6402	-147.383

1 Site not sampled for water quality or temperature in the 1980s or location moved slightly from original location.

2 Proposed mainstem Susitna River temperature monitoring sites for purposes of 1980s SNTEMP model evaluation.
3 Locations with overlap of water quality temperature monitoring sites with other studies.
Locations in bold font represent that both temperature and water quality samples are collected from a site.

Table 5.5-2. Proposed Susitna-Watana Meteorological Stations.

Susitna River Mile	Description	Station Status (New / Existing)	Latitude (Decimal degrees)	Longitude (Decimal degrees)
25.8	Susitna at Susitna Station	New	61.545399	-150.51601
44.3	Willow Creek	Existing (Talkeetna RWIS)	61.765	-150.0503
80.0	Susitna River near Sunshine Gage	Existing (Talkeetna RWIS)	62.1381	-150.1155
95.9	Susitna River at Talkeetna	Existing (Talkeetna Airport)	62.32	-150.095
136.8	Susitna River at Gold Creek	New	62.767601	-149.69099
184.1	Susitna River at Watana Dam (near river)	New	62.8240	-148.5636
184.1	Susitna River at Watana Dam Camp (upland on bench)	New	62.8226	-148.5330
224.0	Susitna River above Cantwell	New	62.7052	-147.53799

Table 5.5-3. Parameters for water quality monitoring and laboratory analysis.

Parameter	Analysis Method	Sample Holding Times
In-Situ Water Quality Parameters		
Dissolved Oxygen (DO)	Water Quality Meter	Not Applicable
pH	Water Quality Meter	Not Applicable
Water Temperature	Water Quality Meter	Not Applicable
Specific Conductance	Water Quality Meter	Not Applicable
Turbidity	Water Quality Meter	Not Applicable
Redox Potential	Water Quality Meter	Not Applicable
Color	Platinum-Cobalt Scale (SM)	Not Applicable
Residues	Defined in 18 ACC 70	Not Applicable
General Water Quality Parameters (grab samples for laboratory analysis)		
Hardness	EPA - 130.2	180 days
Nitrate/Nitrite	EPA - 353.2	48 hours
Alkalinity	EPA - 2320	14 days

Ammonia as N	EPA - 350.1	28 days
Total Kjeldahl Nitrogen	EPA - 351.2	28 days
Total Phosphorus	EPA - 365.3	28 days
Ortho-phosphate	EPA - 365.3	48 hours
Chlorophyll *a*	SM 10300	28 days
Total Dissolved Solids	EPA - 160.1	7 days
Total Suspended Solids	EPA - 160.2	7 days
Turbidity	EPA - 180.1	48 hours
TOC	EPA - 415.1	28 days
DOC	EPA – 415.1	28 days
Fecal Coliform	EPA 1604	30 hours
Petroleum Hydrocarbons	EPA 602/624 (TAqH) EPA 610/625 (TAH)	14 days
Radionuclides[1]	EPA 900.0, 901.1, 903.1, 904.0, 905.0, Alpha Spectroscopy	5 days
Metals – (Water) Dissolved and Total		
Aluminum	EPA – 6010B/6020A	48 hours
Arsenic	EPA – 6010B/6020A	48 hours
Barium	EPA – 6010B/6020A	48 hours
Beryllium	EPA – 6010B/6020A	48 hours
Cadmium	EPA – 6010B/6020A	48 hours
Chromium (III & IV)	EPA – 6010B/6020A	48 hours
Cobalt	EPA – 6010B/6020A	48 hours
Copper	EPA – 6010B/6020A	48 hours
Iron	EPA – 6010B/6020A	48 hours
Lead	EPA – 6010B/6020A	48 hours
Magnesium	EPA – 6010B/6020A	48 hours
Manganese	EPA – 6010B/6020A	48 hours
Mercury	EPA – 7470A	48 hours
Molybdenum	EPA – 6010B/6020A	48 hours
Nickel	EPA – 6010B/6020A	48 hours
Selenium	EPA – 6010B/6020A	48 hours
Thallium	EPA – 6010B/6020A	48 hours
Vanadium	EPA – 6010B/6020A	48 hours

Zinc	EPA – 6010B/6020A	48 hours
Metals –Sediment (Total)		
Aluminum	EPA - 200.7	180 days
Arsenic	EPA - 200.7	180 days
Cadmium	EPA - 200.7	180 days
Copper	EPA - 200.7	180 days
Iron	EPA - 200.7	180 days
Lead	EPA - 200.7	180 days
Mercury	EPA – 245.5 / 7470A	28 days
Zinc	EPA - 200.7	180 days
Metals – Fish Tissue (Use EPA Sampling Method 1669)		
Total Mercury	EPA – 1631	7 days
Methylmercury	EPA – 1631	7 days
Arsenic	EPA - 1632, Revision A	7 days
Cadmium	EPA - 1632	7 days
Selenium	EPA - 1632	7 days

Note: List of Radionuclides suggested for analysis includes the following: Americium-241; Cesium-137; Lead-210; Plutonium-238, 239, 240; Potassium-40; Radium-226; Radium-228; Strontium-90; Thorium-230, 232; Uranium-234, 235, 238; Tritium Gross Alpha, Gross Beta

Table 5.5-4. List of water quality parameters and frequency of collection.

Parameter	Task	Frequency of Collection
In-Situ Water Quality Parameters		
Dissolved Oxygen (DO)	Baseline WQ and Sediment	Each Sampling Event
pH	Baseline WQ and Sediment	Each Sampling Event
Water Temperature	Baseline WQ and Sediment	Each Sampling Event
Specific Conductance	Baseline WQ and Sediment	Each Sampling Event
Turbidity	Baseline WQ and Sediment	Each Sampling Event
Redox Potential	Baseline WQ and Sediment	Each Sampling Event
Color	Baseline WQ (Visual)	Monthly
Residues	Baseline WQ (Visual)	One Survey-summer
General Water Quality Parameters (grab samples for laboratory analysis)		
Hardness	Baseline WQ	Monthly
Alkalinity	Baseline WQ	Monthly
Nitrate/Nitrite	Baseline WQ	Monthly
Ammonia as N	Baseline WQ	Monthly

Total Kjeldahl Nitrogen	Baseline WQ	Monthly
Total Phosphorus	Baseline WQ	Monthly
Ortho-phosphate	Baseline WQ	Monthly
Chlorophyll *a*	Baseline WQ	Monthly
Total Dissolved Solids	Baseline WQ	Monthly
Total Suspended Solids	Baseline WQ	Monthly
Turbidity	Baseline WQ	Monthly
TOC	Baseline WQ	One Survey-summer
DOC	Baseline WQ	One Survey-summer
Fecal Coliform	Baseline WQ	One Survey-summer
Petroleum Hydrocarbons	Baseline WQ	One Survey-summer
Radioactivity	Baseline WQ	One Survey-summer
Metals – (Water) Dissolved and Total		
Aluminum	Baseline WQ (Total & Dissolved)	One Survey-summer
Arsenic	Baseline WQ (Total & Dissolved)	Monthly
Barium	Baseline WQ (Total & Dissolved)	Monthly
Beryllium	Baseline WQ (Total & Dissolved)	Monthly
Cadmium	Baseline WQ (Total & Dissolved)	Monthly
Chromium (III & IV)	Baseline WQ (Total & Dissolved)	One Survey-summer
Cobalt	Baseline WQ (Total & Dissolved)	Monthly
Copper	Baseline WQ (Total & Dissolved)	Monthly
Iron	Baseline WQ (Total & Dissolved)	Monthly
Lead	Baseline WQ (Total & Dissolved)	Monthly
Manganese	Baseline WQ (Total & Dissolved)	Monthly
Magnesium	Baseline WQ (Total & Dissolved)	Monthly
Mercury	Baseline WQ (Total & Dissolved)	Monthly
Molybdenum	Baseline WQ (Total & Dissolved)	Monthly
Nickel	Baseline WQ (Total & Dissolved)	Monthly
Selenium	Baseline WQ (Total & Dissolved)	One Survey-summer
Thallium	Baseline WQ (Total & Dissolved)	Monthly
Vanadium	Baseline WQ (Total & Dissolved)	Monthly
Zinc	Baseline WQ (Total & Dissolved)	Monthly
Metals –Sediment (Total)		
Aluminum	Sediment Samples	One Survey-summer
Arsenic	Sediment Samples	One Survey-summer
Cadmium	Sediment Samples	One Survey-summer

Copper	Sediment Samples	One Survey-summer
Iron	Sediment Samples	One Survey-summer
Lead	Sediment Samples	One Survey-summer
Mercury	Sediment Samples	One Survey-summer
Zinc	Sediment Samples	One Survey-summer
Metals – Fish Tissue (Use EPA Sampling Method 1669)		
Total Mercury	Fish Tissue Screening	One Survey-late summer
Methyl-mercury	Fish Tissue Screening	One Survey-late summer
Arsenic	Fish Tissue Screening	One Survey-late summer
Cadmium	Fish Tissue Screening	One Survey-late summer
Selenium	Fish Tissue Screening	One Survey-late summer

5.5.10 Figures

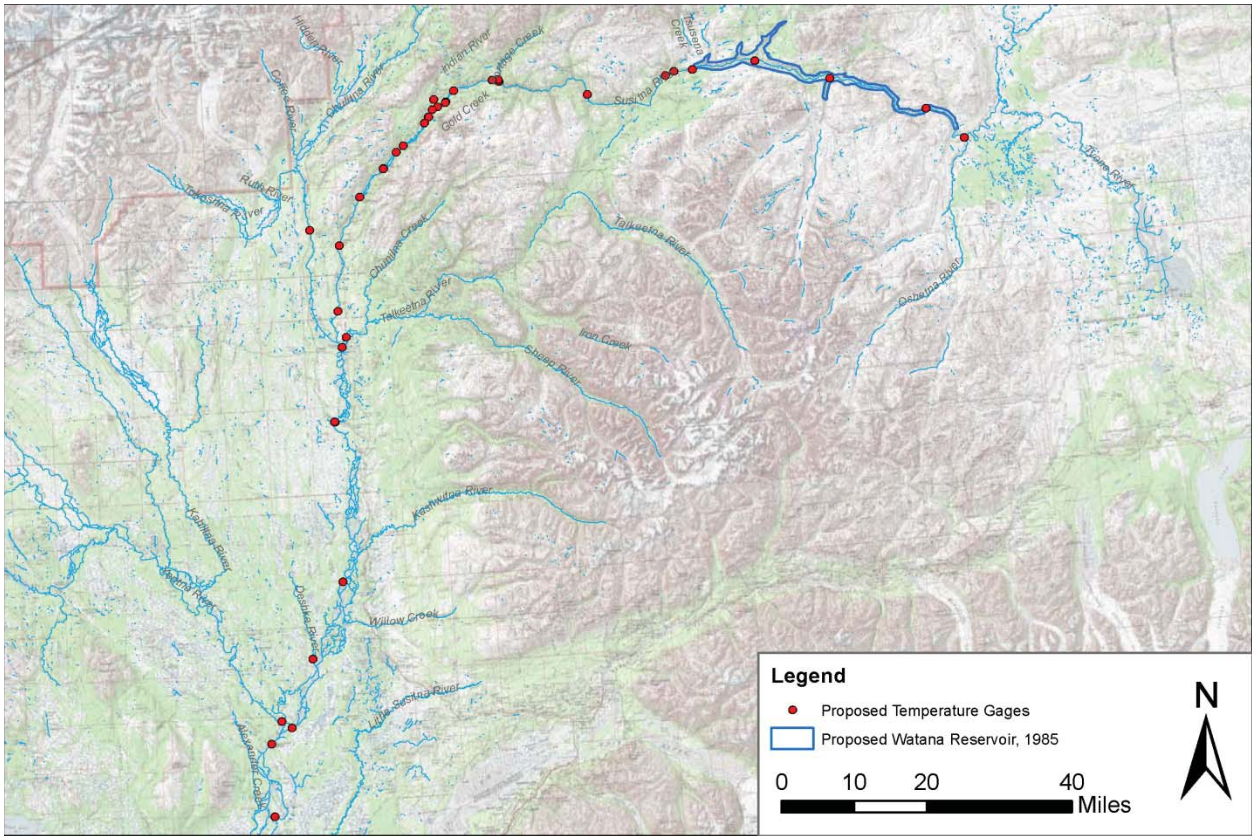

Figure 5.5-1. Proposed 2012 Stream Water Quality and Temperature Data Collection Sites for the Susitna-Watana Hydroelectric Project.

Figure 5.5-2. Example of a 10-foot (3-meter) tripod MET station (guy wires for stabilization and an enclosure will be installed).

5.6. Water Quality Modeling Study

5.6.1. General Description of the Proposed Study

5.6.1.1. Study Goals and Objectives

The collective goal of the water quality studies is to assess the impacts of the proposed Project operations on water quality in the Susitna River basin with particular reference to state water quality standards. Predicting the potential impacts of the dam and its proposed operations on water quality will require the development of a water quality model. The goal of the Water Quality Modeling Study will be to utilize the extensive information collected from the Baseline Water Quality Study to develop a model(s) in which to evaluate the potential impacts of the proposed Project and operations on various physical parameters within the Susitna River watershed.

There are a large number of water quality models available for use on the Susitna-Watana Project. Selection of the appropriate model is based on a variety of factors, including cost, data inputs, model availability, time, licensing participant familiarity, ease of use, and available documentation. Under the current study, a multi-dimensional model capable of representing reservoir flow circulation, temperature stratification, and dam operations among other parameters is necessary. The proposed model must account for water quality conditions in the proposed Susitna-Watana Reservoir, including temperature, dissolved oxygen (DO), suspended sediment and turbidity, chlorophyll a, nutrients, and metals; and water quality conditions in the Susitna River downstream of the proposed dam. The model must also simulate current Susitna River baseline conditions (in the absence of the dam) for comparison to conditions in the presence of the dam and reservoir.

The objectives of the Water Quality Modeling Study are as follows:

- In consultation with licensing participants, identify an appropriate reservoir and river water temperature model for use with past and current monitoring data.
- Using the data developed in Section 5.5 and 5.10, model water quality conditions in the proposed Susitna-Watana Reservoir, including (but not necessarily limited to), temperature, DO, suspended sediment and turbidity, chlorophyll a, nutrients, ice, and metals.

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

5.6.2. Existing Information and Need for Additional Information

In the 1980s, hydrologic and temperature modeling was conducted in the Susitna River basin to predict the effects of one or more dams on downstream temperatures and flows. The modeling suite used was called H2OBAL/SNTEMP/DYRESM. The modeling suite addressed temperature and had some limited hydrodynamic representation, but it lacked the ability to predict vertical stratification or local effects. In addition, the modeling suite lacked a water quality modeling component.

Review of existing water quality and sediment transport data revealed several gaps that present challenges for calibrating a water quality model (URS 2011). Analysis of existing data was used to identify future studies needed to develop the riverine and reservoir water quality models and to eventually predict pre-Project water quality conditions throughout the drainage. Some general observations based on existing data are as follows:

Large amounts of data were collected during the 1980s. A comprehensive data set for the Susitna River and tributaries is not available.

- The influence of major tributaries (Chulitna and Talkeetna rivers) on Susitna River water quality conditions is unknown. There are no monitoring stations in receiving water at these mainstem locations.
- Continuous temperature data and seasonal water quality data are not available for the Susitna River mainstem and sloughs potentially used for spawning and rearing habitat.

Concentrations of water quality parameters including metals in sediment immediately below the proposed Project are unknown. Metals in these sediments may become mobile once the Project begins operation. Monitoring information in the immediate vicinity of the reservoir and riverine habitat will be important for developing two models (reservoir and riverine) and coupled for predicting expected water quality conditions below the proposed dam.

5.6.3. Study Area

Water quality samples will be collected and temperature data loggers will be installed at 39 sites identified in Table 5.6-1 and Figure 5.6-1 as part of the 2012 Baseline Water Quality Study. The study area begins at RM 10.1 and extends past the proposed dam site to RM 233.4. The lowermost boundary of the monitoring that will be used for developing and calibrating models is above the area protected for Beluga whale activity. Twelve mainstem Susitna River monitoring sites are located below the proposed dam site and two mainstem sites above this location for calibration of the models. Five sloughs will be included in the models and represent important fish-rearing habitat. Tributaries to the Susitna River will be monitored and include those contributing large portions of the lower river flow like the: Talkeetna, Chulitna, Deshka, and Yentna rivers. A partial list of the remaining tributaries that will be included in modeling and represents important spawning and rearing habitat for anadromous and resident fisheries include: Gold Creek, Portage Creek, Tsusena Creek, Watana Creek, and Oshetna Creek. These sites were selected based on the following rationale:

- Adequate representation of locations throughout the Susitna River and tributaries above and below the proposed dam site;
- Preliminary consultation with AEA and licensing participants including co-location with other study sites (e.g., instream flow, ice processes);
- Access and land ownership issues; and

Eight of the sites are mainstem monitoring sites that were previously used for SNTEMP modeling in the 1980s. Thirty-one of the sites are Susitna River mainstem, tributary, or slough locations, most of which were also monitored in the 1980s.

5.6.4. Study Methods

This section assesses potential water quality models and identifies key considerations for the selection of the appropriate modeling platform. In coordination with licensing participants, a final modeling platform will be selected and implemented.

For the current project, the model will need to be capable of simulating both river and reservoir environments. It must also be a multi-dimensional dynamic model that includes hydrodynamics, water temperature, water quality, and sediment transport modules and considers ice formation and breakup. Ice dynamics evaluated in the Ice Processes Study will be used to inform the water quality model. Ice formation and breakup will have a profound impact on hydrodynamics and water quality conditions in the reservoir and riverine sections of the basin. Ice cover affects transfer of oxygen to and from the atmosphere and this directly impacts the dissolved oxygen concentration at points along the water column. The output from the ice study (Section 5.10) will provide boundary conditions for the water quality model.

The model will be configured for the reservoir and internally coupled with the downstream river model. This will form a holistic modeling framework which can accurately simulate changes in the hydrodynamic, temperature, and water quality regime within the reservoir and downstream. A model for use in this study should feature an advanced turbulence closure scheme to represent vertical mixing in reservoirs, and be able to predict future conditions. Thus, it will be capable of representing the temperature regime within the reservoir without resorting to arbitrary assumptions about vertical mixing coefficients.

The model will need to have the ability to simulate an entire suite of water quality parameters, and the capacity for internal coupling with the hydrodynamic and temperature modeling processes. The model will be configured to simulate the impact of the proposed Project on temperature as well as DO, nutrients, algae, turbidity, TSS, and other key water quality features both within the reservoir and for the downstream river. This avoids the added complexity associated with transferring information among multiple models and increases the efficiency of model application.

Other important factors when selecting a water quality model include the following:

- The model and code are easily accessible and are part of the public domain.
- The model is commonly used and accepted by EPA and other public regulatory agencies.
- The water quality model will be available for current and future use and remain available for the life of the project and beyond (including upgraded versions).
- Model output can be compared to relevant ADEC water quality criteria (18 ACC 70.020(b)).

The following sections summarize the capabilities of models considered for use on this project.

5.6.4.1. H2OBAL/SNTEMP/DYRESM Model Review

The existing H2OBAL/SNTEMP/DYRESM model of the Susitna River basin is perhaps the most obvious candidate model to implement when assessing the effects of the originally proposed Project. The existing model was expressly configured to represent the unique conditions in the Susitna River basin. However, the modeling suite is limited to flow and temperature predictions. Hydrodynamics are simplified, and water quality is not addressed.

The Arctic Environmental Information and Data Center (AEIDC) previously completed a study that examined the temperature and discharge effects if the proposed Project was completed and compared the effects to the natural stream conditions, without a dam and reservoir system (AEIDC 1983a). The study also assessed the downstream point at which post-project flows would be statistically the same as natural flows. Multiple models were used in the assessment: SNTEMP, a riverine temperature model, H2OBAL, a water balance program and DYRESM, a reservoir hydrodynamic model.

The simulation period covered the years 1968 through 1982. Only the summer period was simulated, using historical meteorological and hydrological data to represent normal, maximum and minimum stream temperature conditions, represented by the years 1980, 1977, and 1970, respectively (AEIDC 1983a). Post-project modifications were applied to these summer periods to compare natural conditions to post-project stream temperatures. Due to a lack of data, a monthly time-step was used in these summer condition simulations.

Mainstem discharges from the Susitna-Watana Dam site were estimated from statistically-filled streamflow data and the H2OBAL program, which computes tributary inflow on a watershed area-weighted basis. Post-project flows were predicted for both a one-dam scenario and a two-dam scenario using release discharge estimates from a reservoir operation schedule scenario in the FERC license application. Flows derived from H2OBAL were input into SNTEMP.

SNTEMP is a riverine temperature simulation model that can predict temperature on a daily basis and for longer time periods. This allows for the analysis of both critical river reaches at a fine scale and the full river system over a longer averaging period (AEIDC 1983b). SNTEMP was selected because it contains a regression model that can fill in data gaps in temperature records. This is useful because data records in the Susitna River watershed are sparse. SNTEMP can also be calibrated to adjust for low-confidence input parameters. SNTEMP outputs include average daily water temperatures and daily maximum and minimum temperatures.

SNTEMP contains several sub-models, including a solar radiation model that predicts solar radiation based on stream latitude, time of year, topography, and meteorological conditions (AEIDC 1983b). SNTEMP was modified to include the extreme shading conditions that occur in the basin by developing a monthly topographic shading parameter. Modifications were also made to represent the winter air temperature inversions that occur in the basin. Sub-models are also included for heat flux, heat transport, and flow mixing.

SNTEMP validation indicated that upper tributary temperatures were under-predicted (AEIDC 1983b). Most of the data for the tributaries were assumed or estimated, leading to uncertainty. Five key poorly defined variables were identified as possible contributors to the under-prediction of temperatures: stream flow, initial stream temperature, stream length, stream width and distributed flow temperatures. Distributed flow temperatures were highlighted as the most important of the five variables. During calibration, groundwater temperature parameters were adjusted to modify distributed flow and improve tributary temperature prediction.

Water temperatures are derived from USGS gages, but when data was lacking, SNTEMP computed equilibrium temperatures and then estimated initial temperatures from a regression model. AEIDC noted that the reliability of the regression models "restricts the accuracy of the physical process temperature simulations" (1983a). The level of confidence in the regression model varies by the amount of gage data available. Continuous data yielded higher confidence, while years with only grab sample data notably decreased the confidence in the predicted temperatures.

The DYRESM model is a one-dimensional, hydrodynamic model designed specifically for medium size reservoirs (Patterson, et al. 1977). The size limitation ensures that the assumptions of the model algorithm remain valid. DYRESM predicts daily temperature and salinity variations with depth and the temperature and salinity of off-take supply. The reservoir is modeled as horizontal layers with variable vertical location, volume, temperature and salinity. Mixing between layers is through amalgamation. Inflow and withdrawal are modeled by changes in the horizontal layer thickness and insertion or removal of layers, as appropriate. The model incorporates up to two submerged off-takes and one overflow outlet. Model output is on a daily time-step.

The DYRESM model was run to simulate the reservoir scenario for 1981 conditions (AEIDC 1983a). Other reservoir release temperature estimates were not available. The AEIDC report cautions that the results from 1981 may not be representative of other years due to annual variations in meteorology, hydrology, reservoir storage, and power requirements. The lack of reservoir release temperature data limited the simulation of downstream temperatures under operational conditions to one year. AEIDC noted that the "effort to delineate river reaches where post-project flows differ significantly from natural flows has been unsuccessful" (AEIDC 1983a). This was attributed in large part to the lack of estimates for the reservoir release temperatures. Additional data was needed to increase the predictive ability of SNTEMP.

Perhaps the biggest limitations of the existing H2OBAL/SNTEMP/DYRESM modeling suite are the lack of suitable data, simplified hydrology and the lack of a water quality component. Modeling is limited to discharge and temperature. Other issues that limit the suitability of the modeling suite for the Water Quality Modeling Study are the chronic under-prediction of upper tributary temperatures, and the inability to predict vertical stratification within the reservoir.

5.6.4.2. Other Modeling Approaches

Two other modeling approaches may provide better results than the previously used H2OBAL/SNTEMP/DYRESM model. These are discussed below.

5.6.4.3. Two-Dimensional Approach (Ce-Qual-W2)

The U.S. Army Corps of Engineers' CE-QUAL-W2 model is a two-dimensional, longitudinal/vertical (laterally averaged), hydrodynamic and water quality model (Cole, et al. 2000). The model can be applied to streams, rivers, lakes, reservoirs, and estuaries with variable grid spacing, time-variable boundary conditions, and multiple inflows and outflows from point/nonpoint sources and precipitation.

The two major components of the model include hydrodynamics and water quality kinetics. Both of these components are coupled (i.e., the hydrodynamic output is used to drive the water quality output at every time-step). The hydrodynamic portion of the model predicts water surface elevations, velocities, and temperature. The water quality portion of the model can simulate 21 constituents including DO, suspended sediment, chlorophyll *a*, nutrients, and metals. A dynamic shading algorithm is incorporated to represent topographic and vegetative cover effects on solar radiation.

5.6.4.4. Three-Dimensional Approach (EFDC)

The Environmental Fluid Dynamics Code (EFDC) model was originally developed at the Virginia Institute of Marine Science and is considered public domain software (Hamrick 1992). This model is now being supported by EPA. EFDC is a dynamic, three-dimensional, coupled water quality and hydrodynamic model. In addition to hydrodynamic, salinity, and temperature transport simulation capabilities, EFDC is capable of simulating cohesive and non-cohesive sediment transport, near field and far field discharge dilution from multiple sources, eutrophication processes, the transport and fate of toxic contaminants in the water and sediment phases, and the transport and fate of various life stages of finfish and shellfish. The EFDC model has been extensively tested, documented, and applied to environmental studies world-wide by universities, governmental agencies, and environmental consulting firms.

The structure of the EFDC model includes four major modules: (1) a hydrodynamic model, (2) a water quality model, (3) a sediment transport model, and (4) a toxics model. The water quality portion of the model simulates the spatial and temporal distributions of 22 water quality parameters including DO, suspended algae (3 groups), periphyton, various components of carbon, nitrogen, phosphorus and silica cycles, and fecal coliform bacteria. Salinity, water temperature, and total suspended solids are needed for computation of the 22 state variables, and they are provided by the hydrodynamic model. EFDC incorporates solar radiation using the algorithms from the CE-QUAL-W2 model.

5.6.4.5. Qualitative Comparison of Models

Table 5.6-2 presents an evaluation of the models' applicability to a range of important technical, regulatory, and management considerations. Technical criteria refer to the ability to simulate the physical system in question, including physical characteristics/processes and constituents of interest. Regulatory criteria make up the constraints imposed by regulations, such as water quality standards or procedural protocol. Management criteria comprise the operational or economic constraints imposed by the end-user and include factors such as financial and technical resources. The relative importance of each consideration, as it pertains to the Project, are presented alongside the models' applicability ratings. Although the evaluation is qualitative, it is useful in selecting a model based on the factors that are most critical to this project.

5.6.4.6. Technical Considerations

The following discussion highlights some of the key technical considerations for modeling associated with the Susitna-Watana Project and compares the ability of CE-QUAL- W2 and EFDC to address these considerations. For informational purposes, the H2OBAL/SYNTEMP/DYRESM modeling suite is also discussed in the technical considerations. Based on a review of the literature, some key factors that will likely be important in the modeling effort include:

1. Predicting vertical stratification in the reservoir when the dam is present;
2. Nutrient and algae representation;
3. Sediment transport;
4. Ability to represent metals concentrations;
5. Integration between temperature and ice dynamics models; and
6. Capability of representing local effects.

5.6.4.6.1. Predicting Vertical Stratification

Both EFDC and CE-QUAL-W2 are equipped with turbulence closure schemes which allow prediction of temporally/spatially variable vertical mixing strength based on time, weather condition, and reservoir operations. Therefore, both are capable of evaluating the impact of dam/reservoir operations/climate change on reservoir stratification. In contrast, the existing H2OBAL/SYNTEMP/DYRESM model does not have the necessary predictive capability because vertical stratification is represented based on parameterization through calibration. Therefore, it cannot represent the response of vertical mixing features to the changes in external forces.

5.6.4.6.2. Nutrient and Algae Representation

Both EFDC and CE-QUAL-W2 are capable of simulating dynamic interactions between nutrients and algae in reservoirs and interactions between nutrients and periphyton in riverine sections. This is very important for addressing the potential impact of the proposed Project on water quality and ecology in the river. EFDC has better nutrient predictive capabilities due to its sediment diagenesis module, which simulates interactions between external nutrient loading and bed-water fluxes. EFDC is thus capable of predicting long-term effects of the proposed Project. CE-QUAL-W2 does not have such a predictive capability. The existing H2OBAL/SNTEMP/DYRESM modeling suite is not capable of representing nutrient and algae interactions.

5.6.4.6.3. Sediment Transport

EFDC is fully capable of predicting sediment erosion, transport, and settling/deposition processes. CE-QUAL-W2 has limited sediment transport simulation capabilities. It handles water column transport and settling; however, it is not capable of fully predicting sediment bed re-suspension and deposition processes. H2OBAL/SNTEMP/DYRESM is not capable of simulating sediment transport.

5.6.4.6.4. Ability to Represent Metals Concentrations

EFDC is fully capable of simulating fate and transport of metals in association with sediments in both rivers and reservoirs. CE-QUAL-W2 does not have a module to simulate metals; however, a simplified representation can be implemented using the phosphorus slot in the model and simple partitioning (to couple with its basic sediment transport representation). The H2OBAL/SNTEMP/DYRESM is not capable of addressing metals issues.

5.6.4.6.5. Integration between Temperature and Ice Dynamics Models

The CE-QUAL-W2 model has a coupled temperature-ice simulation module, which is of moderate complexity and predictive capability. EFDC has a slightly simpler ice representation which was previously applied to a number of Canadian rivers (e.g., Lower Athabasca River and the North Saskatchewan River in Alberta, Canada). Both models, however, can be coupled to external ice models with a properly designed interface to communicate temperature results. Fully predictive simulation within either model would require code modification to handle the interaction between temperature simulation, ice formation and transport, hydrodynamics simulation, and water quality simulation.

5.6.4.6.6. Capability of Representing Local Effects

CE-QUAL-W2 is a longitudinal-vertical two-dimensional model; therefore, it is capable of resolving spatial variability in the longitudinal and vertical directions. It is not capable of representing high resolution local effects such as lateral discharge, areas impacted by secondary circulation, or certain habitat characteristic changes. EFDC is a three-dimensional model which can be configured at nearly any spatial resolution to represent local effects. H2OBAL/SNTEMP/DYRESM is a one-dimensional modeling suite and therefore has limited capability representing local effects.

5.6.4.7. Reservoir and River Downstream of Reservoir Modeling Approach

Reservoir modeling will focus on the length of the river from above the expected area of reservoir inundation to the proposed dam location. It will involve first running the initial reservoir condition. This initial condition represents current baseline conditions in the absence of the dam. Subsequently, the model will represent the proposed reservoir condition, when the dam is in place. The reservoir representation will be developed based on the local bathymetry and dimensions of the proposed dam. It is recommended that a three-dimensional model be developed for the proposed reservoir to represent the spatial variability in hydrodynamics and water quality in longitudinal, vertical and lateral directions. The model will be able to simulate flow circulation in the reservoir, turbulence mixing, temperature dynamics, nutrient fate and transport, interaction between nutrients and algae, sediment transport, and metals transport. The key feature that needs to be captured is water column stratification during the warm season and the de-stratification when air temperatures cool down. The capability of predictively representing the stratification/de-stratification period is of critical importance for evaluating the impact of the dam since this is the critical water quality process in the reservoir.

With the dam in place, the original river will be converted into a slow flowing reservoir; therefore, any sediment previously mobilized will likely settle in the reservoir, disrupting the natural sediment transport processes. Before the construction of the dam, primary production is likely driven by periphyton. After construction of the dam, periphyton will be largely driven out of existence due to deep water conditions typical of a reservoir environment. In lieu of periphyton, phytoplankton will likely be the dominant source of primary production of the ecological system with the dam in place. Nutrients from upstream will have longer retention in the reservoir, providing nutrient sources to fuel phytoplankton growth. All processes would need to be predictively simulated by both the reservoir model and the pre-reservoir river model for the same river segment.

Because the dam is not in place when the model is constructed, proper calibration of the model using actual reservoir data is not possible. To achieve reasonable predictions of water quality conditions in the proposed reservoir, a literature survey will be conducted to acquire parameterization schemes of the model. An uncertainty analysis approach will also be developed to account for the lack of data for calibration, therefore enhancing the reliability of reservoir model predictions.

Downstream of the proposed dam location, a river model will also be developed to evaluate the effects of the proposed Project. It is anticipated that the same model platform used for the reservoir model will be implemented for the river model (at a minimum the two models will be tightly coupled). The river model will be capable of representing conditions in both the absence and presence of the dam. The downstream spatial extent of this model is yet to be determined, but it is likely it will extend to shortly downstream of the Susitna-Talkeetna-Chulitna confluence (e.g., Sunshine USGS Gage). If water quality modeling indicates that water quality effects extend into the lower river downstream of the initial modeling effort, then, as appropriate, water quality modeling will extend farther downstream. This would require additional channel topography and flow data at select locations in order to develop a model for predicting water quality conditions under various Project operational scenarios.

Flow, temperature, TSS, DO, nutrients, turbidity (continuous at USGS sites & bi-weekly at additional locations required for calibrating the model), and chlorophyll-a output from the reservoir model will be directly input into the downstream river model. This will enable downstream evaluation of potential impacts of the proposed Project on hydrodynamic, temperature, and water quality conditions.

The river model will be calibrated and validated using available data concurrently with the initial reservoir condition model (representing absence of the dam). Output from the models will be used directly in other studies (e.g., Ice Processes, Productivity, and Instream Flow studies).

The model will be calibrated in order to simulate water quality conditions for load following analysis. Organic carbon content from inflow sources will be correlated with mercury concentrations determined from the Baseline Water Quality Study discussed in Section 5.5. Predicted water quality conditions established by Project operations and that promote methylation of mercury in the bioaccumulative form will be identified by location and intensity in both riverine and reservoir habitats. Water temperature modeling and routing of fluctuating flows immediately prior to and during ice cover development may be conducted with a separate thermodynamics based ice process model (e.g., CRISSP 1D).

5.6.5. Consistency with Generally Accepted Scientific Practice

Models will be the primary method used for predicting potential impacts to water quality conditions in both the proposed reservoir and the riverine portion of the Susitna basin. The models will be developed for each of the reservoir and riverine sections of the Susitna River and will be used to predict conditions resulting from Project operations under several operational scenarios. In the absence of a dam and data describing actual water quality conditions in the proposed reservoir, models are the only way to predict potential changes that may occur in the Susitna River from the presence of a dam. The 401 Water Quality Certification process includes the use of baseline assessment information and the use of models. The use of models is a scientifically accepted practice for predicting impacts to water quality and generating operational scenario outputs to inform the Project certification.

5.6.6. Schedule

The anticipated schedule for this work is presented below.

Modeling Activity	Timeline
Coordination with water quality data collection and analysis	On-going throughout modeling effort
Model Evaluation/Selection	September 30, 2012
Model Calibration (Water Quality)	June 2013-October 2013
Initial Study Report	December 2013
Re-calibration adjustments	June 2014-August 2014

Verification runs	July 2014-September 2014
Generate Results for Operational Scenarios	July 2014 –November 2014
Updated Study Report	December 2014

5.6.7. Level of Effort and Cost

The estimated cost for proposed water quality modeling effort in 2013 and 2014, including planning, model calibration and development, modeling various operational scenarios and reporting is approximately $1,050,000.

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5.6.9. Tables

Table 5.6-1. Proposed Susitna River Basin Water Quality and Temperature Monitoring Sites.

Susitna River Mile	Description	Susitna River Slough ID	Latitude (decimal degrees)	Longitude (decimal degrees)
10.1	Susitna above Alexander Creek	NA	61.4014	-150.519
25.8[3]	**Susitna Station**	NA	61.5454	-150.516
28.0	**Yentna River**	NA	61.589	-150.468
29.5	**Susitna above Yentna**	NA	61.5752	-150.248
40.6[3]	**Deshka River**	NA	61.7098	-150.324
55.0[1]	**Susitna**	NA	61.8589	-150.18
83.8[3]	**Susitna at Parks Highway East**	NA	62.175	-150.174
83.9[3]	Susitna at Parks Highway West	NA	62.1765	-150.177
97.0	LRX 1	NA	62.3223	-150.127
97.2	**Talkeetna River**	NA	62.3418	-150.106
98.5	**Chulitna River**	NA	62.5574	-150.236
103.0[2,3]	**Talkeetna**	NA	62.3943	-150.134
113.0[2]	LRX 18	NA	62.5243	-150.112
120.7[2,3]	**Curry Fishwheel Camp**	NA	62.6178	-150.012
126.0	--	8A	62.6707	-149.903
126.1[2]	LRX 29	NA	62.6718	-149.902
129.2[3]	--	9	62.7022	-149.843
130.8[2]	LRX 35	NA	62.714	-149.81
135.3	--	11	62.7555	-149.7111
136.5	Susitna near Gold Creek	NA	62.7672	-149.694
136.8[3]	**Gold Creek**	NA	62.7676	-149.691
138.0[1]	--	16B	62.7812	-149.674
138.6[3]	**Indian River**	NA	62.8009	-149.664
138.7[2]	**Susitna above Indian River**	NA	62.7857	-149.651
140.0	--	19	62.7929	-149.615
140.1[2]	LRX 53	NA	62.7948	-149.613
142.0	--	21	62.8163	-149.576
148.0	Susitna below Portage Creek	NA	62.8316	-149.406
148.8[2]	**Susitna above Portage Creek**	NA	62.8286	-149.379
148.8	**Portage Creek**	NA	62.8317	-149.379
148.8[3]	Susitna above Portage Creek	NA	62.8279	-149.377
165.0[1]	Susitna	NA	62.7899	-148.997
180.3[1]	Susitna below Tsusena Creek	NA	62.8157	-148.652
181.3[3]	Tsusena Creek	NA	62.8224	-148.613
184.5[1]	**Susitna at Watana Dam site**	NA	62.8226	-148.533
194.1	Watana Creek	NA	62.8296	-148.259
206.8	Kosina Creek	NA	62.7822	-147.94
223.7[3]	**Susitna near Cantwell**	NA	62.7052	147.538
233.4	Oshetna Creek	NA	62.6402	-147.383

1 Site not sampled for water quality or temperature in the 1980s or location moved slightly from original location.

2 Proposed mainstem Susitna River temperature monitoring sites for purposes of 1980s SNTEMP model evaluation.
3 Locations with overlap of water quality temperature monitoring sites with other studies.
Locations in bold font represent that both temperature and water quality samples are collected from a site.

Table 5.6-2. Evaluation of models based on technical, regulatory, and management criteria.

● High Suitability ◐ Medium Suitability ○ Low Suitability

Considerations	Relative Importance	H2OBAL/SNTEMP/ DYRESM	CE QUAL W2	EFDC
Technical Criteria				
Physical Processes:				
• advection, dispersion	High	◐	●	●
• momentum	High	○	●	●
• compatible with external ice simulation models	High	○	●	●
• reservoir operations	High	◐	●	●
• predictive temperature simulation (high latitude shading)	High	◐	●	●
Water Quality:				
• total nutrient concentrations	High	○	●	●
• dissolved/particulate partitioning	Medium	○	●	●
• predictive sediment diagenesis	Medium	○	○	●
• sediment transport	High	○	◐	●
• algae	High	○	●	●
• dissolved oxygen	High	○	●	●
• metals	High	○	◐	●
Temporal Scale and Representation:				
• long term trends and averages	Medium	◐	◐	●
• continuous – ability to predict small time-step variability	High	○	●	●
Spatial Scale and Representation:				
• multi-dimensional representation	High	○	◐	●
• grid complexity - allows predictions at numerous locations throughout model domain	High	○	◐	●
• suitability for local scale analyses, including local discharge evaluation	Medium	○	◐	●
Regulatory Criteria				
Enables comparison to AK criteria	High	○	●	●
Flexibility for analysis of scenarios, including climate change	High	◐	●	●

● High Suitability ◐ Medium Suitability ○ Low Suitability				
Considerations	**Relative Importance**	**H2OBAL/SNTEMP/ DYRESM**	**CE QUAL W2**	**EFDC**
Technically defensible (previous use/validation, thoroughly tested, results in peer-reviewed literature, TMDL studies)	High	◐	●	●
Management Criteria				
Existing model availability	High	●	●	●
Data needs	High	●	●	●
Public domain (non-proprietary)	High	●	●	●
Cost	Medium	●	◐	◐
Time needed for application	Medium	N/A	◐	◐
Licensing participant community familiarity	Low	●	◐	◐
Level of expertise required	Low	●	●	●
User interface	Low	◐	◐	◐
Model documentation	Medium	◐	●	●

5.6.10. Figures

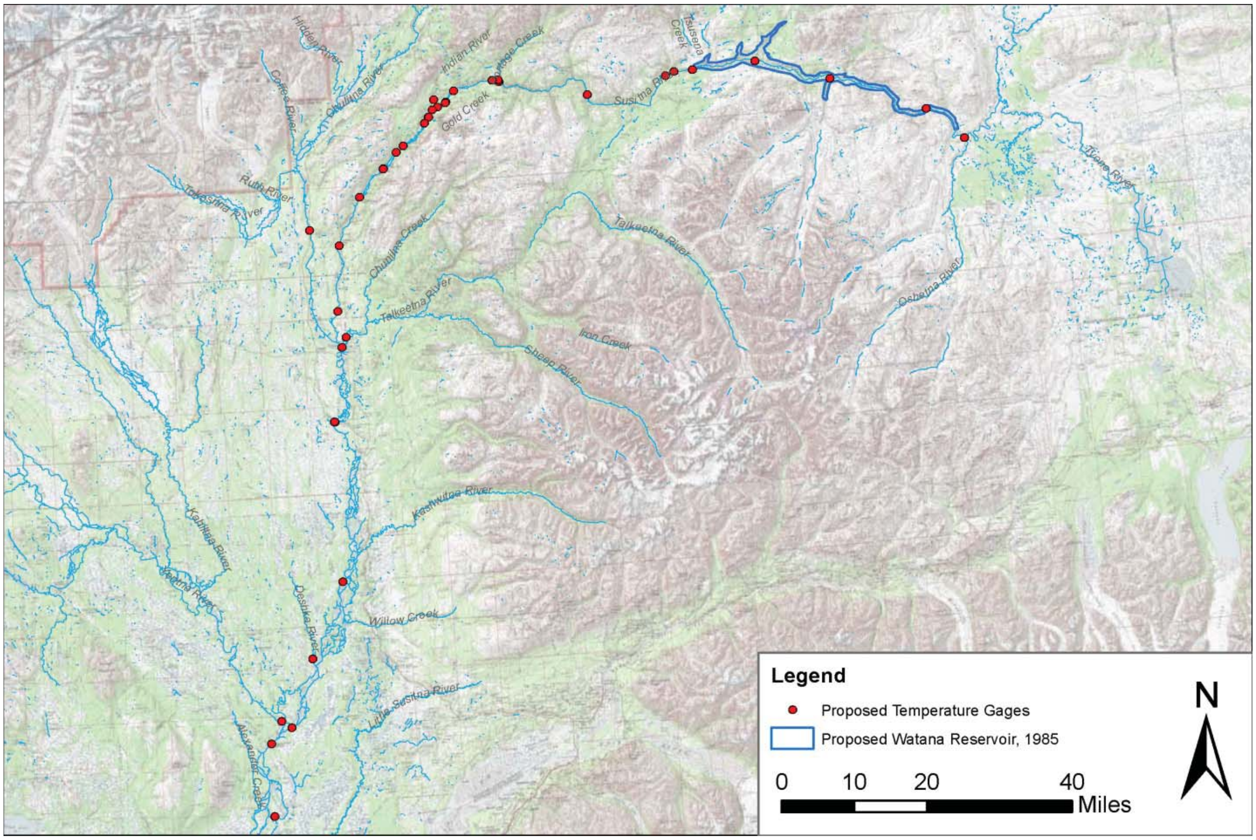

Figure 5.6-1. Proposed 2012 Stream Water Quality and Temperature Data Collection Sites for the Susitna-Watana Hydroelectric Project.

5.7. Groundwater-related Aquatic Habitat Study

5.7.1. General Description of the Proposed Study

5.7.1.1. Study Goals and Objectives

The overall goal of the study is to understand the effects of the Project on groundwater and surface-water (GW/SW) interactions as they relate to habitat for aquatic species (e.g., fish, riparian vegetation) in the Susitna River. The study is designed to be a coordinated effort with other studies to help guide their data collection activities related to GW/SW interpretative goals. Outside of Objective 9 (below), this study itself does not include field activities; it will use existing information and the data collected by other studies to provide an overall understanding of watershed to local scale groundwater processes and GW/SW interactions.

The objectives of the study are as follows:

1. Synthesize historical data available for Susitna River groundwater and groundwater related aquatic habitat, including the 1980s and other studies;
2. Use available information to characterize the large-scale geohydrologic process-domains/terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow ground water aquifers, GW/SW interactions);
3. Assess the effect of Watana Dam/Reservoir on groundwater and groundwater related aquatic habitat in the vicinity of the dam;
4. Map groundwater influenced aquatic habitat (e.g., upwelling areas, springs);
5. Determine the GW/SW relationships of floodplain shallow alluvial aquifers at Riparian Instream Flow study sites;
6. Determine GW/SW relationships of upwelling/downwelling at Instream Flow Study sites in relation to spawning, incubation, and rearing habitat (particularly in the winter);
7. Characterize water quality (e.g., temperature, DO, conductivity, nutrients) of selected upwelling areas where groundwater is a primary determinant of fish habitat (e.g., incubation and rearing in side channels and sloughs, upland sloughs);
8. Characterize the winter flow in the Susitna River and how it relates to GW/SW interactions; and
9. Characterize the relationship between the Susitna River flow regime and shallow groundwater users (e.g., domestic wells).

5.7.2. Existing Information and Need for Additional Information

Various portions of the Susitna Watershed have had different scales of groundwater and GW/SW interaction studies reported. The lower Susitna Watershed is part of the geologic Susitna Basin (Kirschner, 1994) (Figure 5.7.1). This region has generally been referred to as the lower Susitna

River. The major physiographic regions of the Susitna Watershed are described in Wahrhaftig (1994), and include the Alaska Range on northern portion of the watershed which also forms the watershed boundary in the headwaters of the watershed. The Talkeetna Mountains cross the central portion of the watershed and result in physiographic features such as Devils Canyon and Watana Canyon. The Upper Matanuska Valley covers the lower portion of the watershed, which is bounded on the downstream end by Cook Inlet. The watershed scale geology covers a range of highly metamorphic marine sedimentary formations, referred to as Flysch belts (Beikman, 1994) (Figure 5.7.2). There are also younger volcanic deposits in the middle portion of the watershed. The Susitna River flows out of the Talkeetna Mountains in the vicinity of Talkeetna, where it then flows through the Talkeetna sedimentary basin.

Hydropower-related studies in the Susitna Watershed during the 1980s included observations and monitoring of GW/SW interactions. These studies focused on river habitats such as sloughs that were determined to be important fish habitat. A large amount of physical hydrology data (e.g., stage-discharge relationships, main stage versus upwelling discharge, piezometers), water quality data (e.g., temperature), aquatic habitat and other observations were reported for various study sites.

Since the 1980s, various wells have been drilled for domestic water supply, mining exploration, oil and gas exploration and other activities associated with resource development or evaluations in the watershed.

A Groundwater-Related Aquatic Habitat Study is needed because riparian vegetation processes (recruitment, maintenance of existing vegetation) and fish habitat (spawning, incubation, and rearing) in the Susitna River are partially dependent on groundwater levels; GW/SW interactions (upwelling and downwelling), and water quality. In addition, shallow groundwater wells used by residents (e.g., domestic) may also be dependent on Susitna River GW/SW interactions.

The information developed in this study will be used for the affected environment and environmental effects portion (Exhibit E environmental report) of the Project license application and to determine what, if any, protection, mitigation, or enhancement measures may be appropriate for the Project license.

5.7.3. Study Area

The study areas related to groundwater processes primarily cover the Susitna River from the Parks Highway bridge (RM 84, located near USGS Gage on Susitna River at Sunshine) to an area just upstream of the dam (RM 184) for detailed studies. If hydrologic modeling shows the Project impact extends below RM 84, then the study area will be extended downstream to the point the simulation proposed Project operations do not indicate significant variations in hydrologic conditions. The review of background information and large-scale geohydrologic process-domains/terrain of the Susitna River cover the complete Susitna Watershed. This overview at a watershed scale is important for determining the boundary conditions affecting groundwater flow conditions along the river corridor.

5.7.4. Study Methods

The Groundwater Aquatic Habitat Study is divided into nine study components related to the study objectives outlined in Section 5.7.1.1: (1) Existing Data Synthesis, (2) Geohydrologic Process-Domains and Terrain; (3) Watana Dam / Reservoir, (4) Upwelling / Springs Broad-Scale

Mapping, (5) Riparian Vegetation Dependency on GW/SW Interactions; (6) Fish Habitat GW/SW Interactions; (7) Water Quality in Selected Habitats, (8) Winter GW/SW Interactions, and (9) Shallow Groundwater Users. Each of the components and their related study methods are explained further in the following subsections. The methods described represent standard approaches for summarizing data and assessing the physical/biological processes related to groundwater and aquatic habitat.

5.7.4.1. Existing Data Synthesis

Data from prior Susitna River hydroelectric evaluations and other studies will be used to help develop a detailed reference source of available data to support the GW/SW interactions and processes related to potential project operations and design. The addition of the historical data will help provide a more thorough review of the GW/SW interactions and how they may change under the various Project operational designs. The use of existing information will also help meet the need for detailed analysis under the proposed Project timeframe. The specific steps of the data synthesis include;

- Identify existing reports and data from the 1980s licensing effort, prior studies, and more recent studies that relate to GW/SW interactions and related aquatic habitat in the Susitna River.
- Identify applicable geology, soils, and other geohydrologic references for the Susitna Watershed. Information collected by the Geology and Soils Study (Section 4.5.4). Water quality data will be provided by the Baseline Water Quality Study (5.6) for groundwater and surface water. Additional water quality data will be provided by Instream Flow Study historical information reviews.
- Produce searchable and annotated bibliography of references and data sources for use by study teams and resource agencies.
- Synthesize collected references and data with respect to the objectives of this study (e.g., understanding the potential impacts of the Project on GW/SW interactions and aquatic habitat).

5.7.4.2. Geohydrologic Process-Domains and Terrain

Project operations could have impacts along the river from the dam and reservoir location to below the confluences of the Chulitna and Talkeetna Rivers. Site specific studies will help characterize these influences for key aquatic habitat and riparian study areas. The

- Define the significant geohydrologic units in the Susitna Basin that provide groundwater recharge to the mainstem and associated side channels and sloughs. ASTM standard D5979 will be used to help define the geohydrologic units (ASTM, 2008b).
- Relate the geohydrologic units (e.g. bedrock, alluvial) to geomorphologic and riparian mapping units (process-domain river segments) in coordination with the Geomorphology and Instream Riparian Studies (Montgomery, 1999).
- Define the groundwater regional scale to local flow systems in the mainstem reaches and the relationship with the process-domain river segments. Similar studies for the Tanana Watershed have been reported by Anderson, 1970. ASTM standard D6106 will be used to help characterize the groundwater aquifers relevant to Project proposed operations.

- Identify the relationship between the process-domain river segments and the planned intensive study areas to help transfer the analysis of potential Project affects on GW/SW interaction from the individual study areas back to the larger process-domain river segments.

5.7.4.3. Watana Dam/Reservoir

The construction and operations of the dam and supporting infrastructure may influence groundwater conditions downstream of the dam and the characteristics of the discontinuous permafrost conditions in the vicinity of Project operations. Variation in reservoir levels will result in transient head conditions on the upstream side of the dam. Project engineering programs and the Geology and Soils Study (Section 4.5) will provide information to help evaluate the groundwater conditions in the Project area and evaluate the potential for the groundwater impacts downstream of the dam.

- Evaluate engineering geology information from the dam and reservoir area. Information will be used from the Geology and Soils Study (Section 4.5) and past geotechnical studies of the proposed dam location. This will include geologic well logs, pump tests, seismic data if available, permafrost information, water level records.
- Coordinate with the engineering efforts and geomorphology and fluvial geomorphology modeling (Section 5.8, 5.9) studies to utilize existing data-collection programs and evaluate the need for additional data collection in the Project area to evaluate groundwater conditions.
- Describe the pre-Project groundwater conditions at the Watana Dam and Reservoir vicinity.
- Characterize the known permafrost and bedrock hydrogeology at the Watana Dam vicinity.
- Develop conceptual GW/SW models of the pre-Project and post-Project conditions.
- Identify the key potential groundwater pathways for groundwater flow with the Project (e.g., Deadman Creek drainage) and how the proposed dam construction designs will affect groundwater flow.
- Evaluate the potential changes in the groundwater flow system as a result of Project operations.

5.7.4.4. Upwelling / Springs Broad-Scale Mapping

The proposed Project operations could impact ice formation and related GW/SW interactions. Broad-based mapping will be used to understand the pre-Project conditions and GW/SW interaction and relationships along the river corridor. This will help evaluate the potential spatial distribution of propose Project operations. The following methods will be used to map GW/SW interactions and upwelling during winter and summer seasons.

- Aerial and GPS mapping of winter open leads, Spring 2012-Spring 2014 (Ice Processes Study (Section 5.10). Open leads from RM 0 to RM 250 will be mapped aerially or by satellite imagery 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 or from orthophotographs, and the width of each lead will be estimated. Open leads in the Middle River will be compared with the location of open leads documented in 1984-1985 in the Middle River, as appropriate. To provide some context, air temperatures from 1984-1985 will be compared with air temperatures measured during the 2012-2013 and 2013-2014 winter seasons from the closest long term site with data covering both periods. GIS coverages of open leads will be developed. The general focus for ground water studies will cover the portion of the Susitna River from RM 84 (located near USGS Gage on Susitna River at Sunshine) to RM 184 (near the proposed dam location).

- Aerial photography of the ice free period showing turbid and clear water habitat, summer 2012-Summer 2014 (Instream Flow Studies (Section 6.5)). Aerial photography at a range of flows from 5,000 cfs to 23,000 cfs will be collected in the Geomorphology and Instream Flow Studies to map geomorphic change and to document habitat surface area versus discharge. The aerial photography will be used to document turbid and clear water (i.e., groundwater influenced) habitats. Clearwater inflow from side drainages (e.g. Portage Creek), will be separated from those dominated by groundwater recharge (upwelling) to surface-water features.

In a study performed by Harza-Ebasco Susitna Joint Venture (1984) turbidity and concurrent, co-located sediment concentration measurements were collected under various flow conditions at three different locations on the Susitna River (near Cantwell, near Chase, and at Gold Creek). It was found that turbidity was well-correlated with suspended sediment concentration ($r^2 = 0.92$). This suggests the potential Project impacts on turbidity in the Susitna may be assessed by determining potential Project impacts on suspended sediment concentrations.

- Conduct a pilot thermal imaging assessment of a portion of the Susitna River, fall 2012 or during 2013 (Baseline Water Quality Study (Section 5.5). Thermal imagery of a portion of the Susitna River (e.g., 10 miles of the Middle River) will be collected. Data from the thermal imagery will be ground-truthed and the applicability and resolution of the data will be determined in terms of identifying water temperatures and thermal refugia/upwelling. The thermal imaging assessment will build on the similar studies reported in the 80s (Sandone and Estes, 1984) and evaluate the potential applications with current thermal imaging technology. In coordination with the Instream Flow and fish studies, a determination will be made as to whether additional thermal imaging data will be applicable and whether or not additional thermal imaging will be collected to characterize river temperature conditions. If the pilot study is successful, then a description of thermal refugia throughout the project area can be mapped using aerial imagery calibrated with on-the-ground verification.
- Identify potential GW/SW interaction areas based on observations of spawning or rearing fish (Fish Population Studies (Section 7)). Where aggregations of spawning fish or rearing fish are observed from radio telemetry data, sonar, visual spawning surveys, or other sampling (electrofishing, seining) that potentially are related to groundwater upwelling, test whether or not upwelling is present by using temperature profiling techniques (e.g., measuring the vertical temperature profile or measuring the temperature along the bottom of the river along a transect).
- Characterize the identified upwelling/spring areas at a reconnaissance level whether the identified upwelling/spring areas using the methods outlined above are likely either to be

(1) main flow/stage dependent, (2) regional/upland groundwater dependent, or (3) mixed influence.

5.7.4.5. Riparian Vegetation Dependency on Surface-Water / Groundwater Interactions

Coordinate project activities with the Ice Processes (Section 5.10), Geomorphology (Section 5.8), Riparian (Section 9.6), and Instream Flow studies (Section 6). The work under this objective will be accomplished by the Riparian Instream Flow Study (Section 6.6).

- Select representative intensive riparian vegetation study reaches suitable for the overlapping needs of the Ice Processes, Water Quality, Geomorphology, Botanical Riparian, and Instream Flow GW/SW studies. For example, the riparian instream flow, aquatic instream flow and water quality studies all need quantitative information regarding the relationship between river stage, upwelling areas and floodplain shallow aquifer groundwater levels. Field sampling GW/SW designs will be coordinated to accommodate the various study objectives.
- Develop physical modeling studies of select intensive study reaches representative of Susitna Project Area riverine process-domains (Montgomery 1999). Physical models, including surface-water hydraulic (1-D and 2-D), geomorphic reach analyses, GW/SW interactions, and ice processes will be integrated such that physical process controls of riparian vegetation recruitment and establishment may be quantitatively assessed under both existing conditions and dam operation flow regimes.
- Collect empirical data related to GW/SW interactions (e.g., piezometers, water levels, water temperature and conductivity, tracer studies). GW/SW interaction data will be collected at the intensive study reaches utilizing multiple transects of arrays of groundwater wells, piezometers and stage gages. Additional information, such as unfrozen volumetric soil-moisture content and soil temperature profiles will be measured to help understand the characteristics of active freeze/thaw processes and moisture transfer from infiltration and underlying dynamic groundwater tables in the soil horizon critical to riparian root zones. The GW/SW data will be used to quantify, and model, the relationship between floodplain shallow surface aquifers and floodplain plant community types.
- Where appropriate, develop MODFLOW (USGS 2005 and USGS 2012) GW/SW interaction models of floodplain shallow alluvial aquifer and surface-water relationships. MODFLOW GW/SW interaction models will be used to model GW/SW relationships using empirical monitoring data collected at intensive study reach GW/SW monitoring stations. Similar approaches to understanding GW/SW interactions have been reported in Nakanishi and Lilly, 1998. ASTM standard D6170 will also be used to help determine the model code and approach used for analysis (ASTM, 2008b). ASTM standard D5981 will be used to help develop calibration goals and procedures for groundwater modeling efforts (ASTM, 2008c). Predictive models of groundwater response to dam operational flow regime will be developed from the empirically developed models.
- Collect field data on riparian plant communities in coordination with Botanical Riparian Studies. Riparian floodplain plant community characterization and mapping at each

intensive study reach will overlap in design with the Botanical Riparian Survey of the entire project study area. Some additional more intensive riparian plant community measurements concerning dendrochronology, soils and effective plant community rooting zones will be done in support of the riparian vegetation GW/SW interaction analyses. Riparian plant community characterization will follow the Botanical Riparian survey methods utilizing an Integrated Terrain Unit (ITU) approach (Jorgenson et. al. 2003) for mapping riparian habitats to Level IV of the Alaska Vegetation Classification (Viereck et al. 1992).

- Develop integrated physical process and plant succession models in coordination with the Instream Flow, Geomorphology, Ice Processes and Botanical Riparian Study Teams. The riparian vegetation GW/SW interactions study approach and design will be integrated with the findings of the riparian plant community succession and geomorphology, ice processes physical processes modeling to characterize physical processes and riparian plant community relationships. The results of these studies will be used to assess (1) changes to physical processes due to dam operations, and (2) response of riparian plant communities to operations alterations of natural flow and ice processes regimes.

5.7.4.6. Aquatic Habitat Groundwater / Surface-Water Interactions

Coordinate project activities related to fish habitat with the Ice Processes, Instream Flow Riparian Study, Geomorphology Studies and Water Quality Study. The work under this objective will be accomplished by the Instream Flow Study. GW/SW interactions have been shown to strongly influence salmonid habitat use and biological functions including selection of spawning and rearing habitats, as well as egg/alevin survival. Understanding these interactions relative to fish will require close coordination with other studies focused on riverine processes that are likewise influenced by these interactions. The Instream Flow Program Lead and the Groundwater Aquatics Study Lead will work closely with other study leads (Fisheries, Ice, Geomorphology, Water Quality) to ensure the groundwater studies are fully integrated.

- Habitat mapping that incorporates groundwater affected aquatic habitat. This work will expand on the results of the Upwelling/Springs Broad-Scale Mapping (Section 5.7.4.4) and will provide a more intensive evaluation of specific study sites identified as exhibiting GW/SW interactions. Selection of sites will be based in part on results of the upwelling/springs mapping tasks as well as results of previous investigations (e.g., 1980s studies) of certain sites that have indicated a groundwater influence. Study sites will be selected that are representative of different types of GW/SW /hyporheic flow connections including main and side channel (side slough) head, floodplain groundwater lateral flow, and direct groundwater upwelling. Sites will include those known (based on 1980s studies) to be used by fish, and to the extent identifiable, sites that exhibit groundwater influence but are not extensively used by fish. Consideration will also be given to completion of egg survival studies as a means to compare egg survival at these different locations. These studies will allow for a comparative assessment of groundwater related parameters and surface-flow linkages that are influencing fish use and will be important for characterizing other sites and expanding results from measured to unmeasured areas. A variety of techniques will be considered for implementation at each site with the final determination based on site specific characteristics. These will include installation of pressure transducers (mainstem – side channel – side slough – other) to assess linkages of surface flow to other habitats and potential groundwater influence, installation of piezometers to monitor/map GW/SW upwelling areas, installation of Mark VI standpipes to monitor hyporheic water quality (temperature and dissolved oxygen concentration), dye injection to trace surface-hyporheic flow paths, handheld Thermal Infrared Imaging (TIR), thermal profiling (including installation of a spatial array of temperature monitors at surface and subsurface points), and others. The selection will be made collaboratively with the Geomorphology, Riparian, Water Quality and Fisheries study leads.

- Hydraulic unsteady flow routing to identify water-surface elevations. As noted in Figure 6.5-3 in Section 6.5, the mainstem flow routing model will serve to predict water-surface elevations under different flow conditions longitudinally throughout the length of the river below the Watana Dam site (RM 184). The model will thus be able to predict water surface elevations (WSEs) proximal to the intensive study sites noted above, as well as other areas identified as being groundwater influenced. The WSEs empirically measured in side channels, sloughs and groundwater wells installed in the floodplain at the intensive study sites can therefore be related to mainstem WSEs allowing for a detailed analysis of spatial and temporal changes in WSE under different operating conditions, including base load and load following scenarios.
- HSC and HSI development that includes groundwater related parameters (upwelling / downwelling). Development of HSC and HSI will follow the general procedures outlined in the Instream Flow Study as noted under Section 6.5.4.4.1. Parameters specific to groundwater that will be measured where appropriate include turbidity, evidence of upwelling/downwelling currents, substrate characteristics, and water temperature. Other parameters may also be included. These parameters will be incorporated into the development of HSC type curves that reflect utilization of these parameters by fish. This work will be closely coordinated with the Fish Studies (Section 7).
- Develop mainstem, side channel, slough habitat models that incorporate GW/SW related processes (main channel head, upwelling / downwelling) (Figure 6.5-2). An integral part of the SWIFS will be development of habitat-specific models that can be used in evaluating flow (and WSE) relationships between the mainstem river and other habitat types (including those influenced by groundwater), under different operational scenarios. These types of models (e.g., flow routing) are generally described in more detail in the Instream Flow Study (Section 6.5).

5.7.4.7. Water Quality in Selected Habitats

Water-quality characteristics are likely to vary with GW/SW interactions and potential impacts due to proposed Project operations. Coordinate project water-quality activities with the Instream Flow Riparian Study (Section 6.6), Geomorphology Studies (Section 5.8, 5.9) and Instream Flow Studies (Section 6.5). The work under this objective will be accomplished by the Baseline Water Quality Study (Section 5.5). The following methods will be used in coordination with the indicated studies to understand water quality characteristics and the variation between groundwater and surface water. This will help evaluate the potential changes in water quality related to GW/SW interactions and potential impacts related to proposed Project operations.

- At selected instream flow, fish population, and riparian study sites collect basic water chemistry (temperature, DO, conductivity, pH, turbidity, redox potential) that define habitat conditions and characterize GW/SW interactions (Section 5.5). For example, where possible, characterize differences between groundwater representative of regional groundwater conditions, groundwater in the mixing zone at the GW/SW interface (slough or river bed), and surface-water sources (sloughs and side channels).
- Characterize the water quality differences between a set of key productive aquatic habitat types (3-5 sites) and a set of non-productive habitat types (3-5 sites) that are related to the absence or presence of groundwater upwelling to improve the understanding of the water-quality differences and related GW/SW processes. For example, use the Fish Population Study (Sections 7.5, 7.6, 7.9) results and coordinate with the Instream Flow Study (Section 6.5) to select paired productive and non-productive habitats (also see the second bullet in this section).

5.7.4.8. Winter Groundwater / Surface-Water Interactions

Winter GW/SW interactions are critical to aquatic habitat functions. Proposed Project operations will have an impact on the winter flow conditions of the mainstem and side channels and sloughs. The collection of hydrologic conditions (i.e. water levels, discharge, ice conditions) is critical to understanding current winter flow conditions and evaluating the potential impacts of Project operations. The following methods will be used to help measure and evaluate winter flow conditions and associated GW/SW interactions.

- Measure water levels/pressure at the continuous gaging stations on the Susitna River during winter flow periods. Continuous gaging stations will be measuring water levels and temperature as part of the Instream Flow studies taking place. Water levels measured during full ice cover are generally referred to as water pressure and represent the hydrostatic head of the river. The Project is expected to increase average monthly flows in the Susitna River during the winter months, and this may have an impact on GW/SW interactions during that season.
- Measure winter discharge measurements to help identify key sections of the mainstem with groundwater baseflow recharge to the river (upwelling). Winter discharge will be measured as part of the Instream Flow (Section 6) studies and in coordination with USGS winter measurement efforts at USGS gaging stations to identify winter gaining and losing reaches. These field activities will be closely coordinated with the Ice Process studies (Section 5.10).
- In key study areas, measure channel/slough temperature profiles to help characterize the GW/SW interactions and temporal variations over the winter flow season.

5.7.4.9. Shallow Groundwater Users

There are a number of groundwater wells located in the Susitna River floodplain, which have demonstrated the interconnections between groundwater and surface water. The influence of proposed Project operations could change water levels and water quality water supply wells. A majority of the wells are expected to be private homeowner wells. The below methods will be used to evaluate the potential impacts of the Project on water supply wells in the area under potential impact by the Project.

- Use the Alaska Department of Natural Resources Well Log Tracking System (WELTS) and the USGS Groundwater Site Inventory (GWSI) Database to map domestic and other water-supply wells along the Susitna River downstream of the proposed Watana Reservoir.
- At a reconnaissance level stratify the wells by potential to be affected by the Susitna River flow regime (high, medium, and low) using factors such as depth and proximity to the Susitna River. Select a small number of representative wells with high potential to be affected by the Susitna River flow regime and monitor well levels and river stage. River stage information will come from correlations with the gaging stations measuring water levels that are part of the Instream Flow studies.
- Based on the results from the well monitoring and an analysis of potential Project operations flow data, determine the potential effects of the Project on shallow groundwater wells and determine if additional monitoring of wells may be appropriate. ASTM method D6030 will be used to help address groundwater vulnerability (ASTM 2008).

5.7.5. Consistency with Generally Accepted Scientific Practice

The proposed study methodology was cooperatively developed with the assistance of science and technical experts from state and federal management agencies. The methods for data collection, data analysis, modeling, and interpretation are consistent with common scientific and professional practices. ASTM and USGS standards and practices will be used with each study component as applicable. Many of these technical experts have experience in multiple FERC licensing and relicensing proceedings. The scope of each of the studies is consistent with common approaches used for other FERC proceedings and reference specific protocols and survey methodologies, as appropriate.

5.7.6. Schedule

The groundwater study will occur in 2013 and 2014 study period. Coordination with other study groups will occur throughout the project period. The collection of information for the existing data synthesis will be initiated at the beginning of the study period and be completed by the end of summer 2013. The definition and development of geohydrologic process domains and terrains will take place in the same time period, to help guide other study design and field efforts during the summer of 2013.

Winter focus studies will begin with existing data collections activities started in 2012 and increase with the installation of data collection systems in study sites in early summer 2013. Data from water quality, instream flow and other studies will be provided after data quality assurance have been completed, normally within a month of data collection in the field. Coordination with each of the associated studies providing data will occur at the beginning of the study period and be part of the schedules for each study. Final study reporting will be complete in October 2014. The Initial Study Report will be issued in December, 2013 and the Updated Study Report will be issued in December, 2014.

5.7.7. Level of Effort and Cost

The level of effort for the groundwater study objectives is primarily distributed in other studies. The groundwater study costs reflect the analysis of data collected in other studies. The study objectives and associated primary costs associated with each objective for the 2013-14 study period are:

- 5.7.4.1 - Existing Data Synthesis
  - Groundwater Study
- 5.7.4.2 - Geohydrologic Process-Domains and Terrain
  - Groundwater Study
- 5.7.4.3 - Watana Dam / Reservoir
  - Groundwater Study–analysis only
  - Engineering, Geology (Section 4.5), Geomorphology (Section 5.8, 5.9) studies include field and data collection costs
- 5.7.4.4 - Upwelling / Springs Broad-Scale Mapping
  - Groundwater Study–analysis only
  - Ice Processes (Section 5.10), Geomorphology (Section 5.8, 5.9), Instream Flow (Section 6), Water Quality (Section 5.5, 5.6) studies include field and data collection costs
- 5.7.4.5 - Riparian Vegetation Dependency on Groundwater / Surface-Water Interactions
  - Groundwater Study–coordination and analysis only
  - Riparian Instream Study (Section 6.6) includes field and data collection costs
- 5.7.4.6 - Fish Habitat Groundwater / Surface-Water Interactions
  - Groundwater Study –coordination and analysis only
  - Instream Flow Study (Section 6) includes field and data collection costs
- 5.7.4.7 - Water Quality in Selected Habitats
  - Groundwater Study–coordination and analysis only
  - Water Quality (Section 5.5, 5.6), Instream Flow (Section 6) studies include field and data collection costs
- 5.7.4.8 - Winter Groundwater / Surface-Water Interactions
  - Groundwater Study–coordination and analysis only
  - Instream Flow Study (Section 6) includes field and data collection costs
- 5.7.4.9 - Shallow Groundwater Users
  - Groundwater Study

The groundwater study costs are estimated to be $500,000 to $850,000 beyond the data collection costs allocated throughout the studies mentioned above.

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5.7.9. Figures

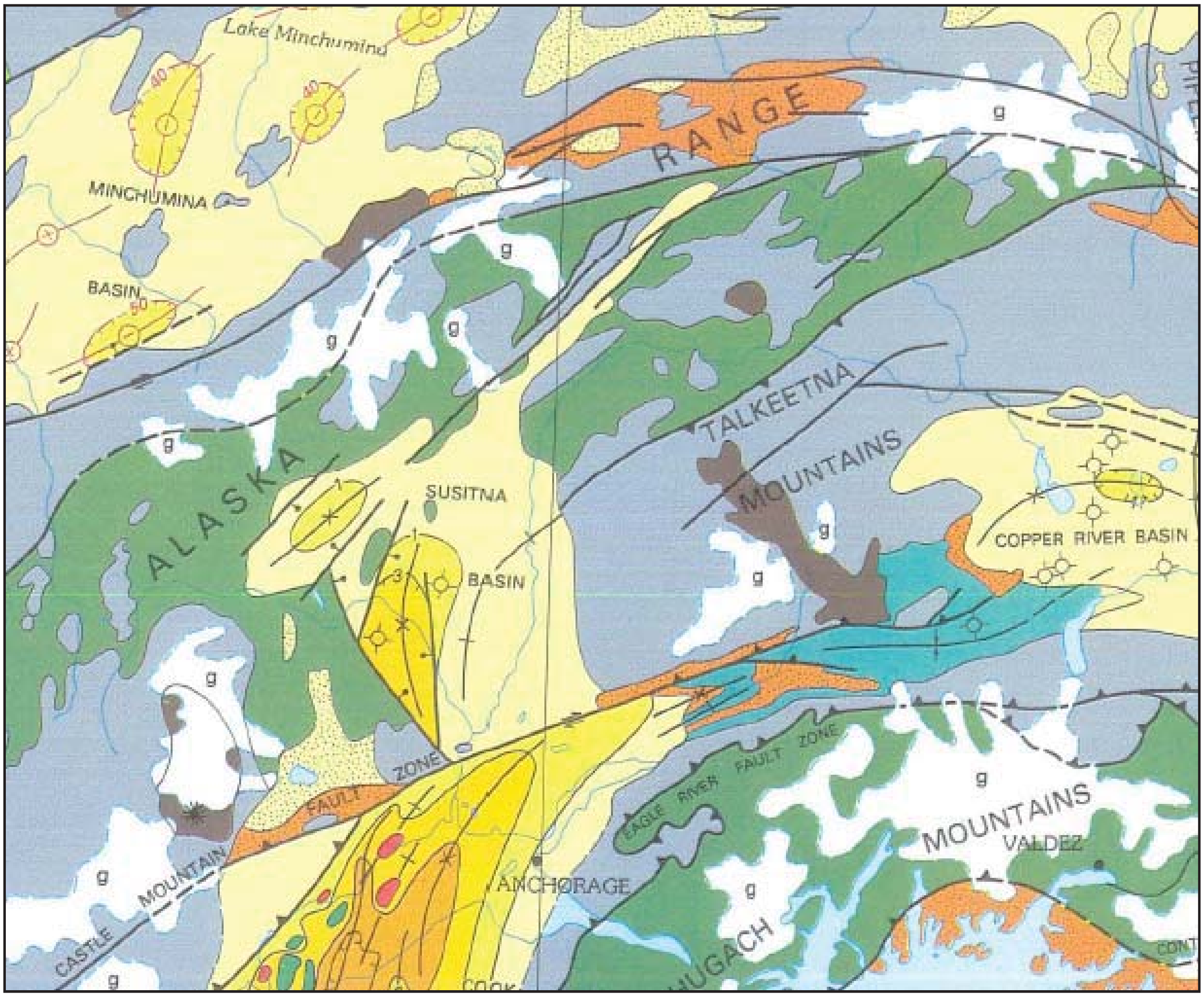

Figure 5.7-1. Sedimentary basins and geologic structure in Susitna Watershed (modified from Kirschner 1994).

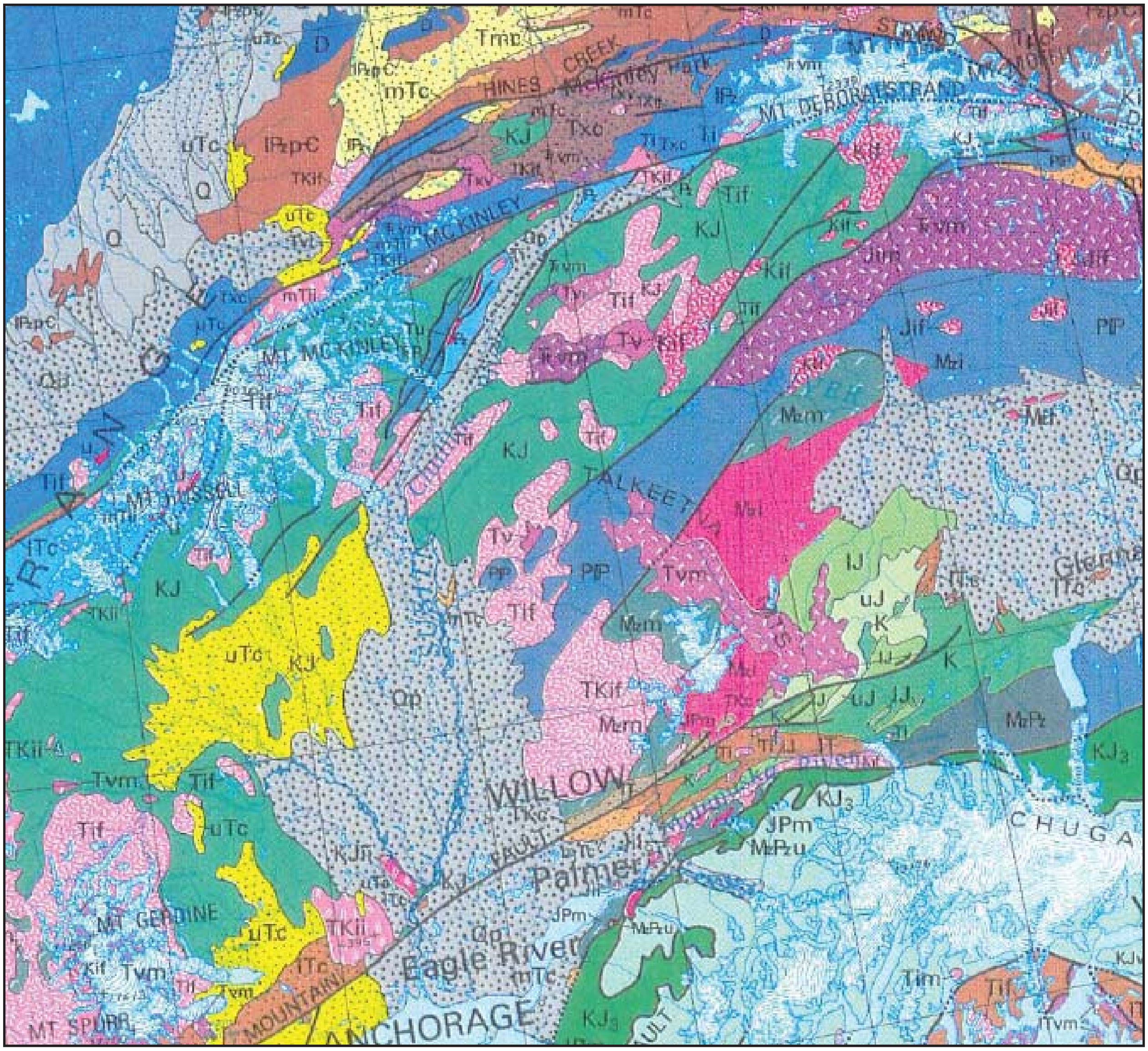

Figure 5.7-2. Geologic units in Susitna Watershed (modified from Beikman 1994).

5.8. Geomorphology Study

5.8.1. General Description of the Proposed Study

5.8.1.1. Study Goals and Objectives

The overall goal of the Geomorphology Study is to evaluate the effects of the Project on the geomorphology and dynamics of the Susitna River, which in turn will inform the analysis of potential project-induced impacts to channel formation processes and aquatic habitats. The results of this study, along with results of the Fluvial Geomorphology Study below Susitna-Watana Dam, will be used in combination with geomorphic principles and criteria/thresholds defining probable channel forms to predict the potential for alteration of channel morphology from Project operation. This information will be used to determine whether mitigation measures may be needed and, if so what those measures may be.

Specific objectives of this study can be summarized as follows:

- Determine how the river system functions under existing conditions
- Determine how the current system forms and maintains a range of aquatic and channel margin habitats
- Identify the magnitudes of changes in the controlling variables and how these will affect existing channel morphology in the identified reaches downstream of the dam, and
- Determine the likely changes to existing habitats through time and space

In order to achieve the study objectives the following analyses are required:

- Geomorphically characterize the Project-affected river channels
- Collect sediment transport data to supplement historical data to support the characterization of Susitna River sediment supply and transport (to be performed by USGS);
- Empirically characterize Susitna River sediment supply and transport conditions;
- Assess channel and study site stability/change (1980s versus current conditions);
- Characterize the surface area versus flow relationships for riverine habitat types over a range of flows (e.g., 5,100 to 23,000 cubic feet per second [cfs]) in the Middle River;
- Conduct a reconnaissance level geomorphic assessment of potential Project effects on the Lower River channel;
- Conduct a reconnaissance level riverine habitat assessment of potential Project effects on the Lower River channel;
- Characterize the proposed Watana Reservoir geomorphology (changes resulting from conversion of the channel/valley to a reservoir);
- Assess potential issues related to large woody debris transport and recruitment; and

- Characterize geomorphic conditions at stream crossings along access road/transmission line alignments.

5.8.2. Existing Information and Need for Additional Information

An analysis of the Middle Susitna River reach geomorphology and how aquatic habitat conditions change over a range of stream flows was performed in the 1980s using aerial photographic analysis (Trihey & Associates 1985). The AEA Susitna Water Quality and Sediment Transport Data Gap Analysis Report (URS 2011) states that "if additional information is collected, the existing information could provide a reference for evaluating temporal and spatial changes within the various reaches of the Susitna River." The gap analysis emphasizes that it is important to determine if the conditions represented by the data collected in the 1980s are still representative of current conditions and that at least a baseline comparison of current and 1980s-era morphological characteristics in each of the identified sub-reaches is required.

An analysis of the Lower River reach and how riverine habitat conditions change over a range of stream flows was performed in the 1980s using aerial photographic analysis (R&M Consultants Inc. and Trihey and Associates 1985a). This study evaluated the response of riverine aquatic habitat to flows in the Lower River reach between the Yentna River confluence (RM 28.5) and Talkeetna (RM 98) (measured at Sunshine gage near RM 84) ranging from 13,900 cfs to 75,200 cfs. The study also included an evaluation of the morphologic stability of islands and side channels by comparing aerial photography between 1951 and 1983. As with the Middle River information, it is important to determine if the conditions represented by the 1980s data are representative of current conditions. Such a comparison should include not only an identification of change, but should consider if the relative proportions of the various meso-habitat types have remained constant within a reach. If the relative proportions of the various meso-habitat types have remained constant in the various reaches, it provides a reasonable basis for using the 1980's data.

Considerable information is available from a variety of sources that will support the development and execution of the Geomorphology Study. Much of the available information is from the 1980s studies associated with the earlier efforts to develop the Susitna Hydroelectric Project (FERC No. 7114). In some cases, the older information will need to be replaced or supplemented with newer information as the Susitna River is a dynamic system and historical data such as cross sections and aerial images in many areas will likely have changed considerably since they were collected in the 1980s. However, when compared with current information, these data provide valuable tools to understand the behavior and physical processes driving the geomorphology of the Susitna River. Comparability of the two sets of data will indicate that the fundamental relationships between channel form and fluvial process have remained constant and thus provide a basis for using the historical data. Additional data and analyses are needed to determine if historical data can be used to reflect current conditions and to address some of the data gaps identified for AEA Susitna Water Quality and Sediment Transport Data Gaps Analysis Report (URS 2011). A more specific description of existing information and the need for additional information for each geomorphology study component are provided in the appropriate sections below.

5.8.3. Study Area

The study area for the Geomorphology Study is the Susitna River from its confluence with the Maclaren River (RM 260) downstream to the mouth at Cook Inlet (RM 0). The study area has been divided into three large-scale reaches:

- Upper River: Maclaren River confluence (RM 260) downstream to the proposed Watana Dam site (RM 184).
- Middle River: Proposed Watana Dam site (RM 184) downstream to the three rivers confluence (RM 98.5).
- Lower River: Three rivers confluence (RM 98.5) downstream to Cook Inlet (RM 0).

Each of the 10 study components that make up the Geomorphology Study has a component-specific study area often related to the three large-scale reaches identified above. The study area and the reaches are shown on Figure 5.8-1. Identification of the study area that each study component addresses is provided in the discussion of each study component in Section 5.8.4, Study Methods.

5.8.4. Study Methods

The methods for each of the 10 Geomorphology Study components are presented in this section.

5.8.4.1. Study Component 1: Delineate Geomorphically Similar (Homogeneous) River Segments

The goal of the Delineate Geomorphically Similar (Homogeneous) River Segments study component is to geomorphically characterize the Project-affected river channels. This effort is being performed as part of the 2012 studies and is also described in the study plan for Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography. The study area is the length of the Susitna River from its mouth at Cook Inlet (RM 0), upstream to the proposed Watana Dam site (RM 184), and upstream of the proposed Watana Dam site, including the reservoir inundation zone and on upstream to the Maclaren River confluence. The tributary mouths along the Susitna River and in the reservoir inundation zone that may be affected by the Project are also included in the study area.

5.8.4.1.1. Existing Information and Need for Additional Information

This effort will support the understanding of the conditions in the Susitna River by applying a geomorphic classification system based on form and process. It will also support efforts by other studies, including the Instream Flow, Instream Flow Riparian, Fish and Ice Processes studies by providing a basis to stratify the river into reaches based on current morphology and their potential sensitivity to the Project. A delineation of the Susitna River into reaches was performed in the 1980s for the Middle River (Trihey & Associates 1985) and the Lower River (R&M Consultants, Inc. and Trihey & Associates 1985a).

5.8.4.1.2. Methods

This effort consists of identification of a geomorphic classification systems and conducting the delineation of geomorphic reaches based on the identified classification system.

5.8.4.1.2.1. Identification and Development of Geomorphic Classification System

The first step in the geomorphic reach delineation effort will be the identification of the system to be used to classify and delineate the reaches. Classification of the river segments is required to provide a basis for communication among the various disciplines and for identifying relatively homogeneous river segments that can then be used as a basis for extrapolation of results and findings from more spatially-limited studies. Numerous river classifications exist (Leopold and Wolman 1957, Schumm 1963 and 1968 Mollard 1973, Kellerhals et al. 1976, Brice 1981, Mosley 1987, Rosgen 1994 and 1996, Thorne 1997, Montgomery and Buffington 1997, Vandenberghe 2001), but no single classification has been developed that meets the needs of all investigators. Several factors have prevented the achievement of an ideal geomorphic stream classification, and foremost among these has been the variability and complexity of rivers and streams (Mosley 1987, Juracek and Fitzpatrick 2003). Problems associated with the use of existing morphology as a basis for extrapolation (Schumm 1991) further complicates the ability to develop a robust classification (Juracek and Fitzpatrick 2003). For purposes of classifying the Susitna River, available classification systems will be reviewed, and it is anticipated that a specific system will be developed that borrows elements from several classifications systems. The classification scheme will consider both form and process. Development of this system will be coordinated with the Instream Flow, Instream Flow Riparian, Ice Processes, and Fish studies so it is consistent with their needs. These studies may require further stratification to identify specific conditions of importance to their efforts, in which case, these studies will further divide the river into subreaches. However, the overall reach delineations developed in the Geomorphology Study will be used consistently across all studies requiring geomorphic reach delineations.

5.8.4.1.2.2. Geomorphic Reach Delineation

The Lower River (RM 0 to RM 98), the Middle River (RM 98 to RM 184), and the Upper River to the Maclaren River confluence (RM 184 to RM 260) will be delineated into large-scale geomorphic river segments (a few to many miles) with relatively homogeneous characteristics, including channel width, entrenchment, ratio, sinuosity, slope, geology/bed material, single/multiple channel, braiding index, and hydrology (inflow from major tributaries) for the purposes of stratifying the river into study segments. Stratification of the river into relatively homogeneous segments will permit extrapolation of the results of sampled data at representative sites within the individual segments.

Because there are several studies that required a reach delineation for planning 2012 field activities, an initial delineation primarily based on readily available information (most recent high quality aerials, bed profile from the 1980s, geomorphic descriptions from the 1980s) was developed in April 2012. As additional information is developed, such as current aerial photographs and transects, the delineation will be refined and the various morphometric parameters will be included in the delineation. Coordination with the River Flow Routing Model Transect Data Collection Study will be conducted to obtain cross-section channel/floodplain data. Coordination with the Instream Flow Study, Instream Flow Riparian Study, Geomorphic Modeling Study, and Ice Processes Study will be conducted to ensure that the river stratification is conducted at a scale appropriate for those studies.

A reconnaissance-level site visit of the Susitna River will be conducted that will be coordinated with other studies to take advantage of scheduled boat and helicopter trips as well as opportunities to coordinate with other studies. The Study Lead, Geomorphology Lead and Sediment Transport Modeling Lead, the erosion Study Lead, and at least one other senior member of the Geomorphology Study team will participate in the reconnaissance trip. They will be joined by representatives from the Instream Flow Study, Instream Flow Riparian Study, Ice Processes Study, and Fish Study. The purpose of this site visit will be to provide key team members an overview of the river system. This will be extremely useful for all the Geomorphology Study components since it will permit team members to verify on the ground assessments that have been made from remotely sensed information.

5.8.4.1.2.3. Information Required

The following available existing information will be needed to conduct this study:

- Historical aerial photographs,
- Information on bed material size,
- Location and extent of lateral and vertical geologic controls,
- Drainage areas of major tributaries, and
- Topographic mapping, including USGS survey quadrangle maps and LiDAR.

The following additional information will need to be obtained to conduct this study:

- Current high resolution aerial photography,
- Field observations made during a site reconnaissance,
- Extended flow record for the Susitna River and tributaries being developed by USGS, and
- Profile of the river (thalweg or water surface).

5.8.4.1.3. Study Products

The results of the Delineate Geomorphically Similar River Segments study component will be included in the Geomorphology Report. Information provided will include

- A geomorphic classification system developed specifically for the Susitna River that considers both form and physical processes.
- A delineation of the Susitna River into reaches of similar geomorphic characteristics, which has been coordinated with other relevant studies (Instream Flow, Riparian Instream Flow, Ice Processes, and Fish studies). The delineation will include broad large-scale reaches and further delineation into sub-reaches.

- Tables of morphometric parameters describing the physical characteristics of each sub-reach developed from the analysis of aerial photographs, LiDAR, bed profiles, bed material samples, geologic mapping, and transect surveys.

In addition, an ArcGIS shapefile will be provided with the following information:

- Mapping of the large-scale reaches and sub-reaches overlaid on recent aerial photography and topographic mapping.

5.8.4.2. Study Components 2: Bedload and Suspended Load Data Collection at Tsusena Creek, Gold Creek, and Sunshine Gage Stations on the Susitna River and Chulitna River near Talkeetna

The goal of the Bedload and Suspended Load Data Collection at Tsusena Creek (RM 182), Gold Creek (RM 136), and Sunshine gage (RM 84) stations on the Susitna River and the Chulitna River near Talkeetna study component is to empirically characterize the Susitna River sediment supply and transport conditions. This effort is being performed by USGS. The effort described is for 2012 and may be modified in subsequent years based on experience gained from the 2012 work. The study covers the Susitna River from RM 84 (Sunshine Station) upstream to RM 182 (Tsusena Gage) and the Chulitna River near its confluence with the Susitna River. Figure 5.8-2 identifies the location of the study gages and other existing and historical USGS gages in the Susitna River basin.

5.8.4.2.1. Existing Information and Need for Additional Information

The collection of the data described in this study will supplement sediment transport data collected in the 1980s. The additional data are needed to determine if historical data can be used to reflect current conditions or if there have been shifts in the rating curves that might be related to climate change, glacial surges or other as yet unidentified causes and to address some of the data gaps identified in the Susitna Water Quality and Sediment Transport Data Gaps Analysis Report (URS 2011).

This study will provide information on current transport conditions and support assessment of Project effects on sediment supply. Sediment data derived from the gages will be used to provide sediment inputs at model boundaries. This information will be used by several study components in this study as well as the Fluvial Geomorphology Modeling below Watana Dam Study.

5.8.4.2.2. Methods

The following scope of work was provided by USGS:

- Operate and maintain the stream gages;
- Maintain datum at the site;
- Record stage data every 15 minutes;
- Make discharge measurements during visits to maintain the stage-discharge rating curve and to define the winter hydrograph;
- Store the data in USGS databases;

- Collect at least five suspended sediment samples at Susitna River above Tsusena Creek, at Gold Creek, and at Sunshine; and the Chulitna River near Talkeetna during the year for concentration and size analysis;
- Collect at least five bed material samples during the year at Susitna River above Tsusena Creek, at Gold Creek, and at Sunshine; and the Chulitna River near Talkeetna for bedload transport determination and size analysis;
- Collect at least five bedload samples during the year at Susitna River at Gold Creek, Susitna River at Sunshine, Susitna River above Tsusena Creek, and the Chulitna River near Talkeetna for bedload transport determination and size analysis;
- Operate and maintain the stream gages at the Susitna River near Denali and the Chulitna River near Talkeetna;
- Operate a stage-only gage at a site upstream from Deadman Creek. Logistics at this site may preclude continuous operation or telemetry of the information; and
- Compilation of suspended and bedload data, including calculation of sediment transport ratings and daily loads, in a technical memorandum delivered to AEA during federal fiscal year (FFY) 2013, and as early as March 2013, if possible. Provisional results from sampling will be available as soon as lab data are available. Provisional results from sediment load computations will be made available as soon as possible.

The bed load and suspended sediment data will be combined with existing rating curves to identify the differences and similarities between the historical and current data sets. This information will be used to evaluate whether the historical data sets are representative of current conditions in the Susitna River at Gold Creek and the Susitna River at Sunshine.

The sediment transport data available for the Chulitna and Talkeetna rivers will be reviewed. This will be accomplished using the sampling results collected in 2012 to help determine whether or not the historical rating curves are expected to be accurate. Because current data are not being collected on the Chulitna and Talkeetna rivers, this will primarily be accomplished by developing the mass balance of sediment above (Gold Creek data) and below (Sunshine data) three rivers to estimate the contributions from the Chulitna and Talkeetna rivers. The estimate based on the mass balance developed from the current data will be compared against estimates based on the historical Chulitna and Talkeetna sediment transport relationships. In addition, the historical Chulitna and Talkeetna sediment transport relationships and their applicability to current conditions will secondarily be evaluated comparing the historical versus new sediment rating curves at Gold Creek and at Sunshine (two locations where new data are being collected in 2012). Based on the results of the effort, a recommendation on whether or not additional sediment transport sampling is necessary in the Chulitna or Talkeetna rivers will be made.

5.8.4.2.3. Study Products

The results of the Bedload and Suspended Load Data Collection at Tsusena Creek, Gold Creek, and Sunshine gage stations study component will be included in the Geomorphology Report. Information provided will include:

- Calculation of discharge, suspended sediment discharge, and bedload discharge;

- Tabulation of all discharge, suspended sediment, bedload, and bed material sampling results;
- Data sheets reflecting field measurements;
- Comparison of historical and 2012 sediment transport measurements to determine if historical sediment transport rating curves can be expected to accurately represent current conditions;
- Narrative on data collection activities including description of methods, any difficulties encountered, and recommendations for potential future data collection in 2013;
- Posting of near real-time stage and discharge data on the USGS website; http://waterdata.usgs.gov/ak/nwis/; and
- Publication of the data in the USGS's annual Water-Resources Data for the United States report (http://wdr.water.usgs.gov/).

In addition, an ArcGIS Shapefile will be provided with the following information:

- Location of gage stations and measurement transects (if different from gage location).

5.8.4.3. Study Component 3: Sediment Supply and Transport Middle and Lower River

The objective of this task is to empirically characterize the sediment supply and transport conditions in the Susitna River between the proposed Watana Dam site (RM 184) and the Susitna Station Gage (RM 28). The Three Rivers Confluence (RM 98) separates the Middle River from the Lower River. The estimates for the Lower River Sediment Balance will be developed in 2012 as part of the Reconnaissance Level Geomorphic and Aquatic Habitat Assessment of Project Effects on Lower River Channel. The remaining efforts, which include Middle River Sediment Balance, Bed Material Mobilization, and Effective Discharge, will be conducted in 2013.

5.8.4.3.1. Existing Information and Need for Additional Information

Sediment transport data are available along the mainstem Susitna River and several of the major tributaries between the proposed Watana Dam site (RM 184) downstream to Susitna Station (RM 28) (URS 2011). The Project will reduce sediment supply to the reach of the Susitna River downstream from the dam, and will also alter the timing and magnitude of the flows that transport the sediment. Information provided in the Pre-Application Document (AEA 2011) suggests that peak flows may be reduced in magnitude and may occur later in the season. The results of this study component will provide the initial basis for assessing the potential for changes to the Middle River and Lower River sediment balance and the associated changes to geomorphology because it will permit quantification of the magnitude in the reduction of sediment supply below the dam. The studies will also support the Fluvial Geomorphology Modeling below Watana Dam Study through development of sediment supply information that will be required as input to the model.

5.8.4.3.2. Methods

The methods are divided into five sections: (1) Middle River Sediment Balance, (2) Lower River Sediment Balance, (3) Characterization of Bed Material Mobilization, (4) Effective Discharge, and (5) Information Required.

The development of the sediment balances for the Middle River (RM 184 to RM 98) and the Lower River (RM 98 to RM 28) will consider various techniques to characterize the sediment supply to each reach, the sediment transport capacity through the reaches, and deposition/storage within the reaches. Sources of sediment supply are expected to include the mainstem Susitna River, contributing tributaries, and identified locations of mass wasting. Potential procedures to estimate sediment supply include the use of regional sediment supply relationships (e.g., regression equations based on watershed area) and calculation of differences in sediment loads between gaging stations. While it is recognized that the gages are spatially separated, the comparison of the loads at the gages will permit an assessment of whether there is significant storage or loss of sediment between gages. If the data indicate that there is little difference between the gages then it can be reasonably concluded that there is sufficient supply of sediment within the between gages reach to allow an assumption of transport capacity limitation rather than supply limitation. The sediment transport measurements collected by USGS, both historical and current, will be used to develop bedload and suspended load rating curves to facilitate translation of the periodic instantaneous measurements into yields over longer durations (e.g., monthly, seasonal, and annual). Since gradations of transported material will be available, the data will allow for differentiation of transport by size fraction. Previous studies have documented the potential for bias in suspended load rating curves due to scatter in the relationship between sediment concentration or load and flow (Walling 1977a). Part of the scatter is often caused by hysteresis in the sediment load versus discharge relationship, where the loads on the rising limb are higher than on the falling limb due to availability of material and coarsening of the surface layer during the high-flow portion of the hydrograph (Topping et al. 2010). Bias is also introduced in performing linear least-squares regressions using logarithmic transformed data and then back-transforming the predicted sediment loads to their arithmetic values (Walling 1977b, Thomas 1985, Ferguson 1986). The hysteresis effect can be accounted for by applying separate (or perhaps, shifting) rating curves through rising and falling limbs of flood hydrographs (Guy 1964, Walling 1974, Wright et al. 2010). The USGS Office of Surface Water (1992) endorsed the recommendations by Cohn and Gilroy (1991) to use the Minimum Variance Unbiased Estimator (MVUE) bias correction for normally distributed errors, or the Smearing Estimator (Duan 1983) when a non-normal error distribution is identified. Once the sediment measurements are available for review, the potential for bias in the sediment rating curves will be considered and addressed as appropriate.

The rating curves for the mainstem Susitna stations, for gaged tributary stations, and those developed for contributing ungaged areas between stations will be used to develop the sediment balance for the pre-Project hydrology for representative wet, average, and dry years and warm and cold Pacific Decadal Oscillation (PDO) phases (The inclusion of the warm and cold PDO phases was requested by NOAA-NMFS and USFWS in the May 31, 2012 study requests; the rationale for the request was discussed at the June 14, 2012 Water Resources TWG meeting and it was agreed that the PDO phases would be included in the suite of representative annual hydrologic conditions.). The sediment balance will be calculated based on the assumption that the sediment load in the Susitna River is currently in a state of equilibrium. To develop the sediment balance for the post-Project condition, the historical (pre-Project) sediment rating curve developed for the river immediately below the Watana Dam site (Tsusena Creek) will be reduced by 100 percent for the bedload and 90 percent for the suspended load on a preliminary basis. If the reservoir trap efficiency analysis discussed below indicates that a substantially different amount of sediment will pass through the reservoir, the sediment load curves will be adjusted accordingly.

5.8.4.3.2.1. Middle River Sediment Balance

The sediment balance for the Middle River between the proposed Watana Dam site (RM 184) and the Three Rivers Confluence (RM 98) will be estimated for wet, average, and dry years for both warm and cold PDO phases by integrating the sediment load curves over the respective hydrographs and comparing the resulting sediment inflows with the amount passing out the downstream end of each segment. Estimates of the contributions to the sediment supply from the Upper River identified mass wasting locations and contributing tributaries downstream of the dam will be an important aspect of this analysis. Potential procedures to estimate the Middle River sediment supply include the use of watershed area and regional sediment supply relationships and the determination of the differences on a seasonal or annual basis between the sediment loads estimated for the Susitna River at the Tsusena Creek and Gold Creek gage locations. Past USGS sediment data may be available for Indian River and Portage Creek, which could also be used to assist in the estimation of the Middle River sediment supply inputs. If data being collected by USGS for the Determine Bedload and Suspended Sediment Load by Size Fraction study at Tsusena Creek, Gold Creek, and Sunshine Gage Stations are available in time for this analysis, the 2012 data from Tsusena Creek will be compared to the 2012 Gold Creek data to estimate the sediment inflow between these two locations. This will allow development of a sediment rating curve from the 1985 data for the Susitna River at Tsusena Creek (representative of sediment transport at the Susitna-Watana dam site).

5.8.4.3.2.2. Lower River Sediment Balance

The Lower River Sediment Balance will depend on the sediment balance supply from the Middle River, as well as the supply from the Chulitna and Talkeetna rivers and other local tributaries along the reach. The total sediment load delivered to the Lower River under pre-Project conditions will be evaluated using the sediment rating curves developed from the historical data for the Sunshine and Susitna Station gaging stations and any new sediment transport collected by USGS under the Determine Bedload and Suspended Sediment Load by Size Fraction study at Tsusena Creek, Gold Creek, and Sunshine gage stations. The post-Project sediment supply from the Middle River will be taken from the Middle River analysis discussed above. The sediment transport rating curves at Gold Creek, Sunshine, and the Chulitna River will be used to determine the combined sediment contribution of the Talkeetna and other sediment inflows between Gold Creek and Sunshine. Moving downstream, the sediment rating curves at Sunshine, Yentna River, and Susitna Station can be used to determine the sediment contribution between Sunshine and Susitna Station.

5.8.4.3.2.3. Characterization of Bed Material Mobilization

The approximate discharge at which bedload transport begins in the Susitna River near the proposed dam and at selected locations in the Middle and Lower Rivers will be estimated using the USGS empirical sediment rating curves, incipient motion calculations (i.e., estimates of the critical discharge at which bed material begins to mobilize), and field observations. The resulting estimates of the critical discharge will be used to assess the frequency and duration of bed mobilization under the pre- and post-Project condition hydrology. This will be performed on both a monthly and annual basis at the selected locations for a range of flow years.

The concept of incipient motion as advanced by Shields (1936) relates the critical shear stress for particle motion (τ_c) to the dimensionless critical shear stress (τ^*_c) and the unit weight of sediment (γ_s), the unit weight of water (γ), and the median particle size of the bed material (D_{50}). One key limitation of this relation is the specification of τ^*_c (often referred to as the Shields parameter), which can range by a factor of three (Buffington and Montgomery 1997). The large range in published values for τ^*_c is caused largely by the difficulty in defining and identifying when bed material motion actually begins. To work around this limitation, Parker (Parker et. al. 1982) defined a reference Shields stress (τ^*_r) that corresponds to a dimensionless transport rate $W^* = 0.002$, corresponding to a very low, but measurable transport rate. For this relationship, W^* is a function of the unit bed load and the total boundary shear stress, both of which are relatively simple parameters to calculate from field data if bed load and discharge measurements are included (In the NOAA-NMFS and USFWS Study Plan Requests, it was proposed that the bed material mobilization analysis be calibrated based on the use of tracers. This topic was discussed at the Water Resources TWG held on June 14, 2012. AEA's Consultants indicated that the use of tracers in a large river such as the Susitna would not be practical due to the difficulty in locating the tracers after mobilization. Therefore, the use of tracers is not included in the proposed study plan.).

Bed material mobilization at various locations along the study reach will be characterized using the reference shear approach of Parker, following the methods of Mueller et al. (2005). Data collected by USGS, which will include the necessary series of coupled flow and bedload transport measurements, will be used to formulate a series of bedload rating curves. These curves will then provide a basis for estimating τ^* that corresponds to a dimensionless transport rate $W^* = 0.002$ for bed material mobilization.

5.8.4.3.2.4. Effective Discharge

The concept of effective discharge, as advanced by Wolman and Miller (1960), relates the frequency and magnitude of various discharges to their ability to do geomorphic work by transporting sediment. They concluded that events of moderate magnitude and frequency transport the most sediment over the long-term, and these flows are the most effective in forming and maintaining the planform and geometry of the channel. Andrews (1980) defined the effective discharge as "*the increment of discharge that tran sports the largest frac tion of the annual sediment load over a period of years.*"

Alluvial rivers adjust their shape in response to flows that transport sediment. Numerous authors have attempted to relate the effective discharge to the concepts of dominant discharge, channel-forming discharge, and bankfull discharge, and it is often assumed that these discharges are roughly equivalent and correspond to approximately the mean annual flood peak (Benson and Thomas 1966, Pickup 1976, Pickup and Warner 1976, Andrews 1980 and 1986, Nolan et al. 1987, Andrews and Nankervis 1995). Quantification of the range of flows that transport the most sediment provides useful information to assess the current state of adjustment of the channel and to evaluate the potential effects of increased discharge and sediment delivery on channel behavior. Although various investigators have used only the suspended-sediment load and the total sediment load to compute the effective discharge, the bed-material load should generally be used when evaluating the linkage between sediment loads and channel morphology because it is the bed-material load that has the most influence on the morphology of the channel (Schumm 1963, Biedenharn et al. 2000).

For purposes of this study, the effective discharge will be computed for the Susitna River below Tsusena Creek, at Gold Creek, and at Sunshine. This will be performed by dividing the full range of flows at each location into at least 30 logarithmic classes (Biedenharn et al. 2000) and then computing the sediment transport capacity at the average discharge within each flow class using the previously described rating curves. The bed material transport in each flow class over the long-term will be determined by multiplying the individual transport rates by the corresponding flow duration, which is derived from mean daily flow duration curves. The effective discharge is the flow, or range of flows, where the incremental bed material transport is greatest. Effective discharges will be determined for both the pre- and post-Project conditions. If, as expected, the post-project value is lower than the pre-project value it provides an indication that the morphology of the channel will change since there is a reasonably well identified relationship between the effective discharge and the size of the channel.

5.8.4.3.2.5. Information Required

The following available existing information will be needed to conduct this study:

- Current and historical aerial photographs;
- Historical suspended sediment and bedload data for the Susitna River and contributing tributaries; and
- Flow records for the Susitna River and contributing tributaries.

The following additional information will need to be obtained to conduct this study:

- Suspended and bedload data for the Susitna River at Tsusena Creek and Gold Creek being performed by USGS;
- Extended flow record for the Susitna River and gaged tributaries within the study area being developed by USGS;
- Estimated flows for the ungaged tributaries within the study area;
- Extended flow records for the Susitna River and tributaries being developed by USGS;
- Collection of bed material samples throughout the Middle and Lower Rivers, as well as contributing tributaries;
- Hydraulic conditions in the Susitna River from the Hydraulic Routing Model; and
- Surveys of channel geometry for contributing tributaries to simulate hydraulic conditions.

5.8.4.3.3. Study Products

The results of the Sediment Supply and Transport Middle and Lower River study component will be included in the Geomorphology Report. Information provided will include

- Tabular and graphical summary of available discharge and sediment transport data;
- Description of procedures used to develop sediment transport rating curves from suspended load and bedload data, including development of curves for specific sediment size-classes;
- Graphical and numerical relationships for sediment discharge rating curves;
- Narrative describing procedures used to perform effective discharge and bed mobilization calculations;
- Determination of total sediment load delivered to the Susitna River for pre- and post-Project conditions (the latter based on preliminary assumption that 100 percent bedload and 90 percent of suspended load will be trapped behind the Project dam; this estimate can be refined if the trap efficiency analysis indicates substantially different results);
- Estimate of Middle River sediment supply inputs from local tributaries and other sources;
- Tabular and graphical representation and comparison of the duration and frequency of bed material mobilization in the Middle and Lower Rivers for pre- and post-Project conditions;
- Estimates of the effective discharge for the pre- and post-Project conditions, and the likely effects on channel morphology; and
- Estimates of the overall sediment transport balance along the reach and the likely effects on channel morphology, particularly with respect to aggradation/degradation trends and changes in braiding potential. In reaches with net sediment deficit, results from the bed mobilization analysis will also be considered in assessing degradation tendencies.

5.8.4.4. Study Component 4: Assess Geomorphic Change Middle and Lower Rivers

The goal of the Assess Geomorphic Change Middle and Lower Rivers study component is to compare existing and 1980s geomorphic feature data from aerial photo analysis to characterize the relative stability of the 1980s study sites and river morphology under unregulated flow conditions. The effort for the Middle River will be conducted in 2012 as part of the Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography study and for the Lower River as part of the Reconnaissance Level Geomorphic and Aquatic Habitat Assessment of Project Effects on Lower River Channel study. The study area extends from the mouth of the Susitna River (RM 0) at Cook Inlet to the proposed Watana Dam site (RM 184).

5.8.4.4.1. Existing Information and Need for Additional Information

An analysis of the Middle Susitna River reach geomorphology and how aquatic habitat conditions changed over a range of stream flows was performed in the 1980s using aerial photographic analysis (Trihey & Associates 1985). A similar analysis was performed for the Lower River (R&M Consultants, Inc. and Trihey and Associates 1985a). The1980s Lower River study also included an evaluation of the morphologic stability of islands and side channels by comparing aerial photography between 1951 and 1983. The AEA Susitna Water Quality and Sediment Transport Data Gap Analysis Report (URS 2011) states that “if additional information is collected, the existing information could provide a reference for evaluating temporal and spatial changes within the various reaches of the Susitna River." The gap analysis emphasizes that it is important to determine if the conditions represented by the data collected in the 1980s are still representative of current conditions and that at least a baseline comparison of current and 1980s-era morphological characteristics in each of the identified subreaches is required.

Understanding existing geomorphic conditions and how laterally stable/unstable the channels have been over recent decades provides a baseline set of information needed to provide a context for predicting the likely extent and nature of potential changes that will occur due to the Project. Results of this study may also be used in the Instream Flow Riparian and Ice Processes studies to provide the surface areas of bars likely to become vegetated in the absence of ice-cover formation. This would be accomplished by evaluating the areas of exposed bars within river segments over a range of flows and developing exposed bar area-discharge curves that could then be used to assess the impacts of the Project flows on bar inundation by both flows and ice. Increases in areas that would be both inundation- and ice-free are likely to permit vegetation establishment and persistence.

5.8.4.4.2. Methods

This study component has been divided into the Middle and Lower Rivers since the available information differs. The analysis of geomorphic change will be conducted for a single representative discharge.

5.8.4.4.2.1. Middle River

Coordination will occur with AEA's Spatial Data Contractor to digitize the riverine geomorphic features from RM 98 to RM 150 defined in the 1980s from hard copy maps found in the Middle River Assessment Report (Trihey & Associates 1985). The September 6, 1983 aerials flown at a flow of 12,500 cfs will be used for the historical condition. Each feature will be a polygon (without slivers). Geomorphic features that are visible between the 1980s and current images, including the main channel, side channels, the presence and extent of mid-channel bars, vegetated bar areas, and changes at tributary deltas will be digitized for a single representative flow. (*Note: the AEA Spatial Data Contractor will complete the digitizing and develop associated metadata for the 1980s digitizing.)* From RM 98 to RM 184 the geomorphic features at a single representative stream flow, currently identified as 12,500 cfs, on the 2012 aerial photographs will also be digitized and delineated using the orthorectified photography and ArcGIS software (each geomorphic feature will be a polygon without slivers. (*Note: the Study Contractor will complete the digitizing and develop associated metadata for the 1980s digitizing.)*

The information developed from digitizing the aerials will be used to analyze and compare the geomorphology for 1980s and current conditions. From RM 98 to RM 150, GIS software will be used to compare the 2012 versus 1980s total surface area associated with each geomorphic feature. Results will be compiled into tables and graphs, as appropriate, to show the difference in surface areas of the feature types between 2012 and the 1980s photography. The lead geomorphologist will provide training to ensure appropriate application of the geomorphic definitions. Since this 34-mile river segment below the proposed Watana Dam site (RM 150 to RM 184) was not analyzed in the 1980s, this portion of the river will undergo a new assessment

(2012 photography only) that will not be compared to past studies. However, the methods for analyzing riverine geomorphic features will remain the same.

The change in channel planform over the length of the river (main channel location, side channel location, bars, channel and side channel width, channel and side channel location) will be qualitatively assessed between the 1980s and 2012. Reaches will be identified that are relatively stable versus those that are more dynamic. Reaches that would be most susceptible to channel change (e.g., width or planform change) with changes in the flow or sediment regime resulting from the Project or Project operations will be qualitatively identified since these are currently the most dynamic. Depending upon the results of the riverine geomorphic analysis, additional historical photographic analysis may be requested as part of future geomorphic studies, but this additional analysis is not included at this time. Additional analysis of historical aerial photographs and the corresponding flows that occurred between 1985 and 2012 could be pertinent if substantial changes in the riverine habitat types (surface area, locations, etc.) are identified during comparison of the 2012 and 1980s photography. While the long-term changes in river morphology are the result of a range of flows, if significant changes are identified between pairs of aerial photographs, review of the hydrologic record frequently identifies events that are more than likely to have been morphogenetically significant. This type of additional aerial photo analysis could provide more specific information on the flow magnitude(s) and other conditions (for example ice formation) that may cause substantial geomorphic channel adjustments. If additional analysis is identified, it will be performed as part of the 2103-2014 studies.

5.8.4.4.2.2. Lower River

The 36,600 cfs September 6, 1983 set of Lower River aerial photographs and current satellite images or aerial photographs will be obtained to compare historical and present-day channel planform and pattern from RM 28 to RM 99. Planform shifts of the main channel and side channels will be identified between the 1983 and current aerial photography. The three rivers confluence area is also a part of the analysis (extended to RM 99). Geomorphic features that are visible between the 1983 and current images, including the presence and extent of side channels, vegetated bar areas, and changes at tributary deltas will be mapped and characterized. In areas where the mainstem channel consists of a dynamic braid plain mostly void of stabilizing vegetation, the effort will be directed at defining the edges of the active channel rather than detailing the myriad of channels within the active area. Major sloughs and side channels along the lower river margins will be included in the digitizing effort.

The rest of the Lower River effort will be similar to the Middle River. The geomorphic change over the length of the river (main channel location, side channel location, bars, channel and side channel width, channel and side channel location) will be qualitatively assessed between the 1980s and current conditions. Reaches will be identified that are relatively stable versus those that are more dynamic. Reaches that would be most susceptible to channel change (e.g., width or planform change) with changes in the flow or sediment regime resulting from the Project or Project operations will be qualitatively identified. Depending upon the results of the riverine geomorphic analysis, additional historical photographic analysis may be requested as part of future geomorphic studies, but this additional analysis is not included at this time. Additional analysis of historical aerial photographs and the corresponding flows that occurred between 1985 and 2012 could be pertinent if substantial changes in the riverine habitat types (surface area, locations, etc.) are identified during comparison of the 2012 and 1980s photography. This type of additional aerial photo analysis could provide more specific information on the flow magnitude(s) and other conditions (for example ice formation) that may cause substantial geomorphic channel adjustments.

5.8.4.4.2.3. Information Required

The following available existing information will be needed to conduct this study:

- Historical 1980s orthorectified aerial photographs for the Middle and Lower rivers.

The following additional information will be needed to conduct this study:

- Obtain recent or develop 2012 orthorectified aerial photos (or satellite imagery) in the Middle and Lower Rivers at a flow similar to the historic aerials (12,500 cfs Middle River and 36,600 cfs Lower River; and
- Acquire historic orthorectified aerial photos and digitized geomorphic features from the AEA Spatial Data Contractor (SDC) for the Middle and Lower Rivers for a single discharge.

5.8.4.4.3. Study Products

The results of the Assess Geomorphic Change Middle and Lower Rivers component will be included in the Geomorphology Report. Information provided will include:

- Maps showing riverine geomorphic features outlined in the Middle River and Lower River for both the 1980s and 2012 for flows of 12,500 cfs and 36,600 cfs, respectively;
- Maps showing the distribution of all riverine geomorphic features for both dates and for the Middle and Lower River reaches;
- Overlay map of 1980s and 2102 riverine geomorphic features to assess the level of change in the channel morphology over the past three decades;
- Tabular and graphical representation of the areas for each riverine geomorphic feature type by geomorphic sub-reaches within the Middle and Lower River reaches; and
- Qualitative assessment of the level of geomorphic change for the lengths of the Middle River and Lower River reaches including identification of stable versus non-stable areas.

In addition, an ArcGIS Shapefile will be provided with the following information:

- 1980s orthorectified aerial imagery on GIS layer for the Middle and Lower River reaches; and
- Digitized polygons for each riverine habitat feature type in the Middle and Lower River reaches.

5.8.4.5. Study Component 5: Riverine Habitat versus Flow Relationship Middle River

The goal of the Riverine Habitat Versus Flow Relationship Middle River study component is to develop existing and 1980s riverine habitat type area data over a range of flows to quantify riverine habitat versus surface area relationships. The study area extends from the three rivers area (RM 98) to the Watana Dam site (RM 184). Up to 20 study sites not exceeding 50 percent of the reach will be studied in the 2012 study, Aquatic Habitat and Geomorphic Mapping of the Middle River Using Aerial Photography. All or part of the remaining portion may be studied in 2103-2014, depending on the outcome and recommendations from the 2012 study as well as the selection of instream flow study sites.

5.8.4.5.1. Existing Information and Need for Additional Information

Understanding existing geomorphic conditions, how aquatic habitat changes over a range of stream flows, and how stable/unstable the geomorphic conditions have been over recent decades provides a baseline set of information needed to provide a context for predicting the likely extent and nature of potential changes that will occur due to the Project. Results of this study will also provide the basis for macro-habitat mapping to support the Instream Flow Study and will be used in the Ice Processes Study to provide the surface areas of bars likely to become vegetated in the absence of ice-cover formation.

5.8.4.5.2. Methods

New aerial photography obtained in 2012 will be combined with 1980s and other information to create a digital, spatial representation (i.e., GIS database) of riverine habitat. The result will be a quantification of the area of the riverine habitat types for three flow conditions for the historical 1980s condition and the current 2012 condition. The results will be presented as riverine habitat versus area relationships for the Middle River, reaches in the Middle River, and individual habitat study sites. Comparison between the results from the 1980s and 2012 can be made. The historical information will only be developed for the Reach from RM 98 to RM 150 as the delineation of habitat in the Devils Canyon section, RM 150 to RM 184, was not performed.

The methods for this study component have been divided into three tasks: aerial photography, digitize riverine habitat types, and riverine habitat analysis.

5.8.4.5.2.1. Aerial Photography

New (2012) color aerial photography of the Middle River (RM 98 to RM 184) at stream flows corresponding to those analyzed in the Trihey & Associates study (1985) (stream flow at the Gold Creek gage [15292000]) will be obtained to provide the foundation for the aquatic habitat and geomorphic mapping of the Middle River, as well as to provide a resource for other studies.

Three sets of aerial photography will be obtained in 2012 at the following approximate discharges: 23,000 cfs, 12,500 cfs, and 5,100 cfs. (Note: seven sets of aerial photographs were flown and evaluated in the 1985 study at the stream flows of 5,100 cfs, 7,400 cfs, 10,600 cfs, 12,500 cfs, 16,000 cfs, 18,000 cfs, and 23,000 cfs). If hydrologic conditions will not allow obtaining the aerials at 5,100 cfs in 2012, the lowest flow for which aerials can be obtained, either 7,400 cfs or 10,600 cfs, will be substituted.

Determination of the scale of the aerial photography (i.e., flying elevation) and the digital scan resolution will be coordinated with AEA's Spatial Data Contractor, AEA, the Instream Flow Study Lead, and licensing participants. The Geomorphology Study Lead will coordinate with the Spatial Data Contractor who will both obtain (fly) the aerial photography and orthorectify the aerial photography.

The flow record for the previous 10 years at the USGS Gold Creek gage will be reviewed. The river typically rises from about 2,000 cfs to over 15,000 cfs during the ice break-up period in late April to mid-May in a matter of a few days. Because of the influence of ice and ice break-up on water surface elevations during this period, it is unlikely that aerial photographs that allow a valid comparison with the 1980s habitat mapping can be collected in the spring. The river does not recede to 12,500 cfs until mid-August to mid-September and to 5,100 cfs until sometime in October. The river is intermittently in the 23,000 cfs range in the June through August timeframe. For developing the schedule, it is assumed that the orthorectified aerial photographs for 23,000 cfs will be available in August 1, 2012, aerials for 12,500 cfs will be available by October 15, 2102, and aerials for 5,100 cfs will be available by November 15, 2012. Analysis of riverine habitat for flows at which aerials are not obtained in 2012 will need to be completed in 2013-2104. Snowfall in the Project area for 2012 is close to an all-time record, and this may influence the timing and magnitude of the discharges this year. If it does not appear that the Susitna River will recede to 5,100 cfs prior to ice and/or snow cover becoming a potential issue with the quality of the photographs in the fall, a decision will be made to obtain aerial photographs for the low-flow discharge in 2012 at either 7,400 cfs or 10,600 cfs.

5.8.4.5.2.2. Digitize Riverine Habitat Types

The Geomorphology Study will coordinate with the Instream Flow Study, the Instream Flow Riparian Study, Ice Processes Study, and other pertinent studies to identify large-scale (typically many miles) aerial photography analysis study reaches for the riverine habitat digitizing. For this initial work, the number of study sites to be analyzed is assumed to not exceed 20 detailed study sites from the 1980s effort or more than 50 percent of the reach. In addition to consideration of habitat and geomorphic characteristics of the reach, a visual qualitative side-by-side comparison of the aerials will be performed to ensure that the selected reaches are also representative of the level of change that has occurred over the period of comparison. Aerial photography will be obtained for the entire reach so that additional areas may be digitized in the future if warranted.

Coordination will occur with AEA's Spatial Data Contractor to digitize (within the aerial photography analysis study reaches) the riverine habitat types from RM 98 to RM 150 defined in the 1980s from hard copy maps found in the Middle River Assessment Report (Trihey & Associates 1985). Each habitat type must be a polygon (without slivers). The habitat types were classified into the following categories: main channel, side channel, side sloughs, upland sloughs, and tributary mouths.

Riverine habitat types for the identified study sites will be delineated and digitized from the 2012 aerials at each of the three stream flows used for the 1980s digitizing effort. Sites will include those identified for the 1980s digitization effort as well as up to six additional sites between RM 150 and RM 184, identified in coordination with the Instream Flow Study, the Riparian Instream Flow Study, Ice Processes Study, and other pertinent studies. The habitat types will be digitized from the orthorectified photography using ArcGIS software (each habitat type must be a polygon without slivers). Riverine habitat will be classified using the same classification categories used in the Trihey & Associates study (1985) main channel, side channel, side sloughs, upland sloughs, and tributary mouths. *Note: the digitizing (and associated metadata) will be completed by Contractor during this study.*

5.8.4.5.2.3. Riverine Habitat Analysis

The information developed in the previous task will be used to develop relationships for riverine habitat versus flow for the specified reaches and habitat study sites. The relationships will be developed for both 1980s and 2012 aerials. The riverine habitat type surface area versus flow relationships between the 1980s and current conditions will be compared at both a site and reach scale to determine if changes in the relationships have occurred. The comparison can only be performed for a portion of the reach, since the 1980s study did not cover the entire Middle River.

From RM 98 to RM 150 GIS software will be used to compare the 2012 versus 1980s total surface area associated with each delineated riverine habitat type at each measured flow. Results will be compiled into tables and graphs, as appropriate, to show the difference in surfaces area of the feature types between 2012 and the 1980s photography and to show the change in riverine habitat types versus flow. To ensure accurate comparison to the 1980s data set, not only will the same approximate flows be compared, but the same definitions will be used for each of the riverine habitat features that are delineated (see above). The lead geomorphologist will provide training to ensure appropriate application of the habitat definitions.

Since the 34-mile river segment below the proposed Watana Dam site (RM 150 to RM 184) was not analyzed in the 1980s, this portion of the river will be a new assessment (2012 photography only) that will not be compared to past studies. However, the methods for analyzing riverine habitat types over the range of flows will remain the same as for the downstream reach (23,000 cfs, 12,500 cfs and 5,100 cfs). Because this reach has a high level of lateral and vertical control, the areas associated with riverine habitat types have likely experienced little change. Results of the study component Assess Geomorphic Change will determine whether there has been change in geomorphic features in this portion of the Middle River.

Habitat features will be compared and contrasted quantitatively and a qualitative assessment will be made of the similarity of the sites in 2012 compared to the 1980s in order to assess the stability of the study sites. A decision will also be made as to whether the remaining portions of the Middle River, beyond the original selected study sites analyzed in 2012, will be digitized and analyzed in 2013-2014.

5.8.4.5.2.4. Information Required

The following available existing information will be needed to conduct this study:

- Historical 1980s orthorectified aerial photographs for the Middle River; and
- USGS flow records for the past 10 years for the Susitna River at Gold Creek.

The following additional information will be needed to conduct this study:

- Obtain (fly) 2012 orthorectified aerial photos in the Middle River at 5,100, 12,500, and 23,000 cfs (corresponds to 1980s flow); and
- Acquire historical 1980s digitized riverine habitat features from the AEA Spatial Data Contractor (SDC) for the Middle River for flows of 5,100, 12,500, and 23,000 cfs.

5.8.4.5.3. Study Products

The results of the Riverine Habitat Versus Flow Relationship Middle River component will be included in the Geomorphology Report. Information provided will include

- Tabulation of the riverine habitat types versus flow on a reach and individual site basis for the 1980s and 2012 conditions;
- Graphical representation of the riverine habitat type area versus flow relationships by reaches for both the 1980s and 2012 data; and
- Assessment of the change and similarity in riverine habitat types between the 1980s and 2012 and conclusions on site stability to aid the Instream Flow Study in site selection and determination of the applicability of the 1980s data to represent current conditions.

In addition, an ArcGIS shapefile will be provided with the following information:

- Orthorectified aerial imagery of the Middle River at 5,100 cfs, 12,500 cfs and 23,000 cfs;
- Digitized polygons representing the 1980s riverine habitat types for the Middle River at 5,100 cfs, 12,600 cfs and 23,000 cfs from RM 98 to RM 150 (Middle River below Devils Canyon); and
- Digitized polygons representing the current (2012) riverine habitat types for the Middle River at 5,100 cfs, 12,500 cfs and 23,000 cfs from RM 98 to RM 150 (Middle River below Devils Canyon) and RM 150 to 184 (Middle River in Devils Canyon and Above Devils Canyon).

5.8.4.6. Study Component 6: Reconnaissance Level Assessment of Project Effects on Lower River Channel

The goal of the Reconnaissance Level Assessment of Project Effects on Lower River Channel study component is to utilize comparison of pre- and post-Project flows and sediment transport conditions to estimate the likelihood for potential post-Project channel change in the Lower River. The study area for this effort is the Lower River from RM 98 to RM 0. This effort will be conducted in 2012 as part the Reconnaissance Level Geomorphic and Aquatic Habitat Assessment of Project Effects on Lower River Channel. The results of this effort will help determine what additional analysis of Project effects may be warranted in the Lower River for the 2013-2104 studies.

5.8.4.6.1. Existing Information and Need for Additional Information

An analysis of the Lower River reach and how riverine habitat conditions change over a range of stream flows was performed in the 1980s using aerial photographic analysis (R&M Consultants, Inc. and Trihey and Associates 1985a). This study evaluated the response of riverine aquatic habitat to flows in the Lower River reach between the Yentna River confluence (RM 28.5) and Talkeetna (RM 98) (measured at Sunshine gage [approximately RM 84]) ranging from 13,900 cfs to 75,200 cfs. The study also included an evaluation of the morphologic stability of islands and side channels by comparing aerial photography between 1951 and 1983.

In another study, 13 tributaries to the lower Susitna River were evaluated for access by spawning salmon under existing and with proposed stream flows for the original hydroelectric project (Trihey and Associates 1985b). The study contains information regarding fish run timing, mainstem and tributary hydrology, and morphology. Based on the results of this study, it was concluded that passage for adult salmon was not restricted under natural flow conditions nor was it expected to become restricted under the proposed Project operations.

The AEA Susitna Water Quality and Sediment Transport Data Gap Analysis Report (URS 2011) states that "if additional information is collected, the existing information could provide a reference for evaluating temporal and spatial changes within the various reaches of the Susitna River." The gap analysis emphasizes that it is important to determine if the conditions represented by the data collected in the 1980s are still representative of current conditions, and that at least a baseline comparison of current and 1980s morphological characteristics in each of the identified subreaches is required.

Results of this study will provide the initial basis for assessing the potential for changes to the Lower River reach morphology due to the Project. Additional studies will be planned for 2013-2014 if the results of this study identify a potential for important aquatic habitat and channel adjustments in response to the Project.

Issues associated with geomorphic resources in the Lower River reach for which information appears to be insufficient were identified in the PAD (AEA 2011), including

- G16: Potential effects of reduced sediment load and changes to sediment transport as a result of Project operations within the Lower River.
- F19: The degree to which Project operations affect flow regimes, sediment transport, temperature, water quality that result in changes to seasonal availability and quality of aquatic habitats, including primary and secondary productivity.

5.8.4.6.2. Methods

5.8.4.6.2.1. Stream Flow Assessment

Pre-Project and available post-Project hydrologic data will be compared. This will include a comparison of the monthly and annual flow duration curves (exceedance plots) and plots/tables of flows by month (maximum, average, median, minimum) for the Susitna River at the Sunshine and Susitna Station gaging stations. Additional hydrologic indicators may be used to further illustrate and quantify the comparison between pre- and post-Project stream flows. The pre-Project data analysis will include the extended record being prepared by USGS.

Using the extended record currently being prepared by USGS, a flood-frequency and flood-duration analysis for pre- and post-Project annual peak flows will be performed. The flood-frequency analysis will be performed using standard hydrologic practices and guidelines as recommended by USGS (1982).

5.8.4.6.2.2. Sediment Transport Assessment

The sediment transport data USGS has collected will be used to develop bedload and suspended load rating curves to facilitate translation of the periodic instantaneous measurements into yields over longer durations (e.g., monthly, seasonal, and annual). This information will be used to perform an overall sediment balance for both the suspended sediment load and the bed load. The development of this information will be performed in the Sediment Supply and Transport Middle and Lower River study (see Section 5.8.4.3).

5.8.4.6.2.3. Integrate Sediment Transport and Flow Results into Conceptual Framework

Prediction of project-induced changes to river morphology in an alluvial river is fundamentally based on the magnitudes and directions of change in the driving variables, hydrology and sediment supply. Initial, qualitative assessment of change can be based on Lane's (1957) equality:

$Q_w.S{\sim}Q_s.D_{50}$,

where Q_w is the flow, S is the slope, Q_s is the sediment transport and D_{50} is the median size of the bed material. A change in any one of the variables will require a change in the others to maintain the balance.

Use of the expansion of Lane's relation by Schumm (1977) allows the response to the changes in driving variables to be expressed in terms of channel morphometric parameters such as channel width (b), depth (d), slope (S), meander wavelength (λ), width-depth ratio (F) and sinuosity (P). For example, a potential range of changes in response to the Project in the vicinity of the 3 Rivers confluence where flows will be reduced and sediment supply could be effectively increased could be expressed as follows;

$Q_w^-, Q_s^+ \sim b^{\pm}, d^-, \lambda^{\pm}, S^+, P^-, F^+$

where + represents an increase, – represents a decrease and ± represents indeterminacy. Application of these qualitative relations assumes that the river is alluvial and that the form and characteristics of the channel are the result only of the interaction of the flows and the sediment load. Where non-fluvial factors such as bedrock outcrop or coarse-grained paleo-flood deposits limit the adjustability of the channel, the ability to predict the direction and magnitude of channel change in response to changes in the water and sediment load below dams is reduced (Miller 1995, Grant and Swanson 1995, Grant et al. 2003).

Using the data developed for the pre- and post-Project flood frequency, flood duration, and sediment load, the geomorphic response of the Susitna River in a conceptual framework along the longitudinal profile of the river system from the three rivers confluence through Lower River reach will be predicted. The conceptual framework developed by Grant et al. (2003) that relies on the dimensionless variables of the ratio of sediment supply below the dam to that above the dam and the fractional change in frequency of sediment transporting flows will be used to predict the nature and magnitude of the Lower River geomorphic response. Other analytical approaches may be considered to evaluate potential for geomorphic adjustments in the river reaches due to the Project. These may include an evaluation of morphologic changes based on changes to the degree and intensity of braiding using Germanoski's (1989) modified braiding index (MBI) that has been used to predict channel responses to anthropomorphically–induced changes in Alaskan, glacial-fed rivers including the Toklat, Robertson, and Gerstle Rivers (Germanoski 2001). As demonstrated by Germanoski and Schumm (1993), Germanoski and Harvey (1993), and Harvey and Trabant (2006), the following are the expected directions of responses in the MBI values to significant changes in bed material gradation and sediment supply:

- If the D50 increases and there is a supply of sediment then MBI increases;

- If the D50 increases and there is a significant decrease in the supply of sediment then MBI decreases;
- If the bed aggrades then MBI increases; and
- If the bed degrades then MBI decreases.

Specific MBI values for braided reaches of the Susitna River under existing conditions will be developed from aerial photography and the likely changes in values in response to the Project will be assessed. Prediction of the direction, if not the magnitude of changes will provide useful information for assessing likely Project impacts on in-stream habitats.

5.8.4.6.2.4. Information Required

The following available existing information will be needed to conduct this study:

- Historical suspended sediment and bedload data for the Susitna River;
- Flow records for the Susitna River; and
- Characterization of bed material from previous studies.

The following additional information will need to be obtained to conduct this study:

- Suspended and bedload data for the Susitna River at Tsusena Creek and Gold Creek being performed by USGS;
- Extended flow record for the Susitna River and gaged tributaries within the study area being developed by USGS;
- Channel morphologic data for existing conditions including, width, depth, width/depth ratios, and MBIs.

5.8.4.6.3. Study Products

The results of the Reconnaissance Level Assessment of Project Effects on Lower River Channel Sediment component will be included in the Geomorphology Report. Information provided will include

- Pre- and post-Project comparison of hydrologic parameters for the Susitna River at Sunshine and at Susitna Station, including:
  - Monthly and annual flow duration curves;
  - Annual peak flow frequency; and
  - Monthly flow statistics (maximum, average, median, minimum).
- Summary of changes in sediment transport for pre- and post-Project conditions in the Lower River; and
- Results of the assessment of anticipated Project effects on the Lower River based on the analytical framework in Grant et al. (2003) and other indicators of potential channel change such as the MBI by Germanoski (1989).

5.8.4.7. Study Component7: Riverine Habitat Area versus Flow Lower River

The objective of the Riverine Habitat Area Versus Flow Lower River study component is to conduct a reconnaissance-level assessment of the potential for Project effects associated with changes in stage to alter Lower River riverine habitat. This effort will be conducted in 2012.

5.8.4.7.1. Existing Information and Need for Additional Information

An analysis of the Lower River reach and how riverine habitat conditions change over a range of stream flows was performed in the 1980s using aerial photographic analysis (R&M Consultants, Inc. and Trihey and Associates 1985a). This study evaluated the response of riverine aquatic habitat to flows in the Lower River reach between the Yentna River confluence (RM 28.5) and Talkeetna (RM 98) (measured at Sunshine gage at approximately RM 84) ranging from 13,900 cfs to 75,200 cfs. Results of this study will provide the initial basis for assessing the potential for changes to the Lower River reach morphology due to the Project. Additional studies will be planned for 2013-2014 if the results of this study and other studies identify a potential for important aquatic habitat and channel adjustments in response to the Project.

5.8.4.7.2. Methods

This study component is divided into three tasks: Riverine Habitat-Flow Relationship Assessment, Synthesis of the 1980s Aquatic Habitat Information, and Contingency Analysis to Compare Wetted Channel Area. The third task is optional and dependent on a determination if comparison of riverine habitat in the Lower River under pre- and post-Project flows is warranted for additional flow conditions.

5.8.4.7.2.1. Change in River Stage Assessment

A tabular and graphical comparison of the change in water surface elevations associated with the results of the pre- and post-Project stream flow assessment (above) will be developed using the stage-discharge relationships (rating curves) for the Sunshine and Susitna Station gaging stations. This comparison will include monthly and annual stage duration curves (exceedance plots) and plots/tables of stage by month (maximum, average, median, minimum). Additional parameters to describe and compare the pre- and post-Project water surface elevations may be performed. A graphical plot of a representative cross section at each gaging station will be developed with a summary of the changes in stage (water surface elevation) for the two flow regimes. If possible, the location of the active channel and the floodplain will also be identified on the cross section. Changes in stage will be related to exposure of bars through the previously developed bar area-discharge curves thereby providing the link between both vegetation and ice impact assessments. The stage change information will also be used to estimate and compare the areas of the various riverine habitat types for the existing and with-Project conditions over a range of flow frequencies.

The availability of USGS winter gage data with respect to discharge and ice elevation/thickness will be investigated. Coordination with the Documentation of Susitna River Ice Breakup and Formation Study will occur to obtain information on ice elevation/thickness, as appropriate. The potential need for an analysis of discharge effects on ice elevation will be identified and conducted, if feasible.

5.8.4.7.2.2. Synthesis of the 1980s Aquatic Habitat Information

A synthesis/summary of the 1980s Response of Aquatic Habitat Surface Area to Mainstem Discharge Relationships in the Yentna to Talkeetna Reach of the Susitna River (R&M Consultants, Inc. and Trihey & Associates 1985a) will be provided. A synthesis/summary of the Assessment of Access by Spawning Salmon into Tributaries of the Lower Susitna River (R&M Consultants, Inc. and Trihey & Associates, 1985b) will also be provided. Data will be summarized with respect to the anticipated pre- and post-Project flow changes, where applicable (see Stream Flow Assessment section above).

5.8.4.7.2.3. Site Selection and Stability Assessment

Up to eight sites in the Lower River will be selected from the Yentna to Talkeetna reach map book (R&M Consultants, Inc. and Trihey and Associates 1985a) at the approximately 36,600 cfs flow at Sunshine Gage to study in 2012. These sites will be selected in coordination with the Instream Flow Study, the Instream Flow Riparian Study, the Ice Processes Study, and licensing participants. A side-by-side comparison of the sites using the 1983 36,600 cfs aerials and the most appropriate current aerials or satellite imagery will be performed to qualitatively assess site stability. Sites that have been substantially reworked by the Susitna River since the 1980s will not be selected for comparison of riverine habitat in the 1980s versus the present. Only sites that have been relatively stable during the period will be selected.

5.8.4.7.2.4. Aerial Photography Analysis, Riverine Habitat Study Sites (RM 28 to RM 98)

Using GIS and the September 6, 1983 aerials for the 36,600 cfs flow, mainstem and side channel riverine habitat will be digitized from the 1985 map book (R&M Consultants, Inc. and Trihey and Associates 1985a) for the selected sites. Each area associated with a habitat type will be a polygon (without slivers). To provide a comparison with current conditions, either recent satellite imagery at a flow similar to 36,600 cfs or aerials obtained in 2012 (if appropriate satellite imagery is not available) will be used to delineate the current wetted areas within the riverine and side-channel habitats for the selected sites.

The difference in wetted surface area of the main channel and side-channel riverine habitats (as defined in R&M Consultants, Inc. and Trihey & Associates 1985a) will be compared between the 1983 and current conditions. The areas of the riverine habitat types, along with the Geomorphic Assessment of Channel Change subtask (see below) will be compared and contrasted quantitatively, and a qualitative assessment will be made of the similarity of the 1980s sites compared to the 2012 sites. The assessment of site stability will help determine the applicability of Lower River riverine habitat information developed in the 1980s to supplement information being developed in the current Project studies.

5.8.4.7.2.5. Optional: Additional Aerial Photography Analysis, Riverine Habitat Study Sites (RM 28 to RM 98)

Based on the results of the comparison of riverine habitat areas at the selected study sites for the Lower River and results of the Geomorphic Assessment of Channel Change subtask (see below), a determination of whether to perform a similar effort and comparison for up to two additional discharges will be made (discharges corresponding to the analysis of wetted habitat areas in the Lower River include 75,200 cfs, 59,100 cfs, 36,600 cfs, 21,100 cfs and 13,900 cfs). This decision will be made in coordination with the Instream Flow Study, Instream Flow Riparian Study, Ice Processes Study, Fish Study, and licensing participants. If the decision is made to analyze riverine habitat at two additional discharges, the flows will be selected and the associated habitat areas digitized from the 1985 map book. Satellite imagery at similar discharges or new aerial photographs will be obtained (if appropriate satellite imagery is not available). The riverine habitat types will be delineated and digitized on these images to represent the current condition. The difference in wetted surface area of the main channel and side channel riverine habitats will be compared between the 1983 and current conditions for the two additional discharges (The USFWS Study Plan Request included digitizing the riverine habitat types for three flows in the Lower River. This topic was discussed at the Water Resources TWG held on June 14, 2012. It was explained that the current proposal by AEA is to digitize riverine habitat for a single flow in 2012, then based on decisions on whether to continue detailed studies into the Lower River and how far those studies would be carried downstream, the optional aerial photo analysis identified in this task would be performed in 2013. The USFWS agreed at the meeting that this approach was appropriate.).

5.8.4.7.2.6. Information Required

The following available existing information will be needed to conduct this study:

- Historical 1980s orthorectified aerial photographs for the Lower River; and
- USGS flow record for the Sunshine and Susitna Station gages including measurement notes, rating curves, stage shifts, cross sections, and information on ice thickness.

The following additional information will need to be obtained to conduct this study:

- Results of study component 4 Assess Geomorphic Change Middle and Lower Rivers.

5.8.4.7.3. Study Products

The results of the Riverine Habitat Area versus Flow Lower River component will be included in the Geomorphology Report. Information provided will include

- Comparison of pre- and post-Project stage at the Susitna River at Sunshine and the Susitna Station gages associated with the flow duration curves (monthly and annual) and monthly statistics;
- Summary of available USGS measurements of ice elevation/thickness to identify the need to perform analysis of the discharge effect on ice elevation;
- Narrative describing the synthesis of the 1980s aquatic habitat versus flow relationships and the anticipated post-Project flow changes;
- Identification, based on site stability, of up to eight sites in the Lower River for analysis of changes in riverine habitat area from the 1980s to the current condition at the selected flow; and
- Results for the selected flow of the comparison of the riverine habitat areas, by type, for the selected sites for 1980s and current aerial imagery.

In addition, an ArcGIS Shapefile will be provided with the following information:

- Digitized polygons of the 1980s and current riverine habitat surface areas at the selected sites.

5.8.4.8. Study Component 8: Reservoir Geomorphology

The goal of the Reservoir Geomorphology study component is to characterize changes resulting from conversion of the channel and portions of the river valley to a reservoir. The study area extends from the proposed Watana Dam site (RM 184) upstream to include the reservoir inundation zone and the portion of the river potentially affected by backwater and delta formation in the river, which is currently assumed to correspond to approximately 5 miles above the reservoir maximum pool (at approximately RM 238). The proposed study area is shown in Figure 5.8-3. Specific objectives of this study component include

- Estimate reservoir sediment trap efficiency and reservoir longevity;
- Estimate the Susitna River and inflow tributary delta formation with respect to potential effects on upstream fish passage; and
- Estimate erosion and beach formation in the Watana Reservoir drawdown zone and shoreline area.

5.8.4.8.1. Existing Information and Need for Additional Information

The construction and operation of the proposed Susitna-Watana Project will impound a reservoir for approximately 39 miles upstream from the dam. The reservoir will likely trap essentially all of the coarse sediment load and much of the fine sediment load that enters the impoundment from the upstream Susitna River. The coarse sediment load will form a delta at the head of the reservoir that will be re-worked by seasonal fluctuations of the reservoir elevation.

Similar to the mainstem Susitna River delta at the head of the reservoir, deltas of varying size will likely form where tributaries enter the reservoir. The amount and distribution of sediment deposits may impact the connectivity of the surface flows between the reservoir and the tributary channels, which may, in turn, block fish passage into the tributaries. The available information does not contain data describing the magnitude and size-distribution of the annual sediment loads from the tributaries that enter the reservoir, a potentially significant data gap.

Operation of the Project would result in seasonal and daily water-level fluctuations in Watana Reservoir, which will result in beach formation and erosion and/or mass wasting of soils within the impoundment. The results of the erosion potential portion of this study will provide information on the extent of these processes and the potential for alterations to Project operations or erosion control measures to reduce erosion and mass wasting.

5.8.4.8.2. Methods

The methods are divided into three areas: reservoir trap efficiency and sediment accumulation rates, delta formation, and reservoir erosion (In the Study Plan comments the NOAA-NMFS and the USFWS requested that a description of reservoir sediment removal procedures be included in the Geomorphology effort. At the Water Resources TWG meeting held June 14, 2012, AEA's consultants indicated that there are no plans for removal of sediment deposited in the reservoir since no feasible procedures for accomplishing this on a large reservoir with a substantial permanent pool currently exist. The reservoir will have a finite life as a result of sedimentation and this will be estimated as part of the Reservoir Geomorphology study component.).

5.8.4.8.2.1. Reservoir Trap Efficiency and Sediment Accumulation Rates

Inflowing sediment loads from the mainstem Susitna River will be determined by integrating the bedload and suspended load equations developed for the Susitna River at Tsusena Creek over the extended hydrologic record for the Susitna River. Due to the short record at this station, the information collected at Vee Canyon and the bedload and suspended load data collected at Gold Creek will be used to further refine Tsusena sediment rating curves. The methods described in Empirically Characterize Susitna River Sediment Supply and Transport study component will be used to develop the incoming sediment load.

Sediment loading from the significant tributaries within the reservoir may also affect reservoir life. The reservoir tributary loading will be accounted for in the sediment load data collected for the Susitna River at Tsusena Creek. Similarly, if the sediment loading from the reservoir perimeter is substantial, it will be incorporated into the analysis. Potential additional sediment loading resulting from glacial surge will be investigated in the Glacial and Runoff Changes Study (Section 5.11.4.4 Analyze Potential Changes in Sediment Delivery to Watana Reservoir). If this investigation indicates that the increased sediment load can actually be delivered in substantial quantities to Watana Reservoir, more detailed analyses of the increased loading will be performed and a sediment loading scenario accounting for glacial surge will be added to the reservoir trap efficiency and sediment accumulation analysis. This would include an estimate of the reduction in reservoir life that could result from sediment loading associated with periodic glacial surges.

Due to the relatively large storage capacity of the proposed reservoir, it is reasonable to assume that all sand and coarser sediment size-fractions delivered to the reservoir will be trapped, while a substantial amount of the fine-grained, colloidal sediments associated primarily with glacial outwash will pass through the reservoir into the downstream river. When applied over a long-term horizon, the amount of trapped sediment can be used to evaluate the impacts of sedimentation on reservoir storage capacity. If the analysis indicates that a substantial amount of fine sediment will deposit in the reservoir, consolidation of the deposits will also be considered in the analysis. (Note that consolidation of sands and gravels is minimal.) Potential methods for estimating the trap efficiency of the fine sediment include the relationships from Einstein (1965) and Li and Shen (1975). The latter method may be the most appropriate because it accounts for the tendency of suspended particles to be carried upward in the water column due to turbulence. Estimates of the trap efficiency for the fine sediment will be made using the Brune (1953) method. The Brune (1953) method that was recommended by Strand and Pemberton (1987) for use in large or normally-ponded reservoirs (Morris et al. 2007) can be used to check the reasonableness of results obtained from the other methods, although this method does not provide means of separating the behavior of different particle sizes in the inflowing load. Chen (1975) may also be another method to check the reasonableness of the trap efficiency determination. The Churchill (1948) method is also commonly used to estimate reservoir trap efficiency; however, this method is more applicable for settling basins, small reservoirs and flood-retarding structures and should probably not be used for this study. The proposed methods will provide a basis for estimating the quantity of the various size fractions that either pass through or are trapped in the reservoir. If the initial analyses indicate that a more sophisticated approach is necessary to obtain reasonable trap efficiencies, consideration will be given to using a numerical model such as Environmental Fluid Dynamics Code (EFDC) (Hamrick 1992) model to refine the estimates.

5.8.4.8.2.2. Delta Formation

Estimation of the formation of deltas on the mainstem Susitna River and its tributaries as they enter the proposed Watana Reservoir will require estimation of sediment load. Although the USGS measurements in the Bedload and Suspended Load Data Collection at Tsusena Creek, Gold Creek, and Sunshine Gage Stations study component target three locations along the Susitna River, sediment transport estimates will be needed at additional locations, including ungaged tributaries. Because of the potential impacts on fish movement into the tributaries, ungaged tributaries that require study will be identified in coordination with the Fish Studies. In these locations, reconnaissance will be performed to characterize the sediment transport regime and to identify appropriate methods of calculating yields. In cases where bed material delivery to the proposed reservoir could produce deltas with the potential to affect upstream fish migration, surveys of tributary channel geometry and bed material gradations based on samples collected during the reconnaissance will be coupled with selected bed material transport functions to calculate sediment yield rating curves. Long-term flow hydrographs synthesized for the ungaged tributaries will be needed from other studies for each of the selected tributaries to calculate sediment yields. Alternate approaches to quantifying sediment yield, such as previous studies of regional sediment yields (Guymon 1974), may also be considered.

To estimate the development of the deltas, the sediment yield results can be coupled with the physical constraints imposed by Project operations (i.e., variation in lake levels) on the topset and foreset slopes of the deltas to simulate growth and development of deltas throughout the period of the license (USBR 1987, Morris and Fan 1998). The volume of sediments deposited will be distributed within the topographic constraints of the reservoir fluctuation zone identified for the period when mainstem and tributaries are delivering significant sediment load. Consideration will be given to which portion of the sediment load would form the delta deposits based on settling characteristics.

5.8.4.8.2.3. Reservoir Erosion

Erosion and mass wasting potential will be assessed within the reservoir fluctuation zone and along the shoreline for 100 vertical feet above the proposed full pool elevation. The following potential erosion processes will be evaluated:

- Mass wasting;
- Surface erosion from sheetwash;
- Wave erosion (wind and boat wakes if motorized boat recreation is permitted);
- Solifluction, freeze-thaw, and melting of permafrost;
- Beach/bank development at full pool; and
- Erosion by ice movement on the reservoir surface.

The following existing spatial data will be collected:

- Topography (LiDAR as available);
- Geo-rectified aerial photography and recent stereo pairs to evaluate existing mass wasting sites;
- Geologic and soil mapping, including work done for the Susitna Hydroelectric Project (Acres 1982) and subsequent mapping by USGS and the Alaska Division of Geologic and Geophysical Surveys. This task will be coordinated with the Geology and Soils study; and
- Vegetation mapping; this task will be coordinated with the Botanical Resources study.

In addition, the following information will be obtained from other resource study leads:

- Expected reservoir surface elevation fluctuations (seasonal, daily, maximum hourly lowering rate) from Project Operation study;
- Expected motorized watercraft recreational use data (if any – from Recreation and Aesthetic Resource study);
- Daily air temperature (maximum/minimum) and wind (speed, direction) data from Water Quality study; and
- Expected ice development and movement within the reservoir from Ice Processes study.

The existing spatial data will be evaluated to determine if sufficient geologic and soil data are available to evaluate erosion and mass wasting potential. The mass wasting work will be coordinated with the Geology and Soils study and geotechnical investigations of the dam site and reservoir area that are planned under the geotechnical exploration and testing program. The geotechnical investigations for the dam site and reservoir will cover large deep rotational and block failures; the reservoir erosion study will cover shallow translational slides (added in response to FERC comment letter dated 31 May, 2012). The initial investigation will be completed by spring 2013. If additional soil/geologic mapping or data on soil characteristics are needed, field mapping and sample collection will occur during summer 2013 in coordination with the Geology and Soils, and geotechnical studies. This work could include mapping or collection of soil properties of interest in representative areas, including soil texture, depth, permafrost presence/absence, infiltration capacity, and cohesion.

The spatial data (topography, geology, soils, vegetation) will be used to prepare an erosion and mass wasting hazard map of the reservoir shoreline and inundation area. Areas with similar slope, soil, aspect, and potential wave fetch will be delineated. Areas above and below the full pool elevation will be mapped separately.

The erosion potential for representative erosion/mass wasting hazard polygons will be evaluated as follows:

- Mass wasting – evaluate potential for mass wasting based on slope gradient, soil properties, and anticipated pore pressures/fluctuations. This work will be carried out in coordination with the geotechnical investigation of the dam site and reservoir area. A GIS-based model such as SHALSTAB may be used to analyze shallow translational slides if sufficient data exist;

- Surface erosion from sheetwash – estimate surface erosion potential using WEPP and/or RUSLE;
- Wind (aeolian) erosion from exposed reservoir and delta surfaces and the floodplain downstream of Watana Dam will be evaluated using the USDA-NRCS WEQ (Wind Erosion Equation) or WEPS (Wind Erosion Production System) to provide information on dust production for the recreation and aesthetics studies (in response to request by USDOI-NPS in letter dated 24 May, 2012);
- Wave erosion (wind and boat wakes if motorized boat recreation is permitted) – estimate erosive energy of waves based on methods in Finlayson (2006) and Sherwood (2006);
- Solifluction, freeze-thaw, and melting of permafrost – evaluate potential based on soil properties, seasonal reservoir water elevations, and daily maximum/minimum temperatures;
- Beach/bank development at full pool – use the beach development model in Penner (Penner 1993, Penner and Boals 2000); and
- Erosion by ice movement on the reservoir surface – evaluate potential for ice erosion based on reservoir elevation and coordination with Ice Processes Study.

5.8.4.8.2.3.1. Bank and Boat Wave Erosion downstream of Watana Dam

It has been suggested that Project operations may cause increased bank erosion, cumulative to on-going erosion associated with boat waves, particularly during load-following operations (This effort was added based on requests from the agencies at the Water Resources TWG meeting on June 14, 2012). Load-following will primarily occur during the winter months when flows are relatively low (in the range of 5,000 cfs to 14,500 cfs). Boat activity is relatively infrequent (or not present due to ice conditions) during this period; thus, cumulative impacts of these two processes are very unlikely. Based on preliminary information, it appears that the lower portion of the bank that would be impacted by the load-following operations is well-armored with cobble-sized material; thus, additional erosion due to the load-following alone is unlikely. The Project may reduce flows and the associated river stage during the runoff period in late-spring and summer. During the initial phases of the study, data will be collected to assess the amount of armoring of the portion of the banks that will be impacted by load-following to assess whether or not bank erosion in this zone is likely. In addition, the bank material characteristics in the range of stages during the periods of frequent boat activity will be assessed under existing conditions and Project operations to determine if changes associated with the Project could cause an increase in bank erosion. If the information indicates the lower portion of the bank is not sufficiently armored and/or boat activity may cause an increase in erosion of the upper part of the bank, the magnitude of the potential effects will be investigated. Factors that may be considered include

- The potential effects of rapid changes in stage, and the associated pore-water pressures on bank stability during the load-following period;
- The typical wave climate and frequency of use of the types of boats that operate in the reach (it is assumed that the boat types and frequency of use will be available from the Recreation Studies); and

- The change in erosion potential associated with the boat waves due to the change in stage under Project operations during the period of primary boat activity.

5.8.4.8.3. Study Products

The results of the Reservoir Geomorphology component will be included in the Geomorphology Report. Information provided will include:

- Determination of average annual trap efficiencies for sediment by general size characterization (clays, silts, sands, and gravels);
- Estimate of average annual sediment loading to the reservoir from the potential primary sources including the upstream Susitna River, reservoir tributaries, and shoreline erosion;
- Estimate of reservoir life based on extrapolation of the sedimentation rate;
- Sediment outflow rating curves to serve as downstream supply for the Fluvial Geomorphology Modeling Study;
- Discussion of the tributary delta formation processes and characterization of the estimated size, vertical extent, and morphology (topset and foreset slopes) of the deltas at the selected tributary mouths;
- Discussion of potential erosion areas within the proposed reservoir, including erosion type, relative erosion potential, Project-related factors affecting erosion, and potential mitigation measures; and
- Map showing reservoir erosion hazard areas (completed in coordination with the geology/soils and geotechnical studies).

In addition, an ArcGIS Shapefile will be provided with the following information:

- Identification of all tributaries studied for potential tributary delta formation;
- Estimated footprint of delta formation for the selected tributaries; and
- Reservoir erosion hazard map units.

5.8.4.9. Study Component 9: Large Woody Debris

The goal of the Large Woody Debris study component is to assess the potential for Project construction and operations to affect the input, transport, and storage of large woody debris in the Susitna River. Specific objectives include

- Evaluation of large woody debris recruitment in the Middle and Lower River channels (including upstream of Watana Reservoir);
- Characterization of the presence, extent, and function of large woody debris downstream of the Watana Dam site; and
- Estimation of the amount of large woody debris that will be captured in the reservoir and potential downstream effects of Project operation.

The study area for the Large Woody Debris study component includes the Susitna River from the mouth (RM 0) upstream to the confluence with the Maclaren River (RM 260).

5.8.4.9.1. Existing Information and Need for Additional Information

The role of large woody debris in the development of channel morphology and aquatic habitat has been widely studied in meandering and anastomosing channels. Large wood and wood jams can create pool habitat, affect mid-channel island and bar development, and create and maintain anastomosing channel patterns and side channels (Abbe and Montgomery 1996 and 2003, Fetherston et al. 1995, Montgomery et al. 2003, Dudley et al. 1998). In addition, large wood can provide cover and holding habitat for fish and help create habitat and hydraulic diversity (summary in Durst and Ferguson 2000). Despite the wealth of large woody debris research, little is known of the role of large woody debris in the morphology and aquatic biology of braided, glacial rivers. Large woody debris may play a role in island formation and stabilization, as well as side channel and slough avulsion and bank erosion, although the role of large woody in altering hydraulics in the lower Susitna River may be limited due to the size of the river (J. Mouw, ADF&G, personal communication, May 14, 2012). Construction and operation of the Project has the potential to change the input, transport, stability, and storage of large woody debris downstream of the Watana Dam site by changes to the flow regime, ice processes, and riparian stand development, and interruption of wood transport through the reservoir. An assessment of the source, transport, and storage of large woody debris in the Susitna River and the role of large woody debris in channel form and aquatic habitat is needed to evaluate the magnitude of these effects. Construction and operation of the Susitna-Watana Project will likely alter large woody debris input and transport downstream of the Watana Dam site. An assessment of the source, transport, and storage of large woody debris in the Susitna River and the role of large woody debris in channel form and aquatic habitat would provide data on the current status of large wood in the river which, in conjunction with data from the studies of hydrology, geomorphology, riparian and aquatic habitat, and ice processes, would be used to determine the potential effects of Project operations on large wood resources. The information can also be used to determine whether protection, mitigation and enhancement (PM&E) measures, such as a large woody debris management plan and handling of wood that accumulates in the reservoir, are necessary.

5.8.4.9.2. Methods

Available recent and historic high-resolution aerial photography will be used to assess large woody debris characteristics in the Susitna River between the mouth and the Maclaren River. It is anticipated that large woody debris input, transport, and storage characteristics will vary along the length of the river. Four reaches have been initially delineated with distinct characteristics: downstream of the three rivers confluence; between the three rivers confluence and Devils Canyon; Devils Canyon; and upstream of Devils Canyon. However, the Geomorphically Similar River Segments delineated by the Aquatic Habitat and Geomorphic Mapping study will be used as a basis for final reach determination.

Large woody debris will be inventoried to the extent practical on the aerial photographs. Information regarding the sources of large woody debris, locations of large woody debris in the river channel, and the relationship of large woody debris to channel or slough habitat will be collected and correlated with bank erosion and riparian vegetation mapping from the geomorphology mapping and riparian habitat mapping studies to identify potential recruitment methods (Mouw 2011, Ott et al. 2001). If adequate historic aerial photographs are available, the stability of large wood pieces and jams between photo years will be assessed in representative areas of the river.

It is likely that not all wood will be able to be identified on the aerial photographs. As a supplement to large woody debris information obtained from aerial photographs, a reconnaissance assessment of large woody debris in the Susitna River will be made in coordination with aquatic/riparian habitat mapping in the summer of 2012. This assessment will be useful to direct more detailed field data collection in representative portions of the study area during the 2013-2014 study seasons. The objective of the 2013-2014 field studies will be to verify the large wood data collected from the aerial photographs and to provide more detailed field information on large wood input and storage. It is anticipated that the following types of large woody debris data will be collected as part of a field inventory of large wood in 2013-2014:

- GPS location (to correlate with geomorphology, aquatic, and riparian habitat mapping from other studies);
- Wood size class (based on diameter, length);
- Root wad status of attachment;
- Single piece, accumulation, or log jam;
- Decay class;
- Species if known;
- Input mechanism if known (windthrow, bank erosion, ice processes, etc.);
- Channel location (side; mid channel; side channel inlet, middle, outlet; associated with island or bar – and where on island or bar, etc.);
- In wetted or bankfull channel or potential input (leaning over bankfull channel);
- Function (scour pool, bar forming, island forming, side channel inlet protection, bank protection, aquatic cover, etc.); and
- For log accumulations and jams: key piece size.

The aerial photograph and field inventories of large wood will be used to determine large wood input processes, large wood transport and storage, and how large wood is functioning in the Susitna River to influence geomorphic, riparian, and aquatic habitat processes. Based on estimated large wood input and transport upstream of the Watana Dam site, the potential effects of reservoir operation on trapping upstream large wood will be assessed. In addition, the potential for operation of the Project to alter large wood input and transport downstream of the dam site will be analyzed. The analysis will require coordination with other geomorphology component studies, and the sediment transport, ice processes, riparian habitat, aquatic habitat, and instream flow studies.

5.8.4.9.3. Study Products

The results of the large woody debris component will be included in the Geomorphology Report. Information provided will include

- Existing large woody debris input mechanisms and source areas;
- Existing large woody debris loading by geomorphic zone;
- Observations and discussion of how large woody debris is currently functioning in the Susitna River;
- Discussion of potential for Project construction and operation to affect large woody debris input and transport in the Susitna River; and
- Map showing current large woody debris loading.

In addition, an ArcGIS Shapefile will be provided with the following information:

- Location of large woody debris mapped from aerial photographs and during field visits.

5.8.4.10. Study Component 10: Geomorphology of Stream Crossings along Transmission Lines and Access Alignments

The goal of the Geomorphology of Stream Crossings along Transmission Lines and Access Alignments study is to characterize the existing geomorphic conditions at stream crossings along access road/transmission line alignments and to determine potential geomorphic changes resulting from construction, operation, and maintenance of the roads and stream crossing structures.

5.8.4.10.1. Existing Information and Need for Additional Information

Development of the Watana Dam would require road transportation from either the Denali Highway or the railroad near Gold Creek or Chulitna to the dam site as well as a transmission line from the powerhouse to an existing transmission line intertie. Construction, use, and maintenance of the roads and transmission lines have the potential to affect stream geomorphology if stream crossing structures constrict flow or alter transport of sediment or large wood, or if sediment is delivered to the streams from erosion of the road prism.

Three different access/transmission alignments are currently being considered (Figure 5.8-4). The alignments are designated as Denali, Chulitna, and Gold Creek. The Alaska Department of Transportation/Public Facilities (ADOT&PF) evaluated potential access corridors, including the Denali and Chulitna options (HDR 2011). The analysis considered the number of stream crossings as one criterion, among many others, during the screening process, but a detailed analysis of the geomorphic effects of the stream crossings on bedload transport, large woody debris, and channel functions was not conducted.

A road in the Denali Alignment would cross Seattle Creek and Brushkana Creek, two major drainages within the Nenana River watershed and Deadman Creek within the Susitna River watershed. A road in this alignment would require a total of 15 stream crossings. A Gold Creek access alignment would require 23 stream crossings. The major streams that would be crossed by the Gold Creek access alignment include Gold Creek, Fog Creek, and Cheechako Creek. Smaller streams crossed include tributaries to Prairee and Jack Long creeks, and a number of unnamed tributaries to the Susitna River. A road in the Chulitna alignment would require about 30 stream crossings including the Indian River, and Thoroughfare, Portage, Devils, Tsusena, and Deadman creeks. The Chulitna alignment would also cross 10 small, unnamed tributaries of

Portage Creek, three small tributaries of Devils Creek, seven smaller tributaries to the upper Susitna River, and two tributaries of Tsusena Creek. Construction of Project access roads and transmission lines would require stream crossing structures. Stream crossing structures have the potential to affect stream geomorphology by

- Altering hydraulics upstream and downstream of the crossing if flow is constricted. This can lead to sediment deposition upstream of the crossing or bank erosion/channel incision downstream;
- Altering migration of streams across a floodplain;
- Inhibiting movement of large woody debris; and
- Increasing sediment delivered to a stream if road erosion is occurring near stream crossings.

Data collected during this study would help to determine the potential for proposed stream crossings to affect stream hydraulics, morphology, sediment transport, and large woody debris transport. This analysis would also provide data needed for design of appropriate stream crossing structures and PM&E measures to minimize effects.

5.8.4.10.2. Methods

The following data would be obtained from existing sources:

- Topography at stream crossings;
- Aerial photography of stream crossings;
- Crossing design – information on the culvert or bridge characteristics planned at each crossing will be obtained from Project engineering designs (HDR 2011 and subsequent reports); and
- Road design – information on the proposed road prism in the vicinity of stream crossings will be obtained from Project engineering designs, including surfacing, gradient, expected traffic levels, and road prism width.

A field assessment of each stream crossing along routes being considered will be made during the summer of 2013. Fieldwork will be carried out in conjunction with the Aquatic Resources Study (Access Alignment, Transmission Alignment and Construction Area component), if possible. The following geomorphic information will be collected for each stream crossing:

- Stream characteristics – gradient, wetted and bankfull width, and depth;
- Substrate characteristics – existing substrate size and description of relative sediment loading (based on field evidence of fresh deposits, large gravel bars, etc.);
- Existing large woody debris size and loading;
- Geomorphic channel type (Rosgen classification is recommended by the USFS in their study request dated 31 May, 2012) and confinement;
- Existing and potential for bank erosion will be measured or evaluated for a minimum of 100 feet upstream and downstream of each proposed crossing; and

- Potential for channel migration will be evaluated from aerial photographs if available, supplemented by field/aerial observations.

The potential effects of stream crossings on geomorphology will be analyzed based on stream characteristics and the proposed design of crossing structures. The evaluation will include

- Channel morphology, sediment dynamics – the hydraulic characteristics and bedload transport capacity of existing channel and of proposed crossing structures will be estimated and compared. Guidelines in the existing stream crossing design MOU will be considered (ADOT&PF 2001);
- Channel migration zone – the existing channel migration zone will be mapped for alluvial channels that show evidence of migration across the floodplain. Effects of proposed crossing structures on channel migration will be analyzed;
- Large woody debris transport – potential effects on large woody debris transport will be evaluated based on channel crossing type and width. The potential for culvert plugging will be ranked based on observed large woody debris size in the stream and proposed culvert size; and
- Erosion and delivery of road sediment to stream – erosion from any unpaved roads will be estimated using the WEPP or SEDMODL algorithms. Wind (aeolian) erosion from unsurfaced areas (roads, parking areas, airstrip, etc.) will be evaluated using the US EPA methodology (AP-42) to provide information on dust production for the recreation and aesthetics studies (This effort added in response to request by USDOI-NPS in letter dated 24 May, 2012).

5.8.4.10.3. Study Products

The results of the Geomorphology of Stream Crossings along Transmission Lines and Access Alignments component will be included in the Geomorphology Report. This will include a discussion of the potential effects of road/transmission alignments on

- Channel migration zones (potential effects of crossings on stream and vice versa);
- Channel aggradation/erosion upstream and downstream of crossing;
- Blocking large woody debris transport; and
- Increased turbidity/sediment input to streams.

5.8.5. Consistency with Generally Accepted Scientific Practice

The methods described for the geomorphology are similar to those used for other recent hydroelectric project licensing procedures and follow current scientific literature (see literature cited, section 5.8.8).

- The geomorphic classification component will use a combination of the numerous river classifications that currently exist (Leopold and Wolman 1957, Schumm 1963 and 1968, Mollard, 1973, Kellerhals et al. 1976, Brice 1981, Mosley 1987, Rosgen 1994 and 1996, Thorne 1997, Montgomery and Buffington 1997, Vandenberghe 2001).

- The bedload and suspended load data collection component will be conducted by USGS using its currently accepted field methods.
- The sediment supply and transport in the middle and lower river component will use published USGS sediment and flow data and USGS-endorsed correction factors to develop rating curves (Cohn and Gilroy 1992, Duan 1983). Bed mobilization and effective discharge will be computed using currently recognized methods (Mueller et. al. 2005, Biedenharn et al. 2000).
- The geomorphic change analysis and habitat versus flow components will use geo-rectified aerial and satellite images to compare the river between years and flows. These methods are widely used to compare changes in river systems.
- The reconnaissance level assessment of geomorphic change in the lower river will utilize published USGS flow and sediment data and the analytical framework developed by Grant et al (2003).
- The reservoir geomorphology study will use several widely-accepted methods to calculate sediment trap efficiency (Churchill 1948, Brune 1953, Einstein 1965, Miller 1953, Lara and Pemberton 1965, Chen 1975). The delta formation study will use methods developed and applied at similar projects (e.g. Boundary Hydroelectric Project, FERC 2144) to analyze delta formation. Reservoir erosion will use models and analysis methods developed and widely used for either general erosion (e.g. SHALSTAB, WEPP/RUSLE) or for reservoir-based beach development (Penner 1993, Penner and Boals 2000).
- The large woody debris study, large wood inventory will be based on widely-used methods (Shuett-Hames et al. 1999).
- The geomorphology of stream crossings along transmission and access alignments will use guidelines from the existing stream crossing design MOU (ADOT&PF 2001) along with site-specific analyses of channel dynamics.

5.8.6. Schedule

The primary field effort is the USGS data collection effort (Study Component 2). It will be conducted in the late spring and summer of 2012. Provisional results of the data collection effort will be delivered to the other studies as soon as they are available from the lab during fall 2012. Suspended and bedload data, including calculation of sediment transport ratings and daily loads, will be compiled in a technical memorandum delivered early in FY 2013.

Performing the digitization of the 2012 aerial photography is dependent on the AEA SDC being able to fly the aerials at the appropriate discharge. The only portions of this effort that can be completed in 2012 are for flows for which the current aerial photographs are supplied in orthorectified format by November 15, 2012. The most critical discharge in regard to schedule is the 5,100 cfs since there are years when the Susitna at Gold Creek does not fall to this level until late October or early November.

Table 5.8-1. Geomorphology Study implementation schedule

Study Component	Field Effort	Estimated Completion
1 Geomorphic River Segment Delineation	NA	Summer 2012
2 Sediment Data Collection	Summer 2012	Summer 2012
3 Sediment Supply and Transport Assessment	NA	Sum 2012/ Fall 2013[1]
4 Geomorphic Change Middle and Lower River	NA	Summer 2012
5 Riverine Habitat Middle River	NA	Winter 2012
6 Recon Assessment Lower River Project Effects	Summer 2012	Summer 2012
7 Riverine Habitat Lower River	NA	Winter 2012
8 Reservoir Geomorphology	Summer 2013	Spring 2014
9 Large Woody Debris	Summer 2013	Summer 2014
10 Geomorphology of Stream Crossings	Summer 2013	Summer 2104
11 Initial Study Report		December 2013
12 Updated Study Report		December 2014

[1] Lower River sediment supply and transport to be completed in summer 2012, remainder of study component to be completed by fall 2013

5.8.7. Level of Effort and Cost

Initial planning level estimates of the costs to perform the components of the Geomorphology Study are provided in the table below. The total effort for the Geomorphology Study, including component 2 Sediment Data Collection to be performed by the USGS, is estimated to cost between approximately $1.2 million and $1.8 million.

Table 5.8-2. Geomorphology Study cost

Study Component	Estimated Cost Range
1 Geomorphic River Segment Delineation	$60k to $80k
2 Sediment Data Collection	$400k to $550k
3 Sediment Supply and Transport Assessment	$60k to $90k
4 Geomorphic Change Middle and Lower River	$80k to $120k[1]
5 Riverine Habitat Middle River	$200k to $300k[1]
6 Recon Assessment Lower River Project Effects	$40k to $60k
7 Riverine Habitat Lower River	$100k to $150k[1]
8 Reservoir Geomorphology	$140k to $180k
G-1.9 Large Woody Debris	$80k to $120k
G-1.10 Geomorphology of Stream Crossings	$80k to $140k

[1] Includes acquisition of orthorectified aerial imagery

5.8.8. Literature Cited

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5.8.9. Figures

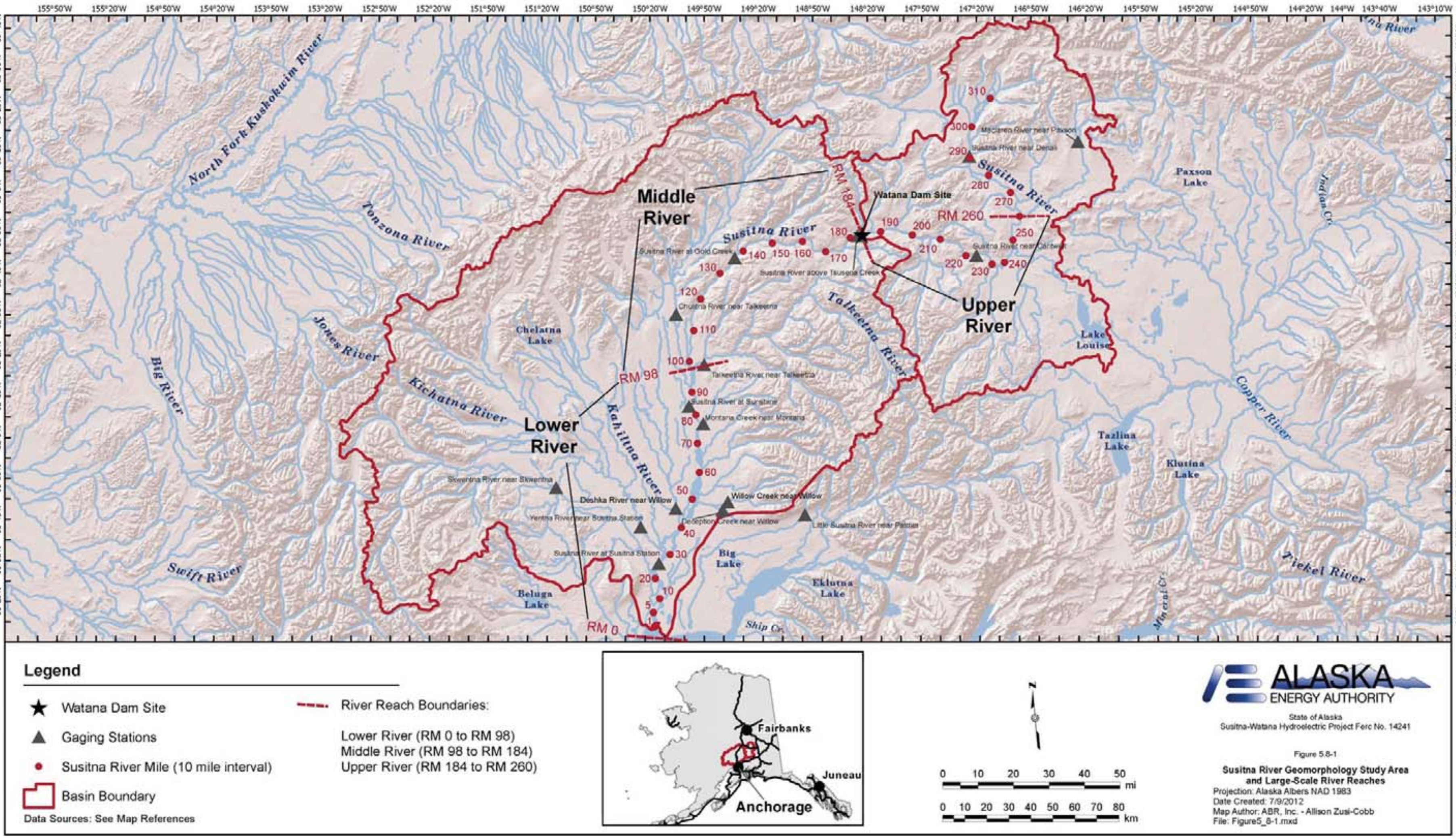

Figure 5.8-1. Susitna River Geomorphology study area and large-scale river reaches.

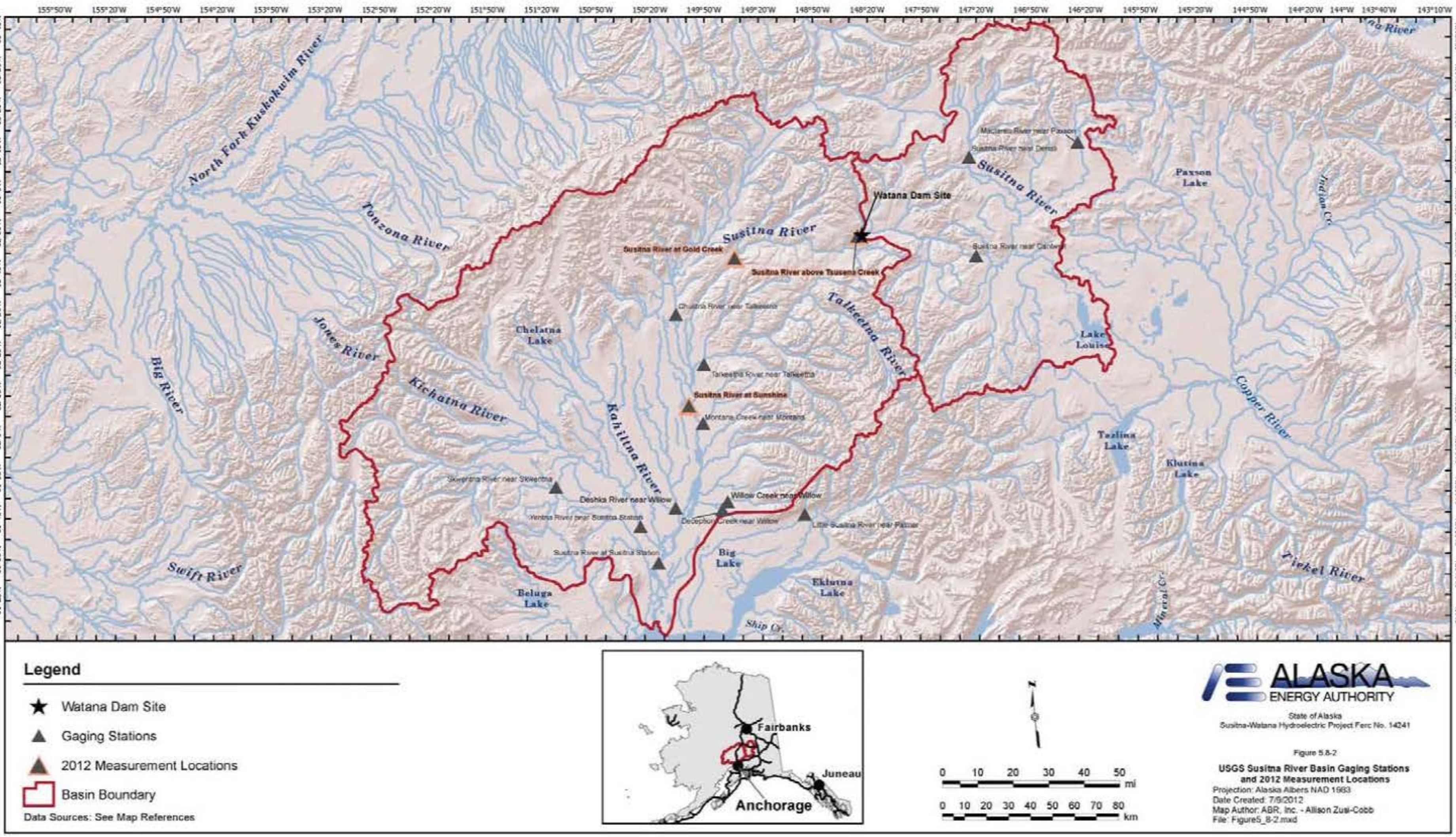

Figure 5.8-2. USGS Susitna River basin gaging stations and 2012 measurement locations.

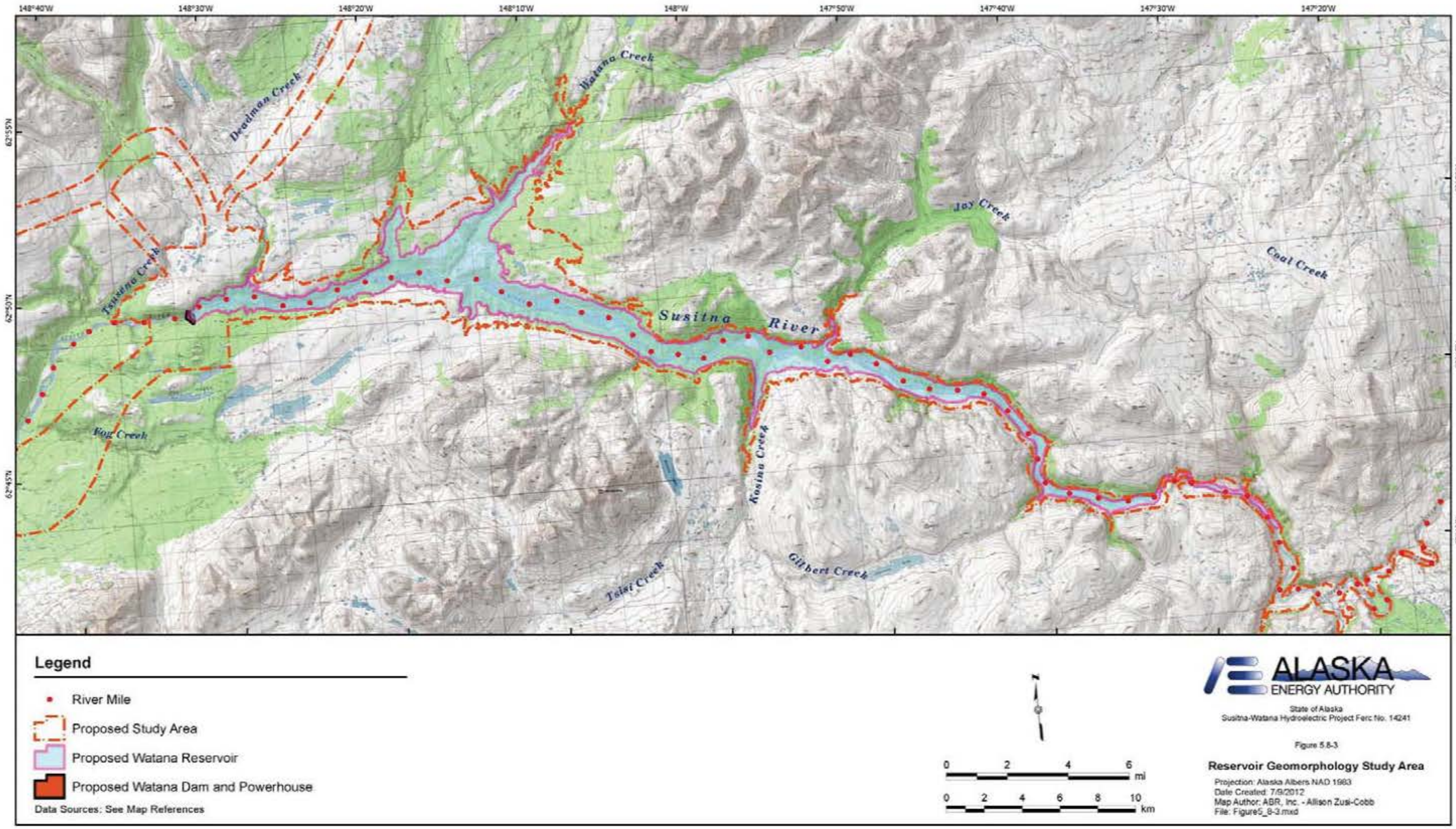

Figure 5.8-3. Susitna-Watana Geomorphology Study reservoir geomorphology study area.

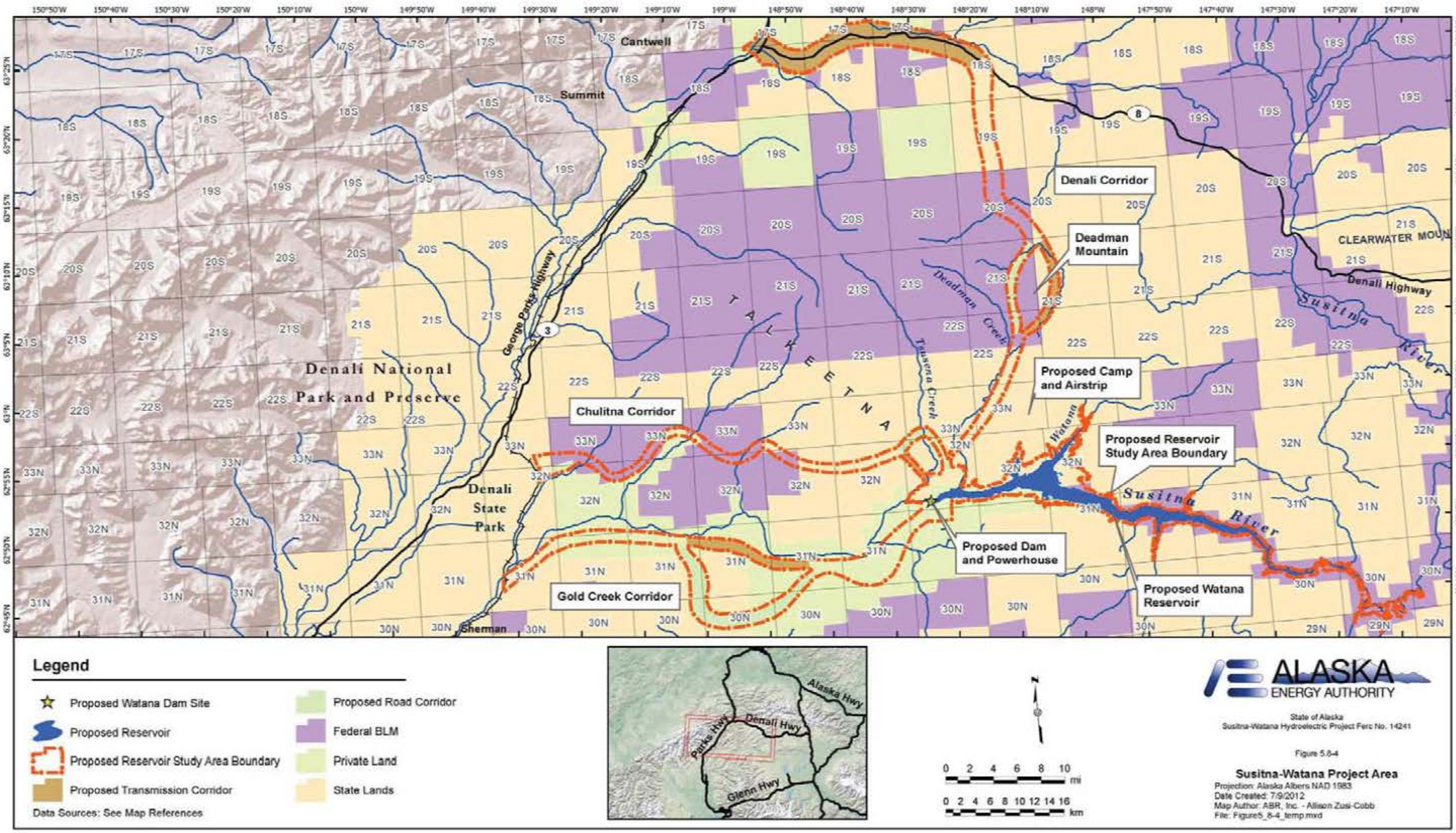

Figure 5.8-4. Susitna-Watana access corridors.

5.9. Fluvial Geomorphology Modeling below Watana Dam Study

5.9.1. General Description of the Proposed Study

The overall goal of the Fluvial Geomorphology Modeling below Watana Dam Study is to model the effects of the proposed Susitna-Watana Hydroelectric Project (Project) on the fluvial geomorphology of the Susitna River. More specifically, the purpose of the modeling study, along with the Geomorphology Study, is to assess the potential impact of the Project on the dynamic behavior of the river downstream of the proposed dam, with particular focus on potential changes in instream and riparian habitat. Whether the existing channel morphology will remain the same or at least be in "dynamic equilibrium" under post-Project conditions is a significant question in any instream flow study (i.e., Is the channel morphology in a state of dynamic equilibrium such that the distribution of habitat conditions will be reflected by existing channel morphology or will changes in morphology occur that will influence the relative distribution or characteristics of aquatic habitat over the term of the license? [Bovee 1982]). This key issue prompts four overall questions that must be addressed by the two Geomorphology Studies:

- Is the system currently in a state of dynamic equilibrium?
- If the system is not currently in a state of dynamic equilibrium what is the expected evolution over the term of the license?
- Will the Project affect the morphologic evolution of the Susitna River compared to pre-Project conditions?
- If the Project will alter the morphology of the river what are the expected changes over the term of the license?

The methods and results from the Geomorphology Study and the Fluvial Geomorphology Modeling Study will address these questions.

Specific objectives of this study are:

- Model channel formation processes in the Susitna River downstream of the proposed Watana Dam site;
- Estimate the potential for channel change for with-Project operations; and
- Coordinate with other studies to provide channel output data.

5.9.2. Existing Information and Need for Additional Information

Sediment transport issues downstream of Watana Dam are expected to stem from the influences of the regulated outflows and the deficit of sediment due to trapping in the reservoir. These issues are particularly important because fish resources have the greatest potential to be impacted by the Project, and most of the potential impacts would occur downstream of the Project (AEA 2010). The effect of altered flows on anadromous and resident fish habitats and their associated populations was the major focus of studies conducted in the 1980s (APA 1984). The major fish habitats are located in the Susitna River, side channels, side sloughs, upland sloughs, and tributary mouths (APA 1984).

Modeling of the hydraulics of the Susitna River below the previously proposed project, a necessary step in developing a sediment transport model, was performed in the 1980s. This work included development and application of one-dimensional HEC-2 hydraulic models to support the calculation of water-surface profiles and channel hydraulics (Acres 1983). The models represented the reach between Devils Canyon (Susitna RM 186.8) and Talkeetna (RM 99), excluding Devils Canyon (Susitna RM 162.1 to RM 150.2). The Aquatic Resources Data Gap Analysis (HDR 2011) indicates that sediment transport modeling of a portion of the Susitna River was also undertaken. Realizing the complexity of the sediment transport problem at the Chulitna River confluence, APA commissioned the Iowa Institute of Hydraulic Research to develop a quasi-steady, one-dimensional numerical model of sediment transport for the 14-mile reach of the Susitna River from the Chulitna confluence downstream to Sunshine Station (Holly 1985). The model was based on sediment transport data from 1981 and 1982, as the following years of data collection had not yet been completed. The topography was derived from 28 cross-sections (approximately 1 every ½ mile) measured by R&M Consultants and aerial photography (Ashton and R&M 1985). The model was still in development as of the writing of the 1985 report; however, the companion report, referenced in Holly (1985), was not found in the Susitna documentation.

The Aquatic Resources Data Gap Analysis (HDR 2011) indicates that channel equilibrium, an important macrohabitat variable, was not addressed in the APA Project instream flow study. The question of whether the existing channel morphology will remain the same, or at least be in "dynamic equilibrium", once the proposed action is implemented is a significant question in an instream flow study. Instream flow versus habitat relationships developed for today's river assumes that similar relationships will persist for the duration of the project, within a reasonably defined range of variability. In the case of the proposed Project instream flow study, the question is whether the river is currently in a state of equilibrium or disequilibrium. If it is in a state of disequilibrium, will the state be exacerbated or reversed as a result of the Project? If it is exacerbated or reversed, the impact of the Project cannot be assessed without estimating a post-Project channel configuration (Bovee et al. 1998). The same holds true if the river is currently in a state of equilibrium and shifts to disequilibrium for a significant period of time with the Project in place.

The AEA Susitna Water Quality and Sediment Transport Data Gap Analysis Report (URS 2011) concluded: "Numerical modeling of the sediment transport dynamics would provide a basis for comparing the changes in channel morphology and aquatic habitat associated with the proposed Project and the proposed operations." The Fluvial Geomorphology Modeling below Watana Dam Study addresses the need to develop a sediment transport model of the Susitna River. It was also indicated in the Data Gap Analysis Report (URS 2011) that further quantification of the sediment supply and transport capacity would help identify the sensitivity of the channel morphology (and associated aquatic habitats) to the effects of the proposed Susitna-Watana Project. The report indicated that information on sediment continuity could provide a basis for evaluating whether the Susitna River below the Chulitna confluence would be at risk of aggradation, and if so, whether the magnitude would alter aquatic habitats and hydraulic connectivity to these habitats. URS (2011) also pointed out that side channels and sloughs are of particular importance to fisheries, and changes to the relationships between flow and stage at which the habitats are accessible could impact the fisheries. These relationships can be affected by not only flow distribution, but also changes in the bed elevations due to sediment transport processes. Other impacts to the sediment transport regime could affect the cleaning of spawning gravels, hyporheic flows through redds, groundwater inflows, and hydraulic connectivity for out migration to the main channel.

A more specific description of existing information and the need for additional information for each modeling study component is provided in the appropriate subsections of Section 5.10.4, below.

5.9.3. Study Area

The potential study area is the portion of the Susitna River from Watana Dam (RM 184) downstream to its mouth at the Cook Inlet (RM 0). The downstream limit of the modeling effort will be determined based on results of the Geomorphology Study concerning the potential for the Project to affect channel morphology, and in coordination with other studies and the agencies. As a minimum, the study area for this effort includes the entire Middle River from the Watana Dam site (RM 184) downstream to the three rivers confluence area (RM 98). (Note: Modeling of Devils Canyon will not be performed because this reach is considered too dangerous to perform cross section and other surveys needed to develop the model. Devils Canyon will be assumed to be a stable, pass-through reach in terms of sediment transport due to the high level of bed rock control and steep gradient present in this reach).

The spatial extent of the Lower River modeling effort has not been determined; however, as a minimum the 1D modeling will be continued downstream into the Lower River to at least Sunshine Station (RM 84) (see below for a discussion of the 1D and 2D modeling approach). The decision on whether to continue the 1D modeling further downstream in the Lower River and whether detailed 2D modeling sites will be included in the Lower River will be made based on an assessment of the potential for the Project to affect channel morphology in this portion of the reach. An initial assessment of potential Project effects is being conducted in 2012 as part of the Geomorphology Study.

The results of this 2012 effort will be presented to and reviewed by the licensing participant to perform the first check-in as to whether the fluvial geomorphology modeling should be continued below RM 84. The second check-in of the downstream extent will be based on the 1D fluvial geomorphology modeling. If the results of the modeling effort show differences between existing and the modeled with-Project conditions that are beyond the range of natural variability then the 1D modeling will be continued further downstream in the Lower River. In addition, the need for adding 2D modeling sites in the Lower River will be determined through consultation with the licensing participants and other pertinent study leads (NOAA-NMFS and USFWS requested as a minimum the 1D modeling extend to Sunshine Station [study requests dated May 31, 2012]. Discussions at the TWG meeting on June 14, 2012 defined the process for evaluating further downstream extension of the modeling).

The 2D models will be used to evaluate the detailed hydraulic and sediment transport characteristics on smaller, more local scales where it is necessary to consider the more complex flow patterns to understand and quantify the issue(s). The 2D models will be applied to specific detailed study sites, within the selected 1D modeling area, that are representative of important habitat conditions and the various channel classification types. These sites will be chosen in coordination with the Instream Flow, Riparian Instream Flow, Ice Processes and Fish studies to facilitate maximum integration of available information among the studies. Sites will be chosen such that there is one 2D site for each geomorphic reach type (except Devils Canyon) and the sites will cover the range of riverine aquatic habitat types. At least one unstable site, likely representative of a braided channel reach, will be included in the 2D sites. 2D modeling will also be considered at the primary tributary deltas based on screening that considers the importance to the existing fishery and the potential for adverse project effects. 2D modeling is likely to include the Three Rivers Confluence area (the distribution of the 2D sites is based on the study requests submitted by NOAA-NMFS and USFWS on May 31, 2012 and discussions during the June 14, 2012 Water Resources TWG meeting).

5.9.4. Study Methods

The Fluvial Geomorphology Modeling below Watana Dam is divided into three study components:

- Bed Evolution Model Development, Coordination, and Calibration,
- Model Existing and with-Project Conditions, and
- Coordination on Model Output.

Each of these components is explained further in the following subsections.

5.9.4.1. Study Component: Bed Evolution Model Development, Coordination and Calibration

The overall goal of the Bed Evolution Model Development, Coordination and Calibration study component is to develop a model that can simulate channel formation processes in the Susitna River downstream of Watana Dam.

5.9.4.1.1. Existing Information and Need for Additional Information

Modeling of hydraulics of the Susitna River below the proposed Project, a necessary step in developing a sediment transport model, was performed in the 1980s. One-dimensional HEC-2 hydraulic models were developed in the 1980s to support the calculation of water-surface profiles and channel hydraulics (Acres 1983). However, the 1980s effort did not include sediment transport modeling. Both 1D and 2D sediment transport models are required to characterize the bed evolution for both the existing and with Project conditions in the Susitna River. This study component involves the selection and development of the sediment transport models.

5.9.4.1.2. Methods

The Bed Evolution Model Development, Coordination and Calibration study component is divided into three tasks:

- Development of Bed Evolution Modeling Approach and Model,
- Coordination with other Studies on Processes Modeled, and
- Calibration/Validation of the Model.

5.9.4.1.2.1. Development of Bed Evolution Model Approach and Model Selection

Development of the bed evolution model for a dynamic system such as the Susitna is a complex undertaking that requires considerable investigation and coordination. The work in the Lower and Middle River contained in the Geomorphology Study provides a considerable part of the required investigation. Based on the study results and input from the Reservoir Operations and Flow Routing Model Development, Instream Flow, Instream Flow Riparian, Ice Processes, and

Fish studies, models will be developed that represent the physical processes that control the dynamic nature of the Susitna River, and that will provide other studies with the required information on the potential changes in the channel and floodplain for their analyses.

Some of the important steps in the development of the modeling approach and model are:

- Review and understand available data,
- Develop an understanding of the dominant physical processes and governing physical conditions in the study reach,
- Coordinate with other studies to understand their perspective on system dynamics, and the physical features and processes that are important to their studies,
- Identify an overall modeling approach that is consistent with the study goals, the constraints on information that is currently available or can practically be obtained, and the needs of the other studies ,
- Identify a modeling approach that is consistent with the spatial and temporal scale of the area to be investigated,
- Determine the spatial limits of the modeling effort,
- Determine the time scales for the various models,
- Review potential models and select a model(s) that meets the previously-determined needs and conditions,
- Identify data needs and data gaps for the specific model and study area being investigated,
- Collect the required data to fill data gaps,
- Develop the model input,
- Identify information to be used to calibrate and validate the model,
- Perform initial runs and check basic information such as continuity for water and sediment, hydraulic conditions, magnitude of sediment transport, and flow distributions,
- Collaborate with other studies on initial model results,
- Refine model inputs,
- Perform calibration and validation efforts, to include comparison of modeled water-surface elevations, in-channel hydraulic conditions (e.g., velocity and depth), sediment transport rates, and aggradation/degradation rates with available measured data,
- Perform model runs for existing conditions to provide a baseline for comparison of with-Project scenarios,
- Work with other studies to develop scenarios to evaluate the potential Project effects, and apply the model to those scenarios,
- Coordinate with other studies to evaluate and define the appropriate format for presentation of the model results, and

- Develop and run additional scenarios, as necessary, based on results from the initial scenarios and identified project needs.

The following subsections outline the identified issues to be considered and summarize the development of the modeling approach, the model selection, and the model development.

Issues to be Considered: To develop the modeling approach, specific issues that need to be addressed have been identified. These specific issues have been further differentiated into reach-scale and local-scale issues since the scale influences the proposed approach.

<u>Reach-Scale Issues:</u> Reach-scale issues refer to aspects of the system that involve the overall behavior and general characteristics of the Susitna River over many miles. Each reach represents a spatial extent of the Susitna River that has a consistent set of fluvial geomorphic characteristics. Reach-scale issues include:

Historical changes in the system and the existing status with respect to dynamic equilibrium:

- Changes in both the bed material (sand and coarser sizes) and wash (fine sediment) load sediment supply to the system due to trapping in Watana Reservoir.
- Long-term balance between sediment supply and transport capacity and the resulting aggradation/degradation response of the system for pre- and post-Project conditions.
- Changes in bed material mobility in terms of size and frequency of substrate mobilized due to alteration of the magnitude and duration of peak flows by the Project.
- Project-induced changes in supply and transport of finer sediments that influence turbidity.
- Potential for changes in channel dimensions (i.e., width and depth) and channel pattern (i.e., braiding versus single-thread or multiple-thread with static islands) due to the Project and the magnitude of the potential change.
- Project-induced changes in river stage due to reach-scale changes in bed profile, channel dimensions, and potentially hydraulic roughness.

<u>Local-Scale Issues:</u> Local-scale issues refer to aspects of the system that involve the specific behavior and characteristics of the Susitna River at a scale associated with specific geomorphic and habitat features. Local-scale issues are addressed using a more detailed assessment over a smaller spatial area; however, these analyses must draw from and build upon the understanding and characterization of the system behavior as determined at the reach scale. Local-scale issues include:

- Processes responsible for formation and maintenance of the individual geomorphic features and associated habitat types.
- Potential changes in geomorphic features and associated aquatic habitat types that may result from effects of Project operation on riparian vegetation and ice processes.
- Effects of changes in flow regime and sediment supply on substrate characteristics in lateral habitat units.

- Changes in upstream connectivity (breaching) of lateral habitats due to alteration of flow regime and possibly channel aggradation/degradation. These changes may induce further changes in the morphology of lateral habitats, including:
  - Potential for accumulation of sediments at the mouth.
  - Potential for accumulation of fines supplied during backwater connection with the main stem.
  - Potential for changes in riparian vegetation that could alter the width of lateral habitat units.
- Project effects at representative sites on the magnitude, frequency and spatial distribution of hydraulic conditions that control bed mobilization, sediment transport, sediment deposition and bank erosion.
- Potential for change in patterns of bed load deposits at tributary mouths that may alter tributary access or tributary confluence habitat, as discussed below.

Tributary confluences are areas of interest for determining the potential Project effects on sediment transport and morphology. Modeling of tributary deltas is discussed as a separate topic from the mainstem.

<u>Synthesis of Reach-Scale and Local-Scale Analyses:</u> The final step in the effort will be the synthesis of the reach-scale and local-scale analyses to identify potential Project-induced changes in the relative occurrence of aquatic habitat types and associated surface area versus flow relationships. In addition to the results of the hydraulic and sediment transport modeling, this synthesis will require application of fluvial geomorphic relationships to develop a comprehensive and defensible assessment of potential Project effects. Examples of this type of integrated analysis that have been successfully performed by the project team include instream flow, habitat and recreation flow assessments to support relicensing of Slab Creek Dam in California; a broad range of integrated geomorphic assessments and modeling to assist the Platte River Recovery Implementation Program in Central Nebraska; and ongoing work to support the California Department of Water Resources and Bureau of Reclamation to design restoration measures for the San Joaquin River in the Central Valley of California downstream of Friant Dam.

Development of Modeling Approach: The proposed modeling approach considers the need to address both reach-scale and local-scale assessments and the practicality of developing and applying various models based on data collection needs, computational time, analysis effort and model limitations. Based on these considerations, an approach that uses 1D models to address reach-scale issues and 2D models to address local-scale issues is proposed. Considering the broad physical expanse of the Susitna River system, the general hydraulic and sediment transport characteristics of the various subreaches that make up the overall study area will be evaluated using 1D computer models and/or established hydraulic relationships. The 2D models will be used to evaluate the detailed hydraulic and sediment transport characteristics on smaller, more local scales where it is necessary to consider the more complex flow patterns to understand and quantify the issues. The 2D models will be applied to specific detailed study sites that are representative of important habitat conditions - the various channel classification types and selected primary tributaries. These sites will be chosen in coordination with the licensing participants and the Instream Flow, Riparian Instream Flow, Ice Processes and Fish studies to facilitate maximum integration of available information between the studies.

The proposed approach to integrating 1D modeling at the reach-scale and 2D modeling at the local–scale will provide the following advantages:

- 1D modeling will allow for efficient assessment of the hydraulic conditions and sediment transport balance over the length of the study reach downstream of Watana Dam.
- The 1D model uses cross-sectional data that are being obtained as part of the Flow Routing and Instream Flow studies. (Note that some supplemental cross sections may be required for the 1D sediment transport model.)
- The 1D model will provide the boundary conditions for the 2D model, including starting water-surface elevations and upstream sediment supply.
- 2D modeling applied at the detailed study sites that are also chosen for the Ice Processes and Riparian Instream Flow studies will allow for the fullest level of integration of these efforts, particularly as they relate to assessments of potential changes in channel width and pattern for this study.
- 2D modeling at the detailed study sites will provide an understanding of the hydraulic conditions and sediment transport processes that contribute to formation of individual habitat types.
- 2D modeling provides a much more detailed and accurate representation of the complex hydraulic interaction between the main channel and the lateral habitats than is possible with a 1D model.

Model Selection: Many computer programs are available for performing movable boundary sediment-transport simulations. The choice of an appropriate model for this study depends on a number of factors, including: 1) the level of detail required to meet the overall project objective(s), 2) the class, type, and regime of flows that are expected to be modeled, and 3) the availability of necessary data for model development and calibration. While 2D modeling would provide the most comprehensive assessment of hydraulic and sediment transport conditions in the study reach, the extent of required data, effort required for model development, and computational time required for execution to model the entire system make this impractical. Considering the very broad physical expanse of the overall Susitna River system, a one-dimensional (1D) computer model and/or engineering relationships that can be applied in a spreadsheet application is the most practical approach to modeling overall system behavior at the scale of the study reach. 2D modeling will then be used for evaluating the detailed hydraulic and sediment-transport characteristics that control the complex geomorphic features and habitat at the local scale. A variety of candidate models will be evaluated for application on the Susitna River. Potential candidate models for the 1D and 2D portions of the study are discussed below.

General Discussion of 1D Models: Most 1D movable boundary sediment-transport models are designed to simulate changes in the cross sectional geometry and river profile due to scour and deposition over relatively long periods of time. In general, the flow record of interest is discretized into a quasi-unsteady sequence of steady flows of variable discharge and duration. For each model time-step and corresponding discharge, the water-surface profile is calculated using the step-backwater method to compute the energy slope, velocity, depth, and other hydraulic variables at each cross section in the network. The sediment-transport capacity is then calculated at each cross section based on input bed material information and the computed hydraulics, and the aggradation or degradation volume is computed by comparing the transport capacity with the upstream sediment supply (i.e., the supply from the next upstream cross section for locations not identified as an upstream boundary condition). The resulting aggradation/degradation volume is then applied over the cross-section control volume (i.e., the sub-channel concept), and the shape of the cross section is adjusted accordingly. Because the sediment-transport calculations are performed by size fraction, the models are capable of simulating bed material sorting and armoring. The computations proceed from time-step to time-step, using the updated cross-sectional and bed material gradations from the previous time-step.

1D sediment-transport models should not be applied to situations where 2- and 3-dimensional flow conditions control the sediment-transport characteristics because they do not consider secondary currents, transverse movement and variation, turbulence, and lateral diffusion; thus, the models cannot simulate such phenomena as point bar formation, pool-riffle formation, and planform changes such as river meandering or local bank erosion. 1D models typically distribute the volume of aggradation or degradation across the entire wetted portion of the channel cross section after each time-step; thus, the effects of channel braiding are also not directly considered. 1D models are, however, useful in evaluating the general sediment-transport characteristics and overall sediment balance of a given reach, and they are also useful in providing boundary conditions for localized 2D models.

<u>Potential 1D Models:</u> 1D models that are being considered for this study include the Corps of Engineers HEC-RAS (version 4.1; USACE 2010a), the Bureau of Reclamations SRH-1D (version 2.8; Huang and Greimann, 2011), DHIs MIKE 11 (version 2011; DHI, 2011), and Mobile Boundary Hydraulics HEC-6T (version 5.13.22_08; MBH, 2008). A summary of each of these models, including potential benefits and limitations, are summarized in the following sections.

- **HEC-RAS:** HEC-RAS, version 4.1.0 (USACE 2010a) is a publicly available software package developed by the Corps of Engineers to perform steady flow water surface profile computations, unsteady flow simulations, movable boundary sediment transport computations, and water quality analysis. HEC-RAS includes a Windows-based graphical user interface that provides functionality for file management, data entry and editing, river analyses, tabulation and graphical displays of input/output data, and reporting facilities. The sediment-transport module is capable of performing sediment-transport and movable boundary calculations resulting from scour and deposition over moderate time periods, and uses the same general computational procedures that were the basis of HEC-6 and HEC-6T (USACE 1993; MBH, 2010). In HEC-RAS, the sediment transport potential is estimated by grain size fraction, which allows for simulation of hydraulic sorting and armoring. This model is designed to simulate long-term trends of scour and deposition in streams and river channels that could result from modifying the frequency and duration of the water discharge and stage, sediment supply or direct modifications to channel geometry. Benefits of the HEC-RAS software include widespread industry acceptance, public availability, and ease of use. Potential limitations of the program include excessive computer run-times, file size output limitations, and the inherent problems associated with 1D modeling of aggradation and degradation by equal adjustment of the wetted portion of the bed that can result in unrealistic channel geometries.

- **SRH-1D:** SRH-1D (Huang and Greimann 2011) is a publicly-available, mobile boundary hydraulic and sediment transport computer model for open channels that is capable of simulating steady or unsteady flow conditions, internal boundary conditions, looped river networks, cohesive and non-cohesive sediment transport (Ruark et al. 2011), and lateral inflows. The hydraulic and sediment transport algorithms in SRH-1D are similar to those in HEC-RAS 4.1 and HEC-6T except that it also includes the capability to perform fully-unsteady sediment transport simulations. Advantages of SRH-1D include robust algorithms for hydraulic conditions and sediment routing, including sediment sorting. Potential disadvantages include limited testing under a broad range of conditions outside the Bureau of Reclamation and the lack of graphical user interface that complicates data input and manipulation and display of output.
- **MIKE 11:** Danish Hydraulic Institute's (DHI) MIKE 11 is a proprietary software package developed for 1D dynamic modeling of rivers, watersheds, morphology and water quality. The model has the ability to solve the complete non-linear St. Venant equations (in only the streamwise direction) for open channel flow, so the model can be applied to any flow regime. MIKE 11 provides the choice of diffusive and kinematic wave approximation and performs simplified channel routing using either the Muskingum or Muskingum-Cunge methods. The program includes a module for simulating erosion and deposition of non-cohesive sediments. Advantages of MIKE 11 include its robust hydrodynamic capabilities (though not necessarily better than HEC-RAS), the user-friendly graphical interface and the reporting and presentation capabilities. Disadvantages primarily stem from the proprietary nature of this model and high cost of the software license.
- **HEC-6T:** HEC-6T was written by William A. Thomas, former Chief of the Research Branch at the USACE Hydrologic Engineering Center (HEC). Mr. Thomas planned, designed, wrote and applied the publically available version of HEC-6; HEC-6T is a proprietary enhancement of the original version. HEC-6T is a DOS-based program that includes a Windows-based graphical user interface for input data manipulation and post-processing of simulation results. Limitations of this program include reduced capabilities for modeling numerous ineffective flow areas as compared to HEC-RAS 4.1 and limited capabilities of the graphical user interface. This software is relatively inexpensive: the fact that it is proprietary is not a significant limitation.

<u>1D Model Selection Process and Initial Evaluation:</u> Based on the above information and experience with these models, the Geomorphology Study team tentatively proposes to use HEC-6T for the reach-scale sediment transport analysis. This proposal is based on confidence gained that HEC-6T is capable of effectively and efficiently modeling the processes that are important for this scale of geomorphic analysis. The selection of the 1D (as well as the 2D) model will be coordinated with the other pertinent studies and the licensing participants. As part of the coordination process, a technical memorandum titled Fluvial Geomorphology Modeling (Tetra Tech 2012) was posted on the AEA website in May 2012. Specific model-selection criteria are identified in Table 5.9-1 along with an evaluation of each candidate model relative to the criteria.

Table 5.9-1. Evaluation of 1D Models

Evaluation Criteria	Models			
	HEC-RAS	SRH-1D	MIKE 11	HEC-6T
General				
Proprietary/cost (if applicable)	○	○	● / $8K	● / $3K
Full or quasi unsteady for sediment transport simulation	Quasi	Both	Full	Quasi
Ice for fixed bed	●	○	○	○
Ice for moveable bed	U	○	○	○
# of transport equations supported	7	13	10	18
Supports user defined transport equation	○	○	○	●
Closed loop capability	○[1]	●	●	●
Experience with model: High (H); Moderate (M); Low (L)	H	L	M	H
Model Size Limitations				
# of cross sections	NL	NL	NL	5,000
# of hydrograph ordinates	40,000	U	NL	NL
# of sediment sizes	20	U	NL	20
Sediment Sizes Supported				
Wash load (silts, clays)	●	●	●	●
Considers settling and resuspension	●	●	●	●
Sand	●	●	●	●
Gravel and cobble	●	●	●	●

Notes: ● = Yes; ○ = No; U = Unknown, currently investigating capabilities; NL = No Limit
[1] Not currently available, but in development.

Potential 2D Models: Potential 2D models that are being considered for this study include the Bureau of Reclamation's SRH2-D version 3 (Lai 2008; Greimann and Lai 2008), USACE's Adaptive Hydraulics ADH version 3.3 (USACE 2010b), the U.S. Geological Survey's (USGS) MD_SWMS suite (McDonald et al. 2005; Nelson et al. 2010), DHIs MIKE 21 version 2011 (DHI 2011), and the River2D modeling suite (University of Alberta 2002; University of British Columbia 2009).

- **SRH-2D:** The Bureau of Reclamation's SRH-2D (Lai 2008) is a finite-volume, hydrodynamic model that computes water-surface elevations and horizontal velocity components by solving the depth-averaged St. Venant equations for free-surface flows in 2D flow fields. SRH-2D is a well-tested 2D model that can effectively simulate steady or unsteady flows and is capable of modeling subcritical, transcritical and supercritical flow conditions. The model uses an unstructured arbitrarily shaped mesh composed of a combination of triangular and quadrilateral elements. SRH-2D incorporates very robust and stable numerical schemes with a seamless wetting-drying algorithm that results in minimal requirements by the user to adjust input parameters during the solution process. A potential limitation of this software is that the mobile bed sediment transport module is currently not publically available; however, Tetra Tech has gained permission to use the sediment transport module on a number of other projects. Preliminary contact with the model developers indicates that permission would be granted for use in this study. This version of the model (Greimann and Lai 2008) includes a "Morphology" module that calculates bed load transport capacities at each model node based on user defined bed material sediment gradations but does not simulate routing of that sediment and related adjustments to the channel bed. SRH-2D also includes a second module that uses the capacities from the Morphology module to perform sediment-routing calculations and associated bed adjustments. Based on guidance from the model developers and confirmed by Tetra Tech's use of the model for other studies, the maximum practical model size is about 16,000 elements, which could be a potential limitation in applying the model to larger-scale areas.
- **ADH:** The USACE ADH program was developed by the Coastal and Hydraulics Laboratory (Engineer Research Development Center) to model saturated and unsaturated groundwater, overland flow, 3D Navier-Stokes flow, and 2D or 3D shallow-water, open-channel flow conditions. ADH is a depth-averaged, finite-element hydrodynamic model that has the ability to compute water-surface elevations, horizontal velocity components and sediment transport characteristics (including simulations to predict aggradation and degradation) for subcritical and supercritical free-surface flows in 2D flow fields. The ADH mesh is composed of triangular elements with corner nodes that represent the geometry of the modeled reach with the channel topography represented by bed elevations assigned to each node in the mesh. A particular advantage of the ADH mesh is the ability to increase the resolution of the mesh—and thereby the model accuracy—by decreasing the size of the elements during a simulation in order to better predict the hydraulic conditions in areas of high hydraulic variability. However, use of the adaptive mesh option often results in excessively long simulation run times (several days per run) that could be impractical for this study. Additionally, the wetting and drying algorithm in this model has significant numerical stability limitations when applied to shallow, near-shore flows that occur in rivers like the Susitna River. The model is publically available.
- **MD_SWMS Modeling Suite (FaSTMECH/SToRM):** The USGS Multi-Dimensional Surface-Water Modeling System (MD_SWMS; McDonald et al. 2005) is a pre- and post-processing application for computational models of surface-water hydraulics. This system has recently been incorporated into iRIC, a public-domain software interface for river modeling distributed by the International River Interface Cooperative (iRIC) (Nelson et al. 2010). iRIC is an informal organization made up of academic faculty and

government scientists whose goal is to develop, distribute and provide education for the software. iRIC consists of a graphical user interface (GUI) that allows the modeler to build and edit data sets, and provides a framework that links the GUI with a range of modeling applications. The GUI is an interactive 1D, 2D and 3D tool that can be used to build and visualize all aspects of computational surface-water applications, including grid building, development of boundary conditions, simulation execution and post-processing of the simulation results. The models that are currently included in iRIC include FaSTMECH (Flow and Sediment Transport with Morphologic Evolution of Channels) and SToRM (System for Transport and River Modeling) that were part of the MD-SWMS package, as well as NAYS, MORPHO2D, and a Habitat Calculator for assessing fish habitat under 2D conditions. Of these models, SToRM appears to be the most relevant for modeling the Susitna River for purposes of this project, primarily because it uses an unstructured triangular mesh (in contrast to the structured, curvilinear mesh required for FaSTMECH), and provides both steady-flow and unsteady-flow capability. NAYS is a fully unsteady, 2D model designed for a general, non-orthogonal coordinate system with sophisticated turbulence methods that can evaluate the unsteady aspects of the turbulence, and MORPHO2D is 2D model capable of analyzing the interactions between sediment transport and vegetation and between surface water and groundwater. Both NAYS and MORPHO2D were developed in Japan, and have not been widely used or tested in the U.S. The SToRM model blends some of the features of finite volumes and finite elements, and uses multi-dimensional streamline upwinding methods and a dynamic wetting and drying algorithm that allows for the computation of flooding. Subcritical, supercritical and transcritical flow regimes (including hydraulic jumps) can be simulated. The program includes advanced turbulence models and an automatic mesh refinement tool to better predict the hydraulic conditions in areas of high hydraulic variability. The most recent version of the SToRM model does not include the capability to model sediment-transport, but the program authors are currently working on implementing sediment-transport algorithms that may be available for use in this study (pers. Comm., Jonathon Nelson, USGS, June 18, 2012). MD_SWMS has been successfully applied to a number of rivers in Alaska, including the Tanana River near Tok (Conaway and Moran 2004) and the Copper River near Cordova (Brabets 1997); some of the modules are currently being validated using high-resolution scour data from the Knik River near Palmer.

- **MIKE 21:** Developed by DHI, MIKE 21 is a proprietary modeling system for 2D free-surface flows that can be applied in rivers, lakes, coastal and ocean environments. It has the ability to simulate sediment transport and associated erosion and deposition patterns. The software includes a Windows-based GUI as well as pre- and post-processing modules for use in data preparation, analysis of simulation results and reporting modules that have graphical presentation capabilities. MIKE 21 has the ability to model a range of 2D mesh types that include Single Grid, Multiple Grid, Flexible Mesh, and Curvilinear Grid. The primary limitation to MIKE-21 is that is proprietary software and is relatively expensive as compared to other available software.
- **River2D Modeling Suite:** River2D is a two-dimensional, depth-averaged finite-element hydrodynamic model developed at the University of Alberta and is publically available from the University. The River2D suite consists of four programs: R2D_Mesh,

R2D_Bed, River2D and R2D_Ice, each of which contains a graphical user interface (GUI). The R2D_Mesh program is a pre-processor that is used to develop the unstructured triangular mesh. R2D_Bed is used for editing the bed topography data and R2D_Ice is used to develop the ice thickness topography at each node for simulating ice-covered rivers. Following mesh development, the hydrodynamic simulations are run using the River2D program, which also includes a post-processor for visualizing the model output. River2D is a very robust model capable of simulating complex, transcritical flow conditions using algorithms originally developed in the aerospace industry to analyze the transitions between subsonic and supersonic conditions (transonic flow). Many 2D models become numerically unstable due to wetting and drying of elements; however, River2D uniquely handles these conditions by changing the surface flow equations to groundwater flow equations in these areas. The model computes a continuous free surface with positive (above ground) and negative (below ground) water depths, which allows the simulation to continue without changing or updating the boundary conditions, increasing model stability. River2D also has the capability to assess fish habitat using the PHABSIM weighted-usable area approach (Bovee, 1982). Habitat suitability indices are input to the model and integrated with the hydraulic output to compute a weighted useable area at each node in the model domain. River2D Morphology (R2DM) is a depth-averaged, two-dimensional hydrodynamic-morphological and gravel transport model developed at the University of British Columbia. The model was developed based on the River2D program, and is capable of simulating flow hydraulics and computing sediment transport for uni-size and mixed-size sediment using the Wilcock-Crowe (2003) equation over the duration of a hydrograph. R2DM can be used to evaluate the changes in grain size distributions, including fractions of sand in sediment deposits and on the bed surface,. The sediment-transport module has been verified using experimental data, and was successfully applied to the Seymour River in North Vancouver, British Columbia (Smiarowski, 2010). River2D is available in the most recent version of iRIC (Version 2.0).

2D Model Selection Process and Initial Evaluation: The selection of the 2D model will be coordinated with the other pertinent studies and the licensing participants. Specific model selection criteria are identified in Table 5.9-2 along with an evaluation of each candidate model relative to the criteria.

Table 5.9-2. Evaluation of 2D models

Evaluation Criteria	Model				
	SRH-2D	**ADH**	**SToRM**	**MIKE 21**	**River2D**
General					
Proprietary/cost (if applicable)	○	○	○	● / $20K	○
Unsteady flow capability	●	●	●	●	●
Ice for fixed bed	○	○	○	●	●
Ice for moveable bed	○	○	○	●	●

Number of transport equations supported	4	2	○[1]	10	2
Supports user defined transport equation	○	●	○[1]	●	○
Relative execution speed: Fast (F), Slow (S)	F	S	U	F	S
Model stability: High (H), Moderate (M), Low (L)	H	M	U	H	H
Experience with model: High (H), Moderate (M), Low (L)	H	M	L	L	M
Moveable boundary simulation	●	●	○[1]	●	●
Grid Structure/Model Formulation					
Finite element (FE)/ Finite Volume (FV)	FV	FE	FV/FE	FV/FE	FE
Grid structure: Flexible Mesh (FM)	FM	FM	FM	FM	FM
Model Size Limitations					
# of grid elements	16,000	Unlimited	U	Unlimited	>100,000
Sediment Sizes Supported					
Wash load (silts, clays)	○	●	○[1]	●	○
Considers settling	○	●	○[1]	●	○
Sand	●	●	○[1]	●	●
Gravel and cobble	●	●	○[1]	●	●

Notes: ● = Yes; ○ = No; U = Unknown, currently investigating capabilities; NL = No Limit
[1] Not currently available, but in development.

Model Development: The manner in which the models are developed will depend on the model software programs that are ultimately selected for use. Regardless of the selected modeling software, the models will be developed in accordance with the software developers' guidance and recommendations.

5.9.4.1.2.2. Coordination with other Studies

As previously discussed, it is envisioned that a combination of 1D and 2D sediment transport models will be used to assess potential changes in the aggradation/degradation behavior and related processes in the Susitna River downstream from Watana Dam due to the potential size and complexity of the system to be modeled. As a result, the current vision for the modeling approach is to use a reach-scale 1D model to evaluate the potential effects of the Project on the overall aggradation/degradation behavior of the study reach, and then use a series of representative, local-scale 2D models at key locations where the dynamic behavior of the channel and habitat cannot be adequately assessed using the 1D modeling approach. The 1D model will provide boundary conditions for the individual 2D models. Because of this modeling approach, it will be very important to coordinate with other studies since results from the detailed 2D model will only be available at specified locations that will be selected from the key locations identified by the Instream Flow, Instream Flow Riparian, Ice Processes and Fish study teams and in consultation with the licensing participants. It is anticipated that a minimum of four to six detailed mainstem 2D study sites will be identified with each representing a length of river on the order of one to several miles that includes a representation of each geomorphic reach (excluding Devils Canyon) and one unstable reach (likely a braided reach). The 2D sites will also include selected primary tributary confluences. Coordination among the studies will also be necessary to insure efficient collection of field data, since it is likely that a considerable amount of the data necessary for development and calibration of the 1D and 2D models will either be required for the other studies, or will be easily obtained along with data that will be required for those studies. For example, the Instream Flow Study will likely obtain velocity magnitude and direction, flow depth, and discharge measurements, the data from which would be very useful for calibration of the 2D models. It may also be possible to obtain subaqueous bed material data for the modeling by lowering a laser/video through the ice thickness transect holes that will be bored as part of the Ice Study when turbidity levels are expected to be low.

The temporal resolution for model execution will be selected to insure model stability and proper representation of important variability in flow conditions (e.g., daily fluctuations associated with load-following). The overall time-scale for model execution will also be an important factor. Because a key purpose of the 1D model will be to assess the long-term sediment balance in the study reach, this model will likely be executed for a continuous period of 50 years to represent the length of a FERC license. On the other hand, due to the computational requirements of the 2D model, much shorter time-periods will be evaluated.

Close coordination between the study leads and key study team members will be required throughout the model development process. It is important that all the study teams have an understanding of the capabilities and limitations of the models, the information that will be provided by the model, and the selection of the detailed study areas. This will be accomplished through frequent informal communication and more formal technical workgroup meetings. It is also recommend that the study leads and other key participants spend time together in the field to develop a practical understanding of each study's needs.

5.9.4.1.2.3. Model Calibration and Validation

Calibration and validation of the models will be a stepwise process. First the hydraulic components of the models will be calibrated by adjusting roughness and loss coefficients to achieve reasonable agreement between measured and modeled water-surface elevations, and to the extent data are available, measured and modeled velocities. Discharges along the study reach will be obtained from the three USGS gages. These gages will also provide a continuous record of stages and water-surface elevations at the gage locations. These data will be supplemented with stage data from at least 10 pressure-transducer type water-level loggers that will be installed as part of various studies being conducted in the Middle and Lower River reaches. Water-levels measured during the cross section and bathymetric surveys will also be used to calibrate the models. In addition to water-surface elevations, the depths and velocities predicted by the 2D model should be compared with measured data at the detailed sites. As noted above, it is anticipated that these data will be collected for the Instream Flow Study at the same detailed sites at which the bed evolution model is being applied. Depending on the range of conditions and spatial coverage of the depth and velocity data from the Instream Flow Study, additional data may be needed for calibration specifically for this study. Specific calibration criteria will be established for both the 1D and 2D models during the model selection phase.

The sediment transport portions of both the 1D and 2D model will be first calibrated based on the available measured sediment transport data and the associated sediment rating curves for both bed load and suspended load. For coarse-grained rivers such as the Susitna River, the bed material load transport is dominant with respect to channel forming processes; however the fine-grained suspended load (i.e., wash load) may be important in evaluating the changes to other features including turbidity, instream habitat, side channels, sloughs and floodplains. The sediment transport model will also be validated, to the extent possible, by comparing modeled and measured (or if necessary, qualitatively observed) changes in bed elevations and bed material gradations from the Geomorphology Study, by making model runs for specific time-periods. This effort will include comparison of 1980s and current 2012 transect data if sufficient data are available.

5.9.4.1.2.4. Tributary Delta Modeling

Tributary confluences are areas of interest for determining the potential Project effects on sediment transport and morphology. Alteration of the mainstem flow regime has the potential to change the elevation at which tributary sediments are initially deposited since the main stem may be at a different stage when the tributaries are at peak flow. Additionally, the ability to mobilize and transport bed load delivered by tributaries may also be altered. Changes in the configuration of sediments deposited at the tributary confluences can affect the ability of fish to access the tributaries and the extent of clear water habitat associated with some tributary confluences. Modeling sediment transport and deposition processes at select tributary mouths will therefore be necessary.

The tributaries to be modeled will be determined in conjunction with the Instream Flow and Fish studies and the licensing participants based on fish use and the potential for Project effects. The Geomorphology Study will model a subset of tributary confluences with the Susitna River that represent the range of conditions among all of the tributaries. The selection of primary tributary deltas for 2D modeling will be based on screening that considers the importance of the existing fishery and potential adverse Project effects. Based on the discussion at the June 14, 2012 Water Resources TWG meeting, it is likely that the effort will include the Three Rivers Confluence area (Susitna, Talkeetna and Chulitna confluence). The selection of the tributary delta sites for 2D modeling will be coordinated with the other pertinent studies and in consultation with the licensing participants.

It is currently proposed that a model will be created for the tributary deltas that uses estimated bed load transport from the tributary, the topography and the bathymetry of the confluence, measurements of the characteristics of the tributary deposits, and the ability of the main stem in the area of the confluence to mobilize and transport those deposits. The approach will include field observations to characterize the sediment transport regime that will be used to identify appropriate methods of estimating bed load transport. Surveys of tributary channel geometry and sampling of bed material gradations will be coupled with an appropriate bed material transport function to calculate sediment yield rating curves. Hydrology synthesized for ungaged tributaries will be needed from other studies for each of the selected tributaries for this purpose as well as for the purpose of the flow routing models (summer ice-free model and winter ice-covered model). The yield and topography in the area of the expected delta along with the ability of the main stem to mobilize and transport the bed material will provide a basis for characterizing how Project operations would affect the formation of tributary deposits. At this time, it is envisioned that a relatively detailed 1D hydraulic model of the main stem in the vicinity of each tributary will provide sufficient hydraulic information to evaluate the potential for, and likely extent of, additional growth of the tributary deposits into the mainstem. For complex tributary confluences that are of particular interest to the instream flow studies, local-scale 2D models can be developed and applied to support the analysis.

5.9.4.1.2.5. Wintertime Modeling and Load-Following Operations

It is currently not proposed to execute the sediment transport models—either 1D or 2D—during, the winter period when flows are low and the bed material is not mobilized. However, if the Characterization of Bed Material Mobility component of the Geomorphology Study indicates that the bed material is mobilized during winter-time flows, including higher than existing flows due to load following, the sediment transport modeling will be extended to include the winter flow period. One winter operational issue of potential importance is the resuspension of fines sediments during load-following that could result in increased turbidity during the early portion of the otherwise clear water conditions during the winter months. To address this, an effort to model the resuspension of fines can be undertaken for the 1D model and the 2D model for the early portion of the winter period. This effort would include investigation of a controlled release to flush the fines from the system prior to commencement of winter load-following operations. Decisions on continuing the 1D and 2D modeling into the winter period will be made in consultation with the licensing participants and in coordination with the Instream Flow, Instream Flow Riparian, Ice Processes and Fish studies (this section on Wintertime Modeling and Load-Following Operations was added based on a study comment supplied by NOAA-NMFS in their May 31, 2012 study request, the Natural Resources Defense Council May 30, 2012 study request, and discussions on load-following and turbidity during the June 14, 2012 Water Resources TWG meeting.

5.9.4.1.2.6. Information Required

The following existing information will be needed to conduct this study:

- Historical and current aerial photographs,
- Historical channel cross sections,
- LiDAR to develop sub-aerial topography and extend surveyed transects across the floodplain,
- Flow records from USGS mainstem and tributary gages , and
- Historical bed material sample data.

A site reconnaissance of the study reach will be conducted prior to development of the sediment-transport models. This site reconnaissance will be carried out to observe and characterize the following:

A site reconnaissance of the study reach will be conducted prior to development of the sediment-transport models. This site reconnaissance will be carried out to observe and characterize the following:

- Hydraulic and geomorphic controls (natural and man-made) that will influence sediment-transport conditions,
- Hydraulic roughness conditions along the main channel and in the overbanks,
- Variations in bed material size,
- The sediment-transport regime, and areas that appear to be in equilibrium, or are aggradational or degradational, and
- In areas that are not in equilibrium, qualitatively assess the degree of erosion or deposition.

Based on the above observations and information from the Geomorphology Study (see Section 5.9.4.1, above), the overall study reach will be subdivided into sediment-transport subreaches that have similar geomorphic characteristics, and are therefore, expected to have similar sediment transport characteristics for purposes of assessing the overall sediment balance along the study reach.

Beyond the general site reconnaissance, potential sites for local-scale 2D modeling will be identified and characterized, with particular focus on sites that have been previously identified by the other study teams as important to their particular focus areas. This assessment will involve mapping of the geomorphic features (side channels, sloughs, sub-aerial and subaqueous bars, floodplains, terraces, etc.). Specific data that will need to be collected to facilitate the 2D modeling includes a number of items that are in addition to the general observations made during the site reconnaissance discussed above. To develop the model geometry, detailed bathymetric surveying will be necessary. Surface and sub-surface bed material samples will be collected to characterize the gradation of the sediments. Data that can be used in the calibration of the model will also be required, including detailed velocity (magnitude and direction) mapping, depth mapping, water-surface elevation profiles, and discharge measurements.

A site reconnaissance and data collection effort will also be necessary for each of the key tributaries that have the potential to deliver significant quantities of sediment to the reach and/or are important to other study teams. The reconnaissance to these sites will be relatively detailed, because specific data will need to be collected, in addition to the general observations, to facilitate the modeling at the tributary mouths. Cross-sectional surveys of approximately six transects over a representative reach above the confluence will be necessary, with a spacing of about three- to five-times the active channel width. Surface and sub-surface bed material samples will be collected to characterize the gradation of the sediments along the reach, and will include at least one representative sample of the surface material on the fan.

In addition to the above information that will be collected during the site reconnaissance and detailed site visits, the following will need to be obtained to conduct this component of the modeling study:

- Current channel transacts at a density sufficient to develop a 1D sediment transport model (it is anticipated that much of the required transect information will be collected as part of the Instream Flow Study),
- Extended flow records for mainstem gages and major tributaries,

- Estimated flows from key ungaged tributaries that will be accounted for in the water and sediment inflows, and where potential development of tributary fans is to be evaluated,
- Information describing the influence of ice processes on channel and floodplain morphology,
- Information describing the influence of riparian vegetation on channel and floodplain morphology,
- Information developed in the Geomorphology Study on channel changes that have occurred since the 1980s,
- Information developed in the Geomorphology Study on the physical processes most important to accurately modeling the study reach, and
- Input from the Instream Flow, Instream Flow Riparian, Ice Processes, and Fish studies to identify river segments for detailed modeling (2D),
- The velocity and depth measurements collected by the Instream Flow Study to characterize habitat for calibrating the hydraulic model(s), and
- Data collected on the distribution of flow between the main channel and lateral habitat to help calibrate the hydraulic portion of the 2D model.

5.9.4.1.3. Study Products

The products of this component of the modeling study will include:

- 1D hydraulic models that will be used to estimate sediment loading from each of the tributaries that supply significant volumes of bed load along the modeled reach,
- A single, calibrated, 1D mobile-boundary sediment-transport model, or a series of models, that extend from the proposed dam to a yet-to-be determined downstream limit.
- A number of calibrated 2D sediment-transport models for selected detailed study areas.
- Model calibration data and documentation.
- A report describing model calibration and application to existing conditions.

5.9.4.2. Study Component: Model Existing and with-Project Conditions

The goal of the Model Existing and with-Project Conditions study component is to provide a baseline and series of with-Project scenarios of future channel conditions for assessing channel change. The extent of the study area is the Susitna River downstream of Watana Dam, the specific downstream boundary of which will be determined in study component Bed Evolution Model Development, Coordination and Calibration.

5.9.4.2.1. Existing Information and Need for Additional Information

Once the 1D and 2D bed evolution models are developed in the previous study component, the model will be run for the existing condition (the Susitna River without Watana Dam in place) in order to establish a baseline for comparison to with Project model runs. The model will also be run for various Project scenarios to determine the potential effects of the Project on the fluvial geomorphology of the Susitna River.

5.9.4.2.2. Methods

5.9.4.2.2.1. Existing Conditions – Base Case Modeling

The time period and representative hydrologic conditions to be assessed with the bed evolution model will be determined through coordination with the technical work group, based on the availability of data, study objectives and model limitations. The hydrologic inputs for the various with-Project scenarios will be obtained from the Reservoir and Flow Routing Study and the model run for flows representative of each scenario. It is currently envisioned that a 50 year, continuous period of record that represents the length of the FERC licensing period will be used for the 1D modeling, and shorter modeling periods will be used for the 2D model due to computational limitations. As previously indicated, the 1D model will be applied to address the analysis of reach-scale issues and the 2D model to address local-sale issues.

The shorter periods for the 2D model will include specific years or portions of annual hydrographs for selected years of wet, average and dry hydrologic conditions and warm and cold Pacific Decadal Oscillation (PDO) phases. Therefore, up to six annual hydrologic conditions will be considered. (The inclusion of the warm and cold PDO phases was requested by NOAA-NMFS and USFWS in the May 31, 2012 study requests; the rationale for the request was discussed at the June 14, 2012 Water Resources TWG meeting and it was agreed that the PDO phases would be included in the suite of representative annual hydrologic conditions.) Other scenarios might include rapid release of flows from an ice jam or larger flood events that are not contained in the period of the hydrologic record chosen for simulation.

Each run be subjected to a quality control process to ensure the appropriate data were used and model outputs are reasonable. Naming conventions for the model input and output files for the various scenario files will be applied so that files can be easily archived and retrieved in the future.

5.9.4.2.2.2. Future Conditions - with-Project Scenarios

In coordination with the other studies and licensing participants, the with-Project scenarios will be identified. Similar to the existing conditions, the with-Project scenarios will be modeled with both the 1D model to determine the reach-scale Project effect and the 2D model to determine the local-scale Project effects. The with-Project scenarios will be evaluated over the same time period as the existing conditions base case.

5.9.4.2.2.3. Synthesis of Reach-Scale and Local-Scale Analyses

In addition to the raw model output, the model results will be interpreted, and additional analysis applied as necessary to represent channel processes that are not directly represented in the modeling. The last step in the analysis effort involves the synthesis of the reach-scale and local-scale analyses to identify potential Project-induced changes in the relative occurrence of aquatic habitat types and associated surface area versus flow relationships. In addition to the results of the hydraulic and sediment transport modeling, this synthesis will require application of fluvial geomorphic relationships to develop a comprehensive and defensible assessment of potential Project effects. Examples of this type of integrated analysis that have been successfully performed by the project team include instream flow, habitat and recreation flow assessments to support relicensing of Slab Creek Dam in California; a broad range of integrated geomorphic assessments and modeling to assist the Platte River Recovery Implementation Program in Central Nebraska; and ongoing work to support the California Department of Water Resources and Bureau of Reclamation to design restoration measures for the San Joaquin River in the Central Valley of California downstream of Friant Dam.

5.9.4.2.2.4. Interaction with Other Studies

The Fluvial Geomorphology Modeling Study team will interact extensively with the Flow Routing, Instream Flow, Riparian Instream Flow, Ice Processes and Fish study teams. The types of interaction will vary depending on the specific study, but a considerable amount of physical data describing the system, including transects, topography/bathymetry, substrate characterization, aerial photography, and pre- and post-Project flows generally will be shared. Selection of joint sites for detailed studies will be an important aspect of the collaboration. By selecting commons sites, the potential for exchange of information between the study teams will be maximized and ensure that the most effective and extensive use of detailed study site data will occur.

Flow Routing Study: It is anticipated that the Flow Routing Study will provide the pre- and post-Project hydrology information for all studies, including the Fluvial Geomorphology Modeling Study. This hydrology information will include mainstem pre- and post-Project flows at various points along the study area and inflows for gaged and ungaged tributaries. This information is expected to be provided for the 50 year, extended flow record.

For the Fluvial Geomorphology Modeling effort the upstream boundary condition at RM 184 will be the existing condition or pre-Project daily flows from the extended flow record. For the post-Project condition, the upstream boundary condition will be the average daily releases from Watana Dam unless load-following scenarios are evaluated. In the latter case, the Project outflows will need to be on an hourly or possibly finer time increment. Estimated daily inflows from tributaries provided by the Flow Routing Study will be input along the length of the 1D sediment transport model and may be inputs to the localized 2D models depending on the location and specific issues to be addressed.

Instream Flow Study: For the Instream Flow Study, an assessment of whether the current channel geometry and substrate characterization used in evaluation of habitats will remain relatively unchanged over the period of the license under both the pre- and post-Project conditions will be important. The Geomorphology Studies will determine whether the channel morphology is in a state of dynamic equilibrium such that the distribution of habitat conditions over the timeframe of the license (assumed to be 50 years, corresponding to the maximum FERC licensing period) will be adequately reflected by existing channel morphology. If it is determined that the river is not in a state of dynamic equilibrium, the Geomorphology Studies will provide projections of the direction and magnitude of the changes. Changes in the relative occurrence of aquatic habitat types and the associated surface area versus flow relationships that may occur as a result of the Project will be an important outcome of these studies. As part of this evaluation, pre- and post-Project changes in channel dimensions (width and depth) and the proportion and distribution of geomorphic features and habitat types will be estimated for each of the reach types delineated using the channel classification system to be developed for the Susitna River. This will provide the Instream Flow Study with an important part of the information required to evaluate the post-Project effects on aquatic habitat. Other important information to be provided by the Fluvial Geomorphology Modeling study for the Instream Flow Study include:

- Identification of zones of substrate mobilization, deposition and scour at the reach scale for pre- and post-Project flow regimes.
- Potential changes in lateral habitat connectivity due to aggradation and degradation.
- Pre- and post-Project changes in spatial and seasonal patterns of the fine sediment (wash load) transport and the associated Project effects on turbidity.
- Changes in substrate composition in both the main channel and lateral habitats.
- Pre- and post-Project large woody debris (LWD) recruitment and transport.

Riparian Instream Flow Study: Riparian vegetation plays a large role in the development of islands and lateral habitats, primarily by protecting surfaces from erosion and promoting sediment deposition. Vegetation can also contribute to channel narrowing by encroaching onto bars and islands and riverward growth of banks through trapping of sediments. Conversely, changes in the flow regime and/or ice processes can alter riparian vegetation patterns, including the extent, species composition and age-classes; thus, there is a feedback mechanism between the two processes. As a result, the influence of riparian vegetation on the morphology of the Susitna River is an important consideration in these studies. The Riparian Instream Flow and Geomorphology studies need to be closely coordinated because of the interaction described above. The collaboration will begin with coordinated selection of the detailed study sites among the Riparian Instream Flow, Ice Processes and Geomorphology study teams. By working on the detailed study sites together the teams will develop an understanding of the interaction between the processes that are responsible for creation and maintenance of the islands and lateral habitats. Estimates of the ages of island and floodplain surfaces from the Riparian Instream Flow Study based on dendrochronology combined with the inundation results from the 2D modeling will greatly facilitate this effort by helping to identify rates of sediment deposition and reworking of these surfaces. Similarly, profiling of deposited sediments in the riparian corridor to identify the types of sediments that make up the floodplain will also contribute to the understanding of the physical processes and development of the functional model for linkage of the geomorphology, riparian vegetation and ice processes.

The results of the fluvial geomorphology model along with applicable geomorphic principles will be applied to interpret model results. Understanding of the geomorphology of the system will also be used to provide a reality check on the extent of changes indicated by the modeling.

Examples of the linkage between the Riparian Instream Flow Study and the fluvial geomorphology model include:

- Altering Manning's n-values to represent establishment (increased n) or removal (decreased n) of vegetation.
- Application of shear stress parameter to determine the erodibility of banks and potential influence of vegetation.
- Interpretation of flow and sediment transport patterns to determine areas of sediment deposition within and adjacent to vegetation.
- More accurate water surface elevations from the local-scale 2D models than is provided by the 1D models for periods when the flows only partially inundate the riparian corridor.
- Use of geomorphic threshold relationships to understand the potential for removal of vegetation by the flows and the potential for additional channel narrowing due to changes in the vegetation patterns.

Ice Processes Study: Ice processes influence both the channel morphology and riparian vegetation. For example, ice can prevent vegetation from establishing on bars by annually shearing off or uprooting young vegetation. Similarly, ice can scour vegetation from the banks, increasing their susceptibility to erosion. In both examples these influences affect channel morphology. Ice jams can also directly influence the channel morphology by diverting flows onto floodplain where new channels can form, particularly when the downstream water surface elevations are low, allowing the return flows to headcut back into the floodplain. Ice can also move bed material that would normally not be mobilized by rafting large cobbles and boulders.

There will be close collaboration between the Geomorphology and Ice Process studies to identify the key physical processes that interact between the two. Working together to analyze the conditions at the detailed study sites will be a key part of this collaboration. A significant portion of the influences of ice processes on morphology are directly related to their effects on riparian vegetation. Additionally, influences of ice processes beyond the riparian vegetation issues that may be incorporated directly into the fluvial geomorphology modeling may include:

- Simulating the effects of surges from ice jam breakup on hydraulics, sediment transport and erosive forces using unsteady-flow 2D modeling with estimates of breach hydrographs.
- Simulating the effect of channel blockage by ice on the hydraulic and erosion conditions resulting from diversion of flow onto islands and the floodplain.
- Use of the detailed 2D model output to assess shear stress magnitudes and patterns in vegetated areas, and the likelihood of removal or scouring.
- Use of the detailed 2D model output to assess shear stress magnitudes and patterns in unvegetated areas, and the likelihood of direct scour of the boundary materials.

Fish Study: The primary interaction with the Fish Study will be in the selection of the sites for detailed study. Part of the selection process will consider the use of the specific sites as well as the types of habitat present at the site by target fish species. The local-scale 2D models can be used to evaluate instream habitat quality on a spatially-distributed basis rather than the cross-sectionally-based approach used in traditional Instream Flow Incremental Methodology (IFIM) studies.

5.9.4.2.2.5. Information Required

The following available existing information will be needed to conduct this study:

- The calibrated existing conditions model(s) developed in the previous tasks, including the data used to develop them,
- Extended flow records for mainstem gages and major tributaries for existing conditions,
- With-Project mainstem flows corresponding to the periods and locations in the extended flow record.
- The with-Project sediment outflow rating curve from Watana Dam.

5.9.4.2.2.6. Study Products

The products of this component of the modeling study will include:

- Results from the 1D mobile boundary sediment-transport model(s) that extend from the location of the proposed dam to a yet-to-be determined downstream limit.

- Results from the 2D sediment-transport models for selected detail study areas.
- A report describing the model runs, and interpreting the model results.

5.9.4.3. Study Component: Coordination on Model Output

The goal of the Coordination on Model Output is to provide necessary output to the various studies that will require determination of potential channel changes associated with the Project. The extent of the study area is the Susitna River downstream of Watana Dam, the specific downstream boundary of which will be determined in Bed Evolution Model Development, Coordination and Calibration study component.

5.9.4.3.1. Existing Information and Need for Additional Information

Several studies require the results of the Fluvial Geomorphology Modeling Study to conduct their efforts. These include the Instream Flow, Riparian Instream Flow, and Ice Processes Studies. The primary concern is whether the Project will affect aspects of the channel morphology including but not limited to substrate characteristics, cross-sectional geometry, and connectivity with lateral habitats.

5.9.4.3.2. Methods

Coordination with Instream Flow, Instream Flow Riparian, Ice Processes, Productivity, and Fish studies will be conducted to confirm information they will need with respect to potential impacts of the Project on bed evolution in-channel conditions under the various Project scenarios. Because of the detailed spatial nature of the information produced by the models, GIS will likely be an important tool for visually illustrating and conveying model results for use in the other studies.

The plan for transferring results in a manner that will facilitate efficient and effective use by other studies will require considerable effort. The details of the plan will be worked out as the overall modeling approach is developed in the technical work group meetings and through informal coordination with the respective study teams.

5.9.4.3.2.1. Information Required

The following available existing information will be needed to conduct this component of the modeling study:

- Study plans for other studies

The following additional information will need to be obtained to conduct this component of the modeling study:

- Locations of sites for other studies
- Lists of output required for other studies
- Output formats required for other studies
- Schedule dates for providing output

5.9.4.3.3. Study Products

The products of this component of the modeling study will include summarized results from the 1D and 2D sediment-transport modeling in an appropriate format. Although the desired format is not known at this time, the formatted products could include the following:

- Spreadsheets summarizing predicted hydraulic conditions (main channel velocity, hydraulic depth, energy gradient, shear stress, etc.) at various times during the 1D mobile boundary sediment-transport simulations.
- Spreadsheets summarizing the sediment-transport results (bed profiles, aggradation/degradation volumes, changes in mean bed elevation, changes in the active (surface) and inactive (subsurface) gradation, etc.) at various times during the 1D mobile boundary sediment-transport simulations.
- ArcGIS shapefiles representing the predicted hydraulic conditions (velocity magnitude and direction, water depth, shear stress magnitude and direction, etc.) at various times during the 2D modeling simulation at each of the detailed study sites.
- ArcGIS shapefiles representing the sediment-transport results (predicted change in bed elevation, sediment size, etc.) at various times during the 2D modeling simulation at each of the detailed study sites.

5.9.5. Consistency with Generally Accepted Scientific Practice

A wide range of temporal scale processes, unknown initial and forcing conditions, unresolved heterogeneities, and unanticipated mechanisms make geomorphic prediction challenging and problems of scale important (Wilcock and Iverson, 2003). Fluvial geomorphologic analyses typically involve focusing on a variety of spatial scales at which landforms have characteristic features (Grant et al., 1990; Rosgen, 1996; Thomson et al., 2001). These scales generally reference the river channel width (W) due to the similarity of forms among systems of different absolute size that are governed by the same underlying processes (Pasternack, 2011). For example, the analysis could include an assessment at the watershed scale, river segment scale (10^3-10^4 W), morphologic or reach scale (10^0-10^1 W), and intensive local scale (10^{-1}-10^0 W). As discussed in more detail below, the Geomorphology Modeling Study will require both reach-scale (1D modeling) and intensive local-scale (2D modeling) analyses. Synthesis of the reach-scale and local scale analyses will therefore be necessary to identify potential Project-induced changes in the relative occurrence of aquatic habitat types and associated surface area versus flow relationships. In addition to the results of the hydraulic and sediment transport modeling, this synthesis will require application of fluvial geomorphic relationships to develop a comprehensive and defensible assessment of potential Project effects. Examples of this type of integrated analysis that have been successfully performed by the project team include instream flow, habitat and recreation flow assessments to support relicensing of Slab Creek Dam in California; a broad range of integrated geomorphic assessments and modeling to assist the Platte River Recovery Implementation Program in Central Nebraska; and ongoing work to support the California Department of Water Resources and Bureau of Reclamation to design restoration measures for the San Joaquin River in the Central Valley of California downstream of Friant Dam.

1D and 2D models are commonly used tools to assess hydraulic and sediment transport conditions in rivers[18]. The potential models that are described in the model selection section have been in use by the engineering and geomorphic community for many years (in some cases, many decades) for evaluating both existing/baseline conditions and predicting the likely effects of proposed changes in flow regime, sediment supply and other natural and anthropogenic factors. All of the proposed models have been developed using scientifically-sound relationships to describe the physical processes that are important to the analysis. The proposed modeling steps, that include initial reconnaissance to understand the study reach, field data collection to obtain quantitative information necessary to build the model inputs files, calibration steps to insure model results are consistent with field conditions, modifications to the model input to represent the range of potential future conditions, are commonly employed by practitioners and researchers. Results from the application of these types of models have provided significant technical basis for FERC licensing of numerous projects through the U.S. and similar licensing throughout the world.

<u>1D Modeling at the Reach Scale</u>: Potential 1D models that are being considered` for this study include the Corps of Engineers HEC-RAS (version 4.1; USACE 2010a), the Bureau of Reclamations SRH-1D (version 2.8; Huang and Greimann, 2011), DHIs MIKE 11 (version 2011; DHI, 2011a), and Mobile Boundary Hydraulics HEC-6T (version 5.13.22_08; MBH, 2008). Based on the above information and experience with these models, the Geomorphology Study team tentatively proposes to use HEC-6T for the reach-scale sediment transport analysis. This proposal is based on confidence gained that HEC-6T is capable of effectively and efficiently modeling the processes that are important for this scale of geomorphic analysis. HEC-6T has been successfully applied to model the sediment-transport conditions in a wide range of river systems for a variety studies. The study team is currently using the model to evaluate sediment augmentation for habitat restoration purposes in the Central Platte River in Nebraska (Tetra Tech, 2010). It was successfully used to evaluate the effects of seismic retrofit options for San Clemente Dam on sediment-transport through the reservoir and in the downstream Carmel River (Mussetter Engineering, Inc., 2008)

<u>2D Modeling at the Local Scale:</u> Potential 2D models that are being considered for this study include the Bureau of Reclamation's SRH2-D version 3 (Lai 2008; Greimann and Lai 2008), USACE's Adaptive Hydraulics (ADH) version 3.3 (USACE 2010b), the U.S. Geological Survey's USGS's MD_SWMS modeling suite (McDonald et al.; 2005 Nelson et al., 2010), DHIs MIKE 21 version 2011 (DHI 2011b) River2D modeling suite (University of Alberta 2002; University of British Columbia, 2009). The selection of the 2D model will be coordinated with the other pertinent studies and the licensing participants. In addition to the User's Manuals that are available with each of the potential models, a number of standalone references are also available that provide guidance for development and application of the 2D models, or highlight successful application of 2D geomorphologic modeling. For example, Pasternack (2011) includes an entire chapter that provides instruction for 2D model development, and separate chapters for SRH-2D model execution and interpretation of SRH-2D model results. Conaway and Moran (2004) present successful application of MD_SWMS to modeling sediment-transport conditions in Alaskan rivers. MD_SWMS has also been successfully used to model sediment-

[18] The March 2008 Edition of the American Society of Civil Engineers Journal of Hydraulic Engineering was entirely dedicated to the practice and challenges associated with sediment transport modeling.

transport and Island formation in a gravel bed portion of the Snake River (McDonald et al. 2005).

5.9.6. Schedule

A preliminary schedule has been developed, and indicates the Model Development, Coordination and Calibration study component will be completed by Spring of 2014; the Model Existing and with-Project Conditions study component will be completed by Fall of 2014; and Coordination on Model Output study component will be completed by Fall of 2014. A more specific breakdown of the anticipated schedule is presented in Table 5.9-3.

Table 5.9-3. Fluvial Geomorphology Modeling Study schedule.

Component	Task	Subtask	Estimated Completion
Bed Evolution Model Development, Coordination and Calibration	Development of Bed Evolution Modeling Approach and Model	Develop Approach	Fall 2013
		Develop Model	Winter 2013
	Coordination with other Studies on Processes Modeled	-	Winter 2013
	Calibration/Validation of Model	-	Spring 2014
Model Existing and with-Project Conditions	Model Existing Conditions	-	Summer 2014
	Model with-Project Conditions	-	Fall 2014
Coordination on Model Output	-	-	Fall 2014

Initial and Updated Study Reports explaining the actions taken and data collected to date will be issued in December 2013 and 2014.

5.9.7. Level of Effort and Cost

Initial estimates of the costs to perform the components of the Fluvial Geomorphology Modeling Study are provided in Table 5.9-4. The total effort for the Geomorphology Modeling Study is estimated to cost between approximately $1.0 million and $1.7 million.

Table 5.9-4. Geomorphology Modeling costs.

Component	Task/Subtask		Estimated Cost Range
Bed Evolution Model Development, Coordination and Calibration	Development of Bed Evolution Modeling Approach and Model	Develop Approach	$50k to $100k
		Develop Model	$550k to $800k
	Coordination with other Studies on Processes Modeled		$50k to $100k

	Calibration/Validation of Model	$100k to $200k
Model Existing and with-Project Conditions	Model Existing Conditions	$125k to $200k
	Model with-Project Conditions	$125k to $200k
Coordination on Model Output		$50k to $100k

5.9.8. Literature Cited

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5.10. Ice Processes in the Susitna River Study

5.10.1. General Description of the Proposed Study

The ice processes study will further the understanding of natural ice processes in the Susitna River and provide a method to model/predict pre-Project and post-Project ice processes in the Susitna River. The study will provide a basis for impact assessment, which will inform the development of any necessary protection, mitigation, and enhancement measures. The study also will provide ice processes input data for other resource studies (e.g., fluvial geomorphology modeling, instream flow, instream flow riparian, groundwater).

5.10.1.1. Study Goals and Objectives

The overall goal of the ice processes study is to understand existing ice processes in the Susitna River and to model/predict both pre-Project and post-Project ice processes. The specific objectives are to

- Document the timing, progression, and physical processes of freeze-up and breakup during 2012-2014 between the Oshetna River confluence (River Mile [RM] 233.4) and tidewater (RM 0)
- Develop a modeling approach for assessing ice processes in the Susitna River
- Calibrate the model based on existing conditions
- Determine the potential effect of various Project operational scenarios on ice processes downstream of Watana Dam
- Determine the extent of the open water reach
- Determine the changes in timing and ice-cover progression and ice thickness and extent.
- Provide observational data of existing ice processes and modeling results of post-Project ice processes to the fisheries, instream flow, instream flow riparian, fluvial geomorphology, and groundwater studies

Thermal and ice modeling for the reservoir and the general thermal modeling for the river during the 5 months when ice is not present will be accomplished under the Water Quality Modeling Studies (Section 5.6). The output from this work will be used in the river ice processes studies.

5.10.2. Existing Information and Need for Additional Information

5.10.2.1. Existing Information

Ice affects the Susitna River for approximately seven months of the year, between October and May. When air and water temperatures drop below freezing, shelf ice grows along the banks of the river, and frazil ice begins accumulating in the water column and flowing downstream, eventually accumulating against ice bridges and solidifying into a solid cover (Ashton 1986). By mid-winter, much of the river is under a stable ice cover, with the exception of persistent open leads corresponding with warm upwelling water or turbulent, high-velocity flows. Flows generally drop slowly throughout the winter until snowmelt commences in April. During April and May, river stages rise and the ice cover weakens, eventually breaking into pieces and flushing downstream (Beltaos 2008). Ice jams are recurrent events in some reaches of the river that, if severe, can flood upstream and adjacent areas, drive ice overbank onto gravel bars and into sloughs and side channels, affect riparian vegetation, and threaten infrastructure, such as the Alaska Railroad and riverbank property.

Ice processes were documented between the mouth of the Susitna River (RM 0) and the proposed dam site (RM 184) between 1980 and 1985 (R&M Consultants, Inc. 1981, 1982, 1983, 1984, 1985). Both freeze-up and breakup progressions were monitored using aerial reconnaissance. Locations of ice bridges during freeze-up and ice jams during breakup were recorded each season. One winter, a time-lapse camera was installed in Devils Canyon to observe ice processes through the narrow, turbulent rapids. Additional ice data were collected to calibrate a model. These included ice thicknesses, top of ice elevations, air and water temperatures, slush ice porosity, and frazil density.

Other entities (National Weather Service, U.S. Geological Survey [USGS], and U.S. Army Corps of Engineers [USACE]) also have collected and compiled ice thickness, breakup, and freeze-up data for various locations on the river, although these data were not collected for the purpose of understanding the potential effects of the Project.

Freeze-up and melt-out processes in the Middle River (between Gold Creek and Talkeetna) were modeled using ICECAL, a numerical model developed by the USACE Cold Regions Research and Engineering Laboratory (CRREL) (Harza-Ebasco 1984). The model utilized the outputs from a temperature model developed for the river (SNTEMP) and empirical data on frazil production and ice-cover progression derived from observations. Both the Watana-only and Watana-Devils Canyon operations, as proposed in the 1980s, were modeled for a range of meteorological conditions. The results of the model included predictions of the extent of ice cover for cold, average, and warm winters; the timing of ice cover progression for this range; and the inundated area beneath the ice cover for selected cross-sections. Empirical data on frazil production and ice cover progression was used to estimate changes in ice cover progression up to Talkeetna. Reservoir ice was simulated using DYRESM and calibrated to conditions at Eklutna Lake (Harza-Ebasco 1986).

5.10.2.2. Additional Information Needs

The need for additional information beyond what was gathered and analyzed during the 1980s is driven by three factors: 1) the new proposed configuration of the Project and project operational scenarios; 2) advances in predictive models of winter flow regimes beyond what was available in the 1980s; and 3) the need to supplement previously documented observations of natural ice processes.

The Project consists of one dam that will be at a lower height and have a different configuration than the originally proposed project in the 1980s. The Preliminary Application Document (PAD) proposes an operational scenario that would release more water in the winter, with a potential for day-to-day fluctuations, as opposed to the 1980s proposal of constant flows. The ICECAL Model only simulated conditions between Talkeetna and Gold Creek and did not simulate flow fluctuations with a time-period shorter than one week; whereas, it is likely that daily flow fluctuations will be considered when determining project operations. The ICECAL model was largely an empirical data-driven model, rather than a dynamic predictive model, as is available today. A dynamic model will be able to simultaneously predict flow and temperature fluctuations downstream of the dam, as well as ice-cover progression.

Ice bridging, leads, and ice jams are all influenced by channel geometry, and, in some cases, tributary mouth locations, and additional documentation of ice processes are needed to determine whether locations of these features and timing of ice cover progression are similar to conditions observed in the 1980s. In some locations, this geometry may have changed. In addition, in the 1980s, the location of frazil production early in the freeze up period varied significantly between study years. An assessment is needed to determine the importance of the Susitna River upstream and downstream of the proposed dam in frazil production for a range of meteorological conditions.

Finally, updated ice processes information is needed by the fisheries, instream flow, instream flow riparian, fluvial geomorphology, and groundwater studies.

5.10.3. Study Area

The ice processes observation study area includes the 234-mile segment of river between tidewater and the Oshetna River confluence (from RM 0 to RM 233.4). Observations of open leads, breakup progression, and freeze-up progression will be made in this area.

Predictive ice modeling, coupled with dynamic flow routing and temperature modeling, is planned for the Middle River between the proposed dam and the Three-Rivers Confluence near Talkeetna (from RM 184 to RM 100). There are currently no accepted models for predicting dynamic ice processes on complex braided channels, such as those found in the Lower Susitna River downstream of the Talkeetna; therefore, no modeling is planned for the 100-mile reach between tidewater and the Talkeetna River (from RM 0 to RM 100).

In order to calibrate and verify the model, ice thickness and top-of-ice elevations will be surveyed in the modeled reaches (RM 0 to RM 184).

5.10.4. Study Methods

5.10.4.1. Aerial Reconnaissance

Aerial reconnaissance and GPS mapping of ice features, including ice jams, ice bridges, frazil accumulations, and open leads during the breakup and freeze-up periods will be performed from tidewater to the Oshetna River confluence (from RM 0 to RM 233.4). The number of observations will vary depending on ice process conditions, but it is anticipated that approximately 10 reconnaissance trips per year will occur during breakup and 10 reconnaissance trips per year will occur during freeze-up in 2012, 2013, and 2014. The data collected will include geodatabases of ice features and open leads, georeferenced photographs, and videos of ice processes. Ice processes field observation standards follow those of EM-1110-2-1612, Ice Engineering, developed by the USACE (U.S. Army Corps of Engineers 2002).

5.10.4.2. Time-Lapse Camera Monitoring

Time-lapse camera monitoring of breakup and freeze-up will be done at locations corresponding to flow routing model instrumentation, key ice processes, and fish habitat locations. The selection of transects will be refined with input from the other resource studies (e.g., fluvial geomorphology, fisheries). The current locations of the time-lapse cameras for 2012 are:

- RM 9.5 – Near Upper Tidal Influence

- RM 25.6 – Susitna Station
- RM 59 – Rustic Wilderness Side Channel
- RM 88 – Birch Creek Slough
- RM 99 – Slough 1
- RM 103 – Talkeetna Station
- RM 121 – Curry Slough
- RM 129 – Slough 9
- RM 141 – Slough 21
- RM 149 – Mouth of Portage Creek
- RM 184 – Dam Site

5.10.4.3. River Ice Thickness and Elevation

Field data collection of ice thickness and elevation will be conducted at the transects identified in 2012 for the flow routing model study. Ice thicknesses and elevations will be used to calibrate the ice model to observed conditions. The following data will be collected along with these measurements:

- air temperature;
- water temperature;
- effective water depth;
- thickness of snow cover;
- slush-ice thickness;
- slush-ice porosity; and
- frazil-ice density.

5.10.4.4. River Ice-Processes Model Development for Existing Conditions

A one-dimensional, thermal ice model with flow-routing capability will be selected, developed, and applied to the Susitna River between the proposed dam site and Talkeetna. Candidate model frameworks include Comprehensive River Ice Simulation System Project (CRISSP1D), developed at Clarkson University (Chen et al. 2006); and River1D with Ice, developed at the University of Alberta (Hicks 2005, Andrishak and Hicks 2005a). Alternatively, comparable dynamic ice-processes might be incorporated into the Susitna River Hydraulic and Thermal Processes Model, which is also being developed for this Project. The Susitna River Ice-Processes Model will be used to simulate time-variable flow routing, heat-flux processes, seasonal water-temperature variation, frazil-ice development, ice-transport processes, and ice-cover growth and breakup.

A Model Evaluation Group (MEG) will advise the selection, development, and application of the thermal ice model. The MEG will be comprised of approximately five members, with a mix of academics, consultants, and outside government agencies (e.g., USACE CRREL, the University of Alberta Ice Engineering Group).

Air- and water-temperature inputs to the river ice model will be obtained from empirical data for existing conditions, including meteorological stations and temperature sensors deployed in 2012 as part of the water quality studies. The model will be calibrated to the range of observed conditions in the reach, and an attempt will be made to match existing conditions observations taken in the 1980s, as well as ice thickness and elevation measurements taken in 2012 and 2013.

5.10.4.5. River Ice-Processes Model Projections for Proposed Conditions

For the Middle River, the calibrated ice-processes model will be used to model the proposed Project operational scenarios. The ice model will predict water temperature, ice cover formation and extent, and flow fluctuations (routing) between the proposed dam site and Talkeetna.

Input to the ice model will rely on flow releases from Watana Dam provided by the reservoir operations model and on water temperatures of the flow releases from Watana Dam provided by the reservoir water temperature model. Meteorological (MET) input data for the model will be obtained from MET stations being installed as part of the Water Quality Study.

The product of the proposed conditions models will be quantitative predictions of the extent and elevation of ice cover downstream of the dam; the timing and evolution of ice-cover progression under mild, moderate, and cold climate scenarios; and the timing of breakup for the proposed Project operation scenario.

5.10.4.6. Review and Compilation of Existing Cold-Regions Hydropower Project Operations and Effects

Hydropower projects in northern North America, especially Canada, and in other northern countries have operated on ice covered rivers for many decades (National Research Council of Canada 1990). Other river systems where ice-modeling has been completed include:

- Peace River, Canada (Andrishak and Hicks 2005b)
- Athabasca River, Canada (Katopodis and Ghamry 2005)
- Ohio River, USA (Shen et al. 1991)
- St. Clair River, USA (Kolerski and Shen 2010)
- Romaine River, Canada (Thériault et al. 2010)

References to the effects of these hydropower operations on ice cover will be summarized, and, where relevant, study authors contacted to obtain additional information that may be relevant to the Susitna River. The product of this portion of the study will be a white paper summarizing these references.

5.10.5. Consistency with Generally Accepted Scientific Practice

The proposed ice processes studies including methodologies for data collection, analysis, modeling, field schedules, and study durations are consistent with generally accepted practice in the scientific community. The study plans were developed with the input of technical experts including USACE CRREL and the University of Alberta Ice Engineering Group.

5.10.6. Schedule

Field data will be collected as follows:

- Ice thickness and elevation data along transects will be collected between March 1 and April 1, 2013, and again between March 1 and April 1, 2014.
- Open lead locations will be documented at the same time that ice thickness and elevation data are collected.
- Breakup reconnaissance observations will be conducted between April 10 and May 15, 2013, and 2014.
- Freeze-up reconnaissance observations will be conducted between October 1 and January 15, 2012, 2013, and 2014.
- Continuous time-lapse camera data will be collected during the breakup and freeze-up periods.

Model selection will occur in 2012. Model development and calibration will occur continuously during 2013 and 2014. Preliminary modeling runs for existing conditions will be calibrated to 2012 and 2013 conditions by the end of 2013, and proposed operations scenarios will be run primarily in 2014. AEA will issue Initial and Updated Study Reports documenting actions taken to date in December 2013 and 2014, respectively.

5.10.7. Level of Effort and Cost

The level of effort for field work will depend on the data needs of the chosen model, and related disciplines such as fisheries, instream flow, riparian, geomorphology, and groundwater. Below is a rough estimate of costs associated with field documentation and model development in 2013-2014, which are the major components of the ice study.

Documentation of ice observations is anticipated to cost $1,000,000 for the 2013-2014 period (two breakups and one freeze-up, plus winter ice thickness and elevation surveys). Assuming a year-long modeling effort will be required, development and calibration of ice routines for the thermal and hydraulic model is anticipated to cost between $800,000 and $1.5 million. The cost will depend on the length of the modeled reach and the extent to which model code will need to be developed in order to adapt the model to the Susitna River. The low-end cost assumes that a pre-existing coupled hydraulic-ice model is used. The high-end cost assumes that comparable ice processes have to be ported over to a pre-existing hydrodynamic/hydraulic model.

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5.11. Glacial and Runoff Changes Study

5.11.1. General Description of the Proposed Study

5.11.1.1. Study Goals and Objectives

Glaciers have generally retreated during the last century (Kaser et al. 2006, Meier et al. 2007), and glaciers in Alaska are currently subject to some of the highest glacial wastage rates on Earth (Arendt et al. 2002, Hock et al. 2009). Projections indicate that Alaskan glaciers may lose up to 60 percent of their current volume within the next 100 years (Radic and Hock 2011). Figure 5.11-1 provides an example of a glacier within the Upper Susitna Basin that has recently retreated.

Such changes will alter stream flow both in quantity and timing (Hock et al. 2005a). This is because glaciers temporarily store water as snow and ice during varying time scales with the release controlled by both climate and internal drainage (Jansson et al. 2003).

Typical characteristics of discharge from glacier dominated drainages include pronounced diurnal patterns and mid- to late summer high flows due to the dominance of glacier melt water over precipitation. Annual runoff from a glaciered basin strongly depends on glacier mass balance. During years of positive glacier net balance water is withdrawn from the annual hydrological cycle into glacier storage, and total stream flow is reduced. During years of negative glacier mass balance water is released from storage and total stream flow increases.

Glaciers also tend to dampen interannual streamflow variations, where melting variations tend to offset precipitation variations. As little as 10 percent glacierization in a hydrologic basin reduces year-to-year variability in precipitation to a minimum (Huber 2005). As glaciers retreat, total glacier runoff will initially increase but then be followed by a reduction in runoff as the mass of the glacier dwindles (Figure 5.11-2).

With a high fraction of ice cover in the drainage basin, the increases in runoff during glacial mass wasting events can temporarily exceed any other component of the water budget. Nevertheless, glaciers tend to be only crudely represented in hydrological modeling (Hock et al. 2005b). Hence, the watershed runoff response due to glacier retreat is not well understood.

The primary goal of this study is to analyze the potential impacts of glacial retreat on the Susitna-Watana Project (Project). Specifically, how could glacial retreat, along with associated changes to the climate, impact the flow of water into the proposed reservoir and water quality. Currently several glaciers flow down the southern flanks of the Alaska Range near 13,832-foot Mount Hayes to form the three forks of the upper Susitna River (Figure 5.11-3).

Glaciers in this area provide a significant portion of the total run-off within the upper Susitna drainage, and it is well documented that these glaciers are currently retreating (Molnia 2008). Given this trend, changes to the run-off represented by glacial melting may occur in the near future, and may impact the Project. Therefore, understanding how changes to the upper basin hydrology due to glacial retreat and climate change can affect Project operations is necessary to inform the evaluation of potential protection, mitigation and enhancement (PM&E) measures.

Specific objectives of the study are to:

1) Review existing literature relevant to glacial retreat in Southcentral Alaska and the Susitna watershed. This information will summarize the current understanding of potential future changes in runoff. This will include estimates of the volume of run-off currently provided via mass wasting of glaciers and the time that such sources of run-off may continue, as well as trend analyses available in the historic record.
2) Develop a modeling framework that includes the effects of glacier wastage and glacier retreat on runoff in the Susitna basin, and estimate potential glacier mass changes until the year 2100.
3) Project future river runoff in the Susitna-Watana basin to the year 2100 using various climate projection scenarios.
4) Qualitatively assess the potential effects of climate change models on permafrost, vegetation, and runoff patterns, and adjust river runoff as appropriate for sensitivity analyses.
5) Summarize the results of this study in a Technical Report.

Modeling will rely on two existing models. Glacier response will be simulated using the glacier melt and runoff model by Hock (1999). Hydrological processes outside the glacier will be modeled using the Water Balance Simulation Model (WaSiM-ETH).

5.11.2. Existing Information and Need for Additional Information

Approximately 5 percent of the Upper Susitna River basin is covered by glaciers. Permafrost is generally discontinuous, although seasonal freeze and thaw cycles affect the entire basin. Long-term (less than 60 years) stream flow observations from the U.S. Geological Survey (USGS) are available at five locations in the basin: Denali, Cantwell, Gold Creek, Sunshine, and Susitna Station. While substantially smaller than the Yukon River basin, the Susitna River exports nearly half as much sediment as the Yukon River annually (Milliman and Meade 1983).

5.11.2.1. Existing information on glacial retreat in Alaska

The most comprehensive study to date was prepared by the USGS (Molnia 2008). This study has documented retreat on several key glacial contributors to the Upper Susitna River; however, additional study is needed to evaluate changes to precipitation, run-off, and evapotranspiration that may occur following glacial retreat. For example, as the glacier retreats the surface of the earth changes from ice, to bare ground, to shrubs, to forest. Each of these changes has implications for water quality and run-off volumes. Many of these transitions will occur during the expected life of the Project.

There has been extensive melting of glaciers and thawing of permafrost during the recent period. Statewide, Alaskan glaciers lost 10.1 cubic miles (41.9 cubic kilometers) of water per year, plus or minus 2.1 cubic miles (8.6 kilometers) of water per year, between 1962 and 2006 (Berthier et al. 2010). However, like temperature and precipitation, glacier ice loss is not uniform across wide areas; even while most glaciers in Alaska are losing mass, some have been growing (e.g., Hubbard Glacier in Southeast Alaska). Alaska glaciers with the most rapid loss are those terminating in sea water or lakes.

5.11.2.2. Documented changes in climate

Scenarios Network for Alaska and Arctic Planning (SNAP) (2008) reported that Alaska has seen a statewide increase in temperatures of 2.69 degrees Fahrenheit (°F) since 1971. This has not been equal across the state. Statewide, Barrow displayed the greatest increase (4.16 °F) and Kodiak showed the least (0.87 °F). The U.S. Global Change Research Program (2009) reported that Alaska has experienced a 3.4 °F rise in average annual temperatures over the past 50 years, with an increase in winter temperatures of 6.4 °F. These increases in temperatures have led to other related changes in climate. For example, the average snow-free days have increased across Alaska by 10 days, and the number of frost free days has steadily increased in Fairbanks, Alaska (Figure 5.11-4).

Precipitation rates are generally increasing across the state. On the whole, Alaska saw a 10 percent increase in precipitation from 1949 to 2005, with the greatest increases recorded during winters (U.S. Climate Research Center 2009). However, this trend is very location-specific across Alaska. Figure 5.11-5 shows that while temperatures have increased in Talkeetna, mean annual precipitation has remained relatively constant. Responses to the increased precipitation levels can be offset in some locations by the increased temperatures and longer growing seasons, which have increased evapotranspiration rates, causing reductions in available moisture through changes to the precipitation-potential evapotranspiration (P-PET) ratio.

5.11.2.3. Projections of the future

The observed trends in temperature, precipitation, and snowpack are largely consistent with climate model projections for Alaska (Christensen et al. 2007, Karl et al. 2009). The magnitude of projected changes depends on many factors and will vary seasonally. Projected changes in climate will translate into hydrologic changes through alteration of rain and snowfall timing and intensity, evapotranspiration, and groundwater and surface flows. For example, precipitation is predicted to increase in the Susitna Basin, but this may be offset by an increase in evapotranspiration from warmer temperatures and a longer growing season. Milder winters could result in reductions in snowpack, since a higher percentage of precipitation would occur as rain. But given the elevation of the upper Susitna basin, increases in precipitation may simply result in increased seasonal snow storage, resulting in greater spring runoff.

For any hydropower project it is important to understand the variability of the discharge as it directly affects power generation.

Both air temperature and precipitation are currently predicted to increase over time in Alaska, including the southcentral region (SNAP 2011). Temperatures in this region are projected to increase over the coming decades at an average rate of about 1 °F per decade (SNAP 2011).

5.11.3. Study Area

The proposed study area is the Susitna River basin upstream of the proposed Watana Dam site.

5.11.4. Study Methods

The studies and study components to be conducted include the following components:

- Review existing literature relevant to Southcentral Alaska, the Susitna watershed, and glacial retreat, and document trends in the historic record.
- Develop a modeling framework.
- Analyze changes in glacial systems, temperature, and precipitation, and their impacts on watershed hydrology, including future runoff projections. The changes in runoff will be translated into time series data summarizing changed hydrology and temperature dynamics in the Susitna basin.
- Qualitatively assess the potential effects of climate change models.
- Summarize results of this study in a Technical Report.

5.11.4.1. Review Existing Literature

Existing literature will be reviewed to summarize the current understanding of the rate and trend of glacial retreat and the contribution of glacial mass wasting to the overall flow of the Upper Susitna watershed. This will include trend analyses of glacial retreat, temperature, and precipitation.

Input data will include air temperature, precipitation, relative humidity, wind speed, and radiation data. These will be obtained in part from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) dataset (OSU, 2012). PRISM is a unique knowledge-based system that uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital grid estimates of monthly, yearly, and event based climatic parameters. To obtain daily and sub-daily data, a WGEN (Weather Generator) model will be used that provides daily values for precipitation, maximum temperature, minimum temperature, and solar radiation. The model accounts for the persistence of each variable, the dependence among the variables, and the seasonal characteristics of each variable (Richardson and Wright 1984). For reanalysis and present day assessment we will use the North America Regional Reanalysis (NARR), which was computed at NCEP and initially covers the period from 1979 to 2003. The highest resolution output is 20 miles (32 kilometers) every three hours. Where available, meteorological data will be used with hourly time resolution from the National Weather Service and from the Alaska-Pacific River Forecast Center, Anchorage.

5.11.4.2. Develop a Modeling Framework

The study will use the fully-distributed temperature index mass balance model by Hock (1999, 2003), that computes snow and ice melt and resulting runoff on hourly to annual time scales based on temperature and precipitation data. The model incorporates the effects of topography on melt by varying the degree-day factor according to potential direct solar radiation, which is computed from topography and solar geometry. The model converts mass changes into glacier geometry changes, and thus it is able to model the effects of a changing geometry on the mass balance.

The model has been used world-wide on many glaciers of different size and located in a wide range of climatic settings for a wide range of applications in different disciplines including basic and applied research, and ranging from providing the mass balance input to ice flow modeling on valley glacier and continental ice sheet scales (Schneeberger et al. 2001), predicting the response of glaciers and glacier discharge to future climate (Schuler et al. 2005a, de Woul et al. 2005), quantifying the risk for glacier outburst floods (Schuler et al. 2002, Huss et al. 2007), assessing the glacial history of empty cirques (Dühnforth and Anderson 2011), and reconstructing the mass balance history on a century time scale (Huss et al. 2008a). Applications have recently been broadened by using global climate data sets including output from global and regional climate model for impact studies (Hock et al. 2007). The model requires a digital elevation model (DEM), temperature, and precipitation data.

Data generated from the mass balance ice model will be input into the WaSiM-ETH to analyze the present and future runoff and soil water storage variations. WaSiM-ETH (Schulla 1997, Schulla and Jasper 2000) is a well-established tool for modeling the spatial and temporal variability of hydrological processes in complex basins ranging from less than 0.4 square mile (1 square kilometer) (Liljedahl et al. 2009) to more than 193,000 square miles (500,000 square kilometers) (Kleinn et al. 2005). It has been widely used by both research scientists and state agencies for water resources management. In total, WaSiM-ETH has been applied to more than 55 watersheds on all continents resulting in more than 120 publications documenting the wide range of applications that have led to constant improvement and refinement of the model.

WaSiM-ETH calculates evapotranspiration, snow accumulation, snow and glacier melt, runoff, interception, infiltration, soil water storage, and runoff, such as surface, interflow, and baseflow. Recently the model has been enhanced to include permafrost (Liljedahl et al., in prep). Minimum input data requirements include a digital elevation model, vegetation and soil maps, precipitation, and air temperature. Complementary inputs are wind speed, vapor pressure, and shortwave incoming radiation. Spatial interpolation of the meteorological input data may be applied along with corrections of precipitation and adjustment of radiation due to solar and local geometry. The model can be run with hourly to monthly time steps.

WaSiM-ETH includes a simple glacier melt model that describes the melt of firn, ice, and snow on glaciers as well as routing of the water through the glacier. The melt model is represented by an extended temperature index method including potential direct radiation (Hock 1999), and the water is routed through the glacier using three linear reservoirs (Hock and Noetzli 1997) to account for the different travel times for firn, snow, and ice storages. WaSiM-ETH is considered the ideal model for this project because:

- the model is robust and has been successfully applied to many watersheds as evidenced by the extensive publication record;
- WaSiM-ETH is a reasonable compromise between detailed physical basis and minimum data requirements and, therefore, suitable in data sparse regions such as Alaska;
- WaSiM-ETH is a very suitable model to couple with a soil thermal regime model due to the implemented Richards equation, two dimensional (2-D) groundwater module, and the soil moisture evapotranspiration dynamics;
- the model is coded in a modular way allowing easy adjustments and modifications in model formulations, and it can also easily be coupled to existing glacier models; and
- the model is user-friendly and includes a very detailed model description and user manual facilitating use of the model code (Schulla 2012).

Although this approach has been shown to be highly efficient in modeling glacier runoff (Hock et al. 2005b) the model does not allow any changes in glacier firn extent, glacier geometry, and area, i.e., the glacier cannot retreat nor advance. Hence, the model will not be able to accurately predict the runoff changes due to expected glacier retreat as the reservoir of ice is depleted. Also, since the firn areas (i.e., the high reaching accumulation areas) are assumed constant in the current version, the model is not able to account for a faster runoff generation when firn areas decline and more bare ice becomes exposed at the surface. The glacier module will be enhanced by allowing for a time-variant firn area and by updating the glacier extent after each mass-balance year. This will be accomplished by volume-area scaling (Bahr et al. 1997, Radic et al. 2008). By accounting for glacier retreat/advance, the model will be able to represent changes in glacier volume and their effects on long-term river runoff.

Field data will be generated from locally installed meteorological stations (MET) stations to aid in downscaling the data from gridded climate products (see Water Quality Study, Section 5.5) The data will allow smaller scale climate variability to be accessed and guide determination of some model parameters (for example the temperature lapse rate).

Future hydrological simulations will be forced with the Max Planck Institute for Meteorology ECHAM5 model (3 hour time steps) and SNAP (daily) models. The SNAP dataset includes the years 1980-2099, with data downscaled to 2 kilometer grid cells. Future projections from SNAP are derived from a composition of the 5 best ranked General Circulation Models (out of 15 used by the Intergovernmental Panel on Climate Change [IPCC]) models for Alaska. Based on how closely the model outputs matched climate station data for temperature, precipitation, and sea level pressure for the recent past, their individual ranking order for overall accuracy in Alaska and the far north was as follows: 1) ECHAM5, 2) GFDL21, 3) MIROC, 4) HAD, and 5) CCCMA. The five-model composite uses mean values from the outputs of these models. Results from three emission scenarios (A2, A1B, and B2) are available from the SNAP website (http://www.snap.uaf.edu/home). Input parameters to the permafrost model within WASIM are spatial datasets of vegetation and soil thermal properties, which are specific for each vegetation and soil class and geographical area. The following datasets will be used:

- **Soils Map.** This data set consists of a circumpolar map of dominant soil characteristics. The map, in Esri digital format, was created using the Northern and Mid-Latitude Soil Database. The map shows the dominant soil of the spatial polygon and also the proportion of polygon encompassed by the dominant soil or non-soil (Tarnocai et al. 2002). Additional data will come from a standardized global soil texture and water-holding capacities data set (Webb et al. 2000). When combined with the World Soil Data File (Zobler 1986), the result is a global data set with variations in physical properties throughout the soil profile.
- **Land cover map.** Land cover will be estimated using Version 2.0 of the global land cover characteristics database. The USGS Earth Resources Observation System (EROS) Data Center, the University of Nebraska-Lincoln (UNL), and the Joint Research Centre of the European Commission have generated a 1-kilometer (0.6-mile) resolution global land cover characteristics data base for use in a wide range of environmental research and modeling applications. The dataset is derived from 1-kilometer (0.6-mile) Advanced Very High Resolution Radiometer (AVHRR) data spanning a 12-month period (April 1992-March 1993) and is based on a flexible database structure and seasonal land cover regions concepts (USGS 2012).

The models will primarily be calibrated and validated against existing river discharge records and glacier mass balance data. The model will be run over the period from 1960 to 2010. Future simulations will be forced by a suite of downscaled IPCC AR4 projection scenarios and, if available, the newer AR5 simulations. Assessment of changes in glacier mass and river runoff will be the primary focus, but detailed output from the WaSIM model, such as future permafrost an active layer and soil water storage, will also be analyzed. Change in streamflow will be analyzed on annual, seasonal, and single event time scales. Results will allow us to quantify the integrated glacier-hydrology responses to climate change for the Susitna basin.

5.11.4.3. Analyze Changes in Glacial Systems and their Impacts on Watershed Hydrology

The temperature and precipitation data will be used to provide a range of future scenarios for the Susitna River basin hydrologic regime that consider all inputs (glaciers, precipitation, temperature, permafrost, evaporation, and transpiration, etc.). This will be presented as a series of trendlines, showing the changes to various physical parameters (temperature, flow, water quality, etc.) over time. The results may be used to inform project analysis conducted in other studies. The uncertainty associated with the scenario analysis and downscaled temperature and precipitation projections will be incorporated into long-term planning and assessment by using scenario based sensitivity studies. It will also incorporate new information generated as part of the Geology and Soils (Section 4.0), Water Quality (Section 5.6), and Geomorphology (Section 5.8) studies.

5.11.4.4. Analyze Potential Changes in Sediment Delivery to Susitna-Watana Reservoir

Glacial surges have been reported for a number of Alaskan glaciers (Humphrey and Raymond 1994, Clarke et al. 1986), including those that are located in the Alaska Range. Glacial surges have been reported for the Susitna and West Fork Glaciers in the upper Susitna Basin (Harrison 1994). Suspended sediment loads as a result of a glacial surge on the Variegated Glacier were reported to increase significantly (Humphrey and Raymond 1994), and it has been suggested (R&M Consultants and Harrison 1981, Harrison, written communication, 2012) that the increased suspended sediment loads resulting from glacial surges might increase sediment delivery to the Susitna-Watana reservoir, thereby accelerating reservoir sedimentation. Unpublished sediment data at the West Fork Glacier, Denali Highway Bridge, and Gold Creek collected by Harrison and others (Harrison written communication, 2012) following the 1987-88 surge of the West Fork Glacier will be obtained and reviewed to determine whether the glacial surge produced significantly increased sediment loads at those locations. Given the order of magnitude variability in the measured suspended sediment loads in non-glacial surge periods (D. Meyer, USGS, personal communication, 2012) it is unlikely that the glacial surge impacts will be detectable. Further, the presence of about 50 miles of extensive braid plains between the termini of the upper Susitna basin glaciers and the head of the Susitna-Watana Reservoir is likely to buffer the impacts of any surge-related increase in sediment concentration at the reservoir. Sediment delivery to the Susitna-Watana Reservoir is unlikely to be supply-dependent.

An initial investigation of the potential loading of sediment from a glacial surge of the magnitude reported by Harrison (1994) and Humphrey and Raymond (1994) for the upper Susitna River basin glaciers will be developed. The potential for the increased loading from the surge to be actually delivered to the Susitna-Watana Reservoir will be investigated based on the sediment transport capacity of the reaches of the Susitna River upstream of the reservoir. If this investigation indicates that the increased sediment load can actually be delivered in substantial quantities to Watana Reservoir, more detailed analyses of the increased loading will be performed and a sediment loading scenario accounting for glacial surge will be added to the

Reservoir Geomorphology study component of the Geomorphology Study. This would include an estimate of the reduction in reservoir life that could result from sediment loading associated with periodic glacial surges.

5.11.4.5. Qualitatively Assess the Potential Effects on Basin Hydrology

Changes in snowpack, temperature, and precipitation have been previous documented over time in the state (Christensen et al. 2007, Karl et al. 2009). The magnitude of future changes depends on many factors and will vary seasonally. Projected changes in climate will translate into hydrologic changes through alteration of rain and snowfall timing and intensity, evapotranspiration, and groundwater and surface flows.

The study will attempt to qualitatively evaluate the projected changes in precipitation, temperature, and evapotranspiration over the next 100 years in the upper Susitna basin. The assessment will look at a several possible cases to evaluate the sensitivity of glacial retreat and runoff changes to differing climatological inputs. This will include no change from current conditions, continuation of current warming trends, and adherence to various climatological scenarios such as SNAP (2011).

In addition to the temporal and spatial patterns, an estimate the various extreme precipitation indices will be performed. These indices will include consecutive wet days, consecutive dry days, maximum 1 day precipitation (Rx1Day), maximum 5 day precipitation (Rx5Day), total annual precipitation (PRECPTOT), and simple daily intensity index (SDII, annual total precipitation divided by the number of wet days in the year), and will be estimated using open source software. The impact of major extreme precipitation indices on flows will be studied.

5.11.4.6. Summarize Results in a Technical Report

The technical report will include a description of the assumptions made, models used, and other background information. Additionally this report will include an analysis of the impacts of past climate variability and trends and projections on the hydropower facilities.

5.11.5. Consistency with Generally Accepted Scientific Practice

Modeling will rely on two existing models. Glacier response will be simulated using the glacier melt and runoff model by Hock (1999). Hydrological processes outside the glacier will be modeled using WaSiM-ETH.

5.11.6. Schedule

The study elements will be completed in several stages and based on the following timeline summarized in Table 5.11-1.

Table 5.11-1. Glacial and Runoff Changes Study schedule.

Monitoring Activity	Timeline
Review existing literature	January to March 2013
Develop a Modeling Framework	April to June 2013

Analyze results	June to November 2013
Initial Study Report issued	December 2013
Updated Study Report issued	December 2014

5.11.7. Level of Effort and Cost

The total estimated cost is $1,000,000.

5.11.8. Literature Cited

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5.11.9. Figures

Figure 5.11-1. September 1999 oblique aerial photograph of the terminus of an unnamed glacier that drains to the East Fork of the Susitna River. The western end of the lake corresponds to the 1955 position of the terminus. The large trimline suggests that the glacier has recently thinned significantly more than 50 meters (164 feet) and retreated more than 2 kilometers (1.2 miles). From Molnia, 2008.

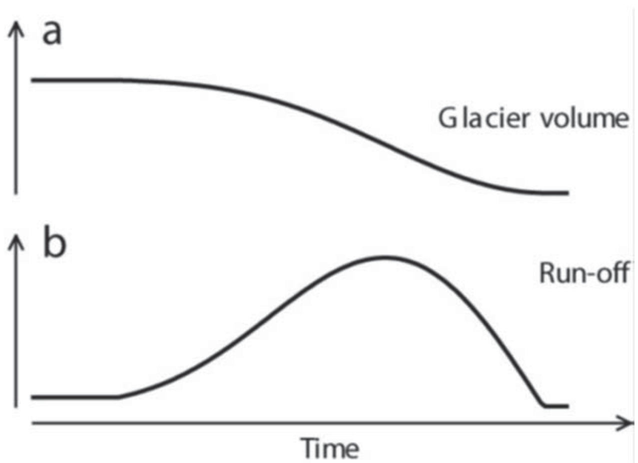

Figure 5.11-2. Schematic representation of the long-term effects of negative glacier mass balances on a) glacier volume and b) glacier runoff. Note that runoff is initially larger during prolonged mass wasting until the glacier is small enough to reduce excess runoff (Jansson et al. 2003).

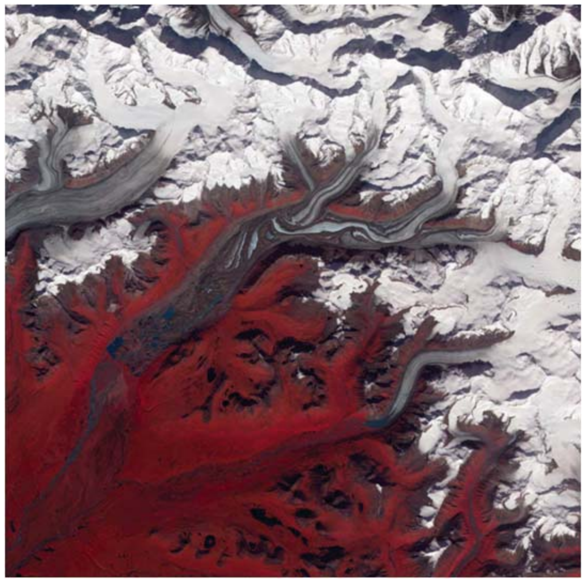

Figure 5.11-3. Susitna Glacier and other unnamed glaciers contributing to upper Susitna River drainage.

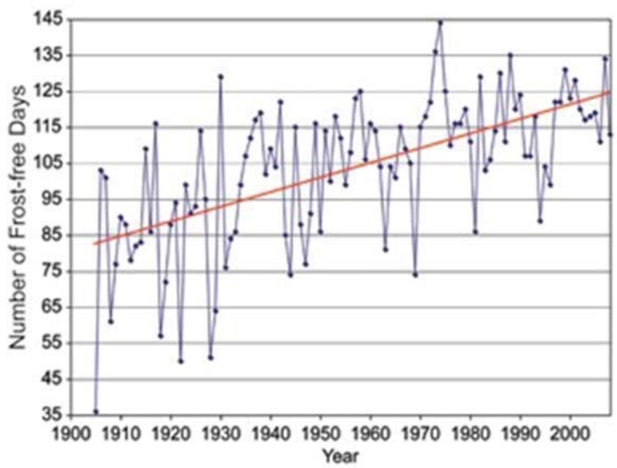

Figure 5.11-4. Fairbanks Frost-Free Season, 1904 to 2008. Over the past 100 years, the length of the frost-free season in Fairbanks, Alaska, has increased by 50 percent. U.S. Global Change Research Program (2009).

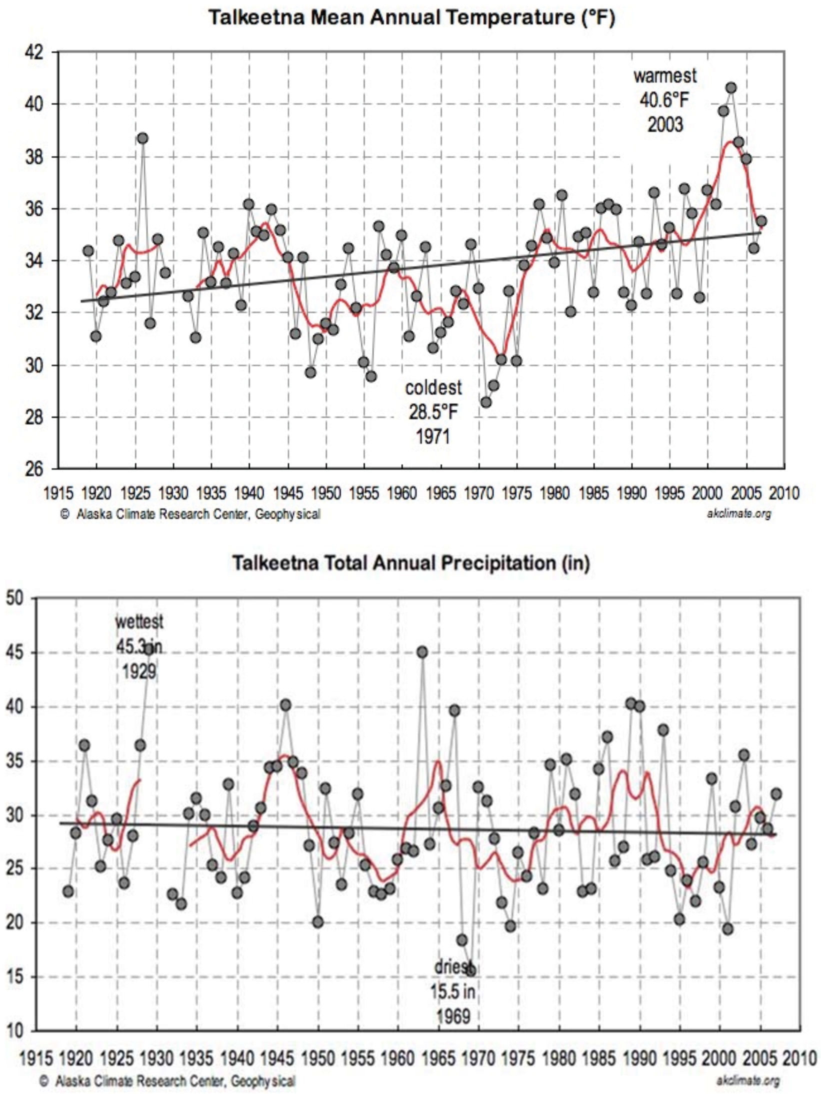

Figure 5.11-5. Mean annual and total annual precipitation at Talkeetna, Alaska 1915-2010 showing the trend line. From Alaska Climate Research Center, http://climate.gi.alaska.edu/Climate/Location/TimeSeries/Talkeetna.html

5.12. Mercury Assessment and Potential for Bioaccumulation Study

5.12.1. General Description of the Proposed Study

Many studies have documented increased mercury concentrations in fish following the flooding of terrestrial areas to create hydroelectric reservoirs. Anoxic conditions created at the bottom of the reservoir can create conditions for microbial methylation of mercury. Methylmercury is a more toxic and bioavailable form of mercury, and it biomagnifies up aquatic food chains. Fish-eating birds and mammals are known to suffer a range of toxic effects from consumption of methylmercury in fish, including behavioral, neurochemical, hormonal, and reproductive effects.

The purpose of this study is to determine if significant mercury is currently present in the river and the degree to which mercury may become more bioavailable after completion of the dam. This will inform the development of any appropriate protection, mitigation, and enhancement measures.

Specific objectives of this study are to:

- Summarize available and historic water quality information for the Susitna River basin, including data collection from the 1980s APA Susitna Hydroelectric Project.
- Characterize the baseline water quality conditions of the Susitna River and tributaries. This will include collection and analyses of water, sediment pore water, sediment, and fish tissue samples for mercury.
- Gather information on the area to be flooded by the new reservoir (post impoundment surface area, mercury content of underlying bedrock, type of soil flooded, biomass quantity, etc.) in order to estimate potential mercury input and degree of mercury methylation in the newly formed reservoir.
- Assess mercury components, including:
    - Mercury sources;
    - Conversion process to methylmercury;
    - Mercury methylation rate;
    - Pathways for mercury movement from different media (sediment, water, fish, terrestrial animal) before and after dam construction; and,
    - Transport of mercury downstream from the reservoir.
- Coordinate study results with other study areas, including fish, instream flow, and other piscivorous bird and mammal studies.

5.12.2. Existing Information and Need for Additional Information

Many studies have documented increased mercury levels in fish following the flooding of terrestrial areas to create hydroelectric reservoirs (Bodaly et al. 1984; Bodaly et al. 2007; Rylander et al. 2006; Johnston et al. 1991; Kelly et al. 1997). Increased mercury concentrations have also been noted at other trophic levels within aquatic food chains of reservoirs, such as aquatic invertebrates (Hall et al. 1998). These problems have been particularly acute in projects from northern climates including Canada and Finland (Rosenberg et al. 1997). When boreal forests with large surface-area-to-volume ratios are flooded, substantial quantities of organic carbon and mercury stored in vegetation biomass (Grigal, 2003) and soils become inputs to the newly formed reservoir (Bodaly et al. 1984; Grigal, 2003; Kelly et al. 1997). This flooding accelerates microbial decomposition, causing high rates of microbial methylation of mercury.

Increases in methylmercury concentrations in reservoirs can last decades; fish mercury elevations have been documented for twenty to thirty years in some systems (Bodaly et al. 2007). Results from these studies may be used by the project proponent and environmental regulators to select the most appropriate mitigation strategies (Mailman et al. 2006) to reduce adverse impacts resulting from impaired water quality.

Historical mercury data from the study area are limited. Some samples were collected during previous studies of the APA Susitna Hydroelectric Project in the 1980s. This consisted of the collection of a water samples at Gold Creek (RM 136) in 1982. Total mercury was found to be 0.12 micrograms per liter (µg/L) in turbid, summer water, and 0.04 µg/L in the clear, winter water (AEIDC, 1985). The same results were found downriver at Susitna Station (RM 26).

Frenzel (2000) collected samples of sediment from the Deshka River, the Talkeetna River, and Colorado Creek and Costello Creek, which are tributaries to the Chulitna River. Mercury concentrations in the sediment were found to range from 0.04 to 0.46 µg/g, more than an order of magnitude. This suggests that mercury occurrence is strongly drainage specific. Additional samples were collected of Slimy Sculpin from the Deshka River, Talkeetna River, and Costello Creek. Mercury concentrations ranged from 0.08 µg/g at Talkeetna and Costello Creek, to 0.11 µg/g at the Deshka River.

Samples of fish tissue and sediment from the Deshka River and Costello Creek were speciated for metallic mercury and methylmercury. The results indicated that 19.54 percent of the mercury in the Deska River sediments was methylmercury. At Costello Creek only 0.02 percent of the mercury detected was found to be methylated. This study suggests, based on limited data, that mercury concentration varies significantly between separate drainages, and that methylation is also tributary specific. Previous studies (St. Louis et al, 1994) have shown that methylmercury occurrence is positively correlated with wetland density, and the Deshka River has significantly more wetlands in the drainage than other tributaries to the Susitna. Overall concentrations were also found to be positively correlated with the turbidity of the water. Very little mercury was found in filtered water samples.

These results are in agreement with the results from Krabbenhoft et al (1999). In nationwide mercury sampling, in a wide array of hydrological basins and wide array of environmental settings, wetland density was found to be the most important factor controlling methylmercury production. It was also found that methylmercury production appears proportional to total mercury concentrations only at low total mercury levels. Once total mercury concentrations exceed 1,000 nanograms per gram (ng/g), however, little additional methylmercury was observed to be produced. While atmospheric deposition was found to be the predominate source for most mercury, volcanic activity was a likely source of mercury at some sites. Sub-basins characterized as mixed agriculture and forested had the highest methylation efficiency, whereas areas affected by mining were found to be the lowest.

A more recent study has been done by the Alaska Department of Environmental Conservation (ADEC) Department of Environmental Health (ADEC 2012). ADEC is currently analyzing salmon (all five species) as well as other fresh water species for total mercury in the Susitna River drainages (Table 5.12-1). The State water quality standards for acute and chronic toxicity have not been exceeded to date.

5.12.3. Study Area

Water quality and sediment samples will be collected at the sites identified in Table 5.12-2. The study area begins at RM 10.1 and extends past the proposed dam site to RM 233.4. Tributaries to the Susitna River will be sampled and include those contributing large portions of the lower river flow such as the Talkeetna, Chulitna, Deshka, and Yentna rivers. Also included are smaller tributaries such as Gold, Portage, Tsusena, and Watana creeks, and Oshetna River. These sites were selected based on the following rationale:

- Adequate representation of locations throughout the Susitna River and tributaries above and below the proposed dam site for the purpose of a baseline mercury characterization;
- Location on tributaries where proposed access road-crossing impacts might occur during and after construction (upstream/downstream sampling points on each crossing);
- Preliminary consultation with licensing participants including co-location with other study sites (e.g., instream flow, ice processes); and
- Sites that are in the Susitna River mainstem, tributary, or slough locations, most of which were monitored in the 1980s.

5.12.4. Study Methods

This study was created to respond to comments from the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), among other licensing participants. Originally the study components described here were spread into several other sections of the overall study plan. They have been consolidated here to provide an overview of the proposed mercury assessment and bioaccumulation plans.

This study consists of five study components:

- Summarize available/historical water quality information.
- Collect and analyze water, sediment, sediment pore water, and fish tissue samples for mercury.
- Gather information on geology, soils, and vegetation in the area to be flooded by the new reservoir.
- Access mercury components, including:
    - Mercury sources;
    - Conversion process to methylmercury;
    - Mercury methylation rate;
    - Pathways for mercury movement from different media (sediment, water, fish, terrestrial animal) before and after dam construction; and,

  - o Transport of mercury downstream from the reservoir.
- Technical report on analytical results and mercury assessment.

Each of these study components is described in detail below.

5.12.4.1. Summary of available/historical water quality information

Existing literature will be reviewed to summarize the current understanding of the occurrence of mercury in the environment. This review will include a summary of 1980s APA Susitna Hydroelectric Project water quality studies, including data, and a summary of other cold regions hydroelectric projects regarding mercury issues.

5.12.4.2. Collection and analyses of water, sediment, sediment pore water, and fish tissue samples for mercury

Data will be collected from multiple aquatic media including surface water, sediment, and fish tissue. The collection of these samples will be handled as part of other media specific study plans. The work will be done as a single, comprehensive survey to determine the baseline concentrations of mercury in the watershed. The in-water mercury study methodology will be designed to meet the Clean Water Act 401 Water Quality Certification Process:

- Conducting a water quality baseline assessment;
- How existing and designated uses are met;
- Use of appropriate field methods;
- Use of acceptable data quality assurance methods;
- Scheduling of technical work to meet deadlines; and
- Derivation of load calculations of potential pollutants (pre-Project conditions).

Mercury in water will be tested monthly during the summer since it has been shown to vary in concentrations throughout the year (Frenzel, 2000). An initial screening survey is proposed for mercury in sediment, sediment pore water, and tissue samples (Table 5.12-3). The following sections summarize the sampling efforts to be conducted in other studies.

5.12.4.3. Water

The purpose of the water sampling is to collect baseline water quality information to support an assessment of the effects of the proposed Project operations on water quality in the Susitna River basin. Monthly grab samples that will be sent to an off-site laboratory for analysis. The laboratory will have at a minimum, National Environmental Laboratory Accreditation Program (NELAP) Certification in order to generate credible data for use by regulatory agencies for evaluating current and future water quality conditions.

Water samples will be collected at the locations in bold on Table 5.12-2. The initial sampling may be expanded if significant methlymercury concentrations are found in the surface water, sediment pore water, sediment, or fish tissue. The proposed spacing of the sample locations follows accepted practice when segmenting large river systems for development of Total Maximum Daily Load (TMDL) water quality models. Water sampling during winter months will be focused on locations where flow data is currently collected (or was historically collected by the USGS).

Water samples will be analyzed for the parameters reported in Table 5.12-4.

Grab samples will be collected during each site visit in a representative portion of the stream channel/water body, using methods consistent with Alaska State and EPA protocols for sampling ambient water and trace metal water quality criteria. Mainstem areas of the river not immediately influenced by a tributary will be characterized with a single grab sample. Areas of the mainstem with an upstream tributary that may influence the nearshore zone or is well-mixed with the mainstem will be characterized by collecting samples at two locations; in the tributary and in the mainstem upstream of the tributary confluence. All samples will be collected from a well-mixed portion of the river/tributary.

These samples will be collected on approximately a monthly basis (4 samples from June to September). The period for collecting surface water samples will begin at ice break-up and extend to beginning of ice formation on the river. Limited winter sampling (once in December, and again in March) will be conducted where existing or historic USGS sites are located. Review of existing data (URS 2011) indicated that few criteria exceedances occur with metals concentrations during the winter months. If the 2013 data sets suggest that mercury concentrations exceed criteria or thresholds then an expanded 2014 water quality monitoring program will be conducted to characterize conditions on a monthly basis throughout the winter months.

Variation of water quality in a river cross-section is often significant and is most likely to occur because of incomplete mixing of upstream tributary inflows, point-source discharges, or variations in velocity and channel geometry. It is possible that a flow-integrated sampling technique employed by USGS known as the equal width increment/equal transit rate (EWI) method (Edwards and Glysson, 1988; Ward and Harr, 1990) will be used. In this method, an isokinetic sampling device (a sampler that allows water to enter without changing its velocity relative to the stream) is lowered and raised at a uniform transit rate through equally-spaced vertical increments in the river cross-section. This can be done either by wading with hand-held samplers or from a boat using a winch mounted sampler, depending on river stage and flow conditions. The number of vertical increments used will differ between sites depending upon site specific conditions.

Sampling will avoid eddies, pools, and deadwater. Sampling will avoid unnecessary collection of sediments in water samples, and touching the inside or lip of the sample container. Samples will be delivered to EPA approved laboratories within the holding time frame. Each batch of samples will have a separate completed chain of custody sheet. A field duplicate will be collected for 10 percent of samples (i.e., 1 for every 10 water grab samples). Laboratory quality control samples including duplicate, spiked, and blank samples will be prepared and processed by the laboratory.

Quality Assurance/Quality Control (QA/QC) samples will include field duplicates, matrix spikes, duplicate matrix spikes, and rinsate blanks for non-dedicated field sampling equipment. The results of the analyses will be used in data validation to determine the quality, bias and usability of the data generated.

Sample numbers will be recorded on field data sheets immediately after collection. Samples intended for the laboratory will be stored in coolers and kept under the custody of the field team at all times. Samples will be shipped to the laboratory in coolers with ice and cooled to approximately 4° C. Chain of custody records and other sampling documentation will be kept in sealed plastic bags (Ziploc®) and taped inside the lid of the coolers prior to shipment. A temperature blank will accompany each cooler shipped. Packaging, marking, labeling, and shipping of samples will be in compliance with all regulations promulgated by the U. S. Department of Transportation in the Code of Federal Regulations, 49 CFR 171-177.

Water samples will be labeled with the date and time that the sample is collected and preserved/filtered (as appropriate), then stored and delivered to a state-certified water quality laboratory for analyses in accordance with maximum holding periods. A chain of custody record will be maintained with the samples at all times.

The state-certified laboratory will report (electronically and in hard copy) each chemical parameter analyzed with the laboratory method detection limit, reporting limit, and practical quantification limit. The laboratory will attempt to attain reporting detection limits that are at or below the applicable regulatory criteria and will provide all laboratory QA/QC documentation.

The procedures used for collection of water quality samples will follow protocols from ADEC and the EPA Region 10 (Pacific Northwest). Water samples will be analyzed by a laboratory accredited by the ADEC or recognized under the NELAP. Water quality data will be summarized in a report with appropriate graphics and tables with respect to Alaska State Water Quality Standards (ADEC 2005) and any applicable federal standards.

The results will be compared to the appropriate NOAA SQuiRT table, "Screening Quick Reference Table for Inorganics in water", to assess whether a metal level exceeds acute and/or chronic toxicity benchmarks for aquatic organisms.

Additional details of the sampling methods will be provided in the Sampling and Analysis Plan (SAP) and the Quality Assurance Project Plan (QAPP) for this study.

5.12.4.3.1. Sediment and Sediment Pore Water

In general, all sediment samples will be taken from sheltered backwater areas, downstream of islands, and in similar riverine locations in which water currents are slowed, favoring accumulation of finer sediment along the channel bottom. Samples will be analyzed for mercury (Tables 5.12-4 and 5.12-5). In addition, sediment size and total organic carbon (TOC) will be included to evaluate whether these parameters are predictors for elevated mercury concentrations. Samples will be collected just below and above the proposed dam site. Additional samples will be collected near the mouth of tributaries near the proposed dam site, including Fog, Deadman, Watana, Tsusena, Kosina, Jay, Goose creeks, and the Oshetna River. The purpose of this sampling will be to determine where metals, if found in the water or sediment, originate in the drainage.

Mercury occurrence is typically associated with fine sediments, rather than with coarse-grained sandy sediment or rocky substrates. Therefore, the goal of the sampling will be to obtain sediments with at least 5 percent fines (i.e., particle size <63 µm, or passing through a #230 sieve). At some locations, however, larger-sized sediment may be all that are available.

Surficial sediment sampling will be conducted with a Van Veen sampler lowered from a boat by a power winch. This sampling device collects high quality sediment samples from the top 4 to 6 inches of sediment (EPA 2001). For most sediment types, the Van Veen sampler is better than other sampling devices for reducing sample loss from debris blockage. The Van Veen sampler also minimizes surrounding water disturbance as the device is lowered through the water column, and collects high quality samples (EPA 2001). The support frame enhances the versatility of the Van Veen sampler, with features allowing the addition of weights (to increase penetration in compact sediments) or pads (to provide added bearing support in extremely soft sediments) (EPA 2001). It is commonly used in national and regional sediment monitoring programs including the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends Program, the EPA Environmental Monitoring and Assessment Program, and the EPA National Estuary Program.

Three sediment samples will be collected per visit at each of the sites sampled. These three samples will be collected and analyzed separately to characterize the presence of metals and generate statistical summaries for site characterization. A photographic record of each sediment sample will be assembled from images of newly collected material.

Sediment sample collection will incorporate specific field methods that define high quality samples (from EPA 2001):

- Sampler is not overfilled with sediment.
- Overlying water is present when the sampler is retrieved.
- Overlying water is clear, not turbid.
- At least 2 inches of sediment depth is collected.
- There is no evidence of incomplete closure of the sampling device.

If a sediment sample does not meet all of the above criteria, it will be discarded and another sample will be collected.

Sediment data will be compared to the appropriate NOAA SQuiRT table, "Screening Quick Reference Table for Inorganics in Freshwater Sediment", to assess whether a metal level exceeds acute and/or chronic toxicity benchmarks for aquatic organisms.

Sediment interstitial water, or pore water, is defined as the water occupying the space between sediment particles. Interstitial waters will be collected from sites as indicated in Table 5.12-2 and separated from sediments in the field house laboratory using a pump apparatus to draw pore water from each of the replicate samples. Filtering of samples will utilize a 0.45 µm pore size filter in both the lab and field apparatus. In some cases, pore water may be drawn from sediment samples in the field by using 100 milliliter (mL) syringes immersed in the dredge sample once a sediment sample is collected in a sample jar. These would be cases where sediment samples have slightly coarser particle sizes and pore water extraction in the field is possible. In other instances, where sediment samples have finer particle sizes requiring more time to draw samples for laboratory analysis; these samples will be transferred to the field laboratory for pore water extraction.

5.12.4.3.2. Fish Tissue

Methylmercury bioaccumulates and the highest concentrations are typically in the muscle tissue of adult predatory fish. Target fish species in the vicinity of the Susitna-Watana Reservoir will be Dolly Varden, Arctic grayling, stickleback, whitefish species, burbot and resident rainbow trout. If possible, filets will be sampled from seven (7) adult individuals from each species. For stickleback, whole fish samples will have to be used. Body size targeted for collection will represent the non-anadromous phase of each species life cycle (e.g., Dolly Varden; 90 mm – 125 mm total length to represent the resident portion of the life cycle). Collection times for fish samples will occur in late August and early September. Samples will be analyzed for methyl and total mercury (Tables 5.12-4 and 5.12-5).

Field procedures will be consistent with those outlined in applicable Alaska State and/or EPA sampling protocols (USEPA 2000). Clean nylon nets and polyethylene-gloves will be used during fish tissue collection. The species, fork length, and weight of each fish will be recorded. Fish will be placed in Teflon sheets and into zipper-closure bags and placed immediately on ice. Fish samples will be submitted to a state-certified analytical laboratory for individual fish muscle tissue analysis. Results will be reported with respect to applicable Alaska State and federal standards.

Detection of mercury in fish tissue and sediment will prompt further study of naturally occurring concentrations in soils and plants and how parent geology contributes to concentrations of this toxic in both compartments of the landscape. The focused study will estimate the extent and magnitude of mercury contamination so that an estimate of increased bioavailability might be made once the reservoir inundates areas where high concentrations of mercury are sequestered.

The bio-magnification of mercury contamination from sediments and plants to the fish community may be facilitated through consumption of contaminated food sources like benthic macroinvertebrates. Therefore elevated concentrations of mercury in fish tissue may prompt additional sampling and analysis of tissues in the benthic macroinvertebrate community. Contamination of this component of a trophic level may also be a conduit for mercury biomagnification in waterfowl and other wildlife that consume this food source.

5.12.4.4. Gather information on the area to be flooded by the new reservoir

Researchers have found a number of parameters associated with mercury levels in fish after a new reservoir is created. These parameters have been included in various studies to predict mercury levels in fish post-impoundment. Some studies have found that the primary source of mercury to new reservoirs was the inundated soils (Meister et al. 1979), especially the upper organic soil horizon which often has higher mercury levels than the lower inorganic soil layers (Bodaly et al. 1984). Underlying geology can also be important (Lockhart et al. 2005), if mercury-containing source rock is present, as occurs in some areas of Alaska (Gray et al. 2000). The type and quantity of vegetation in the area to be inundated has great influence on mercury input and methylation. Peat is a particularly large source of methylmercury to the system, because areas of poorly drained soil and wetlands enhance methylation of mercury (Grigal 2003).

Thus, to provide inputs for fish mercury uptake post-impoundment, data will be gathered for the following parameters within the area to be flooded:

- Mercury content of terrestrial soils in the area to be flooded;
- Characterization of underlying geology in the area to be flooded, which assesses whether the rock types contain leachable mercury;
- Characterization of type and amount of vegetative biomass to be inundated;
- Total inundation zone; and
- Quantitation of wetland area to be flooded.

This information will be derived from existing sources and studies. Much of this data will be generated during the geology and soils studies that are being performed as part of dam design.

5.12.4.5. Pathway assessment of mercury into the reservoir, within the reservoir, and transport of mercury downstream from the reservoir

Assessment of the potential pathways for mercury will be based on readily available literature (Hydro-Quebec 1993; Johnston et al. 1991; Therriault and Schneider 1998), and additional mercury studies will be researched and evaluated, to ensure the most applicable methods are used to meet project needs.

The pathway assessment will incorporate both existing conditions, and conditions with the reservoir and dam in place. The reservoir representation will be developed based on the local bathymetry and dimensions of the proposed dam. The Water Quality Modeling Study (Section 5.6) provides for a three-dimensional model to be developed for the proposed reservoir to represent the spatial variability in hydrodynamics and water quality in longitudinal, vertical and lateral directions. The model will be able to simulate flow circulation in the reservoir, turbulence mixing, temperature dynamics, nutrient fate and transport, interaction between nutrient and algae, and potentially sediment and metal transport. The key feature that needs to be captured is the stratification of water column during summer and de-stratification during winter.

Downstream of the proposed dam location the water quality modeling will evaluate the effects of the proposed project on mercury concentrations. The river model will be capable of representing conditions in both the absence and presence of the dam. The downstream spatial extent of this model is yet to be determined, but it is likely it will extend to shortly downstream of the Susitna-Talkeetna-Chulitna confluence (e.g., Sunshine USGS Gage).

Organic carbon content from inflow sources along with pathway analyses will be used to correlate with mercury concentrations to predict the potential for methylation of mercury in riverine and reservoir habitats.

5.12.4.6. Technical report on analytical results and mercury assessment

The technical report will include a description of the study goals and objectives, assumptions made, sample methods, analytical results, models used, and other background information. Field data, laboratory report, and quality assurance information will be attached. Mercury will be modeled in the water and sediment for the reservoir and downstream. Output parameters will include quantitation of mercury inputs to the reservoir, an estimation of mercury methylation rates, mercury circulation among different media (fish, air, water, sediment, etc.), and bioabsorption and transfer. This will lead to an estimation of mercury levels within fish tissue after reservoir impoundment. Fish mercury concentrations will be estimated for a variety of fish species that are important either for human or animal consumption.

Coordination will occur with the instream flow, ice processes, productivity, and fish studies to obtain information needed to reflect the results of this study in the context of the various Project scenarios.

5.12.5. Consistency with Generally Accepted Scientific Practice

Field sampling practices proposed in this study are consistent with ADEC (2003, 2005); USGS (Ward and Harr, 1990); Edwards et al, 1988); and EPA (USEPA, 2000). Results will be compared to established NOAA cleanup levels (NOAA, 2012). Studies, field investigations, laboratory testing, engineering analysis, etc. will be performed in accordance with general industry accepted scientific and engineering practices. The methods and work efforts outlined in this study plan are the same or consistent with analyses used by applicants and licensees and relied upon by the Commission in other hydroelectric licensing proceedings.

The Clean Water Act Section 401 Water Quality Certification process includes a baseline assessment of mercury conditions and will determine if existing conditions will result in a potential for bioaccumulation. The monitoring strategy used in this study follows scientifically accepted practice for identifying impacts to water quality and will be used for Project certification. ADEC and the USGS are currently pursing similar sampling programs for fish tissue in the state (ADEC, 2012; Frenzel, 2000; and Krabbenhoft et al, 1999).

FERC has a long history of performing similar studies during hydroelectric permitting, including most recently at the Middle Fork American River Project (FERC Project No. 2079) in 2011; and Yuba County Water Agency Yuba River Development Project (FERC Project No. 2246)

5.12.6. Schedule

The study elements will be completed in several stages and based on the following timeline shown below.

Study Schedule

Monitoring Activity	Timeline
QAPP/SAP Preparation and Review	January 2013 – March 2013
Water Quality Monitoring (monthly)	June 2013 - October 2013 (one sampling event in each of December 2013 and March 2014)
Sediment Sampling (one survey)	August-September 2013
Fish Tissue Sampling (one survey)	August - September 2012/2013
Data Analysis and Management	June 2013 – November 2013
Initial Study Report	December 2013
Updated Study Report	December 2014

5.12.7. Level of Effort and Cost

The following are costs associated with individual tasks for conducting mercury baseline monitoring in the Susitna basin for 2013/2014:

Planning ($60,000)

Monitoring ($300,000)

Data Analysis ($100,000)

Reporting ($100,000)

5.12.8. Literature Cited

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5.12.9. Tables

Table 5.12-1. Mercury concentrations in fish, Susitna Drainage

Species	Number of Samples	Mean (mg/kg)	Std. Deviation
CHAR-ARCTIC	3	0.21000	0.052915
BURBOT	1	0.09400	0
GRAYLING	18	0.10239	0.033477
NORTHERN PIKE	98	0.21071	0.206272
SALMON-PINK	16	0.25813	0.051279
SALMON-RED	14	0.02907	0.017398
SALMON-SILVER	5	0.09520	0.053905
STICKLEBACK-NINESPINE *	1	0.07600	0
STICKLEBACK-THREESPINE *	2	0.07350	0
TROUT-LAKE	3	0.38000	0.319531
TROUT-RAINBOW	27	0.11187	0.086007
WHITEFISH-ROUND	7	0.10929	0.048623

*Concentrations in mg/kg. * indicates sample analyzed as whole body composite sample. All other fish samples analyzed as skinless fillets. Samples that were below detection limits were listed as 1/2 of detection limit. NOTE: If Std. Dev. is listed as 0, all the samples were below detection limits (ADEC 2012).*

Table 5.12-2. Proposed Susitna River Basin Mercury Monitoring Sites

Susitna River Mile	Description	Susitna River Slough ID	Latitude (decimal degrees)	Longitude (decimal degrees)
25.8	**Susitna Station**	NA	61.5454	-150.516
28.0	**Yentna River**	NA	61.589	-150.468
29.5	**Susitna above Yentna**	NA	61.5752	-150.248
40.6	**Deshka River**	NA	61.7098	-150.324
55.0	**Susitna**	NA	61.8589	-150.18
83.8	**Susitna at Parks Highway East**	NA	62.175	-150.174
97.2	**Talkeetna River**	NA	62.3418	-150.106
98.5	**Chulitna River**	NA	62.5574	-150.236
103.0	**Talkeetna**	NA	62.3943	-150.134
120.7	**Curry Fishwheel Camp**	NA	62.6178	-150.012
136.8	**Gold Creek**	NA	62.7676	-149.691
138.6	**Indian River**	NA	62.8009	-149.664
138.7	**Susitna above Indian River**	NA	62.7857	-149.651
148.8	**Susitna above Portage Creek**	NA	62.8286	-149.379
148.8	**Portage Creek**	NA	62.8317	-149.379
184.5	**Susitna at Watana Dam site**	NA	62.8226	-148.533
223.7	**Susitna near Cantwell**	NA	62.7052	-147.538

Table 5.12-3. List of parameters and frequency of collection

Parameter	Media	Frequency of Collection
Metals – (Water) Dissolved and Total		
Mercury	Water (Total & Dissolved methylmercury)	Monthly
Metals –Sediment (Total)		
Mercury	Sediment	One Survey-summer
Mercury	Sediment pore water	One Survey-summer
Metals – Fish Tissue (Use EPA Sampling Method 1669)		
Total Mercury	Fish Tissue	One Survey-late summer
Methylmercury	Fish Tissue	One Survey-late summer

Table 5.12-4. Parameters for laboratory analysis.

Parameter	Analysis Method	Sample Holding Times
Metals – Surface Water, Sediment Pore Water (Total, Dissolved, and methylmercury)		
Mercury	EPA – 1631	48 hours
Metals –Sediment (Total)		
Mercury	EPA – 245.2/7470A	28 days
Metals – Fish Tissue		
Total Mercury	EPA – 1631	7 days
Methylmercury	EPA – 1631	7 days

5.13. Attachments

ATTACHMENT 5-1. DOCUMENTATION OF CONSULTATION ON WATER RESOURCES STUDY PLANS

ATTACHMENT 5-1

DOCUMENTATION OF CONSULTATION ON WATER RESOURCES STUDY PLANS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

December 30, 2011

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: Proposed 2012 pre-licensing studies for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) verbal request for recommendations on pre-licensing studies in 2012 for the Susitna-Watana Hydroelectric Project. The Service has previously provided some verbal comments at project planning meetings and in conversations with AEA project and consulting staff. The Service will be better able to provide complete comments (as part of the National Environmental Policy Act scoping process), after reviewing more thorough descriptions of the proposed project and project operations anticipated in the Preliminary Application Document (PAD). The following comments and study recommendations for 2012 are considered preliminary until we review the PAD and fully understand the scope of the proposed project.

We recognize that the newly proposed Susitna-Watana project is different than the proposed Su-hydro project of the 1980s. Differences in: 1) the two proposed project designs; 2) the past and present study methodologies (due to evolving scientific technologies); and 3) the scientific rigor of previous investigations, may limit the applicability of study results from the 1980s. In many instances, the 1980s studies were limited in spatial and temporal scope, and the methodologies may have been limited, outdated, non-replicable, or lacking in resolution, potentially making them incomparable to present technologies. For these reasons, the Service is concerned about the applicability of the 1980s Su-hydro studies relative to the proposed Susitna-Watana project.

The Service appreciates that AEA recently had the 1980s studies synthesized for identification of data gaps. A reasonable next step is to review the study results for appropriateness and

applicability to the newly proposed Susitna-Watana project. Specifically, results from the 1980s studies should be reviewed for statistical validity.

The Service and other resource agencies have previously expressed concerns about the assumptions, relevance, and applicability of 30-year old studies conducted for a different project proposal, in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the upper and lower reaches (as defined by AEA) of the Susitna River for both the 1980s and in the proposed Susitna-Watana project.

To begin assessing potential impacts to fish and wildlife resources in the project area, the Service recommends the following reconnaissance level studies and reviews for 2012:

- Biometric review of biologic and hydrologic study results from the 1980s.
  Rationale: To assess the statistical validity of the 1980s Su-hydro study results for applicability to proposed studies for the Susitna-Watana project.

- Establish cross-sections for the lower reach, determine the hydraulic connection between the Susitna River and sloughs and off-channel habitats, and incorporate them into the hydrologic model.
  Rationale: To quantify and evaluate the effect of project operations on the lower reach (as climate and other conditions change within the watershed)

- Monitor flow and sediment in the Chulitna and Talkeetna Rivers, and in Gold Creek.
  Rationale: To quantify and evaluate individual tributary flow contributions and sediment loads and assess the potential effect of project operations on lower reach habitats and functions.

- Quantify distribution of fish assemblages relative to available habitat and stream temperature at channel, reach, and spatial scales (as defined by Torgersen et al. 1999).
  Rationale: To assess and quantify fish assemblages relative to available habitats that may be affected by proposed project operations; there are approximately 20 fish species in the Susitna River and little information known about their distribution.

- Collect longitudinal thermal imaging data in all Susitna River study reaches
  Rationale: Information is needed to assess and quantify important aquatic habitats (e.g., thermal refugia) that may be affected by proposed project operations

The Service considers these minimum recommendations necessary to establish a framework to identify future applicable studies throughout the licensing process. When we review the PAD we will likely revise our recommendations to reflect the integration we would like to see in the 2012 studies.

Thank you for the opportunity to provide comments on pre-licensing studies for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Acting For:

Ann G. Rappoport
Field Supervisor

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

February 10, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided some initial comments on the draft study plans during the work group meetings January 24-26, 2012, and had anticipated providing additional comments after receiving revised and more thorough descriptions of the proposed studies. Since that meeting, we have conducted an initial review of the Instream Flow, Aquatic Resource, Water Resource, and Eagle and Raptor Nest draft 2012 study plans provided at the January 24-26, 2012, meetings. Due to the short turnaround time requested for feedback (11 business days) on the study plans and their ongoing evolution, our comments should be consider cursory. The following represents our overall issues and concerns with the study plans and the enclosure provides a more detailed accounting of our comments and recommendations for each specific study plan.

Expanded Study Framework and Timeframe: The Service and other resource agencies have frequently expressed concerns about the limited temporal and spatial scale, and limited timeframe, for proposed studies in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the lower reaches (as defined by AEA) of the Susitna River for the proposed Susitna-Watana project. As part of the hierarchical framework, an ecologically meaningful space-timing scale should be identified related to project studies. As the spatial scale of studies increases, the time scale of important processes such as ice, sedimentation, and channel formation also increases, because they operate at slower rates,

time lags increase, and indirect effects become increasingly important. Studies related to these dynamic fish habitat forming processes need to be adequate (i.e., 5 years or more) to begin to understand mechanistic linkages (Wiens et al 1986; Wiens 2007). For this purpose, the Service recommends conducting fish habitat forming process studies on the minimum temporal scale of 5 years. This temporal scale equates to the typical life cycle of Chinook salmon, an Alaska Department of Fish and Game designated stock of concern.

To address these concerns, the Service expects that the 2012 studies and future project-related studies will be conducted on a hierarchical framework (Urban et al 1987; Frissell et al 1986) at a variety of scales including meso-habitat, reach, and basin wide. The Service also expects that the 2012 studies will not only help fill data gaps identified in the Preliminary Application Document (PAD), but will also be integrated between each other and with future project-related studies. This framework and integration is necessary to understand existing conditions and predicted changes to fish habitat in relation to changes in physical processes from proposed regulated flows. We recommend you establish a schedule for analysis of data obtained in 2012 and a framework for how to incorporate the 2012 data into 2013-2014 study plans. This is necessary for resource agencies to adequately assess potential project impacts to Alaska's fish and wildlife resources.

Winter Flow Regimes: At the January 24-26 work group meetings, and in the PAD, winter operations were described as load-following with flows ranging from 3,000 to 10,000 cfs in a 24-hour period. Regulated flows, including load-following operation, result in substantial changes to the natural hydrograph of a river. Dam construction and operation globally has resulted in adverse effects to anadromous and resident fish, macroinvertebrates, and their habitats. The Service is particularly concerned with the lack of study focus on Susitna River winter flows under natural and proposed flow operations. We recommend that winter base flows be assessed beginning in 2012 under the Instream Flow 2012 Study Planning, Water Resources Study Planning, and in the Aquatic Resources Study Planning. During colder winter months, glacial river base flows, such as those in the Susitna River, are derived entirely from groundwater inputs resulting in reduced habitat availability. We recommend assessing base flows as they relate to mainstem winter habitats (including adult spawning and juvenile fish overwintering locations, and the potential for stranding or increased mortality or condition related to changes in flow and water temperature), water quality conditions, ice-processes, and habitat and geomorphic processes in the Susitna River under current conditions and underthe proposed operation.

Temperature: In our December 30, 2011, letter we recommended thermal imagery (Torgerson et al. 1999) be conducted in 2012 throughout the Susitna River mainstem to identify important thermal habitats that may be utilized for spawning, refugia, or as overwintering areas. It is important to characterize the Susitna River water temperature profile as it relates to habitat because the proposed dam is expected to significantly alter the water temperatures downstream of the dam. Please review this letter as a reference for this study, as well as other Service recommendations.

Modeling Design: There is currently a lack of information in the draft study plans related to overall modeling approaches that will be used for the Susitna-Watana project. When identifying

instream flow model(s) the purpose and assumptions must be compared to Water Resources and Aquatic Resources study objectives. Model assumptions and model inputs need to be clearly stated and available for review. Spatial pattern should be one of the independent variables in the model analysis. At a minimum, we recommend using 2D hydrodynamic model(s) at a mesohabitat, reach, and basin wide scale (Crowder and Diplas 2000). We specifically recommend a 2D model be included to predict physical processes to spatially represent variation in input variables, and how those variables change temporally and spatially under differing flows. Selected model(s) should also include a sensitivity analysis (Turner et al. 2001). This information is critical to the general project understanding of existing ecological spatial patterns, and predicted spatial patterns under proposed regulated flows from the Susitna-Watana dam.

Mercury: Since the January meetings, it was brought to our attention that fish mercury concentrations frequently increase after impoundment of a reservoir, particularly boreal reservoirs. Soil flooding releases organic matter and nutrients, providing food to bacterial communities that methylate inorganic mercury. Methylation and bioaccumulation are the primary pathways for mercury accumulation in fish (Therriault, 1998). Although not identified in the 2012 draft studies, future studies should include pre- and post-impoundment mercury concentration studies.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
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Enclosure

The following comments and recommendations are based on our review of the 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project provided at the January 24-26, 2012, work group meetings.

Synthesis of Existing Fish Population Data (F-S1)

Recommend including information on seasonal distribution and abundance of anadromous and resident fish species among riverine habitat types and river reaches. As part of the spawning and incubation period for resident and anadromous species, studies need to include fry emergence periods and time (of day) information to determine potential impacts from fluctuating winter/spring flows. Potential issues include stranding of fish (by life stage and species) and downstream displacement relative to potential ramp rates. This study needs to integrate with instream flow and geomorphic studies to look at effects of daily flow fluctuations, particularly in winter, in the middle and lower river reaches.

For clarity, we recommend referring to river "reaches" as defined in the PAD rather than river "segments."

Fish persistence should be evaluated relative to spatial and temporal availability of fish habitat under existing and proposed flows. The Service recommends fish habitat studies be developed concurrent with the water resource studies to interface and characterize fish habitat as it relates to physical (hydrologic, sedimentation, and geomorphic) processes. Fish habitat metrics should be developed and integrated with modeling efforts related to physical processes and fish presence.

Chinook Salmon Presence above Devil's Canyon Study (F-S4)

Chinook salmon presence above Devil's Canyon study should include an upstream and downstream fish passage component. This 2012 study should include fish passage relative to all life stages of Chinook salmon. There is the potential to include Dolly Varden and Humpback whitefish pending results of an otolith/anadromy analysis by the Service for these species.

The Service supports the genetic component of the study (F-S4) which is necessary to determine whether the Chinook salmon meta-population in the vicinity of the proposed dam is a distinct population.

Wetland Mapping Study (B-S3)

The draft wetland study states that the methods used will be consistent with guidance in the Alaska Regional Supplement (USACE 2007), the U.S. Army Corps of Engineers (USACE) Manual (Environmental Laboratory 1987), and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Therefore, the Service recommends the use of the Cook Inlet Classification (CIC) developed by Mike Gracz. The CIC is an HGM-based wetland ecosystem classification scheme analogous to Cowardin. The Service supports the use of CIC for wetland mapping in the Cook Inlet Basin over Cowardin because CIC is regionally

specific and indicative of function (e.g., a spring fen always receives groundwater discharge; whether a palustrine emergent wetland does is unknown). CIC can be cross-walked with Cowardin if necessary. CIC methodologies and Mike Gracz' mapping protocols are described on www.cookinletwetlands.info.

In terms of compensatory mitigation related to a site that will be monitored over time using site-specific, precise functional attribution, the best functional assessment method available is the use of the HGM Regional Guidebooks. The citation for slope/flat wetlands is as follows:

- Hall, J.V., J. Powell, S. Carrick, T. Rockwell, G.G. Hollands, T. Walter and J. White. 2003. Wetland Functional Assessment Guidebook, Operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion, Alaska, using the HGM approach. State of Alaska, Department of Environmental Conservation, Juneau, Alaska.

Eagles and Raptor Nest Study (W-S3)

The Service's Migratory Bird branch is evaluating the potential for an eagle study that would compare productivity/behavior of golden eagles in disturbed areas (such as the Golden Valley Wind project, Usibelli Coal Mine, and the Susitna-Watana dam) versus undisturbed areas (Denali Park). We would like to explore the option of partnering with Watana projects to complete eagle nesting surveys. The Service could potentially provide experienced biologists to conduct the surveys. The benefits to this partnership include: 1) assistance to the project sponsors to conduct an eagle nesting survey; 2) provide cost savings to project sponsors by eliminating the need to hire a consultant to complete the survey; and 3) allow the Service to collect information valuable for our study. These surveys would not be considered compensatory mitigation, but would help meet eagle nest survey requirements. The Service generally recommends a pre-project survey with a follow-up survey just prior to construction.

Since 2009, compensatory mitigation is required for "take" or disturbance of active and inactive bald eagle nests. For golden eagles, there is a "no net loss" policy. Identifying ways to offset compensatory mitigation requirements early in the project development process can help the resource and the project sponsors. For example, a 2-year pre-construction eagle tracking study could help minimize required compensatory mitigation if the study demonstrated a "disturbance" rather than a "loss of territory."

Riparian (B-S2)

In addition to comments provided previously, we recommend riparian studies be integrated with other 2012 studies and with future project-related studies.

Beluga Prey Species Study (F-S6)

This study should identify components that specifically interface with the water resource and fish habitat studies. Anadromous prey species such as eulachon, Pacific and Arctic lamprey have been documented as present in the lower reach of the Susitna River and may be impacted by the proposed regulated flows. Relationships between natural flows and existing habitats should be

developed to best predict changes during proposed regulated flows that may impact beluga whale prey species.

Instream Flow Planning Study (F-S5)

1) Selection of a model or series of models of 1D or 2D nature will drive the type of data needs for the field studies. This discussion and selection must be made prior to finalizing habitat studies.
2) The habitat suitability curve development is a useful product. Conduct the studies in such a manner as to ensure the development uses actual suitability data and is not dominated by best professional consensus.
3) Need a better understanding of how the instream flow study relates to the routing model or uses its own calibrated flow model. Concern is that the overall routing model may have significant variation in water level between cross-sections depending on their placement in relation to the habitat cross-sections. Location in pools or riffles and within these features or braided section will vary the water level of a certain flow and may not correctly interpret the water level of a habitat cross-section.
4) Anticipate that the habitat study will have its own cross-sections and flow analysis separate from the routing model. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new spots as needed for 2013 and 2014.
5) Desire to have a large map with the routing and habitat cross-sections on it over recent aerial imagery.
6) In review of 1980s studies, were there any groundwater/surface water exchange studies?
7) Need to confirm whether the 1980s studies included mapping of groundwater upwelling areas along the river for gaining and losing reaches. We recommend at least a large-scale thermal temperature study along the river to note locations and relate it to the habitat study areas and cross-section surveys.

Reservoir and Flow Routing Model Transect Data Collection (WR-S1)

1) We recommend that the cross-section re-surveys in 2012 go beyond the forest limit but stay within the floodprone area, as there may be key floodplain elements not captured in the LIDAR data.
2) Need to evaluate appropriate model to consider ice effects as ice is a significant factor, not only for habitat but also for recreational use. We highly recommend utilizing one model that is fully dynamic and can deal with both floods and ice dynamics during winter low flows for routing. A model was recommended in the January work group discussion, created in Canada that may be appropriate. Model selection will drive data needs so this needs to be selected soon and with a full idea of the types of available models out there to select the best one.
3) Given the discussion of ice dynamics, cross-sections are likely needed in the lower reach to adequately assess ice dynamics as ice forms and slowly freezes upstream. We recommend that these cross-sections be identified and obtained in 2012 to maximize utilization of the model and potentially correlated to lower river habitat studies to reduce redundancy of effort.

4) Instream flow and habitat study cross-sections are assumed to be different than the routing cross-sections. We recommend creating a map for distribution that overlays the original routing and habitat cross-sections to begin to understand their spatial location and orientation and begin discussing 2012 study locations. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new sampling locations as needed for 2013 and 2014.
5) Flows need to be measured to calibrate routing as much as possible. We recommend that water surface and flow be captured at key cross-sections while in the field to calibrate the routing model results and to verify Manning's n assumptions.

Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations (G-S1)

1) For locations obtaining bedload data need to also do a bed pebble count to compare to transported load to calibrate for shear stress and other calculations.
2) Recommend that gravel bar sampling be part of the study to compare to transport load data obtained. This methodology must be well documented.
3) Evaluate the Chulitna and Talkeetna as well as other key tributary deltas for sediment distribution and load into the system.
4) Recommend attempting to get high flow values near bankfull stage at both Gold Creek and Watana sites to add to data.
5) Recommend sediment sampling at the Susitna-Watana dam site to demonstrate correlation to Gold Creek and/or model changes in sediment loading between the sites.
6) Evaluate 3-inch versus 6-inch bedload sampler use for 2012 field season to try to capture large fractions of bedload movement as able.

Geomorphic Assessment of Middle River Reach using Aerial Photography (G-S2)

1) Include a listing and evaluation of flood and ice conditions during and between aerial photography events, especially during breakup periods to help correlate differences to significant events in the watershed.
2) Does not address winter flows and habitat use under winter conditions; needs to come up with a plan to address this beginning winter 2012/13.
3) For geomorphic analysis and comparison to habitat studies, cross-section locations for substrate classification, large woody debris counts in floodprone width, and categorization of fluvial process (Montgomery and Buffington, Rosgen) should be determined and fieldwork performed. If location agrees with an old cross-section, it will help verify any changes over time and with flow to help determine stability and shear stress equations.

Geomorphic Assessment of Project Effects on Lower River Channel (G-S4)

1) There is a need to evaluate the hydrology and habitat use of the lower river to evaluate change over time from dam operations:
    a. Winter operations are a major concern given the need to evaluate daily flow fluctuations of 3,000-10,000 cfs in the winter. This effect must be modeled into

the lower reach to see if the magnitude of fluctuating flows in the winter extends further downstream than spring and summer flow periods. Additionally, ice and open water effects will be extended into the downstream area so modeling will need to address this by extending it downstream.

b. In the January work group meetings it was pointed out that ice is generated upstream and flows down the river to the lower reaches, beginning to form in the lower reach and slowly ice up the river upstream. This also needs modeling from a thermal standpoint, hence again, the need for cross-sections in the lower reaches.
c. Recommend that the gage at Su Station be turned on by the U.S. Geological Survey (USGS) and maintained by USGS to help calibrate lower reach modeling efforts over the next 5 years, especially for ice effects and dynamics modeling.
d. Cross-sections need to be made in the lower reach to add to an ice dynamics model as well as habitat studies – recommend selecting locations and getting these cross-sections in 2012 to facilitate modeling efforts.

2) Re-do all cross-sections at existing and past gage sites in the middle and lower reaches (including Su Station) to evaluate hydraulics, assess stability by comparing to old cross-section data and give an initial assessment of stability or changes in rating curve information. Also, it would be beneficial to do an initial evaluation of these gage sites at winter flows and with ice dynamics to begin to understand the impact winter flows will have. This will help with evaluating changes over the last 30 years in the lower reaches to determine whether additional work in 2013-2014 is needed.

Documentation of Sustina River Ice Breakup and Formation (G-S3)

1) Key elements to identify are: where ice generation occurs (production zones) and where ice lodges and begins the process of ice formation in the river.
2) Recommend that flights include an ice scientist, fishery biologist, riparian specialist and fluvial geomorphologist so that multiple observations can be made at the same time and can be stitched together to understand the processes taking place.
3) Recommend video be taken during all river flights for later reference.
4) Documentation of frazil ice generation is very important – current thought is that 80% is generated upstream of Devil's Canyon in the middle reach.
5) Daily flights might be needed during the height of breakup or freeze-up.
6) Is CRREL involved with the ice research?
7) Highly recommend utilizing our Canadian neighbors and their research and models for ice issues.

Review of Existing Water Temperature Data and Models (WQ-S1)

1) Identify appropriate temperature models to use based on new technology and understanding.
2) Evaluate MET station locations and strongly consider an additional station around the Deshka or Yentna which could help with ice studies.

3) Discuss MET station locations with NOAA Weather Forecast Center to access experts as well as potentially help with storing data.
4) Perform large-scale thermal study of the river for groundwater exchange areas over different flows.
5) At old, existing, and new gage sites, include continuous temperature monitoring; consider a water quality study at gage sites for 2012, 2013, and 2014 seasons with parameters agreed to by all parties and performed by USGS.
6) Evaluate past assumptions for temperature modeling (at least our understanding of it), i.e., summer analysis of surface water temperatures only, as this dominates habitat use, versus winter analysis of intergravel temperature only. Provide quantification of the hypothesis and assumptions made and determine if they are still relevant.
7) 2012 fieldwork in the work group meeting was discussed to primarily show how mainstem temperatures influence side channel habitat. This should be expanded to do a thermal analysis up and down the river (#4).
8) Discussed in the work group meetings that 2013-2014 work will deal with upwelling water temperatures. A thermal analysis in 2012 can help determine these sites.
9) Fieldwork needs to be performed that can help calibrate heat transfer coefficients and other assumptions in selected temperature models between mainstem and other waters.
10) Analysis of temperature effects on ice formation was not discussed and needs to be part of the scope in coordination with ice and habitat studies.
11) Ensure that solar radiation information will be collected at all MET sites as it is crucial to modeling efforts (ice, etc.) and evaluate other metrics that are needed for calibrating models.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Paul Dworian*	**Name:**	*Joe Klein*
Organization:	*URS*	**Organization:**	*ADF&G*
Study Area:	*Water Quality*	**Phone Number:**	
Date:	*3/15/12*	**Time:**	*12:30*

Call Placed by: ☐ AEA Team ☒ Other Party

Others on Call: None

Subject: Measurement techniques for GW influences on sloughs

Discussion: Wanted to express some thoughts and concerns regarding the upcoming study:

1. Thinks there are two types of upwelling – sources from the river, or sourced from a terrestrial GW source.
2. Changes in flows of river could change one and not the other.
3. Upwelling in summer determines spawning.
4. Upwelling in winter determines survival.
5. Mentioned use of USGS manual for determining field techniques to measure upwelling. Wants direct measurements.
6. May not be comfortable with using temperature measurements in this case.
7. Would like to intensive, long-term studies of selected sloughs. Those with upwelling and large fish populations, those with upwelling and small fish populations, and those with neither. 1-2 sloughs of each type monitored all winter.
8. What causes the upwelling and how will flow changes caused by dam effect this?
9. Would like us to use a seepage meter to monitor upwelling. USGS has these.
10. Rate of flow for upwelling is a critical component.
11. Discussed use of GW wells – after discussion we agreed they may not be worth effort – hard to interpret data at high cost.
12. He indicated that there was a recent Mat-Su study on age dating water – determine whether upwelling water was from stored GW or recent river source. Says it was done at pebble as well. I've heard of such studies, but I'm leery as to their applicability here. Even stored GW may not be old enough for this to be distinguished.

Dwornian, Paul

From:	Ashton, William S (DEC) <william.ashton@alaska.gov>
Sent:	Tuesday, April 10, 2012 10:38 AM
To:	McGregor, Elizabeth A (AIDEA); Dworian, Paul; MAL@vnf.com; Robert.plotnikoff@tetratech.com; Harry.Gibbons@tetratech.com; rfilbert@longviewassociates.com
Subject:	RE: AEA Su-Wa Water Quality Meeting

I am available 12:30pm to 3:00pm April 11.

Thanks

William Ashton
Storm Water & Wetlands
Wastewater Discharge Authorization Program, Division of Water
Alaska Dept. of Environmental Conservation
555 Cordova St
Anchorage, AK 99501
ph 907-269-6283
william.ashton@alaska.gov

From: Betsy McGregor [mailto:BMcGregor@aidea.org]
Sent: Tuesday, April 10, 2012 10:17 AM
To: Ashton, William S (DEC); Dworian, Paul (paul.dworian@urs.com); Matthew Love (MAL@vnf.com); Robert.plotnikoff@tetratech.com; Gibbons, Harry (Harry.Gibbons@tetratech.com); rfilbert@longviewassociates.com
Subject: AEA Su-Wa Water Quality Meeting

Hi.
I would like to set up a meeting tomorrow to discuss the water quality study plans on Wednesday April 11. I have attached the draft 2012 Temperature Monitoring Study Plan and the 2013-2014 Study Requests for your reference.
I am available between 11:30 and 3:00 pm tomorrow.
Please let me know your availability.
Thanks!
Betsy

BETSY MCGREGOR
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Anchorage, AK 99501
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SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Paul Dworian*	**Name:**	*William Aston*
Organization:	*URS*	**Organization:**	*ADEC*
Study Area:	*Water Quality*	**Phone Number:**	
Date:	*4/12/12*	**Time:**	*1:00*
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call: Betsy McGregor (AEA); Craig Addley (CE); Rob Plotnikoff (TT)

Subject: Water quality sampling/sample plans (2012 and 2013)

Discussion:

William Ashton (ADEC)

Did not review all the data.

Overall the work plans look good.

At 135.3 (Slough 11) – there was a large escapement near Gold Creek at this slough. Is that a slough fish and game would like to monitor? ADEC does not think it is critical. But Fish and Game might.

No questions or concerns on MET collection. Try and correlate with previous data.

Section 1.2.6.3 - Baseline water quality…spatial. Sampling not worked out. Are they the same sample locations in table (yes).

Still developing locations for water quality sampling? (yes).

Sampling will start at break up and run to freeze up. Water about winter sampling? Water quality during winter is very different. Not as robust as the summer sampling, but enough to get some data points. Sample at USGS gauge stations. Susitna at Cantwell would be good.

What will be the definitive station for upstream? (Betsy –Denali or Cantwell). Nothing will be done at Cantwell unless added to water quality scope. No other field work there. Only water temp. Cantwell is ideal, but Denali might work. May be done by ice people.

Probably need to co-locate winter sampling with USGS stations. Be nice to do some below Sunshine. This goal would be second tier critical.

Results are more robust if correlated with discharge measurements. Correlate stage with water quality results.

Water quality parameters – looks like a good list. Might want to add chromium, nickel, and selenium. Hexavalent Chromium would be hard to sample – due total chromium instead.

ADEC has website on fish tissue sampling. For methyl mercury – would be a good idea to use same practices.

Water quality modeling – ADEC does not have a particular mode to recommend? They would like to use model in public domain, common, used by agencies. As long as those are true, decision is good.

TSS – What about turbidity? (will include).

Tried to do turbidity modeling in 1980s, but don't remember results. Collected a lot of data from Eklutna.

Between Gold Creek and confluence is 30 miles – not sure how much of a station is at Curry.

Sample spring peak, July/August, and late September. Three sample events during summer, three in winter.

If we look at list for temp, if we start at Portage Creek – there are seven tributaries that will be sampled. Above Portage Creek there are additional samples. Want a few in reservoir. Indian is a major fisheries stream. Gold Creek – don't know well enough to know if we need it. Deshka, Yetna. Need those two. Not good mixing right away.

Trib and upstream of trib are important examples.

Number of samples – want a fully mixed sample if possible. Variability in river from side to side. Are we doing sampling from shore or from boat (depends – the shore may be less desirable, but possible).

Main river is what we are monitoring.

Side channels would be handled in ISF work.

Use USGS sample methodology for rivers of different sizes.

USE ADEC water quality standards to judge results. Laurie with Fish and Game may be able to bring in other standards. For example, copper. New studies show lower standard may be more protective.

State reviews water quality standards every three years. Will check and see when next revision is coming out.

Rob Plotnikoff (Tetratech)

Change in type of measurement method for snow. May not be able to exactly correlate new results with old data.

Hexavalent chromium may be hard to sample due to sample due to holding time. Use total Chromium instead.

Old winter data represents about 20% of total data set. Big differences in concentrations.

Turbidity is not a conservative measurement TSS is a better measure. Most criteria for turbidity are hard to get right, and are hard to model.

Need to measure temp results at same time as thermal imagery over flight.

Downstream of tribs – need to do some sampling because of reported elevated metals contributions.

Outside bends are good sample locations.

Helps to have extra observations for sites. More data makes a better model. Need to look for places where metals might concentrate.

USGS has criteria for compositing samples. We would use those criteria.

Some water quality parameters vary with depth, others do not.

May not be able to do a boat at high flow.

Craig Addley (CE)

Locations selected are based on old locations. CE (Trehee) selected locations. Water temp locations may not be the same as where we need to do water quality samples. May be redundant for water quality sampling. May need to change going forward.

USGS at Tosina Creek is going to do winter water quality samples. Same at Gold Creek and Sunshine. Denali at Susitna may be added. 3 samples between freeze up and break up. Need to clarify parameters.

Data would feed into reservoir modeling, so sample point by Cantwell Susitna is necessary for reservoir modeling.

Turbidity is necessary due to other issues on the project. Want to include turbidity as a primary parameter.

Spatial and temporal sampling scheme. Temporal sampling – there are some places at gauges where turbidity is modeled continuously. And spot samples through winter. What about ice free period? Need to do additional sampling in fall?

What do you think about where tribs come in? Should we sample there? How far down gradient should we plan on sampling? What is break off in size of tributary? In some cases it might be a meaningless sample. Downstream sample shows nothing – where it is well mixed it might not show. Just downstream would show highly variable results. Sample trib, upstream of trib - downstream sample is just...noise.

Spatial sampling – want something at top of reservoir, down by dam, down by Portage, Gold Creek, are there some places in between that we need to fill? (maybe some more sampling dowgradient).

Where in the river do we sample – do we sample at one location, if river is well mixed? (upgradient and trib most important)

Collect field composite samples from main channel river.

Send composite sampling protocol to ADEC.

The challenge will be sampling at high flow.

Toxicity criteria – what criteria should we be using? Is there any criteria other than state we need to be worried about? (ADEC criteria should be used).

Is there anything we need to study that isn't being studied? (no).

Make sure we have good data. May need to put triggers in to adapt to results as we find them.

There are avenues we can use to adjust approach. Each year there is a review, and opportunity to adjust plan.

Mainstem is taken care of – we will have good data on flow. Challenge will be at other locations.

Betsy McGregor (AEA)

Co-locate as much as possible with other studies.

Are water quality sites supposed to be connected to discharge? (yes).

Would like to do thermal study in fall of 2012. Fly whole river. Need to verify from ground. Group at UAF does this.

Should we ignore mixing zones (no. need to know what is going on with mixing)

Downstream would need to be done on some sites.

Don't imagine sampling from bank is a good idea – especially in lower river.

Samples in main river might not give all information we need. Would we need to sample both side channels and main river? (yes.)

Some issues at Tusina site due to safety at high flow.

Any tributaries that currently have water quality exceedences? (no). Wondering about mitigation options. (we will keep an eye out for such opportunities.)

Are we measuring discharge at same time as sampling (discharge critical to modeling – will either conform to existing sites, or measure directly).

Routing component to water quality model? (yes).

Dwororian, Paul

From:	Klein, Joseph P (DFG) <joe.klein@alaska.gov>
Sent:	Thursday, April 12, 2012 9:44 AM
To:	McGregor, Elizabeth A (AIDEA); Schwarz, Terence C (DNR); Sager, Kimberly R (DNR); eric Rothwell; Michael_Buntjer@fws.gov; bob_henszey@fws.gov; Ashton, William S (DEC); william_rice@fws.com; LaCroix.Matthew@epamail.epa.gov; susan walker; dreiser@r2usa.com; kfetherston@r2usa.com; Robert.plotnikoff@tetratech.com; mlilly@gwscientific.com; Dworian, Paul
Cc:	craig.addley@cardno.com; Hayes, Sandie T (AIDEA)
Subject:	RE: AEA Su-Wa - Groundwater Meeting

Betsy- Thanks for working to set up a meeting and inviting all interested participants. The range and level of expertise should generate some interesting discussion and approaches toward addressing this interdisciplinary topic.

For background, I found the following documents useful in my preparation .

Field Techniques for Estimating Water Fluxes Between SW and GW
http://pubs.usgs.gov/tm/04d02/

Thermal Profile Method to Identify Potential GW areas and Preferred Salmonid Habitat
http://pubs.usgs.gov/sir/2006/5136/

Regards

Joe Klein, P.E.
Supervisor Aquatic Resources Unit
Alaska Department of Fish and Game
333 Raspberry Rd
Anchorage, AK 99518
(907) 267-2148
joe.klein@alaska.gov

From: Betsy McGregor [mailto:BMcGregor@aidea.org]
Sent: Wednesday, April 11, 2012 4:32 PM
To: Schwarz, Terence C (DNR); Sager, Kimberly R (DNR); eric Rothwell; Klein, Joseph P (DFG); Michael_Buntjer@fws.gov; bob_henszey@fws.gov; Ashton, William S (DEC); william_rice@fws.com; LaCroix.Matthew@epamail.epa.gov; susan walker; dreiser@r2usa.com; kfetherston@r2usa.com; Robert.plotnikoff@tetratech.com; 'Michael R. Lilly' (mlilly@gwscientific.com); Dworian, Paul (paul.dworian@urs.com)
Cc: craig.addley@cardno.com; Hayes, Sandie T (AIDEA)
Subject: AEA Su-Wa - Groundwater Meeting

Hi.
We are trying to set up a meeting to discuss the addition of a groundwater study as a follow up to the meeting held by Eric Rothwell, Michael Lilly and Craig Addley last week.
Sandie will set up a Doodle Poll to determine the best time for a teleconference/GoToMeeting meeting to be held between April 17 and 19.
Please respond to the poll and let me know if there are others that should be part of this discussion.
Thanks!

Betsy

Betsy McGregor
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SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF MEETING

AEA Team Member		Other Party	
Name:	*Bill Fullerton*	**Name:**	*Various – see below*
Organization:	*TetraTech*	**Organization:**	*ADF&G, ADNR, BLM, NMFS, USFWS*
Study Area:	*Susitna River*	**Phone Number:**	
Date:	*4/19/2012*	**Time:**	*10:00 – 12:00*
Meeting	[X] AEA Team	[ ] Other Party	

Meeting Location: GoTo Meeting Teleconference

Attendees at Meeting:
Betsy McGregor (AEA), Bill Fullerton (TetraTech), Rob Plotnikoff (TetraTech), Paul Dworian (URS), Michael Lilly (GWScientific), Aaron Wells (ABR), James Brady (HDR), Michael Barclay (HDR), Sean Burill (LGL), Craig Addley (CardnoENTRIX), MaryLou Keefe (R2), Dudley Reiser (R2), Stuart Beck (R2), Kevin Fetherston (R2), Joe Klein (ADF&G), Ron Benkerte (ADF&G), Terri Schwartz (ADNR), Mike Sondergaard (BLM), Eric Rothwell (NMFS), Sue Walker (NMFS), Mike Buntjer (USFWS), Betsy McCracken (USFWS), Bob Henszey (USFWS)

Subject:
Preliminary Geomorphic Reach Delineation of Susitna River

Discussion:
In response to discussion at the April TWG meeting, Bill prepared a preliminary geomorphic reach delineation of the Susitna River from Cook Inlet to its confluence with the Maclaren River and presented it to the group. (See attached table and maps).

Discussion ensued. Bill noted that the current slope information in the Upper River is very coarse until the LiDAR imagery becomes available.

Inquiries were made about the location of the Stage Refuge and why RM 0 is located where it is.

Sue Walker requested that the map be extended to tidewater and include the location of mean high water as it defines the upper extent of Cook Inlet Beluga Whale critical habitat.

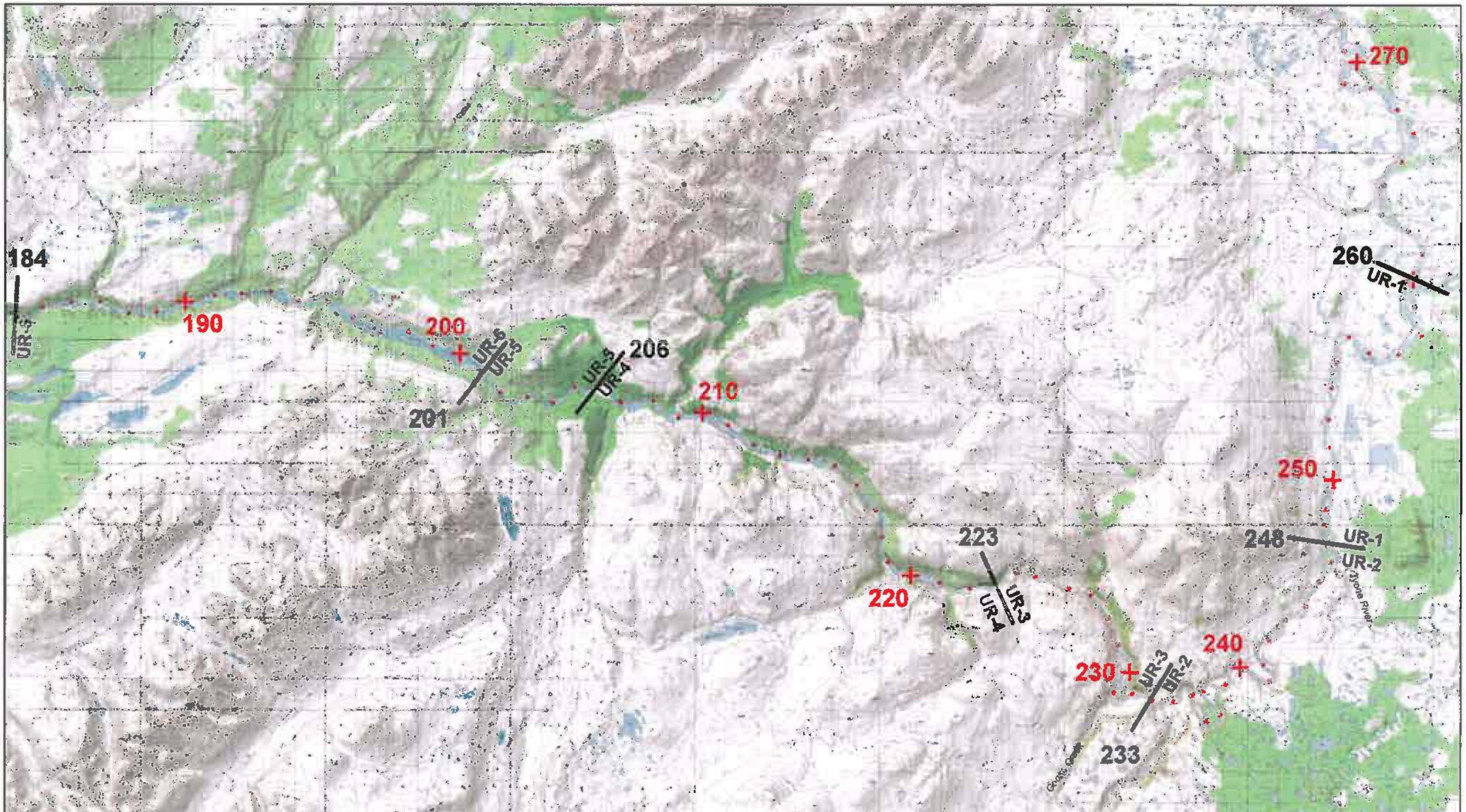
Betsy McGregor requested a reach break within LR-4 at the upper extent of tidal influence and delineation of the mean low water line (tidal) if possible, as well.

Preliminary Geomorphic Reach Delineation – Susitna River

Reach	U/S RM	D/S RM	~Slope[1] (ft/mi)	General Description
				Upper River
UR-1	260	248	NA[2]	Island and bar braided, predominately straight, floodplain appears to be very limited. Maclaren River confluence at upstream end (U/S).
UR-2	248	233	NA	Sinuous, single thread channel, appears to be incised, and meanders with very limited floodplain.
UR-3	233	223	NA	Channel progressively narrows in downstream (D/S) direction, canyon walls confine channel, single thread channel of varying sinuosity.
UR-4	223	206	NA	Channel widens but primarily single thread, low sinuosity, bars and a few vegetated islands present, confined with very limited floodplain.
UR-5	206	201	NA	Narrow, highly confined canyon reach, single thread channel with only a few bars.
UR-6	201	184	NA	Channel widens, more frequents bars than U/S and vegetated islands are present, channel is low sinuosity, floodplain is still very limited by canyon. Wide, straight section between RM 200 and RM 205. Watana Creek enters at RM 194. Deadman Creek enters at RM 186.5 and appears to have debris fan that severely constricts the channel. D/S limit of reach is the Susitna-Watana Dam site.
				Middle River
MR-1	184	182	9	Short confined reach from Susitna-Watana Dam site downstream to Tsusena Creek. Continuation of UR-6 characteristics (only divided due to dam-site).
MR-2	182	166.5	10	Canyon walls pull back from the channel and floodplain exists (about 2 to 3 channel widths). Channel is straight with bars and a few vegetated islands. Near 90 degree bends likely associated with faults.
MR-3	166.5	163	17	Short transition straight reach as channel narrows and floodplain disappears. A few open bars and a couple of small vegetated islands exist. Reach is a transition to Devils Canyon.
MR-4	163	150	30	Very steep, narrow, bedrock controlled Devils Canyon reach. Only a few, narrow attached bars in the reach and no islands.
MR-5	150	145	12	This is a short transition reach below Devils Canyon. Single thread, narrow channel (1 vegetated island) without floodplain.
MR-6	145	119	10	Canyon walls pull back and the valley bottom widens. Frequent side channels, vegetated island and bars throughout this reach. Tributaries entering in this reach include Gold Creek, Indian Creek and 4th of July Creek. The reach ends as the Susitna River canyon walls move back in and the valley bottom narrows.
MR-7	119	104	8	The channel is more constricted in this reach than the upstream reach and the side channels become less frequent. Vegetated islands occur in the less confined portions of the reach. The canyon walls gradually tapers between RM 110 and RM 104. Lone Creek enters in this reach.
MR-8	104	98.5	8	This reach is a transition between the canyon and the Three Rivers confluence. The channel becomes unconfined and then braided above the confluence with the Chulitna River.
				Lower River
LR-1	98.5	61	5	As a result of the heavy sediment load delivered by the Chulitna River as well as the reduction in slope, the Susitna becomes heavily braided in this reach. Terraces generally define the edges of the braidplain. Talkeetna also joins the Susitna at the U/S end of the reach. There is one constriction in the reach (RM 84 the location of the USGS Sunshine gage) where the channel is confined to a single thread. The downstream end of the reach is the confluence with the Kashwitna River.
LR-2	61	40.5	4	The Susitna branches into multiple channels in this reach. The channels occupy a 3-to-5-mile wide corridor. The downstream end of this reach is marked by the Kroto Creek (Deshka River) confluence and constriction by terraces just downstream of the confluence. The lower portion of the each is referred to as the Delta Islands.

Reach	U/S RM	D/S RM	~Slope[1] (ft/mi)	General Description
LR-3	40.5	28	2	The gradient is reduced by 50%f in this reach compared to LR-2. Below the constriction, the Susitna branches into 4 to 6 channels. The Kroto Slough splits off from the main river and flows across the western edge of the floodplain and joins the Yentna River about 0.5 miles above the Susitna confluence.
LR-4	28	0	1.4	The upper 2 miles of this reach is dominated by the Yentna River confluence and a constriction at RM 26 that forces the river into a single channel. The Susitna Station USGS gage is located at this constriction. The gradient flattens to a reach average of 1.4 ft/mi as the Susitna approaches Cook Inlet. Between RM 26 and RM 20, there are vegetated islands and a 3-mile-long side channel. At RM 20, the river branches into multiple channels at the start of the delta.

Notes: [1] Approximate thalweg slope scaled from APA 1985.
[2] Upper River thalweg profile not available.



LEGEND:

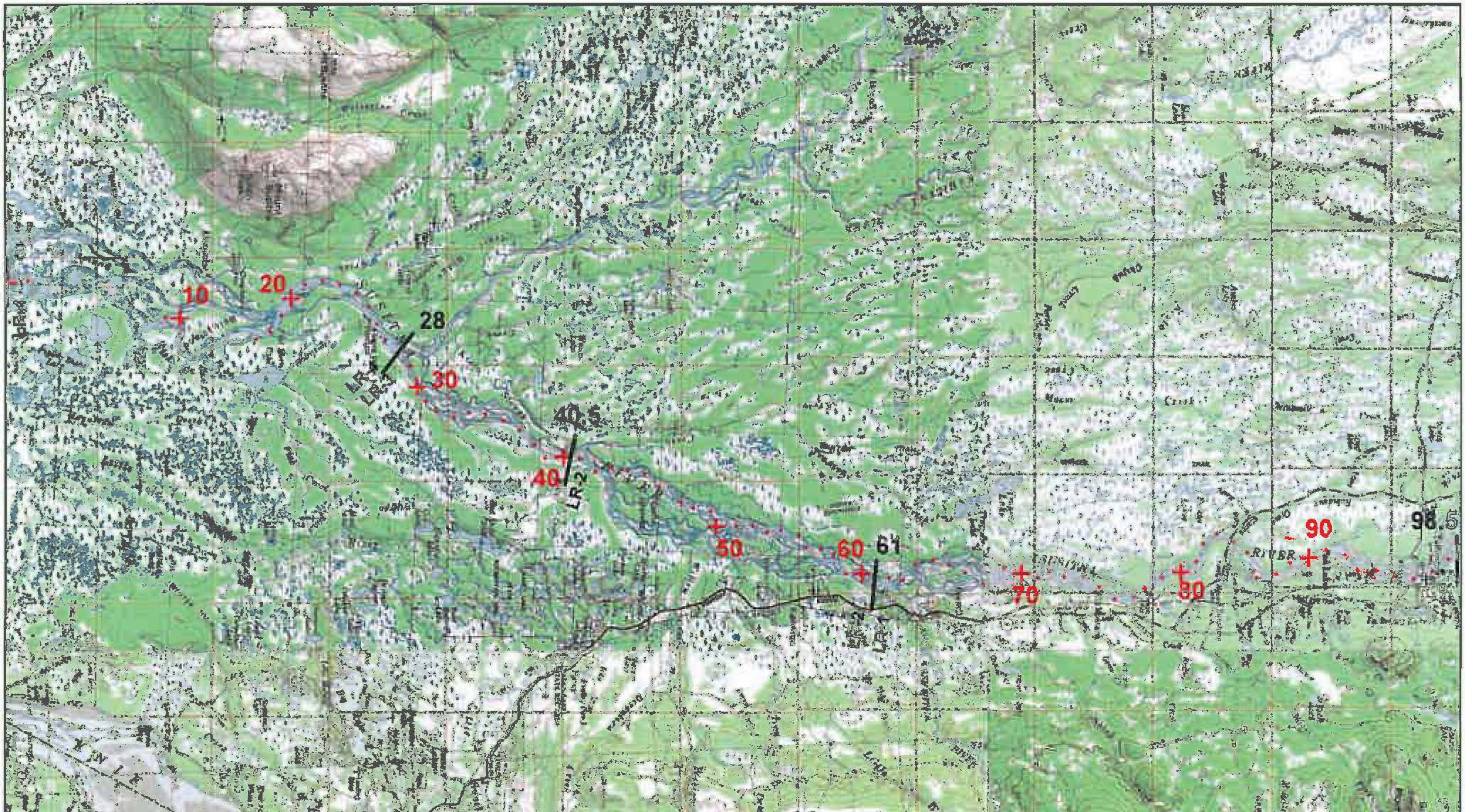
- + River Miles —— Reach Boundary
- • River Miles

N

0 2.5 5 10 Miles

ALASKA ENERGY AUTHORITY

Susitna Upper River Preliminary Reaches and River Miles



LEGEND:

+ River Miles —— Reach Boundary

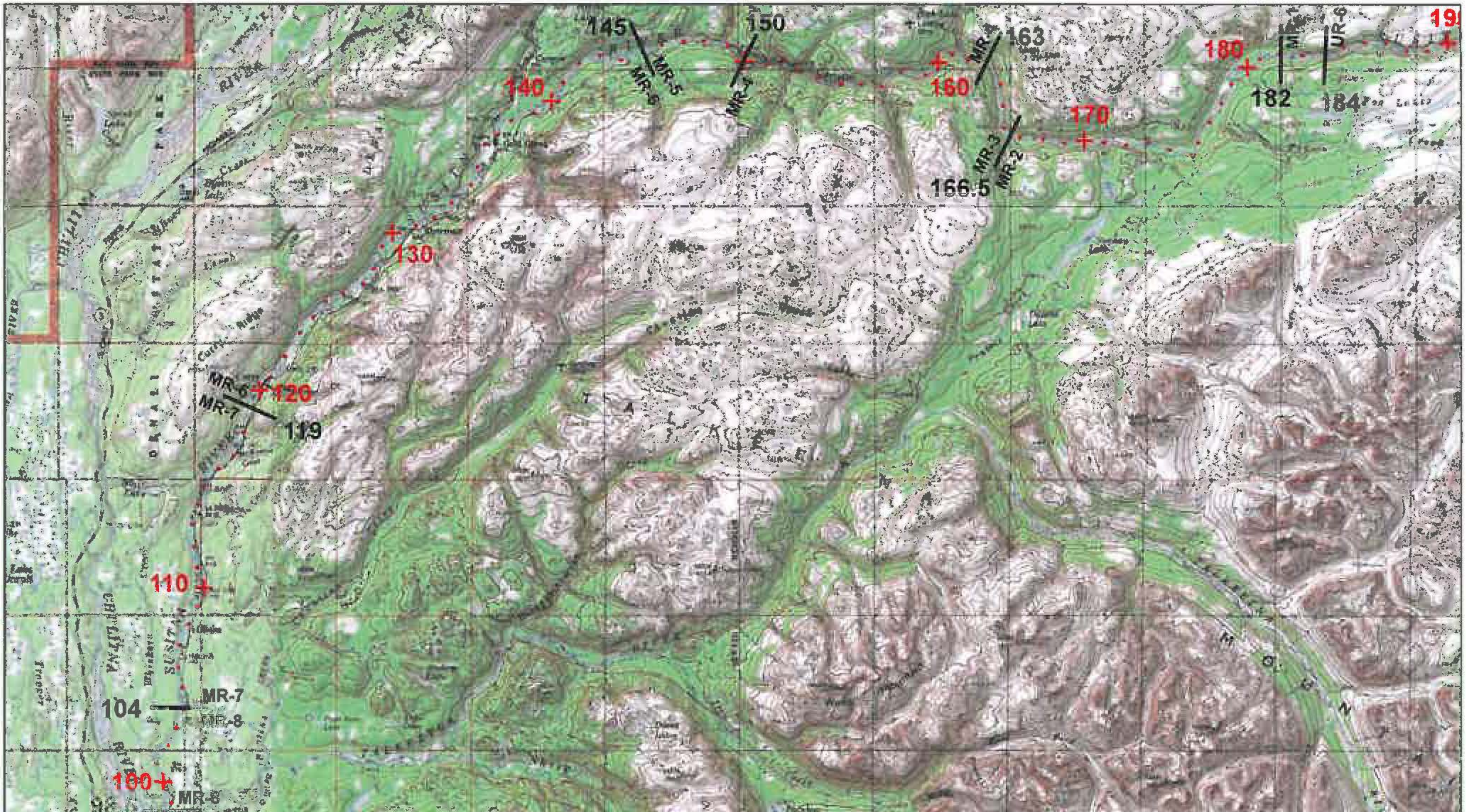
• River Miles

N

0 5 10 20 Miles

ALASKA ENERGY AUTHORITY

Susitna Lower River Preliminary Reaches and River Miles



LEGEND:

River Miles — Reach Boundary

River Miles

N

0 5 10 20 Miles

ALASKA ENERGY AUTHORITY

Susitna Middle River Preliminary Reaches and River Miles

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Parties	
Name:	*Paul Dworian*	**Name:**	*Various*
Organization:	*URS*	**Organization:**	*Various*
Study Area:	*Water Quality*	**Phone Number:**	*N/A*
Date:	*4/19/12*	**Time:**	*2:00* – 4:00
Call Placed by: [X] AEA Team [ ] Other Party			

People on Call: Betsy McGregor (AEA); Craig Addley (CE); Rob Plotnikoff (TT); Betsy McCracken (FWS); Terry Schwarz (DNR); Kim Sager (DNR); Eric Rothwell (NOAA); Joe Klein (ADF&G); Michael Buntjer (FWS); Bob Henszey (FWS); William Ashton (ADEC); William Rice (FWS); Matthew LaCroix (EPA); Susan Walker (NOAA); Dudley Reiser (R2); Kevin Fetherston (R2); Rob Plotnikoff; Michael Lilly (gwscientific)

Subject: Groundwater Study

Discussion:

Craig Addley:

Impetus of putting together is request from agencies. Items not covered elsewhere, some are covered.

The objectives of the study are as follows:

1. Synthesize historical data available for Susitna River groundwater and groundwater related aquatic habitat, including the 1980s studies; (What is new or added?)
2. Use available information to characterize the large-scale geohydrologic process-domains/terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow ground water aquifers, surface water / ground water interactions); (Michael Lilly will discuss).
3. Assess the effect of Watana Dam on groundwater and groundwater related aquatic habitat in the vicinity of the dam;
4. Map groundwater influenced aquatic habitat (e.g., upwelling areas); Mostly in existing studies.
5. Determine the surface-water/groundwater relationships of floodplain shallow alluvial aquifers at Riparian Instream Flow study sites; (Keven and Michael will discuss)
6. Determine surface-water / groundwater relationships of upwelling/downwelling at Instream Flow Study sites in relation to spawning, incubation, and rearing habitat (particularly in the winter); will outline where study comes from.
7. Characterize water quality (e.g., temperature, DO, conductivity, nutrients) of selected upwelling areas where groundwater is a primary determinant of fish habitat (e.g., incubation and rearing in side channels and sloughs, upland sloughs). Mostly covered by water quality study.

Terry Swartz (DNR) – Good list. Would like to add on to #3 take into account reservoir behind dam.

Map groundwater influence – springs as well as upwelling. From DNR perspective – surface and GW rights. Like to get an idea how changes in stages effect drinking water sources from wells. Assume most people have wells close to river. This could be a contentious issue for DNR. Identify gaining and losing reaches of river. Will find during low flow easier than peak flow. Need to make sure we don't put hydraulic pressure on porous media.

Paul Dworian (URS) – Gaining/losing of river could be a seasonal issue. Problem is that each reach has numerous gains/losses. When flow is high harder to measure.

Craig Addley: Will add in Terry's concerns. Good work done in 1980s on 4 sloughs where good mass balance flows were done.

Michael Lilly: Existing Data Synthesis: Look closely at 1980s data. Used wells and transects. Used temp differences. ID applicable geology. Produce bibliography and references. Synthesize objectives of studies. It will include mapping. Cross over from old maps. Lots of GW work done in 1980s, but scattered in various studies. Not much additional data outside of study. Any 1980s observation wells intact? Not verified – will try and verify this summer. In lower basin there has been some work. Not much potential in upper basin. Alan Olson suggests there may be some data in the fish data.

Michael Lilly: Geohydrologic Process-Domains and Terrain

1. Define the significant geohydrologic units in the Susitna Basin that provide groundwater recharge to the main stem and associated side channels and sloughs.
2. Relate the geohydrologic units (e.g. bedrock, alluvial) to geomorphologic and riparian mapping units (process-domain river segments) in coordination with the Geomorphology and Instream Riparian Studies.
3. Define the groundwater regional scale to local flow systems in the main stem reaches and the relationship with the process-domain river segments. Lot of what was studied in 1980s was in main stem and side channel. Little focus outside of that.
4. Identify the relationship between the process-domain river segments and the planned intensive study areas to help transfer the groundwater and surface-water interaction results from the individual study areas back to the larger process-domain river segments. Add certain types of river zones.

Joe Klein: Need more detail on how work will be done. How do you tie in regional relationships to local effects? Project need for field work?

Michael Lilly: Need to summarize what we know about geology and surficial geology. 1980s report where they mapped surficial geology deposits, and some updated data since then. But you need to think about properties of units. May have areas of permafrost. Are they in gaining or losing reaches? Same rock units might have different effects in different areas. Won't need field work for regional perspective. Probably won't need field work.

Watana Dam – Focus is not on dam itself, but on reservoir itself. Will make this clearer.
1. Evaluate engineering geology information from the dam area.
2. Coordinate with the engineering and geomorphology studies to utilize existing data-collection programs and evaluate need for additional data collection.

3. Describe the pre-project groundwater conditions at the Watana Dam vicinity.
4. Characterize the known permafrost and bedrock hydrogeology at the Watana Dam vicinity. Area is dominated by bedrock terrain.
5. Develop a conceptual groundwater/surface-water model of the pre-project and post-project conditions. Conceptual model will take all this into account. What are main functions taking place. Under dam, around dam. Dam will not be sitting on alluvial sediments. Don't want to lose water in sediments. Closely coordinated with engineering studies.
6. Identify the key potential groundwater pathways for groundwater flow with the Project.
7. Evaluate the potential changes in the groundwater flow system as a result of the Project and Project operations.

On north side of river are quaternary deposits. Will need to take into account during engineering. Very carefully done to prevent dam failure. Need to investigate fracture zones.

Craig Addley: MWH has been asked about these issues. Any dam you put in they go all the way to bedrock and grout to keep water from bypassing dam. There is some seepage through RC dam. Dam is barrier to GW flow. There is an elevation above which GW would come though alluvium into dead man creek at a certain level. That would require some more engineering studies to keep from happening.

Craig Addley: Upwelling Mapping. Intent is to ID areas where springs or upwelling are part of study. Ice study on-going right now. Open leads are being put into GIS. Will redo in fall through spring of next year.

1. Aerial and GPS mapping of ice features including open leads, spring 2012-Spring 2014 (Ice Processes Study).
2. Open leads from RM 0 to RM 250 will be mapped aerially or by satellite imagery 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 or from orthophotographs, and the width of each lead will be estimated. Open leads in the Middle River will be compared with the location of open leads documented in 1984-1985 in the Middle River, as appropriate. GIS coverage of open leads will be developed.
3. Aerial photography of the ice free period showing turbid and clear water habitat, summer 2012-Summer 2014 (Geomorphology and Instream Flow Studies). Aerial photography at a range of flows from 5,000 cfs to 23,000 cfs will be collected in the Geomorphology and Instream Flow Studies to map geomorphic change and to document habitat surface area versus discharge. The aerial photography will be used to document turbid and clear water (i.e., groundwater influenced) habitats.
4. Conduct a pilot thermal imaging assessment of a portion of the Susitna River, fall 2012 or during 2013 (Baseline Water Quality Study). Timing is still being discussed. Betsy would like to do in Fall 2012. If we can get good contrast, this would be a good tool. Did try and do in 1980s. Was not successful. But new technology may make a difference, or better timing of the study. If pilot study works, we will use in 2013.

We will look at other methodologies as well.

Terry Swartz (DNR): How will we decide how upwelling in controlled by stage or upland GW sources? Assume each slough has at least a pressure transducer to record stage.

Craig Addley: That will be important to determine. Site specific studies hopefully will be able to be used on broader reach. We do not have a clear path lined out this minute.

Paul Dworian: Send copy of USGS report on evaluating upwelling methods.

(lots of cross talk – hard to know who's speaking)

Kevin Featherston: Riparian Vegetation Surface Water / Groundwater Interactions. Last question of local effects on process domains. There will be process domains relative to riparian – there are regions of river with same processes. In a moderately confined channel with major hill slope GW influences. Different process domains. Side channel abutting hill slope may have more upland character. In terms of larger study – relative to GW, trying to determine what location provide most value. Range of sites from highly constrained river channel to broad river channel where there is a lot of deposition. Will characterize 180 mile area into discreet domains. Will work with Bill Fullerton to designate domains. Measure channel migration rates. Compared to more confined channels.

Relative to GW, objective is to relate between GW and existing flood plain communities. Reach will be defined as 10 to 20 times active channel width. Will be able to age vegetation, and relate to measured flows. For example, cottonwood grows within 1.5 meters of low flow level.

Will create transect thought sloughs and riparian vegetation. With data, be able to use to utilize vegetation to map GW on other areas. Use modeling to show stages and flood plain inundation at different stages.

4-5 different reaches, different type of GW stage relationships modeled. Extrapolate up to larger scale.

Michael Buntjer With change in flow system with different operational scenarios. Hydrograph would change; need to know how high water gets in different areas. May change plant communities.

Joe Klein: Ho to determine transmissivity? Will have pressure transducers in wells? I understand floods are important. There is a life history associated with plant communities. Want to evaluate with different flow scenarios. Reset rate important.

Michael Buntjer: Do well tests – falling head tests. On Chena River used stage changes as pumping test. Yes, pressure transducers in wells.

Rob Plotnikoff: Currently we will have 3 full stations, and 4 more that will be retrofitted. Most are near river where we need them. Adequate representation will be determined on how well model gets calibrated.

Kevin Featherston: Flow scenario that reduces flooding may change disturbance, plant develop into more mature state. Flood state critical to whole game.

Craig Addley: We need to move along. May need to extend study beyond growing season. We have routing model to model stage changes.

Dudley Reiser: Fish Habitat Surface Water / Groundwater Interactions. We already know there is upwelling areas, and that they are important for fish. Why do we want to know this? Come down to how will this impact fish, and how will dam operate? That's the focus. GW – time lag of maybe months between what happens at surface and GW response. Need to think about daily changes to GW from dam operations. Need to focus on GW/surface water interaction and exchange. Influenced by stem flow, but also upland flow. 1980s found pretty good relationship between surface flow and upwelling areas. Pressure transducers are good tools. Intensely investigated areas that can be used as bellwethers for rest of sites. Use 1980s areas. May use same techniques, or embellish techniques. Geomorphology – might be able to extrapolate to other areas. May detect other areas that well not studied intensively enough using Geomorphology. Challenge is in best techniques to use. Hand held devices for thermal imagery. Goal is to establish relationship between GW and surface water. Upwelling influences water quality.

Michael Buntjer: Are there other areas with similar qualities that don't have fish? Maybe we need to make sure they go together. Upwelling may not be predictor. For example, is Slough 21 unique?

Dudley Reiser: Right. May be some sites that were not selected in 1980s, because they focused only on areas where they found fish. Don't have all the answers right now. Need to be open to new ideas. Keep goals in mind. Tributaries might be important due to GW interactions. Extrapolation is a key because we cannot study in depth every single slough.

Terry Schwartz: Are study sites that incorporate private property? There may be people that want to participate. May try and get list of wells that may be impacted. Only permitted wells known. Non permitted wells do not have water rights.

Betsy McGregor: We will look at land ownership from access perspective. May target sites based on drinking water wells. On list as action item.

Joe Klein: Sites with upwelling and no fish – might have to do experiments to evaluate why. Magnitude may make a difference. Can you record magnitude over time? A way to measure flux over time? Likely habitats that are used by fish, but have unsuccessful spawning. What causes failure? Need to know for future scenarios.

Michael Lilly: Measure head difference over time in piezometers. Can measure in winter. Can look at differences over time. Characterize the water quality differences between a set of key productive aquatic habitat types and a set of non-productive habitat types to improve the understanding of the water-quality differences and related groundwater/surface-water processes. Did egg survival studies in 1980s.

(Lots of cross talk – people leaving call. Hard to track speakers).

Eric Rothwell (NOAA): Like hierarchy of design. Like how it scales down. Not sure how we use data to analyze operations impact on upwelling. Habitat suitability – how will we judge? Is this the draft we want agencies to work with?

Dudley Rieser: Not sure how this will play out in suite of GW indicators. Maybe temp differentials. Linkage to operations will depend on how relations sort out. Goal is to develop models that bring in GW component. This study is building block of making these determinations. May be able to do GIS analyses using regional study methods.

Craig Addley: During ice time periods, where does ice set up? What is pressure under ice? May have to look and see how that impacts GW. We will take another shot for final to agencies. Let's on to water quality. Didn't really include fish part. Clearly they will help direct where studies will be performed. Questions on water quality? We mostly want to look at how water quality influences productivity. Local and regional sources of GW make difference.

Michael Lilly: Lot we talked about – look at sloughs that are both productive and not productive. Help increase understanding of key parameters and how operations may impact environments. Most of this has been touched on elsewhere.

Craig Addley: Let's wind up. Is there a way to detect upland and side sloughs – can detect chemistry –wise.

Michael Lilly: Longer GW is separated, more different it becomes.

Unknown: In next version would like to see diagram of what an in stream flow site looks like. Maybe a plan views of some of the proposed study sites.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Michael R. Lilly*	**Name:**	*Eric Rothwell*
Organization:	*GW Scientific - ABR*	**Organization:**	*NOAA*
Study Area:	*General Project Area - Hydrology*	**Phone Number:**	*907-271-1937*
Date:	*4/23/12*	**Time:**	*16:00*
Call Placed by: [ ] AEA Team [x] Other Party			

Others on Call: none

Subject: Study Requests, question on groundwater analysis methods, winter period hydrology program, winter hydrology methods

Discussion:

Eric Rothwell called Michael Lilly (GW Scientific) to talk about groundwater study request questions and how winter flow condition would be measured. I followed the telephone discussion with an email response (listed below) plus one report reference regarding the application of groundwater models to define aquifer properties. The email discussions covers the topics discussed on the phone. There are no specific follow-up actions items. It may be helpful to touch base with Eric and see if he has further questions about the technical topics and the study request process.

Date: Tue, 24 Apr 2012 16:27:59 -0800
To: Eric Rothwell <eric.rothwell@noaa.gov>,
Craig Addley <craig.addley@cardno.com>,
Betsy McGregor <BMcGregor@aidea.org>
From: "Michael R. Lilly, GW Scientific" <mlilly@gwscientific.com>
Subject: Discussion with Eric Rothwell, NOAA
Cc: Dudley Reiser <dreiser@r2usa.com>, Stuart Beck <sbeck@r2usa.com>,
mlilly@gwscientific.com, Bob Burgess <bburgess@abrinc.com>,
Robin Reich <Robin@solsticeak.com>, Dave Brailey <dbrailey@alaska.net>,
Kevin Fetherston <kfetherston@r2usa.com>,
Dave Brailey <dbrailey@alaska.net>

Hello Eric,

Thank you for the call yesterday. Below are some points we discussed. Happy to answer additional questions.

- Regarding the use of numerical analysis to help determine aquifer properties: I have attached a USGS publication on work we did in the Fairbanks area that was in support of Fort Wainwright SuperFund programs and general environmental investigations focusing on groundwater contamination and groundwater/surface-water interactions. In this example, we used the Chena River as a free (though up to Mother Nature's schedule) pump/aquifer test. A series of wells were used to record continuous water levels to measure and use the resulting pressure response in the water-table aquifer from stage changes in the Chena River to determine riverbed conductance (shallow wells closest to river) vertical hydraulic conductivity (deep wells near the river) and horizontal conductivity (shallow wells far from river. Comments in ()'s are general applications of the well network. Data was used ina variety of ways.

- Later, to help tie down the estimates used in the above study for porosity, we used the cyclic rise/fall of the water table to directly measure the saturated porosity of the soils with unfrozen volumetric soil moisture sensors. This is described in the Thesis by Julie Ahern (I was her main technical advisor), available at: http://ine.uaf.edu/werc/publications/theses/ (reference at top)

- the same approach illustrated above can be taken with a variety of geohydrologic systems. It is not necessary to link surface-water (routing) models to the groundwater modeling efforts, but the routing models can help provide design flow conditions, which then can become input data sets for cross-sectional models. This can help look at both "mass" exchange between groundwater and surface water, and pressure effects (e.g. water levels rising into riparian root zones some distance away from the river.

- In regards to winter flow conditions, the current gauging stations being proposed by the Project are intended to measure water levels during the summer, and water-level/pressure conditions during winter. The sensors are vented pressure-transducers, which also record temperature at the sensor body. Sensor will be placed in the deepest part of the channels as possible, so as stage (water) levels drop in the fall and ice formation is started, there is the greatest potential for measuring the winter water levels/pressures under ice cover to help understand the winter flow regime. So the stations are duel purpose - water levels to use with rating curves to develop discharge estimates, and water levels/pressure to understand the winter conditions. Depending on location and time of year, this could be a range of ice cover to full ice cover.

- Understanding the groundwater/surface-water interactions and winter flow regime is a very active discussion at AEA, which I am sure Craig and Betsy can further discuss. I anticipate Instream Flow programs under Dudley will play a major role, as well as ice process and flow routing studies.

It would be good to follow-up with Betsy and Craig on the questions of how study requests are addressing this. The above information covers our discussion and the questions you raised. Please let me know if additional details would be helpful. It would be very helpful to keep Betsy in the loop on all discussions.

Have a good day,

Michael

Kathy Dubé

From: Mouw, Jason E B (DFG)
Sent: Monday, May 14, 2012 10:50 AM
To: Kathy Dubé
Subject: RE: Large woody debris - Susitna River

Hi Kathy,

Thank you for the inquiry; I have been instructed to direct all inquiries on Susitna to Joe Klein. His email is joe.klein@alaska.gov.

Some of my observations on drifted wood debris have been published, but most of what I have seen and learned on the role of wood on the Susitna remains unpublished. I will say that the role of wood on the Susitna seems to be a bit less important to geomorphology than in the temperate coast region. Wood and ice are critical to fish habitat, but drifted wood on the Susitna is relatively small and not as effective at obstructing flow, especially given the hydrology and hydraulics of the Susitna. It is surprising how much wood is simply getting buried. Ice is also important, but its role also seems quite limited, in spite of some of the awesome examples of the destruction it can bring.

Jason

From: Kathy Dubé [mailto:kdube@watershednet.com]
Sent: Thursday, May 10, 2012 5:01 PM
To: Mouw, Jason E B (DFG)
Subject: Large woody debris - Susitna River

Hi Jason,

I am working on some of the geomorphology studies for the proposed Susitna-Watana hydroelectric project, including potential effects on large woody debris processes in the Susitna River. I know that you have done quite a bit of work on large woody debris and riparian vegetation interactions in Alaska, and am wondering if you have any insights/information/studies/data on large woody debris in the Susitna River that may be helpful to our study planning process. Please give me a call or e-mail to discuss this at your convenience.

Thanks,
Kathy

Kathy Dubé
Watershed GeoDynamics

kdube@watershednet.com

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Kathy Dubé*	**Name:**	*Ric Wilson*
Organization:	*Watershed GeoDynamics*	**Organization:**	*USGS*
Study Area:	*Geomorphology*	**Phone Number:**	*907-786-7448*
Date:	*5/15/12*	**Time:**	*1:15 PM PDT*

Call Placed by: [X] AEA Team [ ] Other Party

Others on Call:
None

Subject:
Available USGS geology/soil mapping for project area

Discussion:
Kathy called Ric to check on availability of geology/soil mapping that the USGS may have for the project area (e.g., that is not already posted on the USGS website). Ric said the Cook Inlet Reach map may cover the area; if not, the best thing would be to look at the reference maps for the 1998 central AK map (he will e-mail).

He said that he thought NRCS may have an exploratory soil survey of AK (Samuel Reiger et al.)

There is an old (1960's) road corridor surficial geology map (Florence Robinson) that has nice detail but may not cover project area.

Rick also suggested contacting Dick Rieger (USGS, surficial mapping), Lyn Yehle (yehle@usgs.gov), and Hank Schmoll (schmoll@usgs.gov); they are retired, but have worked in the area and may have more info.

Kathy Dubé

From: Frederic (Ric) Wilson
Sent: Tuesday, May 15, 2012 1:26 PM
To: Kathy Dubé
Subject: Re: Geology/soils/permafrost/glacial history of Susitna River area
Attachments: AK Geomap Publications.pdf

Kathy,
It was nice to talk to you. Here is the pdr that provides the references for the regional maps we've recently produced.
Ric

At 04:17 PM 5/10/2012, you wrote:

Hi Ric,

I just left you a phone message, but I think I may have messed up the phone number (after I said it I thought it sounded wrong). Anyway, my correct contact information is below.

As I mentioned, I am working on some of the geomorphology studies for the proposed Susitna-Watana Hydroelectric Project, and I'm looking for any recent maps/information on geology, soils, permafrost, extent of glacial ice cover, etc. for the Susitna River corridor. I have found some information online, but you may have more recent data, or be able to point me in a better direction.

Thanks,
Kathy

Kathy Dubé
Watershed GeoDynamics

kdube@watershednet.com

Dr. Frederic (Ric) Wilson
Research Geologist
U.S. Geological Survey
Alaska Science Center
4210 University Dr.
Anchorage, AK 99508
(907) 786-7448

Betsy McGregor

From:	Michael R. Lilly, GW Scientific <mlilly@gwscientific.com>
Sent:	Friday, May 18, 2012 11:36 AM
To:	Bob_Henszey@fws.gov
Cc:	Michael_Buntjer@fws.gov; eric Rothwell; Kevin Fetherston; mlilly@gwscientific.com; Dudley Reiser; Stuart Beck; Betsy McGregor; Bob Burgess
Subject:	Re: Agency Study Requests - GW Study

Hello Bob,

Thanks for the note. I am in Fairbanks this week if you want to get together, talking on the phone is also good. Kevin will be in touch with you to talk some specifics about riparian vegetation. I will call so we can talk about groundwater topics. Is there a time that is good for you? Good question below, and we are actively talking about the LIDAR data use now and how to verify its accuracy and applications for the studies.

Thanks,

Michael

At 10:47 AM 5/18/2012, Bob_Henszey@fws.gov wrote:

Hi Michael,

Eric Rothwell and I are working on similar agency requests for groundwater studies. He mentioned you were interested in discussing what the agencies were thinking for a groundwater study. I can't share our draft request at this time, but I would be more than happy to discuss what the FWS is thinking over the phone. In fact, your insights would be beneficial, especially in study site instrumentation, modeling and budget estimates. Please feel free to call me if you would like to discuss the groundwater study. In the mean time, you might like to look at the water-table summary statistics in Table 1 in the link below. I would like to test these, and select one or more for the Riparian Instream Flow Study. The approach in this paper is similar to what I'm thinking for the Susitna River, but the water table depths would be calculated by subtracting the 2D water table surface from the LiDAR surface and working with plant community polygons rather than individual species.

Thanks for your interest,
Bob
ne.water.usgs.gov/platte/reports/wetlands_24-3.pdf

Robert J. Henszey, Ph.D.
Fish & Wildlife Biologist
Conservation Planning Assistance
US Fish & Wildlife Service
101 12th Avenue, Room 110
Fairbanks, AK 99701
Phone: 907-456-0323, Fax: 907-456-0208
Bob_Henszey@fws.gov

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Paul Dworian*	**Name:**	*Bob Gerlach*
Organization:	*URS*	**Organization:**	*Alaska State Veterinarian*
Study Area:	*Methylmercury in fish*	**Phone Number:**	*(907) 375-8200*
Date:	*6/21/12*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call: none

Subject: Existing data/sampling efforts for methylmercury in fish in Susitna River basin

Discussion:

I consulted with Bob Gerlach, VMD, State Veterinarian, (907) 375-8200, bob.gerlach@alaska.gov (Anchorage).

The state veterinary office has been collecting data from the Susitna river drainage basin on methylmercury. He agreed to send me the data he has for inclusion into the methylmercury study plan as part of the background section. Here is a link to the website:

http://dec.alaska.gov/eh/vet/fish.htm

The website only has average concentrations listed. But it mentions samples being taken from the Susitna drainage basin. Bob has agreed to send me Susitna specific data – species, sample locations, and results. This information may modify the study approach for methylmercury.

Dwarian, Paul

From:	Myerchin, Paul
Sent:	Wednesday, July 11, 2012 2:06 PM
To:	david.griffin@alaska.gov
Cc:	Plotnikoff, Robert; Dworian, Paul; Pearson, Michelle
Subject:	Revised Changes to Application

David,

I believe this has important implications in permit processing expediency. We have since revised access to all Denali State Park sites by boat. Could you please take this into consideration regarding permit review and processing.

Please call or email Michelle Pearson for any further correspondence.

Thanks David.

TABLE 1 REVISED
SUMMARY OF DENALI STATE PARK
WATER QUALITY STUDY SITES

River Mile	Land Owner	Status	Coordinates (NAD 83)	Description	Access Type (Proposed)
RM 136.5	State Park	**A**[1]	Lat: 62.7680 Long: -149.0695	Susitna near Gold Creek	Boat
RM 136.8	State Park	**A**[1]	Lat: 62.7690 Long: -149.692	Gold Creek	Boat
RM 138	State Park	P	Lat: 62.7812 Long: -149.674	Susitna	Boat
RM 138.6	State Park	P	Lat: 62.8009 Long: -149.664	Indian River/Susitna	Boat

Dworian, Paul

From:	Myerchin, Paul
Sent:	Wednesday, July 11, 2012 9:10 AM
To:	Griffin, David W (DNR)
Cc:	Pearson, Michelle; Dworian, Paul
Subject:	RE: URS AEA Denali Park Land Access Request

Thanks Dave. Also, I'll be out all next week on field deployment, so if you have any questions or concerns, could you please cc: me, and forward all correspondence to the following recipients:

Michelle Pearson (URS); michelle.pearson@urs.com; (907) 261-6792
Paul Dworian (URS); paul.dworian@urs.com ; (907) 261-6735

Regards,

Paul Myerchin

From: Griffin, David W (DNR) [mailto:david.griffin@alaska.gov]
Sent: Wednesday, July 11, 2012 9:07 AM
To: Myerchin, Paul
Cc: Pearson, Michelle; Dworian, Paul; Vania, Mark
Subject: RE: URS AEA Denali Park Land Access Request

Hi Paul,

Yes I have received your permit package. I haven't had an opportunity to review the details, but should have some time to take a look at it today. If I have questions or need additional information I'll be in touch.

Thanks,
Dave

From: Myerchin, Paul [paul.myerchin@urs.com]
Sent: Tuesday, July 10, 2012 3:26 PM
To: Griffin, David W (DNR)
Cc: Pearson, Michelle; Dworian, Paul; Vania, Mark
Subject: URS AEA Denali Park Land Access Request

David,

Just wanted to confirm if you had received our permit package for park access. Please let me know if there is anything else that you may need. On another note, I will be out of the office from 7/16 through 7/20. Please forward all correspondence to the following recipients regarding our submitted permit:

1) Michelle Pearson (URS), michelle.pearson@urs.com ; Phone (907) 261-6792
2) Paul Dworian (URS), paul.dworian@urs.com ; Phone (907) 261-6748

Thanks David,

Paul Myerchin

Dwoorian, Paul

From:	Myerchin, Paul
Sent:	Monday, July 02, 2012 11:51 AM
To:	jesse.labenski@alaska.gov
Cc:	Dworian, Paul; Pearson, Michelle; Wayman, John; Vania, Mark
Subject:	AEA Water Quaity Study Site Clarifications/Corrections
Attachments:	ADNR Email Data Package Submittal_7_2_12.pdf

Jessie,

Heres a quick summary of station location changes. I've also provided tables for each site and corresponding figures in the attached .pdf package. Please let me know if you have any questions, need clarification, or any additional information. Have a good weekend!

Regards,

Paul Myerchin
907-261-6748 (office)

Summarized Station Changes:

RM 10.1 Station location changed to RM 15.1. due to woody debris. Coordinate and location provided in figure and table.

RM 29.5 Longitudal coordinate provided is not correct (inconsistent with newest location provided by AEA. Coordinate provided in attached table

RM 98.1/98.5 Primary station location on property located on private property for which permission has not been received. Two alternate locations are provided on attached figure with corresponding coordinates in provided site specific table (RM 98.1_98.5).

RM 113 Primary location moved to west bank due to ROW access restrictions. West bank stakeholders include ADNR and Matsu Borough. Coordinate provided in table and figure.

RM 138.0 South/east bank (alternate location) on ADNR land. Coordinate location provided in attached table.

Dworian, Paul

From: Myerchin, Paul
Sent: Tuesday, July 10, 2012 1:15 PM
To: jesse.labenski@alaska.gov
Cc: Pearson, Michelle; Vania, Mark; Dworian, Paul
Subject: Revised site location for RM 97
Attachments: StationLocations_LandStatus_Sites_97_95_8.pdf

Jesse,

We would like to re-locate the RM 97 site on State Lands (ADNR). The new revised location information is as follows

RM 95.8 (formerly RM 97)
Revised Coordinates: Lat. 62.306219; Long . -150.109044.
The site is located on the east bank of the Susitna River as per attached site figure.

Please let me know if you need any additional information.

Your help is appreciated and thanks for your time, effort, and attention with these requests.

Paul Myerchin

6. INSTREAM FLOW STUDIES: FISH, AQUATICS AND RIPARIAN

6.1. Introduction

Project construction and operation would have an effect on the flows downstream of the dam, the degree of which will ultimately depend on final Project design and operating characteristics. The Project would be operated in a load following mode. Project operations would cause seasonal, daily, and hourly changes in Susitna River flows compared to existing conditions. The potential alteration in flows would influence downstream resources/processes, including fish and aquatic biota and their habitats, channel form and function including sediment transport, water quality, groundwater/surface water interactions, ice dynamics and riparian and wildlife communities (AEA 2011).

The potential operational flow induced effects of the Project will need to be carefully evaluated as part of the licensing process. This study plan describes the Susitna-Watana Instream Flow Study (IFS) that will be conducted to characterize and evaluate these effects. The plan includes a statement of objectives, a description of the technical framework that is at the foundation of the IFS, the general methods that will be applied, and the study nexus to the Project. This plan will be subject to revision and refinements as part of the licensing participant review and comment process identified in the ILP. In particular, at this stage in its development, the IFS has not identified specific study sites. These details and others will be developed in consultation with licensing participants as part of the continuing study planning process and during study implementation.

6.2. Nexus between Project Construction / Existence / Operations and Effects on Resources to be Studied

As described above, the operational strategy of the Project could result in a variety of flow responses to the river below Watana Dam. These may include seasonal, daily and hourly changes in river stage that would vary longitudinally along the river. Having a clear understanding of Project effects on instream flow and riparian habitats and biological resources present within the Susitna River corridor will be critical to environmental analysis of the Project.

6.3. Resource Management Goals and Objectives

Several natural resources agencies have jurisdiction over aquatic species and their habitats in the Project area. These agencies will be using in part, the results of the IFS and other fish and aquatic studies to satisfy their respective mandates. The following federal and state agencies and Alaska Native entities have identified their resource management goals, or provided comments in the context of FERC licensing, related to instream flow and riparian resource issues.

6.3.1. National Marine Fisheries Service

The following text is an excerpt of the May 31, 2012 NMFS letter and Instream Flow Study Request:

"NMFS has authority to request water quality and other natural resource studies related to the project pursuant to the: Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. §4321 et seq.), Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. §1531 et seq.), Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. §668a-d), Migratory Bird Treaty Act (MBTA) (40 Stat. 755, as amended; 16 U.S.C. §703 et seq.), Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. §661 et seq.), and Federal Power Act (16 U.S.C. § 91 et seq.).

Under Section 18 of the FPA, NMFS and the USFWS have authority to issue mandatory fishway prescriptions for safe, timely, and effective fish passage. Under Section 10(j) of the FPA, NMFS and USFWS are authorized to recommend license conditions necessary to adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife (including related spawning grounds and habitat) affected by the development, operation, and management of hydropower projects. Section 10(a)(1) of the FPA requires FERC to condition hydropower licenses to best improve or develop a waterway or waterways for the adequate protection, mitigation, and enhancement of fish and wild life (including related spawning grounds and habitat) based on NMFS and Service recommendations and plans for affected waterways. Therefore, one of the resource management goals of NMFS is to inform development of fishway prescriptions for this project pursuant to Section 18 of the FPA.

A number of Federal regulations address the need to protect and preserve fish and wildlife resources and their habitats, including preventing the "take" of certain species (or groups of species). The following is a list of some of the most important of these regulations which are applicable or may be applicable to the proposed license applications:

- *Federal Power Act*
    - *FERC is required to give equal consideration to "protection, mitigation of damage to, and enhancement of, fish and wildlife (including spawning grounds and habitat)."*
- *Magnuson-Stevens Fishery Conservation Act*
    - *Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established a new requirement to describe and identify EFH in each fishery management plan. The EFH provisions of the MSA (§305(b)) require federal agencies to consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH*
- *Fish and Wildlife Coordination Act*
    - *Requires equal consideration and coordination of wildlife conservation with other water resources development programs.*

- *National Environmental Policy Act*
  - *Requires evaluation of project alternatives, cumulative effects.*
- *Endangered Species Act*
  - *Section 7(a)(2) requires Federal agencies to ensure that their activities are not likely to jeopardize the continued existence of listed species or adversely modify designated critical habitat.*
- *Anadromous Fish Conservation Act"*

6.3.2. U.S. Fish and Wildlife Service

The following text is an excerpt of the May 31, 2012 USFWS Instream Flow Study Request:

> *"The U.S. Fish and Wildlife Service (USFWS), U.S. Department of Interior, has authority to request fish and wildlife resources studies related to this project pursuant to:*
>
> *The National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), the Migratory Bird Treaty Act (MBTA) (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and the Federal Power Act (16 U.S.C. § 791 et seq.).*
>
> *Under Section 18 of the Federal Power Act (FPA), the National Marine Fisheries Service (NMFS), U.S. Department of Commerce and the USFWS have authority to issue mandatory fishway prescriptions for safe, timely, and effective fish passage. Under Section 10(j) of the FPA, NMFS and USFWS are authorized to recommend license conditions necessary to adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife (including related spawning grounds and habitat) affected by the development, operation, and management of hydropower projects. Section 10(a)(1) of the FPA requires FERC to condition hydropower licenses to best improve or develop a waterway or waterways for the adequate protection, mitigation, and enhancement of fish and wild life (including related spawning grounds and habitat) based on NMFS and USFWS recommendations and plans for affected waterways.*
>
> *Consistent with our mission and with the legal authorities described above, our resource goal in this matter is to conserve existing fish and wildlife resources and their habitats in the Susitna River basin. With regard to fish passage, we will recommend scientifically-based and coordinated studies, collaborate with others, and ensure development of the best information possible to inform potential development of fishway prescriptions for this project pursuant to Section 18 of the Federal Power Act."*

6.3.3. Alaska Department of Fish and Game

The following text is an excerpt of the May 30, 2012 ADF&G letter and Instream Flow Study Request:

> *"The Fish and Game Act requires the Alaska Department of Fish and Game to, among other responsibilities, "...manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state" (AS 16.05.020)."*

6.3.4. Alaska Native Entities

6.3.4.1. Chickaloon Village Traditional Council

The Chickaloon Native Village provided comments on Project licensing activities in a May 31, 2012 letter to the FERC. Chickaloon Native Village is a federally recognized Alaska Native tribe. Chickaloon Village is an Ahtna Athabascan Indian Tribe governed by the nine-member Chickaloon Village Traditional Council. The Chickaloon Village Traditional Council strives to increase traditional Ahtna Dene' practices for the betterment of all residents in the area. Preserving and restoring the regions natural resources is one way of supporting Ahtna culture and the regional ecosystem.

6.4. Summary of Consultation with Agencies, Alaska Native Entities, and Other Licensing Participants

Input regarding the issues to be addressed in the IFS has been provided by licensing participants during workgroup meetings commencing in late 2011. During 2012, workgroup meetings were held in January, February, April and June during which resource issues were identified and discussed and objectives of the instream flow studies were defined. Various agencies (USFWS, NMFS, ADF&G, etc.) provided written comments specific to this study which have been considered and will be addressed as part of this plan. Following is a summary of consultations pertaining to instream flow and riparian aspects of the IFS. A summary of communications relevant to the Instream Flow study plans is provided in Table 6.4-1.

Table 6.4-1. Summary of consultation on Instream Flow study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Letter	12/30/2011	A.G. Rappoport	USFWS	Critically review 1980s data for applicability to current Project, extend modeling to lower river, monitor flow/sediment in Chulitna and Talkeetna rivers and Gold Creek, quantify fish distributions and collect longitudinal thermal imaging data.
Letter	1/12/2012	P. Bergmann	USDOI	Fully characterize fish habitat use, HSC, species and assemblages throughout all three reaches of the Susitna River and tributaries, address climate change in studies, invasive species, effects of flow changes on fish passage through Devils Canyon. (Filed with FERC.)
Technical Workgroup Meeting Notes	1/24/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Chugach Electric Association, Nuvista Light & Power, and other interested parties	Meeting to discuss Project and 2012 study plans. See Attachment 1-1.
Letter	2/10/2012	A.G. Rappoport	USFWS	Use minimum 5-year temporal scale, include winter evaluations beginning in 2012, conduct thermal imaging, use 2-D models, use site-specific data instead of professional judgment for HSC.
E-mail (internal to USFWS)	2/14/2012	W. Rice	USFWS	Suggestion pertaining to installation and operation of streamflow gages on Susitna River.
Letter	2/21/2012	A.G. Rappoport	USFWS	Requested that Adult Salmon Distribution and Habitat Utilization Study be integrated with instream flow and expand spawning habitat study to lower river.
Letter	2/29/2012	J.W. Balsiger	NMFS	Requested information on how interrelated studies will be integrated, requested climate change be incorporated into many, if not all studies. (Filed with FERC.)
Technical Workgroup Meeting Notes	3/02/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, and other interested parties	Meeting to discuss the 2012 study plans and table of 2013-2014 studies, potential methods and objectives. See Attachment 1-1.

Comment Format	Date	Stakeholder	Affiliation	Subject
E-mail	3/07/2012	J. Klein	ADF&G	Provided information in preparation for an agency teleconference (on 03/07/2012) to discuss instream flow study planning. Requested instream flow study address "patchy" salmon habitat use, winter habitat needs, groundwater influence and HSC curves representative of habitat types, seasons and inter-annual variability.
E-mail	3/07/2012	B. Henszey	USFWS	Bob suggested consideration of the following riparian instream flow needs that might affect migratory bird habitat: •Channel encroachment of riparian veg (appears to be recognized). •Channel degradation lowering the adjacent water table, causing changes in adjacent veg (appears not to be recognized). •Channel aggradation raising the adjacent water table, causing changes in the adjacent veg (not sure this will happen, but should be considered). •Changes in the timing and duration of the hydroperiod (surface and shallow groundwater) on key riparian life stages (e.g., establishment, high flow and ice scour of seedlings, shifting high water levels to later in the season on mature veg).
E-mail	3/07/2012	S. Walker	NMFS	Provided 02/29/2012 comment letter and some suggestions related to instream flow study planning in preparation for an agency teleconference (03/07/2012). Requested careful consideration of constraints of 1980s studies to evaluate proposed Project operations (i.e., winter load following and reduction of summer peak flows). Indicated studies important in middle and lower river.
E-mail	3/07/2012	M. Buntjer	USFWS	Provided 02/10/2012 and 12/20/2011 USFWS letters in preparation for an agency teleconference (on 03/07/2012) to discuss instream flow study planning.
Meeting Notes (Prepared by D. Reiser)	3/07/2012	S. Walker, M. Buntjer, B. McCracken, B. Henszey, J. Klein	NMFS, USFWS, ADF&G	Written summary of teleconference meeting held on 03/07/2012 to discuss 2012 and 2013/2014 studies. Topics included: model flow vs. habitat relationships in all reaches affected by the Project; complete analysis of

Comment Format	Date	Stakeholder	Affiliation	Subject
				fish habitat issues, ice and potential effects of Project on formation, breakup, etc., fish use of winter habitat; groundwater and water temperature and potential Project influences; time series analysis of habitats; and evaluation of riparian communities under alternate Project operations.
Technical Workgroup Meeting Notes	4/04/2012	Various	AEA, USFWS, NMFS, BLM, ADF&G, ADEC, ADNR, Natural heritage Institute/Hydropower Reform Coalition, Coalition for Susitna Dam Alternatives, Alaska Ratepayers, Mike Wood, and other interested parties	Meeting to discuss 2012 study plans and 2013-2014 Study Requests prepared by AEA team. Eric Rothwell (NMFS) requested groundwater / surface water study be developed. See Attachment 1-1.
Technical Workgroup Meeting Notes	4/06/2012	Various	AEA, USFWS, NMFS, BLM, USGS, ADF&G, ADNR, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, Mike Wood, and other interested parties	Meeting to discuss 2012 study plans and 2013-2014 Study Requests prepared by AEA team. Meeting to discuss 2012 and draft 2013-2014 study plans. See Attachment 1-1.
Phone conversation	5/18/2012	B. Henszey	USFWS	1. Intensive study reach should be located below the Dam site to assess channel issues relative to channel degradation due to lack of sediment transport. 2. Would like to see enough well transects at our intensive study reaches to capture all the riparian plant community types found in the Susitna River floodplain. 3. Groundwater root zone interactions need to be measured and modeled in the groundwater/surface water study.
Phone conversation	5/22/2012	J. Mouw	ADF&G	1. Balsam poplar phenology, seed release period he has observed on the Susitna River (seed release generally in the window of June 20-July 4th), 2. Dendrochronological studies he is conducting on the Talkeetna River floodplain, 3. Types of historic river gauge data, and 4. General ecology of riparian forest succession he has observed. 5. Role of beaver in floodplain wetland and off-channel

Comment Format	Date	Stakeholder	Affiliation	Subject
				water body formation.
Phone conversation	5/25/2012	B. Henszey	USFWS	Discussed proposed riparian vegetation sampling design
Study Requests and Letters	5/30/2012 - 5/31/2012	Various	Multiple Stakeholders	Stakeholders' comments on PAD, SD1 and study requests. (Filed with FERC).
E-mails (several)	6/07/2012	J. Klein, M. Buntjer, B. Henszey, S. Walker	NMFS, USFWS, ADF&G	Reponses to request for follow-up post-licensing participant meeting to be held in the afternoon of 06/13/2012.
Technical Workgroup Meeting Notes	6/13/2012	Various	AEA, USFWS, NMFS, ADF&G, ADEC, ADNR, BLM, EPA, USGS, FERC, Natural Heritage Institute/Hydropower Reform Coalition, Alaska Ratepayers, Coalition for Susitna Dam Alternatives and other interested parties	Meeting to discuss Stakeholder Study Requests. See Attachment 1-1.
Meeting Notes	6/13/2012	J. Klein, M. Buntjer, B. McCracken, S. Walker (via teleconference), B. Henszey	ADF&G,USFWS,NMFS	Meeting to discuss planning for September agency field reconnaissance trip to review instream flow study methods and models and to identify candidate study sites.
Technical Workgroup Meeting Notes	6/14/2012	Various	AEA, USFWS, BLM, NMFS, Coalition for Susitna River Dam Alternatives, EPA, ADF&G, ADNR, NPS, USGS, Natural Heritage Institute/Hydropower Reform Coalition, FERC, and other interested parties	See Attachment 1-1. Sue Walker (NMFS) requested: 1. An analysis of climate change effects on evapotranspiration rates of trees and how this may affect tree growth rates. 2. Analysis of how operational flows may affect potential for exotic plant species invasion of natural floodplain plant communities.

6.5. Fish and Aquatics Instream Flow Study

6.5.1. General Description of the Proposed Study

6.5.1.1. Focus of IFS

The 2013-2014 IFS plan is specifically directed toward establishing an understanding of important biological communities and associated habitats, and the hydrologic, physical, and chemical processes in the Susitna River that directly influence those resources. The focus of much of this work will be on establishing a set of analytical tools/models based on the best available information and data that can be used for defining both existing or base conditions; i.e., without Project, and how these resources and processes will respond to alternate Project operations.

6.5.1.2. Study Goals and Objectives

The objective of the IFS and its component study efforts is to provide quantitative indices of existing aquatic habitats and the effects of alternate Project operational scenarios. Specific objectives of the study include the following:

1. Map the current aquatic habitat in mainstem and lateral habitats of the Susitna River affected by Project operations.
2. Select study sites and sampling procedures to measure and model mainstem and lateral Susitna River habitat types.
3. Develop a hydraulic routing model that estimates water surface elevations and average water velocity along modeled transects on an hourly basis under alternate operational scenarios.
4. Develop seasonal, site-specific Habitat Suitability Curves (HSC) and Habitat Suitability Indices (HSI) for species and lifestages of fish selected in consultation with licensing participants. Criteria will include observed physical phenomena that may be a factor in fish preference (e.g., depth, velocity, substrate, embeddedness, proximity to cover, groundwater influence, turbidity, etc.). If study efforts are unable to develop robust site-specific data, HSC/HSI will be developed using the best available information and selected in consultation with licensing participants.
5. Develop integrated aquatic habitat models that produce a time series of data for a variety of biological metrics under existing conditions and alternate operational scenarios. These metrics include (but are not limited to):
    - water surface elevation at selected river locations;
    - water velocity within study site subdivisions (cells or transects) over a range of flows during seasonal conditions;
    - varial zone area;
    - frequency and duration of exposure/inundation of the varial zone at selected river locations; and
    - habitat suitability indices.

6. Evaluate existing conditions and alternate operational scenarios using a hydrologic database that includes specific years or portions of annual hydrographs for wet, average and dry hydrologic conditions and warm and cold Pacific Decadal Oscillation (PDO) phases.
7. Coordinate instream flow modeling and evaluation procedures with complementary study efforts including riparian (Section 6.6), geomorphology (Section 5.8 and 5.9), groundwater (Section 5.7), water quality (Section 5.5), fish passage (Section 7.12), and ice processes (Section 5.10). If channel conditions are expected to change over the license period, instream flow habitat modeling efforts will incorporate changes identified and quantified by riverine process studies.
8. Conduct a variety of post-processing comparative analyses derived from the output metrics estimated under aquatic habitat models. These include (but are not limited to):
    - juvenile and adult rearing;
    - adult holding;
    - habitat connectivity;
    - spawning and egg incubation;
    - juvenile fish stranding and trapping;
    - ramping rates; and
    - distribution and abundance of benthic macroinvertebrates.

6.5.2. Existing Information and Need for Additional Information

6.5.2.1. Summary of Existing Information

Substantial physical, hydrologic and biological information is available for the Susitna River as a result of previous hydropower licensing efforts conducted during the 1980s. The extent and details of many of those studies were provided in the Draft Environmental Impact Statement (DEIS 1984) for the previous proposed project (FERC No. 7114) along with companion appendices and attachments in the way of ADF&G reports. A gap analysis report conducted by HDR (2011) summarized some of the data. The gap analysis provided an initial listing of salient reports and data that warrant more detailed evaluations.

The 1980s project was envisioned as a two-dam project, with an upper dam, reservoir and powerhouse near RM 184 (Watana Dam). The upper development would be operated in load-following mode to meet power demands. A lower dam, reservoir and powerhouse (Devils Canyon Dam) would provide additional power generation, but would also reregulate flow releases from the upper development. Downstream flow releases from the Devils Canyon Dam would not have the daily flow fluctuations associated with load-following operations of the upper development. In addition, since the Devils Canyon Dam would create a reservoir that would inundate much of the river between the two dams, the instream flow and riparian study efforts in the 1980s focused on the effects of flow releases Susitna River downstream of the Devils Canyon Dam site and the reach between the Devils Canyon Dam and Watana Dam sites were not modeled as part of the instream flow study. These are important differences between the current proposal and that of the 1980s. The Project, as currently proposed, without the re-regulation of flows that a second dam would allow, will require the evaluation of downstream effects of load-following operations on fish and wildlife resources downstream of the Watana Dam site.

Inspection of the 1980s reports confirms that the majority of efforts were focused on the middle and lower river reaches of the Susitna River. As part of the review effort, over sixty reports from the 1980s and earlier were identified as useful for compilation or synthesis of existing information. The identified documents included 83 separate volumes containing descriptions of field studies and reports with tabular data, figures, and maps. A listing of the studies for which reports have been reviewed includes:

- Water quality investigations
- Adult salmon passage in sloughs and side channels
- Adult salmon spawn timing and distribution
- Channel geometry investigations
- Groundwater upwelling detection
- Hydrological investigations and modeling of anadromous and resident fish habitat
- Juvenile salmon abundance and distribution
- Resident fish abundance, distribution and life history
- Salmon habitat suitability criteria
- Salmon spawning habitat evaluation

Synthesis of pertinent information will be completed as part of the IFS and supplemented by analysis of aquatic-related information conducted as part of the Fish and Aquatic Program (Section 7). As part of this synthesis, information will be compiled and reviewed related to instream flow regimes implemented at other large hydropower projects, with a special emphasis on projects developed in arctic and sub-arctic environments.

6.5.2.2. Need for Additional Information

The gap analysis presented in HDR (2011) outlines the major elements required in an instream flow study. Although substantial data and information were collected in the 1980s, those data are approximately 30 years old and therefore additional information needs to be collected to provide a contemporary understanding of the baseline conditions existing in the Susitna River. In addition, the configuration and proposed operations of the Project are different from the previously proposed project and must be evaluated within the context of the existing environmental setting. This includes consideration of potential load following effects on important aquatic and riparian habitats downstream of the proposed Watana Dam site (including both the middle and lower river, as appropriate). Potential effects of proposed Project operations on aquatic habitats and biota and potential benefits and impacts of alternative operational scenarios have not been quantitatively analyzed. The aquatic habitat specific models will provide an integrated assessment of the effects of Project operations on biological resources and riverine processes. These models will provide an analytical framework for assessing alternative operational scenarios and quantitative metrics that will provide the basis for the environmental assessment and aid in comparing alternatives that may lead to refinements in proposed Project operations.

6.5.3. Study Area

During the 1980s studies, the Susitna River was characterized into three reaches corresponding to an upper river reach representing that portion of the watershed above the Watana Dam site at RM 184; a middle river reach (extending from RM 184 downstream through Devil Canyon to the confluence of the three rivers at RM 98.5) and a lower river reach (extending from the confluence of Chulitna and Talkeetna rivers (three rivers) to Cook Inlet (RM 0). Potential Project effects to the upper river reach above the Watana Dam site are addressed in Section 7: Fish and Aquatics, Section 8: Wildlife, Section 9: Botanical, and other studies; however, Project effects to the upper river reach will not be addressed in the instream flow study.

The "middle river" encompasses the approximate 85-mile reach between the proposed Watana Dam site and the three rivers confluence, located at RM 98.5. The river flows from Watana Canyon into Devil Canyon, the narrowest and steepest gradient reach on the Susitna River. In Devil Canyon, constriction creates extreme hydraulic conditions including deep plunge pools, drops, and high velocities. The Devil Canyon rapids form a partial barrier to the migration of anadromous fish; only a few adult Chinook salmon have been observed upstream of Devil Canyon. Downstream of Devil Canyon, the middle Susitna River widens but remains essentially a single channel with stable islands, occasional side channels, and sloughs. For purposes of this study plan, the middle reach has been further divided into three segments corresponding to Above Devils Canyon, Within Devils Canyon, and Below Devils Canyon.

The "lower river" describes the approximate 98-mile reach between the Chulitna River confluence and Cook Inlet (RM 0). An abrupt change in channel form occurs where the Chulitna River joins the Susitna River near the town of Talkeetna. The Chulitna River drains a smaller area than the Middle Susitna River Reach at the confluence, but drains higher elevations (including Denali and Mount Foraker) and many more glaciers. The annual flow of the Chulitna River is approximately the same as the Susitna River at the confluence, though the Chulitna contributes much more sediment than the Susitna. For several miles downstream of the confluence, the Susitna River becomes braided, characterized by unstable, shifting gravel bars and shallow subchannels. For the remainder of its course to Cook Inlet, the Susitna River alternates between single channel, braided, and meandering planforms with multiple side channels and sloughs. Major tributaries drain the western Talkeetna Mountains (the Talkeetna River, Montana Creek, Willow Creek, Kashwitna River), the Susitna lowlands (Deshka River), and the Alaska Range (Yentna River). The Yentna River is the largest tributary in the Lower River Reach, supplying about 40 percent of the mean annual flow at the mouth.

The instream flow study area includes mainstem and lateral habitats of the Susitna River downstream of the proposed Watana Dam site at RM 184. For purposes of this study, the instream flow study area has been divided into the following river reaches and segments (Figure 6.5-1):

- Middle River Reach – Susitna River from Watana Dam site to confluence of Chulitna and Talkeetna rivers (three rivers) (RM 184 to RM 98.5). This reach is further divided into three segments including:
    - Upper Segment – Watana Dam site to upstream end of Devils Canyon.
    - Middle Segment – upstream end of Devils Canyon to downstream end of Devils Canyon.

  - o Lower Segment – downstream end of Devils Canyon to Three Rivers (RM 98.5).

- Lower River Reach — Susitna River extending below Talkeetna River to mouth (RM 98.5 to RM 0)

Further refinement of these reach designations may occur as part of the Stratification task under the 2012 geomorphology study plans and in consultation with the licensing participants.

6.5.4. Study Methods

Evaluation of potential Project effects to middle and lower river habitats will consist of the following components (these components will be refined based on licensing participant review):

- Analytical Framework;
- Habitat Mapping (See also sections 5.8and 7.9);
- Hydraulic Routing and Hydrologic Data Analysis;
- Habitat Suitability Criteria (HSC) or Habitat Suitability Indices (HSI) development for fish and benthic macroinvertebrates; and
- Habitat-Specific Models Development, including varial zone modeling and fish passage/off-channel fish connectivity.

6.5.4.1. IFS Analytical Framework

Figure 6.5-3 depicts the analytical framework of the IFS commencing with the Reservoir Operations Model (ROM) that will be used to generate alternate operational scenarios under different hydrological conditions. The overall framework includes analytical steps that are consistent with those described in the Instream Flow Incremental Methodology (IFIM) (Stalnaker et al. 1996), which will be used as a guide for completing the instream flow evaluation for the Project. The ROM will provide the input data to the mainstem flow routing model that will be used to predict hourly flow and water surface elevation data at multiple points downstream, taking into account accretion and flow attenuation. Coincident with the development of the flow routing model, a series of biological and riverine process studies will be completed (other studies) to supplement the information collected in the 1980s as necessary to define reliable relationships between mainstem flow and riverine processes and biological resources. This will result in development of a series of flow sensitive models (e.g., models of selected anadromous and resident fish habitats by species and life stage, models to assess connectivity and passage conditions provided into side channel and slough habitats, models to describe invertebrate habitats, temperature model, ice model, sediment transport model, turbidity model, large woody debris (LWD) recruitment model) that will be able to translate effects of alternative Project operations on the respective processes and biological resources.

As part of the Analytical Framework, an Instream Flow Study-Technical Work Group (IFS-TWG) will be formed consisting of technical representatives from agency and licensing participant groups. The IFS-TWG will provide input into specific study design elements pertaining to the IFS including selection of study sites, selection of methods and models, selection of HSC criteria, review and evaluation of hydrology and habitat-flow modeling results, and review of Project operations/habitat modeling results. The IFS-TWG will meet independently of the larger licensing participant group.

Resource and process effects will be location and habitat specific (e.g., responses are expected to be different in side sloughs versus mainstem versus side channel versus tributary delta versus riparian habitats) but there will also be a cumulative effect that translates throughout the entire length of the Susitna River. Alternate Project operational scenarios will likely affect different habitats and processes differently, both spatially and temporally. The habitat and process models will therefore be spatially discrete (e.g., by site, segment, and reach) and yet able to be integrated to allow for a holistic evaluation of each alternative operational scenario. This will allow for an Integrated Resource Analysis of separate operational scenarios that includes each resource element, the results of which can serve in a feedback capacity leading to new or modifications of existing operations scenarios.

The IFS plan is focused on development of macro-habitat specific models that can reliably estimate flow-habitat response patterns for different species and life stages of fish and other aquatic biota. This will include a mainstem aquatic habitat model, side channel models, one or more side slough models (may vary by flow activation level), a tributary mouth and delta model; and a riparian model. These models represent the core tools that will be used for assessing changes in aquatic habitats under alternative Project operational scenarios. The conceptual framework for these tools is depicted in Figure 6.5-3. A study focused on groundwater related aquatic habitat will be also be developed that may incorporate one or more of these models to assess linkages between surface flows and groundwater flows that comprise important fish habitats. Additionally, a fish passage model (Section 7.12) will also be used to develop the relationship between main channel flow and connectivity with side channel and off-channel areas. Data collection and modeling for the fish passage study will be coordinated with the instream flow, fisheries, and geomorphology studies (Section 5.9 and 5.10) to ensure identification of potential fish passage barriers and hydraulic control points.

6.5.4.2. Habitat Mapping

During the 1980s studies, the riverine related habitats of the Susitna River were divided into six macro-habitat categories consisting of mainstem, side channel, side slough, upland slough, tributaries, and tributary mouths (ADF&G 1984). The distribution and frequency of these habitats varies longitudinally within the river depending in large part on its confinement by adjoining floodplain areas, size, and gradient. These habitat feature types are depicted in Figure 6.5-2 which was adopted from ADF&G (1983) and Trihey (1982); the habitat types were described with respect to mainstem flow influence by ADF&G in the Susitna Hydroelectric Aquatic Studies Procedures Manual (1984) as follows:

- **Mainstem Habitat** consists of those portions of the Susitna River that normally convey streamflow throughout the year. Both single and multiple channel reaches are included in this habitat category. Groundwater and tributary inflow appear to be inconsequential contributors to the overall characteristics of mainstem habitat. Mainstem habitat is typically characterized by high water velocities and well armored streambeds. Substrates generally consist of boulder and cobble size materials with interstitial spaces filled with a grout-like mixture of small gravels and glacial sands. Suspended sediment concentrations and turbidity are high during summer due to the influence of glacial melt-water. Streamflows recede in early fall and the mainstem clears appreciably in October. An ice cover forms on the river in late November or December.

- **Side Channel Habitat** consists of those portions of the Susitna River that normally convey streamflow during the open water season but become appreciably dewatered during periods of low flow. Side channel habitat may exist either in well-defined overflow channels, or in poorly defined water courses flowing through partially submerged gravel bars and islands along the margins of the mainstem river. Side channel streambed elevations are typically lower than the mean monthly water surface elevations of the mainstem Susitna River observed during June, July and August. Side channel habitats are characterized by shallower depths, lower velocities and smaller streambed materials than the adjacent habitat of the mainstem river.
- **Side Slough Habitat** is located in spring fed overflow channels between the edge of the floodplain and the mainstem and side channels of the Susitna River and is usually separated from the mainstem and side channels by well vegetated bars. An exposed alluvial berm often separates the head of the slough from mainstem or side channel flows. The controlling streambed/streambank elevations at the upstream end of the side sloughs are slightly less than the water surface elevations of the mean monthly flows of the mainstem Susitna River observed for June, July, and August. At intermediate and low-flow periods, the side sloughs convey clear water from small tributaries and/or upwelling groundwater (ADF&G 1981c, 1982b). These clear water inflows are essential contributors to the existence of this habitat type. The water surface elevation of the Susitna River generally causes a backwater to extend well up into the slough from its lower end (ADF&G 1981c, 1982b). Even though this substantial backwater exists, the sloughs function hydraulically very much like small stream systems and several hundred feet of the slough channel often conveys water independent of mainstem backwater effects. At high flows the water surface elevation of the mainstem river is sufficient to overtop the upper end of the slough (ADF&G 1981c, 1982b). Surface water temperatures in the side sloughs during summer months are principally a function of air temperature, solar radiation, and the temperature of the local runoff.
- **Upland Slough Habitat** differs from the side slough habitat in that the upstream end of the slough is not interconnected with the surface waters of the mainstem Susitna River or its side channels. These sloughs are characterized by the presence of beaver dams and an accumulation of silt covering the substrate resulting from the absence of mainstem scouring flows.
- **Tributary Habitat** consists of the full complement of hydraulic and morphologic conditions that occur in the tributaries. Their seasonal streamflow, sediment, and thermal regimes reflect the integration of the hydrology, geology, and climate of the tributary drainage. The physical attributes of tributary habitat are not dependent on mainstem conditions.
- **Tributary Mouth Habitat** extends from the uppermost point in the tributary influenced by mainstem Susitna River or slough backwater effects to the downstream extent of the tributary plume which extends into the mainstem Susitna River or slough (ADF&G 1981c, 1982b).

The studies completed in the 1980s demonstrated that these habitat types are utilized to varying degrees and at different times by different species and life stages, with some species seeming to prefer certain habitat types over others (Dugan et al. 1984). Importantly, there will likely be both inter- and intra-habitat: flow response differences between and among these habitat types, and each will require separate investigation. Fortunately, many of the studies conducted in the 1980s were directed toward understanding those relationships (e.g., Marshall et al. 1984) and thus, there is already an existing pool of information and data that will be useful in the development of the 2013-2014 studies. The IFS will utilize these same designations, with some refinements or additions if necessary in consultation with the licensing participants to provide further clarity of habitat types.

The aquatic habitat specific models will be used to evaluate the effects of alternate Project operational scenarios on aquatic habitats in the Susitna River. One of the initial model development tasks will be the selection of detailed study sites and establishment of transects. These study sites and transects will be representative of habitat conditions based on channel morphology and major habitat features (See also Section 5.8 and 7.9). Study sites, transects and 2-D model mesh density will also be selected, as appropriate, to describe distinct habitat features that are important to aquatic biota (e.g., known areas of groundwater influence; spawning habitats, rearing habitats, etc.). In order to select these study sites and transects, specific information on both channel morphology and other important habitat features within the Susitna River will be needed. This information will allow AEA and licensing participants to decide on the final number and placement of study sites and data collection methods to best represent the system within the modeling platform.

The Habitat Mapping study component provides the critical information needed about the distribution of major and distinct habitat features in the study area to select these areas for the aquatic habitat specific models.

6.5.4.2.1. Proposed Methodology

The distribution and proportion of major habitat types in the Susitna River will be identified using analyses of bathymetric data, aerial photography, site-specific habitat and biological surveys (e.g., 1980s studies), and licensing participant knowledge of the Project area This effort will be coordinated with other riverine process and fish studies (See Sections 5.8- Geomorphology Study, 5.9 - Fluvial Geomorphology Study, and various fish studies designed to characterize the distribution, abundance and habitat characteristics of fish populations in the lower, middle and upper Susitna River (Sections 7.5, 7.6, 7.7, and 7.9). The location and distribution of distinct habitat types, areas of intense fish spawning activity/rearing will also be identified using available information and the results of site-specific surveys (See Section 7.6 – Fish Distribution and Abundance in the Middle and Lower Susitna River) and 7.9 – Characterization of Aquatic Habitats in the Susitna River with Potential to be Affected by the Susitna – Watana Hydroelectric Project). The specific tasks likely to be involved in this study component include the following (subject to revision and refinement following licensing participant review):

- Channel Typing – Use bathymetric data and aerial mapping techniques to determine the proportion of major channel types by reach and for the total Project area (Section 5.9).
- Wetted Width Calculations – Use Geographical Information System (GIS) analysis to calculate wetted widths of channel at selected locations representing different habitat types, under different flow conditions (this study).

- Wetted Surface Area Calculations – Use GIS analysis to calculate by reach the total wetted surface area of the Susitna River channel under different flow conditions (this study).
- Aquatic Habitat Mapping – Using aerial photography, and aerial videography, map existing main channels, side channels, side sloughs, upland sloughs, tributary mouths and other salient habitat features that are aligned with the Susitna River under different flow conditions. This work will rely on the analysis being completed by the 2012 Geomorphology studies. Mapping efforts will also incorporate areas of groundwater influence identified by groundwater studies (See Section 5.7), and any aquatic areas of particular importance identified as part of the water quality (See Section 5.5) and fish and aquatic biological studies (See Section 7).
- Interviews –Interview licensing participants, local biologists, anglers, guides and other personnel familiar with the Project area and identify areas supporting fish spawning/rearing and other areas of concentrated biological activity.
- Data Compilation – Compile information on channel type, width, depth, surface area, aquatic habitat types, and concentrated biological activity to determine the location and distribution of representative and distinct habitats.

6.5.4.2.2. Work Products

The Habitat Mapping study component will include the following work products:

- Map and tabular summary of channel types
- Map and tabular summary of macrohabitat types
- Map and tabular summary of areas of known groundwater influence and other areas of special ecological importance
- Tabular summary of wetted width and wetted surface area calculations
- Documentation of interviews

These work products and other results of the aquatic habitat mapping study will be compiled and presented in a draft and final study report. This work will rely in part on the analysis being completed by 2012 Geomorphology studies (Section 5.8), Groundwater studies (Section 5.7), and Characterization of Aquatic Habitats (Section 7.9).

6.5.4.3. Hydraulic Routing and Hydrologic Data Analysis

Project operations will likely store water during the snowmelt season (May through August), and release it during the winter (October through April) (AEA 2011). This would alter the seasonal hydrology in the Susitna River downstream from the dam (lower flows from May through August and higher flows from October through April). In addition to these seasonal changes, the Project may be operated in a load-following mode. Daily load-following operations will typically release higher volumes of water during peak-load hours, and lower volumes of water during off-peak hours. Flow fluctuations that originate at the powerhouse will travel downstream and attenuate, or dampen, as they travel downstream. The waves created by load-following operations impact the aquatic habitat of the Susitna River downstream from the powerhouse, especially along the margins of the river that are alternately wetted and dewatered (the varial zone). Assessment of potential Project-related impacts on downstream habitats will rely on information provided by the instream flow study (surface water flow routing during ice-free conditions), the geomorphology study (sediment supply/transport regime and channel morphology; Sections 5.8 and 5.9), ice processes study (surface water flow routing during the winter, ice growth and break up)(See Section 5.10), groundwater study (surface water/groundwater interactions)(See Section 5.7), and riparian instream flow botanical surveys (See Section 6.6).

6.5.4.3.1. Proposed Methodology

To analyze the impacts of alternate Project operational scenarios on habitats downstream of the Watana Dam site, a hydraulic routing model will be used to translate the effects of changes in flow associated with Project operations to downstream Susitna River locations; the hydraulic routing model will be extended downstream until the flow fluctuations are within the range of without-Project conditions.

Steady-state flow models assume that the change in velocity or flow at a given location is fairly uniform. Unsteady flow models are used when flows change rapidly and the consideration of time is an additional variable. One-dimensional unsteady flow hydraulic models are commonly used to route flow and stage fluctuations through rivers and reservoirs. Examples of public-domain computer models used to perform these types of processes include FEQ (USGS 1997), FLDWAV (U.S. National Weather Service 1998), UNET (U.S. Army Corps of Engineers 2001), and HEC-RAS (U.S. Army Corps of Engineers 2010a, 2010b, and 2010c). The HEC-RAS model has proven to be very robust under mixed flow conditions (subcritical and supercritical), as will be expected in the Susitna River. The HEC-RAS model also has the capability of automatically varying Manning's "n" with stage through the use of the equivalent roughness option. Another feature of HEC-RAS is the capability of varying Manning's "n" on a seasonal basis. The robust performance and flexibility of HEC-RAS make this model an appropriate choice for routing stage fluctuations downstream from the proposed Project dam under summer ice-free conditions. Under winter ice-covered conditions, the CRISSP1D (Comprehensive River Ice Simulation System Project) model can be used to route unsteady flows downstream through the Susitna River. CRISSP1D is a one-dimensional unsteady flow model that can be used to analyze water temperature, thermal ice transport processes, and ice cover breakup (Chen et al 2006). The seasonal timing of the transition from the HEC-RAS model to the CRISSP1D model and vice versa will vary from year-to-year and will depend on meteorological conditions.

The foundation of the IFS analyses rests with the development of the Susitna River Mainstem Flow Routing Models (HEC-RAS, CRISSP1D and/or other routing models) (MFRM) that will provide hourly flow and water surface elevation data at numerous locations longitudinally distributed throughout the length of the river extending from RM 184 downstream to RM 75 (about 23 miles downstream from the confluence with the Chulitna River). Two different flow routing models will be developed: a summer ice-free model (HEC-RAS); and a winter model to route flows under ice-covered conditions (CRISSP1D or equivalent).

The routing models will initially be developed based on approximately 100 transects and on gaging stations at approximately nine locations on the Susitna River that will be established and measured in 2012 as part of the IFS program. The hourly flow records from USGS gaging stations on the Susitna River will also be utilized to help develop the routing models. Depending on the initial results of the flow routing models, it may be necessary to add additional transects to improve the performance of the models between RM 75 and RM 184, and to possibly extend the models further downstream past RM 75.

During the development and calibration of the HEC-RAS model, the drainage areas of ungraged tributaries will be quantified and used to help estimate accretion flows to the Susitna River between locations where flows are measured. The flow estimates developed for ungaged tributaries will be refined based on flows measured in those tributaries in 2013 and 2014.

The gaging stations initially installed in 2012 will be maintained through 2013 and 2014 to help calibrate and validate the flow routing models and provide data supporting other studies. The gaging stations will be used to monitor stage and flow under summer ice-free conditions and to monitor water pressure under winter ice-covered conditions. Continuous measurement of water pressures during the 2012/2013 and the 2013/14 winter periods under ice-covered conditions will produce information different from open-water conditions. During partial ice cover, the pressure levels measured by the pressure transducers is affected by flow velocities, ice-cover roughness characteristics and other factors such as entrained ice in the water column. The pressure-head data are important for understanding groundwater/surface-water interactions.

Periodic winter discharge measurements will be completed at selected gaging stations in the winter, in coordination with USGS winter measurement programs, and will provide valuable information for understanding hydraulic conditions in the river during a season when groundwater plays a more prominent role in aquatic habitat functions. Winter flow measurements will also be used to help develop the CRISSP1D model (or equivalent).

Output from the flow routing models will provide the fundamental input data to a suite of habitat specific and riverine process specific models that will be used to describe how the existing flow regime relates to and has influenced various resource elements (e.g., salmonid spawning and rearing habitats and the accessibility to these habitats in the mainstem, side channels, sloughs, and tributary deltas, invertebrate habitat, sediment transport processes, ice dynamics, large woody debris (LWD), the health and composition of the riparian zone). These same models will likewise be used to evaluate resource responses to alternative Project operational scenarios, again via output from the routing models, including various baseload and load following alternatives, as appropriate. As an unsteady flow model, the routing models will be capable of providing flow and water surface elevation information at each location on an hourly basis and therefore Project effects on flow can be evaluated on multiple time steps (hourly, daily, and monthly) as necessary to evaluate different resource elements.

The study objective for the flow routing data collection effort is to provide input, calibration, and verification data for a river flow routing model extending from the proposed dam site to RM 75. Specific objectives are as follows:

- Survey cross sections to define channel topography and hydraulic controls between RM 75 and RM 184, excluding Devils Canyon (for safety reasons);
- Measure stage and discharge at each cross section during high and low flows, with the potential addition of an intermediate flow measurement;
- Measure the water surface slope during discharge measurements, and document the substrate type, groundcover, habitat type, and woody debris in the flood-prone area for the purposes of developing roughness estimates; and

- Install and operate approximately 8 to 10 water-level recording stations in collaboration with other studies.

The routing model will rely upon existing Susitna River hydrology as well as output from the ROM.

The assessment of hydrology data will include a summary of seasonal and long-term hydrologic characteristics for the river including daily, monthly and annual summaries, exceedance summaries and recurrence intervals of small and large floods. The analysis will utilize the Indicators of Hydrologic Alteration (IHA) and Range of Variability models developed by the Nature Conservancy (TNC 2005) for computing baseline hydrologic characteristics. The IHA/ROV models are components of an analytical software package typically used to characterize and compare complex river reach or river basin-scale hydrologic regimes from two or more periods of time, such as pre-dam and post-dam (The Nature Conservancy 2005).

The traditional approach developed by The Nature Conservancy utilizes average daily flows to compute a set of 33 parameters that may be categorized in 5 general groups of statistics:

- Magnitude of annual extremes (1-, 3-, 7-, 30- and 90-day maximum and minimum flows)
- Timing of annual extremes (Julian date of 1-day maximum and minimum)
- Magnitude of monthly conditions (variability of monthly means over analysis period)
- Frequency and duration of high and low flow pulses (defined by annual exceedance flows)
- Rate and frequency of changes in daily flows

In addition to the analyses using daily flow records, modifications to the analysis package will be considered in consultation with licensing participants to utilize hourly data to evaluate the rate of change and range of daily flows:

- Minimum, maximum and mean daily flow hydrograph;
- Hourly rate of change for various event types (ramping; diurnal meltwater fluctuations; storm events);
- Annual or seasonal frequency of change rates; and
- Reservoir pool levels (annual and monthly extremes; daily stage change).

6.5.4.3.2. Work Products

The Hydraulic Routing and Hydrologic Data Analysis study component will include the following work products:

- Executable model of the Susitna River to route unsteady flows from the Watana Dam site downstream to the river reach where the influence of Project operations is dampened to within the range of natural stage fluctuations.
- Tabular summaries of selected IHA-type statistics.
- Summary charts to provide visual comparisons of selected hydrologic statistics to facilitate discussion of the effect of modeled future operational scenarios on the without-Project hydrologic regime.

These work products and other results of the hydraulic routing and hydrologic data analyses will be compiled and presented in a study report.

6.5.4.4. Habitat Suitability Criteria Development

Habitat suitability criteria and index curves have been utilized by natural resources scientists for over two decades to assess the effects of habitat changes on biota. The abbreviation HSI is used in this document to refer to either Habitat Suitability Index (HSI) models or Habitat Suitability Criteria (HSC) curves, depending on the context. HSI models provide a quantitative relationship between numerous environmental variables and habitat suitability. An HSI model describes how well each habitat variable individually and collectively meets the habitat requirements of the target species and lifestage, under the structure of Habitat Evaluation Procedures (USFWS 1980). Alternatively, HSC are designed for use in the Instream Flow Incremental Methodology to quantify changes in habitat under various flow regimes (Bovee et al. 1998). HSC describes the instream suitability of habitat variables related only to stream hydraulics and channel structure. Both HSC and HSI models are scaled to produce an index between 0 (unsuitable habitat) and 1 (optimal habitat). Both models and habitat index curves are hypotheses of species-habitat relationships and are intended to provide indicators of habitat change, not to directly quantify or predict the abundance of target organisms. For the Susitna-Watana Hydroelectric Project aquatic habitat studies, HSC (i.e., depth, velocity and substrate/cover) and HSI (i.e., turbidity, duration of inundation and dewatering) models will be integrated to analyze the effects of alternate operational scenarios.

HSC/HSI curves represent an assumed functional relationship between an independent variable, such as depth, velocity, substrate, groundwater, turbidity, etc., and the response of a species life stage to a gradient of the independent variable (suitability). In traditional instream flow studies, HSC curves for depth, velocity, substrate and/or cover are combined in a multiplicative fashion to rate the suitability of discrete areas of a stream for use by a species and life stage of interest. HSC curves translate hydraulic and channel characteristics into measures of overall habitat suitability in the form of weighted usable area (WUA). Depending on the extent of data available, HSC curves can be developed from the literature, or from physical and hydraulic measurements made in the field in areas used by the species and life stages of interest (Bovee 1986). HSC curves for the Susitna-Watana Hydroelectric Project will be based on information consisting of (in order of preference): 1) new site specific data collected for selected target species and life stages (seasonally if possible (e.g., winter)); 2) existing site specific data collected from the Susitna River during the 1980s studies; 3) site specific data collected from other Alaska rivers and streams; and 4) HSC curves, data and information from other streams and systems outside of Alaska.

For use in the mainstem aquatic habitat model, HSC curves for some species (e.g., benthic macroinvertebrates, fry) will also need to be developed to describe the response of aquatic organisms to relatively short-term flow fluctuations. Some species/lifestages may exhibit similar use of depths and velocities; these species/lifestages may be grouped into guilds to facilitate evaluation of Project effects when considering multiple species and lifestages by seasons. The use of habitat guild curves may be appropriate where species utilization of particular habitat types overlap. HSC for off-channel habitats will include spawning/incubation, and fry/ juvenile rearing lifestages. In addition, specific criteria will be developed for evaluating the connectivity of mainstem flows to off-channel habitats including adult passage into and juvenile fish egress from side channel and side-slough habitats. This element will be coordinated with the Fish Passage/Barrier analysis study described in Section 7.13. Methods to develop HSC for benthic macroinvertebrate and algal habitats are described in the River Productivity study (Section 7.8), and development of HSC/HSI curves for fish is described in the following section.

6.5.4.4.1. Fish HSC/HSI Proposed Methodology

The fish community in the Susitna River is dominated by anadromous and non-anadromous salmonids, although numerous non-salmonid species are also present (See Table 6.5-3). Selection of specific target species for which HSC curves will need to be developed will be done in collaboration with agency and licensing participant representatives.

Development of HSC will involve the following steps.

- Selection of target species/lifestages. For planning purposes, target species are assumed to include Chinook, coho, chum and sockeye salmon, rainbow trout, arctic grayling, and Dolly Varden. Other species and lifestages will be identified in collaboration with agency and licensing participant personnel.
- Develop a Periodicity Table. A species and life stage periodicity table will be developed applicable to the different reaches of the Susitna River. The periodicity information will be used to define temporal and spatial changes in fish species distribution, identify time periods when various life stages (e.g., emergent fry) are present and potentially affected by Project operations, and assist in development of the aquatic habitat modeling efforts.
- Develop Draft HSC Curves. Draft HSC curves for target species and life stages will be developed using 1980s data as well as other available scientific literature for those species. Habitat suitability information will address fish responses to changes in depth, velocity, substrate, cover, groundwater, turbidity, indices of stranding and trapping (depressions and isolated pools), rates of colonization, stranding and trapping mortality, and connectivity to off-channel habitat types.
- Collect Site-Specific Habitat Suitability Information. For target species/lifestages, site-specific habitat suitability information will be collected using HSC-focused biotelemetry, spawning survey field efforts, and fish sampling studies supplemented by information from previous surveys. Habitat use information (water depth, velocity, substrate type, upwelling, turbidity, cover) will be collected at the location of each identified target fish and life stage. Methods will be used for collecting HSC information during seasonal conditions. If possible, a minimum of 100 habitat use observations will be collected for each target species life stage. However, the actual number of measurements targeted for each species and life stage will be based on a statistical analysis that considers variability and uncertainty. While information will be collected on all species and lifestages encountered, the locations, timing and methods of sampling efforts may target key species and lifestages identified in consultation with the technical workgroup,
- Habitat Utilization Frequency Histogram/ Habitat Preference. Histograms (i.e., bar chart) will be developed for each of the habitat parameters (e.g., depth, velocity, substrate, cover, groundwater use, etc.) using the site-specific field observations. The histogram developed using field observations will be compared to the draft HSC curves and literature-based HSC curves. Consideration will also be given to developing HSC curves that are not habitat availability biased (e.g., developed when/where a wide range of habitat availability exists).

- Licensing participant and Expert Panel. If deemed necessary and appropriate by AEA in consultation with licensing participants, a panel of licensing participants and regional experts (agency, Alaska Native entity, industry and university researchers) will be selected to review the HSC data and select final curve sets to be used in the aquatic habitat specific models.

6.5.4.4.2. Work Products

The final work product of this study effort will consist of HSC curves for the target fish species and life stages, and/or habitat guilds. Separate draft reports will be prepared that describe survey methods, results of 2012 review of 1980s HSC data, results of 2013 and 2014 sampling efforts, and discussion of recommendations for final HSC selection. A final report describing survey methods and results and the final selection of HSC curves will be prepared at the end of 2014.

6.5.4.5. Habitat-Specific Models Development

This study component develops the core structures of the aquatic habitat specific models. Development of these models will require careful evaluation of existing data and information as well as focused discussions with technical representatives from the licensing participants. These models will rely in part on information and technical analyses performed in other study components as a basis for developing model structures (e.g., Habitat Mapping; other riverine process studies). Physical habitat models are often used to evaluate alternative instream flow regimes in rivers (e.g., the Physical Habitat Simulation [PHABSIM] modeling approach developed by the U.S. Geological Survey; Bovee 1998, Waddle 2001). Methods available for assessing instream flow needs vary greatly in the issues addressed, their intended use, their underlying assumptions, and the intensity (and cost) of the effort required for the application. Many techniques, ranging from those designed for localized site or specific applications to those with more general utility have been used. The summary review reports of Wesche and Rechard (1980), Stalnaker and Arnette (1976), EA Engineering, Science and Technology (1986), the proceedings of the Symposium on Instream Flow Needs (Orsborn and Allman eds. 1976), Electric Power Research Institute (2000), and more recently the Instream Flow Council (Annear et al. 2004) provide more detailed information on specific methods. The methods proposed in the IFS include a combination of approaches that vary depending on habitat types (e.g., mainstem, side channel, slough, etc.) and the biological importance of those types, as well as the particular instream flow issue (e.g., connectivity/fish passage into the habitats, provision of suitable habitat conditions in the habitats, etc.).

6.5.4.5.1. General Approach – Proposed Methodology

Development of the models will involve completion of a series of tasks as noted below.

- Transect/Study Segment Selection – In coordination with licensing participants and riverine process study leads, use the results of the Habitat Mapping study component to select transects/study segments within each of the selected habitat types identified in the Susitna River to describe habitat conditions based on channel morphology and major habitat features. Additional habitat transects/segments will be selected to describe distinct habitat features such as groundwater areas, spawning and rearing habitats, overwintering habitats, distinct tributary mouths/deltas, and potential areas vulnerable to fish trapping/stranding. The transects used for defining the flow routing model will also be integrated into this analysis.

- Agency/Licensing participant Site Reconnaissance – Conduct a site reconnaissance with personnel from agencies, Alaska Native entities and other licensing participants to review river reaches, select candidates study sites and potential transect/study segment locations, and discuss options for model development. This reconnaissance trip has been scheduled for early-mid September and will encompass a 3-4 day effort. The first day will be an office based meeting during which specific methods will be reviewed and their applicability to addressing specific questions will be discussed, and the field itinerary reviewed. This will be followed by a 1-2 day field reconnaissance of representative habitat types including but not limited to mainstem channel, side channels, side sloughs, and upland sloughs. Stops will be made at each of these habitat types and assessment methods will be discussed, with the goal of reaching consensus on which methods will be applied for evaluating flow-habitat relationships. Participants will reconvene in the office on the final day of the trip to discuss observations and reach agreement on assessment methods.
- Model Selection: Field Surveys and Data Collection – Once study sites and transects/study segments have been identified, detailed field surveys will begin. These will be tailored based on habitat types to be measured and the selected models to be used. It is likely this will involve a combination of 1-D and 2-D modeling approaches as well as application of empirically based methods such as the RJHAB model applied in the 1980s studies (ADF&G 1984L). The RJHAB model was used to assess/model the effects of flow alterations on juvenile fish habitat for off-channel areas. At this time, it is anticipated that two-dimensional modeling will be applied to one or more representative reaches in the middle river. For this, a multi-stepped approach will be used so that after each field data collection effort, topographic data will be projected via computer analysis to identify locations requiring the collection of more data points. Table 6.5-2 provides a listing of potential models/methods that will be considered as part of the IFS. The most appropriate methods for selected study sites will be determined via careful review of site conditions and the underlying questions needing to be addressed. Methods selection will be done as a collaborative process within the IFS-TWG.

Regardless of specific method, field surveys will involve measurement of water velocities, water depths, water surface elevations, bottom profiles/topography, substrate characteristics, and other relevant data (e.g., upwelling, water temperature) under different flow conditions. One of the tasks for 2012 is to evaluate and determine specific flow targets for these field surveys.

6.5.4.5.2. Hydraulic – Habitat Model Integration

Susitna mainstem flow routing models (HEC-ResSim; HEC-RAS; CRISSP1D and/or other routing models) will provide hourly flow and water surface elevation data at numerous locations longitudinally distributed throughout the length of the river extending downstream from RM 184. Two different flow routing models will be developed: a summer ice-free model (HEC-RAS); and a winter model to route flows under ice-covered conditions (CRISSP1D). Output from the flow routing model will provide the fundamental input data to a suite of habitat specific and riverine process models that will be used to describe how the existing flow regime relates to and has influenced various resource elements (e.g., salmonid spawning and rearing habitats, invertebrate habitat, sediment transport processes, ice dynamics, large woody debris (LWD), the composition and structure of riparian floodplain vegetation). These same models will likewise be used to evaluate fish habitat responses to alternate Project operational scenarios. As an unsteady flow model, the routing model will be capable of providing flow and water surface elevations on an hourly basis and therefore Project effects on flow can be evaluated on multiple time steps (hourly, daily, monthly) as necessary to evaluate different resource elements.

Habitat-specific models represent the core analytical tools for assessing potential Project effects on fish and aquatic resources. These models will integrate the habitat-hydraulic modeling and biological information on the distribution, timing, abundance, and suitability of habitats to estimate a variety of metrics (habitat-flow responses, time series, habitat durations, passage conditions, varial zone areas and frequency of inundation and dewatering, incubation conditions [temperature]) that will be used to compare the effects of Project operational scenarios and support licensing decisions.

6.5.4.5.3. Habitat Weighted Usable Area/Habitat Metrics

The methods proposed in the IFS will include a combination of approaches depending on habitat types (e.g., mainstem, side channel, slough, etc.) and the biological importance of those types, as well as the particular instream flow issue (e.g., connectivity/fish passage into the habitats, provision of suitable habitat conditions in the habitats, etc.). During the 1980s studies, methods were designed to focus on both mainstem and off-channel habitats, although mainstem analysis was generally limited to near-shore areas. PHABSIM-based 1-D models, juvenile salmon rearing habitat models, fish passage models, and others were employed and will be considered as part of the IFS plan. As part of the 2013-2014 study efforts, more rigorous approaches and intensive analyses will be applied to habitats determined as representing especially important habitats for salmonid production. This will include both 1-D and 2-D hydraulic modeling that can be linked to habitat based models.

As part of the Geomorphology Modeling Study (Section 5.9), several 2-D models are being considered including the Bureau of Reclamation's SRH2-D, USACE's Adaptive Hydraulics ADH, the U.S. Geological Survey's (USGS) MD_SWMS suite, DHIs MIKE 21, and the suite of River2D models (see Section 5.9 for a description of various 2-D model attributes and references). The River2D model is a two-dimensional, depth-averaged finite-element hydrodynamic model developed at the University of Alberta that is capable of simulating complex, transcritical flow conditions. River2D also has the capability to assess fish habitat using the PHABSIM weighted-usable area approach (Bovee, 1982). Habitat suitability indices are input to the model and integrated with the hydraulic output to compute a weighted useable area at each node in the model domain. While evaluation of habitat indices directly incorporated into the River2D suite of models, other 2-D models are also complementary to habitat evaluations. Selection of potential 2-D models for fish and aquatics evaluations will be coordinated with other pertinent studies and the Licensing participants.

The models noted above will be used to translate changes in water surface elevation/flow at each of the measured transects/study segments into changes in depth, velocity, substrate, cover and other potential habitat (e.g., turbidity, upwelling). Linking this information with HSC/HSI curves will allow for translation of changes in hydraulic conditions resulting from Project operations into indices of habitat suitability. This will allow for the quantification of habitat areas containing suitable habitat indices for target species and life stages of interest for baseline conditions and alternate operational scenarios.

In response to the effect of potential load-following operations, habitat modeling using weighted usable area indices may need to be developed using both daily and hourly time steps. Evaluating the effects of changes in habitat conditions on an hourly basis may require additional habitat-specific models such as effective habitat and varial zone modeling.

6.5.4.5.4. Effective Habitat and Varial Zone Modeling

The risk of salmonid redd dewatering and scour will be assessed by developing an effective spawning/incubation model. Spawning/incubation analyses will be based on identifying potential use of a small, discrete channel area (cell) by spawning salmonids on an hourly basis and then tracking that cell through the subsequent egg and alevin incubation periods to determine whether that cell was subject to dewatering or scour. Within each cell, the maximum and minimum stage for spawning to occur will be identified based on the range of flow depths and velocities between those two stages. Use of that cell by spawning fish is assumed to occur if substrate conditions are suitable and habitat suitability indices for both depth and velocity are within an acceptable range. HSC/HSI information used to develop the effective spawning/incubation model will be developed in consultation with the licensing participants as part of the previously described section on HSC development.

A varial zone habitat model will be developed to quantify the magnitude, frequency and duration of the channel area that may be exposed to inundation and dewatering. The varial zone analysis will be conducted by discrete portions of each of the habitat types (e.g., mainstem, side channel, sloughs) using an hourly time step integrated over a specified period that considers fluctuations in water surface elevations that occurred during the period. The varial zone is defined as the area between the high water surface elevation and the low water surface elevation for a given project operating range using a span of time periods reflective of the aquatic species and life stage of interest. The selection of time periods to define the upper and lower extent of the varial zone for the Project will be coordinated with licensing participants. However, for planning purposes, three time scales are being considered: 12 hours, 7 days and 30 days. A 12-hour time series may provide an indication of the effects of water level changes on aquatic biota that rapidly colonize a previously dewatered area. Salmonid fry and some benthic macroinvertebrate may rapidly recolonize or occupy a previously dewatered area when they are moving downstream from upstream areas during outmigration or a result of displacement from upstream areas. A 7-day time series may be used as an indicator of the risk of dewatering due to hourly and daily changes in load-following operations, such as weekday versus weekend generation. Some aquatic organisms may require several days to colonize an area, or the density of organisms may increase rapidly over the first several days of access to a previously dewatered area. A 30-day time series can be used as an indicator of the risk of dewatering associated with weekly to monthly changes in flow patterns, such as changes in minimum flow requirements or seasonal runoff. A complex assemblage of benthic macroinvertebrates may require weeks to months to become established along channel margins. Information on the rate of colonization, dewatering mortalities and conditions supporting suitable habitats for organisms of interest will be developed as part of the HSC/HSI study component. Figures 6.5-5 and 6.5-6 illustrate the concept of a varial zone and the framework for the varial zone model.

6.5.4.5.5. Fish Passage/Off-channel Connectivity

The extent to which mainstem flows dictate connectivity to off-channel habitats will be evaluated via development of models that consider the depth, velocity and substrate requirements of adult salmon upstream migrations as well as juvenile downstream movements. This analysis will be completed on a representative number of the different habitat types found in the Susitna River including side channels, side-sloughs, and upland sloughs. Candidate locations for this analysis will be identified during the 2012 Agency Field Reconnaissance trip scheduled for September. To the extent applicable, the analysis will utilize information and modeling results developed during the 1980s studies, but entirely new studies will be completed as a means to test the results of the earlier studies, as well as to apply new technologies in making this evaluation (e.g., possible application of 2-D modeling). This work will be closely coordinated with and linked to the Fish Barrier Analysis study described in Section 7.12 of this study plan.

6.5.4.5.6. Temporal Habitat Analyses

The hydraulic-routing and habitat models will be used to process output from the ROM. This will be done for each scenario and hydrologic period and will allow for the quantification of Project operation effects on:

- Habitat areas (for each habitat type – mainstem, side channel, slough, etc.) by species and life stage;
- Varial zone area;
- Effective spawning areas for fish species of interest (i.e., spawning sites remain wetted through egg hatching);
- Other riverine processes that will be the focus of the Geomorphology (Section 5.8 and 5.9), Water Quality (Section 5.5), and Ice Processes (Section 5.10) studies including mobilization and transport of sediments, channel form and function, water temperature regime, and ice formation and decay timing. The IFS studies will be closely linked with these studies and will incorporate various model outputs in providing a comprehensive evaluation of instream flow related effects on fish and aquatic biota and habitats.

The various indices of Project effects on aquatic habitats will be summarized and tabulated to allow ready comparison of the effects of alternative operational scenarios. It is anticipated that the varial zone and effective habitat analysis will be used as a primary indicator of the effects of operational scenarios related to relatively short-term flow alterations. Analyses of habitat area will be developed for each species and life stage of interest (or as combinations of species via habitat guilds), and the results will be used in part for identifying the spatial distribution of potential habitats. Each indicator of environmental effect will be tallied separately, and the relative importance of the effects of Project operations on various aquatic resources can be determined independently by interested parties.

6.5.4.5.7. Work Products

At a minimum, reports will be prepared at the end of each year of study that will describe the methods and results of the IFS components completed during that year. There will be other technical information prepared throughout the duration of the IFS including \ describing flow routing, fish and aquatics study site selection, HSC field methods, HSC and peridiocity development, habitat modeling, and habitat analyses.

6.5.5. Consistency with Generally Accepted Scientific Practice

The proposed IFS, including methodologies for data collection, analysis, modeling, field schedules, and study durations, is consistent with generally accepted practice in the scientific community. The study plans were collaboratively developed with technical experts representing the applicant, state and federal resource agencies, Alaska Native entities, non-government organizations and the public. Many of these technical experts have experience in multiple FERC licensing and relicensing proceedings. The IFS is consistent with common approaches used for other FERC proceedings and the IFS reference specific protocols and survey methodologies, as appropriate.

6.5.6. Schedule

The schedule for completing all components of the Mainstem Aquatic Habitat Model is provided in Table 6.5-4. Licensing participants will have opportunities for study coordination through regularly scheduled meetings, reports and, as needed, technical subcommittee meetings. Initial and Updated Study Reports will be issued in December 2013 and 2014, respectively. Reports are planned for preparation at the end of 2013 and 2014 for each of the study components. Workgroup meetings are planned to occur on at least a quarterly basis, and workgroup subcommittees will meet or have teleconferences as needed.

6.5.7. Level of Effort and Cost

Based on a review of study costs associated with similar efforts conducted at other hydropower projects, and in recognition of the size of the project and logistical challenges and costs associated with the remoteness of the site, study costs associated with the instream flow study are expected to be approximately $5,000,000 to $6,000,000. Estimated study costs are subject to review and revision as additional details are developed.

Portions of this study will be conducted in conjunction with water resource, geomorphology, water quality, operational modeling, and fisheries and aquatic resource studies; however, specific costs of those studies will be reflected in those individual study plans.

6.5.8. Literature Cited

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6.5.9. Tables

Table 6.5-1. Selected sites measured and models applied in the reach of the Susitna River extending below Devil Canyon to Chulitna River during the 1980s studies. Source Estes and Vincent-Lang (1984). Mainstem flows that overtopped respective habitats are also displayed.

Site	Model Applied	Overtopping Discharge (cfs)
Lower side channel 11	IFG-2	5,000
Side channel 10A	RJHAB	9,000
Side channel 21	IFG-4	9,000
Upper side channel 11	IFG-4	13,000
Slough 9	IFG-4	16,000
Slough 21	IFG-4	18,000/23,000
Side channel 10	IFG-4	19,000
Slough 22	RJHAB	20,000
Whiskers Slough	RJHAB	22,000
Slough 8	RJHAB	25,000
Slough 8A	IFG-4	33,000
Slough 5	RJHAB	Upland slough
Slough 6A	RJHAB	Upland slough

Table 6.5-2. Assessment of physical and biological processes and potential habitat modeling techniques.

Physical & Biological Processes	Habitat Types			
	Mainstem	**Side Channel**	**Slough**	**Tributary Mouths**
Spawning	PHAB/VZM	PHAB	PHAB/HabMap	PHAB/RFR
Incubation	RFR/VZM	PHAB	PHAB/HabMap	PHAB/RFR
Juvenile Rearing	PHAB/RFR	PHAB	PHAB/HabMap	PHAB/RFR
Adult Holding	RFR	RFR	PHAB/HabMap	PHAB/RFR
Macroinvertebrates	VZM/WP	VZM/WP	PHAB/HabMap/WP	NA
Standing/Trapping	VZM	VZM	VZM/WP	VZM/WP
Upwelling/Downwelling	FLIR	HabMap/FLIR	HabMap/FLIR	HabMap/FLIR
Temperature	WQ	WQ	WQ	WQ
Ice Formation	IceProcesses/WQ/RFR	IceProcesses/WQ/RFR	HabMap/Open leads	NA

Notes:

1. PHAB-Physical Habitat Simulation Modeling (1D, 2D, and empirical); VZM-Effective Spawning and Incubation/Varial Zone Modeling; RFR-River Flow Routing Modeling; FLIR - Forward-looking Infrared Imaging; HabMap-Surface Area Mapping; WQ-Water Quality Modeling; WP-Wetted Perimeter Modeling.

Table 6.5-3. Common names, scientific names, life history strategies, and habitat use of fish species within the lower, middle, and upper Susitna River, based on sampling during the 1980s (from HDR 2011).

Common Name	Scientific Name	Life History	Susitna Usage
Arctic grayling	*Thymallus arcticus*	F	O, R, P
Dolly Varden	*Salvelinus malma*	A,F	O, P
Humpback whitefish	*Coregonus pidschian*	A,F	O, R, P
Round whitefish	*Prosopium cylindraceum*	F	O, M2, P
Burbot	*Lota lota*	F	O, R, P
Longnose sucker	*Catostomus catostomus*	F	R, P
Sculpin	*Cottid spp.*	M1, F	P
Eulachon	*Thaleichthys pacificus*	A	M2, S
Bering cisco	*Coregonus laurettae*	A	M2, S
Threespine stickleback	*Gasterosteus aculeatus*	A,F	M2, S, R, P
Arctic lamprey	*Lethenteron japonicum*	A,F	O, M2, R, P
Chinook salmon	*Oncorhynchus tshawytscha*	A	M2, R
Coho salmon	*Oncorhynchus kisutch*	A	M2, S, R
Chum salmon	*Oncorhynchus keta*	A	M2, S
Pink salmon	*Oncorhynchus gorbuscha*	A	M2
Sockeye salmon	*Oncorhynchus nerka*	A	M2, S
Rainbow trout	*Oncorhynchus mykiss*	F	O, M2, P
Northern pike	*Esox lucius*	F	P
Lake trout	*Salvelinus namaycush*	F	U
Pacific lamprey	*Lampetra tridentata*	A,F	U
Alaska blackfish	*Dallia pectoralis*	F	U

Notes:

A = anadromous
M1 = marine
F = freshwater
O=overwintering
R=rearing
P=present
M2 = migration
S=spawning
U=unknown

Table 6.5-4. Schedule for development of all aquatic habitat components of the Instream Flow Study.

Activity	2012				2013				2014				2015			
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4Q	1 Q	2 Q	3 Q	4Q
Finalize Study Plan		---	---	--●--												
Agency Licensing participant Site Visit			---▲--													
Study Site Selection (mainstem, slough, side channels, etc.)			---▲--	---●												
Review of 1980s Data and Information		---	---	---●												
Model Selection by habitat type (1-D, 2-D, mapping, etc.)			---	---●												
Hydraulic Routing: data collection and reporting		---	---	---●	---	---	---	---●	---	---	---	---●				
Hydraulic Routing: develop executable model			---	---●	---	---	---	---●	---	---	---	---●				
HSC/Periodicity Fish: Review literature and 1980s reports			---	---●	---	---	---	---●	---	---	---	---●				
HSC Fish: Field data collection (summer, fall, winter) (both years)			▲-	---▲--	---	--▲--	--▲--	--▲--	●---	--▲--	--▲--	---●				
Coordinate Habitat Mapping (GIS, aerial videography, aerial photography)		---	---	---●	---	---	---	---●								
Habitat Surveys (side channels, sloughs, mainstem)					---	---	--▲--	---●	---	--▲--	--▲--	---●				
Collect Physical and Hydraulic Data					---	--▲--	▲--▲	---●	---	▲--▲	▲---	---●				
Coordinate groundwater/surface flow models				---	---	---	---	---●	---	---	---	---●				
Hydraulic Model Integration and Calibration							---	---●	---	---	---	---●				
Varial Zone Model and Downramping Analysis							---	---●	---	---	---	---●				
Habitat Modeling							---	---●	---	---	---	---●				
Alternate Scenario Post-Processing											---	---●	---	---		
Reporting				●	---	---	---	---●	---	---	---	---●	---	---		
License Application Support											---	---	---●	---●		

Notes:

▲ = field activity
● = reporting
--- = activity

6.5.10. Figures

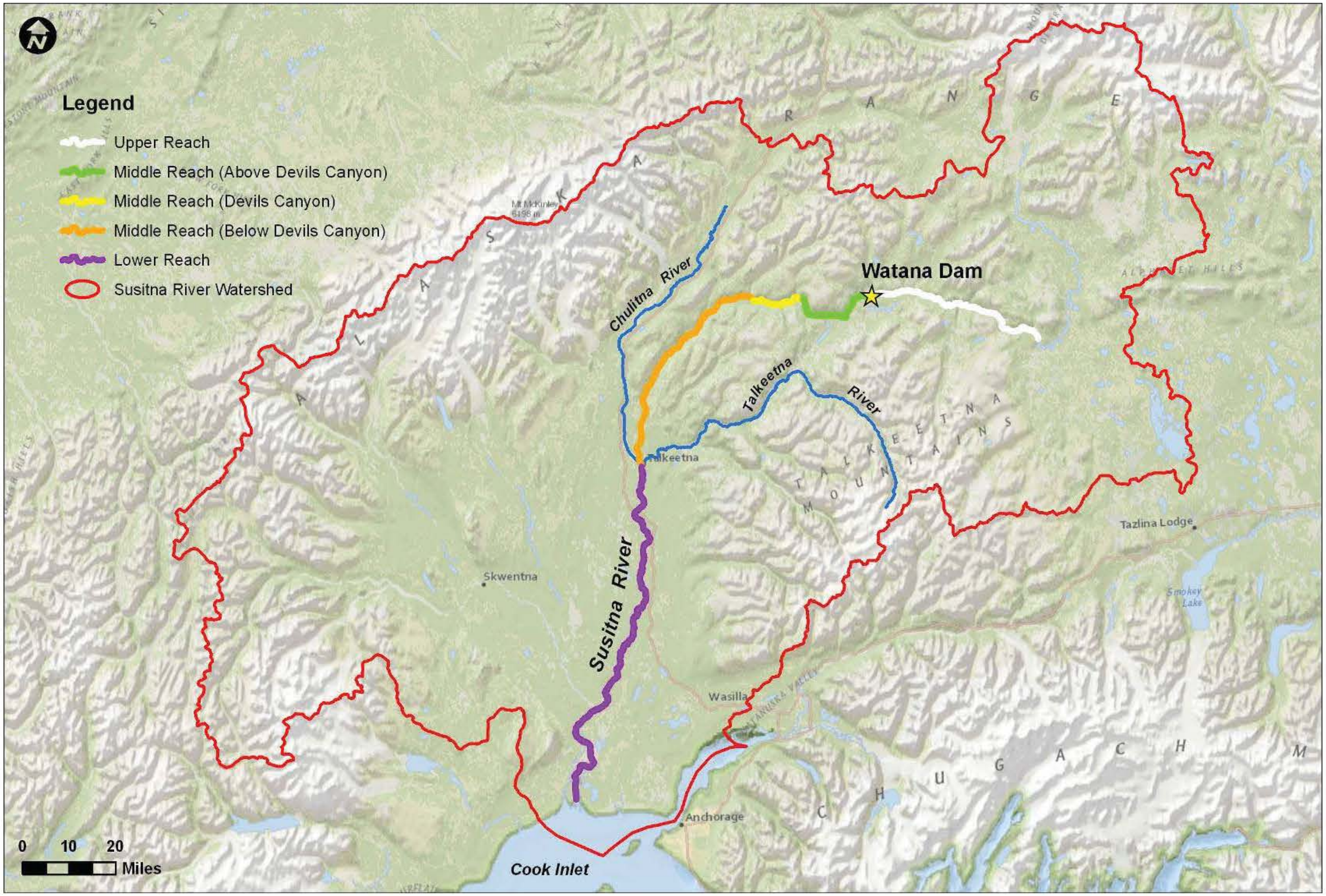

Figure 6.5-1. Map of the Susitna River influenced by Susitna-Watana Hydroelectric Project.

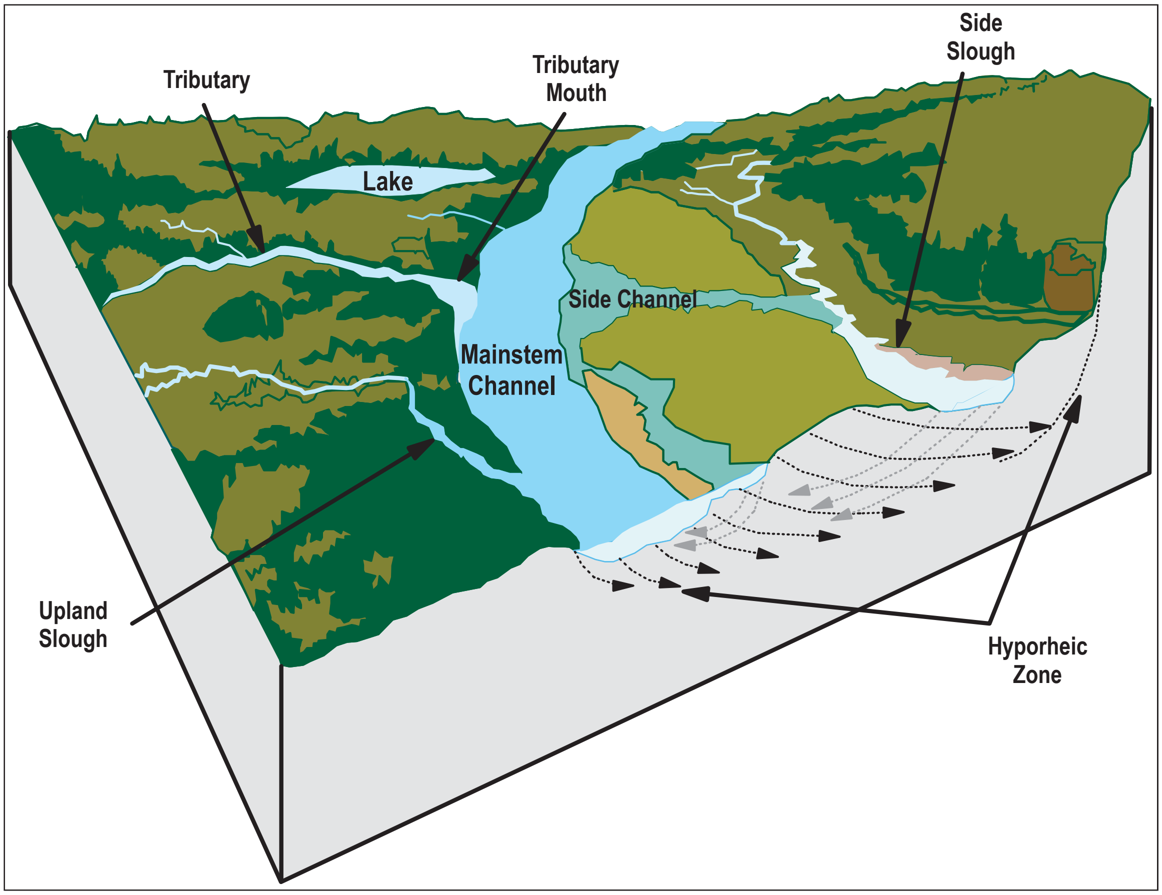

Figure 6.5-2. Habitat types identified in the middle reach of the Susitna River during the 1980s studies (adapted from ADF&G 1983, Trihey 1982).

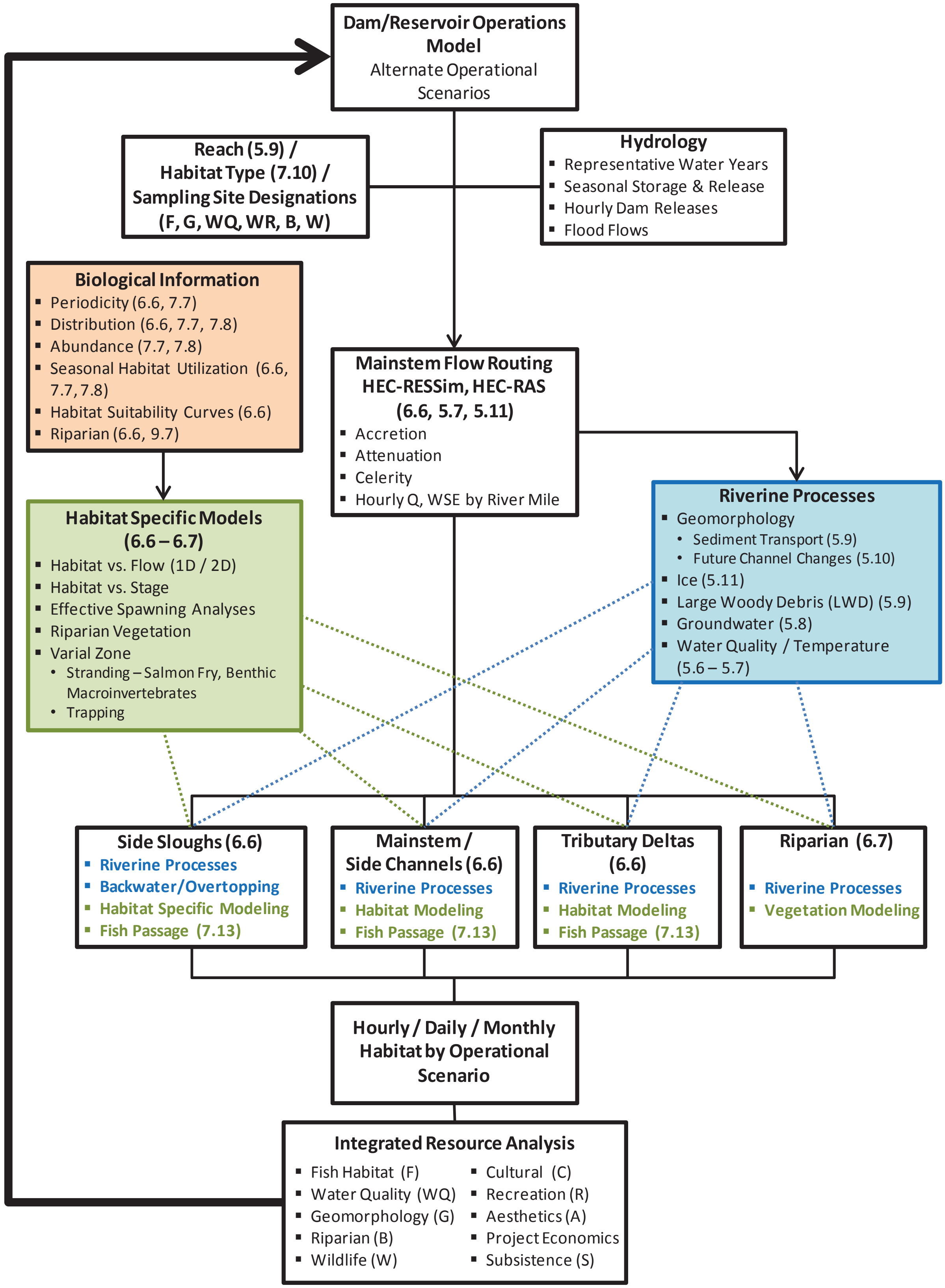

Figure 6.5-3. Conceptual framework for the Susitna –Watana Instream Flow Study depicting linkages between habitat specific models and riverine processes that will lead to an integrated resource analysis.

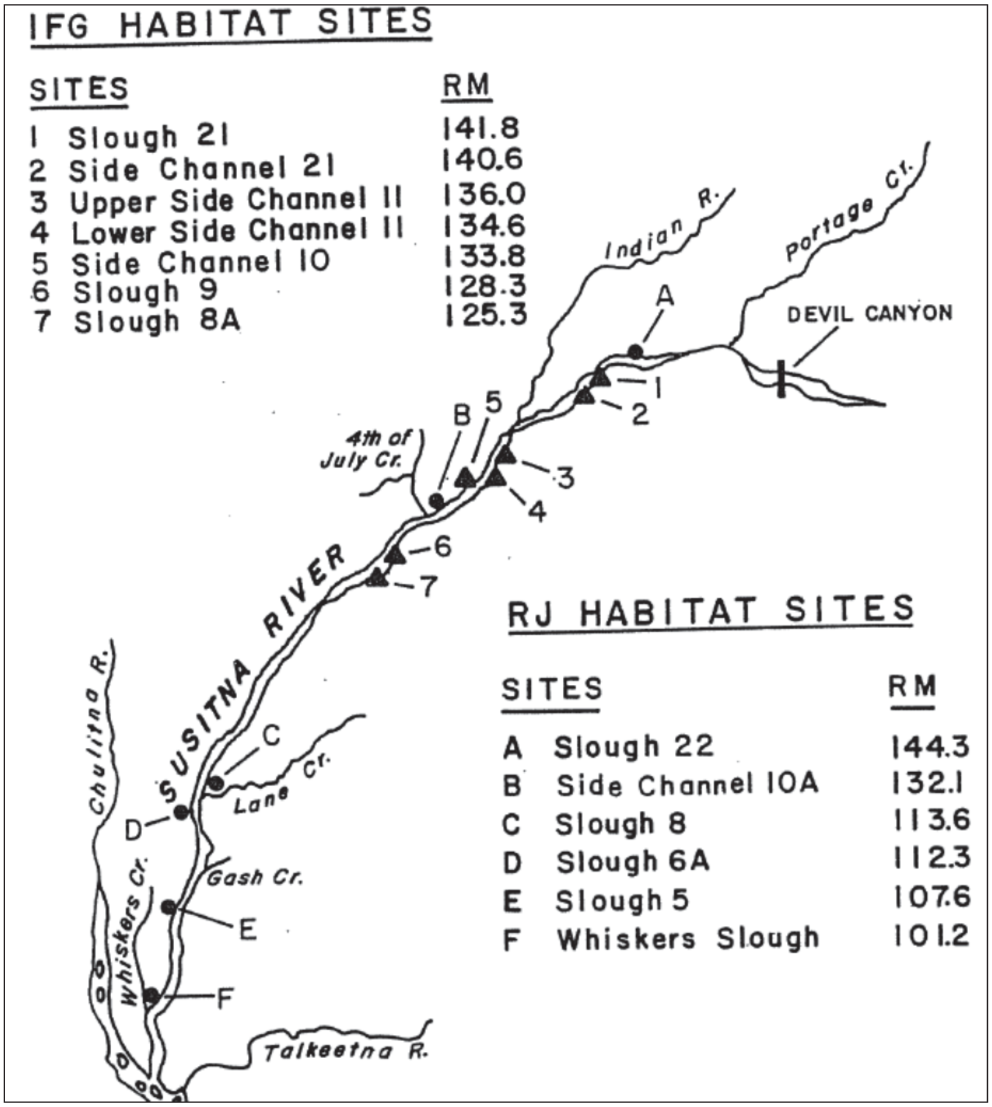

Figure 6.5-4. Location of sloughs and side channels modeled during 1980s studies. Source Estes and Vincent-Lang (1984).

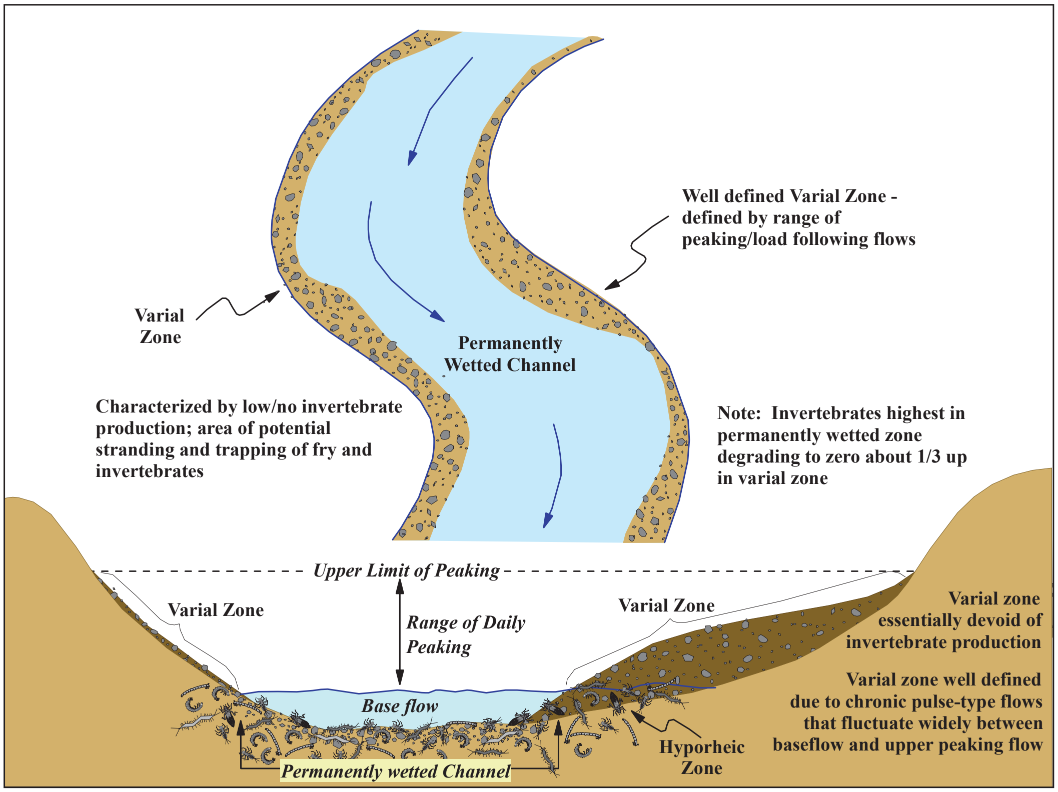

Figure 6.5-5. Schematic diagram illustrating the formation of a varial zone within a river channel.

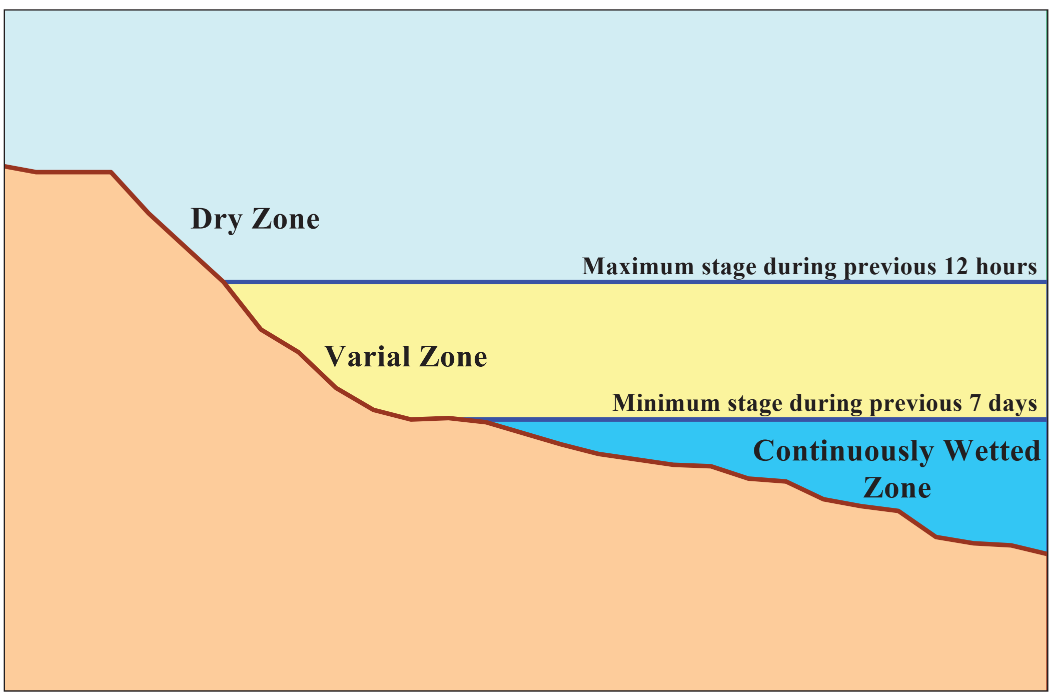

Figure 6.5-6. Conceptual framework of the varial zone model.

6.6. Riparian Instream Flow Study

6.6.1. General Description of the Proposed Study

6.6.1.1. Focus of Riparian IFS

The 2013-2014 Riparian IFS is directed toward providing a physical and vegetation process modeling approach to predicting potential impacts to downstream riparian floodplain vegetation from modification of natural Susitna River flow, sediment, and ice processes regimes resulting from Project operational flows. The focus of much of this work will be on establishing a set of analytical tools/models based on the best available science, information and data that can be used for defining both baseline conditions; i.e., how Project area riparian floodplain vegetation is currently functioning under existing natural flow conditions, and how floodplain plant communities will respond to various alternative Project operations.

Riparian Instream Flow Study objectives are to:

1. Synthesize the 1980s riparian vegetation study information and evaluate the applicability of the studies to the current Project;
2. Select riparian IFS intensive study sites in coordination with the Botanical Riparian Study 2012 field surveys and Instream Flow, Geomorphology, and Ice Processes Studies;
3. Map and measure riparian study reach riparian floodplain vegetation;
4. Develop a physical processes model−geomorphology and ice processes;
5. Develop a groundwater / surface water interaction model of shallow floodplain aquifer and riparian plant community relationships.
6. Develop a cottonwood and willow seed dispersal, hydrology, and Susitna River climate synchrony model;
7. Develop riparian floodplain plant community succession models and riparian vegetation-flow response guild models;
8. Develop scaling model of physical and riparian floodplain vegetation processes from intensive study reach to riverine / riparian process domains throughout the Project study area;
9. Provide riparian vegetation model output for analyzing the Project operational effects on riparian floodplain vegetation aquatic and riparian/wildlife habitat;
10. Coordinate groundwater / surface-water riparian floodplain vegetation modeling with evaluation of potential operational impacts to shallow groundwater well users (see Groundwater-Related Aquatic Habitat Study).

6.6.1.2. Riparian IFS Analytical Framework

Figure 6.5-3 depicts the overall analytical framework of the Instream Flow Studies commencing with the Reservoir Operations Model (ROM) that will be used to generate alternative operational scenarios under different hydroregimes. The ROM will provide the input data that will be used to predict hourly flow and water surface elevation data at multiple points downstream, taking into account accretion and flow attenuation. A series of biological and riverine process studies will be completed (other studies) to supplement the information collected in the 1980s as necessary to define reliable relationships between mainstem flow and riverine processes and biological resources. This will result in development of a series of flow sensitive models (e.g., models of selected anadromous and resident fish habitats by species and life stage, models to describe invertebrate habitats, temperature model, ice model, sediment transport model, turbidity model, large woody debris (LWD) recruitment model, riparian vegetation, others) that will be able to translate effects of alternative Project operations on the respective processes and biological resources. These resource and process effects will be location and habitat specific (e.g., responses are expected to be different in side sloughs versus mainstem versus side channel versus tributary delta versus riparian habitats) but there will also be a cumulative effect that translates throughout the entire length of the Susitna River. Different Project operations will likely affect different habitats and processes differently, both spatially and temporally. The habitat and process models will therefore be spatially discrete (e.g., by site, reach) and yet able to be integrated to allow for a holistic evaluation of each alternative operational scenario. This will allow for an Integrated Resource Analysis of separate operational scenarios that includes each resource element, the results of which can serve in a feedback capacity leading to new or modifications of existing scenarios.

The Riparian ISF Study is focused on integrating hydraulic models (HEC-RAS), geomorphic process models, ice processes models (ice formation, breakup and floodplain scour) and a groundwater / surface water interaction model, to generate a hydrogeomorphic modeling approach that will model the physical floodplain boundary conditions controlling the recruitment, establishment and maintenance of characteristic riparian floodplain plant communities. These models represent the core tools that will be used for assessing changes in riparian floodplain vegetation habitat and riparian plant community composition and spatial distribution under alternative Project operational scenarios.

6.6.2. Existing Information and Need for Additional Information

Information for the study area includes, but is not limited to, recent and historic aerial photography; riparian vegetation surveys and characterizations from recent and early 1980s studies; and riparian vegetation succession conceptual models developed from the 1980s data as part of the original Susitna Hydroelectric Project (SHP) Phase I vegetation mapping studies conducted along the Susitna River from the downstream end of Devils Canyon to Talkeetna, and the vegetation succession studies conducted in the Susitna River floodplain between Gold Creek, and the Deshka River (McKendrick et al. 1982, UAFAFES 1985). The riparian sites visited in the 1980s studies were resampled in 1992–1993 (Collins and Helm 1997, Helm and Collins 1997). Of primary importance to the Riparian Study is the previous vegetation mapping and successional dynamics studies by McKendrick et al. (1982), Collins and Helm (1997), and Helm and Collins (1997). These previous works will serve as a baseline for developing a stratified sampling protocol for both the Instream Flow Riparian and Botanical Riparian Study vegetation surveys. The riparian study modeling efforts will build upon the Collins and Helm (1997) riparian vegetation succession conceptual model (Figure 6.6-1)

Although substantial data and information concerning riparian vegetation were collected in the 1980s, those data are approximately 30 years old and therefore additional information needs to be collected to provide a contemporary understanding of the baseline riparian conditions existing in the Susitna River. Moreover, the previous studies (McKendrick et al. 1982; Collins and Helm 1997; Helm and Collins1997) were largely descriptive of riparian vegetation composition, structure and forest succession, and as such, they do not provide an analytical framework sufficient for assessing potential impacts to riparian vegetation that may result from Susitna-Watana Dam operations, nor do they provide the ability to model and develop potential flow mitigation measures. In addition, the configuration and proposed operations of the Project have changed and must be evaluated within the context of the existing environmental setting. This includes consideration of potential load following effects on riparian ecosystems downstream of the Susitna-Watana Dam (including the lower river reach, as appropriate). Therefore, additional riparian studies are necessary to adequately address the effects of potential Project operations on the riparian floodplain plant communities.

6.6.3. Study Area

The study area includes the Susitna River active valley that would be affected by the operation of the Project downstream of Watana Dam. The active valley is the geographic area that is flooded with a frequency and duration corresponding with current unregulated conditions. The formal Riparian ISF study area will be determined by the 2012 flow routing modeling determination of the hydraulic extent of Project operational influence from the Watana Dam site down river. For purposes of this study, the study area has been preliminarily divided into the following four river segments (Figure 6.5-1):

- Middle Reach Upper Segment (Above Devils Canyon) – Susitna River from Watana Dam site to upper end of Devils Canyon (RM 184 to RM 163)
- Middle Reach Middle Segment (Devils Canyon) — Susitna River from upper to lower end of Devils Canyon (RM 163 to RM 150)
- Middle Reach Lower Segment (Below Devils Canyon) – Susitna River extending from below Devils Canyon to confluence of Chulitna and Talkeetna rivers (three rivers) (RM 150 to RM 98.5); this reach may require further division;
- Lower Reach — Susitna River extending below Talkeetna River to mouth (RM 98.5 to RM 0)

6.6.4. Study Methods

The overarching goal of the Riparian Instream Flow Study is to assess the response of downriver riparian vegetation to Project operational flow regime and to provide recommendations for Project operations that will mitigate potential impacts to riparian vegetation. The study will first develop a process-based model of riparian vegetation succession and dynamics driven by riverine hydrogeomorphic processes. The modeling approach will use geomorphic, hydraulic, ice process and groundwater /surface water interaction models coupled with riparian vegetation succession models based upon vegetation surveys and previous Susitna River riparian forest research (Helm and Collins 1997). Objectives of the modeling approach are to: (1) quantify riparian vegetation physical process relationships under the natural flow regime, (2) assess potential impacts to riparian vegetation resulting from proposed Project operational flow regime, and (3) provide data for development of potential mitigation measures.

6.6.4.1. Synthesis of Historic Susitna River Riparian Vegetation Studies, Supporting Physical Process Investigations, and Other Hydro-Project Riparian Vegetation Investigations

The goal of this study element is to review and synthesize historic Susitna River riparian vegetation studies within the context of physical process investigations conducted in the 1980's including ice processes, sediment transport, surface water / groundwater and herbivory. Other North American hydro-project studies of downriver floodplain vegetation response to hydroregulation will be incorporated into the review to develop a current state-of-the-science review and analysis of potential Project operational flow effects on Susitna River riparian floodplain vegetation.

The objectives of this study task are to:

1. Conduct a critical review of previous Susitna River floodplain vegetation studies;
2. Place potential Susitna River Project operational effects within context of other studied hydroregulated rivers in North America;

Methodology

A literature review and analysis will be conducted including:

1. Historic Susitna River riparian floodplain research, and
2. Research concerning effects of hydroproject operational flow regimes on down river floodplain vegetation.

Work Products

1. Report chapter or technical memorandum with annotated bibliography appendix.

6.6.4.2. Riparian Process Domain Delineation and Intensive Study Reach Selection

Floodplain plant communities within mountain river corridors are dynamic in that channel processes annually disturb floodplain vegetation resulting in a characteristic patchwork of floodplain vegetation composition, structure and ages reflecting time since most recent vegetation disturbance (Naiman et al 1998). Vegetation disturbance can be defined as those processes that remove or impact plant communities and soils. Riverine floodplain vegetation disturbance types found within the Susitna River Project area corridor include: channel migration (erosion and depositional processes), ice processes (shearing impacts, flooding and freezing), herbivory (beaver and moose), wind, and, to an infrequent extent, fire.

Process domains define specific geographic areas in which various geomorphic processes govern habitat attributes and dynamics (Montgomery 1999).Temporal and spatial variability of channel processes can be therefore be classified and mapped throughout a channel network allowing characterization of riparian process domains that have similar suite of floodplain disturbance types and processes. The results of the classification will be used in selecting the riparian intensive study site reaches in coordination with the geomorphology, instream flow and ice processes studies.

Riparian study reaches will be selected that represent the suite of geomorphic and ice processes identified to occur within specific riverine riparian process domains. Together with the 2012 geomorphology study, ice process study and riparian botanical surveys we will develop the riparian process domain characterization which we will be used to locate six or more intensive riparian study reaches to subsample all identified riparian process domains.

The objectives of the riparian process domain delineation and intensive study reach selection are to:

1. develop a riparian process domain stratification of the Project study; and
2. select a sub-sample of intensive study reaches for physical and vegetation modeling.

6.6.4.2.1. Methodology

Riparian process domains will be delineated based upon the results of 2012 Geomorphology and Ice Processes studies, inspection of historic aerial photography used in the Geomorphology Study, and 2012 riparian field studies. The Geomorphology study team is delineating and classifying geomorphically similar river segments and reaches. The Lower River (RM 0 to RM 98.5), the Middle River (RM 98.5 to RM 184) and the Upper River to the Maclaren River confluence (RM 184 to RM 260) will be delineated into large-scale geomorphic river segments (a few to many miles) with relatively homogeneous characteristics, including channel width, entrenchment, ratio, sinuosity, slope, geology/bed material, single/multiple channel, braiding index and hydrology (inflow from major tributaries) for the purposes of stratifying the river into study segments (2012 Geomorphology Study). Channel reaches will be further classified based upon both aerial photographic analysis, and results of a geomorphic reach reconnaissance survey. The results of the 2012 Ice Processes study will be used to delineate river segments and reaches in which ice processes are directly interacting with floodplain vegetation such as river reach and segments where ice dam formation is noted to occur.

Together, the results of the 2012 Botanical Riparian Survey, geomorphology study channel classification and 2012 ice processes study, will be used to delineate riparian process domains have been identified to have similar physical floodplain vegetation disturbance processes.

6.6.4.2.2. Work Products

1. A technical memorandum describing the approach and methodology used to develop the riparian process domain map and intensive study reach selection process.
2. Map of Susitna River riparian process domains and intensive study sites.

6.6.4.3. Intensive Study Reach Riparian Vegetation Mapping and Measurement

The objectives of the intensive study reach riparian vegetation mapping and measurement are to:

1. characterize and map riparian floodplain plant community types relative to underlying alluvial terrain;
2. map and characterize floodplain plant recruitment and establishment patterns; and

3. characterize and measure plant community composition, abundance, structure, and age; and provide data for development of riparian vegetation succession and riparian vegetation –flow response guild models.

The riparian instream flow vegetation mapping and measurement approach builds upon those measures developed for the Botanical Riparian Study.

6.6.4.3.1. Methodology

6.6.4.3.1.1. Remote Sensing

Georeferenced historic, 1980s, and current aerial photography will be used to map riparian plant communities at all intensive study reaches. Mapping of all riparian plant communities will be conducted in the Botanical Riparian Study by digitizing individual plant community polygons in an ARCMAP GIS environment. Remote vegetation mapping will provide base maps for field sampling design, geomorphic reach analyses, and vegetation succession analysis. Figure 6.6-2 is an example of an intensive study reach with typical floodplain plant community types. Aerial photographic mapping results will be provided to the geomorphology team for use in geomorphic reach analyses and modeling.

6.6.4.3.1.2. Intensive Plots

Data will be recorded digitally in the field using a standardized data entry form designed to link directly to a relational database. Study sites will be at a minimum 500 square meters (5,382 square feet) (forested) and 50 square meters (538 square feet) (non-forest) circular plots, although shape may vary depending on the shape of the vegetation stand being sampled. We will follow methods provided by McKendrick et al. (1982), Collins and Helm (1997), and Helm and Collins (1997). Data attributes collected in the field will include, at a minimum:

1. Geo-referenced plot locations (less than 10-foot [3-meter] accuracy);
2. Vegetation cover by species in each of 7 height categories (0.0-0.1 meter [0.0-0.3 foot], 0.1-0.4 meter [0.3-1.3 feet], 0.4-1 meter [1.3-3.3 feet], 1-2 meters [3.3-6.6 feet], 2-4 meters [6.6-13.1 feet], 4-8 meters [13.1-26.2 feet], 8-16 meters [26.2-52.5 feet], and greater than 16 meters [52.5 feet]) based on transect point counts;
3. Ages (cross section cuttings or cores) and height of dominant woody plants;
4. Density by size class (< 0.4 meter [1.3 feet], 0.4-2 meters [1.3-6.6 feet], 2-4 meters [6.6-13.1 feet] and less than 4 centimeters [1.6 inches] DBH (diameter breast height, 1.4 meters [4.6 feet]); less than 4 meters [13.1 feet] and greater than 4 centimeters [1.6 inches] DBH; and greater then 4 meters [13.1 feet] and less than 4 centimeters [1.6 inches] DBH) or other size or structure classes for browse evaluations;
5. Crown dominance for each species;
6. General environmental variables, including physiography, geomorphic unit, surface form, soil drainage, soil moisture, elevation, aspect, and slope
7. Shallow pits for soil and hydrology characterization, including depth of water above or below ground surface, depth to saturated soil, and soil stratigraphic profiles;
8. Topographic elevation will be surveyed and tied in to reach bench mark;

9. Phenological attributes for selected plant species;
10. Vegetation structure and composition to identify each polygon's cover types and vegetation community;
11. Evidence of vegetation and soil ice scour; and
12. Wildlife sign such as browse marks, nests, dens, droppings, singing birds, carcasses, tracks, burrows.

6.6.4.3.1.3. Dendrochronology

Each mapped woody species plant community, including seedlings, will be aged to determine year of origin to be used in historic analysis of vegetation recruitment hydroregime characteristics and to model floodplain turnover / disturbance rates using standard Dendrochronologic techniques (Fritts 1977).

Tree and/or shrub dendrochronologic samples will be taken with either an increment borer or by cutting the shrub or sapling stem and taking a section for laboratory analysis. Increment cores (two per tree) will be collected from each tree. For each tree, floodplain sediment will be excavated to uncover the stem root collar and depth of sediment aggradation will be measured for further age estimation. A sample of tree seedlings for each dominant species will be excavated, heights measured, stems sectioned at the rood collar and annual rings measured under a dissecting microscope. A regression analysis will be conducted to assess the relationship between stem diameter and seedling height. The results will be used to add additional years to trees to account for height of core sample above the root collar.

Cores will be taken as close to the ground surface as possible, generally 12 inches (30 centimeters) above ground surface. Total height of tree core sample above the root collar will be calculated and used to estimate additional years to estimate tree year of origin. Twenty cottonwood seedlings were excavated from floodplain seedling plots and sectioned to determine height / age relationship for seedlings up to one meter in height. This relationship was used to add additional years to each tree core sample based upon core height above root collar and seedling height age relationship.

Increment cores will be mounted on pieces of 1 inch by 2 inch wood and sanded with variable grades of sand paper following standard methods described in Fritts 1976. Ring width measurements will be made, and annual years counted, for both the tree cores and stump sections using a dissecting microscope. Individual trees will be cross-dated, if possible, using standard methods (Fritts 1976).

6.6.4.3.1.4. Seedling Recruitment Plots

Floodplain plant species recruitment patterns will be mapped, and detailed survey sampling of seedlings conducted, to characterize spatial and temporal patterns of plant recruitment. Seedling recruitment (alluvial terrain location and elevation), composition, abundance, age, substrate characteristics and elevation will be sampled at each intensive study reach.

First, a reconnaissance level survey of the study reach will be conducted mapping locations (GPS) of seedling recruitment within various plant community successional stages (e.g., willow stage, alder stage, poplar stage, spruce stage). Second, seedling recruitment patches will be sampled using a stratified random survey for plot locations within each seedling patch. Seedling composition, abundance and height will be sampled using 2-meter (6.6-foot) square plots. At each plot two to three seedlings will be excavated and rooting depth measured. Seedlings will be aged at the root collar in the laboratory and annual rings measured to provide seedling age. Substrate texture and depth to cobbles will be described and measured by excavating to one meter in depth or to cobble refusal layer. Results of seedling mapping and characterization will be used to assess both groundwater and surface water relationships using 1-D / 2-D and MODLFOW modeling.

6.6.4.3.1.5. Habitat Plots

Riparian vegetation mapping and sampling will follow protocols developed in coordination with the Botanical Riparian Study plan. Riparian habitats in this study will be mapped to the Level IV of the Alaska Vegetation Classification (Viereck et al. 1992) with adjustments, as needed, for early successional riparian stages following Helm and Collins (1997). An Integrated Terrain Unit (ITU) mapping approach will be used. The ITU approach is based on methodology developed for various Ecological Land Surveys (ELS) done throughout the state of Alaska over the past 15 years (e.g., Jorgenson et al. 2003). All sampling will occur in the growing season months of June, July, and August.

Field sampling locations will be stratified across the study area using a gradient-directed sampling scheme (Austin and Heyligers 1989) to sample the range of ecological conditions across the sites. Intensive sampling will be conducted along toposequences (transects) placed across the floodplain surface. We will use high-resolution aerial or satellite imagery to pre-determine transect locations in the office. Along each transect, 7-10 plots will be sampled, each in a distinct vegetation type or spectral signature identifiable on aerial photographs. Sample plot locations will be intuitively controlled by the field crew leader, be placed in homogenous patches of vegetation (approximately 1.2-acre [0.5-hectare], minimum area), and ecotones will be avoided. Plots will be spaced adequately to cover the entire transect and to avoid "pseudoreplication" of plots within a single transect (i.e., sampling the same or very similar vegetation and soils within the same transect). Plot locations will be pinpricked on aerial photographs/satellite imagery, and coordinates (including approximate elevations) will be obtained with Global Positioning System (GPS) receivers (accuracy plus or minus 16.4 feet [5 meters]). At each plot (approximately 33-foot [10-meter] radius), geology, hydrology, soil stratigraphy, soil chemistry and vegetation structure and cover will be described or measured (see below). Digital photos will be taken at plot locations, including landscape and ground cover view, and photos of the soil pit face. All field data will be collected on a handheld tablet PC for easy digital upload upon return to the office.

Geologic and surface-form variables that will be recorded include physiography, geomorphic unit, slope, aspect, surface form, and height of microrelief. Sample plot elevations will be surveyed relative to the active channel (unvegetated channel) / active floodplain (vegetated floodplain surface) and water surface at the time of the survey. Hydrologic variables measured include depth of water above or below ground surface, depth to saturated soil, pH, and electrical conductivity (EC). Ground surface variables include percent frost boils and surface fragments. Water-quality measurements (pH and EC) will be made using portable meters that are calibrated daily with standard solutions.

General soils data will be collected from shallow soil plugs/pits (approximately 16-20 inches [40-50 centimeters] deep) or cut banks at each plot. When frozen ground is encountered at less than or equal to 20 inches (50 centimeters deep), we will continue to dig for approximately 4 inches (10 centimeters) into the frozen ground to confirm the presence of ice structure or other evidence of permafrost. General soils data collected at each plot will include depth of surface organic matter, cumulative thickness of all organic horizons, percent coarse fragments, cumulative thickness of loess, depth to upper boundary of coarse fragments (greater than 15 percent by volume), temperature (°C) at 20 inches (50 centimeters), presence of cryoturbation, presence of effervescence using a dilute acid solution, and depth of thaw. When water is not present, EC and pH will be measured from a saturated soil paste. Soil texture will be assessed by hand texturing, using a 2 milimeter (0.1 inch) mesh sieve to remove coarse fragments. A single simplified texture (i.e., loamy, sandy, ashy, organic) will be assigned to characterize the dominant texture in the top 16 inches (40 centimeters) at each plot for ecotype classification.

Vegetation composition and structure data will be measured semi-quantitatively for all vascular and dominant non-vascular plant species, and several categories of non-vascular plants, including percent *Spagnum* species; percent feathermoss, and percent combined *Cladonia*/*Cladina* species. If cover is less than 10 percent or more than 90 percent, then cover of each species or category will be visually estimated to the nearest 1 percent; for cover of 10-90 percent, cover will be estimated to the nearest 5 percent. Isolated individuals or species with very low cover will be assigned a cover value of 0.1 percent. In forested stands, DBH, age (using increment borer or thin cross-section), and height will be recorded for one to two representative dominant trees in each plot. Total cover of each plant growth form (e.g., tall shrub, dwarf shrub, lichens) will be estimated independently of the cover estimates for individual species. Data will be cross-checked to ensure that the summed cover of individual species within a growth form category was comparable to the total cover estimated for that growth form.

Ice process floodplain vegetation interactions will be mapped and characterized at each intensive study reach. Measurements will include type of evidence (soil disturbance, tree / shrub abrasion, whole scale plant community removal due to scour), and elevation surveyed. Mapped ice impact locations and elevation will be utilized in ice processes modeling of spatial extent and elevational zone characterization of ice / vegetation interactions at each study reach.

6.6.4.3.2. Work Products

Technical memorandum will be developed summarizing riparian floodplain plant community sampling results. Detailed descriptions of riparian floodplain species composition, abundance, structure, age and environmental parameters will be presented in figures and tables. Temporal and spatial seedling recruitment patterns will be characterized, mapped and modeled relative to groundwater / surface water.

6.6.4.4. Physical Process Modeling−Geomorphology and Ice Processes

Development of the study approach to physical processes study design, modeling, and methods will be coordinated closely with the Instream Flow, Geomorphology, Ice Processes, Botanical Riparian, and Groundwater-Related Habitat Study Teams. The integrated physical modeling approach is based upon: (1) physical modeling studies of select intensive study reaches representative of Project Area riverine process domains (Montgomery 1999), (2) HEC-RAS modeling of river stage / discharge and floodplain inundation at the intensive study reaches, (3) geomorphic reach analyses, (4) ice processes modeling, (5) groundwater / surface water interaction modeling of floodplain shallow alluvial aquifer and surface water relationships using MODFLOW, and (6) spatially explicit survey, mapping and analysis of the riparian floodplain plant communities' composition, structure, and location throughout the study area (Botanical Riparian Study).

6.6.4.4.1. Geomorphology and Ice Processes Modeling of Floodplain Vegetation Physical Template

The results of geomorphic and ice processes analyses and modeling will be integrated with the Riparian IFS modeling. The physical modeling results will be combined with the groundwater / surface water interactions modeling to produce an integrated physical model of floodplain plant community recruitment and establishment floodplain environmental conditions within the Project study area.

Project operations will likely store water during the snowmelt season (May through August), and release it during the winter (October through April, AEA 2011). This would alter the seasonal hydrology in the Susitna River downstream from the dam (lower flows from May through August and higher flows from October through April). In addition to these seasonal changes, the Project may be operated in a load-following mode. The Project will also store all incoming coarse sediments (sand, gravel, cobble, and boulders). Impacts of both of these processes will attenuate downstream from the location of the proposed dam, as the Susitna receives flow and sediment from unregulated tributaries.

These two Project-related impacts will alter the downstream surface water hydrology, relative balance between sediment supply and sediment transport capacity, ice-related processes in the winter, and surface water/groundwater interactions. All of these physical processes have the potential to alter existing riparian floodplain conditions downstream from the Project site. Assessment of potential Project-related impacts on riparian habitat will rely on information provided by the instream flow study (surface water flow routing during ice-free conditions), the geomorphology study (sediment supply/transport regime and channel morphology), ice processes study (surface water flow routing during the winter, ice growth and break up), groundwater study (surface water/groundwater interactions), and riparian instream flow botanical surveys.

The frequency, duration, and seasonal timing of high flows that inundate the floodplain, create new depositional alluvial surfaces and recharge the groundwater system, have been shown throughout North American rivers to be in synchrony with the cottonwood and willow species seasonal seed dispersal and seedling recruitment (Mahoney and Rood 1998). Project impacts to these riparian processes will be assessed using surface water flow routing during ice-free conditions provided by the instream flow study based on current channel morphology. The Project also has the potential to alter the downstream longitudinal profile of channel bed elevation (scour or deposition), and to alter the channel dimensions (width and depth). These potential changes will be assessed in the geomorphology study, and provided to the instream flow study for surface water flow routing. Potential impacts of the Project on cottonwood recruitment will be assessed based on current morphology and estimated morphology after 50 years of operation.

In a river that meanders through a wide valley, erosion on one side of the channel will be balanced by deposition on the other side as the river migrates laterally. Disturbance to riparian habitat on the eroding bank will be balanced by opportunities for recruitment on the point bar. This type of geomorphic process maintains the characteristic range of floodplain vegetation age classes contributing to the diversity of floodplain vegetation composition and structure (Naiman et al 1998). The rate of channel migration may be impacted by Project operations with additional potential impacts on the riparian community. Potential Project effects on lateral channel migration and reworking of the floodplain will be provided by the geomorphology study.

Impacts of ice-related processes on riparian habitat typically occur during breakup when scour in the river and adjacent floodplain may occur, and when the ice can scrape trees in the floodplain and leave them scarred (Prowse and Culp 2003). During breakup, ice accumulation in meander bends can force meltwater to bypass the bend and scour a meander cutoff (Prowse and Culp 2003). The Project will likely increase flows in the river during the winter, and ice may form at higher elevations. These potential effects may alter conditions during breakup and potentially impact floodplain vegetation at higher elevations than currently occurs. Potential effects of the Project on ice formation and breakup will be provided by the ice processes study.

Riparian floodplain vegetation relies to a large extent on groundwater as a water source (Naiman et al 1998). Floodplain groundwater depths have been demonstrated to control floodplain plant community composition, species richness and structure (Henszey et al 2004; Baird et al 2005; Mouw et al 2009; Naiman et al 1998). Project operations will alter on a seasonal basis the flows in the Susitna River and on a shorter time scale flows associated with potential load-following operations.

The altered surface water flow regime in the Susitna River may interact with the groundwater in the adjacent floodplain affecting shallow floodplain groundwater levels. Surface water hydrographs from the summer ice-free flow routing model (instream flow study) and the winter ice model (ice processes study) will be used as input for a MODFLOW model to assess impacts to the floodplain groundwater regime.

Spatial mapping of botanical communities on the floodplain will be performed as part of the riparian instream flow botanical communities. This mapping will be an important component of the groundwater model because different botanical species will have different root depths and different potential evapotranspiration rates. If the groundwater regime changes, the spatial composition of botanical species on the floodplain may potentially be impacted by Project operations.

Final details of the geomorphology and ice processes modeling elements of the Riparian IFS design will be developed during 2012 as results of the 2012 studies are obtained.

The objectives of the geomorphology and ice processes modeling are to:

1. develop an integrated model of the geomorphic and ice processes generated floodplain vegetation physical template;
2. integrate riparian floodplain vegetation studies with the geomorphology and ice processes modeling; and
3. integrate groundwater / surface water interactions model with geomorphology and ice processes model of floodplain vegetation physical conditions;

6.6.4.4.1.1. Methodology

The results of the geomorphology channel classification, geomorphic reach analyses, sediment transport modeling and ice processes modeling will be integrated during 2012. Upon development of the geomorphology and ice processes study plans, the riparian floodplain vegetation physical processes model integration approach will be developed.

6.6.4.4.1.2. Work Products

Integrated geomorphology, ice processes and riparian vegetation model for the Project area at both the intensive study reach and riparian process domain scales.

6.6.4.5. Physical Process Modeling−Groundwater / Surface Water Interaction Study

A physical model of groundwater / surface water interactions will be developed for four to six intensive study reaches to model groundwater /surface water relationships (GW/SW) with floodplain plant communities. Developing conceptual model and numerical representations of the GW/SW interactions, coupled with important processes in the unsaturated zone will help evaluate natural variability in the Susitna River riparian floodplain plant communities, and assesses how various Project operations may potentially result in alterations of floodplain plant community types, as well as improve the understanding of what controlled fluctuations of flow conditions would result in minimal riparian changes.

Regional and local groundwater flow systems are important to floodplain riparian vegetation (Figure 6.6-3). Seasonal river stage fluctuations generate transient groundwater and surface-water (GW/SW) interactions at a local scale under and adjacent to the river, including side channels, side sloughs and upland sloughs (Figures 6.5-2 and 6.6-3). A typical system representing several types of surface-water features is shown in the intensive study reach schematic (Figure 6.6-2). This plan view shows both the potential orientation of main stem and side channel surface water features, along with typical riparian floodplain plant community types found in the middle river segments of the Susitna River. A schematic cross-section of a typical profile across the river floodplain from main channel through floodplain, secondary channel and adjacent hillslope is shown in Figure 6.6-4. This figure depicts the relative relationships between surface-water stage levels, groundwater levels, land-surface elevations, and riparian floodplain plant community types.

Developing conceptual model and numerical representations of the GW/SW interactions, coupled with important processes in the unsaturated zone will help evaluate natural variability in the Susitna River riparian zones, and how various Project operations would potentially result in alterations of floodplain plant community types, as well as improve the understanding of what Project operational fluctuations of flow conditions would result in minimal riparian changes.

6.6.4.5.1. Methodology

We will use MODFLOW (USGS 2005), the most widely used groundwater model in the U.S. and worldwide. Additionally, we will utilize RIP-ET (riparian−evapotranspiration MODFLOW package; Maddock et al 2012) developed to help better represent plant transpiration processes in the unsaturated zone to more accurately calculate evapotranspiration, separating out plant transpiration from evaporation processes.

The field study will require the installation of groundwater wells and shallow piezometers, water level data collection equipment, general meteorological stations for ET calculations and riparian vegetation sensors to help measure sap flow rates to determine transpiration flux rates (Figures 6.6-2 and 6.6-4). Most of this data-collection infrastructure will be installed in early spring/summer 2013. Installation may take several months in 2013 for field crews to install the necessary data infrastructure.

Wells near the river will be drilled to a depth estimated to be 10 feet below winter low water levels in the adjacent mainstem channel. As wells are drilled further away from the river, the maximum depth will be determined by the drilling equipment, but should extend to depths of 40 feet in typical sands and gravels. All wells will use 1.5-inch PVC screened across the water table and completed to a depth of at least 10 feet below estimated low water table elevations. Each of these wells will have the horizontal and vertical locations surveyed to project accuracy standards used for water level measurements. Each well will have a steel protective outer casing, with locking covers. The top of locking cover, top of cap and a notch point will be surveyed on the lip of the PVC casing. As drilling crews complete wells, they will drill borings for the installation of temperature profile strings. The borings will be in close proximity to the wells, but no closer than four feet to any well.

Well sensors will be installed including pressure transducers at surface-water gauging stations and the central met station (Figure 6.6-2). Soil pits will be excavated to record soil characteristics, install unfrozen moisture content sensors, and log root-zone characteristics. Sensors will be protected in flexible steel conduit and buried where practical to help reduce animal damage. The installation goals will be to install all measurement systems within a three week time frame so data collection can begin approximately early July 2013.

Wells and water-level observation points will be resurveyed as needed in 2013 and will be resurveyed following snowmelt in 2014. Frost jacking of wells is a common issue in arctic conditions. Survey control network will be setup so that subsequent surveying efforts can be quickly done by a two-person survey crew.

The data collection period will begin early July 2013 and continue through September 2014. This will include the fall 2013 winter transition period, winter 2013/14 conditions, spring 2014 and summer 2014. Physical weather and climate conditions are not the same from year to year, so data collected during summer 2013 cannot be combined with data from 2014.

6.6.4.5.2. Work Products

1. A series of cross-section groundwater models for each study cross-section (Figure 6.6-2) that can be used for flow scenario testing.
2. A plan view 3D groundwater model for each study cross-section (Figure 6.6-2) that can be used for flow scenario testing.
3. A set of aquifer properties for geologic units represented in each study area, determined by inverse groundwater modeling of pressure responses between the Susitna River and adjacent groundwater systems(s).
4. Calibration and validation data sets for development of future GW/SW interaction and riparian vegetation-flow response guild models

6.6.4.6. Synchrony of Seed Dispersal, Hydrology and Local Susitna River Valley Climate

Pioneer riparian tree and shrub species in snowmelt-driven rivers are adapted to seasonal spring peak flows for seed dispersal and concordant near surface floodplain groundwater conditions for seedling recruitment and establishment (Figure 6.6-5; Braatne et al. 1996, Mahoney and Rood 1998, Mouw 2012). The timing of snowmelt-spring flows, and tree and shrub seedling release and dispersal, is critical to successful establishment and maintenance of riparian floodplain forests (Figure 6.6-6; Braatne et al 1996, Mahoney and Rood 1998, Scott et al 1997). An empirical model, the "Recruitment Box Model" that captures cottonwood and willow flow response and recruitment requirements has been successfully demonstrated on rivers throughout North America (Figure 6.6-6; Mahoney and Rood 1998, Rood et al 2003). The model describes how seasonal flow pattern, associated river stage (elevation), and flow ramping are necessary for successful cottonwood and willow seedling establishment (Figures 6.6-5 and 6.6-6). We will develop a recruitment box model for balsam poplar and select willow species for the Susitna River. Alterations of peak flows due to dam operations may result in a loss of spring peak flows and associated floodplain groundwater conditions necessary to the dispersal and establishment of riparian trees and shrubs.

The objectives of the seed dispersal, hydrology and climate synchrony study are to:

1. measure cottonwood and select willow species seed dispersal timing,
2. model local Susitna River valley climate relative to cottonwood and willow seed dispersal.
3. develop a recruitment box model of seed dispersal timing, river flow regime and cottonwood and willow establishment.

6.6.4.6.1. Methodology

To evaluate the natural synchrony of balsam poplar (*Populus balsamifera*), and select willow species (*Salix* spp.), seed release and Susitna River natural flow regime we will: (1) conduct a two year survey of seed release of balsam poplar and select willow species, and (2) develop a 'degree-day' model for the onset of seed release relative to local temperature conditions using methods developed by Stella et al. (2006). The results of this study will identify flow regime timing conditions necessary to support riparian forest recruitment and establishment on the Susitna River.

Four floodplain sites near existing meteorological stations in the Middle and Lower Susitna (Figure 6.6-7) will be selected for balsam poplar and select willow species seed release surveys. At each site twenty dominant female balsam poplar trees and willow shrubs will be surveyed weekly during the months of June, July and first two weeks of August, 2013-2014. Seed release will be measured during each survey by counting open catkins for each tree or shrub. Floodplain riparian plant community characteristics will be sampled for each floodplain seed dispersal survey site using the riparian vegetation sampling techniques described in Section 6.7.4.2. Tree data and seed release timing will be analyzed using protocols developed by Stella et al (2006). At all field sites local air temperature measurements will be collected from adjacent weather monitoring stations. A degree-day model using seed release observations and continuous temperature records from the monitoring stations will be developed (Stella et al 2006).

A recruitment box model (Figure 6.6-6; Mahoney and Rood 1998, Rood et al 2003) will be developed to evaluate the potential effects of various proposed spring operational flows on cottonwood and willow recruitment and establishment. Cottonwood and willow timing of seed release and dispersal relative to natural spring peak flows is a critical element necessary for the successful recruitment and establishment of cottonwood and willow on the Susitna River floodplain.

6.6.4.6.2. Work Products

1. Degree-day model of peak seed release window using seed release observations and continuous temperature records from each sample site.
2. Recruitment box model of cottonwood and select willow species.
3. Model of peak runoff / seed release temporal synchrony for operational flow guidelines.

6.6.4.7. Riparian Floodplain Vegetation Succession Models and Riparian Vegetation-Flow Response Guilds

6.6.4.7.1. Riparian Floodplain Vegetation Succession Models

Riparian floodplain vegetation succession model development will build upon previous studies of riparian plant community succession conducted in the Susitna and Talkeetna Rivers (Helm and Collins 1997, Mouw et al 2009). The number of riparian successional models to be developed will depend upon the final riparian Project area delineation as defined by the results of hydrologic assessment of the extent of operational flow changes throughout the Project study area from the Dam site to Cook Inlet. For example, the Helm and Collins (1997) model of riparian vegetation succession focused upon the middle river section and three rivers confluence segments of the Susitna (Figure 6.5-1). Once the extent of potential hydroregime change throughout the study area is assessed, and riparian Project area defined, the number of vegetation succession models incorporating the range of riparian vegetation types seen from the estuarine environment to the Dam site will be determined. For example, Sitka spruce (*Picea sitchensis)* and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) occur within the lower estuarine reaches of the Susitna river, but these tree species do not extend geographically up river to the middle river segments. Therefore, riparian vegetation successional dynamics will vary throughout the Project study area and additional vegetation models will be developed to capture this variability once the extent of operational hydroregime influence is determined.

6.6.4.7.2. Riparian Vegetation-Flow Response Guilds

Criteria, metrics, indices will be developed for quantitatively describing riparian floodplain plant communities with varying natural flow regimes. These environmental flows will be used to develop riparian vegetation-flow response guilds (Merritt et al 2010). We will organize riparian plants into non-phylogenetic groupings of species with shared life history traits related to elements of the natural flow hydroregime, including: life history, reproductive strategy, morphology, adaptations to fluvial disturbance and adaptations to water availability (Merritt et al. 2010). Probabilistic response curves will be developed for select species, guilds and riparian plant community types. Development of a quantified relationship between individual riparian species, guilds and natural flow regime is the goal of the riparian Instream flow study. These riparian vegetation-flow response statistical relationships will enable a modeling of riparian vegetation response to operational flows and provide a defensible basis for recommended flow prescriptions necessary to protect riparian vegetation recruitment and establishment and riparian floodplain plant communities throughout the Project study area.

We will integrate the physical modeling and spatial mapping of riparian vegetation throughout the Project study area with results from the Botanical Riparian Study surveys to predict the extent and characteristics of riparian vegetation change under various simulated operational flows (Pearlstine et al. 1985).

The objectives of the intensive study reach riparian vegetation mapping and measurement are to

1. characterize and map riparian floodplain plant community types relative to underlying alluvial terrain;
2. map and characterize floodplain plant recruitment and establishment patterns;
3. characterize and measure plant community composition, abundance, structure, and age; and
4. provide data for development of riparian vegetation succession models.

6.6.4.7.3. Methodology

Results from the riparian sample surveys will be used to develop riparian floodplain vegetation successional models for the riparian plant community assemblages identified in the riparian botanical survey and intensive riparian instream flow surveys. Riparian vegetation successional models will be developed building on the models of Helm and Collins (1997) and Mouw (2009). Botanical riparian survey data and riparian IFS data will be analyzed and quantitative descriptions of plant community seral stages developed. The number of vegetation succession models is dependent upon the extent of the final riparian Project area as determined by 2012 hydrologic routing model study of the extent of Project operational influence in the Project area.

Riparian vegetation−flow response guilds (plant functional groups) will be developed from the Botanical and Riparian IFS survey data following protocols developed in Merritt et al. (2010). Riparian vegetation−flow response guilds will be used with the physical process modeling approach to analyze riparian vegetation flow regime relationships in the Project area and in modeling the potential impacts to riparian floodplain vegetation due to Project operations.

6.6.4.7.4. Work Products

1. Riparian vegetation successional models for all distinct riparian plant communities identified in the Botanical Riparian and Riparian IFS studies.
2. Development of riparian vegetation-flow response guilds from riparian botanical surveys and physical modeling.

6.6.4.8. Physical and Vegetation Model Scaling From Intensive Study Reach to Riverine / Riparian Process Domains

The results of the intensive reach study modeling will be scaled-up to the riverine / riparian process domains. The goal is to model both natural riparian flow-response guilds and natural

Susitna River physical process regimes as well as to evaluate Project operational impacts to floodplain vegetation and riparian ecosystem processes throughout the entire Project study area. Recent developments in GIS, LiDAR driven digital terrain models (DEMs), and geo-spatial analytical tools (ARCMAP, ESRI) has provided modelers the capacity to use the results of reach scale analyses to scale-up to larger geospatially defined areas or domains. Modeling riparian vegetation response, over a 185 mile Susitna River valley, to alterations of natural flow regimes, is inherently a geospatial analytical problem. Current state-of-the-art and science practice will be utilized to integrate modeling of physical processes (HEC-RAS, MODFLOW), riparian vegetation-flow response guilds with GIS geospatial analysis and display (ARCMAP, HEC-GEORAS).

The objectives of the intensive reach scaling model are to:

1. scale-up reach scale modeling results to riverine / riparian process domains;
2. assess potential impacts of Project operational flows on down river floodplain plant communities and ecosystem processes; and
3. provide input to Project operations.

6.6.4.8.1. Proposed Methodology

The results of the riparian process domain delineation, intensive study reach physical process modeling and riparian vegetation model development will be used with the results of the Botanical Riparian Survey Mapping of the Project area to model potential impacts to riparian floodplain vegetation throughout the Project area. Analyses will be conducted using ARCMAP and flow routing models to project operational flow regime changes throughout the Project area.

6.6.4.8.2. Work Products

Technical report describing the physical and vegetation modeling methods, results and GIS generated maps.

6.6.5. Consistency with Generally Accepted Scientific Practice

The proposed Riparian IFS, including methodologies for data collection, analysis, modeling, field schedules, and study durations, is consistent with generally accepted practice in the scientific community. The Riparian IFS is consistent with common approaches used for other FERC proceedings and references specific protocols and survey methodologies, as appropriate. Specifically, riparian vegetation mapping and measurement, the classification of riparian plant communities, and dendrochronologic techniques will follow standard methods generally accepted by the scientific community. A potential suite of groundwater and surface water models have been identified for integration with ice processes models that are widely used throughout the discipline. Current state-of-the-art and science practice will be utilized to integrate modeling of physical processes and riparian vegetation-flow response guilds with GIS geospatial analysis and display.

6.6.6. Schedule

The schedule for completing all components of the Riparian IFS is provided in Table 6.6-2. Licensing participants will have opportunities for study coordination through regularly scheduled meetings, reports and, as needed, technical subcommittee meetings. Reports will be prepared at the end of 2013 (Initial Study Report) and 2014 (Updated Study Report) for each of the study components. Licensing participants will have the opportunity to review and comment on these reports. Workgroup meetings are planned to occur on at least a quarterly basis, and workgroup subcommittees will meet or have teleconferences as needed.

6.6.7. Level of Effort and Cost

The Instream Flow Riparian Study is planned as a 2 year effort, with field sampling conducted spring through summers and fall of 2013-2014. Delivery of Initial Study Report in late 2013 and Updated Study Report in late 2014. Figure 6.5-7 depicts general work flow and key deliverable dates for the ISF and Riparian ISF Studies.

Riparian ISF Study elements and their estimated levels of effort include:

1. Spring/Summer 2013 field work investigating up to six intensive study reaches. Field effort will involve approximately a team of three ecologists one to two week per study site to map and sample riparian vegetation.
   - $250,000 – $310,000
2. Spring/Summer 2014 field work field work investigating up to six intensive study reaches. Field effort will involve approximately a team of three ecologists one to two week per study site to map and sample riparian vegetation.
   - $250,000 – $310,000
3. Modeling forest succession and physical processes (groundwater / surface water, hydraulic, ice processes, operational flow simulations).
   - $350,000 – $440,000
4. Statistical analyses and report development; meetings, presentations.
   - $350,000 – $440,000
5. Riparian groundwater/surface water interaction study.
   - Costs being developed

Total approximate effort/cost: $1.2-1.5 million (not including costs for riparian groundwater/surface water study instrumentation, field installation and monitoring, and MODFLOW modeling). Details and level of field effort will be based upon approved overall study objectives and design. Field surveys would be conducted for 30 to 40 days in each year, depending on the needs for additional ground-verification data. The Riparian IFS Study will involve extensive, office-based activities including remote sensing interpretation, physical modeling, vegetation modeling, statistical modeling, geospatial analyses and study report preparation.

The types and level of physical process modeling will be determined in coordination with the Instream Flow, Geomorphology, Ice Processes, Botanical Riparian, and Groundwater Related Habitat Study teams. Estimated study costs are subject to review and revision as additional details are developed.

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6.6.9. Tables

Table 6.6-1. Data collection parameters and associated sensors for a GWSW riparian monitoring system.

Process	Parameter	Sensor Type
Surface-water stage fluctuation	Pressure – calculated water levels	CSI CS 450 Pressure transducer
Groundwater stage fluctuation	Pressure – calculated water levels	CSI CS 450 Pressure transducer
Active-layer freezing and thawing	Resistance – calculated temperature	GWS-YSI Vertical thermistor strings
Active-layer freezing and thawing, Moisture availability	Unfrozen volumetric moisture content (%)	CSI CS616 Soil-moisture sensors
Evapotranspiration	Air temperature, Relative Humidity	CSI HC2S3 AT/RH sensor
Evapotranspiration	Wind Speed, Direction	RM Yound 05103 WS/WD sensor
Evapotranspiration	Radiation	CMP3 – Kipp & Zonen Pyranometer
Evapotranspiration	Soil-surface temperature	GWS-YSI Thermistor
Evapotranspiration	Precipitation	TI 525-US Tipping bucket rain gage
Plant transpiration	Delta-Temperature	DI – Dynagage and TDP sensors and sap flow algorithms

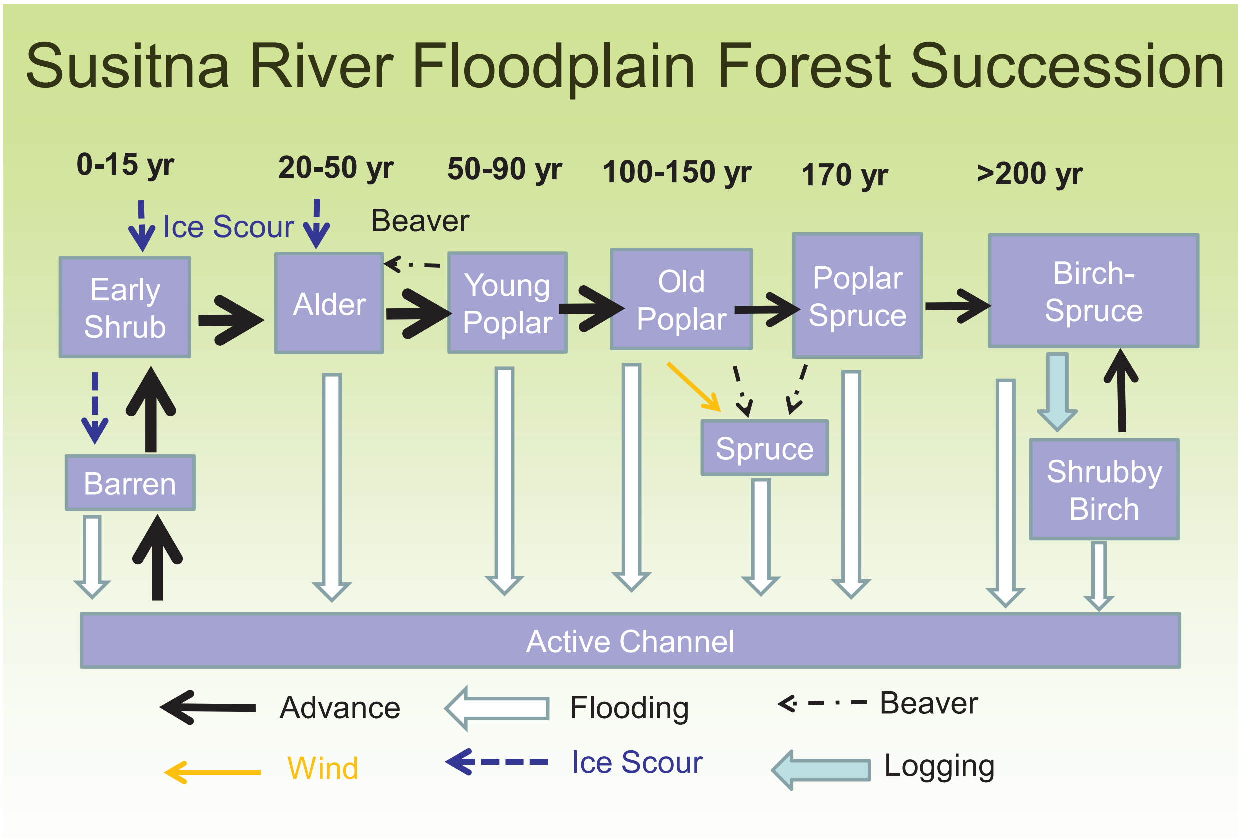
Notes:

1 Campbell Scientific Inc., CSI; Dynomax Inc., DI; Texas Instruments, TI, GW Scientific, GWS.

Table 6.6-2. Tentative Schedule for development of components of the riparian Instream Flow Study.

Activity	2012				2013				2014			
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4Q
Technical Consultant Selection	▲											
Refine and Finalize Study Plan		----▲	--▲---	-------								
Agency Licensing participant Site Visit			--▲									
Intensive Study Reaches Site Selection			--▲									
Review of 1980s Data and Information		-------	-------	-----●								
Model Selection (1-D, HEC-GEORAS, mapping, etc.)			-------	---●								
Hydraulic Routing: data collection and reporting		-------	-------	-----●	-------	-------	-------	-------	-------	-------	-------	-------
Hydraulic Routing: develop executable model				-------	-------	-------	-------	-------	-------	-------	-------	-------
Riparian Vegetation: Review literature and 1980s reports	-----	-----●			-------	-------	-------	-------	-------	-------	-------	-------
Riparian Vegetation: Field data collection (summer) (both years)		▲	▲		-------	---▲	---▲---	---▲	-------	--▲---	---▲--	▲
Riparian Vegetation Mapping (GIS, aerial videography, aerial photography)		-------	-------	-------	-------	-------	-------	-------				
Develop groundwater/surface flow models	------				------	------	------	------				
Study Reach Groundwater Sampling						------	------	------	------	------	------	
Hydraulic Model Integration and Calibration							------	------	------	------	----	
Riparian Habitat Modeling								-------	-------	-------		
Alternate Scenario Post-Processing								-------	-------	-------		
Reporting				●				●●				●●

6.6.10. Figures



(after Helm and Collins 1997)

Figure 6.6-1. Helm and Collins (1997) Susitna River floodplain forest succession. Note: model depicts typical floodplain forests found in the Susitna River Middle river and three rivers confluence segments.

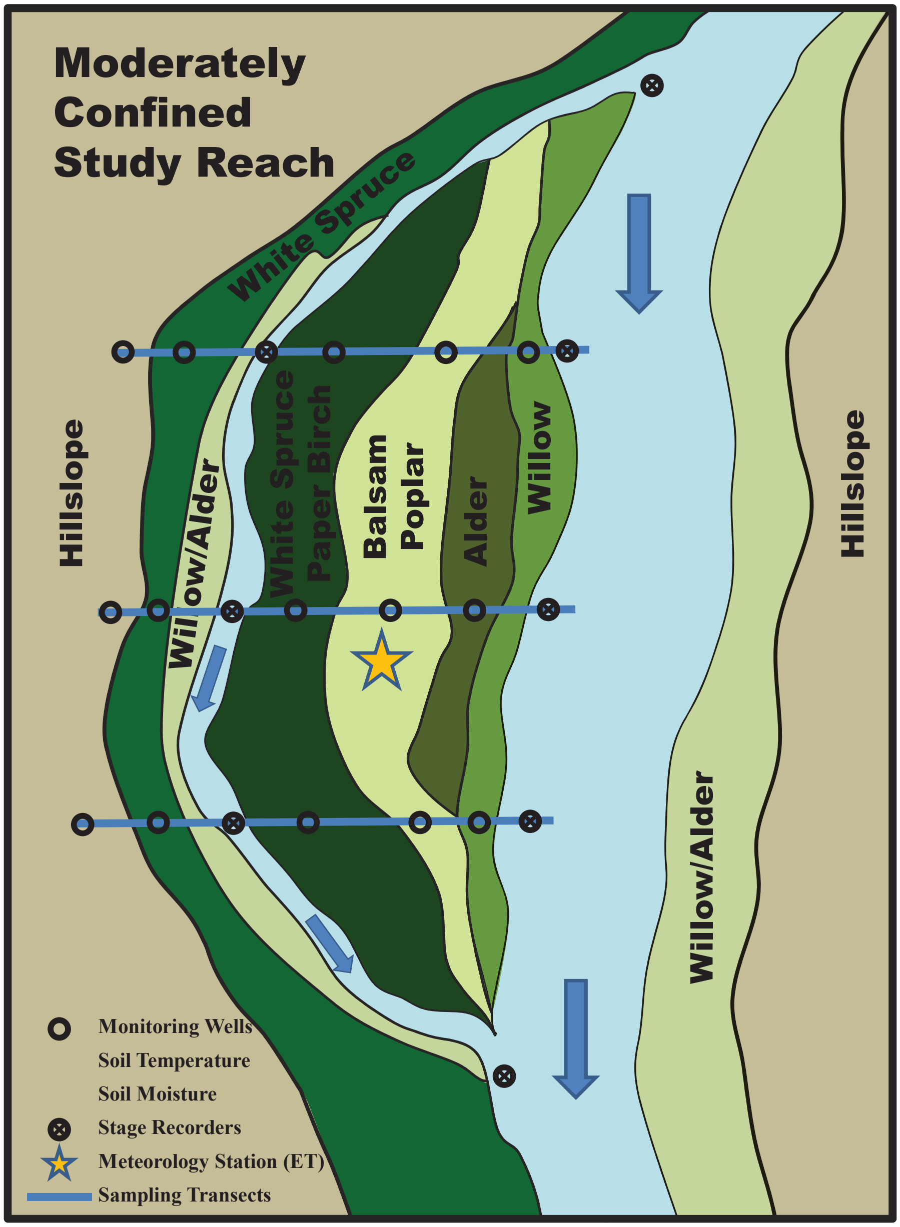


Figure 6.6-2. Typical intensive study reach groundwater / surface water study design illustrating monitoring well and stage recorder transect locations. Typical floodplain plant community types found in middle segment of Susitna River are shown.

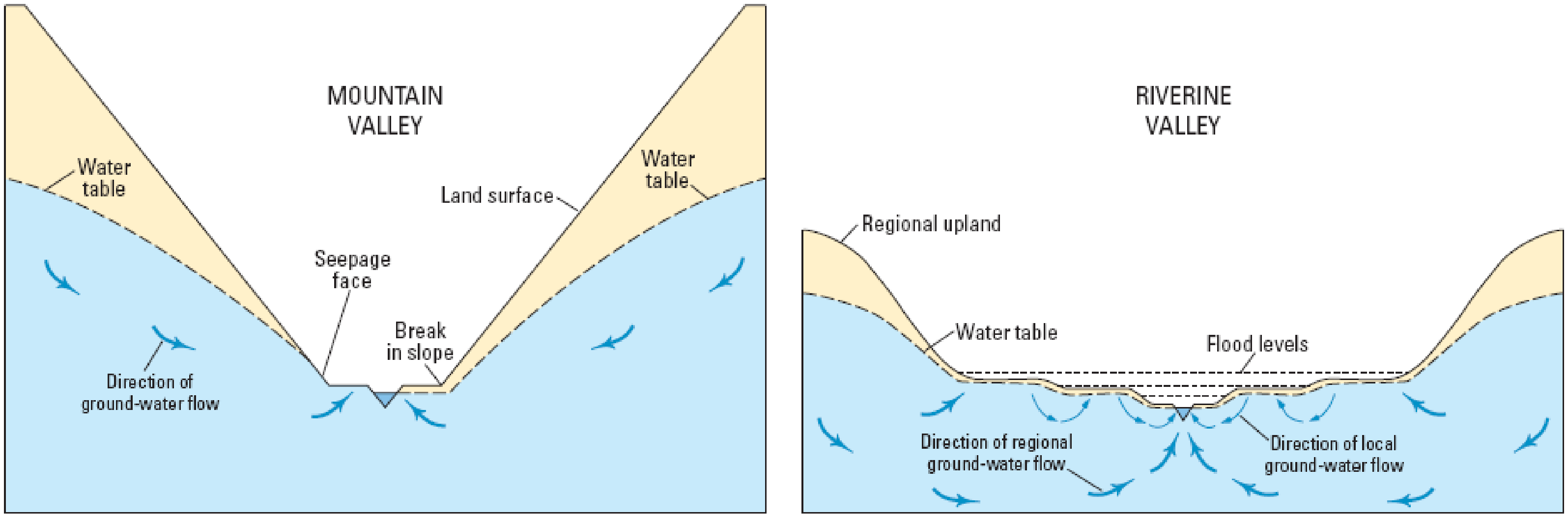
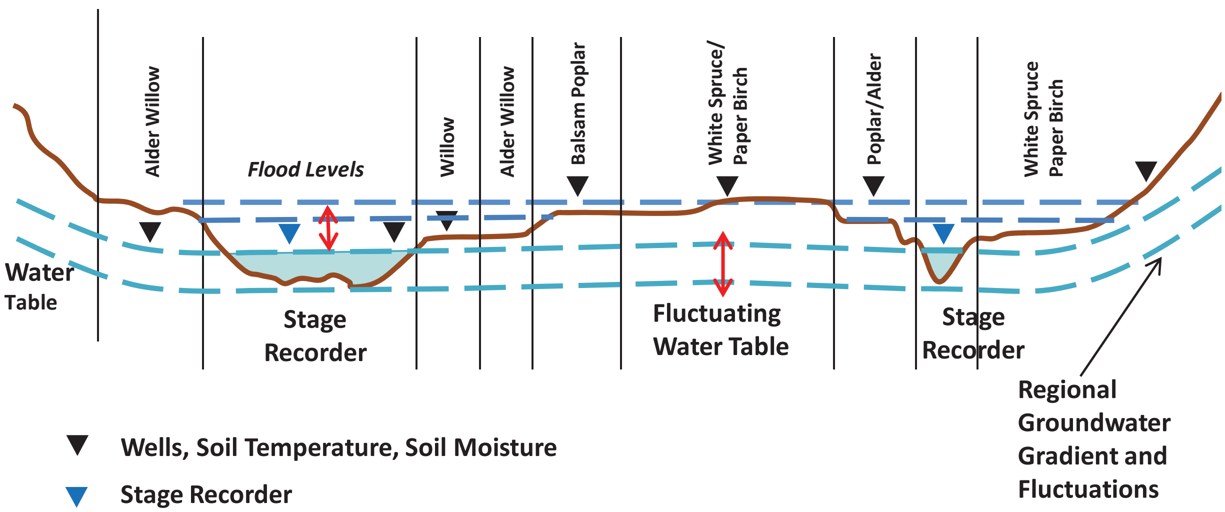


Figure 6.6-3. Riverine hydrologic landscape (Winter 2001)



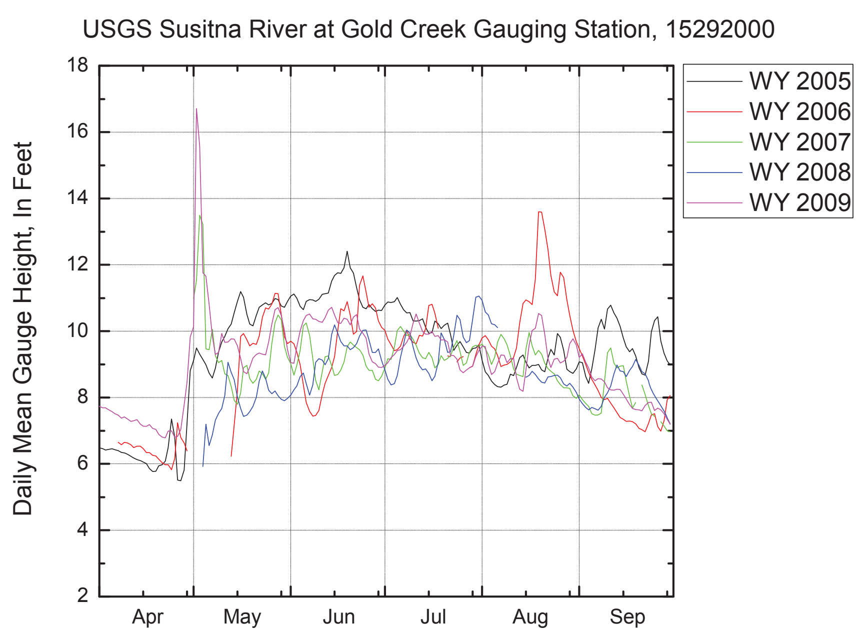


Figure 6.6-4. (A) Transect profile view of typical monitoring well and stage recorder locations looking down river. (B) Gold Creek Gauge Station, Susitna River April through September 2005-2009.

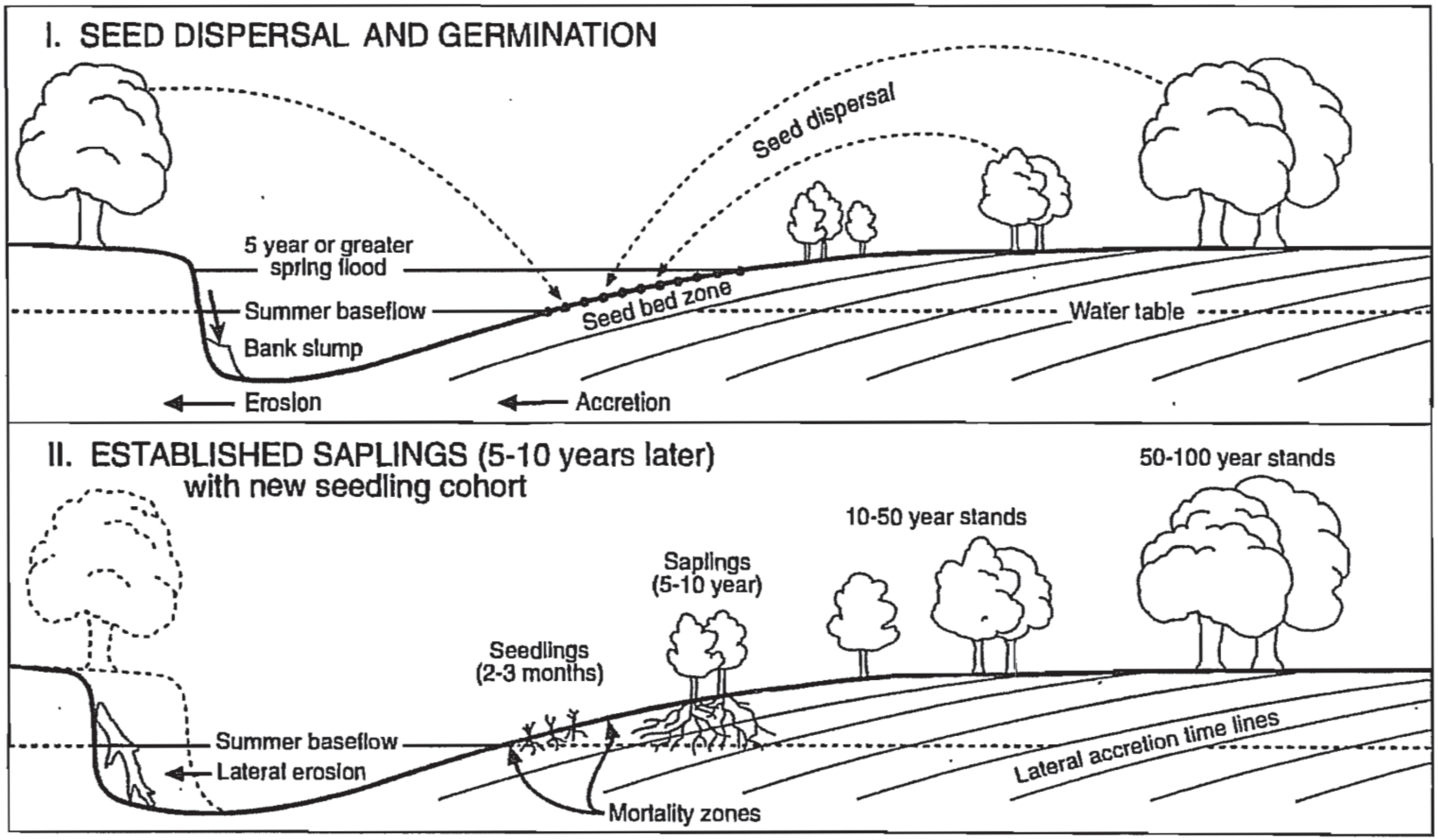


Figure 6.6-5. Cottonwood (*Populus*) life history stages: seed dispersal and germination, sapling to tree establishment. Cottonwood typically germinates on newly created bare mineral soils associate with lateral active channel margins and gravel bars. Note proximity of summer baseflow and floodplain water table (Braatne et al. 1996).

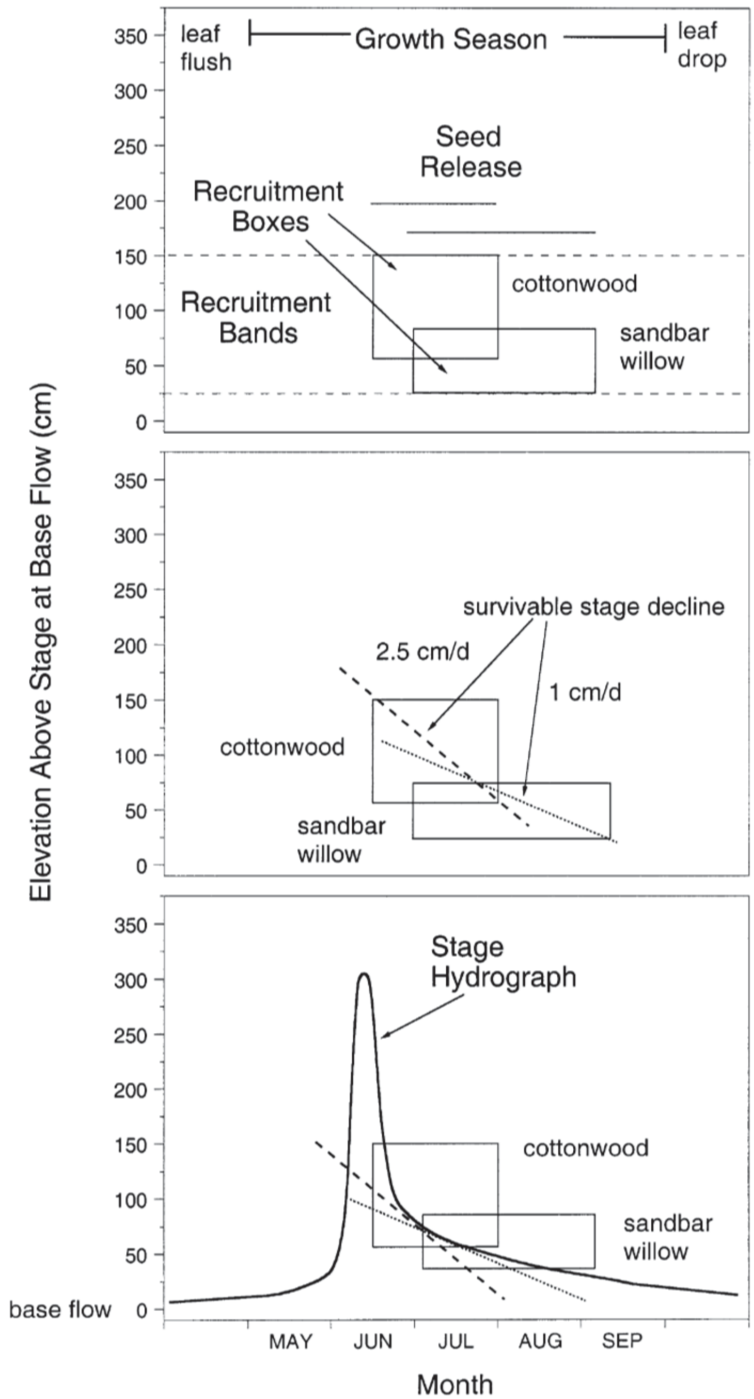


Figure 6.6-6. The riparian "Recruitment Box Model" describing seasonal flow pattern, associated river stage (elevation), and flow ramping necessary for successful cottonwood and willow seedling establishment (from Amlin and Rood 2002; Rood et al., 2005). Cottonwood species (*Populus deltoides*), willow species (*Salix exigua*). Stage hydrograph and seed release timing will vary by region, watershed, and plant species.

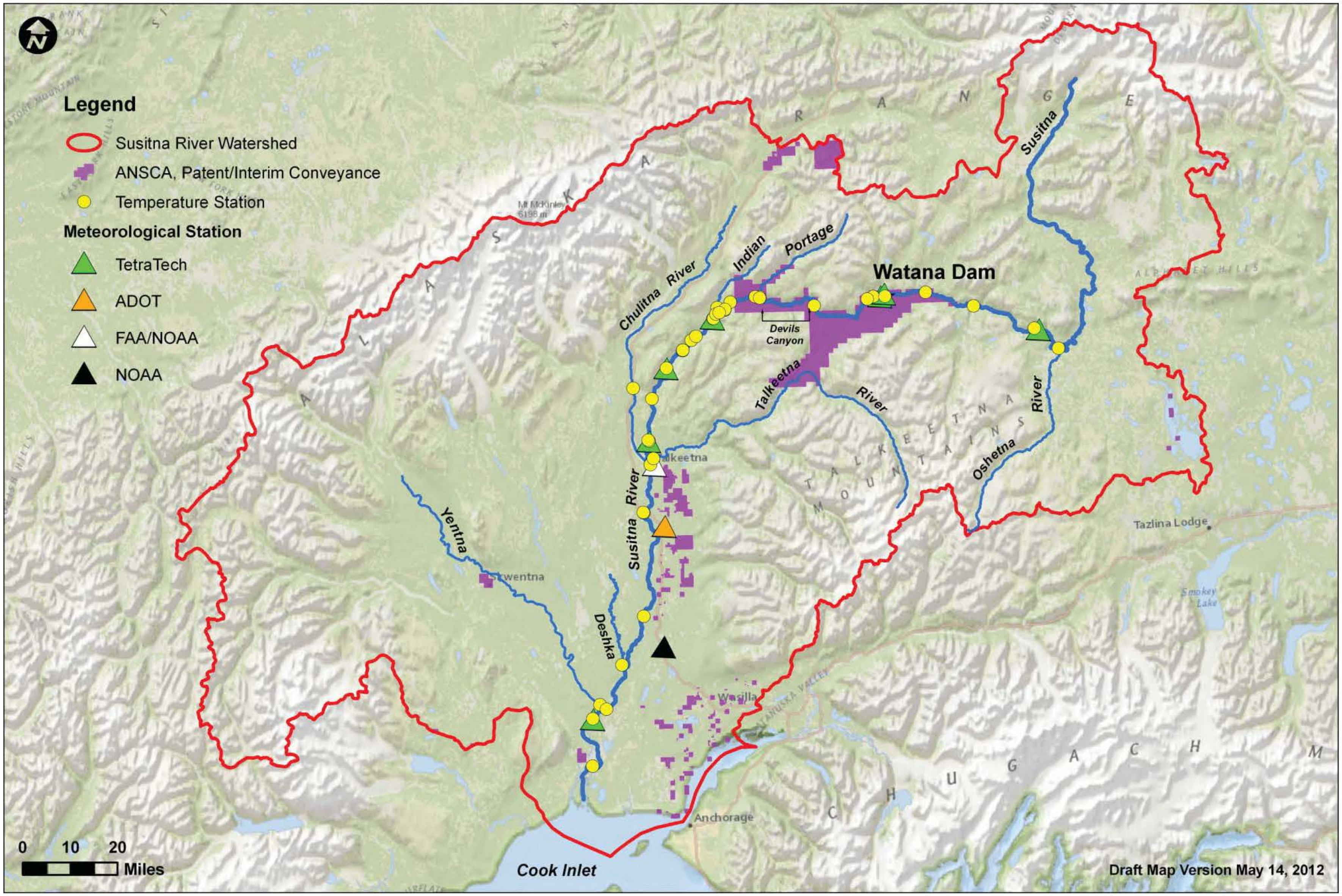


Figure 6.6-7. Project area meteorological station locations.

6.7. Attachments

ATTACHMENT 6-1. DOCUMENTATION OF CONSULTATION ON INSTREAM FLOW STUDY PLAN

ATTACHMENT 6-1

DOCUMENTATION OF CONSULTATION ON INSTREAM FLOW STUDY PLAN

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

December 30, 2011

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: Proposed 2012 pre-licensing studies for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) verbal request for recommendations on pre-licensing studies in 2012 for the Susitna-Watana Hydroelectric Project. The Service has previously provided some verbal comments at project planning meetings and in conversations with AEA project and consulting staff. The Service will be better able to provide complete comments (as part of the National Environmental Policy Act scoping process), after reviewing more thorough descriptions of the proposed project and project operations anticipated in the Preliminary Application Document (PAD). The following comments and study recommendations for 2012 are considered preliminary until we review the PAD and fully understand the scope of the proposed project.

We recognize that the newly proposed Susitna-Watana project is different than the proposed Su-hydro project of the 1980s. Differences in: 1) the two proposed project designs; 2) the past and present study methodologies (due to evolving scientific technologies); and 3) the scientific rigor of previous investigations, may limit the applicability of study results from the 1980s. In many instances, the 1980s studies were limited in spatial and temporal scope, and the methodologies may have been limited, outdated, non-replicable, or lacking in resolution, potentially making them incomparable to present technologies. For these reasons, the Service is concerned about the applicability of the 1980s Su-hydro studies relative to the proposed Susitna-Watana project.

The Service appreciates that AEA recently had the 1980s studies synthesized for identification of data gaps. A reasonable next step is to review the study results for appropriateness and

applicability to the newly proposed Susitna-Watana project. Specifically, results from the 1980s studies should be reviewed for statistical validity.

The Service and other resource agencies have previously expressed concerns about the assumptions, relevance, and applicability of 30-year old studies conducted for a different project proposal, in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the upper and lower reaches (as defined by AEA) of the Susitna River for both the 1980s and in the proposed Susitna-Watana project.

To begin assessing potential impacts to fish and wildlife resources in the project area, the Service recommends the following reconnaissance level studies and reviews for 2012:

- Biometric review of biologic and hydrologic study results from the 1980s.
  Rationale: To assess the statistical validity of the 1980s Su-hydro study results for applicability to proposed studies for the Susitna-Watana project.

- Establish cross-sections for the lower reach, determine the hydraulic connection between the Susitna River and sloughs and off-channel habitats, and incorporate them into the hydrologic model.
  Rationale: To quantify and evaluate the effect of project operations on the lower reach (as climate and other conditions change within the watershed)

- Monitor flow and sediment in the Chulitna and Talkeetna Rivers, and in Gold Creek.
  Rationale: To quantify and evaluate individual tributary flow contributions and sediment loads and assess the potential effect of project operations on lower reach habitats and functions.

- Quantify distribution of fish assemblages relative to available habitat and stream temperature at channel, reach, and spatial scales (as defined by Torgersen et al. 1999).
  Rationale: To assess and quantify fish assemblages relative to available habitats that may be affected by proposed project operations; there are approximately 20 fish species in the Susitna River and little information known about their distribution.

- Collect longitudinal thermal imaging data in all Susitna River study reaches
  Rationale: Information is needed to assess and quantify important aquatic habitats (e.g., thermal refugia) that may be affected by proposed project operations

The Service considers these minimum recommendations necessary to establish a framework to identify future applicable studies throughout the licensing process. When we review the PAD we will likely revise our recommendations to reflect the integration we would like to see in the 2012 studies.

Thank you for the opportunity to provide comments on pre-licensing studies for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Acting For:

Ann G. Rappoport
Field Supervisor

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

February 10, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided some initial comments on the draft study plans during the work group meetings January 24-26, 2012, and had anticipated providing additional comments after receiving revised and more thorough descriptions of the proposed studies. Since that meeting, we have conducted an initial review of the Instream Flow, Aquatic Resource, Water Resource, and Eagle and Raptor Nest draft 2012 study plans provided at the January 24-26, 2012, meetings. Due to the short turnaround time requested for feedback (11 business days) on the study plans and their ongoing evolution, our comments should be consider cursory. The following represents our overall issues and concerns with the study plans and the enclosure provides a more detailed accounting of our comments and recommendations for each specific study plan.

Expanded Study Framework and Timeframe: The Service and other resource agencies have frequently expressed concerns about the limited temporal and spatial scale, and limited timeframe, for proposed studies in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the lower reaches (as defined by AEA) of the Susitna River for the proposed Susitna-Watana project. As part of the hierarchical framework, an ecologically meaningful space-timing scale should be identified related to project studies. As the spatial scale of studies increases, the time scale of important processes such as ice, sedimentation, and channel formation also increases, because they operate at slower rates,

time lags increase, and indirect effects become increasingly important. Studies related to these dynamic fish habitat forming processes need to be adequate (i.e., 5 years or more) to begin to understand mechanistic linkages (Wiens et al 1986; Wiens 2007). For this purpose, the Service recommends conducting fish habitat forming process studies on the minimum temporal scale of 5 years. This temporal scale equates to the typical life cycle of Chinook salmon, an Alaska Department of Fish and Game designated stock of concern.

To address these concerns, the Service expects that the 2012 studies and future project-related studies will be conducted on a hierarchical framework (Urban et al 1987; Frissell et al 1986) at a variety of scales including meso-habitat, reach, and basin wide. The Service also expects that the 2012 studies will not only help fill data gaps identified in the Preliminary Application Document (PAD), but will also be integrated between each other and with future project-related studies. This framework and integration is necessary to understand existing conditions and predicted changes to fish habitat in relation to changes in physical processes from proposed regulated flows. We recommend you establish a schedule for analysis of data obtained in 2012 and a framework for how to incorporate the 2012 data into 2013-2014 study plans. This is necessary for resource agencies to adequately assess potential project impacts to Alaska's fish and wildlife resources.

Winter Flow Regimes: At the January 24-26 work group meetings, and in the PAD, winter operations were described as load-following with flows ranging from 3,000 to 10,000 cfs in a 24-hour period. Regulated flows, including load-following operation, result in substantial changes to the natural hydrograph of a river. Dam construction and operation globally has resulted in adverse effects to anadromous and resident fish, macroinvertebrates, and their habitats. The Service is particularly concerned with the lack of study focus on Susitna River winter flows under natural and proposed flow operations. We recommend that winter base flows be assessed beginning in 2012 under the Instream Flow 2012 Study Planning, Water Resources Study Planning, and in the Aquatic Resources Study Planning. During colder winter months, glacial river base flows, such as those in the Susitna River, are derived entirely from groundwater inputs resulting in reduced habitat availability. We recommend assessing base flows as they relate to mainstem winter habitats (including adult spawning and juvenile fish overwintering locations, and the potential for stranding or increased mortality or condition related to changes in flow and water temperature), water quality conditions, ice-processes, and habitat and geomorphic processes in the Susitna River under current conditions and underthe proposed operation.

Temperature: In our December 30, 2011, letter we recommended thermal imagery (Torgerson et al. 1999) be conducted in 2012 throughout the Susitna River mainstem to identify important thermal habitats that may be utilized for spawning, refugia, or as overwintering areas. It is important to characterize the Susitna River water temperature profile as it relates to habitat because the proposed dam is expected to significantly alter the water temperatures downstream of the dam. Please review this letter as a reference for this study, as well as other Service recommendations.

Modeling Design: There is currently a lack of information in the draft study plans related to overall modeling approaches that will be used for the Susitna-Watana project. When identifying

instream flow model(s) the purpose and assumptions must be compared to Water Resources and Aquatic Resources study objectives. Model assumptions and model inputs need to be clearly stated and available for review. Spatial pattern should be one of the independent variables in the model analysis. At a minimum, we recommend using 2D hydrodynamic model(s) at a mesohabitat, reach, and basin wide scale (Crowder and Diplas 2000). We specifically recommend a 2D model be included to predict physical processes to spatially represent variation in input variables, and how those variables change temporally and spatially under differing flows. Selected model(s) should also include a sensitivity analysis (Turner et al. 2001). This information is critical to the general project understanding of existing ecological spatial patterns, and predicted spatial patterns under proposed regulated flows from the Susitna-Watana dam.

Mercury: Since the January meetings, it was brought to our attention that fish mercury concentrations frequently increase after impoundment of a reservoir, particularly boreal reservoirs. Soil flooding releases organic matter and nutrients, providing food to bacterial communities that methylate inorganic mercury. Methylation and bioaccumulation are the primary pathways for mercury accumulation in fish (Therriault, 1998). Although not identified in the 2012 draft studies, future studies should include pre- and post-impoundment mercury concentration studies.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
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Enclosure

The following comments and recommendations are based on our review of the 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project provided at the January 24-26, 2012, work group meetings.

Synthesis of Existing Fish Population Data (F-S1)

Recommend including information on seasonal distribution and abundance of anadromous and resident fish species among riverine habitat types and river reaches. As part of the spawning and incubation period for resident and anadromous species, studies need to include fry emergence periods and time (of day) information to determine potential impacts from fluctuating winter/spring flows. Potential issues include stranding of fish (by life stage and species) and downstream displacement relative to potential ramp rates. This study needs to integrate with instream flow and geomorphic studies to look at effects of daily flow fluctuations, particularly in winter, in the middle and lower river reaches.

For clarity, we recommend referring to river "reaches" as defined in the PAD rather than river "segments."

Fish persistence should be evaluated relative to spatial and temporal availability of fish habitat under existing and proposed flows. The Service recommends fish habitat studies be developed concurrent with the water resource studies to interface and characterize fish habitat as it relates to physical (hydrologic, sedimentation, and geomorphic) processes. Fish habitat metrics should be developed and integrated with modeling efforts related to physical processes and fish presence.

Chinook Salmon Presence above Devil's Canyon Study (F-S4)

Chinook salmon presence above Devil's Canyon study should include an upstream and downstream fish passage component. This 2012 study should include fish passage relative to all life stages of Chinook salmon. There is the potential to include Dolly Varden and Humpback whitefish pending results of an otolith/anadromy analysis by the Service for these species.

The Service supports the genetic component of the study (F-S4) which is necessary to determine whether the Chinook salmon meta-population in the vicinity of the proposed dam is a distinct population.

Wetland Mapping Study (B-S3)

The draft wetland study states that the methods used will be consistent with guidance in the Alaska Regional Supplement (USACE 2007), the U.S. Army Corps of Engineers (USACE) Manual (Environmental Laboratory 1987), and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Therefore, the Service recommends the use of the Cook Inlet Classification (CIC) developed by Mike Gracz. The CIC is an HGM-based wetland ecosystem classification scheme analogous to Cowardin. The Service supports the use of CIC for wetland mapping in the Cook Inlet Basin over Cowardin because CIC is regionally

specific and indicative of function (e.g., a spring fen always receives groundwater discharge; whether a palustrine emergent wetland does is unknown). CIC can be cross-walked with Cowardin if necessary. CIC methodologies and Mike Gracz' mapping protocols are described on www.cookinletwetlands.info.

In terms of compensatory mitigation related to a site that will be monitored over time using site-specific, precise functional attribution, the best functional assessment method available is the use of the HGM Regional Guidebooks. The citation for slope/flat wetlands is as follows:

- Hall, J.V., J. Powell, S. Carrick, T. Rockwell, G.G. Hollands, T. Walter and J. White. 2003. Wetland Functional Assessment Guidebook, Operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion, Alaska, using the HGM approach. State of Alaska, Department of Environmental Conservation, Juneau, Alaska.

Eagles and Raptor Nest Study (W-S3)

The Service's Migratory Bird branch is evaluating the potential for an eagle study that would compare productivity/behavior of golden eagles in disturbed areas (such as the Golden Valley Wind project, Usibelli Coal Mine, and the Susitna-Watana dam) versus undisturbed areas (Denali Park). We would like to explore the option of partnering with Watana projects to complete eagle nesting surveys. The Service could potentially provide experienced biologists to conduct the surveys. The benefits to this partnership include: 1) assistance to the project sponsors to conduct an eagle nesting survey; 2) provide cost savings to project sponsors by eliminating the need to hire a consultant to complete the survey; and 3) allow the Service to collect information valuable for our study. These surveys would not be considered compensatory mitigation, but would help meet eagle nest survey requirements. The Service generally recommends a pre-project survey with a follow-up survey just prior to construction.

Since 2009, compensatory mitigation is required for "take" or disturbance of active and inactive bald eagle nests. For golden eagles, there is a "no net loss" policy. Identifying ways to offset compensatory mitigation requirements early in the project development process can help the resource and the project sponsors. For example, a 2-year pre-construction eagle tracking study could help minimize required compensatory mitigation if the study demonstrated a "disturbance" rather than a "loss of territory."

Riparian (B-S2)

In addition to comments provided previously, we recommend riparian studies be integrated with other 2012 studies and with future project-related studies.

Beluga Prey Species Study (F-S6)

This study should identify components that specifically interface with the water resource and fish habitat studies. Anadromous prey species such as eulachon, Pacific and Arctic lamprey have been documented as present in the lower reach of the Susitna River and may be impacted by the proposed regulated flows. Relationships between natural flows and existing habitats should be

developed to best predict changes during proposed regulated flows that may impact beluga whale prey species.

Instream Flow Planning Study (F-S5)

1) Selection of a model or series of models of 1D or 2D nature will drive the type of data needs for the field studies. This discussion and selection must be made prior to finalizing habitat studies.
2) The habitat suitability curve development is a useful product. Conduct the studies in such a manner as to ensure the development uses actual suitability data and is not dominated by best professional consensus.
3) Need a better understanding of how the instream flow study relates to the routing model or uses its own calibrated flow model. Concern is that the overall routing model may have significant variation in water level between cross-sections depending on their placement in relation to the habitat cross-sections. Location in pools or riffles and within these features or braided section will vary the water level of a certain flow and may not correctly interpret the water level of a habitat cross-section.
4) Anticipate that the habitat study will have its own cross-sections and flow analysis separate from the routing model. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new spots as needed for 2013 and 2014.
5) Desire to have a large map with the routing and habitat cross-sections on it over recent aerial imagery.
6) In review of 1980s studies, were there any groundwater/surface water exchange studies?
7) Need to confirm whether the 1980s studies included mapping of groundwater upwelling areas along the river for gaining and losing reaches. We recommend at least a large-scale thermal temperature study along the river to note locations and relate it to the habitat study areas and cross-section surveys.

Reservoir and Flow Routing Model Transect Data Collection (WR-S1)

1) We recommend that the cross-section re-surveys in 2012 go beyond the forest limit but stay within the floodprone area, as there may be key floodplain elements not captured in the LIDAR data.
2) Need to evaluate appropriate model to consider ice effects as ice is a significant factor, not only for habitat but also for recreational use. We highly recommend utilizing one model that is fully dynamic and can deal with both floods and ice dynamics during winter low flows for routing. A model was recommended in the January work group discussion, created in Canada that may be appropriate. Model selection will drive data needs so this needs to be selected soon and with a full idea of the types of available models out there to select the best one.
3) Given the discussion of ice dynamics, cross-sections are likely needed in the lower reach to adequately assess ice dynamics as ice forms and slowly freezes upstream. We recommend that these cross-sections be identified and obtained in 2012 to maximize utilization of the model and potentially correlated to lower river habitat studies to reduce redundancy of effort.

4) Instream flow and habitat study cross-sections are assumed to be different than the routing cross-sections. We recommend creating a map for distribution that overlays the original routing and habitat cross-sections to begin to understand their spatial location and orientation and begin discussing 2012 study locations. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new sampling locations as needed for 2013 and 2014.
5) Flows need to be measured to calibrate routing as much as possible. We recommend that water surface and flow be captured at key cross-sections while in the field to calibrate the routing model results and to verify Manning's n assumptions.

Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations (G-S1)

1) For locations obtaining bedload data need to also do a bed pebble count to compare to transported load to calibrate for shear stress and other calculations.
2) Recommend that gravel bar sampling be part of the study to compare to transport load data obtained. This methodology must be well documented.
3) Evaluate the Chulitna and Talkeetna as well as other key tributary deltas for sediment distribution and load into the system.
4) Recommend attempting to get high flow values near bankfull stage at both Gold Creek and Watana sites to add to data.
5) Recommend sediment sampling at the Susitna-Watana dam site to demonstrate correlation to Gold Creek and/or model changes in sediment loading between the sites.
6) Evaluate 3-inch versus 6-inch bedload sampler use for 2012 field season to try to capture large fractions of bedload movement as able.

Geomorphic Assessment of Middle River Reach using Aerial Photography (G-S2)

1) Include a listing and evaluation of flood and ice conditions during and between aerial photography events, especially during breakup periods to help correlate differences to significant events in the watershed.
2) Does not address winter flows and habitat use under winter conditions; needs to come up with a plan to address this beginning winter 2012/13.
3) For geomorphic analysis and comparison to habitat studies, cross-section locations for substrate classification, large woody debris counts in floodprone width, and categorization of fluvial process (Montgomery and Buffington, Rosgen) should be determined and fieldwork performed. If location agrees with an old cross-section, it will help verify any changes over time and with flow to help determine stability and shear stress equations.

Geomorphic Assessment of Project Effects on Lower River Channel (G-S4)

1) There is a need to evaluate the hydrology and habitat use of the lower river to evaluate change over time from dam operations:
    a. Winter operations are a major concern given the need to evaluate daily flow fluctuations of 3,000-10,000 cfs in the winter. This effect must be modeled into

the lower reach to see if the magnitude of fluctuating flows in the winter extends further downstream than spring and summer flow periods. Additionally, ice and open water effects will be extended into the downstream area so modeling will need to address this by extending it downstream.

b. In the January work group meetings it was pointed out that ice is generated upstream and flows down the river to the lower reaches, beginning to form in the lower reach and slowly ice up the river upstream. This also needs modeling from a thermal standpoint, hence again, the need for cross-sections in the lower reaches.
c. Recommend that the gage at Su Station be turned on by the U.S. Geological Survey (USGS) and maintained by USGS to help calibrate lower reach modeling efforts over the next 5 years, especially for ice effects and dynamics modeling.
d. Cross-sections need to be made in the lower reach to add to an ice dynamics model as well as habitat studies – recommend selecting locations and getting these cross-sections in 2012 to facilitate modeling efforts.

2) Re-do all cross-sections at existing and past gage sites in the middle and lower reaches (including Su Station) to evaluate hydraulics, assess stability by comparing to old cross-section data and give an initial assessment of stability or changes in rating curve information. Also, it would be beneficial to do an initial evaluation of these gage sites at winter flows and with ice dynamics to begin to understand the impact winter flows will have. This will help with evaluating changes over the last 30 years in the lower reaches to determine whether additional work in 2013-2014 is needed.

Documentation of Sustina River Ice Breakup and Formation (G-S3)

1) Key elements to identify are: where ice generation occurs (production zones) and where ice lodges and begins the process of ice formation in the river.
2) Recommend that flights include an ice scientist, fishery biologist, riparian specialist and fluvial geomorphologist so that multiple observations can be made at the same time and can be stitched together to understand the processes taking place.
3) Recommend video be taken during all river flights for later reference.
4) Documentation of frazil ice generation is very important – current thought is that 80% is generated upstream of Devil's Canyon in the middle reach.
5) Daily flights might be needed during the height of breakup or freeze-up.
6) Is CRREL involved with the ice research?
7) Highly recommend utilizing our Canadian neighbors and their research and models for ice issues.

Review of Existing Water Temperature Data and Models (WQ-S1)

1) Identify appropriate temperature models to use based on new technology and understanding.
2) Evaluate MET station locations and strongly consider an additional station around the Deshka or Yentna which could help with ice studies.

3) Discuss MET station locations with NOAA Weather Forecast Center to access experts as well as potentially help with storing data.
4) Perform large-scale thermal study of the river for groundwater exchange areas over different flows.
5) At old, existing, and new gage sites, include continuous temperature monitoring; consider a water quality study at gage sites for 2012, 2013, and 2014 seasons with parameters agreed to by all parties and performed by USGS.
6) Evaluate past assumptions for temperature modeling (at least our understanding of it), i.e., summer analysis of surface water temperatures only, as this dominates habitat use, versus winter analysis of intergravel temperature only. Provide quantification of the hypothesis and assumptions made and determine if they are still relevant.
7) 2012 fieldwork in the work group meeting was discussed to primarily show how mainstem temperatures influence side channel habitat. This should be expanded to do a thermal analysis up and down the river (#4).
8) Discussed in the work group meetings that 2013-2014 work will deal with upwelling water temperatures. A thermal analysis in 2012 can help determine these sites.
9) Fieldwork needs to be performed that can help calibrate heat transfer coefficients and other assumptions in selected temperature models between mainstem and other waters.
10) Analysis of temperature effects on ice formation was not discussed and needs to be part of the scope in coordination with ice and habitat studies.
11) Ensure that solar radiation information will be collected at all MET sites as it is crucial to modeling efforts (ice, etc.) and evaluate other metrics that are needed for calibrating models.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

February 21, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: Comments on an additional 2012 draft study plan for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided initial comments on the draft study plans during the work group meetings January 24-26, 2012, and provided additional comments in our February 10, 2012, letter. The following comments and recommendations are based on our review of an additional draft study plan for the Susitna-Watana Hydroelectric Project provided in the Request for Proposals we received February 8, 2012. As in our February 10, 2012, letter, because of the short turnaround time requested for comments on the study plans and their ongoing evolution, our comments should be considered cursory.

Adult Salmon Distribution and Habitat Utilization (F-S3): The study objectives include characterizing the spawning habitat utilization of turbid mainstem and side channel habitats by adult anadromous species as well as the spawning habitat utilization in clear water side sloughs and upland sloughs. However, the methods only mention surveys in the Middle Reach (RM 98 to 150). We recommend that study methods be expanded to ensure characterization of spawning habitat utilization in the lower river reaches of the river as well to allow for a more comprehensive assessment of potential impacts of the project on salmon spawning habitats throughout the length of the Susitna River. In addition, we recommend that this study be fully integrated with instream flow and geomorphic studies to assess the effects of daily flow fluctuations, particularly in fall and winter.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
Field Supervisor

cc: S. Walker, NOAA, susan.walker@noaa.gov
E. Rothwell, NOAA, eric.rothwell@noaa.gov
T. Meyer, NOAA, tom.gcak.meyer@noaa.gov
E. Waters, BLM, ewaters@blm.gov
B. Maclean, BLM, bmaclean@blm.gov
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L. Yanes, ACE, louisa@akcenter.org
A. Moderow, ACA, andy@akvoice.org
P. Lavin, NWF, lavin@nwf.org
R. Wilson, Alaska Ratepayers, richwilsonak@gmail.com

Betsy McGregor

From: Bob_Henszey@fws.gov
Sent: Wednesday, March 07, 2012 9:33 AM
To: Klein, Joseph P (DFG)
Cc: Betsy McGregor; dreiser@r2usa.com; eric Rothwell; kfetherston@r2usa.com; mgagner@r2usa.com; Mike Buntjer; MaryLou Keefe; Steve Padula; susan walker
Subject: RE: Susitna-Watana - Instream Flow Study Request Discussion

Dudley,

I plan to attend. I have not had a chance to formalize my thoughts, but here's a few quick bullets to consider for riparian instream flow needs:

- Channel encroachment of riparian veg (appears to be recognized).
- Channel degradation lowering the adjacent water table, causing changes in adjacent veg (appears not to be recognized).
- Channel aggradation raising the adjacent water table, causing changes in the adjacent veg (not sure this will happen, but should be considered).
- Changes in the timing and duration of the hydroperiod (surface and shallow groundwater) on key riparian life stages (e.g., establishment, high flow and ice scour of seedlings, shifting high water levels to later in the season on mature veg)

These are all considerations that might affect migratory bird habitat in some of Alaska's most productive bird habitat (riparian).

Thanks,
Bob

Robert J. Henszey, Fish & Wildlife Biologist
Conservation Planning Assistance
US Fish & Wildlife Service
101 12th Avenue, Room 110
Fairbanks, AK 99701
Phone: 907-456-0323, Fax: 907-456-0208
Bob_Henszey@fws.gov

"Klein, Joseph P (DFG)" <joe.klein@alaska.gov>

03/07/2012 08:51 AM

To dreiser@r2usa.com, Mike Buntjer <michael_buntjer@fws.gov>, Bob_Henszey@fws.gov, eric.rothwell@noaa.gov, susan.walker@noaa.gov
cc "McGregor, Elizabeth A (AIDEA)" <bmcgregor@aidea.org>, Steve Padula <spadula@longviewassociates.com>, kfetherston@r2usa.com, MaryLou Keefe <mkeefe@r2usa.com>, mgagner@r2usa.com
Subject RE: Susitna-Watana - Instream Flow Study Request Discussion

Dudley, Thanks for your follow up – I am have some workload conflicts but believe I will still be able to call in this afternoon and will let you know if anything changes (albeit it may be posthumously if the fires jump the line). Following are some initial thoughts on major areas of concern to share with you and the group. I know more time will be needed to refine these topics and identify additional concerns and perhaps the discussion today and in future meetings will help to do this.

- Develop flow-habitat relationships with ability to assess observed "patchy" distribution of chum & sockeye spawning and juv rearing integrating fish behavioral based analyses (feeding niches, distance to cover & water edges, ground water influences, and/or water quality preferences, etc.)
- Development of site-specific HSC's for identified target species and life stages that is representative of habitat types, seasonal distribution, and inter-annual variability;
- Evaluation of winter habitat needs for identified target species and life stages; and
- Evaluation of surface – ground water fluxes in a representative sample of habitats used by fish and paired controlled sites. Parameters to investigate include source of origin, rates of exchange over time and space, relationship with mainstem flows, and water quality over time and space.

Joe Klein, P.E.
Supervisor Aquatic Resources Unit
Alaska Department of Fish and Game
333 Raspberry Rd
Anchorage, AK 99518
(907) 267-2148
joe.klein@alaska.gov

From: Dudley Reiser [mailto:dreiser@r2usa.com]
Sent: Wednesday, March 07, 2012 7:54 AM
To: Klein, Joseph P (DFG); 'Mike Buntjer'; Bob_Henszey@fws.gov; eric.rothwell@noaa.gov; susan.walker@noaa.gov
Cc: McGregor, Elizabeth A (AIDEA); Steve Padula; kfetherston@r2usa.com; 'MaryLou Keefe'; mgagner@r2usa.com
Subject: Susitna-Watana - Instream Flow Study Request Discussion

Hi Everyone – as I mentioned last week, I would like to have our first teleconference call today from 3:00 – 5:00 AST to solicit some focused discussion on technical issues and potential study elements that you would like considered as we progress in development of the 2013/2014 Study Plans. I think we touched on a number of those during the meeting but I feel like this would provide an opportunity for you bring up specific items/issues you believe warrant consideration. However, rather than get into too much detail, I would like the discussion to be more broadly based and to focus on major areas of interest or concern, e.g. Eric's discussion regarding load following and potential effects. Perhaps you might consider developing a list of resource issues and perhaps approaches for addressing those, that you think need to be carefully considered. The goal is to make sure we capture the major items in our initial Draft 2013/2014 Study Plan outlines.

Bob - Kevin Fetherston will be available on the call to discuss the riparian program during the later part of the call.

At this time, I am trying to see who is available and wants to participate in the call, and as well, asking for input regarding others you believe should also participate so I can include them on the invite. I will provide call-in instructions in a follow-up email.

That's it for now. Am looking forward to a good discussion.

Thanks

Dudley

Dudley W. Reiser, Ph.D.
R2 Resource Consultants, Inc.
425-556-1288 - office
Fax - 425-556-1290
425-681-6048 - cell

Email – SWIFS01

Betsy McGregor

From: Susan Walker <susan.walker@noaa.gov>
Sent: Wednesday, March 07, 2012 10:54 AM
To: dreiser@r2usa.com
Cc: Joe Klein - ADFG; Mike Buntjer; Bob_Henszey@fws.gov; eric Rothwell; Betsy McGregor; Steve Padula; kfetherston@r2usa.com; MaryLou Keefe; mgagner@r2usa.com
Subject: Re: Susitna-Watana - Instream Flow Study Request Discussion
Attachments: FERC Susitna Watana Hydro Proj P-14241 study 2012.pdf

Good morning Dudley,

Eric Rothwell has been trying to get an update on time and call-in numbers as he is travelling through remote locations today. He will try to call, but is unlikely be able to participate from the road. I, unfortunately, will not be available from 3 to 5 on this short notice either. Eric will email the group tomorrow about additional issues that he did not bring up at last weeks discussion.

I suggest starting with the comments and recommendations on instream-flow studies we provided to the AEA on our latest letter, which I have attached.

Given the planned load-following operations in winter and reduction of peak summer flows, it will be prudent to determine and document the constraints of instream flow studies to predict future, unknown changed habitat features and likely future flow-habitat relationships.
This is especially important in the middle river as the mainstem is expected to channelize over the long-term due to sediment source depletion and isolation of side and off-channel spawning and rearing habitat. It is also important in the lower river as reduced peak flows probably create conditions of channel aggradation - presenting similar limitations in the extension of instream flows and the need for integration of instream flow with geomorphology and other studies.

It is especially important to know:

how 2012 studies will factor into 2013-14 studies, and

what the linkages are between all of the related studies.

On Wed, Mar 7, 2012 at 7:53 AM, Dudley Reiser <dreiser@r2usa.com> wrote:
> Hi Everyone – as I mentioned last week, I would like to have our first
> teleconference call today from 3:00 – 5:00 AST to solicit some focused
> discussion on technical issues and potential study elements that you
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>
> That's it for now. Am looking forward to a good discussion.
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> Thanks
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> Dudley
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>
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>
> Dudley W. Reiser, Ph.D.
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> R2 Resource Consultants, Inc.
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Sue Walker
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SUSITNA-WATANA
HYDROELECTRIC PROJECT

SUSITNA-WATANA INSTREAM FLOW STUDY (SWIFS)
Teleconference Meeting Minutes
March 15, 2012

Project: Susitna-Watana Instream Flow Study
FERC No. 14241

Meeting Date: March 7, 2012 (3-5 PM AST)

Location: Via Teleconference

Participants: Joe Klein (ADFG), Mike Buntjer (USFWS), Betsy McCracken (USFWS), Susan Walker (NMFS), Bob Henszey (USFWS), Betsy McGregor (AEA), Craig Addley (Cardno-Entrix), Steve Padula (Longview), Dudley Reiser (R2), Paul DeVries (R2), Stuart Beck (R2), Kevin Fetherston (R2), Mike Gagner (R2), Michael Link (LGL)

Purpose: Continue discussions regarding instream flow related resource issues that need to be addressed as part of 2013-2014 studies.

Dudley Reiser stated that the main purpose was to allow resource agencies an opportunity to provide more details on resource issues warranting investigation as part of 2013-2014 studies. He reminded the group that there are opportunities for some field efforts this year.

Dudley noted the email comments provided by Joe Klein and requested that he expand on the issues he presented. Some of ADFG issues include:

- Model flow vs. habitat relationships in all reaches affected by the project
- Complete a comprehensive analysis of fish habitat issues including: distribution, use, timing, and evaluation of project impacts
- Ice and potential effects on formation, breakup, etc. related to project operations
- Winter habitat use of fish
- Groundwater influences on fish distribution and how project operations may affect groundwater flows
- Water temperature and how regimes would change with project operations
- Time series analysis of habitats

Dudley acknowledged the need to focus on both mainstem and side channel habitats and that previous studies focused on side channel and slough habitats. He noted that the flow routing transects could also be used for evaluating mainstem habitat effects and that the radiotelemetry (fisheries study) studies would be used to help define main channel use.

Joe Klein indicated he would like to see more emphasis on mainstem habitats than was done in the 1980s.

Mike Buntjer requested a map displaying location of flow routing transects. Betsy McGregor noted that the location of the old ADF&G transects in lower river would need to be digitized and displayed along with flow routing transects in the middle river. This type of info will be useful in identifying data gaps and possibly high priority sampling locations.

Joetta Zablotney is going to generate a GIS map using modern coordinates and aerial photos. This map will be distributed to the group as part of 2013/2014 study plan and will need to be completed by March 20th. Betsy noted that Shawn O'Quinn – (DNR GIS) will assist with this effort.

Craig Addley said that most of the 1980s transects have been digitized and could be displayed on new maps. The group would like to have the transect locations QA/QCed on the ground.

Betsy McCracken asked whether the historic transects were based on habitat or fish use? This will need to be determined based on information review. She also would like to see a study to define unique habitat types, especially those associated with groundwater upwelling.

Dudley stated that groundwater is specifically covered under water quality, but that groundwater influences relative to spawning and rearing habitats and the effects of project operations on these habitats will need to be evaluated. One way for identifying areas of groundwater inflow is via Forward Looking Infrared (FLIR). This has been proposed for use in a test area to see if sufficient difference in temperature can be detected. If works on test area, then it would be expanded to other areas. Some limited assessment of groundwater was done in the 1980s. Dudley noted that this relates to the idea of different levels of study intensities based on resource use/sensitivity. This will be considered in developing the 2013-2014 study plans.

Craig Addley noted that extensive habitat mapping was done during 1980s studies – the majority of side channel, mainstem, and off channel habitats (sloughs) were evaluated under flows ranging from ~800-2,400 cfs. Studies identified spawning locations, juvenile fish and overwintering use of each habitat type and many of these habitat types were subsampled.

The group indicated that load following and ramping rates are a major concern. Stuart Beck described a procedure for evaluating these types of potential impacts using a varial zone analysis that would include an evaluation of stranding and trapping potential, along with redd dewatering.

The agencies requested a list of contractors that identify who is responsible for what studies/issues. Dudley indicated he will work with AEA on getting a list generated. Not all contractors are under contract yet.

Question raised: How will we study or detect channel change with flow regulation changes; i.e., change in hydrology will result in channel changes. Answer – this will be done as part of a number of studies including geomorphology, riparian analysis, ice study, and the instream flow habitat analysis. Part of these studies will evaluate bed profile and substrate compositions.

Question raised: will the flow routing model be used for channel change – Stuart Beck indicated it would be. Stuart also noted that there are ways to predict how project operations will affect changes in morphology and that this will be linked with SWIFS and riparian studies.

Question raised: can the model also be used to evaluate tributary confluences and how they will be affected? S. Beck stated the project would result in sediment supply interruptions – immediately below the dam the sediment supply will change with scour or incision, but some of this impact will be reduced by reductions in high flow events. The USGS is evaluating sediment changes.

Dudley noted that the overall goal is to try and link all of the channel and biological processes that may be affected by the project operations so that time series evaluations can be completed for each process (to the extent possible).

Question raised: will invertebrates be considered in the assessment of project effects? D. Reiser responded that changes in sediment and flow can affect invertebrates and they will be considered. May utilize varial zone analysis described by S. Beck to assess some of these impacts including area, timing, and duration of projected flow changes.

Question raised: will HSC curves be developed for invertebrates? D. Reiser noted that this has been done on other projects and will be considered as part of the SWIFS. However, it also possible that the issue of invertebrate habitats will be covered by fish habitat analysis, that may include use of guilds. Betsy McCracken is interested in potential changes that may result to invertebrate species richness and diversity.

The group noted that Project operations will alter the thermal regime related to flow releases, ADF&G would like to see HSC curves developed for multiple areas and over different time periods/flow levels. D. Reiser responded that we will conduct site-specific data collection but may need to use literature, professional opinion, enveloping and guiding to develop curve sets for some species.

Question raised: how many observations are necessary to build curves? D. Reiser noted this varies; some instances as few as 25-30 observations have been used, in others 75-100 or more have been used. Joe Klein stressed that he just wants to make sure that a good effort was going to be placed on collecting site-specific data.

Concerning the review of literature review and gap analysis/synthesis that will be undertaken this year, the agencies would like to be directed to pieces of information we identify that are especially useful to help them gain a good understanding the resources of the project area.

The group then shifted to a discussion of Riparian habitat. Bob Henszey asked about the types of studies that would be done to assess channel encroachment and the effects of project operations on cottonwood regeneration. He is concerned about potential effects of shallow groundwater table fluctuations and how that would influence cottonwood recruitment.

K. Fetherston indicated that models will be used to predict project operational effects on cottonwood/riparian veg. Joe Klein asked whether there is a published table that shows how seral stages and spp composition change over time. K. Fetherston noted that HEC-RAS and HEC-GeoRAS can be used to determine flow vs. riparian habitat relationships. This work will be coordinated with the ice assessment group and how conditions/ice sheer zones will affect cottonwood galleries. It will also be important to link riparian studies with groundwater, and fisheries at certain locations. Kevin noted that large fluctuations in flow can also increase bank erosion affecting riparian vegetation. The approach will be to intensively study small areas with the goal of being able to extrapolate results out to unsampled areas.

The teleconference adjourned at 5:00 ADT.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Kevin Fetherston*	**Name:**	*Bob Henszey*
Organization:	*R2 Resource Consultants*	**Organization:**	*USFWS*
Study Area:	*Riparian Instream Flow*	**Phone Number:**	
Date:	*5/18/12*	**Time:**	
Call Placed by: ☐ AEA Team ☐ Other Party			

Others on Call:

Subject: Riparian Instream Flow Study Design

Discussion:

The salient issues discussed include:

1. Bob is concerned that we have intensive study reaches located below the Dam site to assess channel issues relative to channel degradation due to lack of sediment transport. I assured him we plan on having a number of sites between the dam site and three rivers.

2. Bob is concerned that we have enough well transects at our intensive study reaches to capture all the riparian plant community types found in the Susitna River floodplain. This is dependent upon the extent of the dam hydrological influence and the number of plant community types we identify within these reaches.

3. Bob is interested in the study characterizing groundwater root zone interactions. This is included in our groundwater/surface water study design.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Kevin Fetherston*	**Name:**	*Jason Mouw*
Organization:	*R2 Resource Consultants*	**Organization:**	*ADF&G*
Study Area:	*Riparian Instream Flow*	**Phone Number:**	
Date:	*5/22/12*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call:

Subject: **Riparian Instream Flow Study Design**

Discussion:

I contacted Jason Mouw, AK Fish & Game riparian ecologist, regarding his ten years of experience studying riparian floodplain forests on the Talkeetna and Susitna rivers and his general knowledge regarding floodplain plant community research in the region.

Primary issues we discussed include:

1. Balsam poplar phenology, seed release period he has observed on the Susitna River (seed release generally in the window of June 20-July 4th),
2. Dendrochronological studies he is conducting on the Talkeetna River floodplain,
3. Types of historic river gauge data, and
4. General ecology of riparian forest succession he has observed.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Kevin Fetherston*	**Name:**	*Bob Henszey*
Organization:	*R2 Resource Consultants*	**Organization:**	*USFWS*
Study Area:	*Riparian Instream Flow*	**Phone Number:**	
Date:	*5/25/12*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call:

Subject: Riparian Instream Flow Study Design

Discussion:

I spoke with Bob Henszey, USFWS, today concerning the riparian floodplain sampling design. He was interested in understanding more of the specific elements of our proposed riparian vegetation sampling design approach. Specifics included:

1. Riparian vegetation seedling survey approach (where, spatially riparian plants colonize the floodplain),
2. Characterization of seedling colonization site environmental parameters (floodplain substrate texture and depth),
3. Measurement approach to ice processes floodplain vegetation interactions,
4. Groundwater / surface water interaction and floodplain vegetation modeling approach.

SUSITNA-WATANA HYDROELECTRIC PROJECT

MEETING RECORD

AEA Team Member		Other Party	
Name:	*Dudley Reiser*	**Name:**	*Agency representatives*
Organization:	*R2 Resource Consultants*	**Organization:**	*ADFG, USFWS, NMFS, EPA*
Study Area:	*Instream Flow Program*	**Phone Number:**	
Date:	*June 13, 2012*	**Time:**	*1:00*

Meeting held by: [x] AEA Team [ ] Other Party

Others at meeting: Ron Benkert, Joe Klein - ADF&G, Matt LaCroix - EPA, Mike Buntjer, Betsy McCracken, Bob Henszey-USFWS, Sue Walker (via telephone) – NMFS, Michael Lilly-GW Scientific, Kevin Fetherston, Phil Hilgert – R2, Bill Fullerton, Mike Harvey, Bob Mussetter – Tetra Tech

Subject:
Identify level of interest and potential timing of a Susitna River site visit to review potential study sites and discuss instream flow/riparian/geomorphology modeling methods.

Discussion:
An agency site visit is scheduled during late July; but meeting participants expressed an interest in reviewing potential instream flow/riparian/geomorphology study sites after the contractors have made a preliminary selection. The general consensus was that a 1-day meeting in Anchorage could be used to review potential model applications, followed by a 1-2 day site visit. Low flow is end of September which provides good site viewing conditions; however, icing can start in early October. A field trip in mid-to-late September should provide sufficient opportunity for contractors to identify potential sites yet minimize the risk of early winter weather cancelling the trip.

Transportation by jet boat is preferred to helicopter; helicopters are frequently unable to fly due to fog and poor flying conditions in the fall. The reach from the 3 Rivers confluence up to Camp Curry exposes people to the major habitat types; perhaps 4 stops could be made in a long day. Mahays River Service is set up for river tours (http://www.mahaysriverboat.com/); discussion focused on a party of about 15 people: 2 ADFG, 2 AEA, (Eric or Sue) NMFS, 2 TT, 2 R2, 1 HDR, Mike Lilly, 4 open spots?

Agency staff will have to pay travel costs so they may have a budget issue in trying to participate. Costs should be identified as soon as practical. Accommodations at the Talkeetna Lodge may be an option after Labor Day.

Action Item:
Schedule trip for mid –to-late-September
Jet boat instead of helicopter
Pre-trip meeting, 2 field days, ½ day follow-up meeting

Prior to field trip R2 to distribute agenda and meeting packet (maps, draft site selection, etc.)

Winter Sampling
Following discussion of the site visit, the general discussion turned to winter sampling. How do fish behave during the winter? Are they torpid and seek out low velocity refuge areas? Could fish use lower Devils Canyon during winter base flow conditions? Data will be needed to evaluate Project effects.

Whiskers Slough is a productive area that is accessible by 4-wheel drive or snow machine during winter. Winter conditions could possibly be conducted at that site. Winter sampling will be difficult and potentially hazardous and the site should be very accessible to try out alternate sampling methods while maintaining safe working conditions. Up to the Indian River area, locals use snowmobiles for transportation – helicopters are used above Indian River. High water velocities immediately below Devils Canyon create unsafe ice for over ice travel. If fish studies are contemplated during the winter, they should coordinate with ice measurement crews to allow back-up (safety margins).

SUSITNA-WATANA
HYDROELECTRIC PROJECT

MEETING RECORD

AEA Team Member		Other Party	
Name:	*Kevin Fetherston*	**Name:**	*Agency representatives*
Organization:	*R2 Resource Consultants*	**Organization:**	*ADFG, USFWS, EPA*
Study Area:	*Riparian Instream Flow Program*	**Phone Number:**	
Date:	*June 14, 2012*	**Time:**	*2:00*
Meeting held by: [x] AEA Team [ ] Other Party			

Others at meeting: Joe Klein - ADF&G, Matt LaCroix - EPA, Mike Buntjer, Betsy McCracken, Bob Henszey-USFWS, Michael Lilly-GW Scientific, Dudley Reiser, Phil Hilgert – R2

Subject:
Riparian Instream Flow 2013-2014 Study Plan Approach and Design.

Discussion:

The riparian instream flow meeting was put together by Bob Henszey and Kevin Fetherston to explore and discuss in depth the 2013-2014 Riparian Instream Flow Study Plan approach and design. The following topics were discussed:

1. General overview of Riparian Instream Flow Study Plan.
2. Details of study approach, sampling designs, and modeling.
3. Operational flow effects on floodplain processes and vegetation and how to approach modeling these potential effects.
4. Floodplain soils characterization methods.
5. Groundwater well types and installation methods.
6. Plant community study design.
7. Riparian vegetation flow-response guilds and statistical modeling methods.
8. Role of beaver in generating floodplain plant communities: beaver dams, pools and wetland complexes.
9. Role of various floodplain vegetation disturbance types: flooding, channel migration, ice scour, herbivory, wind, and fire.
10. Potential for operational flows to alter floodplain conditions favoring exotic plant species invasions.

Action Item:

None

7. FISH AND AQUATIC RESOURCES

7.1. Introduction

Project construction and operation will affect flow, water depth, surface water elevation, and sediment regimes in the mainstem channel as well as at tributary confluences, side channels, and sloughs, both in the area of the inundation upstream from the proposed dam site and downstream in the potential zone of project hydrologic influence. Such modifications may have an adverse effect upon the aquatic communities and fish populations residing in the river, the degree of which will ultimately depend on final Project design and operating characteristics.

The potential effects of the Project on fish and aquatic resources will need to be carefully evaluated as part of the licensing process. This study plan describes the Susitna-Watana Fish and Aquatic Resources Study that will be conducted to characterize and evaluate these effects. The overall objectives of this study are to provide a baseline characterization of existing resources, to collect information that will support the evaluation of potential resource impacts of the proposed Project that were identified during development of the PAD, public comment, and FERC scoping for the License Application. This study will be subject to revision and refinements in consultation with licensing participants as part of the continuing study planning process identified in the ILP. The impact assessments will inform development of any necessary protection, mitigation, and enhancement measures to be presented in the draft and final License Applications.

AEA is committed to conducting a thorough evaluation of the aquatic resources that could potentially be affected by the Susitna-Watana Hydroelectric Project. AEA recognizes that the Susitna River supports a diverse assemblage of fish and aquatic biota and provided a detailed description of these resources in the PAD; however, AEA acknowledges that more information is needed to provide a better understanding of the species interaction with and dependencies on the river. To this end, AEA has initiated baseline studies on hydrology and fish resources in the lower, middle and upper Susitna River in 2012. These 2012 studies will be carried forward in the formal FERC ILP study program in 2013 and 2014. In addition, AEA is proposing to implement 15 additional fish and aquatic studies in 2013 and 2014 that will further document current conditions and provide information that will support the assessment of potential Project impacts.

The actual assessment of potential impacts will rely on information provided by the fish resources studies (See sections 7.5 through 7.16), the instream flow study (surface water flow routing during ice-free conditions; see Section 6.5), the geomorphology study (sediment supply/transport regime and channel morphology; see sections 5.8 and 5.9), ice processes study (surface water flow routing during the winter, ice growth and break up; see Section 5.10), groundwater study (surface water/groundwater interactions; see Section 5.7), and riparian instream flow botanical surveys (See Section 6.6). These studies will result in development of a series of flow sensitive models (e.g., models of selected anadromous and resident fish habitats by species and life stage, models to assess connectivity and passage conditions provided into side channel and slough habitats, models to describe invertebrate habitats, temperature model, ice model, sediment transport model, turbidity model, large woody debris (LWD) recruitment model) that will be able to translate effects of alternative Project operations on the respective processes and biological resources. Because alternate Project operational scenarios will likely affect different habitats and processes differently, both spatially and temporally, the habitat and process models will be spatially discrete (e.g., by site, segment, and reach) and yet able to be integrated to allow for a holistic evaluation of each alternative operational scenario. This will allow for an Integrated Resource Analysis of separate operational scenarios that includes each resource element, the results of which can serve in a feedback capacity leading to new or modifications of existing operations scenarios.

One of the key benefits to this approach is that AEA will be able to evaluate the potential effects of Project operations under different hydrologic conditions (e.g. wet, normal and dry year) and for varying time steps (e.g. hourly, daily, monthly etc.). This will allow for assessments of a wide range of operational characteristics including load following, base load operations, and others. These types of analysis can be extended over variable time intervals that can be used to assess Project effects over a life cycle of a given species. For example, Project operational effects could be evaluated over five year (or other specified interval) increments of time as a means to estimate how Chinook salmon (or other species) habitats might vary over that period (taking into consideration all of the flow-sensitive parameters noted above). These types of analyses could be done both retrospectively as a means to consider influences of existing and historic flow conditions, as well as prospectively as a means to evaluate effects of future project operations.

The information that will be collected and the models developed will be crucial to FERC for completing a thorough environmental impact assessment and for establishing appropriate protection, mitigation, and enhancement measures for inclusion in the Project license necessary for avoiding, reducing, or mitigating for Project effects.

AEA has carefully considered the importance of the Susitna River and its resources and while working diligently with licensing participants and technical consultants has identified and designed the studies presented herein in the PSP. All of the studies are planned to be completed in a timely fashion to support the license application and AEA is confident the information generated will provide FERC with sufficient information to complete its analysis. AEA’s confidence in this matter is strengthened substantially owing to the extensive amounts of data and information that were collected on the Susitna River during the 1980s that formed much of the basis for the PAD. AEA has acquired the majority of the data and information collected during those studies and in 2012 has sanctioned the technical review and compilation of the information so it will be available for use during the 2013-2014 studies and for impact analysis. The results of the two years of intensive study as described in this PSP, coupled with the extensive amount of pre-existing, relevant information collected during the 1980s and ongoing efforts in 2012 will provide FERC the information and analysis needed to complete a sound, scientific assessment of the baseline conditions and potential Project.

7.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

As described above, the construction and operational strategy of the Project will create a reservoir, modify the flow, thermal, gravel recruitment and sediment regimes, and may alter connectivity of aquatic habitats in the Susitna River basin. These potential ecosystem changes will alter the composition and distribution of fish habitat and may have effects on fish and aquatic productivity. The proposed hydropower operations for the Project may influence the abundance and distribution of one or more of the resident and anadromous fish populations. The degree of impact will necessarily vary depending on the magnitude, frequency, duration, and timing of flows as well as potential Project-related changes in temperature and turbidity. Baseline information on existing conditions will be needed, to predict the likely extent and nature of potential changes that will occur due to Project construction and operations.

7.3. Agency and Alaska Native Entities Resource Management Goals and Objectives

Aquatic resources including fish and their habitats are generally protected by a variety of state and federal mandates. In addition, various land management agencies, local jurisdictions, and non-governmental interest groups have specific goals related to their land management responsibilities or special interests. These goals are expressed in various statutes, plans, and directives:

Alaska Statute 41.14.170 provides the authority for state regulations to protect the spawning, rearing, or migration of anadromous fish. Alaska Statute 41.14.840 regulates the construction of fishways and dams. State regulations relating to fish resources are generally administered by ADF&G. ADF&G is responsible for the management, protection, maintenance, and improvement of Alaska's fish and game resources in the interest of the economy and general well-being of the state (AS 16.05.020). ADF&G monitors fish populations and manages subsistence, sport and commercial uses of fish through regulations set by the Board of Fisheries (AS 16.05.221). The *Policy for Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) sets guidelines for ADF&G's management of State salmon resources. The statewide *Policy for the Management of Su stainable Wild Trout Fisheries* (PMSWTF; 5 AAC 75.222) currently guides wild rainbow trout regulatory changes. Cook Inlet Rainbow Trout/Steelhead Management Policy (CIRTMP; ADF&G 1987) provides further guidelines specific to rainbow trout in the Northern Cook Inlet Management Area (NCIMA). ADF&G's authority for protection of fish resources and habitat if further established through the Anadromous Fish Act (AS 16.05.871 – 901) and the Fishway Act (AS 16.05.841).

In addition to the state statutes, the following resource management plans and directives provide guidance and direction for protection of fish resources and aquatic habitats on lands within or adjacent to the Project area:

- Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) passed in 1980 set forth a subsistence use priority for the taking of fish and wildlife on public lands.
- The Federal Subsistence Board, which comprises representatives of the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and U.S. Forest Service, oversees the Federal Subsistence Management Program (57 FR 22940; 36 CFR Parts 242.1–28; 50 CFR Parts 100.1–28), with responsibility for managing subsistence resources on Federal public lands for rural residents.
- Magnuson-Stevens Fishery Conservation and Management Act (PL 104-267) provides federal protection for Essential Fish Habitat (EFH) defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NOAA's

National Marine Fishery Service (NOAA Fisheries) is responsible for designating EFH. In the case of anadromous fish streams (principally salmon), NOAA Fisheries has designated the AWC prepared by ADF&G (Johnson and Klein 2009) as the definition of EFH within freshwater habitats.

- Aquatic Resources Implementation Plan for Alaska's Comprehensive Wildlife Conservation Strategy, September 2006. Prepared by ADF&G, Division of Sport Fish.
- Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources. Prepared by ADF&G, Juneau, Alaska. xviii+824 pp.

Management and land use plans relevant to Fish and Aquatic Resources Study components include the following:

- The role of state land use plans, generally administered by Alaska Department of Natural Resources (DNR), was established by state statute (AS 38.04.005). The Susitna-Matanuska Area Plan (SMAP) and The Southeast Susitna Area Plan (SSAP) direct how the DNR will manage general state uplands and shorelands within the planning boundaries.
- The Susitna Basin Recreation Rivers Management Plan describes how the Department of Natural Resources (DNR) will manage state land and water along six rivers including: the Little Susitna River, Deshka River, Talkeetna River, Lake Creek, Talachulitna River, and Alexander Creek. The plan determines how these six rivers will be managed over the long term including providing management intent for each river segment, new regulations for recreation and commercial use, and guidelines for leases and permits on state land.
- The Susitna Flats Game Refuge Management Plan provides ADF&G guidance to manage the refuge to protect fish and wildlife populations, including salmon spawning and rearing habitats.
- Chickaloon Native Village is an Ahtna Athabascan Indian Tribe and is a federally recognized Alaska Native tribe. The Chickaloon Village Traditional Council strives to increase traditional Ahtna Dene' practices for the betterment of all residents in the area. The Tribe envisions a future with functioning ecosystems, flourishing fish and wildlife populations and a healthy, prosperous community.

7.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Input regarding the issues to be addressed in the Fish and Aquatic Resources Study has been provided by licensing participants during workgroup meetings commencing in late 2011. During 2012, workgroup meetings were held in January, February, April and June during which resource issues were identified and discussed and objectives were defined. Various agencies (USFWS, NMFS, ADF&G, etc.) provided written comments specific to this study which have been considered and will be addressed as part of this plan. A summary of consultations relevant to fish and aquatics resources is provided in Table 7.4-1.

Table 7.4-1. Summary of consultation on Fish and Aquatic Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Letter	12/30/2011	A.G. Rappoport	USFWS	Critically review 1980s data for applicability to current Project. Quantify fish distributions and collect longitudinal thermal imaging data.
Letter	01/12/2012	P. Bergmann	USDOI	Fully characterize fish habitat use, HSC, species and assemblages throughout all three reaches of the Susitna River and tributaries, address climate change in studies, invasive species, effects of flow changes on fish passage through Devils Canyon. (Filed with FERC.)
Technical Workgroup Meeting Notes	01/25/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, The Nature Conservancy, Natural Heritage Institute, Alaska Conservation Alliance, Knik Tribe, Knikatnu Inc, Nuvista Light & Power, and other interested parties	Meeting to discuss Project and 2012 Fisheries Study Plans. See Attachment 1-1.
Letter	02/10/2012	A.G. Rappoport	USFWS	Use minimum 5-year temporal scale, include winter evaluations beginning in 2012, conduct thermal imaging, use 2-D models, use site-specific data instead of professional judgment for HSC,
Letter	02/21/2012	A.G. Rappoport	USFWS	Requested that Adult Salmon Distribution and Habitat Utilization Study be integrated with instream flow and expand spawning habitat study to lower river.
Letter	02/29/2012	J.W. Balsiger	NMFS	Requested information on how interrelated studies will be integrated, requested climate change be incorporated into many, if not all studies. (Filed with FERC.)
Technical Workgroup Meeting Notes	03/01/2012	Various	AEA, USFWS, NMFS, BLM, NPS, ADF&G, ADNR, FERC, Natural Heritage Institute, Hydropower Reform Coalition, Susitna River Advisory Committee,	Meeting to discuss Project and 2012 Fisheries Study Plans and table of proposed 2013-2014 studies, potential methods and objectives. See Attachment 1-1.

Comment Format	Date	Stakeholder	Affiliation	Subject
			Alaska Ratepayers, and other interested parties	
Meeting Notes	03/02/2012	J. Erickson	ADF&G	Discussion of conceptual study designs for salmon escapement studies in the Susitna River.
Meeting Notes (Prepared by D. Reiser)	03/07/2012	S. Walker, M. Buntjer, B. McCracken, B. Henszey, J. Klein	NMFS, USFWS, ADF&G	Written summary of teleconference meeting held on 03/07/2012 to discuss 2012 and 2013/2014 studies. Topics included: model flow vs. habitat relationships in all reaches affected by the Project; complete analysis of fish habitat issues, ice and potential effects of Project on formation, breakup, etc., fish use of winter habitat; groundwater and water temperature and potential Project influences; time series analysis of habitats; and evaluation of riparian communities under alternate Project operations.
E-mail	03/28/2012	J. Erickson, R. Yanusz, M. Willette, L. Fair	ADF&G	Email request for comments on the draft 2012 study plan, which is the basis for the 2013-14 Salmon Escapement Study Plan
Phone Call	03/30/2012	J. Erickson	ADF&G	Follow up to review comments on the 2012 escapement/habitat utilization study plan; the 2013-14 study plan derived directly from the 2012 study plan.
Technical Workgroup Meeting Notes	04/05/2012	Various	AEA, ADNR, ADF&G, BLM-Glennallen, FERC, NMFS, USFWS,USGS, Mike Wood, Natural Heritage Institute, The Nature Conservancy, and other interested parties	Meeting to discuss 2012 study plans and 2013-2014 Study Requests prepared by AEA team. See Attachment 1-1.
E-mail	04/17/2012	J. Klein	ADF&G	Comments on April 2-6 Technical Workgroup Meetings.
E-mail	04/23/2012	M. Bunjer	USFWS	See written comments on study requests:
Teleconference	04/26/2012	S. Walker, E. Rothwell, M. Buntjer, B. McCracken, J. Erickson, J. Klein, M. Sondergaard, M. Cutlip	NMFS, USFWS, ADF&G, BLM, FERC	Open discussion of objectives and approaches to consider in 2013-14 study plans.
Meeting Notes	04/26/2012	B. Templin, C. Habicht, A. Barclay (ADF&G); AEA	ADF&G Gene Lab	Discussion of genetic sampling needs in the Susitna Watershed, which samples to collect in 2013-14, and

Comment Format	Date	Stakeholder	Affiliation	Subject
		contractors (LGL, R2, and HDR)		potential uses to project impact assessment, fishery management, and stock assessment (including estimating abundance of Chinook salmon).
E-mail	05/01/2012	M. Buntjer	USFWS	Mike delivered several historic documents (1950s – 1960s) that were in house at USFWS to the Fisheries Consulting Team .
E-mail	05/04/2012	M. Buntjer	USFWS	Delivery of draft river productivity study request to USFWS for preview.
Phone call	05/14/2012	M. Buntjer	USFWS	Mike called and we discussed various aspects of several fish studies including winter fish sampling, early life history, and river productivity. With respect to winter sampling we discussed pros and cons of potential methods and our experience on other systems. We discussed the need for the early life history to address the Project nexus. Mike also suggested that the USFWS would like us to add particulate organic matter (POM) to the data collection effort under the river productivity study.
Meeting Notes	05/17/12	J. Buckwalter	ADF&G	Upper River fisheries studies – tributaries to sample for Chinook salmon, field sampling logistics, Odyssey Fisheries Database System
Teleconference	05/18/2012	M. Buntjer, B. McCracken, S. Walker, R. Benkert	USFWS, NMFS, ADF&G	Open discussion of winter sampling methods to consider.
Study Requests, Letters	05/30/2012 - 05/31/2012	Various	Multiple Stakeholders	Stakeholders' comments on PAD, SD1 and study requests. (Filed with FERC.)
E-mails (several)	06/07/2012	J. Klein, M. Buntjer, B. Henszey, S. Walker	NMFS, USFWS, ADF&G	Reponses to request for follow-up post-stakeholder meeting to be held in the afternoon of 06/13/2012.
Technical Workgroup Meeting Notes	06/12/2012	Various (see meeting record)	Multiple Stakeholders	Meeting to discuss Stakeholder Study Requests.
Teleconference	06/20/2012	M. Buntjer, B. McCracken, S. Walker, R. Benkert, j. Erickson	USFWS, NMFS, ADF&G	Follow up from the TWG meeting on 12 June 2012. Discussion of sampling design for macroinvertebrates including sampling in channel margins and wood as a substrate. Clarification of semantic issues regarding escapement versus counts and all species versus all species captured.

Comment Format	Date	Stakeholder	Affiliation	Subject
Meeting Notes	06/21/2012	J. Erickson	ADF&G	ADF&G provided the text of the request for the fish genetics study, which the fish genetics study plan is largely built on.
Meeting Notes	06/26/2012	M. Miguera, B. Mahoney, K. Savage, J. Klein, M. Burch, B. Small	NMFS, ADF&G	Meeting to discuss FERC process, 2012 Cook Inlet Beluga Whale (CIBW) Study, 2013-2014 CIBW Study and fish prey studies on eulochon, Chinook, chum, sockeye and coho salmon.
E-mail	06/28/2012	J. Erickson	ADF&G	LGL and ADF&G discuss genetics and escapement study plans, estimating Chinook salmon abundance using genetic-based methods, and relative effectiveness of different methodologies to estimate salmon abundance in the lower, middle, and upper Susitna.
Phone Call	07/10/2012	S. Ivey	ADF&G	Coordination between HDR and ADF&G for Chinook salmon aerial spawning surveys in Indian River.
E-mail	07/10/2012	J. Erickson	ADF&G	Coordination with ADF&G for Chinook salmon aerial spawning surveys in Indian River.
E-mails	05/14/2012, 05/21/2012, 07/12/2012, 07/13/2012	B. Piorkowski, C. Habicht, J. Berger, S. Ivey, M. Bethe, A. Barclay, M. Daigneault, L. Boyle	ADF&G	Various dialogues between HDR and ADF&G regarding Fish Research Permit SF2012-151 for the Upper River Fisheries Distribution and Abundance Study stipulations, amendments and compliance.

7.5. Study of Fish Distribution and Abundance in the Upper Susitna River

7.5.1. General Description of the Proposed Study

This study is focused on fish species that use the Susitna River upstream of Devils Canyon. Fishery resources in the upper sections of the Susitna River basin consist of a variety of salmonid and non-salmonid resident fish (Table 7.5-1). With one known exception (i.e., Chinook salmon), existing information indicates that anadromous fish are restricted to the mainstem Susitna River and tributaries downstream of Devils Canyon near RM 150 due to their apparent inability to pass several steep rapids. In addition to the resident salmonid and non-salmonid fishes present in this part of the river, this study will also investigate the distribution and abundance of any anadromous fish that have passed upstream of Devils Canyon. Chinook salmon are known to pass Devils Canyon at relatively low numbers (maximum peak count of 46 adult Chinook salmon during 1984; Thompson et al. 1986).

The physical habitat modeling efforts proposed in Section 6.5 of this PSP require information on the distribution and periodicity of different life stages for the fish species of interest. Not all life stages of the target fish species may be present throughout the Upper Susitna River, and seasonal differences may occur in their use of some habitats. For example, some fish that use tributary streams during the open-water period may overwinter in mainstem habitats.

This study is designed to provide baseline biological information regarding periodicity and habitat suitability for the Instream Flow Modeling Study (see Section 6.5). Results of this study will include key life history information about fish species in the Upper Susitna River based on two sampling approaches. The first sampling approach will involve active and passive capture methods to identify the seasonal timing, distribution, and abundance of fish at a variety of locations and habitat types upstream of Devils Canyon. The second sampling approach will be the use of biotelemetry to monitor the movements and habitat utilization of radio-tagged fish.

7.5.1.1. Study Goals and Objectives

The overarching goal of this study is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous species (e.g., Bering cisco, Dolly Varden, humpback whitefish, northern pike, and Pacific lamprey), and freshwater rearing life stages of anadromous fish (fry and juveniles) in the Susitna River above Devils Canyon. Specific objectives include:

1. Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of resident fishes, juvenile anadromous salmonids, and the freshwater life stages of non-salmon anadromous species;
2. Determine whether Dolly Varden and humpback whitefish residing in the upper river exhibit anadromous or resident life histories;
3. Collect tissue samples to support the *Genetic Baseline Study for Selected Fish Species* (Section 7.14);
4. Determine baseline metal concentrations in fish tissues for resident fish species in the mainstem Susitna River (see *Mercury Assessment and P otential for Bioaccumulation Study*, Section 5.12);

5. Use biotelemetry (PIT and radio tags) to describe seasonal movements of selected fish species (including rainbow trout, Dolly Varden, whitefish, northern pike, burbot, and Pacific lamprey if present) with emphasis on identifying spawning and overwintering habitats within the hydrologic zone of influence upstream of the project;
6. Document the timing of downstream movement and catch for fish species via outmigrant traps; and
7. Document the presence/absence of northern pike in all samples.

7.5.2. Existing Information and Need for Additional Information

Information regarding resident species, non-salmon anadromous species, and the freshwater rearing lifestages of anadromous salmon was collected during studies in connection with APA's proposed Susitna Hydroelectric Project in the 1980s. Existing information includes the spatial and temporal distribution of fish species and their relative abundance. The Pre-Application Document (PAD) (AEA 2011a) and Aquatic Resources Data Gap Analysis (ARDGA; AEA 2011b) summarized this existing information and also identified data gaps for resident and rearing anadromous fish.

A total of nine anadromous and resident fish species have been documented inhabiting the Susitna River drainage upstream of Devils Canyon (Table 7.5-1). Chinook salmon use of the Upper Susitna River was first documented during the 1980s studies; this is the only anadromous fish documented to pass the rapids at Devils Canyon. Resident species that have been identified in all three reaches of the Susitna River include Arctic grayling, Dolly Varden, humpback whitefish, round whitefish, burbot, longnose sucker, and sculpin. To varying degrees, the relative abundance and distribution of these species were determined during the early 1980s studies. For most species, the dominant age classes and sex ratios were also determined, and movements, spawning habitats, and overwintering habitats were identified for certain species.

One species that has not been documented in the Susitna River, but may occur in the upper Susitna drainage, is lake trout. Lake trout have been observed in Sally Lake and Deadman Lake of the upper Susitna watershed (Delaney et al. 1981a) but have not been observed in the mainstem Susitna or tributary streams. Pacific lamprey have been observed in the Chuit River (Nemeth et al. 2010), which also drains into Cook Inlet. Northern pike is an introduced species that has been observed in the lower and middle river (Rutz 1999, Delaney et al. 1981b). Although it is considered unlikely that Pacific lamprey and northern pike are present in the Upper Susitna, this study will be helpful for evaluating these species' distributions.

In the proposed impoundment zone, Arctic grayling are believed to be the most abundant fish species (Delaney et al. 1981a, Sautner and Stratton 1983) and were documented spawning in tributary pools. In tributaries, juvenile grayling were found in side channels, side sloughs, and pool margins and in the mainstem at tributary mouths and clear water sloughs during early summer. Dolly Varden populations in the upper Susitna River are apparently small but widely distributed. Burbot in the upper Susitna River were documented in mainstem habitats with backwater-eddies and gravel substrate. The abundance of longnose suckers in the Upper Susitna River was less than downstream of Devils Canyon.

Specific information needs relative to fish distribution and abundance in the Upper Susitna River that were identified in the ARDGA (AEA 2011b) include:

- Population estimates of adult Arctic grayling and Dolly Varden in select tributaries within the proposed impoundment zone;
- The migration timing of Arctic grayling spawning in the proposed impoundment zone, the relative abundance and distribution of Dolly Varden, lake trout, and juvenile Chinook salmon in the impoundment zone; and
- Physical habitat characteristics used by round whitefish, longnose sucker, and burbot within the impoundment zone.

Little is known about the density and distribution of juvenile salmon in the Susitna River upstream of the proposed dam site at RM 184. Pacific salmon (all five species) were captured in the lower and middle Susitna River during the 1980s. Chinook salmon are the only anadromous species known to occur in the upper Susitna River and tributaries although the information on the extent of their distribution is limited. In the 1980s, adult Chinook salmon were observed in Cheechako, Chinook, Devil and Fog Creeks (ADF&G 1985). More recent sampling documented adults in Fog Creek, Tsusena and Kosina creeks and also documented juvenile Chinook salmon in Fog Creek, Kosina Creek and in the Oshetna River (Buckwalter 2011). Coho, chum, sockeye, and pink salmon were found in the lower and middle Susitna River during the 1980s but have not been observed upstream of Devils Canyon.

Existing fish and aquatic resource information appears insufficient to address the following issues that were identified in the PAD (AEA 2011a):

- **F1:** Effect of change from riverine to reservoir lacustrine habitats resulting from Project development on aquatic habitats, fish distribution, composition, and abundance, including primary and secondary productivity.
- **F2:** Potential effect of fluctuating reservoir surface elevations on fish access and movement between the reservoir and its tributaries and habitats.
- **F3:** Potential effect of Watana Dam on fish movement.

Site-specific knowledge of the distribution, timing, and abundance of fish likely to occupy the proposed Watana Reservoir primarily depends on the results of surveys conducted by ADF&G during the early 1980s using multiple sampling methods (AEA 2011a). The existing information can provide a starting point for understanding the distribution and abundance of anadromous and resident freshwater fishes in the Susitna River and the functional relationship with the habitat types present. However, any significant differences in the patterns in abundance and distribution observed during the 1980s compared to current conditions need to be determined.

In addition to providing baseline information about aquatic resources in the proposed Project area, aspects of this study are designed to complement and support the following other fish and aquatic studies.

- Instream Flow Study (Section 6.5) – Fish collections will help to validate fish periodicity, habitat associations, and selection of target species for reach-specific analyses.
- Salmon Escapement and Early Life History Study (Section 7.7) - Patterns of distribution and abundance from traditional sampling methods will help to validate and complement information from radio telemetry observations of Chinook salmon.
- Fish Harvest Study (Section 7.15) – Fish distribution and abundance will complement information about harvest rates and effort expended by commercial, sport, and subsistence fisheries.

- Characterization of Aquatic Habitats (Section 7.9) – Fish collections and observations in conjunction with aquatic habitat characterization will aid in the development of fish and habitat associations (Escapement Study and Instream Flow Study).
- Groundwater-related Aquatic Habitat Study (Section 5.7) – Fish observations and collections will aid in the identification of important groundwater habitats.
- Fish Passage Barriers Study (Section 7.12) – Fish collections will provide data on fish use in sloughs and tributaries with seasonal flow-related or permanent fish barriers.
- River Productivity Study (Section 7.8) – Fish collections and observations will help to characterize relative abundance, size-at-age, condition of fish, and contribution of marine-derived nutrients, which are important for estimating overall river productivity.

7.5.3. Study Area

The study area encompasses the mainstem Susitna River from Devils Canyon (RM 150) up to the Oshetna River confluence (RM 233.4) (Figure 7.5-1). The upper Susitna River is further delineated by the location of the proposed Watana Dam at RM 184 because effects of the Project are anticipated to be different upstream and downstream of the proposed dam. The mainstem Susitna River and its tributaries upstream of the proposed dam will be within the impoundment zone and subject to Project operations that affect daily, seasonal, and annual changes in pool elevation plus the effects of initial reservoir filling. In contrast, the mainstem downstream of the Project will be subject to the effects of flow modification from Project operations. Tributary surveys upstream of the proposed Watana Dam are further delineated by the 3,000 foot elevation contour and are based on the known extent of juvenile Chinook salmon distribution. Some study components, such as resident fish life-history studies and juvenile Chinook salmon distribution sampling, may extend beyond the core area.

7.5.4. Study Methods

This study will employ a variety of field methods to build upon the existing information related to the distribution and abundance of fish species in the Upper Susitna River. The following sections provide brief descriptions of the suite of methods that will be used to accomplish each objective of this study. This study was initiated in 2012 and will continue over the next two years to survey as much habitat as possible.

The study utilizes two approaches for obtaining key life history information about the fish that inhabit the Susitna River. The first approach uses passive and active methods to capture fish throughout the year at a variety of locations in the Susitna River upstream of Devils Canyon. The second method utilizes biotelemetry, including radio-tracking and PIT tags, to monitor the movements and habitat utilization of individuals.

7.5.4.1. Passive and Active Sampling

A combination of gill netting, electrofishing, angling, trot lines, minnow traps, snorkeling, outmigrant trapping, beach seines, fyke nets, dual-frequency identification sonar (DIDSON), and video camera techniques will be used to sample or observe fish in the Upper River, and moving in and out of selected sloughs and tributaries draining to the Susitna River. Several assumptions are associated with the use of the proposed methods:

- If it can be conducted safely, snorkeling, electrofishing, and gill netting will require nighttime sampling in clear-water areas to increase the efficacy of fish capture or observation;
- Gill netting is likely the most effective means of capturing fish in open-water areas of the main Susitna River channel;
- All fish sampling and handling techniques described within this study will be conducted under state and federal biological collection permits, and state and federal regulatory agencies will grant permission to conduct the sampling efforts. Limitations on the use of some methods during particular time periods or locations may affect the ability to make statistical comparisons among spatial and temporal strata;
- Fish sampling techniques provide imperfect estimates of habitat use and relative fish abundance. Use and comparison of multiple sampling methods provides the opportunity to identify potential biases, highlight strengths and weaknesses of each method, and ultimately improve estimates of fish distribution and relative abundance; and
- Sampling in the reservoir inundation zone will be scaled based on elevation and Chinook salmon distribution. More intensive surveys will be conducted in tributaries to be inundated up to elevation of 2,200 feet. Sampling from 2,200 feet to 3,000 feet elevation will be focused on Chinook salmon. If Chinook salmon are located, sub-sampling will continue upstream to the upper extent of suitable Chinook salmon habitat.

Some details of the sampling scheme have been provided for planning purposes; however, modifications may be appropriate as the results of 2012 data collection are reviewed. A final sampling scheme will be developed by the first quarter of 2013 in coordination with licensing participants.

The work effort for active and passive fish sampling is divided into 10 methods, as described below.

Gill Net Sampling

Deploy variable mesh gill nets (7.5-foot long panels with 1-inch to 2.5-inch stretched mesh) approximately once per month during the ice-free months of 2013 and 2014, except August, when two sampling events will occur. In open water and at sites with high water velocity, gill nets will be deployed as drift nets, while in slow water sloughs, gill nets will be deployed as set (fixed) nets. Depending on conditions, gill nets may be deployed in ice-free areas, and under the ice during winter months. The location of each gill net set will be mapped using handheld GPS units and marked on high-resolution aerial photographs. The length, number of panels, and mesh of the gill nets will be consistent with nets used by ADF&G to sample the river in the 1980s (ADF&G 1982, ADF&G 1983, ADF&G 1984).

Electrofishing

Conduct monthly, boat-mounted, barge, or backpack electrofishing surveys using standardized transects). Boat-mounted electrofishing is the most effective means of capturing fish in shallow areas (<10 feet deep) near stream banks and within larger side channels. Barge-mounted electrofishing is effective in areas that are wadeable, but have relatively large areas to cover and are too shallow or inaccessible to a boat mounted system. Backpack electrofishing is effective in wadeable areas that are relatively narrow. The effectiveness of barge and backpack electrofishing systems can be enhanced through the use of block nets. In all cases the electrofishing unit will be operated and configured with settings consistent with guidelines established by ADF&G. The location of each electrofishing transect will be mapped using handheld GPS units and marked on high-resolution aerial photographs.

Selection of the appropriate electrofishing system will be made as part of site selection, which will include a site reconnaissance and be determined in collaboration with the Fish and Aquatic Technical Workgroup. To the extent possible, the selected electrofishing system and transects will be standardized and the methods will be repeated during each sampling period at a specific site to evaluate temporal changes in fish distribution. Habitat measurements will be collected at each site using the characterization methods identified in Section 7.9. Any changes will be noted between sample periods. The electrofishing start and stop times will be recorded and the river water surface elevation relative to an arbitrary benchmark will be measured using a hand level. Where safety concerns can be adequately addressed, electrofishing will also be conducted after sunset in clear water areas; otherwise electrofishing surveys will be conducted during daylight hours.

Angling

During field trips organized for other sampling methods, hook-and-line angling will be conducted on an opportunistic basis using artificial lures or flies with single barbless hooks. The primary objective of hook and line sampling will be to capture subject fish for tagging and to determine presence/absence; a secondary objective will be to evaluate seasonal fish distribution.

Trot Lines

Trot lines can be an effective method for capturing burbot, rainbow trout, Dolly Varden, grayling, and whitefish. Trot lines can also be used during periods of winter ice cover. Trot line sampling was one of the more frequently used methods during the 1980s and was the primary method for capturing burbot. Trot lines will consist of 14 to 21 feet of seine twine with 6 leaders and hooks lowered to the river bottom. Trot lines will be checked and rebaited after 24 hours and pulled after 48 hours. Hooks will be baited with salmon eggs, herring, or whitefish. Salmon eggs are usually effective for salmonids, whereas the herring or whitefish are effective for burbot. Trot line construction and deployment will follow the techniques used during the 1980s studies as described in ADF&G (1982).

Minnow Traps

During the 1980s, minnow traps were the primary method used for capturing sculpin, lamprey, and threespine stickleback. Minnow traps also captured rainbow trout and Arctic grayling. Minnow traps will be baited with salmon roe, checked and rebaited after 24 hours, and pulled after 48 hours. Between 5 and 10 minnow traps will be deployed, depending upon the size of the sampling site.

Snorkeling

Two experienced biologists will conduct snorkel surveys along standardized transects in clear water areas during both day and night during each field survey effort. Snorkelers will visually identify and record the number of observed fish by size and species. The location of each snorkel survey transect will be mapped using handheld GPS units and marked on high resolution aerial photographs.

Fyke/Hoop Nets

Fyke or hoop nets will be deployed to collect fish in sloughs and side channels with moderate water velocity (< 3 feet per second). After a satisfactory location has been identified at each site, the same location will be used during each subsequent collection period. The nets will be operated continuously for a two-day period. Each fyke net will be configured with two wings to guide the majority of water and fish to the net mouth. Where possible, the guide nets will be configured to maintain a narrow open channel along one bank. Where the channel size or configuration does not allow an open channel to be maintained, the area below the fyke net will be checked regularly to assess whether fish are blocked and cannot pass upstream. A live car will be located at the downstream end of the fyke net throat to hold captured fish until they can be processed. The fyke net wings and live car will be checked daily to clear debris and to ensure that captured fish do not become injured. The location of the fyke net sets will be mapped using a handheld GPS unit and marked on high-resolution aerial photographs.

Beach Seine

Beach seines are suitable in shallow water areas free of large woody debris and snags such as boulders. Beach seines will be 6 feet in depth and 75 feet in length; however, the actual length of seine used will depend on the site conditions. The location fished will be mapped using handheld GPS units and marked on high resolution aerial photographs. The area swept will be noted. To the extent possible, the same area will be fished during each sampling event.

Outmigrant Trap

Rotary screw traps and inclined plane traps are useful for determining the timing of emigration by downstream migrating juvenile salmonids and resident fish (Objective 6). One site located near the proposed Watana Dam will be selected for an outmigrant trap. Selection of rotary screw traps or inclined plane traps and the location will occur in collaboration with the Fish and Aquatic TWG and be based on the physical conditions at the selected sites and logistics for deploying, retrieving, and maintaining the traps. Flow conditions permitting, traps will be fished on a cycle of 48 hours on, 72 hours off throughout the ice-free period.

DIDSON and Video Cameras

DIDSON and video cameras are proposed to survey up to 10 selected sloughs and side channels during the winter period. The sloughs will be the same as those selected for the winter-time deployment of PIT tag antennas. The deployment techniques will follow those described by Mueller et al. (2006). DIDSON and/or video cameras will be lowered through auger holes drilled through the ice to make 360 degree surveys. Mueller et al. (2006) found that DIDSON cameras were useful for counting and measuring fish up to 52.5 feet (16 meters) from the camera and were effective in turbid waters. In contrast, they found that video cameras were only effective in clear water areas with turbidity less than 4 NTU. However, Mueller et al. (2006) noted that identifying species and observing habitat conditions were more effective with video cameras than DIDSON cameras. In addition to fish observations, video cameras will also be used to characterize winter habitats attributes such as the presence of anchor ice, hanging dams, and substrate type.

Fish Handling

Field crews will record the date, start and stop times, and level of effort for all sampling efforts as well as water temperature and dissolved oxygen at sampling locations. With the exception of snorkeling, all captured fish will be identified to species, measured to the nearest millimeter (mm) total length, and weighed to the nearest gram. The presence/absence of northern pike and other invasive fish species will be documented in all samples (Objective 7). For snorkeling, all fish observed will be identified to species and total length will be estimated within 40 millimeter bin sizes. If present, observations of poor fish condition, lesions, external tumors, or other abnormalities will be noted. When more than 30 fish of a similar size class and species are collected at one time, the total number will be recorded and a subset of the sample will be measured and weighed to provide at least 30 measurements for each species and size class. To meet Objective 5, all juvenile salmon, rainbow trout, Arctic grayling, Dolly Varden, burbot, longnose sucker, and whitefish greater than 60 mm in length will be scanned for passive integrated transponder (PIT) tags using a portable tag reader. A PIT tag will be implanted into all fish of these species that do not have tags and are approximately 60 mm and larger.

Otoliths will be collected from Dolly Varden and humpback whitefish greater than 200 mm (7.8 inches) in length to test for marine derived elements indicative of an anadromous life history pattern (Objective 2). We assume that larger fish are more likely to have exhibited anadromy and therefore propose otolith collection only from fish greater than 200 mm. A target of 30 fish of each species during 2013 and 2014 will be collected (60 fish of each species total).

Tissue samples will be collected from selected resident and non-salmon fish to support the Genetic Baseline Study (Objective 3; Section 7.14). The target number of samples, species of interest, and protocols are outlined in Section 7.14. Tissue or whole fish samples will also be collected in the mainstem Susitna River for assessment of metals concentrations (Objective 4) (see *Mercury Assessment and Potential for Bioaccumulation Study*, Section 5.12). The number of fish per species or species assemblage and the handling protocols will be determined in coordination with the Fish and Aquatics TWG and the Subsistence group for species consumed by humans and the Wildlife TWG for piscivorous furbearers and birds.

7.5.4.2. Remote Fish Telemetry

Remote telemetry techniques will include radiotelemetry and PIT tags. Each of these methods is intended to provide detailed information from relatively few individual fish. Radio-tracking provides information on fine and large spatial scales related to the location, speed of movement, and habitat utilization by surveying large areas and relocating tagged individuals during aerial, boat, and foot surveys. PIT tags can be used to document relatively localized movements of fish as well as growth information from tagged individuals across seasons and years. However, the “re-sighting” of PIT-tagged fish is limited to the sites where antenna arrays are placed. To determine movement in and out of side-sloughs or tributaries requires that tagged fish pass within several feet of an antenna array, thereby limiting its use to sufficiently small water bodies. To characterize growth rates, fish must be recaptured, checked for a tag, and measured.

7.5.4.2.1. Radiotelemetry

Re-location data from the radio-telemetry component of this study will characterize timing and degree of movements among macrohabitats. Radio-tagged fish provide information on a much greater spatial scale than PIT tags, but potentially less on a temporal scale.

Radio transmitters will be surgically implanted in up to 30 fish of sufficient body size of each species in the Upper River. These fish will be captured during sampling events, with the spatial and temporal allocation of fish being determined based on input from the Fish and Aquatic TWG and after the 2012 study results are available (i.e., preliminary fish abundance and distribution). The tag's signal pulse duration and frequency, and, where appropriate, the transmit duty cycle, will be a function of the life history of the fish and configured to maximize battery life and optimize data collection. Large tags will provide the greatest duration and will be used when possible. Duty cycles can be programmed to enable the tag to be dormant for periods when surveys will not be conducted and greatly extend tag life.

Locating radio-tagged fish will be achieved by fixed receiver stations and aerial surveys. With input from the TWG, up to four fixed receivers will be established at tributary mouths along the mainstem of the Upper Susitna River and serviced in conjunction with the Salmon Escapement Study. These fixed stations will be downloaded as power supplies necessitate and up to twice monthly during the salmon spawning period (approximately July through October). The Salmon Escapement Study will provide approximately weekly aerial survey coverage of the study area. At other times of the year, the frequency of aerial surveys will be at least monthly. Spatial and temporal allocation of survey effort will be finalized based on the actual locations and number of each species of fish tagged, and input from the TWG.

7.5.4.2.2. PIT Tag Antenna Arrays

As described above, fish of appropriate size from target species will be implanted with a PIT tagged for mark-recapture studies. Half-duplex PIT tags either 12 mm in length or 23 mm in length will be used, depending upon the size of the fish to be implanted. Each PIT tag has a unique code that allows identification of individuals. Recaptured fish will provide information on the distance and time travelled since the fish was last handled and changes in fish length and weight.

PIT tag antenna arrays with automated data logging will be used at selected side channel, side slough, and upland slough sites to detect movement of tagged fish into or out of the site. A variety of antenna types may be used including hoop antennas, swim-over antennas, single rectangle (swim-through) antennas, or multiplexed rectangle antennas to determine the directionality of movement.

Up to six sites will be selected for deploying PIT tag antenna arrays. AEA will work collaboratively with the Fish and Aquatic TWG to select the sites for antenna deployment. Antennas will be deployed shortly after ice-off in 2013. Data loggers will be downloaded every two to four weeks depending upon the need to replace batteries and reliability of logging systems. Power to the antennas will be supplemented with solar panels.

On an experimental basis, swim-over antennas will be deployed at three sites prior to ice-over and maintained throughout the winter months. Downloading of data and battery replacement every three to four weeks, weather permitting, will be the objective during the winter months.

Depending upon the success at these three sites during the winter of 2012-2013, winter deployment of antennas may be expanded during the following two study years.

7.5.5. Consistency with Generally Accepted Scientific Practices

This study plan was developed by fisheries scientists in collaboration with the Fish and Aquatic TWG and draws upon a variety of methods including many that have been published in peer reviewed scientific journals. As such, the methods chosen to accomplish this effort are consistent with standard techniques used throughout the fisheries scientific community. However, logistical and safety constraints inherent in fish sampling in a large river in northern latitudes also play a role in selecting appropriate methodologies. In addition, some survey methods may not be used in the mainstem river immediately upstream of Devils Canyon to avoid any risk of being swept into the canyon. During the 1980s studies, no surveys were conducted on the mainstem river from RM 150 to RM 189.0, except for spawning surveys conducted by helicopter.

7.5.6. Schedule

The proposed schedule for the completion of the Study of Fish Distribution and Abundance in the Upper Susitna River is:

- Selection of study sites – January – March 2013
- Open water fieldwork – May to October 2013 and May to October 2014
- Ice-over fieldwork – December to April 2013-2014 and December to April 2014-2015
- Reporting of interim results – September 2013 and 2014.
- QC'd geospatially-referenced relational database – December 2013 and 2014.
- Data analysis – October to December 2013 and October to December 2014
- Initial and Revised Study Reports on 2013 and 2014 activities – December 2013 and 2014, respectively.
- Supplemental memorandum on winter 2014-2015 activities – May 2015

7.5.7. Level of Effort and Cost

This is a multiyear study that will begin in early 2013 and end in March 2015. The study will include three winter periods and two ice-free periods. Sampling will be conducted according to a stratified scheme designed to cover a range of habitat types. Stratification for mainstem sites will be based on the five major habitat types: main channel, side channel, tributary mouth, side slough, and upland slough. To evaluate variability within the strata, five sites for each habitat type will be selected for the mainstem river (25 sites). Sampling frequency at each site will vary from month to month:

- December to April – 2 sampling events
    - 3 sites per habitat type for the mainstem river
    - DIDSON, video, gill nets, minnow traps, and trot lines only
- May – 1 sampling event
- June – 1 sampling event
- July – 1 sampling event
- August – 2 sampling events

- September – 1 sampling event
- October/November - No Sampling

Stratification of habitats to be sampled in tributary streams will include pools, runs, and backwaters (if present). Selection of sampling sites will be influenced by the results of the tributary habitat mapping and fish sampling conducted by AEA during 2012, which may indicate some tributaries are unsuitable for sampling because of safety issues or passage barriers. A number of tributaries will be selected in consultation with the Fish and Aquatic TWG. Some tributaries to be considered include:

- Fog Creek,
- Unnamed northern tributary about one mile downstream of Tsusena Creek,
- Tsusena Creek,
- Deadman Creek,
- Unnamed northern tributary between Deadman Creek and Watana Creek,
- Watana Creek,
- Unnamed southern tributary downstream from Kosina Creek,
- Kosina Creek,
- Jay Creek,
- Unnamed Southern tributary between Jay and Goose Creek,
- Unnamed Northern tributary downstream from Oshetna Creek,
- Goose Creek, and
- Oshetna River.

Eight tributary streams will be targeted for sampling during 2013 and 2014. All tributaries in which Chinook salmon juveniles or adults were observed within or at the mouth of a tributary during 2012 or previous surveys by Buckwalter (2011) (i.e., Fog Creek, Kosina Creek, Tsusena Creek, Oshetna River) will be sampled. The remaining tributaries that are suitable for sampling will be selected at random. For each selected tributary stream, up to three habitat types (pool, riffle, backwater) will be selected at random for sampling. Specific sampling methods from those described above will be selected based upon the habitat conditions. To the extent possible, the same sampling methods will be used during all sampling events for a particular site. Physical habitat measurements (length, width, habitat type, photographs) will be collected at all sites sampled.

Estimated cost for implementing the Study of Fish Distribution and Abundance in the Upper Susitna River is $2,000,000.

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7.5.9. Tables

Table 7.5-1. Summary of life history, known Susitna River usage of fish species within the upper Susitna River reaches (Compiled from Delaney et al. 1981).

Common Name	Scientific Name	Life History[a]	Susitna Usage[b]	Distribution[c]
Arctic grayling	*Thymallus arcticus*	F	O, R, P	Low, Mid, Up
Burbot	*Lota lota*	F	O, R, P	Low, Mid, Up
Chinook salmon	*Oncorhynchus tshawytscha*	A	M_2, R	Low, Mid, Up
Dolly Varden	*Salvelinus malma*	A,F	O, P	Low, Mid, Up
Humpback whitefish[d]	*Coregonus pidschian*	A,F	O, R, P	Low, Mid, Up
Lake trout	*Salvelinus namaycush*	F	U	U
Longnose sucker	*Catostomus catostomus*	F	R, P	Low, Mid, Up
Round whitefish	*Prosopium cylindraceum*	F	O, M_2, P	Low, Mid, Up
Sculpin[e]	*Cottid*	M_1, F	P	Low, Mid, Up

[a] A = anadromous, F = freshwater, M_1 = marine

[b] O = overwintering, P = present, R = rearing, S = spawning, U = unknown, M_2 = migration

[c] Low = Lower River, Mid = Middle River, Up = Upper River, U = Unknown

[d] Whitefish species that were not identifiable to species by physical characteristics in the field were called humpback by default. This group may have contained Lake (*Coregonus clupeaformis)*, or Alaska (*Coregonus nelsonii*) whitefish.

[e] Sculpin species generally were not differentiated in the field. This group may have included Slimy (*Cottus cognatus*), Prickly (*Cottus asper)*, Coastal range (Cottus aleuticus), and Pacific staghorn (*Leptocottus armatus*).

7.5.10. Figures

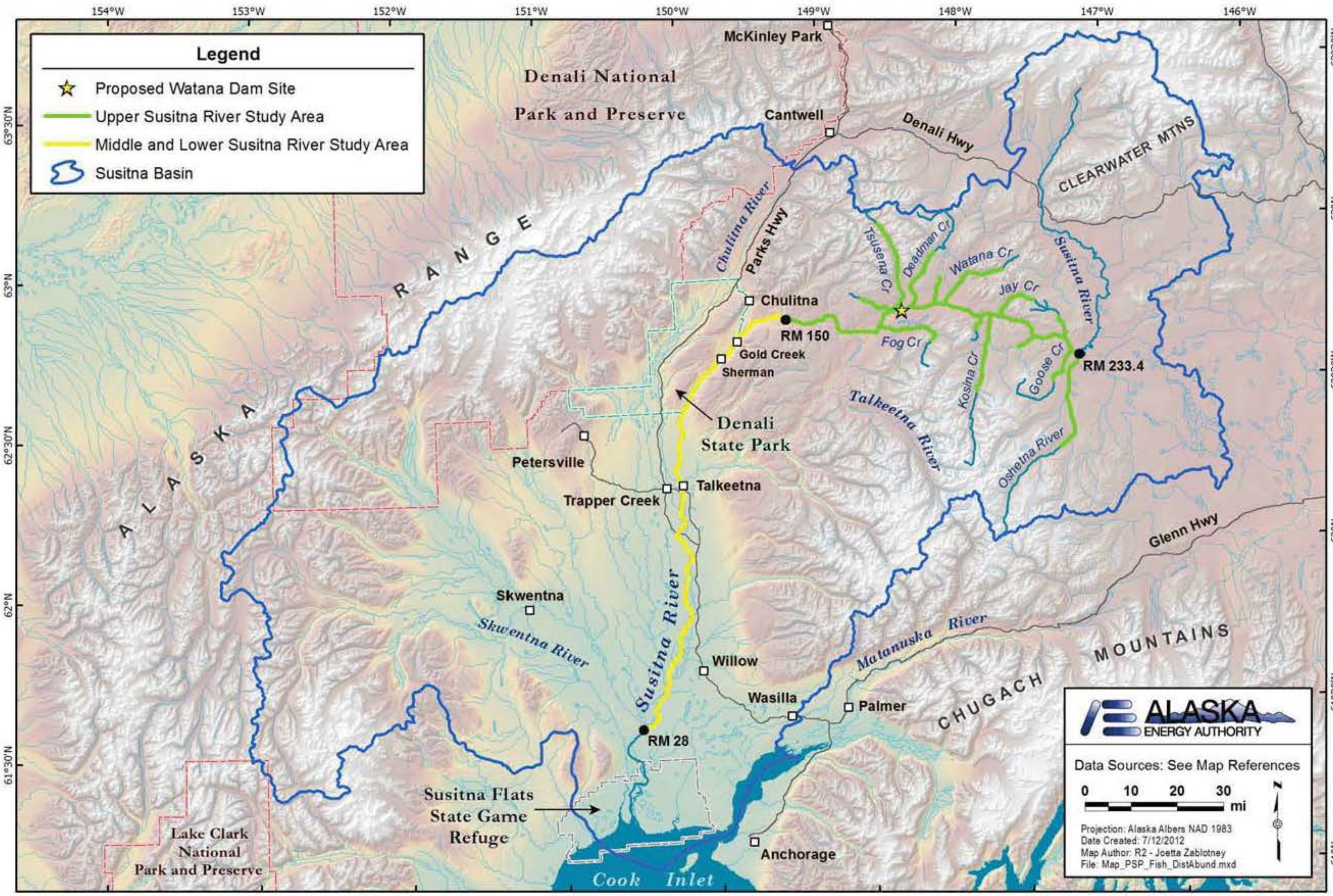

Figure 7.5-1. Fish distribution and abundance study area.

7.6. Study of Fish Distribution and Abundance in the Middle and Lower Susitna River

7.6.1. General Description of the Proposed Study

This study is focused on fish species that use the Susitna River downstream of Devils Canyon. Fishery resources in the upper sections of the Susitna River basin consist of a variety of salmonid and non-salmonid resident fish (Table 7.6-1). Adult salmon species are addressed in the Salmon Escapement Study (Section 7.7).

The physical habitat modeling efforts proposed elsewhere in this PSP require information on the distribution and periodicity of different life stages for the fish species of interest. Not all life stages of the target fish species may be present throughout the Middle and Lower Susitna River, and seasonal differences may occur in their use of some habitats. For example, some fish that use tributary streams during the open-water period may overwinter in mainstem habitats such as groundwater-fed sloughs.

This study is designed to provide baseline biological information and supporting information for the Instream Flow Modeling Study (see Section 6.5). This study will obtain key life history information about the fish in Middle and Lower Susitna River using two sampling approaches. The first sampling approach involves active and passive capture methods to identify the seasonal timing, distribution, and abundance of fish at a variety of locations and habitat types downstream of Devils Canyon. The second sampling approach involves biotelemetry to monitor the movements and habitat utilization of tagged fish.

7.6.1.1. Study Goals and Objectives

Construction and operation of the Project will affect flow, water depth, surface water elevation, water temperature, and sediment dynamics, among other variables, in the mainstem channel as well as at tributary confluences, side channels, and sloughs, both in the area of inundation upstream from the Watana Dam site and downstream in the potential zone of Project hydrologic influence. These changes can have beneficial or adverse effects upon the aquatic communities residing in the river. To assess the effects of river regulation on fish populations, an understanding of existing conditions will be needed, providing baseline information for predicting the likely extent and nature of potential changes that will occur due to the Project's effects on flow and temperature regimes.

The overarching goal of this study is to characterize the current distributions, relative abundances, run timings, and life histories of all resident and non-salmon anadromous species encountered including, but not limited to: Bering cisco, Dolly Varden, eulachon, humpback whitefish, northern pike, and Pacific lamprey, and freshwater rearing life stages of anadromous fish (fry and juveniles) in the Middle and Lower Susitna River. Specific objectives include:

1) Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes;
2) Describe seasonal movements of selected fish species such as rainbow trout, eulachon, Dolly Varden, whitefish, northern pike, Pacific lamprey, and burbot) using biotelemetry

(PIT and radio-tags) with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem of the Susitna River and its associated off-channel habitat;

3) Document the timing of downstream movement and catch for all fish species using outmigrant traps;
4) Characterize the age structure, growth, and condition of juvenile anadromous and resident fish by season;
5) Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike); and
6) Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Genetic Baseline Study (Section 7.14).

7.6.2. Existing Information and Need for Additional Information

Information regarding resident species, non-salmon anadromous species, and the freshwater rearing lifestages of anadromous salmon was collected as part of the studies conducted during the early 1980s. Existing information includes the spatial and temporal distribution of fish species and their relative abundance. The PAD (AEA 2011a) and Aquatic Resources Data Gap Analysis (ARDGA; AEA 2011b) summarized this existing information and also identified data gaps for resident and rearing anadromous fish.

Approximately 18 anadromous and resident fish species have been documented in the Susitna River drainage (Table 7.6-1). Three additional species are considered likely to be present, but have not been documented. To varying degrees, the relative abundances and distributions of these species were determined during the early 1980s studies. For most species, the dominant age classes and sex ratios were also determined, and movements, spawning habitats, and overwintering habitats were identified for certain species. Resident species that have been identified in all three reaches of the Susitna River include Arctic grayling, Dolly Varden, humpback whitefish, round whitefish, burbot, longnose sucker, and sculpin. Other species that were observed in the Middle and Lower reaches include Bering cisco, threespine stickleback, arctic lamprey, and rainbow trout. Eulachon have been documented only in the Lower reach.

Species that have not been documented, but may occur in the Susitna drainage, include lake trout, Alaska blackfish, and Pacific lamprey. Lake trout have been observed in Sally Lake and Deadman Lake of the upper Susitna watershed (Delaney et al. 1981a), but have not been observed in the mainstem Susitna or tributary streams. Pacific lamprey have been observed in the Chuit River (Nemeth et al. 2010), which also drains into Cook Inlet. Northern pike is an introduced species that has been observed in the lower and middle river (Rutz 1999, Delaney et al. 1981b).

Non-salmon species that exhibit anadromous life histories in the Susitna River include eulachon, humpack whitefish, and Bering cisco. Dolly Varden may exhibit both anadromous and resident freshwater life history forms (Morrow 1980); however, Dolly Varden in the Susitna River were regarded primarily as a resident fish during studies conducted in the 1980s (FERC 1984). Other species that can exhibit an anadromous life history include humpback whitefish, threespine stickleback, Arctic lamprey, and Pacific lamprey (Morrow 1980). Northern pike are considered an invasive species in the Susitna drainage and have spread throughout the system from the Yenta drainage after being illegally introduced in the 1950s (Rutz 1999). Alaska blackfish would also be considered an invasive species in this basin, and while not previously captured in the Susitna River, may have been introduced.

Pacific salmon (all five species) were captured in the lower and middle Susitna River during the 1980s. Coho salmon typically outmigrate to sea as age 1+ or age 2+ fish. Because chum and pink salmon outmigrate to sea within a few months of emergence, little is known about their dependence on the Susitna River. Most age 0+ sockeye salmon outmigrate from the middle river. It has not been determined whether they rear in the lower river or if they go to sea at age 0+.

Existing fish and aquatic resource information appears insufficient to address the following issues identified in the PAD (AEA 2011a):

- F4: Effect of Project operations on flow regimes, sediment transport, temperature, and water quality that result in changes to seasonal availability and quality of aquatic habitats, including primary and secondary productivity. The effect of Project-induced changes include stream flow, stream ice processes, and channel morphology (streambed coarsening) on anadromous fish spawning and incubation habitat availability and suitability in the mainstem and side channels and sloughs in the middle river above and below Devils Canyon.
- F6: Potential influence of the proposed Project flow regime and the associated response of tributary mouths on fish movement between the mainstem and tributaries within the Middle River Reach.
- F7: Influence of Project-induced changes to mainstem water surface elevations July through September on adult salmon access to upland sloughs, side sloughs, and side channels.
- F8: Potential effect of Project-induced changes to stream temperatures, particularly in winter, changing the distribution of fish communities, particularly invasive northern pike.

Agency staff have also expressed concerns that over time (i.e., 50 years) historic salmon spawning areas downstream of the Watana Dam site may become less productive due to potential changes in habitat conditions, in particular, those areas affected by sediment transport, gravel recruitment, bed mobilization, and embeddedness.

Site-specific knowledge of the distribution, timing, and abundance of fish in the Susitna River is available from the results of surveys conducted by ADF&G during the early 1980s using multiple sampling methods (AEA 2011a). The existing information can provide a starting point for understanding the distribution and abundance of anadromous and resident freshwater fishes in the Susitna River and understanding the functional relationship with the habitat types present. However, any significant differences between current abundance and distribution patterns and those observed during the 1980s need to be documented.

In addition to providing baseline information about aquatic resources in the Project Area, aspects of this study are designed to complement and support other fish and aquatic studies as follows.

- Instream Flow Study (Section 6.5) – Fish collections will help to validate fish periodicity, habitat associations, and selection of target species for reach-specific analyses.
- Salmon Escapement Study (Section 7.7) - Patterns of distribution and abundance from traditional sampling methods will help to validate and complement information from radio telemetry, fishwheel, and sonar observations of salmon.

- Fish Harvest Study (Section 7.15) – Fish distribution and abundance will complement information about harvest rates and effort expended by commercial, sport, and subsistence fisheries.
- Characterization of Aquatic Habitats (Section 7.9) – Fish collections and observations in conjunction with aquatic habitat characterization will aid in the development of fish and habitat associations.
- Eulachon Distribution and Abundance (Section 7.16) – This study is directed towards eulachon, which is an important forage fish for beluga whales.
- Groundwater-related Aquatic Habitat Study (Section 5.7) – Fish observations and collections will aid in the identification of important groundwater habitats.
- Fish Passage Barriers Study (Section 7.12) – Fish collections will provide data on fish use in sloughs and tributaries with seasonal flow-related or permanent fish barriers.

7.6.3. Study Area

The proposed study area encompasses the Susitna River from RM 28 upstream to Devils Canyon (RM 150) (Figure 7.5-1). RM 28 is near the confluence with the Yentna River, approximates the upper extent of tidal influence, and is the lower extent of the Habitat Characterization Study (Section 7.9).

7.6.4. Study Methods

The study involves the use of two approaches for obtaining key life history information about the fish that inhabit the Susitna River. The first approach includes passive and active methods to capture fish throughout the year at a variety of locations in the Susitna River downstream of Devils Canyon. The second method is remote fish telemetry, used to monitor the movements and habitat utilization of individuals. With one exception, the following study methods are consistent with those described in study requests submitted by NMFS (2012) and USFWS (2012). Because of safety issues associated with winter conditions and remote study locations, AEA has decided to not include ice-diving as a proposed method in this study.

7.6.4.1. Passive and Active Sampling

A combination of gill net, electrofishing, angling, trot lines, minnow traps, snorkeling, fishwheels, outmigrant trapping, beach seines, fyke nets, DIDSON, and video camera techniques will be used to sample or observe fish in the Lower River and Middle River, and moving in and out of selected sloughs and tributaries draining into the Susitna River. The methods proposed are similar to those described in Section 7.5.4.1. A few additional methods that may be applicable to the habitats and species in the Middle and Lower River are described below.

7.6.4.1.1. Fishwheels

Fishwheels will primarily be deployed to capture anadromous salmon as part of the Adult Salmon Escapement and Early Life History Study (Section 7.7). However, non-salmon species are occasionally captured by fishwheel. Non-salmon species collected by fishwheel will provide additional data to support the objectives of this study and will be used opportunistically as a source of fish for tagging studies and tissue sampling.

7.6.4.1.2. Outmigrant Traps

Rotary screw traps and inclined plane traps are useful for determining the timing of emigration of downstream migrating juvenile salmonids and resident fish. Two sites within side channels open continuously throughout the ice-free season will be selected for outmigrant traps near Based on 1980 fish distribution data Whiskers Creek offers a potential location for sampling in the middle river. Selection of rotary screw traps or inclined plane traps will occur in collaboration with the Fish and Aquatic TWG and be based on the physical conditions at the selected sites and logistics for deploying, retrieving, and maintaining the traps. Flow conditions permitting, traps will be fished on a cycle of 48 hours on, 72 hours off throughout the ice-free period.

7.6.4.2. Remote Fish Telemetry

Remote telemetry techniques will include radiotelemetry and PIT technology. Each of these methods is intended to provide detailed information from relatively few individual fish. Radio-tracking provides information on fine and large spatial scales related to the location, speed of movement, and habitat utilization by surveying large areas and relocating tagged individuals during aerial, boat, and foot surveys. PIT tags can be used to document relatively localized movements of fish as well as growth information from tagged individuals across seasons and years. However, the “re-sighting” of PIT-tagged fish is limited to the sites where antenna arrays are placed. To determine movement in and out of side-sloughs or tributaries requires that tagged fish pass within several feet of an antenna array, thereby limiting its use to sufficiently small water bodies. To characterize growth rates, fish must be recaptured, checked for a tag, and measured.

7.6.4.2.1. Radiotelemetry

Re-location data from the radio-telemetry component of this study will be used to characterize the timing of use and degree of movements among macrohabitats and over periods during which the radio tags remain active (possibly up to two or three seasons per tagged fish). Actual tag life will be determined by the appropriate tag for the size of the fish available for tagging.

Radio transmitters will be surgically implanted in up to 10 fish of sufficient body size of each species from five habitat types in the middle and lower river. These fish will be captured during sampling events that are described above (Passive and Active Sampling Methods) and below (Level of Effort and Cost). The final spatial and temporal allocation of tags will be determined based on input from the Fish and Aquatic TWG and after 2012 study results are available (i.e., preliminary fish abundance and distribution). The tag’s signal pulse duration and frequency, and, where appropriate, the transmit duty cycle, will be a function of the life history of the fish and configured to maximize battery life and optimize the data collection. Larger tags can accommodate the greatest battery life and therefore will be used when fish are large enough, but this will not limit application of tags across a range of body sizes. Duty cycles can be programmed to enable the tag to be dormant for periods when surveys will not be conducted (or fish are expected to overwinter in localized area) and this greatly extends tag life.

Locating radio-tagged fish will be achieved by fixed receiver stations and mobile surveys (aerial, boat, and foot). Fixed stations will largely be those used for the Salmon Escapement Study. In addition, up to five additional fixed stations will be established at strategic locations established during the field sampling and with input from the TWG. These stations will be serviced in conjunction with the Salmon Escapement Study during the July through October period and during dedicated trips outside this period. Fixed stations will be downloaded as power supplies necessitate and up to twice monthly during the salmon spawning period (approximately July through October). The Salmon Escapement Study will provide approximately weekly aerial survey coverage of the study area. At other times of the year, the frequency and location of aerial surveys will be at least monthly. Spatial and temporal allocation of survey effort will be finalized based on the actual locations and number of each species of fish tagged and input from the Fish and Aquatic TWG. Foot and boat surveys will be done as part of the spawning ground and habitat sampling in the Escapement Study.

7.6.4.2.2. PIT Tag Antenna Arrays

As described above, all captured fish 60 mm or larger of selected species will be checked for a PIT tag and tagged if one is not present. Half-duplex PIT tags either 12 mm in length or 23 mm in length will be used, depending upon the size of the fish. Each PIT tag has a unique code that allows for identification of individuals. Recaptured fish will provide information on the distance and time travelled since the fish was last handled and changes in length and weight.

PIT tag antenna arrays with automated data logging will be used at selected side channel, side slough, tributary mouth, and upland slough sites to detect movement of tagged fish into or out of the site. A variety of antenna types may be used including hoop antennas, swim-over antennas, single rectangle (swim-through) antennas, or multiplexed rectangle antennas to determine the directionality of movement.

Up to10 sites will be selected for deploying PIT tag antenna arrays. AEA will work collaboratively with the Fish and Aquatic TWG to select the sites for antenna deployment. Antennas will be deployed shortly after ice-off in 2013. Data loggers will be downloaded every two to four weeks, depending upon the need to replace batteries and reliability of logging systems. Power to the antennas will be supplemented with solar panels.

On an experimental basis, swim-over antennas will be deployed at five sites prior to ice-over and maintained throughout the winter months. Downloading of data and battery replacement every three to four weeks, weather permitting, will be the objective during winter months. Depending upon the success of these five sites during the winter of 2012-2013, winter deployment of antennas may be expanded during the two subsequent winter field seasons.

7.6.5. Consistency with Generally Accepted Scientific Practices

This study plan was developed by fisheries scientists in collaboration with the Fish and Aquatic TWG and draws upon a variety of methods including many that have been published in peer review scientific journals. As such, the methods chosen to accomplish this effort are consistent with standard techniques used throughout the fisheries scientific community. However, logistical and safety constraints inherent in fish sampling in a large river in northern latitudes also play a role in selecting appropriate methodologies. To describe the seasonal distribution, relative abundance, and habitat associations of the various fish species in winter, alternate methods involving snorkel and dive surveys were considered. These alternate methods were dismissed based on safety concerns owing to potentially extreme cold temperatures, remoteness of the sampling locations, and because sampling would most appropriately be conducted at night.

7.6.6. Schedule

The proposed schedule for the completion of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is:

- Selection of study sites – January – March 2013
- Open water fieldwork – May to October 2013 and May to October 2014
- Ice-over fieldwork – December to April 2013-2014 and December to April 2014-2015
- Reporting of interim results – September 2013 and September 2014.
- QC'd geospatially-referenced relational database – December 2013 and December 2014.
- Data analysis – October to December 2013 and October to December 2014
- Initial and Final Study Reports on 2013 and 2014 activities – December 2013 and 2014, respectively.
- Supplemental technical memorandum on winter 2014-2015 Activities – May 2015

7.6.7. Level of Effort and Cost

This is a multiyear study that will begin in early 2013 and end in March 2015. The study will include three winter periods and two ice-free periods. Sampling will be conducted according to a stratified sampling scheme designed to cover a range of habitat types. The first level of stratification will be the river sections identified previously. Namely the lower river from RM 28 to RM 98 and the middle river from RM 98 to RM 150. Because the Chulitna and Talkeetna rivers are anticipated to substantially moderate the effects of the proposed Project, sampling effort will be focused more heavily on the middle river. The second stratification level will be the five major habitat types: main channel, side channel, tributary mouth, side slough, and upland slough. To examine variability within the strata, three sites for each habitat type will be selected for the lower river (15 sites) and five sites for each habitat type will be selected for the middle river (25 sites) for a total of 40 sites. Sampling frequency at each site will vary from month to month:

- December to April – 2 sampling events
  - 5 sites per habitat type for middle river section
  - 3 sites per habitat for lower river section
  - DIDSON, video, gill nets, minnow traps, and trot lines only
- May – 1 sampling event
- June – 1 sampling event
- July – 1 sampling event
- August – 2 sampling events
- September – 1 sampling event
- October/November - No Sampling

Total study costs are estimated at $3,000,000.

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7.6.9. Tables

Table 7.6-1. Summary of life history, known Susitna River usage, and known extent of distribution of fish species within the lower, middle, and upper Susitna River reaches (From ADF&G 1981 a, b, c, etc.).

Common Name	Scientific Name	Life History[a]	Susitna Usage[b]	Distribution[c]
Alaska blackfish	*Dallia pectoralis*	F	U	U
Arctic grayling	*Thymallus arcticus*	F	O, R, P	Low, Mid, Up
Arctic lamprey	*Lethenteron japonicum*	A,F	O, M_2, R, P	Low, Mid
Bering cisco	*Coregonus laurettae*	A	M_2, S	Low, Mid
Burbot	*Lota lota*	F	O, R, P	Low, Mid, Up
Chinook salmon	*Oncorhynchus tshawytscha*	A	M_2, R	Low, Mid, Up
Chum salmon	*Oncorhynchus keta*	A	M_2, S	Low, Mid
Coho salmon	*Oncorhynchus kisutch*	A	M_2, S, R	Low, Mid
Dolly Varden	*Salvelinus malma*	A,F	O, P	Low, Mid, Up
Eulachon	*Thaleichthys pacificus*	A	M_2, S	Low
Humpback whitefish[d]	*Coregonus pidschian*	A,F	O, R, P	Low, Mid, Up
Lake trout	*Salvelinus namaycush*	F	U	U
Longnose sucker	*Catostomus catostomus*	F	R, P	Low, Mid, Up
Northern pike	*Esox lucius*	F	P	Low, Mid
Pacific lamprey	*Lampetra tridentata*	A,F	U	U
Pink salmon	*Oncorhynchus gorbuscha*	A	$M_{2,}$ R	Low, Mid
Rainbow trout	*Oncorhynchus mykiss*	F	O, M_2, P	Low, Mid
Round whitefish	*Prosopium cylindraceum*	F	O, M_2, P	Low, Mid, Up
Sculpin[e]	*Cottid*	M_1[f], F	P	Low, Mid, Up
Sockeye salmon	*Oncorhynchus nerka*	A	M_2, S	Low, Mid
Threespine stickleback	*Gasterosteus aculeatus*	A,F	M_2, S, R, P	Low, Mid

[a] A = anadromous, F = freshwater, M_1 = marine

[b] O = overwintering, P = present, R = rearing, S = spawning, U = unknown, M_2 = migration

[c] Low = Lower River, Mid = Middle River, Up = Upper River, U = Unknown

[d] Whitefish species that were not identifiable to species by physical characteristics in the field were called humpback by default. This group may have contained Lake (*Coregonus clupeaformis)*, or Alaska (*Coregonus nelsonii*) whitefish.

[e] Sculpin species generally were not differentiated in the field. This group may have included Slimy (*Cottus cognatus*), Prickly (*Cottus asper)*, Coastal range (Cottus aleuticus), and Pacific staghorn (*Leptocottus armatus*).

[f] Pacific staghorn sculpin were found in fresh water habitat within the Lower Susitna River Reach.

7.7. Salmon Escapement Study

7.7.1. General Description of the Proposed Study

Information from this salmon escapement study will be used in combination with other studies to assess potential effects of the proposed Project on fisheries resources. Construction and operation of the Project will modify the flow, thermal, and sediment regimes of the Susitna River, which may alter the composition and distribution of fish. This study will provide a basis for impact assessment and developing potential protection, mitigation, and enhancement measures, including resource management and monitoring plans. This study will provide information on the distribution and abundance of adult salmon in the lower, middle, and upper Susitna River. This work will be conducted through collaboration between AEA, the Alaska Department of Fish and Game (ADF&G), and other relicensing participants. Information developed in this study may also be used to develop any necessary protection, mitigation, or enhancement measures to address Project impacts to salmonid resources.

7.7.1.1 Study Goals

The primary goal of the study is to characterize the current distribution, abundance, habitat use, and migratory behavior of all species of adult anadromous salmon across mainstem river habitats and select tributaries above the three rivers confluence (i.e., confluence of the Susitna, Chulitna, and Talkeetna rivers). Sufficient information of this nature has been collected for several species elsewhere in the Susitna watershed. However, for Chinook and coho salmon, additional information would aid in assessing the potential impacts of the Project. Therefore, a second goal of this study is to estimate the distribution, abundance, and migratory behavior of adult Chinook and coho salmon throughout the *entire* Susitna River drainage.

7.7.1.2 Study Objectives

1. Capture, radiotag, and track adults of five species of Pacific salmon in the middle and upper Susitna River in proportion to their abundance. Capture and tag Chinook and coho salmon in the lower Susitna River.
2. Characterize the migration behavior and spawning locations of radiotagged fish in the lower, middle, and upper Susitna River.
3. Characterize adult salmon migration behavior and timing within and above Devils Canyon.
4. If shown to be an effective sampling method during the 2012 study, and where feasible, use sonar to document salmon spawning locations in turbid water in 2013 and 2014.
5. Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon.
6. Generate counts of adult Chinook salmon spawning in the Susitna River and its tributaries.
7. Collect tissue samples to support the Fish Genetic Baseline Study (Section 7.14).

8. Estimate system-wide Chinook and coho salmon escapement to the Susitna River and the distribution of those fish among tributaries of the Susitna River.

7.7.2. Existing Information and Need for Additional Information

Existing information includes fish spatial and temporal distribution and relative abundance information from recent and early 1980s studies. The Aquatic Resources Data Gap Analysis (ARDGA; AEA 2011a) and PAD (AEA 2011b) summarized existing information and identified data gaps for adult and rearing salmon. The licensing effort of the 1980s APA Susitna Hydroelectric Project generated a substantial body of literature, some of which will be summarized and used to support the 2013-2014 data collection efforts. The adult salmon habitat use studies conducted by ADF&G during the 1980s are summarized by Woodward-Clyde Consultants and Entrix, Inc. (1985). In recent years, ADF&G has conducted adult salmon (sockeye, coho, and chum) spawning distribution and abundance studies in the Susitna River (e.g., Merizon et al. 2010; Yanusz et al. 2011). In 2012, ADF&G expanded its scope to include Chinook and pink salmon. Existing fish and aquatic resource information appears insufficient to address the issues below that were identified in the PAD (AEA 2011b).

- **F2:** Potential effect of fluctuating reservoir surface elevations on fish access and movement between the reservoir and its tributaries and habitats.
- **F3:** Potential effect of Watana Dam on fish movement.
- **F4:** Effect of Project operations on flow regimes, sediment transport, temperature, and water quality that result in changes to seasonal availability and quality of aquatic habitats, including primary and secondary productivity. The effect of Project-induced changes include stream flow, stream ice processes, and channel morphology (streambed coarsening) on anadromous fish spawning and incubation habitat availability and suitability in the mainstem and side channels and sloughs in the middle river above and below Devils Canyon.
- **F5:** Potential effect of Project flow regime on anadromous fish migration above Devils Canyon. Devils Canyon is a velocity barrier to most fish movement and changes in flows can result in changes in the potential fish movement through this area (approximately RM 150).
- **F6:** Potential influence of the proposed Project flow regime and the associated response of tributary mouths on fish movement between the mainstem and tributaries within the Middle River reach.
- **F7:** Influence of Project-induced changes to mainstem water surface elevations July through September on adult salmon access to upland sloughs, side sloughs, and side channels.
- **F8:** Potential effect of Project-induced changes to stream temperatures, particularly in winter, changing the distribution of fish communities, particularly invasive northern pike.

Susitna River Chinook and coho salmon stocks support important commercial, sport, and subsistence fisheries in Northern Cook Inlet (NCI). The Susitna River currently supports the fourth largest run of Chinook salmon in Alaska (Ivey et al. 2009). Chinook salmon escapements in the Susitna drainage are monitored annually by ADF&G with single aerial (helicopter) or foot surveys. These surveys provide an index of escapement rather than a complete census of the escapement. These measurements provide a ranking of escapement magnitudes across years, but alone these measurements provide little information on the total number of fish in the escapement (Fair et al. 2010).

In 1985, ADF&G operated fishwheels at RM 22 and RM 82 in the Susitna River to estimate the escapement of Chinook salmon to the Susitna River drainage. The Chinook salmon escapement at Flathorn was estimated to be 113,931 fish (length greater than 400 millimeters [15.75 inches]) with a standard deviation of 77,931 (Thompson et al. 1986). This is the only drainage-wide Chinook salmon escapement estimate for the Susitna River. A drainage-wide abundance estimate of returning adult Chinook salmon using capture-recapture methods is most likely to yield the most accurate and precise estimate of the abundance of spawning Chinook salmon.

During the 1985 adult salmon investigation study, spawning ground surveys were conducted for Chinook salmon in the middle and lower Susitna River. These observational surveys were conducted by surveyors wearing polarized sunglasses looking for visual verification of mating pairs, distinct redds, or the confirmed presence of eggs by intra-gravel sampling (Thompson et al. 1986). No spawning areas were observed in the sloughs or middle-river mainstem channel in 1985. The 1985 report does not mention if spawning areas were found in the lower-river mainstem channel. This radiotelemetry study would characterize Chinook salmon spawning in the mainstem Susitna River. ADF&G has used this approach successfully to identify likely spawning areas for sockeye, coho, and chum salmon within the Susitna River drainage (Yanusz et al. 2011; Merizon et al. 2010; Yanusz et al. 2007).

At this time, it is unknown if Chinook salmon spawn upstream of Devils Canyon on an annual basis or if Chinook salmon spawn in the mainstem of the Susitna River below the proposed dam site. The studies will determine where Chinook salmon spawn within the Susitna drainage and quantify the escapement of Chinook salmon that spawn upstream of Devils Canyon as well as the number of Chinook salmon that spawn in the mainstem downstream of the proposed dam. Finally, these studies would assess the Chinook salmon production from the upper river relative to the entire Susitna drainage.

This study will also improve knowledge of the run timing and distribution of spawning Chinook and coho salmon in the Susitna River drainage. Finally, this study will aid in determining how well annual helicopter aerial escapement surveys of select Susitna River tributaries index and monitor trends in escapement of Susitna River Chinook salmon.

7.7.3. Study Area

The study area encompasses the Susitna River from Cook Inlet upstream to the Oshetna River, or as far upstream as Chinook salmon are detected (Figure 7.7-1), with an emphasis on wherever salmon spawn in the middle and upper river. The mainstem Susitna River is divided into two generalized reaches for the purposes of this study plan: the middle river (RM 98 -150) and upper river (RM 150 - 234). Devils Canyon extends from approximately RM 150 to RM 154.

7.7.4. Study Methods

Descriptions of the study methods are organized below by objective. This is a multi-year study initiated in 2012. The methods below refer to research to be conducted in years two and three (2013 and 2014).

7.7.4.1 Objective 1: Capture, radiotag, and track adults of five species of Pacific salmon in the middle and upper Susitna River in proportion to their abundance. Capture and tag Chinook and coho salmon in the lower Susitna and Yentna rivers.

Tasks to address Objective 1 include the following:

- Install and operate two fishwheels at approximately RM 30 of the Susitna and two fishwheels on the lower Yentna River from late May through August, 2013 and 2014.
- Install and operate two fishwheels at Curry (RM 120) from early June to early September in 2013 and 2014 (Figure 1).
- Radiotag a total of 400 Chinook salmon and 400 coho salmon in the lower Susitna (RM 30) and Yenta rivers.
- Radiotag 400 Chinook salmon and 200 each of chum, sockeye, pink, and coho salmon at Curry (RM 120).
- Assess the degree to which radiotagged fish are representative of all salmon passing the tagging sites (e.g., test for size selectivity, compare mark rates among spawning areas).
- Evaluate the potential for handling-induced changes in fish behavior based on the post-release survival and migration rates of radiotagged fish.

Meeting the goals of this study requires that the radiotagged fish of each species are representative of each species' "population" in the middle river. Tagging particular stocks and/or sizes of fish at different rates than others will weaken inferences about relative distribution among tributaries, habitat uses of the middle river such as the relative distribution of spawning fish, migratory behaviors, and any fish passage above Devils Canyon. There are multiple ways to assess whether fish passing the tagging sites are equally vulnerable to being radiotagged. Of greatest importance is to survey spawning areas to determine the size composition of tagged and untagged fish (size distributions) and determine the proportion of fish in different areas that contain a tag (i.e., the mark rate). Statistically significant differences in mark rates among areas would suggest unequal vulnerability; differences in the size distributions of the marked and unmarked fractions of the fish would suggest size-selective capture and tagging.

7.7.4.1.1 Fish Capture

Fishwheels will be used to capture adult salmon for tagging. Two fishwheels will be operated at approximately RM 30 in locations they were fished in 2010-12. Two fishwheels will be operated on the lower Yentna during a similar period, and in the same locations as have been operated for three decades. Two fishwheels will also be operated in 2013 and 2014 near Curry (RM 120) at the same locations in 1981-85 and 2012, from the first week of June through the first week of September. The fishwheels consist of aluminum pontoons, three baskets, and two partially submerged live tanks for holding fish in river water. A tower and winch assembly will be used to adjust the height of the baskets and ensure that the baskets are fishing within 20 cm of the river bottom. Net leads will be installed between fishwheels and the adjacent riverbank to direct fish away from the bank and into the path of the fishwheel baskets. Fishwheels will be operated 12 hours per day. A two-person crew will staff the fishwheels during operations; when the crew is to be absent from the fishwheel for more than 1 hour, the fishwheel baskets will be raised from the water and stopped.

Fishwheel effectiveness, expressed as a fraction of the passing salmon run it captures, often varies within and among seasons. Also known as the catchability coefficient, effectiveness changes with water depth under the fishwheel and water velocity around the fishwheel. The overall abundance of fish in the river at any one time may also affect effectiveness. Variable effectiveness within a season is most problematic for a study of this nature if it varies across the period of the annual run of a particular species and less problematic if it varies across species. Fish later or earlier within a run of a particular species can represent fish of different sizes, ages, and ultimately, fish bound for different habitats. Therefore, stable effectiveness across time, body size, and spawning destination are ideal, and these are assumptions that will need to be tested by appropriate data collection at the fishwheels and surveys of spawning areas. If sufficiently large numbers of fish can be tagged and later examined, any changes in effectiveness can be compensated for by stratification of results.

7.7.4.1.2 Radiotagging

ATS pulse-coded, extended-range tags will be applied to a subset of salmon captured in the lower and middle river fishwheels. There are 100 unique codes on each available frequency. Model F1835B transmitters will be used for pink salmon (16 grams, 30 centimeter long antenna, 96 day battery life), Model F1840B tags for sockeye, coho, and chum salmon (22 grams, 30 centimeter antenna, 127 day battery life), and Model F1845B tags for Chinook salmon (26 grams, 41 centimeter antenna, 162 day battery life). All transmitters will be equipped with a mortality sensor that changes the signal pattern to an “inactive” mode for the remainder of the season once the tag becomes stationary for 24 hours. All of the radio tags will be labeled with return contact information. Each tag will be tested immediately prior to deployment to ensure it is functioning properly upon release.

Only uninjured fish that meet or exceed a specific length threshold will be radiotagged; i.e., Chinook salmon with a mid-eye to fork length (METF) of ≥ 500 millimeters; coho, sockeye, and chum salmon ≥ 400 millimeters; and pink salmon ≥ 325 millimeters. These size thresholds proposed for coho, sockeye, and chum salmon are similar to those used by ADF&G (Yanusz et al. 2011; Merizon et al. 2010). The Chinook salmon length threshold coincides with all ocean-age 3 fish and a to-be-determined portion of ocean-age 2 fish. All fish to be tagged will be placed in a water-filled, foam-lined, V-shaped trough. To minimize handling time (i.e., achieve < 1 minute per fish) and tagging-related effects on fish behavior, anesthetic will not be used. Radio tags will be inserted orally into the stomach of the fish using a piece of PVC tubing (1/3 inch diameter and 18 inches long) with the tag antenna left to protrude from the mouth. No external marks will be applied to radiotagged fish.

All radiotagged salmon will be measured to determine mid-eye-to-fork length (to the nearest centimeter), and sexed based on external morphological characteristics (coloration, body and fin shape, jaw morphology). Some radiotagged fish may be tagged with a spaghetti tag to assess tag loss, evaluate the effects of spaghetti tagging on post-handling behavior and final spawning destination, and, to provide an external mark for anglers to recognize a fish that has a radio tag.

To minimize any effects from fish holding, only salmon just captured or held for less than 1 hour in the fishwheel live tanks will be radiotagged, and all fish will be released immediately after tagging. All fish captured will be inspected for radio and spaghetti tags.

7.7.4.1.3 Spaghetti Tagging

The fishwheels are expected to capture more fish of most species than needed for radiotagging alone and additional marking of fish will provide information to test assumptions about the representativeness of the fish captured to represent fish passing fishwheel sites, by species, and assess abundance through mark-recapture methods. A portion of these additional fish captured will be spaghetti-tagged, and this portion will vary among species according to their abundance and availability above tagging goals.

All Chinook and coho salmon above the daily goals will be spaghetti-tagged. Tagged Chinook salmon can be subsequently examined in several upstream tributaries to test study assumptions and determine the fraction marked in the different stock (see Objective 8).

Sockeye and chum salmon that spawn above Curry will be available for counting and examining for marks in clear-water side channels and sloughs and tributaries. Given the number of radio tags deployed (200/species), some additional marking of sockeye and chum with spaghetti tags may enable a test for the assumption that capture and marking of fish will be in proportion to stock-specific abundance passing Curry. We expect that insufficient numbers of pink salmon could be tagged (and later examined) to develop a defensible abundance estimate in 2013 ("off-peak" year) or in 2014 (peak-year).

7.7.4.1.4 Tagging Goals

Recent (2012) and historical (1981-85) fishwheel catches, effectiveness, and salmon run timing will guide tag application rates over the season. In 2012, Chinook salmon were captured at RM 30 from the last week of May through the first week of July.

Across the five years from 1981 to 1985, Chinook salmon were caught at Curry from as early as June 9 (range June 9-20) to as late as August 20 (range July 29 to August 20), with midpoints of the annual runs ranging from June 9-25. During those studies, catches ranged from 201-379 (average 301) for sockeye salmon, 93-350 (average 215) for coho salmon, 861-4,228 (average 2,131) for chum salmon, and 17,394 for the 1984 even-year pink salmon run. Midpoints of the annual migrations at Curry ranged from approximately August 4-5 for sockeye, August 12-13 for coho, August 3-15 for chum, and July 31 to August 7 for pink salmon. The runs at Curry in 2012 were most similar to those in 1985.

7.7.4.1.5 Numbers and Size of Marked and Unmarked Fish at Selected Locations

To test if Chinook, sockeye, and chum salmon passing fishwheels are equally vulnerable to being captured and radiotagged, fish will be examined on selected spawning grounds to develop two primary metrics: estimates of the proportion of fish tagged (mark rate) and the size distributions of tagged and untagged fish.

Weirs on tributary streams and aerial and foot surveys will be used to count live and dead fish. Combined with fixed-station and aerial re-locating data, these will provide counts of marked and unmarked fish. Lengths of dead fish will be measured to the nearest mm and sex and spawning success noted.

7.7.4.2 Objective 2: Determine the migration behavior and spawning locations of radiotagged fish in the lower, middle, and upper Susitna River.

This is a continuation of the multi-year study initiated in 2012. Tasks to meet Objective 2 include the following:

- Track the locations and behavior of radiotagged fish using an array of fixed-station receivers and mobile-tracking surveys. Aerial surveys will begin in July and end in early October each year.
- Conduct boat- and ground-based surveys to locate holding and spawning salmon to the level of microhabitat use.

Two groups of radiotagged fish will be tracked: adult Chinook, coho, chum, pink, and sockeye salmon will be radiotagged and released in the middle river at Curry (RM 120) and Chinook and coho salmon will be tagged in the lower Susitna (RM 30) and Yentna Rivers; Figure 7.7-1). The two study components and data analyses will be tightly coordinated. All mobile (aerial, boat, and foot) and fixed-station receiver data will be analyzed together, and analysis products will be characterized in a consistent manner.

The primary function of the telemetry component is to track these tagged fish spatially and temporally with a combination of fixed and mobile receivers. Time/date stamped, coded radio signals from tags implanted in fish will be recorded by fixed station or mobile positioning. All telemetry gear (tags and receivers) across both studies will be provided by ATS, Inc. (Advanced Telemetry Systems, www.atstrack.com)

The types of behavior to be characterized include:

- Arrival and departure timing at specific locations/positions;
- Direction of travel;
- Residence time at specific locations/positions;
- Travel time between locations/positions;
- Identification of migratory, holding, and spawning time and locations/positions; and
- Movement patterns in and between habitats in relation to water conditions (e.g., discharge, temperature, turbidity).

These data, in conjunction with habitat descriptions, will allow the characterization of migratory behavior and final destinations for salmon in mainstem habitats (main channel, slough, side channel) and tributaries. In addition, observed spawning locations will be characterized at a microhabitat level (e.g., depth, velocity, substrate). Spawning or final locations of tagged fish will be used to determine the number and proportion of the tagged fish of each species using mainstem habitats.

7.7.4.2.1 Fixed-Station Monitoring

Stand-alone operating telemetry arrays will be deployed at strategic locations on the lower, middle, and upper river to provide migration checkpoints and spawning ground inventories. Each station will include a radio receiver, power supply, antenna switcher, and two or three aerial antennas. Antennas may be mounted in trees or on tripod-mounted poles and orientated to distinguish between upstream and downstream movements of fish (i.e., direction of travel). Receivers will be programmed to scan all frequencies and record coded tags. Initial station installation will include range testing to define the expected detection range (approximately 900 linear feet at 10 feet water depth, configuration dependent) of each antenna. Standard reference or "beacon" tags will be deployed at most fixed stations to provide a continuous record of known signal detections. Fixed stations will be manually downloaded (i.e., by the field crew) on a weekly basis unless a remote communication protocol is established. Raw telemetry files will be archived and then imported into custom database software for processing and summarizing throughout the season, and for post-season reporting.

Figure 7.7-1 shows the locations of the radiotelemetry fixed stations in the lower, middle, and upper rivers. Proposed locations for radiotelemetry fixed stations in the middle and upper river are also shown in greater spatial resolution in Figure 7.7-2 and are listed below.

1. Lane Creek area (~ RM 113.0);
2. Middle River Gateway - (RM 123.7);
3. Slough 11 (~ RM 135.3);
4. Indian River confluence (RM 138.6);
5. Slough 21 (~ RM 141.1);
6. Portage Creek confluence (RM 148.8);
7. Cheechako Creek confluence (RM 152.4)
8. Chinook Creek confluence (RM 157.0);
9. Devil Creek area (RM 164.0); and
10. Kosina Creek confluence (RM 206.8).

The lower river stations were chosen to represent all significant tributaries that are known to contain or may contain Chinook salmon (Figure 7.7-1). The middle and upper river sites were chosen based on: 1) the need to provide geographic separation of the middle river area to describe migration and spawning behaviors, and 2) monitoring at the appropriate resolution through the upper river area to quantify passage through Devils Canyon. See below for additional details about the telemetric monitoring in Devils Canyon (Objective 3).

7.7.4.2.2 Telemetry Aerial Surveys

Aerial surveys of the mainstem Susitna from RM 22 to Kosina Creek will be conducted by helicopter to allow relatively accurate positioning of tagged fish, to locate spawning areas, and to make visual counts of fish in clear water areas, all with respect to mainstem habitat types. Aerial surveys will begin in July and end in early October (≈14 weeks). Survey timing may be adjusted depending on the observed fishwheel catches in the lower and middle river. Surveys will be scheduled at 5-day intervals with the intent to ensure a maximum of 7 days between surveys with weather contingencies. In the event that fixed stations indicate that no tagged fish have migrated upstream of Devils Canyon, aerial surveys to at least Kosina Creek will be conducted at least three times to confirm these results. If radiotagged fish are detected moving upstream in the mainstem at the Kosina Creek telemetry station, aerial surveys will be extended to locate those radiotagged fish and visually survey for untagged fish.

Surveys via helicopter can be conducted at lower elevations and at slower speeds than can be achieved using fixed-wing aircraft, and therefore will allow more time for signal acquisition, higher spatial resolution, and fish/habitat observations. Fixed-wing surveys are most appropriate when the study goal is a spatial resolution of tagged fish locations to be within approximately 800 meters (i.e., to the nearest 0.5 river mile), and some fixed wing surveys will be conducted about every 10 days. The goal for helicopter-based surveys is to be within approximately 300 meters (1000 feet), as well as to determine whether the fish is in off-channel or mainstem habitat. Higher precision will be achievable in reaches where conditions are most favorable. Geographic coordinates will be recorded for each detected signal using an integrated communication link between the telemetry receiver and a GPS unit. The position of the fish will be determined as that position of the aircraft at the time of the highest signal power. Range testing of the mobile aerial setup will be conducted in the lower river to confirm detection ranges for typical flying heights, receiver gains, and antenna orientation, as well as to work with the helicopter pilot to refine the methods for achieving highest spatial resolution.

The mainstem aerial surveys will need to cover over 200 river miles (RM 22 to RM 230), and multiples of that total when side channels and braids of the lower river are included. To allocate survey effort efficiently and to the highest priority needs, resolution will be a function of fish behavior. The highest priority and highest resolution needs will be for fish that appear to be holding or spawning. For migrating fish, resolution to the nearest 300 meters (~1,000 feet) of river will generally be sufficient. The proposed frequent surveys will provide a means of focusing a higher-resolution and time-intensive tracking effort on identifying exact locations of spawning and holding fish. To do this, the aerial survey team will have available the most recent observed river locations (to the nearest 1 kilometer [0.62 miles]) of all mainstem fish "at large" (i.e., tagged and not tracked in a tributary). During the survey, the "river km" of all detected fish will be compared to the last seen location from previous surveys to ascertain whether its position has changed by more than 2 kilometers (1.25 miles). When tagged fish are within 2 kilometers of their last seen location, the helicopter will circle at a lower altitude to pinpoint the fish location to mainstem, side channel, or slough habitats.

As well, when aggregations of two or more tagged fish are found "stationary" (i.e., within 2 kilometers [1.25 miles] on one or more surveys) and/or when visual observations of spawning fish are made from the helicopter, ground- and boat-based surveys will pinpoint spawning locations to within 5-10 meters (16-32 feet) . This protocol will be particularly important for ensuring coverage of any suspected lower river habitats with the appropriate level of spatial resolution.

The channel location (mainstem, side channel, slough) and relative water turbidity at the location of the fish will be classified for each tag detected (time stamp, frequency, code, power level) during aerial surveys. If other fish can be seen in the area of the tag position, their relative abundance will be estimated to provide context for the tag observation.

Tag identification, coordinates, and habitat type data will be archived and systematically processed after each survey. A data handling script will be used to extract unique tag records with the highest power level from the receiver files generated during the survey. These records will be imported into a custom database software application (Telemetry Manager) and incorporated into a GIS-based mapping database. Geographically and temporally stratified data of radiotagged fish will be provided to the habitat sampling team and Instream Flow Study to inform their field sampling efforts.

7.7.4.2.3 Lower River Surveys

Aerial surveys of the lower river will cover mainstem areas from RM 22 to the confluence of the Chulitna River (RM 98). This reach is highly braided with side channels and sloughs, so complete coverage will require considerable effort and in-flight route tracking. With the survey protocol outlined above and the number of tags anticipated to be at-large on any one survey, this area will require up to two survey days to complete.

7.7.4.2.4 Middle River Surveys

Mobile aerial surveys of the middle river will cover mainstem areas from the confluence of the Chulitna River (RM 98) through Devils Canyon (≈ RM 150-154). This reach (52 miles) will require approximately one day to complete, and as much as two days late in the season when all tags are deployed.

7.7.4.2.5 Upper River Surveys

Mobile aerial surveys of the upper river will generally be triggered by detection of fish moving above fixed-stations in the Portage and Devils Canyon stations. During station downloads (~weekly), aerial surveys will cover the mainstem areas from Devils Canyon (≈ RM 150-154) to the confluence of the Kosina Creek (RM 206.8). This reach will include approximately 57 relatively confined river miles. This survey will require approximately one survey day; less when done in conjunction with middle river surveys (i.e., when less conveyance time involved). Radiotagged fish above Devils Canyon will be located at a spatial resolution in habitat types similar to the middle and lower river surveys.

7.7.4.2.6 Boat and Ground Surveys

Telemetry surveys will also be conducted by boat and on foot to obtain the most accurate and highest resolution positions of spawning fish. Using the guidance of fixed-station and aerial survey data on the known positions of tagged fish, specific locations of any concentrations of tagged fish that are suspected to be spawning will be visited to obtain individual fish positions. We expect resolution to be within 5-10 meters (16-32 feet) in turbid water and within 2-3 meters (6.5-10 feet) in clear water (dependent on density and highest resolution at low densities). Underwater stripped-coax antennas and judicious use of signal gain control will allow locating tagged fish and recording their geographic position with a GPS. These data will be collected in concert with the field activities and provided to the habitat suitability sampling team to inform their sampling efforts. These surveys will be conducted approximately weekly during the July through September mobile tracking period.

7.7.4.3 Objective 3: Characterize adult salmon migration behavior and timing within and above Devils Canyon.

The tasks to achieve Objective 3 include the following:

- Establish an array of fixed-station receivers at and above Devils Canyon to monitor the behavior of radiotagged fish from early June to October each year (Figures 7.7-1 and 7.7-2);
- Conduct aerial surveys of the upper river to locate tagged and other salmon; and
- Locate spawning and holding salmon upstream of Devils Canyon.

A combination of fixed-station receivers below (at the Portage Creek confluence, RM 148.8), within (RM 150 and RM 155), and above Devils Canyon will be used to determine the migration timing and behavior of any radiotagged salmon that pass into the upper river area (Figure 7.7-2). Fixed station receivers will be deployed at locations where they will have the highest probability of detecting radiotagged salmon. The fixed station deployed at the confluence with Kosina Creek will provide additional information that can be used to assess the detection efficiencies for all mainstem fixed-station receivers downstream from this site. The data from these receivers will also be used to identify the broad reaches where radiotagged fish are located to guide the aerial and ground-based survey efforts needed to identify spawning areas.

The mobile survey data will aid in confirming the presence of radiotagged fish, and locating any fish not detected at downstream fixed-station receiver sites. These additional detections will be combined with the fixed-station data to estimate detection efficiencies for each fixed-station receiver. The timing and proportion of tagged salmon passing Devils Canyon will be calculated, and their final spawning locations will be identified.

7.7.4.4 Objective 4: Use available technology to document salmon spawning locations in turbid water in 2013 and 2014.

This objective involves using side-scan and/or DIDSON to determine salmon spawning locations in turbid water.

Previous studies in the mainstem Susitna River have relied on late-season visual surveys of redds to identify and characterize salmon spawning that occurs in turbid water after temperatures have fallen and the river water has cleared. The efficacy of this technique in the Susitna mainstem habitats has not been evaluated and it may underestimate the extent of spawning activity in turbid water. Late-season visual surveys of redds may fall below 100 percent detection as detection may vary with discharge, suspended sediment levels, etc.

An AEA-sponsored study in August and September 2012 will examine the feasibility of using sonar to find and characterize spawning activity in turbid water. If successful in 2012, the method will be used again in 2013 and 2014 to sample turbid water to quantify spawning activity. Sonar has the potential to detect redds in turbid water and confirm spawning activity by directly monitoring fish behavior. Radio telemetry provides a powerful tool to identify suspected spawning activity but subsequent sampling of fish with sonar may be needed to help determine whether spawning has actually occurred. Net sampling may help to determine the degree of sexual maturation and reduce confusion between holding and spawning areas in some instances. Depending on the results of the feasibility study, a combination of DIDSON and high resolution side-scan sonar may be used in turbid-water spawning areas to search for and map any spawning activity. Emphasis will be placed on any turbid water spawning areas identified in the 2012 radio telemetry study.

7.7.4.4.1 Sonar Equipment and Methods

The EdgeTech 4125 600/1600 kHz side-scan sonar can generate high-resolution images with an across-track resolution of 0.6 centimeters (~0.25 inches), independent of the range sampled. The system is well suited for collecting data over large areas. Depending on the water depth, the high frequency side-scan sonar can sample a swath of up to 50 meters (164 feet). As a rule of thumb, if the transducer is 1 meter (3.28 feet) above the bottom, one can "see" an approximately 10-meter (32.8-foot) wide swath on each side of the survey boat (port and starboard). The minimum water depth required for the deployment of the transducer is approximately 0.5 meters (1.64 feet). The survey will be conducted at a boat speed of approximately 1 meter per second (3.28 feet per second), slower in shallow water if there is a danger of hitting obstacles. Where the side-scan sonar encounters aggregations of redds, the survey will periodically be paused to supplement the data with stationary spot checks with a DIDSON.

DIDSON is a high-resolution imaging sonar that provides video-type images over a 29-degree field of view and can thus be used to observe fish behavior associated with spawning, i.e., dynamic behavior that cannot be identified on the static side-scan images. To obtain high-quality images of adult salmon the maximum range will be limited to 15 meters (49 feet). Within this field of view, evidence of spawning behavior, e.g., redd digging, chasing, spawning, will be clearly identifiable. Furthermore, on DIDSON images fish can be classified by size category, e.g., < 40 centimeters, 40 – 70 centimeters, > 70 centimeters (< 25 inches, 25-44 inches, > 44 inches, respectively). Although this is not sufficient for definitive species identification, it will allow recognition of smaller resident fish, medium-sized adult salmon, and large Chinook salmon. DIDSON sonar has successfully been used to survey salmon redds in the Columbia River.

If deemed feasible based on results from 2012, acoustic surveys will be made from early August through September to coincide with the times when sockeye, chum, Chinook, and pink salmon are actively spawning

7.7.4.4.2 Data Analysis and Reporting

All sonar data will be collected along with a differential GPS with 10 Hz positioning rate. The GPS coordinates together with heading, pitch and roll information will allow us to match side-scan and DIDSON data with any visual and telemetry-based ground-truthed data. The side-scan analysis will provide locations of individual redds or redd fields. The DIDSON data analysis will provide the coordinates, coverage, and duration of each station surveyed, together with the mean number of fish observed in the field of view, their size categories (< 40 centimeters, 40 – 70 centimeters, > 70 centimeters [< 25 inches, 25 - 44 inches, > 44 inches, respectively]), and a qualitative description of their behavior.

7.7.4.5 Objective 5: Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon.

A comparison will be made of results from 2012–2014 studies to the historical results that characterized the relative abundance, locations of spawning and holding salmon, and use of mainstem, side-channel, slough, and tributary habitat types by adult salmon.

Research conducted in the early 1980s provided information relevant to this study. Annual abundance estimates relevant to at least four fishwheel sites along the Susitna River mainstem were developed in each of three years (1983-85). These abundance estimates were apportioned to mainstem, sloughs, and tributaries, and the results will be useful for assessing the potential impacts of the Project. One weakness of these studies was that they relied heavily on visual observations of fish (and abandoned late-season redds). These methods and results may underestimate the use and relative importance of mainstem habitats, many of which occur in turbid water during a substantial portion of the spawning period. Another concern is that data collected approximately 30 years ago may not characterize the current habitat use in the mainstem Susitna River.

This study will address both of these concerns by deploying a similarly scaled study of the spawning runs to the Susitna in 2012-14 and by using radio telemetry and sonar technology not available in the 1980s. Both methods will provide a more rigorous characterization of the use of mainstem habitats than methods used in the 1980s. To the extent spawning distribution and habitat use in the current study are similar to earlier studies, it will greatly increase the sample size and confidence in the conclusions from studies in both periods. Therefore, it will be important to explicitly compare and contrast the distribution and habitat use of salmon in the lower, middle, and upper river habitats of the Susitna River.

7.7.4.6 Objective 6: Generate counts of adult Chinook salmon spawning in the Susitna River and its tributaries.

This objective will be addressed by conducting adult salmon spawning surveys in 2013 and 2014. Aerial surveys by helicopter are being conducted in July and August 2012, and the protocols developed in 2012 will be followed in 2013 and 2014. Multiple surveys will be flown bracketing the peak timing of spawning. Survey aircraft will be equipped with telemetry receivers and GPS to identify positions of tagged and not-tagged Chinook salmon and any other Pacific salmon that may be observed.

7.7.4.7 Objective 7: Collect tissue samples to support the Fish Genetics Study.

The task for this objective is to collect genetic samples opportunistically from adult anadromous salmon in conjunction with addressing Objectives 1 and 2. Sample collections will be coordinated with the Genetic Baseline Study team (see Section 7.14). Similar to commitments made for 2012, this study will identify the locations of spawning fish and where it is feasible, collect tissue for use with genetics studies by ADF&G and other researchers.

7.7.4.8 Objective 8: Estimate the system-wide Chinook and coho salmon escapement to the Susitna River and the distribution of those fish among tributaries of the Susitna River in 2013 and 2014.

A commonly applied two-event, capture-recapture experiment will be used to estimate the abundance of Chinook salmon in the entire Susitna River drainage. Fishwheels will be used to capture fish for marking. Weirs on tributaries of the Susitna River will be used to recapture marked fish. The best sites for fishwheel operation will likely be on the Yentna River and a second site on the mainstem Susitna River near RM 26, with two fishwheels at each site. At the weir recapture sites Chinook salmon will be counted and inspected for tags. Likely weir recapture sites (in addition to the existing Deshka River weir operated by ADF&G) include Willow Creek and the Middle Chulitna River on the east side of the Susitna River, as well as Talachulitna River and Lake Creek on the west side of the Susitna. It may also be possible to use genetics to identify the spawning destination of fish captured at the fishwheels. Studies being conducted in the summer of 2012 will determine the feasibility of using genetics to serve as an identifiable mark and eliminate the need to address tag loss and tagging effects associated with traditional capture-recapture models.

Radio telemetry would be used to identify the primary spawning locations. A subsample of Chinook salmon captured in the fishwheels will be radiotagged throughout the runs. Radiotagged salmon will be relocated using fixed tracking stations and repeated aerial surveys over the major tributaries. Tissue samples will be collected from the radiotagged fish to add to the Cook Inlet Chinook salmon genetic baseline.

A two-event, capture-recapture experiment will also be used to estimate the abundance of coho salmon in the Susitna River upstream of the confluence with the Yentna River. Fishwheels will be used to capture fish for marking with tags. Weirs on the tributaries (likely the Deshka River, Middle Chulitna River and Willow Creek) and/or possibly fishwheels near Sunshine will be used to recapture marked fish. At the weir recapture sites, coho salmon will be counted and inspected for a tag.

At Willow Creek, a DIDSON unit will likely be required to estimate Chinook and coho salmon abundance in addition to the weir. Past studies at Willow Creek found that, early in the season during spring runoff, Chinook salmon migrated past the likely weir site when high, occluded water conditions precluded installation and operation of a weir. The weir will be installed once the water recedes to levels where the weir can be safely installed. In August and September, when coho salmon migrate into the creek, the weir may be compromised by high water resulting from rain. During these times, coho salmon abundance will be estimated using DIDSON.

7.7.5. Consistency with Generally Accepted Scientific Practice

The fishwheel capture methods for supplying salmon for biotelemetry studies have been used around Alaska and elsewhere in North America since the early 1980s, including on the Susitna River at the locations proposed here (Cannon 1986). Similarly, radio tracking of tagged adult salmon by fixed and mobile (aerial and boat) receivers has been established elsewhere, and used extensively on the Susitna River over the last six years (Yanusz et al. 2007, Yanusz et al. 2011, Merizon et al. 2010). Two-event, capture-recapture experiments are ubiquitous in North America for assessing salmon abundance.

7.7.6. Schedule

This is a multi-year study, most components of which were initiated in 2012. The schedule for 2013-2014 activities is as follows:

- Operate fishwheels in the lower Susitna and Yentna rivers from May through August, 2013 and 2014.
- Operate fishwheels at Curry from June through early September, 2013 and 2014.
- Conduct aerial surveys from mid-June through September in the lower river and from mid-July through early October in middle and upper river.
- Quality Controlled (QC) Data - December, 2013 and 2014.
- QC'd geospatially-referenced relational database – December, 2013 and 2014.
- Initial Study Report – December 2013
- Updated Study Report - December 2014.

7.7.7. Level of Effort and Cost

The schedule, staffing, and costs will be detailed as the 2013–2014 Study Plan develops. Total study costs are estimated at $7,000,000. Objectives 1 through 7 would be approximately $2,000,000 per year and the estimated costs for work associated with Objective 8 is as follows.

Estimated costs for lower river tagging of Chinook and system-wide abundance estimate (includes the shared cost of weirs, boats, vehicles, and a DIDSON sonar to be used for enumerating coho salmon):

- 2013: $1,100,000 – $1,300,000
- 2014: $790,000 – $850,000

Estimated costs for lower river tagging of coho salmon objectives (assumes boats, weirs, DIDSON and vehicles covered under Chinook estimate):

- 2013: $300,000 – $400,000
- 2014: $300,000 – $400,000

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7.7.9. Figures

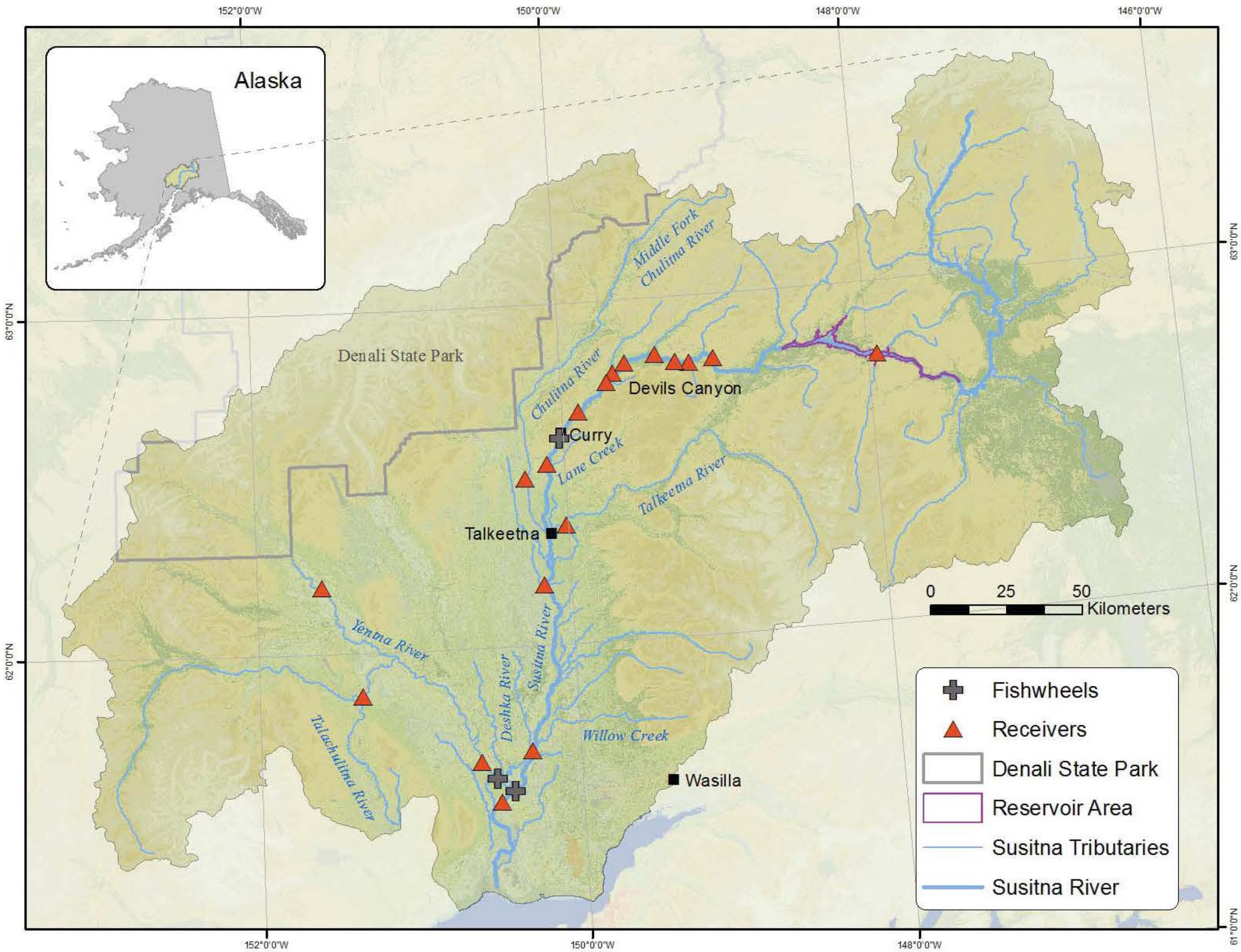

Figure 7.7-1. Susitna watershed showing fish capture sites (fishwheels) and the locations of fixed-station telemetry receivers in the Susitna River.

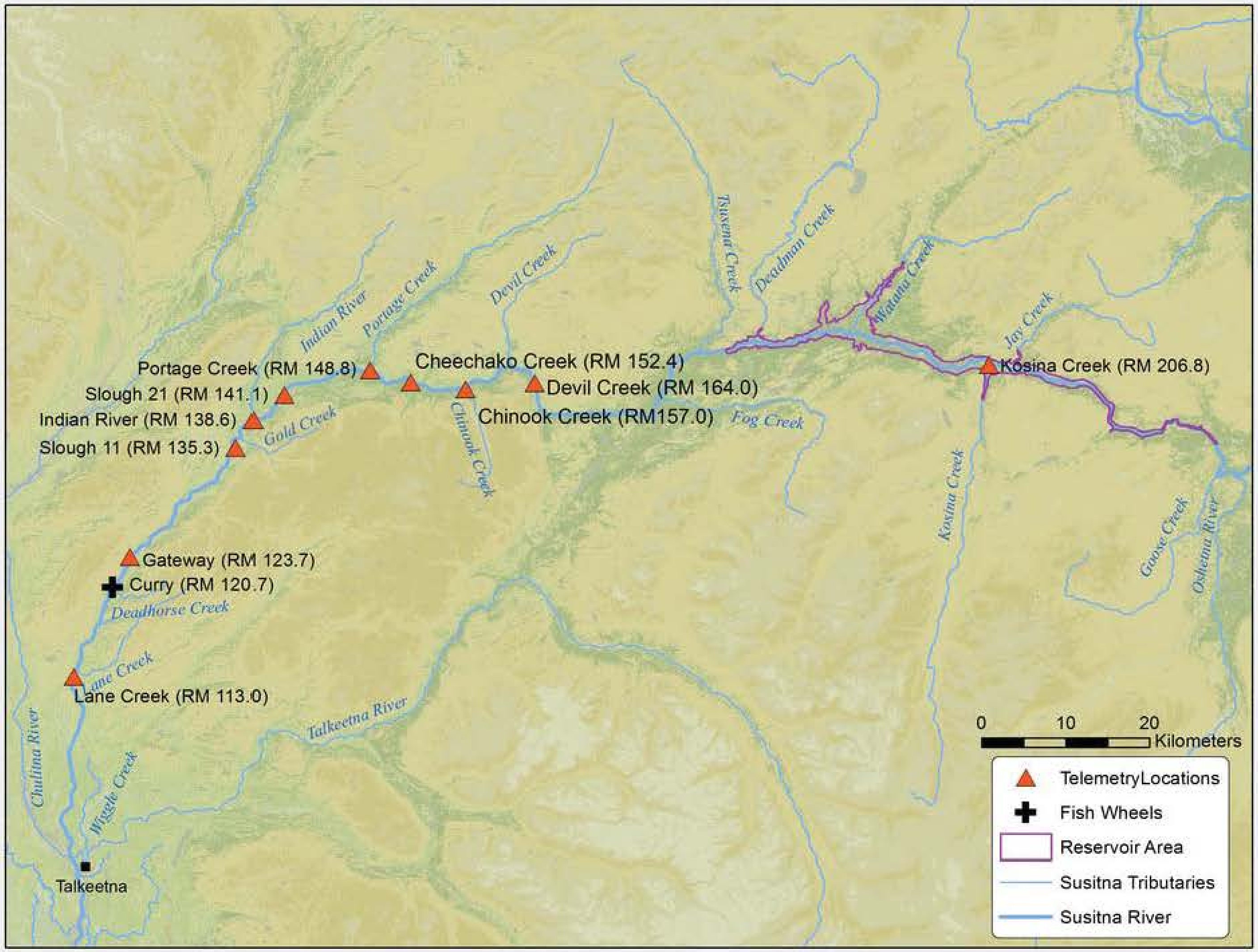

Figure 7.7-2. Fixed-station telemetry receivers in the middle and upper Susitna River, 2012-14.

7.8. River Productivity Study

7.8.1. General Description of the Proposed Study

Algae are an important base component in the lotic food web, being responsible for the majority of photosynthesis in a river or stream and serving as an important food source to many benthic macroinvertebrates. In turn, benthic macroinvertebrates are an essential component in the processes of an aquatic ecosystem, due to their position as consumers at the intermediate trophic level of lotic food webs (Hynes 1970; Wallace and Webster 1996; Hershey and Lamberti 2001). Macroinvertebrates are involved in the recycling of nutrients and the decomposition of organic materials, serving as a conduit for the energy flow from organic matter resources to vertebrate populations, such as fish (Hershey and Lamberti 2001; Hauer and Resh 1996; Reice and Wohlenberg 1993; Klemm et al. 1990).

The significant functional roles that macroinvertebrates and algae play in the freshwater ecosystem make these communities important elements in the study of a stream's ecology. The operations of the proposed Project would likely affect one or more of the factors that can affect the abundance and distribution of benthic macroinvertebrate and benthic algae populations. The degree of impact on the benthic communities and fish resulting from hydropower operations will necessarily vary depending on the magnitude, frequency, duration, and timing of flows, as well as potential Project-related changes in geomorphology, ice processes, temperature and turbidity. By investigating the current populations in the Susitna River, this study will generate information about the current health and status of these populations throughout the varied habitats in the Susitna River. In addition, by applying what is known about the relationships between river regulation and hydropower operation, we can begin to assess the potential impacts of Project operations, as well as provide information to inform development of any necessary protection, mitigation, and enhancement (PM&E) measures.

7.8.1.1. Study Goals and Objectives

The overarching goal of this study is to evaluate the effects of Project-induced changes in flow and the interrelated environmental factors (temperature, substrate, water quality) upon the benthic macroinvertebrate and algal communities in the middle and upper Susitna River. Individual objectives that will accomplish this are listed below.

1. Synthesize existing literature on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities;
2. Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the middle and upper Susitna River;
3. Estimate drift of benthic macroinvertebrates in selected habitats within the middle and upper Susitna River to assess food availability to juvenile and resident fishes;
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.

5. 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;
6. Generate habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats to predict potential change in these habitats downstream of proposed dam site;
7. Characterize the macroinvertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component);
8. Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including course particulate organic matter, fine particulate organic matter, and suspended organic matter in the lower, middle, and upper Susitna River.
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.

7.8.2. Existing Information and Need for Additional Information

A number of evaluations of the benthic macroinvertebrate community were conducted on the Susitna River in the 1970s and in the 1980s for the original APA Susitna Hydroelectric Project (Friese 1975; Riis 1975, 1977; ADF&G 1983; Hansen and Richards 1985; Trihey and Associates 1986). ADF&G studies in the 1970s included sampling of macroinvertebrates using artificial substrates (rock baskets) deployed for a set period of time to allow for colonization. Friese (1975) and Riis (1975) set a total of eight rock baskets in Waterfall Creek, Indian River, and the mainstem middle Susitna River for 30 days during summer (July – September). Riis (1977) also deployed rock baskets in the Susitna River near the mouth of Gold Creek for a colonization period of 75 days; however, only two of seven baskets were retrieved. Results were limited to low numbers of invertebrates per basket, identified to taxonomic family.

Studies conducted in the 1980s for the original APA Susitna Hydroelectric Project focused on benthic macroinvertebrate communities in the sloughs, side channels, and tributaries of the middle reach of the Susitna River from RM 125 to RM 142 during the period from May through October. Efforts included direct benthic sampling with a Hess bottom sampler and drift sampling. ADF&G efforts in 1982 and 1984 also involved collection of juvenile salmon in these side channels and sloughs, and an analysis was conducted to compare gut contents with the drift and benthic sampling results (ADF&G 1983; Hansen and Richards 1985). In addition, Hansen and Richards (1985) collected water velocity, depth, and substrate-type data to develop habitat suitability criteria (HSC), which were used to estimate weighted usable areas for different invertebrate community guilds, based on their behavioral type (swimmers, burrowers, clingers) in slough and side channel habitats. Efforts in 1985 (Trihey and Associates 1986) expanded to include sampling at nine sites in the Middle Susitna River Reach: 3 side channels, 2 sloughs, 2 tributaries, and 2 mainstem sites.

Algal communities were sampled and analyzed for chlorophyll-*a* periodically at Susitna Station from 1978 to 1980. In the 1980s, algae samples were collected as part of the APA Susitna Hydroelectric Project water quality studies, with sampling conducted at Denali, Cantwell (Vee Canyon), Gold Creek, Sunshine, and Susitna Station on the Susitna River, as well as on the Chulitna and Talkeetna rivers (Harza-Ebasco 1985 as cited in AEA 2011). Analysis showed low productivity (less than 1.25 mg/m^3 chlorophyll-*a*) and indicated algal abundance was most likely limited by high concentrations of turbidity (AEA 2011).

Benthic macroinvertebrate information from the 1980s is focused on a limited number of side channel and slough habitats within a 17-mile reach of the Middle Susitna River. Additional information is needed on mainstem benthic communities, as well as those in side channel and slough habitats, within both the Middle and Upper Susitna River reaches. Benthic algae information needs to be collected in conjunction with the macroinvertebrates to define their relationship in the river's trophic system. To assess the impact of future hydropower operations on the benthic communities within the Susitna River, additional information must be collected through an increased sampling effort, including more sampling sites along the river in relation to the distance both downstream from the proposed dam site and upstream from the dam. Additionally samples collected seasonally in the reservoir pool, are needed to help define variability in these communities throughout the year.

7.8.3. Study Area

The River Productivity study will entail field sampling throughout all three of the designated study reaches on the Susitna River (Table 7.8-1; Figures 7.8-1 through 7.8-3). The Upper Susitna River Reach is defined as the section of river above the proposed Watana Dam site at RM 184 (Figure 7.8-1). Sampling within the lower 39 miles of this reach (RM 184 – 233) will document the benthic communities that will eventually be inundated by the proposed reservoir. Sampling in the upper portions of this reach will investigate the benthic communities that will be unaffected by inundation. The Middle Susitna River Reach encompasses the 86-mile section of river between the proposed Watana Dam site and the Chulitna River confluence, located at RM 98 (Figure 7.8-2). Sampling activities within this reach will investigate the benthic communities that may be affected by the Project and its regulated flows. Sampling will be conducted at various distances from the proposed dam site to document longitudinal variability, and estimate the effects that the Project will have on benthos in the river system downstream. The Lower Susitna River Reach is defined as the approximate 98-mile section of river between the Chulitna and Talkeetna rivers confluence and Cook Inlet (Figure 7.8-3) (AEA 2011). Sampling will occur in the upper portion of this reach to determine to what extent, if any, the Project operations would affect benthic communities, as well as the ameliorating affect the two tributaries may have on the mainstem Susitna River below the confluence of the three rivers.

7.8.4. Study Methods

To evaluate the effects of Project-induced changes in flow and the interrelated environmental factors (temperature, substrate, water quality) on the benthic macroinvertebrate and algal communities in the Susitna River, the following nine study components have been proposed:

7.8.4.1. Synthesize existing information on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities.

Several reviews have been written on the effects that modified flows have on the benthic communities residing below dams (Ward 1976; Ward and Stanford 1979; Armitage 1984; Petts 1984; Cushman 1985; Saltveit et al. 1987; Brittain and Saltveit 1989). A majority of these reviews indicate that temperature and flow regimes are often the most important factors affecting benthic macroinvertebrates below dams. The type of dam and its mode of operation will have a large influence over the type and magnitude of effects on the receiving stream below. General information on the effects of hydropower on riverine habitats, as well as Project-specific information, will be reviewed and synthesized. Specifically, the literature review will summarize relevant literature on macroinvertebrate and algal community information in Alaska, including 1980s Susitna River data; review and summarize literature on general influences of changes in flow, temperature, substrates, nutrients, turbidity, light penetration, and riparian habitat on benthic communities; and review and summarize the potential effects of dams and hydropower operations, including flushing flows and load following, on benthic communities and their habitats.

7.8.4.2. Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Susitna River.

7.8.4.2.1. Benthic macroinvertebrate sampling

Macroinvertebrate sampling will be stratified by reach and mainstem habitat type defined in the Project-specific habitat classification scheme (mainstem, tributary confluences, side channels, and sloughs). To accomplish this objective, sampling will occur at 27 sites (9 mainstem and 18 associated off-channel sites) above and below the proposed dam site (RM 184) (Table 7.8-1). Efforts will be made to locate sampling sites at transects established by the instream flow team, in an attempt to correlate macroinvertebrate data with additional environmental data (flow, substrates, temperature, water quality, riparian habitat, etc) for statistical analyses, and HSC development. Three sampling periods will occur from April through October in both study years (2013-2014) to capture seasonal variation in community structure and productivity. In addition, sampling will be conducted in February/March to collect information on winter productivity. However, winter sampling will be limited to a select number of accessible open-water sites.

Sampling will be conducted in riffle habitats within each mainstem habitat type (i.e., mainstem, tributary confluences, side channels, and sloughs). Benthic macroinvertebrate sampling will be conducted using a stream-type sampler (Hess, Surber, Slack) commonly used for other Alaskan benthic macroinvertebrate studies to allow for comparable results; state and federal protocols, as well as methods used in the Susitna River studies in the 1980s, will be considered when designing the sampling approach (Hansen and Richards 1985; Carter and Resh 2001; Klemm et al. 1990; Klemm et al. 2000; Moulton et al. 2002; Peck et al. 2006). Replicate samples (n=6) will be collected to allow for statistical testing of results for short- and long-term monitoring. Measurements of depth, mean water column velocity, and substrate composition will be taken concurrently with benthic macroinvertebrate sampling at the sample location for use in HSC development in the instream flow studies.

In addition, due to the prevalence of large woody debris in the Susitna River, woody snags also will be sampled as a substrate strata for benthic macroinvertebrates as requested by USFWS (USFWS River Productivity Study Request, May 31, 2012). Sampling methods for woody snags will be semi-quantitative (Moulton et al. 2002). Suitable woody snags will have been submerged for an extended period of time so as to be clearly colonized. Sections of woody snags to be sampled will be removed from the water by using a saw, and placed over a plastic bin or in a bucket, and all benthic macroinvertebrates will be removed by handpicking, brushing, and rinsing. The snags will be allowed to dry for a period of time, so that missed organisms will crawl out of the crevices and then can be collected. Snag sections sampled will be measured for length and average diameter to determine surface area sampled. Each snag section will count as a separate, replicate sample.

Benthic macroinvertebrate samples will be processed in a laboratory using methods compatible with those used for other studies in comparable streams/basins in Alaska. State and federal protocols (Barbour et al. 1999; Major and Barbour 2001; Moulton et al. 2002) will be considered when making decisions about the sample processing protocols, including subsampling protocols and the taxonomic resolution of specimen identifications.

Results generated from the collections will include several descriptive metrics commonly used in aquatic ecological studies, such as density (individuals per unit of area), taxa richness (both mean and total), EPT taxa (i.e., *Ephemeroptera, Plecoptera, Trichoptera*) richness, diversity (H'), evenness (J'), percent dominant taxa, the relative abundance of major taxonomic groups, and the relative abundance of the functional feeding groups. Data collected during this study will be compared to the results of 1980s studies (ADF&G 1983; Hansen and Richards 1985; Trihey and Associates 1986) to evaluate any differences between the historic and current community structure. In addition, any invasive benthic macroinvertebrates identified in the sample collections will be identified and their collection locations will be recorded using GIS (NAD 83).

7.8.4.2.2. Benthic algae sampling

Benthic algae sampling will be collected concurrently with benthic macroinvertebrate sampling to allow for correlation between the two collections (Table 7.8-1). Benthic algae sampling will be conducted using methods compatible with other Alaska benthic algal studies, to allow for comparison of results. State and federal protocols will be considered when designing the sampling approach (Eaton et al. 1998; Barbour et al. 1999; Moulton et al. 2002; Peck et al. 2006). Measurements of depth, mean water column velocity, turbidity, and substrate composition will be taken concurrently with algae sampling at the sample location for use in HSC development in the instream flow studies.

Benthic algae samples will be processed in a laboratory, using methods compatible with those used for other studies in comparable streams/basins in Alaska, considering state and federal protocols (Eaton et al. 1998; Barbour et al. 1999; Moulton et al. 2002; Peck et al. 2006) to determine sample processing protocols, including subsampling protocols, and the taxonomic resolution of specimen identifications.

Results generated from the collections would include both dry weight and chlorophyll *a*, and several descriptive metrics to describe the algal community. In addition, any invasive algae taxa identified in the sample collections will be identified and their locations will be recorded using GIS (NAD 83).

7.8.4.3. Estimate drift of invertebrates in selected habitats within the Susitna River to assess food availability to juvenile and resident fishes.

Invertebrate drift sampling will be conducted concurrently with benthic macroinvertebrate sampling at nine of the established benthic collection sites to allow for comparisons between the two collections. Sampling will be stratified by reach and conducted in riffle habitats within the mainstem, tributary confluences, side channels, and sloughs (Table 7.8-1).

Invertebrate drift sampling will be conducted using a drift net similar to those used for other drift studies in Alaska to allow for comparison of results; state and federal protocols will be considered (Keup 1988; Klemm et al. 2000). Drift sampling will be conducted during daytime hours, as a measure of background drift that is available to feeding fish (Waters 1972; Brittain and Eikeland 1988; Keup 1988). Sampling methods will involve collecting duplicate samples to allow for statistical testing of results for short- and long-term monitoring. Water velocity directly in front of the net will be recorded both upon deployment and upon retrieval of the net. Invertebrate drift samples will be processed in a laboratory, using methods compatible with other studies conducted in comparable streams/basins in Alaska. State and federal protocols (Barbour et al. 1999; Major and Barbour 2001; Moulton et al. 2002) will be considered when making decisions about the sample processing protocols, including subsampling protocols, taxonomic resolution of specimen identifications, and length measurements for individual specimens.

Results generated from these collections will include drift density, drift rate, and drift composition. Data collected as part of this study will be compared to data from the benthic macroinvertebrate collections (Section 7.8.4.2.1) and the fish dietary analysis (Section 7.8.4.7). In addition, drift results will be compared to the results of 1980s drift studies (ADF&G 1983; Hansen and Richards 1985; Trihey and Associates 1986) to evaluate any differences between the historic and current drift components of the macroinvertebrate communities.

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.

The literature search will focus on comparable river systems in Alaska and elsewhere. Information will be collected for turbid and non-turbid systems, especially those in glacial systems with lakes. By comparing the response of benthic communities in these systems to environmental perturbations that are similar to those anticipated in the Susitna River (such as changes in turbidity and light penetration), we hope to increase our ability to predict how the benthic communities in the Susitna River may respond to Project-induced changes. If, during this review, one or more comparable Alaska river systems are identified, this task will also evaluate the feasibility of collecting field data from those rivers.

7.8.4.5. 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.

As a Phase I study, a literature review will be conducted to examine and summarize the various existing approaches for conducting trophic analyses, including methods and the level of effort required to obtain sufficient data to conduct a site-specific trophic analysis for the Susitna River. In addition, an investigation will be conducted on the ability of the river water quality model (Water Quality Modeling Study, see Section 5.6) to predict changes in primary productivity in the Susitna River as the result of changes in turbidity and temperature. Based upon the results of the review and investigation, recommendations will be made on whether to conduct a trophic analysis as a Phase II to this study.

7.8.4.6. Generate habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats to predict potential change in these habitats downstream of proposed dam site.

A literature review will be conducted, examining the existing 1980s study (Hansen and Richards 1985) for applicable information and methodology, as well as peer-reviewed periodicals, and government and industry technical reports for applicable benthic macroinvertebrate and algae HSC and their use for instream flow analysis. The review will also examine macroinvertebrate life histories, behavior, and functional feeding groups to assist in grouping taxa into guilds. Velocity, depth, and substrate data collected during benthic macroinvertebrate and benthic algae sampling (as stated in Objective 2, Section 7.8.4.2) will be used to generate HSC criteria for Susitna River benthic populations. These criteria will be used to simulate how the suitable macroinvertebrate and algal benthic habitat may change in response to Project-induced changes to flow, water depth and velocity. Data collection and transect information will be coordinated with the Instream Flow Study. Analysis and modeling efforts will be coordinated with the Instream Flow Team.

7.8.4.7. Characterize the macroinvertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component).

Because macroinvertebrates are a food source for fish and other organisms (Hershey and Lamberti 2001), any significant disturbance to the benthic community has the possibility of affecting their predators. Therefore, it is important to investigate the trophic relationship between fish and the macroinvertebrate community, by conducting a fish gut analysis and comparing results to drift and benthic invertebrate data. Target fish species will be identified in consultation with those conducting fish distribution and abundance studies (Fish Distribution and Abundance in the Middle and Lower Susitna River Study, Fish Distribution and Abundance in the Upper Susitna River Study, and/or Salmon Escapement Study teams) and other licensing participants. Fish collection sites will correspond to benthic macroinvertebrate collection sites (both bottom and drift sampling) to allow for comparison with the macroinvertebrate community composition. Fish stomach contents will be sampled using non-lethal methods (Hyslop 1980; Bowen 1996; Kamler and Pope 2001). The collection efforts will be coordinated with the appropriate fish study team.

Fish gut content samples will be processed in a laboratory using methods compatible with studies conducted in other comparable streams/basins in Alaska. State and federal protocols (Hyslop 1980; Bowen 1996; Barbour et al. 1999; Major and Barbour 2001; Moulton et al. 2000) will be considered in determining the sample processing protocols, including subsampling protocols, the taxonomic resolution of specimen identifications, and data analysis approach. Data collected during this study will be compared to the results of 1980s fish diet studies (ADF&G 1983; Hansen and Richards 1985) to evaluate any differences between the historic and current fish diets.

7.8.4.8. *Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including course particulate organic matter, fine particulate organic matter, and suspended organic matter in the lower, middle, and upper Susitna River.*

Organic matter materials serve as an important food resource to benthic macroinvertebrates, serving as a conduit for the energy flow from organic matter resources to vertebrate populations, such as fish (Hershey and Lamberti 2001; Hauer and Resh 1996; Reice and Wohlenberg 1993; Klemm et al. 1990). This organic matter exists as both fine particulate organic matter (FPOM) and course particulate organic matter (CPOM). FPOM includes particles ranging from 0.45 to 1000 µm in size, and can occur in the water column as seston, or deposited in lotic habitats as fine benthic organic matter (FBOM) (Wallace and Grubaugh 1996). CPOM is defined as any organic particle larger than 1 mm in size (Cummins 1974).

In order to quantify the amounts of organic matter available in the Susitna River for river productivity, CPOM and FPOM (specifically FBOM) will be collected concurrently with all benthic macroinvertebrate sampling (Objective 2, Section 7.8.4.2.1). Suspended FPOM (Seston) will be collected at same time and alongside invertebrate drift sampling (Objective 3, Section 7.8.4.3). Organic matter collection will be conducted using methods compatible with other Alaska studies, to allow for comparable results. State and federal protocols will be considered as study plans are developed, in consultation with resource agencies.

7.8.4.9. *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.*

Colonization is a process in which organisms move into and become established in new areas or habitats (Smock 1996). In disturbed habitats, this process is more accurately called recolonization. Numerous studies have shown that macroinvertebrates can rapidly colonize new or disturbed substrates (Shaw and Minshall 1980; Ciborowski and Clifford 1984; Williams and Hynes 1977; Townsend and Hildrew 1976; Miyake et al. 2003). The rate of recolonization is dependent on several factors, including time of the year, substratum particle size, the structure of the macroinvertebrate assemblages available to colonize at the time, and the distance of the colonist assemblages from the new or disturbed area (Robinson et al. 1990; Smock 1996; Mackay 1992).

Using a stratified sampling approach, a field study will be conducted to estimate potential benthic macroinvertebrate colonization rates for different seasons in the Susitna River. Sets of three to five preconditioned artificial substrates will be deployed incrementally for set periods of colonization time (e.g., 12, 8, 6, 4, 2, and 1 weeks) and then pulled simultaneously at the conclusion of the colonization period. Artificial substrates will be deployed at three depths at fixed sites along the channel bed. Benthic macroinvertebrate colonization rates may be conducted in a variety of habitats (e.g., turbid vs. non-turbid areas, groundwater upwelling areas vs. areas without groundwater upwelling). Benthic macroinvertebrate processing protocols would be identical to those used in sampling in the middle Susitna River (Objective 2, Section 7.8.4.2.1). State and federal protocols for both sampling and processing will be considered as the details of this study component are refined, in consultation with resource agencies.

Colonization information will be compared with colonization results from similar river systems and with post-project colonization results.

7.8.5. Consistency with Generally Accepted Scientific Practices

The methods described herein have been developed in consultation with Agency and Technical workgroup participants. All data collection efforts will follow state or federal guidelines referenced throughout the study methods discussion. In addition, any laboratory analysis will be conducted by a state- or federally-certified facility.

7.8.6. Schedule

The preliminary schedule for the river productivity study elements is presented in Table 7.8-2. During the third and fourth quarters of 2012, the literature review summarizing the impacts of hydropower development and operations on benthic macroinvertebrate and algal communities will be prepared and presented to the TWG. Research, field sampling, and sample processing and analysis will begin in the latter half of the first quarter of 2013, following FERC's approval of the study plan, and continue throughout the remainder of 2013. The Initial Study Report summarizing 2012 and 2013 activities will be issued in December 2013. Field sampling efforts will resume in the latter half of the first quarter of 2014, with analysis and research continuing through the fourth quarter. The Updated Study Report will be produced in December 2014.

7.8.7. Level of Effort and Cost

The initial cost estimate for completion of the nine study objectives above is $800,000. Efforts such as the literature review, trophic analysis, and HSC criteria development will be office-based studies. Collection of benthic macroinvertebrates and algae, with the addition of an analysis of fish feeding habits, will require at least four field efforts per year for the two study years. The colonization study will require frequent site visits each month to deploy additional sets of samplers over the course of the study. A majority of the work effort will take place in the laboratory to subsample, sort, and identify the macroinvertebrate and algae samples. The remainder of the study effort, after sample processing, will be office-based, consisting of data entry, analysis, and synthesis and report writing.

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7.8.9. Tables

Table 7.8-1. Preliminary macroinvertebrate and algae sampling sites, stratified by reach and habitats. Refer to Figures 7.8-1 – 7.8-3 for locations of the preliminary reaches.

Sampling Reach	Reach Description	Number of Mainstem Sites	Number of Associated Off-channel Sites[1]
Upper Reach			
UR-1 or -2	Reference upstream of reservoir	1	2
UR-3 or -4	Reservoir tail (transitional area)	1	2
UR-6	Within reservoir pool	1	2
Middle Reach			
MR-1	Immediately below dam site	1	2
MR-2	Upstream of Devils Canyon	2	4
MR-6	Downstream of Devils Canyon	1	2
Lower Reach			
LR-1	Below 3 River Confluence	2	4
Susitna River Totals		**9**	**18**

Notes: 1 Side-channels, sloughs, tributary confluences associated with a mainstem sampling site.

Table 7.8-2. Preliminary schedule for River Productivity Study.

Activity	2012				2013				2014			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Literature Review on Hydropower Impacts			--------	-------								
Sampling benthic macroinvertebrate communities, algal communities, and organic matter.					▲--	--▲---	▲-▲		----▲-	--▲---	▲-▲	-----
Invertebrate drift sampling					▲--	--▲---	▲-▲		----▲-	--▲---	▲-▲	-----
Literature search of existing river systems							--------	--------				
Review on the feasibility of a trophic analysis							--------	--------				
Generate habitat suitability criteria									--------	--------	--------	-----
Conduct a fish gut analysis					▲--	--▲---	▲-▲		----▲-	--▲---	▲-▲	-----
Establish baseline colonization rates					▲-	▲-	▲-▲		▲-	▲-	▲-▲	
Data Analysis and Reporting				-----●		-----●	--------	---●--	--------	-----●	--------	---●
Initial Study Report								-----●				
Updated Study Report												-----●

7.8.10. Figures

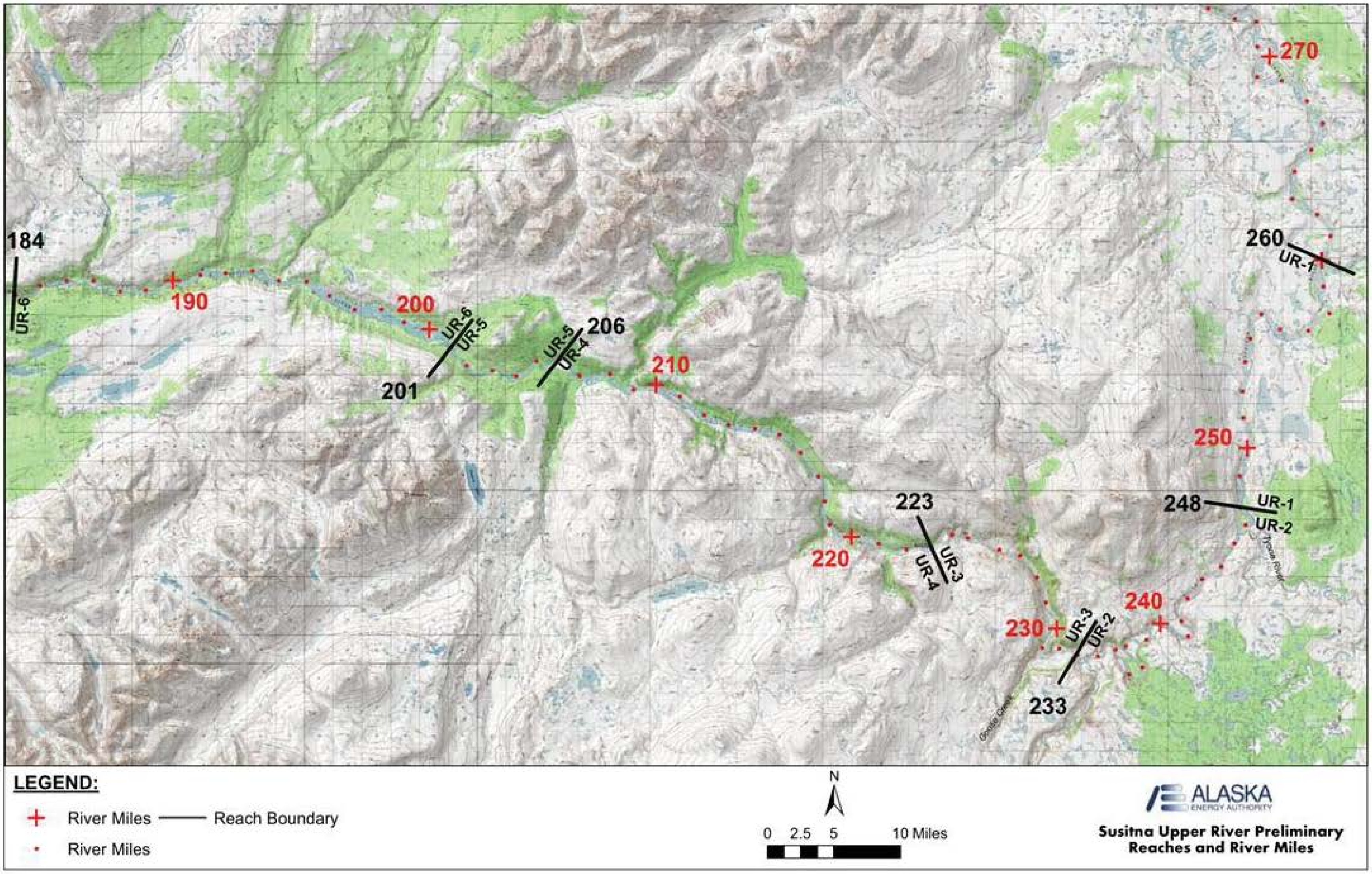

Figure 7.8-1. Upper Susitna River Reach, Preliminary Reaches and River Miles.

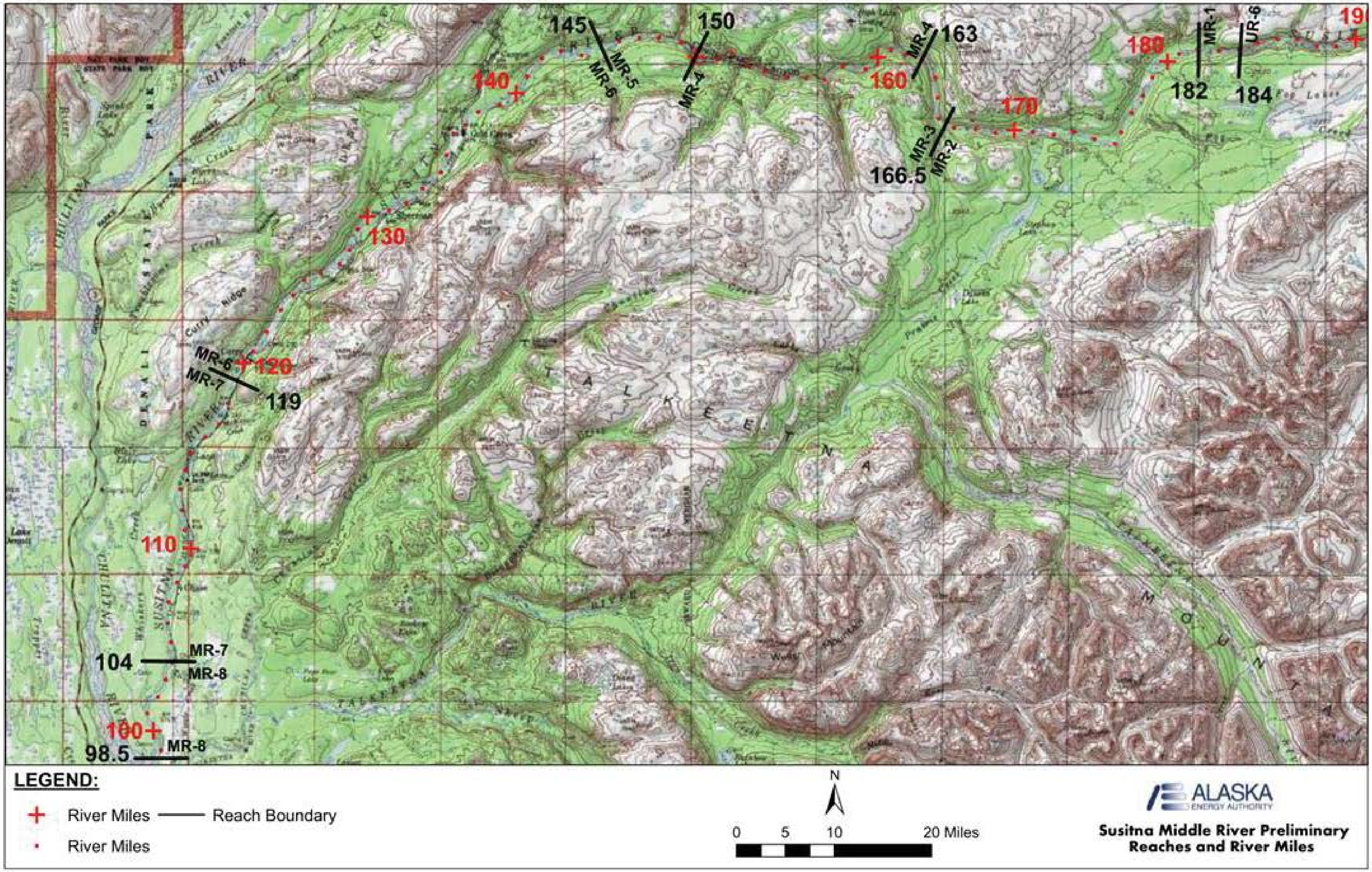

Figure 7.8-2. Middle Susitna River Reach, Preliminary Reaches and River Miles.

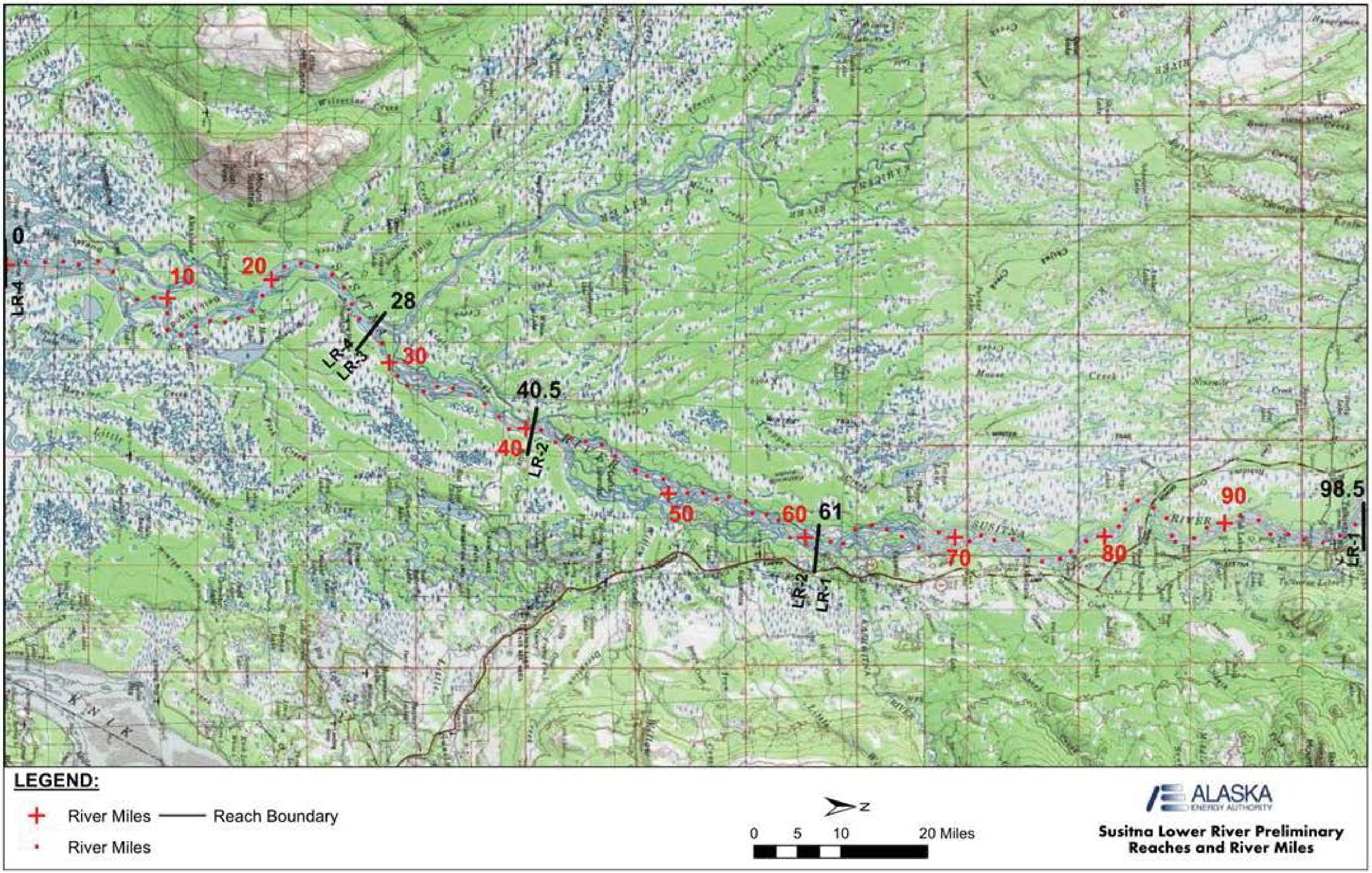

Figure 7.8-3. Lower Susitna River Reach, Preliminary Reaches and River Miles.

7.9. Characterization of Aquatic Habitats in the Susitna River with Potential to be Affected by the Susitna-Watana Project

7.9.1. General Description of the Proposed Study

This is a multi-year study that will provide a baseline characterization of aquatic habitats as they currently exist. Due to the complex nature of the Susitna River the study will characterize habitats at different scales related to degree of potential impact. For example, detailed field surveys will be conducted in the reservoir inundation zone whereas remote videography will be the primary method for habitat characterization of mainstem habitats in the lower river. This study will be valuable for gathering baseline habitat data that can be used along with other data being gathered (e.g. fish distribution and abundance, water surface elevation and discharge relationships, instream flow modeling, flow routing) to assess potential impacts associated with Project operations.

7.9.1.1. Study Goals and Objectives

Construction and operation of the Project will modify the aquatic habitat in the area inundated by the Project reservoir and has the potential to alter aquatic habitats in the mainstem channel of the Susitna River downstream from the Project dam, including along channel margins, at tributary confluences, at the inlets and outlets to side channels sloughs, and off-channel waterbodies in the zone of hydrologic influence. The goal of this study is to characterize all aquatic habitats with the potential to be altered and/or lost as the result of reservoir filling, hydropower operations, and associated changes in flow, water surface elevation, sediment regime, and temperature. The objectives of this study are as follows.

1. Characterize the existing upper mainstem Susitna River and tributary habitat within the proposed inundation zone.
2. Characterize the middle (RM 98 to RM 184) and the lower (RM 28 to RM 98) mainstem Susitna River channel margin and off-channel habitats using the Susitna-Watana Project habitat classification system and standard USFS protocols, with modifications to accommodate site-specific habitats.
3. Characterize the tributary and lake habitat upstream from the proposed Watana Dam site to the Oshetna River (RM 184 to RM 233.4) that is currently accessible to fish from the Susitna River or that would be accessible due to inundation of existing fish passage barriers after the reservoir is filled.

7.9.2. Existing Information and Need for Additional Information

During the 1980s study efforts, habitat characterization in the middle reach of the mainstem Susitna River was conducted at a relatively coarse scale; mainstem habitat types that were representative of distinct functional hydrology were identified. Under this system, the Susitna River was classified into seven mainstem habitat types: mainstem channel, side channel, side slough, upland slough, tributary mouth, tributary, and lakes, defined by source water and hydrologic connectivity (Trihey 1982, ADF&G 1983a). For example, side channels were described as side channels that carried less than 10 percent of the mainstem flow, whereas sloughs were identified as having a water source derived from some combination of groundwater, tributaries, and/or local runoff. Upland sloughs, unlike side sloughs, were those that were disconnected from mainstem flows at their heads. These seven mainstem habitat types were mapped in the middle and lower river based on aerial photography and were given individual alpha-numeric identifiers such as “Slough 22” (ADF&G 1983a). Subsequent sampling of fish populations and collection of water quality and habitat suitability data were conducted in subsets of the mapped habitats. Additional habitat characterization efforts developed during the 1980s defined unique categories of river habitat based on clear or turbid water conditions under specific flows ,in combination with presence or absence of open water leads during winter (Steward and Trihey 1984) or hydrologic zones (ADF&G 1983a, ADF&G 1983b). The habitat categories were focused on main channel and side channel habitats in intensively studied areas in an attempt to scale the information up to the entire Middle Susitna River Reach for simulating the relationship between habitat and flow.

Very little habitat information has been collected in the upper Susitna River. In the early 2000s, ADF&G conducted sampling in the upper Susitna River sub-basin as part of its Alaska Freshwater Fish Inventory (AFFI) program (Buckwalter 2011a). These surveys were focused on documenting fish presence and collecting reach-level habitat data in medium and large tributary drainages (Buckwalter 2011b). The AFFI habitat studies were conducted at a scale that is not necessarily informative for understanding impacts to fish use or productivity. Because the upper river surveys were focused on fish inventory, they applied a dispersed sampling design, that covered 60 streams; however, habitat data were collected at only one transect per stream. The scale of these historic data collection efforts limits their applicability for evaluating fish-habitat relationships and the potential for changes in fish habitat use throughout the Susitna River as a result of hydropower facility development and operation.

To augment the historic habitat data, we propose to first characterize aquatic habitat at the meso-habitat level within mainstem and tributary habitats. Characterization of mesohabitats is important in assessing potential impacts to fish populations because it is at this level that fish selectively use different habitats (Hardy and Addley 2001) to support different life stages and life functions. A full complement of meso-habitat types is required to sustain multiple life stages, support a diverse fish community, and furthermore, the distribution of these habitats throughout the river will influence fish distributions. Fine scale habitat attributes, such as those found at the meso-habitat level are thought to be particularly relevant to aquatic organisms. Organisms interact with their environment at different scales depending on their size and mobility (Parasiewicz 2007), both of which change with growth and development. Parasiewicz (2007) further suggested that mesohabitats are habitats within which an organism can be observed for a significant portion of its daily routine, similar to functional habitat discussed by Kemp (1999). For this study, information will be collected to support the development of habitat descriptions at more ecologically significant scales by considering several attributes that are biologically important to fishes (Harper et al. 1992, Maddock 1999). The higher mainstem habitat classifications used in the 1980s will be retained to allow for some level of comparison over time.

In addition to considering the scale of habitat classification, it is also important to consider the use of an objective classification approach that not only captures existing site-specific characteristics, but also can be used for comparisons across space and time. Meso-habitat assessments based on river morphology and ecologically significant habitat attributes should be consistent and reproducible. The USFS Aquatic Habitat Surveys Protocol (USFS 2001) is an example of a standardized protocol that was developed in Alaska to facilitate creation of a regional stream habitat database as well as one that allows for aggregation of habitat data at multiple scales.

A Susitna River-specific hierarchical classification system is currently under development by the Fish and Aquatics TWG. In its current draft form, the classification system has two components: one for the Susitna River upstream of the proposed Watana dam site and another for the middle and lower Susitna River below Devils Canyon (Figure 7.9-1). The Susitna River classification system combines the historic approach to mainstem habitat classification and a modified version of the meso-habitat classification system from the USFS Aquatic Habitat Surveys Protocol (USFS 2001). This hybrid classification system will describe habitats that are defined by the unique hydrology of this river system, yet are significant to the day-to-day function and behavior of fish and aquatic organisms.

Existing fish, habitat, and aquatic resource information appears insufficient to address the following issues that were identified in the PAD (AEA 2011).

- **F1:** Effect of change from riverine to reservoir lacustrine habitats resulting from Project development on aquatic habitats, fish distribution, composition, and abundance, including primary and secondary productivity.
- **F2:** Potential effect of fluctuating reservoir surface elevations on fish access and movement between the reservoir and its tributaries and habitats.
- **F4:** Effect of Project operations on flow regimes, sediment transport, temperature, and water quality that result in changes to seasonal availability and quality of aquatic habitats, including primary and secondary productivity. The effect of Project-induced changes include stream flow, stream ice processes, and channel morphology (streambed coarsening) on anadromous fish spawning and incubation habitat availability and suitability in the mainstem and side channels and sloughs in the Middle River above and below Devils Canyon.
- **F7:** Influence of Project-induced changes to mainstem water surface elevations from July through September on adult salmon access to upland sloughs, side sloughs, and side channels.
- **F9:** The degree to which Project operations affect flow regimes, sediment transport, temperature, water quality that result in changes to seasonal availability and quality of aquatic habitats, including primary and secondary productivity.

The information collected during this study will be essential to understanding fish habitat use and will provide information relevant to addressing the five potential fisheries issues listed above.

7.9.3. Study Area

The study area encompasses two sections of the Susitna River. The upstream section includes mainstem and tributary habitats from the confluence with the Oshetna River (RM 233.4) to the upstream end of Devils Canyon (see Figure 7.5-1). The downstream section includes the potential zone of Project hydrologic influence in the mainstem river from the downstream end of

Devils Canyon (RM 150) to the upper extent of tidal influence at approximately RM 28 (see Figure 7.5-1).

7.9.4. Study Methods

The Susitna River from the Oshetna River to the intertidal zone includes approximately 200 miles of mainstem channel and likely more than double that distance when the lengths of side channels and sloughs are included. Given the linear extent and remoteness of the river, an approach that combines analysis of aerial imagery with ground-based collection of habitat data will be used. This combination of methods will allow for maximizing coverage of river habitats in concert with efficient collection of detailed data at selected habitats suitable for ground surveys. Furthermore, the habitat characterization methods can be tailored to accommodate variations in channel size and overall stream length. All habitat data collected in this study will be consistent with the Susitna-Watana Project habitat classification system and modified from standard protocols outlined in the USFS Aquatic Habitat Surveys Protocol (USFS 2001).

7.9.4.1. Habitat Characterization Using Remote Imagery

Habitat can be efficiently typed and delineated using remote images such as quality video or aerial photography. Remote habitat typing allows for greater spatial coverage of aquatic habitats than ground-based surveys, as well as the ability to gather data on areas inaccessible by foot or boat. However, both weather and site-specific conditions, such as vegetative cover, can affect the quality of the video and, therefore, the utility of this method.

Video imagery is being collected in 2012 upstream of the proposed Watana Dam site. Imagery will cover the mainstem channel and larger tributaries with a sufficiently open canopy to allow for delineation of river habitats. This initial effort will be limited to selected tributaries to evaluate the effectiveness of video imagery. Video imagery will be collected at a resolution sufficient to allow for delineation at the meso-habitat level as well as remote collection of certain habitat attribute data such as large woody debris and dominant substrate. This effort will be continued in 2013 to provide complete coverage of upper mainstem and tributary habitats where Project affects are possible.

Due to the size and complexity of the middle and lower river, habitat characterizations will be conducted at different scales. The initial focus in 2013 will be to collect video imagery that supports the delineation of both mainstem and meso-habitats in the Middle River along the river’s channel margins from Devils Canyon to the Chulitna River. In 2013, a reconnaissance survey will also be conducted in portions of the Lower River Reach to determine the feasibility of documenting all channel margin habitat with slightly lower resolution video than that proposed for the Middle River Reach. If it proves infeasible to obtain quality video coverage of this extensive area, then a systematic subsampling scheme that focuses on representative channel types will be proposed within reaches where Project impacts are anticipated.

Aerial videography will be collected using low elevation helicopter flights. Video equipment will consist of a high resolution camera with an integrated GPS. Video will be collected by an experienced senior technician during a period of low flows and high water clarity, which is anticipated to occur in mid to late September. The video will be shot from the right rear of a helicopter with its cabin door removed to maximize direct viewing. A narrator/navigator will be positioned in the left front next to the pilot. The video will be shot from an elevation of approximately 100 to several hundred feet to allow for safe navigation and sufficient resolution. The imagery will be post-processed into a navigable video that will include a GPS stamp to reference the location on topographic maps or with existing aerial imagery. Video stills will also be collected to expand the Project's aerial imagery resources and to support habitat mapping efforts.

The video will be supplemented with existing LiDAR and aerial imagery from the Matanuska-Susitna Borough LiDAR and Imagery Project for delineating and mapping the seven mainstem habitat types developed during the 1980s as well as mesohabitats contained within these larger mainstem units (Table 7.9-1). The distribution and frequency of mainstem and meso-habitat types will be documented. If demonstrated to be effective during the 2012 study, aerial video mapping will be preferentially used where there is no canopy or topographic cover obscuring the river channel. However, because some tributary habitats may not be visible from the air due to thick overhead vegetation, steep topographic relief, or small channel size, tributary assessments may rely more heavily upon ground-based mapping in accessible segments or a combination of both video and ground-based surveys. Ground-based data will also be collected for a subset of video delineated units to calibrate remote mapping techniques.

Mesohabitats will be assessed using a time-based frequency method. The video will be stopped at a predetermined time interval and the habitat type that is directly across the channel at the middle of the computer screen will be defined and documented. A line drawn across the video screen determines the dominant habitat at that "point." The time interval is usually within a range of 3-5 seconds depending on the stream width and meso-habitat length; for example, sections with short habitat units will be based on 3-second intervals, while sections with long habitat units will be based on 5-second intervals.

Video mapping will be initiated in the upper Susitna River in 2012. Aerial video imaging activities for 2013 will be implemented based on a review of the results and effectiveness of the 2012 effort. It is anticipated that any refinement will be coordinated with the TWG and licensing participants. Further, additional coordination with other study teams may be conducted to help refine study methods and benefit or supplement data gathering activities in other resource areas.

7.9.4.2. Ground-Based Habitat Surveys

Whereas the remote habitat mapping will be applied to the entire study area, ground-based surveys will be focused on collecting data in the upper mainstem river and tributaries and the middle mainstem river since these reaches can be effectively and safely surveyed by boat or by foot. Additionally, as mentioned above, some ground-truthing of video-delineated habitat units will be completed to increase the accuracy of video delineations. Although comprehensive sampling is desired, the extensive stream network in the upper and middle river likely will prevent continuous coverage of all mainstem reaches and tributaries. Thus, a subsampling approach will be necessary.

Subsampling will be implemented at the mainstem habitat level based on all mainstem habitat units delineated in the upper and middle river. Mainstem habitat units to be surveyed will be randomly selected at a frequency of every X^{th} side channel, tributary mouth, upland slough, etc. For each mainstem unit selected, field crews will conduct a continuous survey of meso-habitat units contained within.

In the upper river, we will attempt to conduct continuous stream surveys for all tributary habitats within the inundation zone up to an elevation of 2,200 feet using the sampling approach described above. For Chinook salmon-bearing streams, a subsampling approach will be used to characterize the habitat above the inundation zone upstream to approximately 3,000 feet elevation or the first fish passage barrier. If tributaries are identified where access may become available to migratory fish as a result of Project construction and creation of the reservoir at a maximum normal pool elevation above 2,050 feet msl, the entire tributary will be surveyed by stratifying reaches based on channel morphology and within these strata, randomly subsampling meso-habitat units as described above.

Habitats will be mapped to the meso-habitat level in accordance with the channel typing and aquatic habitat classification system currently under development for the Project by the Fish and Aquatic TWG (Table 7.9-1). Mesohabitat units will be typed based on a modified) USFS Tier III stream habitat survey protocol (2001). Some sections of stream may contain two or more different habitat units in parallel; in these cases primary and secondary units will be designated.

Aquatic habitat surveys will be conducted by two-person survey crews. Each survey crew will consist of a fish biologist and qualified fisheries technician. In wadeable streams, surveys will generally begin at a tributary confluence or a predetermined location with data collection progressing in an upstream direction. Boat surveys will be conducted by boat and will be limited to stream segments where flow conditions and channel size preclude the ability to conduct wadeable surveys. If permanent impassable barriers are encountered within the 2,200 elevation point, the barriers will be documented and surveys will continue upstream to the survey end. If a permanent impassable barrier is encountered above the 2,200 elevation point surveys will end at that location.

Field habitat surveys conducted for this study include three components:

1. A reach-scale description of channel morphology;
2. A stream survey consistent with the USFS Tier III survey (USFS 2001); and
3. Location and description of special habitat features.

7.9.4.3. Channel Morphology

The USFS developed a protocol using a hierarchical habitat classification system to provide consistent databases based on the same framework to allow for comparisons within a single system and comparisons to data for other streams (USFS 2001). At the highest level, the Tier I survey incorporates information on channel morphology and valley form. Channel morphology data provide a foundation for understanding the channel forming processes that drive the distribution and abundance of distinct aquatic habitat types. Furthermore, this information can provide process-based context for interpreting future responses of the stream channel to perturbations. A reach is defined as a section of channel that has consistent channel morphology and flow volume. Reaches delineated for this study will be a minimum of 100 meters in length. The start and end points of each reach will be georeferenced using GPS. Reach-scale channel morphology variables to be measured or calculated for this survey include:

- Bankfull width;
- Bankfull depth;

- Gradient;
- Channel pattern;
- Channel type;
- Substrate D16, D50, D84 (calculated from pebble count); and
- Sinuosity (calculated).

Reaches will be delineated by a significant change in reach-scale geomorphology (e.g., channel type, gradient, major tributary junction). Channel morphology measurements are conducted at the reach scale and from fast water habitat units only, as those features tend to have a channel geometry that reflects reach-scale flow and geomorphic processes. If major side channels are present throughout the reach, channel morphology measurements (i.e. bankfull width) should be extended to include those features. Reach scale data will be measured at least three times per reach.

Bankfull width will be measured using a 50-meter (164-foot) Kevlar tape or calibrated laser rangefinder. The maximum depth relative to the bankfull flow level will be measured using a graduated wading rod or stadia rod. Gradient will be measured using a clinometer over a distance of at least 20 bankfull widths at each site where bankfull width and depth data are collected. Substrate will be characterized once per reach at a representative riffle segment by conducting a Wolman pebble count (Wolman 1964). Pebble count data will be used to calculate the D_{16}, D_{50} and D_{84} particle sizes. Sinuosity will be calculated during data entry as the ratio of channel thalweg length (i.e. survey distance) to valley bottom length (i.e. straight line distance between reach start and endpoints).

Reach scale channel morphology data will be recorded on the channel morphology field data form. One channel morphology form will be completed for each mainstem habitat unit. Copies of all field forms are provided in Appendix 1.

7.9.4.4. Tier III Meso-habitat Survey

Stream survey data are used to describe aquatic habitats at the meso-habitat scale. Habitat data will be recorded on the stream survey field data form. Separate stream survey data sheet(s) will be completed for each reach. Habitat parameters to be measured for this component of the study include:

- Habitat unit type (See Table 7.9-1);
- Habitat unit length;
- Average wetted width (3 measurements per unit);
- Percent substrate composition;
- Length of undercut bank;
- Dominant riparian vegetation type; and
- Cover.

Habitat units will be sequentially numbered as they are encountered during each survey, and data will be recorded for each habitat unit. Data collected for all habitat units will include the unit length, three measurements of wetted width from which an average wetted width will be calculated, percent substrate composition, percent eroding bank on each side of the channel, percent undercut bank on each side of the channel, dominant riparian vegetation type, cover type, and cover percent. For fastwater habitats, data will be visually estimated for each unit, and measured in every fifth unit of each individual fastwater habitat type (for example, fifth riffle, fifth run, etc.) for calibration purposes.

Additional data will be recorded for pool habitat units. The type and amount of overhead cover will be visually assessed and recorded. The maximum pool depth and depth at the pool tail crest will be measured to the nearest 0.1 foot. These data will be used to calculate residual pool depth. The structural feature responsible for forming the pool will be identified (e.g., boulder, undercut bank, large or small wood).

Split channels are defined as separate flow paths located within the bankfull channel and separated from each other by gravel bars that are barren or support only annual vegetation. When split flow is encountered, each split will be surveyed and the proportion of flow conveyed by the split will be estimated, recorded, and used to classify each channel as primary (majority of the flow) or secondary (minority of the flow). Habitat units in the split that convey the most flow will be designated primary units and will continue to be numbered sequentially as part of the main channel survey. Split flow channels transmitting less flow will be designated as secondary units and will be differentially numbered (e.g. SP1-1, SP1-2, etc).

Side channels are defined as features with a fluvially-sorted mineral bed that are separated from the main channel by an island that is at least as long as the main channel bankfull width and that supports permanent vegetation. At a minimum, the inlet and outlet of each side channel will be documented by collecting a GPS waypoint and taking a photograph looking upstream from the outlet and downstream from the inlet. The side channel will be identified as entering from the left or right bank (looking downstream) and classified as wet or dry. Habitat data will be collected in wetted side channels according to the methodology described above. Side channels will be labeled SC-LB1, SC-RB2, etc. in the order they are encountered.

7.9.4.5. Special Habitat Features

Special habitat features include tributary channels, seeps and springs that contribute groundwater to the mainstem, and temporary (e.g. subsurface flow) or permanent barriers to upstream fish migration. A separate data sheet will be maintained for each reach listing the type, location, and a description of special habitat features.

For features classified as stream barriers, the following information will be recorded in the comments section:

- Barrier type (beaver dam, debris dam, vertical falls, chute/cascade, boulder, other);
- Temporal nature (ephemeral or permanent);
- Maximum height of falls or biggest single step if cascading;
- Maximum depth of plunge pool;
- Chute/cascade gradient and length; and
- Length of feature.

A GPS waypoint and a photograph will be taken of each special feature. Additional photographs will be taken of representative channel conditions throughout each reach. The photo number, waypoint, date, and associated habitat unit or feature number will be recorded for each photograph.

The characterization of habitats will be complemented by the Instream Flow Study (ISF) habitat suitability and transect data collection efforts (See Section 6.5), as well as several fish population studies. All remote video imaging and the majority of field sampling associated with this study are intended to occur in 2013. In 2014, additional fieldwork for habitat characterization and validation will be conducted, as necessary, and the potential effects to habitats resulting from Project operations will be modeled. Information gathered from this study will be provided to the ISF team for modeling of potential changes; hence, this study requires close coordination with the ISF team.

7.9.5. Consistency with Generally Accepted Scientific Practices

Studies to map and characterize aquatic habitats are commonly conducted during water resource development projects, including for hydroelectric projects as part of FERC licensing. Field studies will use protocols developed in consultation with agency representatives and modified from standard federal protocols developed for use in Alaska (USFS 2001) and be consistent with the ISF analysis. Remote mapping will utilize protocols similar to those performed at other hydroelectric projects.

7.9.6. Schedule

Habitat characterization of the upper Susitna River will begin in 2012. Ground-based surveys will be conducted from July through September in 2012 and 2013. Flights for video data collection will be conducted in mid- to late-September 2012. Analysis of the video and habitat typing will occur simultaneously with data management for field survey data from October through December 2012 and 2013.

The following tentative schedule is for the significant 2012-2014 work products.

- Year-1 Study Implementation — July-October 2012
- 2012 Annual Project Report — December 2012
- Year-2 Study Implementation — July-October 2013
- Initial Study Report — December 2013
- Updated Study Report — December 2014

7.9.7. Level of Effort and Cost

The total estimated cost of the study for 2013 and 2014 is $2,000,000. The first year is estimated to cost $600,000, including videography, initial field surveys, and data management. The second year is estimated to cost $1,400,000, including follow up field surveys, data analysis and technical report preparation.

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7.9.9. Tables

Table 7.9-1. Susitna River Mainstem and Meso-habitat Type Descriptions.

Classific-ation Level	Type	Description
Mainstem Habitat Type		
	Main Channel	Channels of the river that convey streamflow throughout the year. Can include single or multiple channels. In the Susitna River, they are visually recognizable during summer months by turbid, glacial water and high velocities. In general, they convey more than 10 percent (approximate) of the total flow passing a given location. [1,2]
	Side Channel	Channels that contain streamflows during open water periods but may be dewatered in a portion of the channel or entirely at low flows.[1] These channels carry mainstem water so also may be characterized by turbid, glacial water. Velocities often appear lower than in mainstem sites. In general, they convey less than 10 percent (approximate) of the total flow passing a given location. [1] Side channel habitat may exist in well-defined channels or in areas possessing numerous islands and submerged gravel bars.
	Tributary Mouth	Clear water areas that exist where tributaries flow into Susitna River mainstem or side channel habitats.[1] This habitat type flow often manifests as a clear water plume extending out into the turbid receiving water of the mainstem Susitna River. Tributary mouth habitat also extends upstream into the tributary to the upper extent of any backwater influence that might exist. The surface area of tributary mouth habitat is affected both by tributary discharge and mainstem stage. [2]
	Tributary	Those reaches of tributary streams upstream of the tributary mouth habitats. Tributary habitat may contain distinct mainstem channel types, off-channel waterbodies, and mesohabitat types.
	Off-Channel	Aquatic habitats located beyond a river's active channel, yet still within the river's active valley. Off-channel habitats lack an upstream surface water connection to the main channel at intermediate or low flows, although downstream surface water connections may exist. Off-channel habitats convey water or contain water from small tributaries, upwelling groundwater, and/or local surface runoff.
Off-Channel Type		
	Side Slough	Overflow channels contained within the Susitna River floodplain that are separated from the mainstem at the upstream end by exposed alluvial berm.[1] These channels generally contain clear water from small tributaries, upwelling groundwater, and local surface runoff. Side sloughs have non-vegetated bars at their upstream ends that are overtopped during periods of moderate to high mainstem discharge. The water surface elevation of the mainstem Susitna river at the downstream end of a side slough generally causes a backwater effect in the lower portion of the slough. Overtopping from mainstem flows occurs multiple times for short durations June through August. [1] Except during periods of overtopping the temperature of side sloughs is independent of the mainstem water temperature.
	Upland Slough	Similar to side sloughs except they are separated from the mainstem channel or a side channel by a well vegetated berm. Upland sloughs contain clear water from small streams, upwelling, and/or local surface runoff. Upland sloughs are rarely overtopped by mainstem discharge. [1,2]
	Backwater	Found along channel margins and created by mainstem flow eddies around obstructions such as boulders, root wads, or in-channel wood. Part of active channel at most flows; scoured at high flow. Substrate typically sand, gravel, and cobble. Generally not as long as the full channel width. [3]

Classific-ation Level	Type	Description
	Isolated Pond	A self-contained off-channel waterbody that lacks a surface water connection to the river when the main channel flow is less than bankfull. Substrate is highly variable.
	Relic Channel	An abandoned channel lacking active flow. [5]
Meso-habitat Type		
	Cascade	A fast water habitat with turbulent flow; many hydraulic jumps, strong chutes, and eddies and between 30-80% white water. High gradient; usually greater than 4% slope. Much of the exposed substrate composed of boulders organized into clusters, partial bars, or step-pool sequences. [3]
	Riffle	A fast water habitat with turbulent, shallow flow over submerged or partially submerged gravel and cobble substrates. [3] Gradients are approximately 2 to less than 4%.
	Run	A fast water habitat with little surface turbulence. A run has generally uniform depth that is greater than the maximum substrate size. [3] Gradients are approximately 0 to less than 2%.
	Pool	A slow water habitat with a flat surface slope and low water velocity that is deeper than the average channel depth. Substrate is highly variable. [3]
	Beaver Complex	A complex waterbody created by beaver dams that includes one or more ponded areas, connecting channels, and outlet channel to the mainstem, side or a tributary channel. Substrate is general fine grained sand, silt and organic debris.
Pool Subtypes		
	Scour Pool	Formed by mid-channel scour or flow impinging against one stream bank or partial obstruction (logs, root wad, or bedrock). Generally with a broad scour hole. Includes corner pools in meandering lowland or valley bottom streams. [3]
	Backwater Pool	Found along channel margins; created by eddies around obstructions such as boulders, root wads, or woody debris. Part of active channel at most flows; scoured at high flow. Substrate typically sand, gravel, and cobble. Generally not as long as the full channel width. [3]
	Beaver Pond	Water impounded by the creation of a beaver dam. Maybe within main, side, or off-channel habitats. [3]
	Alcove	An off-channel habitat that is laterally displaced from the general bounds of the active channel and formed during extreme flow events or by beaver activity; not scoured during typical high flows. Substrate is typically sand and organic matter. Generally not as long as the full channel width. [3]
	Percolation Channel	A slough habitat type that is characterized by groundwater percolation from main and side channel flows. Its upstream surface water connection to the active river channel has been cut off due to an accumulation of sediment and debris at the head of the formerly open channel, yet main river flows continue to provide a groundwater source of flow to the percolation channel. At high or overbank flows, an upstream surface water connection to the active river channel may be present. [4]
	Isolated Pond	A self-contained off-channel waterbody that lacks a surface water connection to the main channel when flow is less than bankfull. Substrate is highly variable. An isolated pond may occur within the off-channel slough habitats or elsewhere in the off-channel portion of the river valley. [2]

[1] Source: Trihey 1982.
[2] *Source*: Schmidt et al. 1984.[3] *Source*: Adapted from Moore et al. 1986.
[4] *Source*: Adapted from Peterson and Reid 1984.
[5] *Source*: Adapted from Washington Department of Ecology (WDOE) *Channel Migration Assessment*.

7.9.10. Figures

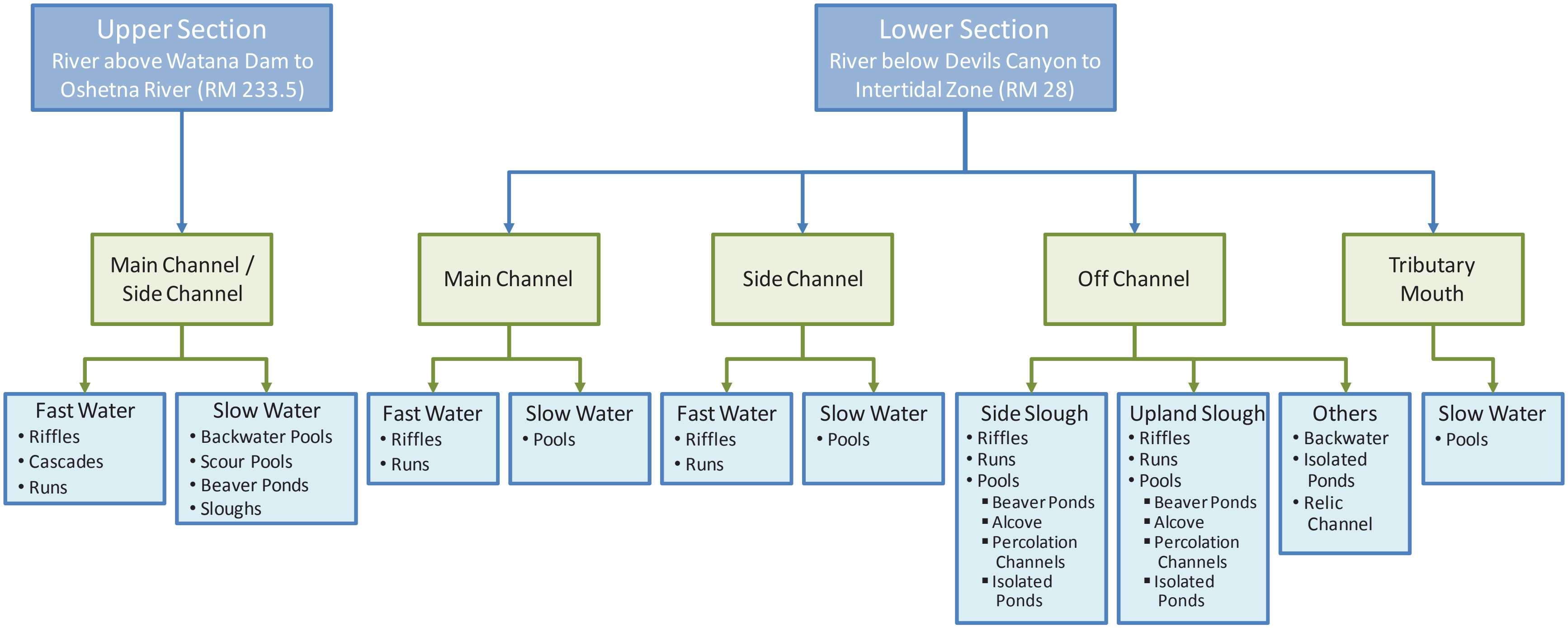

Figure 7.9-1. Hierarchical structure of the Susitna River preliminary habitat classification scheme.

7.10. The Future Watana Reservoir Fish Community and Risk of Entrainment Study

7.10.1. General Description of the Proposed Study

The nature of the fish community inhabiting the proposed Watana Reservoir will depend on a suite of interrelated factors affecting fish populations and their habitat that may be influenced by the design and operation of the Project. This study plan describes the efforts that will be implemented to predict the fish community that will develop in the Project reservoir and identify the effects of the Project on the future reservoir fish community. Figure 7.10-1 shows the relationship between this study and other study programs.

7.10.1.1. Study Goals and Objectives

Construction and operation of the Project will result in inundation of the river upstream from the dam. The actual proposed normal and maximum operating pool levels will depend upon completion of a number of optimization studies, but could be as high as El. 2,100 feet above mean sea level. Several operational scenarios will also be considered as part of the licensing studies. Some operating scenarios, such as load-following, could result in relatively large and frequent fluctuations of the reservoir water surface elevation. Operations would result in seasonal differences in pool elevation such as a winter or early-spring time drawdown in advance of the annual melt of accumulated snow during early summer.

Construction of the Project will fundamentally change the fish habitat characteristics in the area to be inundated. About 39 miles of mainstem river plus several miles of tributary stream will be converted to lacustrine habitat. Conversion from riverine habitat to lacustrine habitat will be beneficial for some fish species and detrimental to others, resulting in a modified fish community. Depending upon the fish protection measures included in the Project license and specific engineering design elements, the modified fish community may be subject to entrainment and mortality as a result of spill or passage through turbines. This study will provide information and tools needed for predicting the likely changes to the fish community due to habitat conversion, potential mortality from entrainment, and for assessing the potential Project operational effects on lacustrine habitat following Project construction.

Understanding the relationship between Project design, operations, lacustrine habitat, and the potential fish community in the proposed Watana Reservoir is important for assessing potential Project impact and development of any necessary PM&E measures. The proposed Watana Reservoir has the potential to provide public benefits in the form of recreational fishing opportunities. Identifying the potential fish community and species valued as sportfish is also important for identifying alternative fishery management strategies in advance of Project construction.

The overarching goal of this study is to predict the fish community that will develop in the Project reservoir based on the existing species and the habitat that will be created in the inundation zone and characterize the potential loss from entrainment. Specific objectives include the following:

1. Develop scenarios for anticipated daily and seasonal changes in reservoir habitat characteristics based on predicted reservoir operations, size, temperatures, and water quality and depth profiles;
2. Develop scenarios for future reservoir fish communities based on current fish species composition upstream of the proposed Dam site and anticipated daily and seasonal changes in reservoir habitat characteristics;
3. Characterize potential management options for the reservoir fishery; and
4. Conduct a qualitative desktop analysis on the potential for entrainment of fish species inhabiting the proposed reservoir upstream of Watana Dam.

7.10.2. Existing Information and Need for Additional Information

Information regarding resident species, non-salmon anadromous species, and the freshwater rearing life stages of anadromous salmon was collected as part of the studies conducted during the early 1980s. Existing information includes the spatial and temporal distribution of fish species and their relative abundance. The Aquatic Resources Data Gap Analysis (ARDGA; AEA 2011a) and PAD (AEA 2011b) summarized this existing information and also identified data gaps for resident and rearing anadromous fish.

At least eight species of fish are known to occur in the upper Susitna River (AEA 2011a). These species are Arctic grayling, Dolly Varden, humpback whitefish (*Coregonus* spp.), round whitefish, burbot, longnose sucker, Chinook salmon, and sculpin (all assumed to be slimy sculpin). Northern pike, Alaska blackfish, and lake trout may also be present. Chinook salmon are the only anadromous species that has been documented in the Upper Susitna River.

In the proposed impoundment zone, Arctic grayling are believed to be the most abundant fish species (AEA 2011a) and were found to spawn in tributary pools. In tributaries, juvenile grayling were found in side channels, side sloughs, and pool margins and in the mainstem at tributary mouths and clear water sloughs during early summer (AEA 2011b). Dolly Varden populations in the Upper Susitna River are apparently small but widely distributed (AEA 2011b). Burbot in the upper Susitna River were documented in mainstem habitats with backwater-eddies and gravel substrate. Longnose suckers were less abundant in the upper Susitna River than downstream of Devils Canyon (RM 150). Lake trout were documented in lakes near the proposed impoundment zone but the impoundment zone has not yet been sampled.

This study is needed to provide information and tools needed for predicting the likely changes to the fish community due to habitat conversion, potential mortality from entrainment, and for assessing the potential Project operational effects on lacustrine habitat following Project construction.

7.10.3. Study Area

The study area encompasses all portions of the basin to be inundated by the proposed Watana Reservoir up to the maximum reservoir water surface elevation to be determined during finalization of design and operational scenarios. About 39 miles of mainstem river (beginning at the dam site at RM 184) plus an unknown amount of tributary stream, will be converted to lacustrine habitat. During normal operation, the reservoir level may fluctuate substantially on a daily and seasonal basis. Annual drawdowns are anticipated to exceed 100 feet with a maximum drawdown of 150 feet. The Project is currently planned to be operated in a load-following mode to maximize firm power generation during winter (November through April), but inflows into the reservoir during this period are anticipated to be relatively low.

7.10.4. Study Methods

The following sections describe the approach that will be used to address each of the four interrelated study objectives associated with the Future Watana Reservoir Fish Community and Risk of Entrainment Study. Each component incorporates significant agency recommendations regarding the general study approach and specific methods to be used. These were developed collaboratively during the drafting of the relevant Study Request. Where appropriate, each study component has been broken down into separate tasks.

7.10.4.1. Reservoir Habitat Scenarios

Based on the alternative Project operating scenarios identified by Project engineers, this study component will develop corresponding scenarios for anticipated daily and seasonal changes in reservoir habitat characteristics. This study component is composed of the three following tasks that will consider reservoir conditions related to the relative size of lacustrine zones, water temperature, and turbidity.

Task 1 – Lacustrine Zone Estimation

Project operations will influence the relative size of different lacustrine zones and, as a result, the amount of habitat for aquatic biota that inhabit each zone. This task will coordinate with the hydrologic study team to adapt an existing model, such as HEC-ResSim, or develop a new unsteady flow hydraulic model of the proposed reservoir that can be used to evaluate daily and seasonal changes in reservoir depth and the amount of exposed shoreline. Based on LiDAR data and a series of transects across the proposed reservoir, model results will provide reservoir water surface elevations and depths that will be used to develop estimates of the size of each of the following lacustrine zones under the alternative operating scenarios identified in coordination with project engineers:

> Varial Zone: Area alternately wetted and dewatered by water level fluctuations; can include some or all of the littoral zone.
>
> Littoral Zone: Near-shore area extending to the deepest extent of light penetration sufficient for primary production.
>
> Limnetic Zone: Open-water layer with sufficient light penetration for primary production to occur.
>
> Profundal Zone: Open-water layer too deep for primary production to occur; below the limnetic zone.
>
> Benthic Zone: Bottom layer of the reservoir associated with the substrate and underlying all other zones.

An important part of this task will be the development of assumptions related to reservoir operations to be incorporated into the hydraulic model. These model assumptions will be developed collaboratively with the Fish and Aquatic TWG. Additional assumptions pertain as to how the lacustrine zone is defined temporally and spatially. Temporal aspects of the defined lacustrine zone will consider minimum and maximum time intervals appropriate to the frequency and magnitude of water level fluctuations expected under the alternative operating scenarios, in particular those related to peaking operations. Spatial definitions will consider turbidity or other factors related to light penetration that also may vary at least seasonally.

Task 2 – Water Temperature Modeling

This task will involve the development of a water temperature model of the proposed reservoir that can be used to evaluate daily and seasonal changes in water temperatures and the potential for thermal stratification. The water temperature model will be developed in coordination with the water quality assessment team and as part of the proposed Water Quality Modeling Study. It is anticipated that the Environmental Fluid Dynamics Code (EFDC), or similar model, will be used for this effort. Model results will be used to predict daily and seasonal variations in reservoir temperatures, including temperature profiles, and identify the potential for thermal stratification. This task will summarize the reservoir temperature model results including an assessment of how the results relate to the future reservoir fish community.

Task 3 – Reservoir Turbidity

Turbidity levels can influence the suitability of aquatic habitat for certain fish species. This task will involve reviewing available information to identify turbidity thresholds that can limit reservoir habitat utilization for species that may otherwise overwinter in the Watana Reservoir. The target species for this effort are lake trout, burbot, grayling, and whitefish. Historic information collected in the Susitna basin during the 1980s and synthesized as part of a 2012 study (Synthesis of Exiting Fish Population Data) will be reviewed to identify utilization relative to turbidity levels. Information collected in 2012 as part of the Upper Susitna River Fish Distribution and Habitat Study will also be reviewed as well as turbidity threshold information available for the target species from other out-of-basin literature sources. This information will be compared to turbidity levels expected to occur in the Watana Reservoir that are identified in coordination with the water quality assessment team. Species-specific turbidity exceedances in the Watana Reservoir during winter will be identified to predict the degree, if any, to which turbidity will limit the overwintering use of reservoir habitat by lake trout, burbot, grayling, and whitefish.

7.10.4.2. Reservoir Fish Community Scenarios

Creation of the reservoir and operation of the Project will drastically alter the habitat available to the existing fish community in the inundation zone. The future reservoir fish community will be determined by the altered habitat conditions, as well as the segment of the existing fish community expected to utilize the reservoir. This study component will develop scenarios for future reservoir fish communities based on the current fish species composition upstream of the proposed dam site and anticipated reservoir habitat characteristics. This study component is composed of the following three tasks related to the existing fish community, potential use of the reservoir by these species, and the potential presences of invasive species.

Task 1 – Define Existing Fish Community

Species that comprise the existing fish community in the Susitna River and certain sub-basins represent the source stocks from which the reservoir could be colonized. In this task, information from two studies conducted during 2012, the Synthesis of Exiting Fish Population Data Study and the Upper Susitna River Fish Distribution and Habitat Study, will be reviewed to characterize the existing fish community in the mainstem river and any tributaries or lakes that could colonize the reservoir. Potential colonizing species will be identified based on their presence in the inundation zone, proximity/connectivity to the inundation zone, and the likelihood of potential movements to the inundation zone.

Task 2 – Identify Potential Use of Lacustrine Habitat

Although the reservoir could potentially be colonized by fish species identified in Task 1, future reservoir habitat may not be suitable for all species. This task will involve a literature review to identify species in the existing fish community that may use lacustrine habitat for one or more life history stages. A white paper will be prepared that identifies the life history and habitat requirements for each species, with a focus on lacustrine elements. The discussion for each species will include an assessment of uncertainty in predicting their lacustrine habitat use. This assessment will be written to aid in the development of a post-construction monitoring program by identifying such uncertainties as expected life histories or those related to future reservoir habitat conditions.

Task 3 – Identify Potential Invasive Species

Northern pike are considered an invasive species in the Susitna drainage and have spread throughout the system from the Yenta drainage after being illegally introduced in the 1950s (AEA 2011b). Alaska blackfish are also considered an invasive species and, while not captured in the Susitna River, may have been introduced to the system. This task will identify the presence of invasive species in lakes and ponds that are currently disconnected from the mainstem but have the potential to be inundated. Information from the two 2012 studies identified above will be reviewed to identify water bodies in which invasive species have been found and that have the potential to be inundated.

7.10.4.3. Reservoir Fishery Management Options

This study component will characterize potential management options for a future reservoir fishery. A future fishery in the Watana Reservoir will be dependent upon the habitat conditions and fish community expected to occur in the reservoir, as described by the previous study components. Management options related to a reservoir fishery will be dependent on public access and recreational goals established for the reservoir. As such, analyses associated with this study component will be conducted in 2014 when more information on public access and recreational goals for the reservoir are available. Implementation of this study component will involve collaborating with ADF&G and the Fish and Aquatic TWG in the development of alternative fishery management strategies for the reservoir. This effort will also coordinate with the recreation team to determine the recreational basis and potential access in support of a potential fishery. The technical memorandum for the overall study will include a section in which the potential management options for a future reservoir fishery, developed in collaboration with ADF&G and the Fish and Aquatic TWG and in coordination with the recreation team, are described in detail.

7.10.4.4. Entrainment Analysis

Fish inhabiting the proposed reservoir could be susceptible to entrainment through the Project (turbines or spillways) or impingement on the intake trash racks. This study component will involve conducting a desktop analysis of the potential for entrainment and impingement of fish species inhabiting the proposed Watana Reservoir. This study component is comprised of the following three tasks related to identifying Project design and operating scenarios, reviewing relevant literature related to entrainment at other projects and biological information for target species, and analyzing this information to assess entrainment and impingement risks at the Project. Target species will be drawn from the Reservoir Fish Community Scenarios and identified in collaboration with the Fish and Aquatic TWG.

Task 1 – Identify Project Design/Operating Scenarios

Potential entrainment risks are influenced by Project design and operations. This task will involve coordinating with Project engineers to understand alternative Project designs and operating scenarios. This task is anticipated to be conducted in 2014 when more dam design and operational details are available. Specific design and operational details to be considered that can directly influence entrainment risks include

- Intake approach velocities
- Trash rack spacing
- Intake depths and design
- Outlet depths and design
- Operating head
- Turbine design
- Turbine speed
- Generation
- Spillway design
- Spill height
- Spill frequency

Task 2 – Literature Review

An abundance of information is available in the literature regarding fish entrainment at hydropower projects (i.e., EPRI 1997, Franke et al. 1997, FERC 1995). This task will entail reviewing such information as well as other analyses of entrainment risks with a focus on deep water intakes and cold water reservoirs. Biological information related to the future Watana Reservoir fish community identified as part of this study will also be considered to identify species and lifestages expected to inhabit the reservoir that may be at risk of entrainment or impingement. Additional biological information related to entrainment and impingement risks will be obtained from the literature. Such information includes the swimming ability of target species, which will influence their ability to avoid entrainment as they approach the intakes, as well as fish size (i.e., body length and width) which will influence impingement risks. General behavioral information related to movements in the water column and reservoir habitat use will also be reviewed.

Task 3 – Desktop Analysis

This task will involve synthesizing the information collected in the previous tasks to conduct a desktop analysis identifying the potential vulnerability target species in the anticipated reservoir community to entrainment and impingement mortality at the proposed dam under alternative design and operating scenarios. Because the size and composition of fish populations comprising the future reservoir community is theoretical under pre-Project conditions, rates of entrainment or impingement will not be predicted as part of this task. Rather, this analysis will focus on identifying species and lifestages at risk of entrainment or impingement based on their size, swimming ability, periodicity, and/or behavior. The analysis will also identify the relative risks associated with different potential sources of indirect or direct mortality, including impingement, strike, shear, grinding, turbulence, cavitation, pressure changes, and dissolved gas levels.

7.10.4.5. Work Products

Deliverable work products include the following:

Summary of Interim Results

Interim reports will be prepared and presented to the Fish and Aquatic TWG to provide study progress. Reports will include up-to-date compilation and analysis of the data and ArcGIS spatial data products.

ArcGIS Spatial Products

Shape files of the various lacustrine zones will be created for each alternative operating scenario. 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. Naming conventions of files and data fields, spatial resolution, and metadata descriptions must meet the ADNR standards established for the Susitna-Watana Hydroelectric Project.

Study Reports

An Initial and Updated Study Report that summarizes study progress and results gathered to date will be prepared and presented to resource agency personnel and other licensing participants, along with spatial data products.

7.10.5. Consistency with Generally Accepted Scientific Practice

The study methods have been developed in consultation with relicensing participants. The methods chosen to accomplish this effort are consistent with standard techniques used throughout the fisheries scientific community. The use of models is common technique used for assessing potential effects of a proposed project. The proposed modeling frameworks described below were developed by the U.S. Army Corps of Engineers and Environmental Protection Agency specifically for predicting the behavior of reservoirs and simulating physical water resource processes.

7.10.6. Schedule

This is largely a desktop analysis that will be completed in late 2013 and 2014 as information from other studies becomes available. Because the completion of this study is dependent on information from other studies, the schedule for this study will be further refined as the scheduling of related studies are completed. A draft schedule for this study is shown in Table 7.10-1. Results from the Reservoir Habitat study component will inform the Reservoir Fish Community study component. In turn, results from the Reservoir Fish Community study component will inform both the Reservoir Fishery and Entrainment study components. As such, the draft schedule reflects the appropriate ordering of implementation for each study component.

Initial and Updated Study reports documenting actions taken to date will be issued in December 2013 and 2014, respectively.

7.10.7. Level of Effort and Cost

Several components of this study will rely on modeling or other efforts developed in coordination with other study programs. As such, the level of effort and expected cost associated with each study component is dependent upon the distribution of effort among the different study programs. The total estimated cost for this study is $165,000. The estimated costs associated with each study component are provided below and include assumptions related to the distribution of effort. The staffing and costs for this study will be further refined as other related portions of the 2013-2014 study program develop.

Reservoir Habitat Scenarios

The estimated cost to complete this study component is $60,000. This cost assumes that the hydrology study team will perform the majority of the reservoir hydraulic modeling effort and water quality study team will perform the majority of the water temperature modeling effort.

Reservoir Fish Community Scenarios

The estimated cost for this study component is $40,000.

Reservoir Fishery Management Options

The estimated cost for this study component is $25,000. This cost assumes that the recreation study team will develop the recreational basis for a future reservoir fishery.

Entrainment Analysis

The estimated cost for this study component is $40,000.

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7.10.9. Tables

Table 7.10-1. Schedule for implementation of the Future Watana Reservoir Fish Community and Risk of Entrainment Study.

Activity	2012				2013				2014			
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q
Reservoir Habitat Scenarios							---------	------●				
Initial Study Report							---------	------●				
Reservoir Fish Community Scenarios								---------	------●			
Reservoir Fishery Management Options									---------	------●		
Entrainment Analysis									---------	------●		
Updated Study Report									---------	---------	------Δ	----▲

Notes:

- ● Interim results
- Δ Draft version
- ▲ Final version

7.10.10. Figures

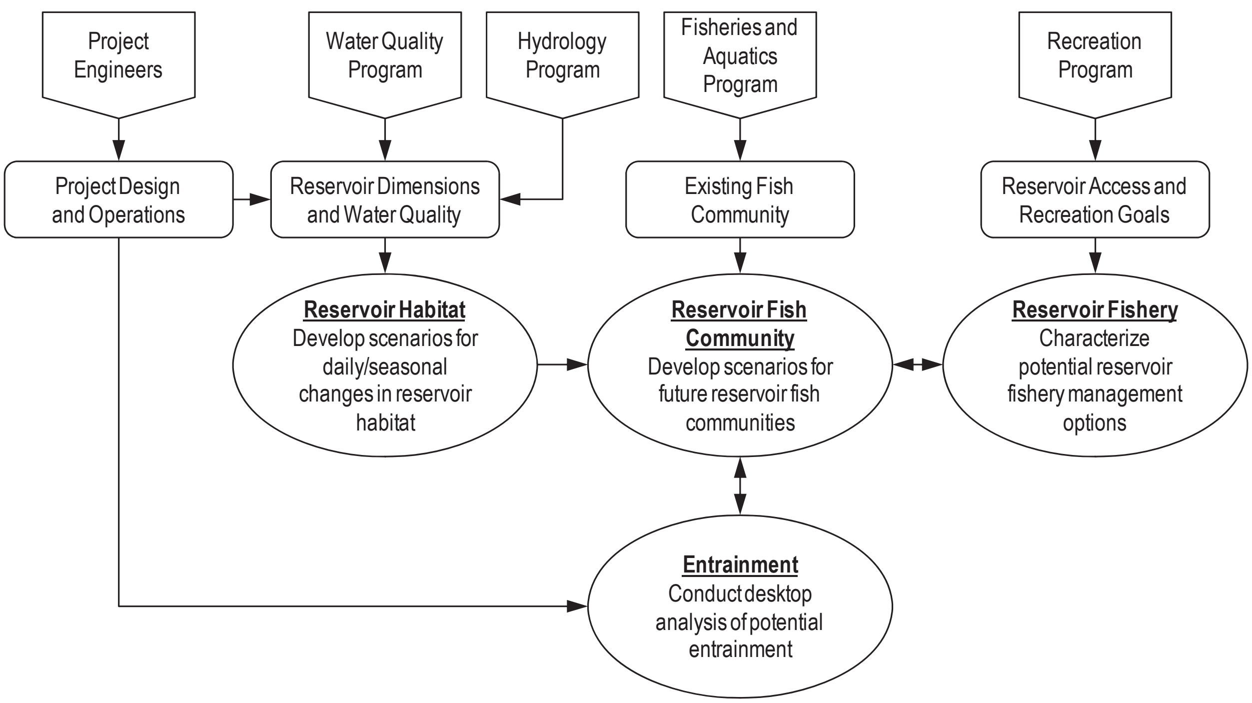

Figure 7.10-1. Flow chart showing relationships between components of the Future Watana Reservoir Fish Community and Risk of Entrainment Study (ovals), other study programs, and related information.

7.11. Study of Fish Passage Feasibility at Watana Dam

7.11.1. General Description of the Proposed Study

The proposed Watana Dam would create a passage barrier on a free-flowing river that supports five species of Pacific Salmon, other anadromous fish species, as well as several migratory resident fish species. Information regarding the biological need for and the engineering feasibility of passage at this location is integral to the resource management decisions that pertain to the license application for construction and operation of the Project as proposed. In implementing this study plan, AEA will compile the available biological information from the 1980s through 2013-14 studies and will develop new information regarding the feasibility of engineering solutions to fish passage at the proposed dam site. AEA will assimilate this information and conduct a conceptual level analysis of engineered passage solutions.

7.11.1.1. Study Goals and Objectives

The primary goal of this study is to determine the biological assumptions and feasibility of developing upstream and downstream passage facilities at Watana Dam. A variety of engineering, biological, sociological, and economic factors may need to be considered. The objective of this study is to compile existing information to support future discussions of potential fish passage measures with licensing participants during the FERC licensing of the Susitna-Watana Hydroelectric Project.

7.11.2. Existing Information and Need for Additional Information

The central feature of the proposed Project is the 700 to 800 foot high Watana Dam at river mile (RM) 184 on the Susitna River that would block the upstream passage of Chinook salmon, possibly other salmon species, and resident fish that migrate through and otherwise use the proposed Watana Dam site and upstream habitat in the Susitna River and tributaries. Chinook salmon were documented in two tributaries to the proposed reservoir during 2003 and 2011 ADF&G sampling efforts. Juvenile Chinook were found in Kosina Creek in 2003 and one adult was observed in 2011 at an approximate elevation of 2,800 feet; juveniles were also found in the Oshetna River near its confluence with the Susitna River, but none were observed in 2011 (ADF&G 2003a and b, 2011). Aside from these observations, other salmon species have been documented above the dam site, but little else is known about anadromous species use above the dam site in either the Susitna River or its tributary streams.

There is currently no specific engineering information and little biological information to provide a basis for determining the need for and feasibility of passage at the proposed Watana Dam. Pacific salmon (all five species) were captured in the lower and middle Susitna River during the 1980s. The extent of their presence in the upper river has not been well documented. Coho, chum, sockeye, and pink salmon were found in the lower and middle Susitna River during the 1980s, but have not been observed upstream of Devils Canyon. ADF&G radio-telemetry studies with sockeye, coho, and chum salmon have been conducted for several years and have not yet documented any tagged fish above Devils Canyon. In 2012, AEA expanded these studies in coordinated with ADF&G to include additional species and add in a focused investigation of distribution of coho, Chinook, sockeye, chum, and pink salmon above Devils Canyon.

Chinook salmon is the one anadromous species known to pass Devils Canyon at relatively low numbers (maximum peak count of 46 adult Chinook salmon during 1984; Thompson et al. 1986). Juvenile Chinook salmon are the only anadromous species known to rear in the upper Susitna River and tributaries (Fog Creek, Kosina Creek, and the Oshetna River) (Buckwalter 2011). Very little is known about Upper Susitna Chinook salmon in terms of run size and inter-annual variability, locations of spawning, rearing, and over-wintering areas, and timing and duration of key life history events (e.g., upriver migration and spawning, period of freshwater residency, smolt out-migration). It is also unclear what flow conditions permit passage through Devils Canyon.

In addition to the anadromous salmon, humpback whitefish and Dolly Varden also express anadromous life history patterns (Morrow 1980), but these life history patterns have not been documented for Susitna River populations. Both of these species have been documented in the Upper Susitna River (Delaney et al. 1981a). In 2012 otoliths will be collected in order to evaluate the presence of anadromy for Susitna populations of Dolly Varden and humpback whitefish. Pacific lamprey exhibit an anadromous life history pattern and have been observed in nearby river systems (Chuit River, Nemeth et al. 2010), but do not have a documented presence in the Susitna River. Other resident fishes present in the Upper Susitna River that may be affected by changes in connectivity between the upper and lower river include Arctic grayling, burbot, round whitefish, a variety of sculpin species, and possibly rainbow trout.

7.11.3. Study Area

The study area extends from the confluence with Portage Creek (RM 148) up to the proposed Watana Dam site (RM 184). It is assumed that any potential upstream passage facilities to be considered (e.g., a trap and haul facility) would be located in the mainstem upstream of the confluence with Portage Creek.

7.11.4. Study Methods

This study will generally follow the guidance provided in NMFS's Anadromous Salmonid Passage Facility Design document (NMFS 2011). Specific study tasks include the following:

- Compile, review, and summarize information;
- Perform site reconnaissance;
- Define and document a development process;
- Develop conceptual alternatives;
- Refine and Evaluate Conceptual Alternatives; and
- Conduct passage feasibility analysis.

Agency coordination and consultation is an integral component of this study. As such, AEA will identify a Fish Passage Workgroup with representatives from state and federal agencies, FERC, and other interested licensing participants. This Workgroup will be convened at regular intervals throughout the study to assist with process development, brainstorming of conceptual ideas, development of evaluation criteria, and design of components. Meetings to accomplish this coordination are expected to occur in all but the initial task listed above.

7.11.4.1. Compile, Review, and Summarize Information

A concise document will be prepared that compiles existing biological, physical, and Project features information needed for assessing passage feasibility. Existing data will be obtained from the 1980s studies, ADF&G surveys between 2003 and 2011 and data developed during the licensing baseline study program and will include the following elements:

- Biological
  - Target fish species
  - Life history periodicity
  - Life-stage specific size, behavior, swimming capacity, and other physical passage constraints
  - Abundance and distribution upstream (including specific spawning locations) and downstream of the proposed Watana Dam site
  - Identify any predatory and/or invasive species that are present and how they might be affected by the Project or any passage facilities
  - Genetics information
- Physical
  - Topographic survey
  - Water quality
  - Hydrologic and hydraulic information
- Project Features
  - Project conceptual drawings
  - Project operations
  - Aerial photos
  - Seasonal flows downstream of the Project (e.g., tailwater rating curve)
  - Seasonal pool elevation (e.g., forebay rating curves, fluctuations, etc.)
  - Project design components (e.g., turbine type, draft tube velocity, sediment capacity, etc.)

Much of the information identified above is being developed as part of 2012 and 2013-14 studies, such as Fish Distribution and Abundance and Salmon Escapement studies. This task will be coordinated with these studies to maintain consistency and to minimize duplication of effort. Additional information may be collected as necessary during the passage feasibility portion of the study.

7.11.4.2. Site Reconnaissance

AEA will organize a site reconnaissance to be attended by members of the Fish Passage Workgroup. At a minimum, the reconnaissance will consist of a helicopter fly-over of the study area from the mouth of Portage Creek to the proposed Watana Dam site at RM 184, as well as tributaries to the reservoir where Chinook salmon are have been documented (i.e. Kosina Creek and Oshetna River). If weather and river conditions allow, the team will land and reconnoiter from the ground at selected locations and discuss potential passage solutions.

7.11.4.3. Define and Document a Development Process

The methods and criteria for determining biological assumptions and feasibility will be developed cooperatively between AEA in consultation with interested licensing participants. At a fundamental level, the biological goals and objectives drive the process, while the technical issues and costs constrain the potential solutions for meeting these goals and objectives. Evaluation criteria will include, but not be limited to

- Biological goals, objectives, and concerns (i.e., target species, swimming capability, life stage, and periodicity);
- Project design and operational constraints;
- Technical issues (i.e., constructability, compatibility with project design and construction schedules, ease of modification, ease of monitoring, etc.); and
- Facility costs (i.e., estimates of costs associated with the construction of capital facilities, lost generation, and operation and maintenance needs).

AEA will propose a draft development process and host a workshop to discuss and refine the process as well as establish appropriate evaluation criteria. Documentation will include an evaluation matrix (i.e., a Pugh comparison matrix) that includes applicable design criterion and weighting factors for each criterion. A final technical memorandum will be prepared that describes the development process.

7.11.4.4. Development of Conceptual Alternatives

This task includes the formation of a Fish Passage Workgroup that will develop a range of conceptual alternatives, including cost estimates, for upstream and downstream passage solutions. The alternatives must be compatible within an ice-affected climate and must meet existing regulatory requirements.

7.11.4.5. Refinement and Evaluation of Conceptual Alternatives

This task includes the synthesis of the biological, hydrological, and geological data with engineering design alternative and socioeconomics to determine the feasibility of passage at the proposed Watana Dam site. Conceptual alternatives that are determined to not be feasible will be eliminated from further consideration. The evaluation criteria that were developed collaboratively by the Fish Passage Workgroup would be used to evaluate the relative merits of the remaining alternatives. Refinement of the conceptual alternatives will include preparation of feasibility-level drawings that would be integrated into the feasibility level engineering design of the project to help communicate the design concepts.

7.11.5. Consistency with Generally Accepted Scientific Practices

The study approach generally follows steps outlined in federal guidelines for Anadromous Fish Passage Design published by the National Marine Fisheries Service (NMFS 2011).

7.11.6. Schedule

Upstream and downstream fish passage facilities can have a significant effect on the overall design and cost of the Project. Consequently, conceptual alternatives would be completed during

2013 so that further refinement of the top ranked conceptual design(s), if determined to be needed and technically feasible, can continue during 2014. Anticipated milestones are

- Compilation, review, and summary of information – March 2013
- Site reconnaissance – June 2013
- Definition and documentation of a development process – June 2013
- Development of conceptual alternatives – August 2013
- Refinement and Evaluation of Conceptual Alternatives – December 2013
- Completion of an Initial Study Report – December 2013
- Preparation of an Updated Study Report – December 2014

7.11.7. Level of Effort and Cost

This study will not include any fieldwork other than the site reconnaissance. However, significant coordination with agency engineers and biologists is anticipated. In addition, significant engineering design work is anticipated to develop conceptual drawings. The anticipated cost for completing this study is $500,000.

7.11.8. Literature Cited

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7.12. Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries

7.12.1. General Description of the Proposed Study

Construction and operation of the Project will likely affect flow, surface water elevation, sediment load and transport, and water depth, in the mainstem channel of the Susitna River at tributary confluences as well as at the inlets and outlets to side channels, sloughs, and various off-channel habitat features both in the area of the inundation upstream from the Watana Dam site and downstream in the potential zone of Project hydrologic influence. These changes in mainstem flow, water elevations and sediment transport can potentially inhibit fish passage into, within, and out of aquatic habitats. Understanding existing conditions of barriers, how those conditions change over a range of stream flows, and the relative importance of habitats upstream of barriers will provide baseline information needed for predicting the likely extent and nature of potential changes to barriers resulting from flow and water elevation changes that will occur due to Project operations.

Environmental variables affecting fish passage in streams are dynamic; therefore, results of this study must be considered representative of only a "snapshot-in-time". The height and configuration of cascades and waterfalls change from season to season with the rise and fall of stream flow, and the feature itself can be present or absent over time with the natural shifting or displacement of keystone rocks or logs. The dynamic alluvial river bed of the mainstem Susitna River also changes with variable flows over time. Thus the bed elevations into and within sloughs, side channels, and at the mouths of tributaries can change within a year, or perhaps not for a decade, or longer. These shifts in bed elevation may change the passage depth conditions, sometimes eliminating and sometimes creating the opportunity for fish passage where it may or may not have previously existed.

Deltas formed at the mouths of tributaries also change in size, height, and composition over time, possibly affecting fish passage into and out of the tributaries. The dynamics of tributary delta formation are primarily a function of tributary sediment load and the erosive power of the mainstem at the tributary mouth. Long-term changes in land use in the tributary watershed, such as increased timber harvest or road building, and changes in the timing and volume of mainstem flow will change tributary mouth passage conditions over time.

This study plan describes a coordinated effort that will be undertaken to identify and evaluate the effects of potential Project-induced changes in water depth and stream bed elevation on fish passage over barriers. Several other fish and aquatic resource studies to be conducted in 2012 and 2013-2014 will be integrated with this passage study to address future Project effects related to flow and sediment transport. This study will describe existing barriers, identify barriers that may be eliminated or created by the Project operation, and will identify potential impacts to fish associated with these anticipated changes. The results will be used to determine what, if any, protection, mitigation, and enhancement measures may be appropriate.

7.12.1.1 Study Goals and Objectives

The goal of this study is to evaluate the potential effects of Project-induced changes in flow and water surface elevation on free access of fish into, within, and out of suitable habitats in the

Upper Susitna River (inundation zone above the Watana Dam site) and the Middle Susitna River (Watana Dam site to the confluence of Chulitna and Talkeetna rivers). This goal will be achieved by meeting the following objectives:

10. Locate and categorize all existing fish passage barriers (e.g., cascade, beaver dam) located in selected tributaries in the middle and upper Susitna River (middle river tributaries to be determined during study refinement);
11. Identify the type (permanent, temporary, seasonal, partial) and characterize the physical nature of any existing fish barriers located within the Project hydrologic zone of influence;
12. Evaluate the potential changes to existing fish barriers located within the Project hydrologic zone of influence; and
13. Evaluate the potential creation of fish passage barriers within existing habitats (tributaries, sloughs, side channels, off-channel habitats) related to future flow conditions, water surface elevations, and sediment transport.

These objectives will be met through the use of existing information, consulting with the Fish and Aquatic TWG and other licensing participants, and the methods described in this study plan.

7.12.2 Existing Information and Need for Additional Information Historic Information

Historic information on anadromous fish passage in sloughs and side channels was collected in the 1980s (ADF&G 1984a). These efforts focused on collection of multi-disciplinary data at specific sloughs and side channels (Table 7.12-1).

Table 7.12-1. Co-location of 1984 aquatic studies pertinent to fish passage at sloughs and side channels.

Slough or Side Channel Name	River mile[1]	Study Name				
		Salmon Passage[2]	Stage/Q[3]	Channel Geometry[4]	Instream Flow[5]	Adult Salmon Use[6]
Whiskers Creek Slough	101.2	X	X	X		X
Mainstem 2 Side Channel	114.5	X	X	X		X
Slough 8A	125.3	X	X	X	X	X
Slough 9	128.3	X	X	X	X	X
Slough 9A	133.2	X		X		X
Side Channel 10	133.8	X	X	X	X	X
Slough 11	135.3	X	X	X		X
Lower Side Channel 11	136.1				X	X
Upper Side Channel 11	136.2	X	X	X	X	X
Slough 20	140.1	X	X	X		X
Side Channel 21	140.6	X	X	X	X	X
Slough 21	141.8	X	X	X	X	X

Slough or Side Channel Name	River mile[1]	Study Name				
		Salmon Passage[2]	Stage/Q[3]	Channel Geometry[4]	Instream Flow[5]	Adult Salmon Use[6]
Slough 22	144.2	X	X	X		X

Notes:

1. River mile is determined from the most downstream point of the study site
2. ADF&G 1984b
3. ADF&G 1984c
4. ADF&G 1984d
5. ADF&G 1984e
6. ADF&G 1984f

Studies conducted in the 1980s by ADF&G evaluated passage in side channels and sloughs for six fish species, including chum, Chinook, sockeye, coho, and pink salmon, and Dolly Varden. Chum salmon were used as a surrogate for the other five species. These studies did not address access changes at existing barriers or access into tributaries.

7.12.2.1 Current Information

Current information specific to the Susitna River includes aquatic studies being conducted by AEA for Project licensing. Project licensing studies that will support the Fish Passage Barriers Study are described below.

- *2012 Aquatic Habitat and Geomorphic Mapping of the Middle River using Aerial Photography (Geomorphic Mapping Study)* - This study will provide a comparison of the habitat mapping conducted in the 1980s with habitat mapping developed at similar discharges in 2012. One of the intents of the Geomorphic Mapping Study is to help address the potential effect of Project operations on the stability of tributary mouths and access to tributaries within the Middle River. It is also intended to provide baseline information to help determine the influence of Project-induced changes on mainstem water surface elevations in July through September on adult salmon access to upland sloughs, side sloughs, and side channels. The Geomorphology Study will coordinate with the Fish Passage Barriers Study and other related studies to identify representative study sites for riverine habitat feature digitizing. Aerial photography at the various flows will help inform the selection, characterization, and demarcation of fish barrier study sites and help identify breaching flows and the backwater influence on fish passage at the selected passage study sites.
- *2012 River Flow Routing Model Data Collection (Flow Routing Study)* - Results of the Flow Routing Study will be used as input for the Passage Study and other related studies as needed to simulate various physical and biological processes. Approximately 100 cross sections will be surveyed in the lower, middle, and upper river sections of the Susitna River. The close proximity of the proposed flow routing transect locations to the previous passage study sites (Table 7.12-2) will greatly assist field data collection and will inform the assessment of the stability of passage conditions over time. Results of Flow Routing Studies in 2013-2014 will also be used as appropriate.

Table 7.12-2. Location of proposed 2012-13 flow routing transect relative to locations of 1984 slough and side channel study sites.

1980's Slough or Side Channel Name	River mile[1]	Salmon Passage Study	River mile[1] Location of Proposed 2012-13 Flow Routing Study Transect
Whiskers Creek Slough	101.2	Yes	101.52
Mainstem 2 Side Channel	114.5	Yes	114.0
Slough 8A	125.3	Yes	124.41/126.11
Slough 9	128.3	Yes	128.66
Slough 9A	133.2	Yes	133.33
Side Channel 10	133.8	Yes	133.3/134.28
Slough 11	135.3	Yes	135.36
Lower Side Channel 11	136.1		136.4
Upper Side Channel 11	136.2	Yes	136.4
Slough 20	140.1	Yes	140.15
Side Channel 21	140.6	Yes	140.83
Slough 21	141.8	Yes	141.49/142.13
Slough 22	144.2	Yes	143.18/144.83

Notes:

1 River miles –based on 1984 river mile index.

- *2012 Upper Susitna River Fish Distribution and Habitat Study* - One component of the Upper River Fish Distribution Study is the identification and characterization of potential fish barriers in tributaries between Devils Canyon and the Oshetna River. The first upstream salmon fish passage barrier encountered in tributaries below approximately 3,000 feet elevation, the highest elevation at which Chinook salmon have been documented, will be located, described, photographed, and measured. Results of the Upper River Fish Distribution Study conducted in 2013-2014 will also be used to evaluate fish use of reaches with barriers.
- *Draft 2013 -2014 Susitna-Watana Instream Flow Study* (IFS) - The IFS plan is focused on development of macrohabitat specific models that can reliably estimate flow-habitat response patterns for different species and life stages of fish and other aquatic biota. In addition, this study will model the effects of flow on passage conditions into and out of specific mainstem habitats. Results of the IFS model will be integrally linked to the barrier analysis to provide complete coverage of existing and potential future depth barriers as well as to synthesize the relevance of passage condition changes to fish populations in the middle and lower Susitna River.
- *2013-2014 Geomorphology Study and Fluvial Geomorphology Modeling below Watana Dam* - The results of these studies, in particular the outputs from the two-dimensional

model at intensive study sites will be used to predict the potential for alteration of channel morphology that may result in creation of fish passage barriers. To address both physical and flow-related barriers, these will be coordinated with the ISF model as well. The fish barrier study will synthesize the relevance of geomorphic passage condition changes to fish populations in the middle and lower Susitna River.

7.12.2.2 Need for Additional Information

The need for additional information regarding potential Project effects on fish passage was identified in the PAD (AEA 2011):

F2: Potential effect of fluctuating reservoir surface elevations on fish access and movement between the reservoir and its tributaries and habitats.

F6: Potential influence of the proposed Project flow regime and the associated response of tributary mouths on fish movement between the mainstem and tributaries within the Middle River Reach.

F7: Influence of Project-induced changes to mainstem water surface elevations July through September on adult salmon access to upland sloughs, side sloughs, and side channels.

7.12.3 Study Area

The study area includes the mainstem and select tributaries in the upper and middle reaches of the Susitna River that would be affected by the construction and operation of the Project. For purposes of this study, the study area has been preliminarily divided into two reaches:

- Upper Reach—Susitna River and select tributaries within this reach up to the 3,000 foot elevation and extending upstream from Watana Dam site (RM 184) to the upper extent of river influenced by Watana Reservoir up to and including the Oshetna River (see Section 7.5, Figure 7.5-1).
- Middle Reach—Susitna River and select tributaries within this reach, extending from Watana Dam site to the confluence of the Chulitna River (RM 98. Passage studies in the mainstem Middle Reach will include sloughs, upland sloughs, side channels, and tributary mouths and deltas.

Passage studies in tributaries to the Middle Reach will include select tributaries and will extend from the mouth to the upper extent of Project hydrologic influence. The upper limit of hydrologic influence will be determined from supporting studies including the Flow Routing Study and the Geomorphic Mapping Study, among others.

7.12.4 Study Methods

Study methods will vary primarily depending on the type of barrier being assessed. In this study, depth barriers are more of a concern in sloughs, side channels, and mouths of tributaries. Physical barriers (cascades and waterfalls) are more of a concern within tributaries. Beaver dam barriers can occur in sloughs, side channels, and tributaries. While the specific methods for each barrier type differ, the general study components and steps are similar for locating and assessing the various types of barriers.

Methods for the study of fish passage barriers will likely consist of the following study components (these components will be refined based on Fish and Aquatic TWG and licensing participants' input):

- Identify fish species to be included in the passage barrier study;
- Define the passage criteria for the identified fish species;
- Select specific study sites and representative study sites;
- Conduct field studies;
- Coordinate with results of IFS and geomorphic models; and
- Evaluate potential effects of altered fluvial processes on fish passage in sloughs, upland sloughs, side channels, and at tributary mouths.

7.12.4.1 Identify Fish Species

The fish community of the Susitna River includes approximately 18 documented fish species. Within this community some fish species exhibit life history patterns that rely on multiple habitats during freshwater rearing and are thus more sensitive to changes in access to side channels, sloughs, and/or tributary habitats (Table 7.12-3). We will select a subset of species to target for the fish passage barrier analysis based on passage sensitivity, the known distribution of the species, and the locations of potential barriers. The species list will be refined in consultation with licensing participants.

Table 7.12-3. Fish and potential fish species within the lower, middle, and upper Susitna River, based on sampling during the 1980s.

Common Name	Scientific Name	Life History	Passage Sensitive
Arctic grayling	*Thymallus arcticus*	Fresh water	X
Dolly Varden	*Salvelinus malma*	Fresh water/ Anadromous	X
Humpback whitefish	*Coregonus pidschian*	Fresh water/ Anadromous	X
Round whitefish	*Prosopium cylindraceum*	Fresh water	X
Burbot	*Lota lota*	Fresh water	X
Longnose sucker	*Catostomus catostomus*	Fresh water	X
Sculpin	*Cottid*	Fresh water/ Marine	--
Eulachon	*Thaleichthys pacificus*	Anadromous	--
Bering cisco	*Coregonus laurettae*	Fresh water/Anadromous	X
Threespine stickleback	*Gasterosteus aculeatus*	Anadromous/Fresh water	X
Arctic lamprey	*Lethenteron japonicum*	Anadromous/Fresh water	X
Chinook salmon	*Oncorhynchus tshawytscha*	Anadromous	X
Coho salmon	*Oncorhynchus kisutch*	Anadromous	X

Chum salmon	*Oncorhynchus keta*	Anadromous	X
Pink salmon	*Oncorhynchus gorbuscha*	Anadromous	X
Sockeye salmon	*Oncorhynchus nerka*	Anadromous	X
Rainbow trout	*Oncorhynchus mykiss*	Fresh water	X
Northern pike	*Esox lucius*	Fresh water	X

7.12.4.2 Define the Passage Criteria for the Identified Fish Species

Basic categories of fish passage criteria for use in this study include water depth, water velocity, and fish leaping ability. Depth criteria will establish the minimum water depth and the maximum distance (at the minimum depth) through which a fish can successfully pass. Depth requirements for successful passage increase with an increase in the length of passage. Depth criteria will be used to assess access into and within side channels and sloughs. The ability of fish to enter slough and side channel habitats from the mainstem Susitna River and access spawning or rearing areas within these habitats is primarily a function of water depth and the length of a reach when the water is shallow (ADF&G 1984b). Velocity criteria pertain to the ability of the fish to swim against the flow, which varies with fish length and, similar to depth, with the distance over which the velocity is maintained.

Leaping criteria will be established for the vertical and horizontal distances fish must leap to pass a physical barrier.

7.12.4.2.1 Depth Criteria for Adult Upstream Migration

Existing depth criteria for evaluating fish passage include the transect criteria (Thompson 1972) and the depth/distance criteria (ADF&G 1984b). Thompson (1972) involves establishing cross sectional and water surface elevation transects at one or more locations to represent the shallowest conditions a fish may encounter while moving upstream. Although there is no longitudinal factor measured in this method, one can assume the criterion represents a minimum depth over a relatively short stream distance. With this method, depth criterion for an individual species should be based on literature values and would be determined in consultation with the Fish and Aquatic TWG.

The depth/distance method evaluates fish passage in two dimensions: depth of water and distance of travel required. This method and criteria for select species were developed for the 1980s Susitna River studies to assess passage into and within side channels and sloughs (ADF&G 1984b). One component of the depth/distance method is the development of species-specific fish passage curves that define relationships between passage depth and reach length in different habitats. Parameters that were used in the 1980s to differentiate habitats within channels and side sloughs were channel complexity, substrate, and velocity (ADF&G 1984b).

7.12.4.2.2 Leaping Criteria for Adult Upstream Migration

The ability of a fish to pass a vertical barrier is determined by species- and life stage-specific endogenous factors such as burst speed, swimming form, and leaping capability. Exogenous factors include water depth, stream flow, and barrier geometry. Powers and Orsborn (1985) present a detailed analysis of passage at physical barriers to upstream migration by salmon and trout. Their analysis is based on collecting data on barrier geometry and stream hydrology to define the existing hydraulic conditions within the barrier. The hydraulic conditions are compared to known fish capabilities to determine if fish passage is feasible. Predicting successful passage at flows outside of those at the time the data were collected depends on stage discharge or other flow indicators for the site. Powers and Orsborn (1985) presents criteria for Chinook, coho, sockeye, pink, and chum salmon passage at waterfalls and cascades. Other sources of leaping height criteria are available from Reiser and Peacock (1985) and the USFS (2007). Table 7.12-4 presents the leaping criteria from the three sources.

Table 7.12-4. Pacific salmon leaping height capabilities from three sources.

Species	Leaping Height (in feet)		
	Powers and Orsborn (1984)[1]	Reiser and Peacock (1985)	ADNR (2007)
Chinook	7.5	7.9	11.0
Coho	7.5	7.3	11.0
Sockeye	7.5	6.9	10.0
Pink	3.5	4.0	4.0
Chum	3.5	4.0	4.0

Notes:

1 Assumes a trajectory of 80^0 with a condition factor of 1.0. Maximum leaping height is less at a lower trajectory and lower fish condition factor.

Leaping curves and jumping equations assume that the depth of the pool the fish must leap from is adequate. Stuart (1964) suggests a ratio of 1:1.25 (barrier height/leaping pool depth). Reiser and Peacock (1985) also suggest a ratio of 1:1.25 and a pool depth of at least 2.5 meters (8.2 feet). Aaserude (1984) concluded that for optimum leaping conditions the depth of the leaping pool must be on the order of, or greater than, the length of the fish attempting to pass. Because assessment of the leaping pool is fundamental to determining fish passage, leaping pool depth criteria will be investigated as part of the study. The refinement of leaping criteria for use in this study will be determined in consultation with licensing participants.

7.12.4.2.3 Downstream Passage Criteria

In natural systems, a section of very shallow surface flow or dry stream bed is the most likely type of barrier to downstream fish migration or movement. Although impassable depths can occur in any reach due to large scale erosion of stream banks or subsurface slow, a more common concern is the deposition of large amounts of cobble and gravel at tributary mouths.

Fish requiring adequate flows for downstream passage in the Susitna River include anadromous juvenile and migratory resident species that move between summer rearing and overwintering habitats. Most research on downstream passage is related to passage at physical structures such as hydroelectric projects, irrigation diversions, and culverts. There is minimal information on depth criteria for downstream passage in natural environments. Alaska requires that passage depth be greater than 2.5 times the depth of a fish's caudal fin (ADF&G and ADOT&PF 2001 as cited in FHWA 2011). Other sources (Powers and Orsborn 1985 and Webb 1975) suggest that only full submergence is necessary. Maine Department of Transportation (2008) suggests 1.5 times the body thickness.

The species, lifestage, and respective passage criteria for downstream migrating fish will be determined in collaboration with licensing participants as part of this study.

7.12.4.3 Select Specific Study Sites and Representative Study Sites

Selection of tributaries and tributary mouths for passage study in the Upper River will expand upon the 2012 Upper Susitna River Fish Distribution and Habitat Study.

Upper River 2013-2014 passage studies will supplement the 2012 passage study and include

- Passage studies in any streams or stream segments requiring study that were not completed in 2012;
- Second assessment of barriers identified in 2012 that require confirmation; and
- Passage survey within the projected reservoir drawdown (or varial) zone. Selection of tributaries for varial zone passage study will be based on those streams selected for study in 2012 initial surveys.

In the Middle River, tributaries and their mouths and deltas will be selected for passage study unless any of the following is true (based on existing information; if any are true, the tributary will not be studied for passage):

- A fish barrier does not currently exist under natural low flow conditions within the hydrologic zone of influence;
- The IFS or geomorphology models do not indicate the potential for future changes in channel form, channel geometry, and/or water depth; and
- The tributary does not currently support fish species identified as target species for passage study.

The large number and complexity of sloughs and side channels in the Middle River will prohibit total coverage of these habitats for passage studies. Thus, sub-sampling of these habitats will be necessary. This study will coordinate with the IFS and geomorphology studies to identify a subset of tributary mouths, sloughs, and side channels for intensive study that represent the range of conditions present in the river. These intensively studied habitats will be modeled to evaluate how Project-induced flow and sedimentation may affect fish passage conditions on a local scale.

7.12.4.4 Conduct Field Studies

This study will rely upon data collected as part of IFS and geomorphology studies. However, we anticipate the need to collect additional information at IFS and geomorphology study sites and at additional sites primarily for physical barriers but also possibly for potential depth barriers. The following methods describe field activities to be conducted for this study.

To maximize access to habitats, passage barrier field efforts will be conducted under low flow conditions. Discharge relationships developed from the routing and IFS studies will enable passage to be analyzed under a wide range of flows. Field data collection methods will vary among physical barriers and depth passage barriers.

7.12.4.4.1 Physical Barriers

Physical barriers (geologic and beaver dam barriers) will be assessed by following the methods of Powers and Orsborn (1984). Physical barriers in tributaries and beaver dams in sloughs and side channels will be located by first reviewing existing information including

- Topographic maps;
- Current high resolution aerial imagery including aerial imagery and LiDAR from the Geomorphic Mapping Study and the 2011 Mat-Su LiDAR and Imagery Project;
- Results of the 2012 Upper River Fish Distribution Study;
- Results of the Flow Routing Study coupled with the projected effects of proposed Project operations on the zone of hydraulic influence; and
- Other relevant and available sources.

A field survey team of two will walk up tributaries or stream reaches where barriers may be present or where their presence could not be ruled out by existing information. Each potential barrier (including beaver dams) will be assessed in two phases. If a stream feature is a possible obstacle to the species of concern, the geometry of the obstacle will be surveyed including measurements of barrier height, leap distance, and estimated depth of leaping pool at high and low flow. It will be drawn to scale, photographed, and its location fixed with GPS. If the obstacle is clearly not a barrier, its location and basic dimensions will be noted with no further measurements.

If the surveyors have uncertainty regarding the barrier status of an obstacle, a decision tree analysis (URS and HDR 2010) will be implemented that is consistent with Powers and Orsborn (1984) and modified as necessary for site-specific species and barrier conditions.

The barrier analysis decision tree is a step-wise process for evaluating potential barriers in the field. Quantitative metrics are used at each step in the decision tree to identify the impassability of the potential barrier. Decision tree questions logically break down the barrier into its physical component parts, allowing a systematic, repeatable, and comparable evaluation of each potential barrier. An advantage to sequentially evaluating each component of a barrier is that if the answer to the first decision tree question suggests that a barrier is impassable, the evaluation is terminated and additional questions need not be addressed to determine barrier passability.

Not all beaver dams in sloughs and side channels will be surveyed on the ground. All significant beaver dams will be identifiable in high resolution aerial imagery and will be included on the GIS fish barrier layer and/or the wildlife layer. Beaver dams in sloughs and side channels that are selected as representative passage study sites will be surveyed on the ground. Beaver dams may also be surveyed in high-use salmon spawning areas.

Beaver dams are not typically thought to impede the downstream movement of juvenile fish. In the Black River drainage, Alaska, Brown and Fleener (2001) found that “high flows in the drainage provided multiple opportunities for both juvenile and adult fish to move over beaver dams during the season.” In *Beaver Management Guidelines*, Canada Ministry of Environment (2001) states “When water is flowing over the dam, juvenile fish are able to migrate downstream, making use of small rivulets at either end of the dam.” Pacific Stream Keepers website on controlling beavers states that “Generally, downstream migrating young salmon are not held back by a beaver dam (Kambietz 2003).”

7.12.4.4.1 Depth Barriers

Several environmental variables may affect fish passage in sloughs and side channels and tributary deltas. In general, at a given passage reach the water conditions (primarily depth) interact with conditions of the channel (length and uniformity, substrate size) to characterize the passage conditions that a particular fish encounters when attempting to migrate into and within a slough, side channel, or tributary delta. The likelihood of a particular fish successfully navigating through a difficult passage reach will depend on the environmental conditions as well as the individual capabilities and condition of the fish.

Depth passage in sloughs, upland sloughs, side channels, and at tributary delta mouths will be assessed following the methods of ADF&G (1984b) that focus on salmon passage in sloughs and side channels. Although salmon passage remains a key concern, the passage methods are generally applicable to other species where depth passage criteria are known or can be developed.

Figure 7.12-1 is a flow chart of the methods used by ADF&G (1984b) for evaluating passage in representative sloughs and side channels.

Where necessary to supplement the data collected under the geomorphology study, similar data collection methods, as described above for sloughs and side channels, will be applied at tributary mouths and deltas. The thalweg profile from the lowest extent of the delta or tributary flow upstream to and slightly beyond the upper extent of the delta, or tributary mouth, will be surveyed at low flows. Cross sections will be surveyed at thalweg breakpoints and tributary discharge will be measured. Stage-discharge relationships in the mainstem will be derived from the closest Flow Routing Study transect. If necessary, the stage-discharge rating will be interpolated between the nearest upstream and downstream Flow Routing Study transects. Substrate along the thalweg and uniformity of channel will be recorded. Mainstem water surface elevation will be measured and the site will be photographed. Once analyzed, these data will enable decision makers to determine the effects of mainstem discharge on fish passage from the mainstem into the selected tributaries.

7.12.4.5 Data Analysis and Report

Fish passage is a mechanistic analysis that compares the physical capabilities and periodicity of a fish species or lifestage with the environmental variables of the barrier. Each barrier is analyzed on a case-by-case basis.

For adult fish passage analyses at physical barriers, the primary factors that must be considered to determine probable passage success are:

- Fish species and respective adult leaping criteria;
- Adult migration timing of fish species;
- Geometry of the physical barrier; and
- Estimate of flow range and hydraulics of the barrier present during adult migration timing.

For passage analyses at depth barriers, the primary factors that must be considered to determine probable passage success are:

- Fish species/lifestage and respective depth/distance criteria;

- Migration timing of fish species/lifestage;
- Longitudinal and cross sectional geometry of the passage reach;
- Mainstem breaching discharge; and
- Mainstem backwater discharge.

The upper extent of tributary use by target species in the Upper River will be determined by the analysis of physical barriers in tributaries. The immediate effects of the proposed Project on depth passage in the Middle River, due to changes in river hydrology and hydraulics, will be analyzed based on the factors listed above. Draft and final study reports will include study goals and objectives, field and analytical methods, results, and conclusions/discussion.

7.12.5 Consistency with Generally Accepted Scientific Practice

The study methods presented above are consistent with the study methods commonly followed in investigations of fish passage. These include but are not limited to ADF&G (1984b, c, and d), Powers and Orsborn (1984), Powers and Orsborn (1985), Reiser and Peacock (1985), Thompson (1972), URS and HDR (2010), and USFS (2001). Methods are specifically adapted from these and other well-known contemporary researchers in the science of fish passage, as cited in this study plan.

7.12.6 Schedule

This is a multi-year study. Baseline data collection of natural fish passage barriers in Susitna River tributaries between Devils Canyon and the Oshetna River was initiated in 2012. It is anticipated that the 2013-2014 study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries will be completed according to the following schedule.

- Data Collection – April-October 2013
- Initial Study Report – December 2013
- Data Collection – April-October 2014
- Updated Study Report – December 2014

7.12.7 Level of Effort and Cost

Estimated cost to complete this work is $500,000.

7.12.8 Literature Cited

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7.12.9 Figures

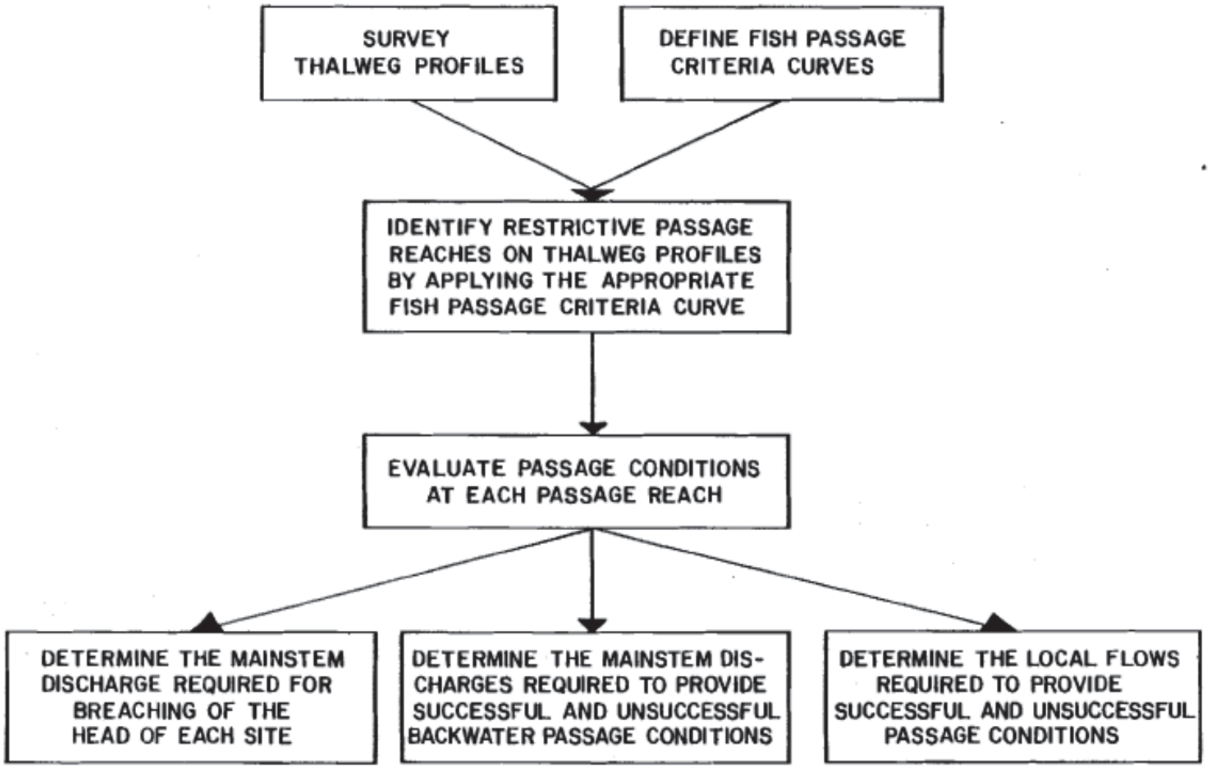

Figure 7.12-1. ADF&G (1984b) flow chart for slough and side channel assessment methods.

7.13. Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area

7.13.1. General Description of the Proposed Study

Construction and operation of facilities associated with the proposed Project will require both temporary and permanent infrastructure including road, railroad siding, airstrip, transmission lines, and construction camps and staging areas (ADOT&PF 2012). Construction and operation of the Project could affect aquatic habitat where Project access roads, transmission lines, airports, and construction areas cross or encroach on streams and other water bodies.[19] A baseline description of aquatic habitats and fish species present in the vicinity of Project-related infrastructure is needed to provide a basis for assessing potential Project effects and to assist in developing plans for PM&Es, including resource management and monitoring plans.

7.13.1.1. Study Goals and Objectives

The goals of this study are to: 1) characterize baseline condition of the aquatic habitat and fish species composition in the vicinity of the proposed Project's infrastructure including access roads, transmission lines, airports, construction areas, and operation facilities; 2) evaluate the potential for the proposed Project's infrastructure to affect these resources; 3) provide data for determining the least environmentally damaging alternative for purposes of USACE issuance of a dredge and fill permit under Section 404(c) of the Clean Water Act; and 4) to provide data for developing any necessary protection, mitigation and enhancement measures, which may include resource management and monitoring plans.

Specific study objectives are to:

1. Characterize the aquatic habitats and fish assemblages at potential stream crossings within a 200-meter (650-foot) buffer zone along proposed access road and transmission line alignments; and
2. Describe aquatic habitats and species present within the construction area for the dam and related hydropower facilities.

7.13.2. Existing Information and Need for Additional Information

AEA will evaluate up to three possible access alternatives for road and transmission lines. The Denali Corridor would run north from the Watana Dam site and connect to the Denali Highway by road (Figure 7.13-1). Within this corridor, the transmission lines would generally parallel the road to the Denali Highway and would run west along the existing Denali Highway to connect to the Anchorage–Fairbanks Intertie. The Chulitna Corridor would accommodate east-west running transmission lines and a road along the north side of the Susitna River that would connect to the Anchorage–Fairbanks Intertie and the Alaska Railroad near the Chulitna station. The Gold Creek Corridor would also accommodate an east-west access and transmission corridor but would run along the south side of the Susitna River (Figure 7.13-1).

[19] Streams would be crossed using standard Alaska ADOT&PF bridge design, or using culverts as appropriate. AEA anticipates that construction would be completed using standard methods and would rely on local borrow pits/quarries within the corridor for fill and surfacing (AEA 2011).

Construction and operation of the Project facilities will require both temporary and permanent infrastructure including road, railroad siding, airstrip, transmission lines, and construction camps and staging areas (ADOT&PF 2012). Construction and operation of the Project could affect aquatic habitat where Project access roads, transmission lines, airports, and construction areas cross or encroach on streams and other water bodies.[20]

Fisheries and aquatic habitat work specific to each of the proposed transportation access and transmission line alignments has not been conducted since the 1980s. This is ample time for shifts in fish species distribution such as range expansion. Thus a description of current aquatic habitats and fish species in the vicinity of Project-related infrastructure is needed to inform Project design, impact assessment, and development of potential PM&Es as necessary.

The most comprehensive fish and aquatic habitat dataset relevant to this study was generated during the 1980s. In 1983, ADF&G established study sites to characterize aquatic habitat and document fish species presence at 42 stream crossings within the then-proposed access and transmission corridors. Study sites were established at 22 stream crossing sites from the Denali Highway to the Watana Dam site, 14 sites along the Devil Canyon access corridor, and six sites along the then-proposed Gold Creek rail portion of the corridor (Schmidt et al. 1984). The 22 crossing sites along the then-proposed Denali-North (Seattle Creek) alignment correspond reasonably well to the present-day Denali Corridor crossing sites. The 14 study sites along the then-proposed Devil Canyon access, which extended from corridor mile 38 of the old Denali corridor to Devils Creek dam site to the old Gold Creek intertie, relate fairly well to a portion of the present-day Chulitna Corridor. The 6 sites along the old Gold Creek intertie correspond to some of the crossings associated with the western portion of the present day Gold Creek Corridor.

In addition to the *Access and Transmission Corridor Aquatic Investigations* (July—October 1983) report (Schmidt et al. 1984), relevant existing information sources include fish species presence and aquatic habitat data collected and maintained under the *Alaska Freshwater Fish Inventory* (AFFI) program (e.g., Buckwalter 2011) and anadromous fish presence data maintained by the ADF&G *Anadromous Waters Catalog* (*AWC*; ADF&G 2011). The Aquatic Resources Data Gap Analysis (ARDGA; HDR 2011) and AEA's Pre-Application Document (PAD) (AEA 2011) summarized existing information and identified data gaps for aquatic conditions and fish species.

The Alaska Department of Transportation and Public Facilities (ADOT&PF) recently conducted a transportation access study to evaluate access corridors to the Watana Dam site (ADOT&PF 2012). In 2011, the ADOT&PF study team used a helicopter to fly over each access route and identified each stream crossing (those previously mapped and those that did not appear on the USGS map; ADOT&PF 2012). The ADOT&PF team landed at selected stream crossings and estimated channel width and incision depth, and where possible, identified more efficient crossing locations (ADOT&PF 2012). Based on the 2011 field reconnaissance coupled with review of existing aquatic resource data, the ADOT&PF identified the number of stream crossings that would be necessary under each alternative. The ADOT&PF considered the

[20] Streams would be crossed using standard Alaska ADOT&PF bridge design, or using culverts as appropriate. AEA anticipates that construction would be completed using standard methods and would rely on local borrow pits/quarries within the corridor for fill and surfacing (AEA 2011).

number of stream crossings and associated fish passage requirements as part of the screening criteria evaluation (ADOT&PF 2012).

The access and transmission line corridors for the proposed Project have not been finalized. Historic data on fish species presence and aquatic habitat are available for many of the streams that would be crossed; however an updated characterization study is needed to assess current conditions and ensure fish presence is accounted for in all streams and water bodies within the vicinity of the proposed crossing locations. Additionally, a more comprehensive and systematically-collected aquatic habitat dataset is necessary to characterize baseline conditions prior to potential development.

A brief summary of the existing information for each of the proposed access/transmission line corridors is presented below.

7.13.2.1. Denali Corridor

The current Denali access alignment corridor (referred to by ADOT&PF as the Seattle Creek [North] alignment) would require approximately 15 stream crossings from the Watana Dam site to the Denali Highway (ADOT&PF 2012). The Denali Corridor alignment would cross streams within both the Nenana River and Susitna River watersheds. Seattle Creek and Brushkana Creek are the two major drainages crossed within the Nenana River watershed. The Denali Corridor would require eight crossings of tributaries within the Nenana River basin and two crossings in the Susitna River watershed. Deadman Creek is the major stream crossed within the Susitna River watershed.

In the 1980s, biologists conducted fish presence surveys in the vicinity of 10 of these 15 stream crossing sites and recorded general habitat and water quality conditions (Schmidt et al. 1984). Resident fish species were confirmed to be present in the vicinity of nine proposed crossing locations, three sites with intermittent flow were deemed unsuitable for fish use and were not sampled for fish presence, and one site had no fish present (Schmidt et al. 1984).

Schmidt et al. (1984) documented that Dolly Varden, slimy sculpin, and Arctic grayling were relatively widespread along the Denali Corridor. Sculpin were captured near nine of the proposed crossing locations and Dolly Varden and Arctic grayling near six of the proposed crossings. No anadromous fish habitat was documented during these surveys. These streams will be re-surveyed in 2013 along with a subset of streams that would be crossed by the transmission line along the Denali Highway.

7.13.2.2. Chulitna Corridor

The current Chulitna alignment corridor (referred to by ADOT&PF as the Hurricane [West] alignment) would require approximately 36 stream crossings. All streams and water bodies that would be intersected by this corridor drain into the Susitna River watershed. The majority of streams that would be crossed by this alignment are smaller tributary streams. However, this alignment would also cross a number of larger streams, including Pass Creek, the Indian River, and Thoroughfare, Portage, Devil, Tsusena, and Deadman creeks.

The Chulitna corridor alignment would cross several known anadromous fish streams (ADF&G 2011). A crossing of Granite Creek, west of the Parks Highway, would facilitate access to the existing railroad line. The ADF&G *AWC* lists Granite Creek (AWC No. 247-41-10200-2381-

3600) as anadromous fish habitat (ADF&G 2011). Bader and Sinnott (1989) captured juvenile Chinook and coho salmon at a point downstream of the proposed Granite Creek crossing (ADF&G 2011; Bader and Sinnott 1989), and no passage barriers have been identified in that creek between the fish capture site and the proposed crossing.

Pass Creek, located southwest of the Chulitna route crossing, is specified as an anadromous fish stream in the *AWC* (AWC No. 247-41-10200-2381-3236) and is designated to provide habitat for all five species of Pacific salmon (ADF&G 2011). However, a waterfall located downstream of the Chulitna alignment crossing presents a barrier to upstream migration of anadromous fish (ADF&G 2011). The Chulitna alignment intersects nine small, unnamed tributaries to Pass Creek; however, only limited electro-fishing assessment data are available and indicate the presence of Dolly Varden and slimy sculpin at the one location sampled (Buckwalter et. al., 2003).

Three additional streams, Indian River (AWC No. 247-41-10200-2551), Thoroughfare Creek (AWC No. 247-41-10200-2582-3201), and Portage Creek (AWC No. 247-41-1020-2585), have been cataloged (ADF&G 2011) as providing habitat for anadromous fish at the potential crossing sites.

The Chulitna alignment would cross 10 small, unnamed tributaries of Portage Creek, the mainstem of Devils Creek and three of its tributaries, seven smaller tributaries to the upper Susitna River (in the Swimming Bear drainages; Schmidt et al. 1984), as well as Tsusena Creek and two of its tributaries. Fish presence sampling has not been conducted in many of these tributary streams, and passage barriers have not been identified. The presence of barriers on some of the Susitna River tributaries above Devils Canyon is being documented as part of the 2012 Upper Susitna River Fish Distribution and Habitat Study.

7.13.2.3. Gold Creek Corridor

The current road and transmission line alignment within the Gold Creek Corridor would require approximately 23 stream crossings (ADOT&PF 2012). All streams and water bodies that would be intersected by this alignment drain into the Susitna River watershed. The major streams that would be crossed include Gold Creek, Fog Creek, and Cheechako Creek. Smaller streams that would be crossed include tributaries to Prairee and Jack Long creeks and a number of unnamed tributaries to the Susitna River.

The Susitna River (including side channels and sloughs), Fog Creek, Cheechako Creek, and Gold are known to provide habitat for anadromous Pacific salmon (ADF&G 2011). Many of the streams that would be crossed are unnamed tributaries of the Susitna River. Fish data are available for a number of streams that would be crossed. However, much of the available fish data were collected downstream from (i.e. not in the direct vicinity of) the proposed crossing sites (ADF&G 1981, 2011; Schmidt et al. 1984). A total of eight of the 23 streams intersected by the southern alignment are known to provide habitat for anadromous fish downstream of the proposed crossing sites (ADF&G 1981, 2011; Schmidt et al. 1984).

7.13.3. Study Area

The access corridor study area includes streams and water bodies within both the Susitna River and Tanana River watersheds (Figure 7.13-1). The Denali alignment would cross streams within both the Nenana River (a tributary of the Tanana River) and Susitna River watersheds. Seattle

Creek and Brushkana Creek are the two major drainages that would be crossed within the Nenana River watershed. Deadman Creek is the major stream that would be crossed within the Susitna River watershed. All streams and water bodies that would be intersected by the Chulitna and Gold Creek alignments drain into the Susitna River watershed.

The study area will include the aquatic habitats (streams and lakes) in the vicinity of both temporary and permanent Project-related infrastructure including access roads, transmission lines, airports, and construction areas. AEA will establish study sites in aquatic habitats within a 200-meter (650-foot) buffer zone along each access alignment corridor, in the vicinity of the potential airport and hydropower facility construction areas. Figure 7.13-1 shows the streams and lakes (based on the most current hydrography layer) within the three access corridors.

The study area will be adjusted as refinements are made to the proposed Project features and specific alignment routes. AEA expects that the initial 2013 sampling effort will occur over a broad area and that collection of more detailed information within refined alignments will be necessary during subsequent sampling efforts in2014.

7.13.4. Study Methods

7.13.4.1. Synthesis of Existing Information

As part of the 2012 study efforts, historic data for aquatic resources sampling reported in Schmidt et al. 1984 (and associated data to the extent possible), the AWC, and AFFI will be incorporated into a geospatial database for the proposed access alignments. AEA will consult with the agencies and will identify gaps in the historic aquatic habitat and fish species presence database to prioritize the initial 2013 sampling efforts and refine the overall field sampling approach. Based on the existing data review, the overall priority for data collection will be: 1) sites not previously surveyed; 2) sites with no previously documented fish presence; 3) sites with fish presence documented downstream of the potential crossing location; and 4) sites with fish presence documented upstream of the potential crossing location. In this study, AEA does not propose to survey for fish presence in streams where the known anadromous fish distribution extends upstream of a proposed crossing location, but aquatic habitat surveys may be conducted in these locations.

At the onset of this study, locations where aquatic habitat and fish species presence data have been previously collected in the vicinity of the proposed access corridors will be identified. AEA will code streams and water bodies by fish presence (e.g., anadromous fish, resident fish, no fish captured or observed) and will identify streams and water bodies for which no data records were found. For areas where no sampling data are available, the team will review connectivity to adjacent streams and water bodies (e.g., where fish/habitat data are available) to aid in field sample planning.

AEA will initiate studies in 2012 to begin the characterization of fish communities, fish distribution, and aquatic habitat throughout the Susitna River. AEA also will begin a study to document the presence of fish passage barriers in the Upper Susitna River, with a focus on streams within the proposed inundation zone. In 2013 and 2014, AEA will expand these efforts to identify the presence of existing fish passage barriers to tributaries downstream of the proposed Watana Dam site. Fish distribution sampling also will begin in the Upper Susitna River in 2012; efforts will be continued as appropriate in 2013 and 2014. Fish species distribution and fish passage data collected during these studies will be incorporated into the Project database; these data will be used to supplement data collection and analysis specific to this study.

7.13.4.2. Field Data Collection

Study sites will be established at proposed crossing sites in streams along the three potential access and transmission corridors and within the vicinity of construction areas and potential airport locations. To account for potential alignment changes or refinements, sampling will occur within a 200-meter (650-foot) buffer along each alignment corridor in 2013. Study sites will also be established on lakes within the proposed access corridors and in the vicinity of construction locations.

Each alignment will be flown to verify that all streams and/or water bodies within 200 meters (650 feet) of the access and transmission corridors and construction areas are included in the field study. The field team will record the location of each area to be sampled with a GPS unit. The field team will also take photographs to document channel conditions during each field data collection effort. The team will sample for fish presence and record aquatic habitat parameters at each study site, as described below.

AEA expects that the initial information collected in 2012 and 2013 will be assessed during the facilities alternatives analysis and will be used to refine Project design. AEA anticipates that the collection of additional site-specific data may be necessary in 2014 to address any newly identified crossing locations and or fill data gaps.

7.13.4.2.1. Aquatic Habitat Data Collection

The field team will record aquatic habitat characteristics in the vicinity of each potential crossing site. At stream crossing locations, AEA will characterize habitat units to the mesohabitat level in accordance with the channel typing and aquatic habitat classification system currently being developed for the Project by the Fish and Aquatic TWG. Habitat characterization will be based on a modified version of the USFS Aquatic Habitat Survey Protocol (2001). Habitat units encountered will be typed, and parameters that describe the current condition of the habitat unit will be measured. If sections of stream contain two or more different habitat units they will be delineated to the meso-habitat level, denoting a primary and secondary unit, and recorded correspondingly.

The habitat survey for each stream will be conducted by a two-person field team. A GPS point will be used to identify the upstream boundary of each mesohabitat unit. Maximum depth and pool crest depth will be measured with a stadia rod and recorded in meters. Wetted and bankfull widths will be measured with a laser range finder and recorded in meters. Dominant substrate type will be estimated by visual identification based on USFS (2001) classifications.

Large woody debris (LWD) observed will be counted for each habitat unit. For a piece of wood to be considered LWD, it must be at least 0.1 meters (4 inches) in diameter and at least 1.0 meter (39 inches) of the LWD must be below the water's surface at bankfull flow (USFS 2001).

The amount of undercut bank (UCB) on each side of the stream will be measured to the nearest meter for each habitat unit. A bank will be considered undercut if the undercut is greater than or equal to 0.3 meters (12 inches) incised into the bank and greater than 1.0 meter (39 inches) long.

If, at bankfull stage, the bank would be considered undercut, then it will be measured even if it is above the current surface of the water (USFS 2001).

The linear distance of stream habitat characterized at the mesohabitat unit level will be a function of wetted channel width (40 times the wetted width up to a maximum of 400 meters [1,300 feet]). AEA is in the process of developing a systematic approach to characterize lake habitats for the Project. In 2013-2014, AEA will utilize the lake habitat classification system to characterize lake habitats that fall within the study area boundaries.

As Project features are refined, additional site-specific data will be recorded along transects in the close vicinity (in accordance with the Habitat Characterization Protocol) of the anticipated crossing location. Data recorded along transects will include but not be limited to channel bed width, wetted channel width, several water depth measurements across each transect, gradient[21], Rosgen channel type (Rosgen 1994), and water quality field parameters. AEA anticipates the need for such parameters to meet permitting requirements (e.g. ADF&G Fish Habitat Title 16 Permit).

Several water quality parameters that impact aquatic life will be measured during the aquatic habitat assessment, including field measurements of surface water temperature, pH, dissolved oxygen (DO), and specific conductivity. Alaska Department of Environmental Conservation (ADEC) standards for the growth and propagation of fish, shellfish, other aquatic life, and wildlife (ADEC water quality standards for aquatic life) will be used to evaluate measured parameters. Water quality sampling will be conducted in coordination with water quality sampling protocols currently being developed for the Project.

7.13.4.2.2. Fish Data Collection

The goal of this task is to characterize fish assemblages in the vicinity of potential stream crossings. Therefore, sampling will not be conducted throughout the entire length of the stream but instead within close proximity to crossing sites (see below). Species richness in stream fish assemblages is related to both environmental conditions within the stream and stream spatial position within the drainage (Grenouillet et al. 2004). In an effort to characterize species composition at each stream crossing, the field team will establish segments of stream habitat to sample for fish presence at each crossing site. Streams will be sampled as described below. As requested by ADF&G during Fish and Aquatic TWG meetings, sampled water body crossings where no fish are found will be sampled again during a different season to adequately assess fish presence.

The field team will use backpack electrofishing gear (Smith-Root LR-24 or similar) as the primary capture method to inventory streams for fish presence. Single-pass electrofishing was selected as the primary fish capture method because it is considered to be the most effective (Barbour et al. 1999, Simon and Sanders 1999, Flotemersch and Blocksom 2005) and widely applied (Hughes et al. 2002) method used in streams and rivers. Electrofishing typically captures more species with less size selectivity than other gear types (Hendricks et al. 1980), electrofishing equipment is relatively compact and portable, and electrofishing is recommended

[21] One study considered stream width and gradient as 2 of the most influential factors that affected species richness among different habitat variables (Grenouillet et al. 2004).

as a standard sampling method for coldwater fishes in streams (Bonar et al. 2009; J. Buckwalter, ADF&G/Habitat Biologist II, personal communication, October 17, 2011).

Electrofishing settings will be determined in the field based on water quality conditions (e.g., conductivity) and professional judgment. Backpack electrofishing will be conducted by trained staff consistent with established protocols and guidelines (e.g. NMFS 2000; Temple and Pearsons 2007; Buckwalter et al. 2010; J. Buckwalter, ADF&G/Habitat Biologist II, personal communication, October 17, 2011). If adult salmonids or aggregations of large (>300 millimeters [11.8 inches]) salmonids are encountered, electrofishing activities in the immediate vicinity will cease, except to capture fish for species identification (Buckwalter et al. 2010). Other fish sampling methods (e.g., fyke nets, minnow traps) will be used when adult anadromous fish are present and when habitat conditions are not suitable for electrofishing.

The length of stream habitat sampled at each crossing site will be directly proportional to the stream channel's wetted width. The linear distance of stream habitat sampled needs to be long enough to provide a true representation of the fish species present but not so long that it becomes more labor intensive than is necessary to meet the study's objectives (Temple and Pearson 2007). In general, large streams require longer sampling sections than smaller streams to assess community structure (Temple and Pearsons 2007). Temple and Pearsons found that a sample reach with a length between 27 and 31 wetted channel widths was the minimum sampling distance required to detect 90 percent of the fish species present (2007). For small streams, such as headwater streams, other studies report minimum sampling distances of 12 to 50 wetted channel widths (Patton et al. 2000), 35 wetted channel widths (Lyons, 1992), and 40 wetted channel widths (Reynolds et al. 2003; Buckwalter et al. 2010). Recent analysis of data collected by single-pass electrofishing using the 40 wetted channel width reach length found that species richness was typically underestimated on intermediate (e.g. drains 200 square kilometers) and mainstem (e.g., drains 1,500 square kilometers) streams in Alaska (as opposed to target headwater (drains 50 square kilometers) streams (J. Buckwalter, ADF&G/Habitat Biologist II, personal communication, October 17, 2011). Based on the above study results and the anticipated channel size for crossing surveys, AEA proposes to survey a stream length of 40 wetted channel widths, up to a maximum of 400 meters (1,300 feet) of stream length.

In addition, the team will use a combination of methods to sample for a variety of fish species and life stages throughout representative lake habitats. Sampling may include the use of multi-mesh gill nets, baited minnow traps, fyke nets, seine nets, and angling gear. The gear used at individual sampling locations will be a function of habitat conditions encountered. Gear type specifications are as follows.

- Gill nets will be situated perpendicular to shore of lakes and fished at varying depths. The team will deploy nets for a minimum of two hours and check nets frequently to minimize potential fish mortality. To the extent possible, the team will sample multiple locations throughout each lake, including around the inlet and outlet areas. If no fish are captured within several hours, gear will be set overnight. The team will use a boat and/or drysuits to deploy gear in offshore habitats.
- Minnow traps (also known as basket traps) will be baited with commercially processed roe and secured to vegetation or substrate to sample overnight (roughly 24 hours).
- Fyke nets will be used to document fish species presence. Each net will be equipped with attached wings and detachable center leads with floats and weighted line. Alternative fyke net sizes and designs may also be used depending on conditions encountered.

- Beach seines may be used to target fish too small to be captured by traps or species that typically are not susceptible to sampling with traps. The team will use a variety of sizes, including a 1.2-meter (4-foot) by 6.1-meter (20-foot) black mesh beach seine with 6.4-millimeter (0.25-inch) mesh. The seine should be adequate to sample slow water habitats but will likely not be suitable in areas with swift current. Beach seine sampling area will be recorded and involve a single pass through the sample area.
- Angling gear will target larger fish in deeper portions of the lakes. A variety of gear will be used.

Captured fish will be held in buckets and/or live wells until the sampling of each segment is complete. Fish will be identified to species and counted. Up to 100 fish of each species collected at each sampling location will be measured to the nearest millimeter to record fork or total length as appropriate. Fish will be released within the sampling location once sampling activities have ceased. Fish disposition (e.g. released, unintended mortality, voucher specimen, injury) will be recorded for each fish handled. Data will be recorded on a standardized datasheet or field computer form.

AEA will obtain a fish resource permit (FRP) from ADF&G prior to initiation of field sampling activities. Sampling activities will be carried out in compliance with FRP stipulations. Any deviations from the approved study plan will be communicated to ADF&G during or immediately following sampling activities.

7.13.4.3. Data Analysis and Reporting

Data generated during this study will provide baseline data related to fish and aquatic habitat in the vicinity of potential water body crossing locations associated with potential transportation access alignments, transmission alignments, and construction areas. AEA will complete a technical report that summarizes methods and results of the aquatic habitat characterization and fish species assemblages in the study area.

Data generated during this study will be incorporated into the Project's geospatially-referenced relational database. Naming conventions of files and data fields, spatial resolution, and metadata descriptions will meet the standards established for the Project. Use of the Project's geospatial database will also allow data specific to each stream crossing to be queried and readily accessible for Project reporting. The database will be designed to create individual reports by crossing location.

Fish capture data will be submitted to ADF&G per FRP requirements. Fish species assemblage (composition and species richness) and distribution will be reported by sampling location and by stream drainage or lake. Catch per unit effort (CPUE) will be determined by dividing the catch (number of fish captured or observed) by the effort (e.g. sample time). To the extent possible, data collected using different methods will be normalized so results can be appropriately compared. CPUE will be determined for each species by location (e.g. stream reach sampled) and gear type. CPUEs will be used to develop an index of relative abundance for each species captured at stream crossing sites.

7.13.5. Consistency with Generally Accepted Scientific Practice

Electrofishing, gill nets, seine nets, minnow traps, angling, and fyke nets are commonly used methods for sampling fish populations (Murphy and Willis 1996; Backiel and Welcomme 1980). Angling using single barbless lures or flies has become a common method for capturing subject fish. These methods described herein have been developed in consultation with the agencies and other licensing participants. All data collection efforts will follow State guidelines and FRP permit stipulations.

7.13.6. Schedule

The preliminary schedule for the Aquatic Resources within the Access Alignments, Transmission Alignments, and Construction Areas study is as follows. AEA will begin this study by reviewing results of the efforts currently underway to compile existing fisheries and aquatic habitat data. AEA anticipates that the historic and more recent existing data on stream crossings will be available in early 2013.

The field team will conduct fish surveys primarily during July and August 2013, at which time fish should be well distributed throughout feeding or rearing habitats. It is possible that some sampling efforts may start in late June and extend beyond August, such as those in lake habitats or those associated with migration periods. Aquatic habitat surveys are typically conducted at low flows. The timing of low-water events is not known for all crossing locations; in general, low water during the open-water season may occur during fall months just prior to freeze up. Aquatic habitat surveys will be conducted concurrent with fish sampling as conditions allow. However, crossing locations may need to be visited more than once. For sites where no fish are encountered on a first survey, a second survey during a different season will be conducted to help confirm fish use of habitat. As discussed in the methods section, additional surveys are anticipated in 2014 to refine the alignments and/or fill in data gaps. The number of 2014 surveys that will be needed cannot be determined until more information is available.

Initial and Updated Study Reports discussing actions to date will be issued in December 2013 and 2014, respectively.

7.13.7. Level of Effort and Cost

This study will require that data be collected over at least two field seasons, primarily to accommodate potential refinements in Project design. AEA anticipates that data will be collected over a broader study area in 2013, for example, within the larger access corridors shown in Figure 7.13-1. As elements of the Project are refined and specific crossing locations are chosen, additional sites may need to be sampled and the collection of more detailed, site-specific information may be necessary at selected crossing sites throughout the study area.

The study will require at least one part-time senior biologist as study lead and additional support staff including multiple field biologists, a GIS team, and administrative staff. The 2013 field effort will require helicopter support for a minimum of two field teams to collect fish and habitat data at potential water body crossings over the span of approximately 30 field days. The remainder of the 2013 study effort would be office-based, with data entry and quality assurance/quality control, analysis, GIS and database queries, and report development. AEA anticipates that the study area within which additional data will need to be collected in 2014 will be refined and therefore reduced. AEA estimates the 2014 field effort will require helicopter support for potentially two field teams for up to 20 days. The remainder of the 2014 would be office-based.

The initial cost estimate for completion of the study objectives for all three access corridors is roughly $600,000 for the 2-year study period. However, costs could be reduced if the number of proposed corridors is reduced and the alignment(s) are refined for year 2014.

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7.13.9. Figures

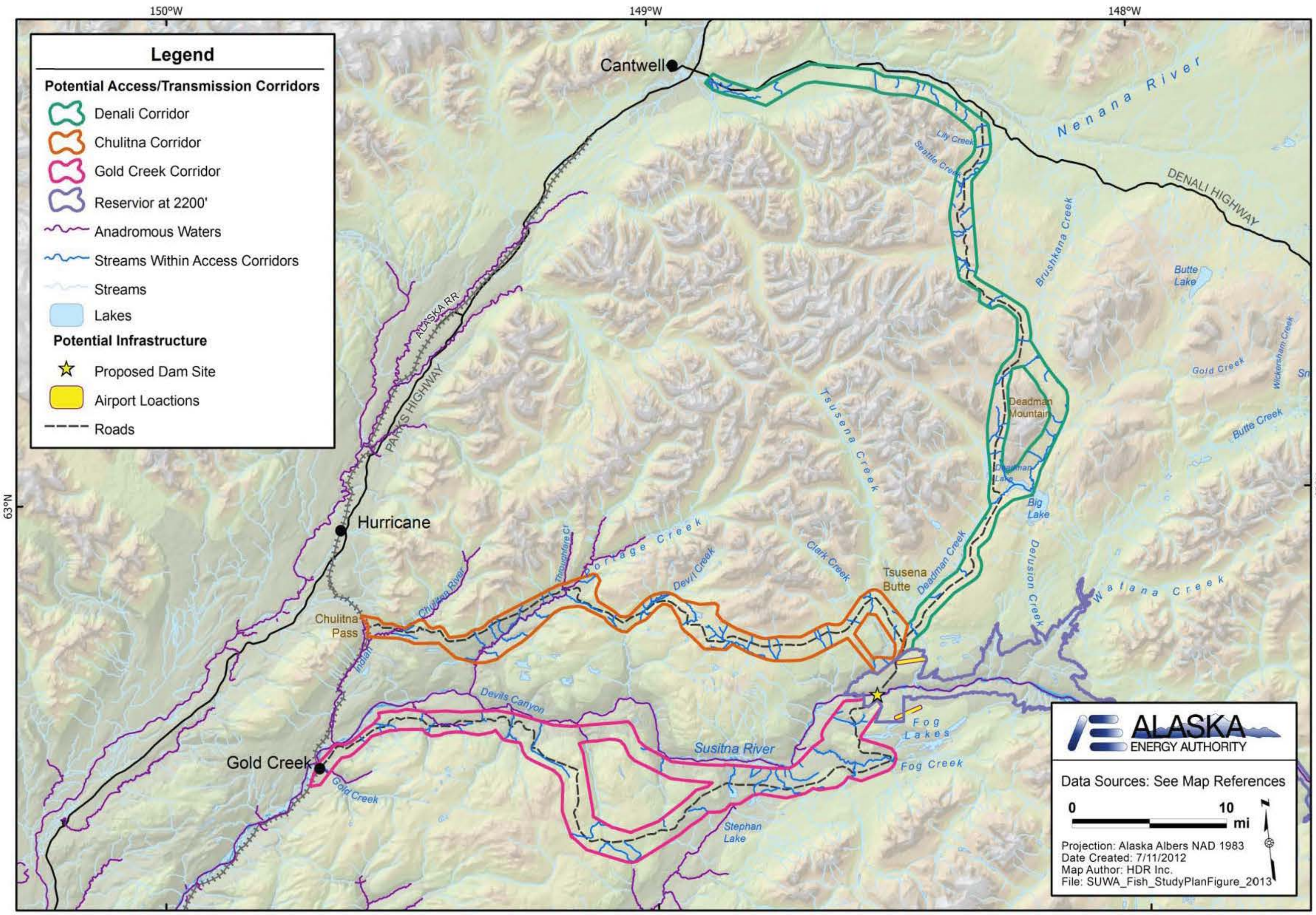

Figure 7.13-1. Study Area for Aquatic Resources in the Potential Access and/or Transmission Alignment Corridors.

7.14. Genetic Baseline Study for Selected Fish Species

7.14.1. General Description of the Proposed Study

Construction and operation of the Project will modify the flow, thermal, and sediment regimes of the Susitna River, which may alter the composition and distribution of fish populations.

Genetic analysis methods can be used to address several goals associated with assessing potential Project impacts. First, there is a potential for the Project to affect genetic diversity and local adaptation of fish populations. Second, genetics can be used as a tool to assess other forms of impacts. Ultimately, the usefulness of genetics as a tool to assess other impacts derives from the degree of population segregation of particular species among areas of the Susitna watershed. If breeding isolation among areas occurs over sufficient time, the unique genetic characteristics act as naturally occurring "tags" of spawning populations.

As part of the first application of genetics, this study will develop a repository of fish tissues from many resident and anadromous fish for use with future studies that may be needed to characterize the genetic legacy and variation for species of interest. As a tool for assessing non-genetic impacts, this study will provide a means of assessing the degree to which Chinook salmon from the middle and upper river rear in areas downstream of the middle river. If known to occur, such information alters the methods that are needed to characterize any effects from the Project. For example, monitoring the abundance of Chinook salmon smolt leaving the middle river to the sea would underestimate the actual contribution of the middle and upper river to the overall Susitna Chinook salmon population.

In addition, if sufficient genetic uniqueness exists among Chinook salmon from different tributaries exists genetics may be used to estimate the overall abundance of spawning Chinook salmon in the Susitna River watershed. For example, counts of Chinook salmon in tributaries (e.g., from counting weirs) can be combined with a sampling program of the entire spawning run obtained in lower river fishwheels to estimate the overall abundance of Susitna River Chinook salmon.

This work will be conducted through collaboration among AEA, ADF&G, and other licensing participants. Information developed in this study may also assist in the development of any necessary protection, mitigation, or enhancement measures to address potential adverse Project impacts to salmonid resources.

7.14.1.1. Study Goals and Objectives

The goals of this study are to (1) acquire genetic material from samples of selected fish species within the Susitna River drainage and (2) assess the use of lower and middle river habitat by juvenile Chinook salmon originating in the middle and upper Susitna River.

Objectives:

1. Develop a repository of genetic samples for fish species captured within the Susitna River drainage, with an emphasis on those species found in the middle and upper Susitna River.
2. Contribute to the development of genetic baseline markers for each of the five species of Pacific salmon spawning in the Susitna River drainage.

3. For 2013 and 2014, quantify the genetic variation among upper and middle river Chinook salmon for use in mixed-stock analyses, including analyses of lower river samples of the entire Susitna Chinook salmon population.
4. In 2013 and 2014, estimate the annual percent of juvenile Chinook salmon in selected lower river habitats that originated in the middle and upper Susitna River.

7.14.2. Existing Information and Need for Additional Information

The baseline genetics data in the Susitna River is limited to the five Pacific Salmon species. Assessing genetic relatedness and isolation of fishes in the watershed can be used to determine potential impacts from the Project. Interbreeding among areas might be hindered by the Project, thereby potentially reducing the fitness of some stocks of resident fishes. Breeding isolation of stocks may be a sign of uniquely adapted traits for particular features of the habitats; such information would alter the impact assessment, and possibly the design of any proposed mitigation measures. To characterize relatedness and any isolation of particular resident fishes, tissue samples for genetic analysis must be collected from a range of locations.

Tissue collections and genetic analyses of Pacific salmon stocks in Alaska are relatively well developed and are used for applied research in several watersheds. The Susitna River salmon stocks are not well represented in the State's tissue repository, and samples obtained here will enable the application of genetic methods to address two objectives. First, if sufficient genetic variation (and isolation) of Chinook stocks exists, genetics can provide a means to identify the extent to which the offspring of fish that spawn in the upper river are found rearing in the middle and lower river. Second, if tributary-specific Chinook salmon stocks in the Susitna River are unique, modern analytical methods can be used to estimate the species' system-wide escapement. Estimating the system-wide Chinook salmon escapement is part of the *Salmon Escapement Study* (Section 7.7), and the rationale and approach for it are outlined in that section.

7.14.3. Study Area

The study area encompasses the Susitna River and its tributaries from Cook Inlet upstream to the Oshetna River confluence (RM 233.4). For baseline data related to stock-specific sampling, there is an emphasis on tributaries of the middle river and the upper river. For assessing habitat use (juveniles) of fish originating in the middle and upper river, and for estimating the system-wide escapement (adults), Chinook salmon tissues will be collected in the lower river (< RM 98).

7.14.4. Study Methods

7.14.4.1. Samples to Collect

The annual targets for data collection to meet the study objectives are indicated below. The sample sizes associated with each collection listed below represent a target rather than a sample size requirement since the abundance of each species or sub-stock is currently unknown.

- 100 tissue samples from spawning Chinook salmon in Portage Creek and Indian River (Objective 1).
- 25 tissue samples from spawning Chinook salmon from any Susitna River tributary with evidence of Chinook spawning upstream in the middle and upper Susitna River. Likely

streams to sample include: Chinook, Devil, Fog, Tsusena, and Kosina creeks, and the Oshetna River (Objectives 1 and 2).

- 100 tissue samples from any mainstem spawning Chinook salmon above Devils Canyon (Objectives 1 and 2).
- 100 tissue samples from each spawning aggregate of pink, sockeye, chum, and coho salmon from the Susitna River upstream of Three Rivers (Objective 1).
- 100 tissue samples from juvenile Chinook salmon at each of the following: Chinook Creek, Oshetna River, Indian River, Portage Creek, the mainstem Susitna River upstream of Three Rivers, as well as Talkeetna and Chulitna rivers (Objectives 1, 2, and 3).
- 75 juvenile Chinook salmon 16 sites across five mainstem habitat types in the lower Susitna River (Objective 3).
- 50 representative samples from each of the following species in the Susitna River (Table 7.14-1), with an emphasis on fish collected opportunistically in the middle and upper Susitna River (Objective 4):

Table 7.14-1. Potential Susitna River Fish Species for Targeted for Genetic Analysis Sampling

Common Name	Scientific Name
rainbow trout	*Oncorhynchus mykiss*
humpback whitefish	*Coregonus pidschian*
round whitefish	*Prosopium cylindraceum*
lake whitefish	*Coregonus clupeaformes*
Alaska whitefish	*Coregonus nelsonii*
Bering cisco	*Coregonus laurettae*
eulachon	*Thaleichthys pacificus*
Pacific lamprey	*Lampetra tridentata*
longnose sucker	*Catostomus catostomus*
slimy sculpin	*Cottus cognatus*
prickly sculpin	*Cottus asper*
coastal range sculpin	*Cottus aleuticus*
Pacific staghorn sculpin	*Leptocuttus armatus*
burbot	*Lota lota*
Arctic grayling	*Thymallus arcticus*
Dolly Varden	*Salvelinus malma*
lake trout	*Salvelinus namaycush*
northern pike	*Esox lucius*
threespine stickleback	*Gasterosteus aculeatus*
ninespine stickleback	*Pungitius pungitius*
Alaska blackfish	*Dallia pectoralis*

7.14.4.2. Tissue Storage

While in the field, tissue samples will be preserved in ethyl alcohol in a 125–500 ml bulk sample bottle for each location. After samples are received by the Gene Conservation Laboratory (GCL), samples will be preserved as follows. At least five pieces of each sample will be placed into plastic plates and freeze dried. Once dry, moisture-indicating desiccant beads will be added and the plate sealed completely with aluminum foil heat-activated tape. Tissues samples will then be stored at room temperature.

7.14.4.3. Laboratory Analysis

DNA from the baseline collections will be extracted from axillary processes using DNeasy 96 tissue kits. Chinook salmon samples will be analyzed for at least 96 single nucleotide polymorphism (SNP) markers.

The DNA samples will be analyzed using Fluidigm 96.96 Dynamic Arrays (http://www.fluidigm.com). The Fluidigm 96.96 Dynamic Array contains a matrix of integrated channels and valves housed in an input frame. On one side of the frame there are 96 inlets to accept the sample DNA from each individual fish and on the other are 96 inlets to accept the assays for each SNP marker. Once in the wells, the components are pressurized into the chip using the IFC Controller HX (Fluidigm). The 96 samples and 96 assays are then systematically combined into 9,216 parallel reactions. Each reaction is a mixture of 4 µl of assay mix (1x DA Assay Loading Buffer (Fluidigm), 10x TaqMan SNP Genotyping Assay (Applied Biosystems), and 2.5x ROX (Invitrogen)) and 5 µl of sample mix (1x TaqMan Universal Buffer (Applied Biosystems), 0.05x AmpliTaq Gold DNA Polymerase (Applied Biosystems), 1x GT Sample Loading Reagent (Fluidigm), and 60-400ng/ul DNA) combined in a 6.7 nL chamber. Thermal cycling is performed on an Eppendorf IFC Thermal Cycler as follows: an initial "hot mix" of 30 min at 70 ^{o}C, and then denaturation of 10 minutes at 96 °C followed by 40 cycles of 96 ^{o}C for 15 seconds and 60 ^{o}C for 1 min. The Dynamic Arrays are read on a BioMark Real-Time PCR System (Fluidigm) after amplification and scored using Fluidigm SNP Genotyping Analysis software.

For some SNP markers, genotyping will be performed in 384-well reaction plates. Each reaction is conducted in a 5 µL volume consisting of 5-40 ng of template DNA, 1x TaqMan Universal PCR Master Mix (Applied Biosystems) and 1x TaqMan SNP Genotyping Assay (Applied Biosystems). Thermal cycling is performed on a Dual 384-Well GeneAmp PCR System 9700 (Applied Biosystems) as follows: an initial denaturation of 10 minutes at 95 °C followed by 50 cycles of 92 °C for 1 second and annealing/extension temperature for 1.0 or 1.5 minutes. The plates are scanned on an Applied Biosystems Prism 7900HT Sequence Detection System after amplification and scored using Applied Biosystems' Sequence Detection Software (SDS) version 2.2.

All genotypes collected will be entered into the GCL Oracle database, LOKI. Quality control measures include re-extraction and re-analysis of 8 percent of each collection for all markers to insure genotypes are reproducible and to identify laboratory errors and rates of inconsistencies. Genotypes are assigned to individuals using a double-scoring system.

7.14.4.4. Data Retrieval and Quality Control

Genotypes will be retrieved from LOKI and imported into *R* (R Development Core Team 2011) with the *RODBC* package (Ripley 2010). All subsequent analyses will be performed in *R*, unless otherwise noted.

Prior to statistical analysis, three analyses will be performed to confirm the quality of the data. First, SNP markers will be identified that are invariant in all individuals or that have very few individuals with the alternate allele in only one collection. These markers will be excluded from further statistical analyses. Second, individuals will be identified that are missing substantial genotypic data because they likely have poor quality DNA. Individuals missing substantial genotypic data will be identified using the 80-percent rule (missing data at 20 percent or more of loci; Dann et al. 2009). These individuals will be removed from further analyses. The inclusion of individuals with poor quality DNA might introduce genotyping errors into the baseline and reduce the accuracies of mixed stock analyses.

The final QC analysis will identify individuals with duplicate genotypes and remove them from further analyses. Duplicate genotypes can occur as a result of sampling or extracting the same individual twice, and will be defined as pairs of individuals sharing the same alleles in 95 percent of screened loci. The sample with the most missing genotypic data from each duplicate pair will be removed from further analyses. If both samples have the same amount of genotypic data, the first sample will be removed from further analyses.

7.14.4.5. Genetic Baseline Development

7.14.4.5.1. Hardy-Weinberg expectations

For each locus within each collection, tests for conformance to Hardy-Weinberg expectations (HWE) will be performed using Monte Carlo simulation with 10,000 iterations in the *Adegenet* package (Jombart 2008). Probabilities will be combined for each collection across loci and for each locus across collections using Fisher's method (Sokal and Rohlf 1995), and collections and loci that violated HWE will be excluded from subsequent analyses after correcting for multiple tests with Bonferroni's method ($\alpha = 0.05$ per number of collections).

7.14.4.5.2. Pooling collections into populations

When appropriate, collections will be pooled to obtain better estimates of allele frequencies following a step-wise protocol. First, collections from the same geographic location, sampled at similar calendar dates but in different years, will be pooled, as suggested by Waples (1990). Then differences in allele frequencies between pairs of geographically proximate collections that were collected at similar calendar dates and that might represent the same population will be tested. Collections will be defined as being "geographically proximate" if they were collected within the same river. Fisher's exact test (Sokal and Rohlf 1995) of allele frequency homogeneity will be used, and decisions will be based on a summary across loci using Fisher's method. Collections will be pooled when tests indicate no difference between collections ($P > 0.01$). When all individual collections within a pooled collection are geographically proximate to other collections, the same protocol will be followed until significant differences are found between the pairs of collections being tested. After this pooling protocol, these final collections will be considered to be populations. Finally, populations will be tested for conformance to HWE following the same protocol described above to ensure that pooling was appropriate, and that tests for linkage disequilibrium will not result in falsely positive results due to departure from HWE.

7.14.4.5.3. Linkage disequilibrium

Linkage disequilibrium between each pair of nuclear markers will be tested for in each population to ensure that subsequent analyses are based on independent markers. The program *Genepop* version 4.0.11 (Rousset 2008) will be used with 100 batches of 5,000 iterations for these tests. The frequency of significant linkage disequilibrium between pairs of SNPs ($P < 0.05$) will then be summarized. Pairs will be considered linked if they exhibited linkage in more than half of all populations.

7.14.4.6. Analysis of Genetic Structure

7.14.4.6.1. Temporal variation

Temporal variation of allele frequencies will be examined with a hierarchical, three-level analysis of variance (ANOVA). Temporal samples will be treated as sub-populations based on the method described in Weir (1996). This method will allow for the quantification of the sources of total allelic variation and permit the calculation of the among-years component of variance and the assessment of its magnitude relative to the among-population component of variance. This analysis will be conducted using the software package *GDA* (Lewis and Zaykin, 2001).

7.14.4.6.2. Hierarchical log-likelihood tests

Genetic diversity will be examined with a hierarchical log-likelihood ratio (G) analysis.

7.14.4.6.3. Visualization of genetic distances

To visualize genetic distances among collections two approaches will be used. Both approaches are based on pairwise F_{ST} estimates from the final set of independent markers with the package *hierfstat* (Goudet 2006). The first approach is to construct 1,000 bootstrapped neighbor-joining (NJ) trees by resampling loci with replacement to assess the stability of tree nodes. The consensus tree will be plotted with the *APE* package (Paradis et al. 2004). While these trees provide insight into the variability of the genetic structure of collections, pairwise distances visualized in three dimensions are more intuitive. In a second approach, pairwise F_{ST} will be plotted in a multidimensional scaling (MDS) plot using the package *rgl* (Adler and Murdoch 2010).

7.14.4.7. Habitat utilization in the lower river by Chinook salmon progeny originating in the Middle and Upper Susitna River

If the results of the Chinook salmon genetics studies conducted during 2012 indicate that the Chinook salmon spawning upstream of Devils Canyon and in the middle river and its tributaries are sufficiently unique, ADF&G will characterize the presence and relative proportion of fish originating from the upper and middle rivers in selected lower river habitats.

In each of two years, 75 juvenile Chinook salmon from each of 16 mainstem locations (across five habitat types) will be collected and preserved as outlined above. These 1,200 tissue samples collected in each year will be analyzed and the results will be pooled into a range of spatial strata to identify any middle and upper river fish, and where feasible, estimate the proportion of fish originating from upstream of the Three Rivers Confluence (RM 98).

7.14.5. Consistency with Generally Accepted Scientific Practice

The laboratory and analytical methods to be used for this study are widely applied in North America and Asia to characterize the origin and genetic variation in salmonid and non-salmonid fish species. ADF&G's Gene Conservation Laboratory (GCL) located in Anchorage, Alaska is on the leading edge of applied fish genetics, and it has a long history of publishing techniques and results from its studies in the peer-reviewed literature. GCL personnel serve on many multi-national scientific work groups from around the Pacific Rim.

7.14.6. Schedule

- Baseline sample collection: June through October 2013 and 2014 (in conjunction with other AEA field studies).
- Mixture sample collection from the lower river: June through August 2013 and 2014.
- Analysis of juvenile and adult Chinook salmon tissue: November 2013 through December 2014.
- Initial and Updated Study Reports explaining actions taken and data collected to date will be issued in December 2013 and 2014, respectively.

7.14.7. Level of Effort and Cost

The total estimate for the cost of the study over two years is approximately $625,000 - $800,000. The estimated cost for each of the four study objectives described above is as follows:

1) $160,000–$180,000 annually
2) $32,000 for the 2013 field season
3) $100,000-$150,000 annually
4) $36,000–$53,000 annually

7.14.8. Literature Cited

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7.15. Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area

7.15.1. General Description of the Proposed Study

Information from this fish harvest study will be used in combination with other studies to assess potential effects of the proposed Project on fisheries resources. Harvest study results will be used to inform the licensing process by analyzing baseline harvest data from the Project area downstream to where the Susitna River joins Upper Cook Inlet and into the marine waters of the Upper Cook Inlet commercial fisheries management area (Figure 7.15-1). This study will provide a basis for impact assessment and developing any potential protection, mitigation, and enhancement measures, if necessary.

7.15.1.1. Study Goals and Objectives

The goal of this study is to compile and analyze baseline information on the harvests of resident and anadromous fishes in and downstream of the proposed Project area to understand the potential for Project construction and operation to alter harvest levels and opportunity. This study has two primary objectives:

1. Describe baseline harvest levels and harvest locations for commercial, sport, personal use, and subsistence fisheries for Susitna River origin resident and anadromous fish; and
2. Describe the potential for the Project to alter harvest levels and opportunities on Susitna River origin resident and anadromous fish based on potential Project-induced changes in fish abundance and distribution from flow- and habitat-related changes as estimated from other Project studies.

7.15.2. Existing Information and Need for Additional Information

The ADF&G documents legal catches from commercial, sport, personal use and subsistence fisheries. Fishing effort and harvest success data are collected annually by fishery, management area, district, subdistrict, and in some cases by smaller statistical harvest reporting areas. Historic harvest statistics are stored by ADF&G in a variety of statewide databases.

7.15.2.1. Commercial Fisheries

The Susitna River watershed is within the Upper Cook Inlet Management Area (UCIMA) for commercial fisheries. Commercial salmon fisheries in the UCIMA target salmon stocks bound for the major river systems of Cook Inlet, including the Susitna River. Salmon are harvested during seasons and according to regulations established by the Alaska Board of Fisheries. The ADF&G Division of Commercial Fisheries, based in Soldotna, monitors salmon returns in Cook Inlet and sets fishing periods based on the perceived strength of the returns to achieve escapement goals for the major rivers of the area. The UCIMA includes central and northern districts (Figure 7.15-1), each being further divided into subdistricts (Shields and Dupuis 2012). Two commercial gear types are permitted in the limited entry commercial fishery: drift gill nets (Central District only) and set gill nets (allowed in portions of both districts). Commercial harvests are recorded at the time of sale on a fish ticket, which includes the date, location code (statistical area), and the number and pounds of each species of salmon delivered. These data are stored in a statewide fish ticket database.

Five species of Susitna River salmon are commercially harvested in Upper Cook Inlet: Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), chum (*O. keta*), pink (*O. gorbuscha*), and coho salmon (*O. kisutch*). Sockeye salmon make up the largest component of the harvest and commercial value. Harvest data are summarized and reported annually by the ADF&G Division of Commercial Fisheries (Shields and Dupuis 2012). The ADF&G Gene Conservation Laboratory has successfully used genetic mixed stock analysis techniques to identify stock-of-origin in commercial fishery catches such that the contribution of Susitna River-origin sockeye salmon can be estimated (Barclay et al. 2010). Efforts are underway to develop the baseline and resolution for other salmon species.

Eulachon (*Thaleichthys pacificus*), also known as smelt or hooligan, are harvested commercially in the UCIMA (Shields and Dupuis 2012; Shields 2005, 2010). Managed under the *Cook Inlet Smelt Fishery Management Plan* (5 AAC 21.505), the fishery has a harvest cap of 100 tons. Harvesters use dip nets, and a majority of the harvest is taken in the vicinity of the Susitna River delta. Harvest statistics have been reported since 1978; the 2011 season was the first year in which the harvest cap was reached (Shields and Dupuis 2012).

7.15.2.2. Sport Fisheries

The Susitna watershed lies within the Northern Cook Inlet Management Area (NCIMA) (Figure 7.15-2) established for the management of recreational fisheries. For the purposes of harvest reporting the NCIMA is divided into four subunits:

- Knik Arm Management Unit lying south of Willow Creek and east of the Susitna River;
- Eastside Susitna Management including all waters of the upper Susitna River above the Chulitna River to and including the Oshetna River;
- Westside Susitna Management Unit including the Chulitna and Yentna rivers; and
- West Cook Inlet Unit including freshwater drainages entering Cook Inlet to the west of the Susitna River mouth (Figure 7.15-2).

Sport fisheries in the NCIMA are managed by the ADF&G Division of Sport Fisheries office in Palmer. The Statewide Harvest Survey (SWHS) annual postal survey of sport fish license holders is the primary method used by ADF&G to compile harvest estimates for NCIMA sport fisheries (Jennings 2007). Sport fishing harvest and effort by species have been estimated and reported annually for the four NCIMA management units since 1977.

Sport fisheries in the NCIMA target the five species of Susitna River salmon, with coho salmon and Chinook salmon making up the largest contributions to the harvest (Jennings 2007). Other species taken in the sport fishery, ordered by amount harvested, include northern pike (*Esox lucius*), rainbow trout (*O. mykiss*), Arctic grayling (*thymallus arcticus*), lake trout (*Salvelinus namaycush*), Dolly Varden (*S. malma*), burbot (*Lota lota*), round whitefish (*Prosopium cylindraceum*) and humpback whitefish (*Coregonus clupeaformis*) (Jennings 2004).

7.15.2.3. Personal Use Fisheries

Three personal use fisheries currently occur within the NCIMA:

- A sockeye salmon dip net fishery at Fish Creek located in Knik Arm;
- A dip net fishery for Alaska residents 60 years or older at the Beluga River (to the west of the Susitna River mouth); and
- A eulachon fishery in the Lower Susitna River (Oslund and Ivey 2010).

Participants in these fisheries obtain a permit from ADF&G and are required to record daily harvest information on the permit. Permits are returned to ADF&G at the end of the season. Personal use harvest data are reported annually in ADF&G annual management reports (for example, Ivey et al. [2009]).

7.15.2.4. Subsistence Fisheries

Subsistence fishing regulations in the Susitna River watershed are complex and restrictive. A portion of the watershed falls within a “nonsubsistence area” defined under the Alaska Administrative Code (AAC) 5 AAC 99.015 (3). Trout, char, grayling, and burbot may not be taken for subsistence in fresh water (5 AAC 01.575. (c)). The only subsistence salmon fishery authorized within the Susitna watershed is a fishwheel fishery on the upper Yentna River near the community of Skwentna (5 AAC 01.593). A subsistence gill net fishery is authorized in the Tyonek drainage for whitefish (5 AAC 01.580), and smelt may be taken in fresh and salt water (5 AC 01.599). A coastal set gill net subsistence fishery operates near the community of Tyonek in Northern Cook Inlet, which targets salmon returning to the Susitna and other river systems of northern Cook Inlet. Educational subsistence fisheries are permitted on the east side of the Central District between Kenai and Anchor Point.

Subsistence salmon harvest data are reported annually in ADF&G annual fishery management reports (for example Oslund and Ivey, 2010, and Shields and Dupuis, 2012) and in the Alaska subsistence salmon fisheries annual reports (for example, Fall et al. 2011). Historic subsistence harvest data are stored in the Alaska Subsistence Fisheries Database (ASFDB) managed by the ADF&G Division of Subsistence in Anchorage (Caylor and Brown 2006). Harvest data for non-salmon species may not be regularly reported.

7.15.2.5. Additional information needs

To assess potential Project effects on harvest rates, it is necessary to draw upon other studies that are designed to estimate abundance and distribution of the various fish stocks in the Susitna River system. Existing information includes fish spatial and temporal distribution and relative abundance information from recent and early 1980s studies. The *Aquatic Resources Data Gap Analysis* (HDR 2011) and the *Susitna-Watana Hydroelectric Project Pre-Application Document* (AEA 2011) summarized existing information and identified data gaps for adult salmon, resident and rearing fish, and for subsistence resources (Northern Land Research, Inc. 2011). In recent years, ADF&G has conducted adult salmon (sockeye, coho, and chum salmon) spawning distribution and abundance studies in the Susitna River (e.g., Yanusz et al. 2011, Merizon et al. 2010). In 2012, ADF&G expanded its scope to include Chinook and pink salmon. Concurrent studies to be conducted as part of the licensing process for the Project include salmon escapement and run apportionment, fish distribution and abundance in the Susitna River, characterization of aquatic habitats in the Susitna River, and subsistence use.

7.15.3. Study Area

The study area includes the Susitna River from its mouth upstream to and including the Oshetna River (RM 233.4). The study area includes tributaries that are connected to the mainstem of the Susitna and marine waters of Upper Cook Inlet where anadromous fish species originating from the Susitna River are intercepted in commercial fisheries north of the latitude of Anchor Point (59° 46.15' N. lat.).

7.15.4. Study Methods

Baseline data on commercial, sport, personal use, and subsistence harvests of resident and anadromous fish in the Project area and other potentially affected areas downstream of the Project will be gathered and synthesized. Specific tasks include compilation and apportionment of ADF&G commercial harvest records, compilation of harvest and effort from sport fisheries, compilation of harvest and effort from personal use fisheries, compilation of subsistence harvest data, and evaluation of potential project effects. These data will be used in combination with the results of fish abundance studies conducted as part of Project licensing to assess potential Project impacts; further, these data will feed into analyses to be completed by recreation, socioeconomic and subsistence study teams. Specific methods are detailed below.

7.15.4.1. Compilation and Apportionment of ADF&G Commercial Harvest Records

Evaluating potential Project effects on commercially harvested fish species is a two-step process to identify: 1) how many Susitna River fish are harvested in the area's commercial fisheries, and 2) how many of those fish use mainstem Susitna River habitats that have the potential to be impacted.

Investigators will contact ADF&G Commercial Fisheries staff in area and regional offices to better understand the spatial and temporal resolution of commercial harvest records in the UCIMA. Harvest statistics for each of the salmon species commercially harvested in the UCIMA are stratified spatially and temporally and are reported annually (Shields and Dupuis 2012). Investigators will compile a minimum of 20 years of harvest and effort statistics from the ADF&G statewide fish ticket database. Data will be requested at the smallest geographic reporting units (statistical areas) and time strata. The number of fish and pounds harvested by species, by day, and by harvest area will be compiled, and trends will be noted. Minimum, maximum, and mean harvest statistics will be calculated over the 20-year period. These data represent a mixture of stocks returning to a combination of river systems draining into Upper Cook Inlet. A review of available genetic stock identification studies will be used to estimate the proportion of Susitna River stocks in the harvest mixtures. Genetic stock composition data are of higher resolution for sockeye salmon (Barclay et al. 2010) than for other species, though some progress has been made apportioning chum and coho salmon stocks (Merizon et al. 2010). Species that lack sufficient genetic data for run apportionment will be assessed based on the best available geographic distribution and timing information from telemetry studies, escapement counts, and harvest reports.

Commercial harvest data from the eulachon fishery will be requested from the state database at the smallest temporal strata that will produce meaningful interpretation. Because of low participation, broad time strata may be required to prevent the identification of individual fishermen. Because the eulachon fishery takes place at the Susitna River mouth, all reported harvest will be assumed to represent stocks potentially affected by the Project.

7.15.4.2. Compilation of Harvest and Effort from Sport Fisheries

Sport fishery harvest and effort data for the 13 species identified above will be compiled at the finest geographic resolution available for freshwater fisheries in the Susitna watershed. Catch, harvest, and angler-day information will be compiled for a minimum of 20 years, and minimum, maximum, and mean values calculated by geographic area. Sources of information will include annual management reports from the ADF&G Sport Fish Division (e.g. Ivey et al. 2009) and from statewide harvest reports (e.g., Jennings et al. 2007). ADF&G Division of Sport Fish staff will be interviewed to better interpret the data available from the SWHS, and to uncover whether focused creel surveys have been conducted in select Susitna tributaries. In general, SWHS estimates from smaller fisheries with low participation are less accurate than those of larger fisheries (Mills and Howe 1992). Additional interviews may be conducted with guides and lodge owners in the Susitna River area to address low participation fisheries.

7.15.4.3. Compilation of Harvest and Effort from Personal Use Fisheries

Harvest and effort data will be compiled for the Fish Creek and Beluga River personal use salmon fisheries. Sources of information will include annual management reports from the ADF&G Sport Fish Division, for example Ivey et al. (2009). These fisheries target stocks returning to a number of river systems including the Susitna River; hence the likelihood of detecting significant Project effects is low. Regardless, harvest and effort data will be compiled for the eulachon fishery at the mouth of the Susitna River from permit return data and annual reports produced by ADF&G.

7.15.4.4. Compilation of Subsistence Harvest Data

All Cook Inlet subsistence fisheries will be reviewed. However, due to their proximity to the Susitna River watershed it is likely that the only fisheries that would have any potential linkage to the Susitna Project are the Tyonek gill net fishery and the Yentna fishwheel fishery. A minimum of 20 years of harvest and effort data will be compiled for the Tyonek Subdistrict subsistence gill net fishery from the ASFDB and/or available reported harvest data. Because this is a marine fishery, an estimate will need to be made as to the proportion of Susitna River stocks in the harvests. The estimate will use available genetic stock identification information (e.g., Barclay et al. 2010) and other sources such as run timing and proximity to other salmon systems. Harvest statistics will be compiled for the fishwheel fishery on the upper Yentna River near the community of Skwentna.

7.15.4.5. Evaluation of Potential Project Effects

Evaluating the potential for flow- and habitat-related changes to alter harvest rates for Susitna River fishery resources will require an integration of the results from multiple studies. Potential effects will differ based on species, fishery type, fishery location, life history and periodicity of affected species, and the magnitude of flow and habitat effects and other Project-related changes. The following studies initiated in 2012 and/or conducted during 2013–2014 will provide information useful for evaluating effects on fish harvest and opportunity.

- The *River Flow Routing and Instream Flow Models Data Collection* initiated in 2012 will predict stage versus discharge relationships for approximately 100 transects in the mainstem of the Susitna River below the proposed reservoir.
- The *Aquatic Habitat and Geomorphic Mapping of the Middle River Study* will provide a comparison of the habitat mapping conducted in the 1980s with habitat mapping developed at similar discharges in 2012. One of the intents of the *Geomorphic Mapping Study* is to help address the potential effect of Project operations on the stability of tributary mouths and access to tributaries within the middle Susitna River. It is also intended to provide baseline information to evaluate the influence of Project-induced changes to mainstem water surface elevations in July through September on adult salmon access to upland sloughs, side sloughs, and side channels used for spawning.
- The *Fish Passage Barriers Study* (Section 7.12) will help inform how Project-induced changes to mainstem water surface elevations in July through September influence adult salmon access to upland sloughs, side sloughs, and side channels.
- The *Upper Susitna River Fish Distribution and Habitat Study* will quantify the amount of riverine habitat likely to be lost due to inundation and interruption of fish passage.
- The *Susitna-Watana Instream Flow Study* (IFS) is focused on development of macrohabitat specific models that can reliably estimate flow-habitat response patterns for different species and life stages of fish and other aquatic biota.
- The *Salmon Escapement and Run Apportionment Study* will provide a watershed perspective on the salmon returns to the Susitna River and apportion runs to the major tributaries (Yentna River, Chulitna River, Talkeetna River, etc.) as well as the mainstem areas potentially affected by the Project.

A synthesis of the results from these studies will be required to estimate Project effects on fisheries as a proportion of the returns to the entire Susitna watershed. It is important to note that there will be high inter-annual variability in fish abundance estimates used to quantify potential impacts; in some cases the error associated with these estimates may exceed harvest levels for a particular fishery. For this reason, potential changes to harvest level and opportunity will be expressed as a range.

Potential effects to marine fisheries

For commercial salmon fisheries in the Northern and Central Districts and the Tyonek subsistence salmon fishery, estimates of harvest rates for Susitna River stocks based on genetic stock allocation will be analyzed to quantify potential effects on harvests. Northern District set gill net fisheries likely harvest a higher proportion of Susitna River salmon than Central District drift and set gill net fisheries. Thus, effects will need to be assessed by district and on a gear type basis. Outputs from the flow routing model and riverine process models developed as part of the instream flow studies will provide simulations of Project effects under various proposed operational scenarios. These localized effects from the models will need to be put into the context of population level of harvested species within the Susitna River system and the mixtures of Susitna River and non-Susitna River stocks in the marine fisheries in the Northern and Central districts of the UCIMA. Potential impacts will be analyzed over the 20-year record of harvest.

Potential effects to eulachon fisheries

Eulachon harvested in the commercial and personal use fisheries operating in the mouth of the Susitna River will be treated as a single stock in the effects analysis. Abundance estimates generated from the fish distribution and abundance study of the PSP, coupled with the reported harvest information, will be used to estimate exploitation rates for the years that abundance data are available. Quantitative estimates of Project effects resulting from proposed operational scenarios will be obtained from the flow routing model and riverine process models developed as part of the instream flow studies.

Potential effects to sport fisheries

Effects on sport fisheries will be analyzed spatially and on a species-by-species basis within the Susitna River system. Potential Project effects within the reservoir and tributaries upstream of the proposed dam site will be assessed by studies conducted in 2013-2014 as part of the Project licensing process, i.e., the fish distribution and abundance study, the aquatic habitat study, the fish passage study, and the instream flow study and related operational models. Analysis will be conducted on a species-by-species basis taking into account migratory versus non migratory and other life history characteristics. The future Watana Reservoir fish community study will provide information on potential sport fishing opportunities anticipated in the proposed Project reservoir.

Middle and Lower River sport fisheries will be analyzed spatially and on a species-by-species basis. Outputs from the flow routing model and riverine process models developed as part of the instream flow studies will provide quantitative results of Project effects under various proposed operational scenarios. These localized effects will need to be put into the context of the species populations within the major tributaries of the Susitna River system to estimate potential effects on harvest opportunity and catch rates.

7.15.5. Consistency with Generally Accepted Scientific Practices

This study plan was developed by fisheries scientists in consultation with ADF&G and USFWS. The data used in this study have been and will be collected by ADF&G as part of their annual harvest assessments and rely upon regionally accepted methods for estimation of harvest.

7.15.6. Schedule

Harvest and effort statistics will be compiled in 2013 along with a synthesis of the best available genetic apportionment of salmon stocks harvested in commercial and subsistence fisheries. Analyses of potential Project-related effects on harvest levels and opportunity will be conducted in 2014 as results from other Project studies become available. Initial and Updated Study Reports discussing actions taken to date will be issued in December 2013 and 2014, respectively.

7.15.7. Level of Effort and Cost

This study will focus on compiling and analyzing existing harvest data and new data collected from other fish, habitat, subsistence, and recreational studies. This study will be primarily a desktop exercise. It is estimated that this study will cost approximately $200,000.

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7.15.9. Figures

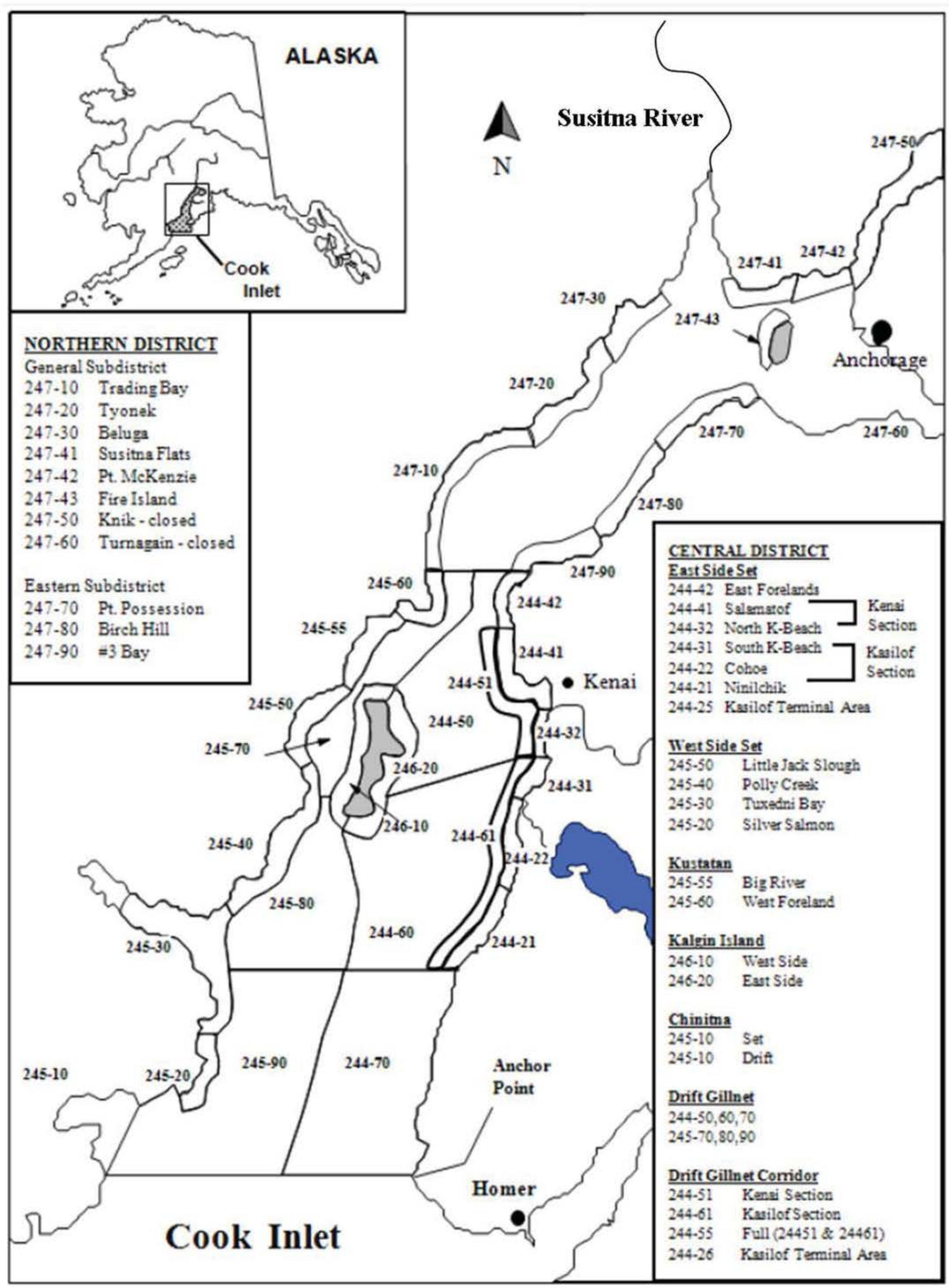

Figure 7.15-1. Upper Cook Inlet Management Commercial Fishing Districts and Statistical Reporting Areas (Shields 2012).

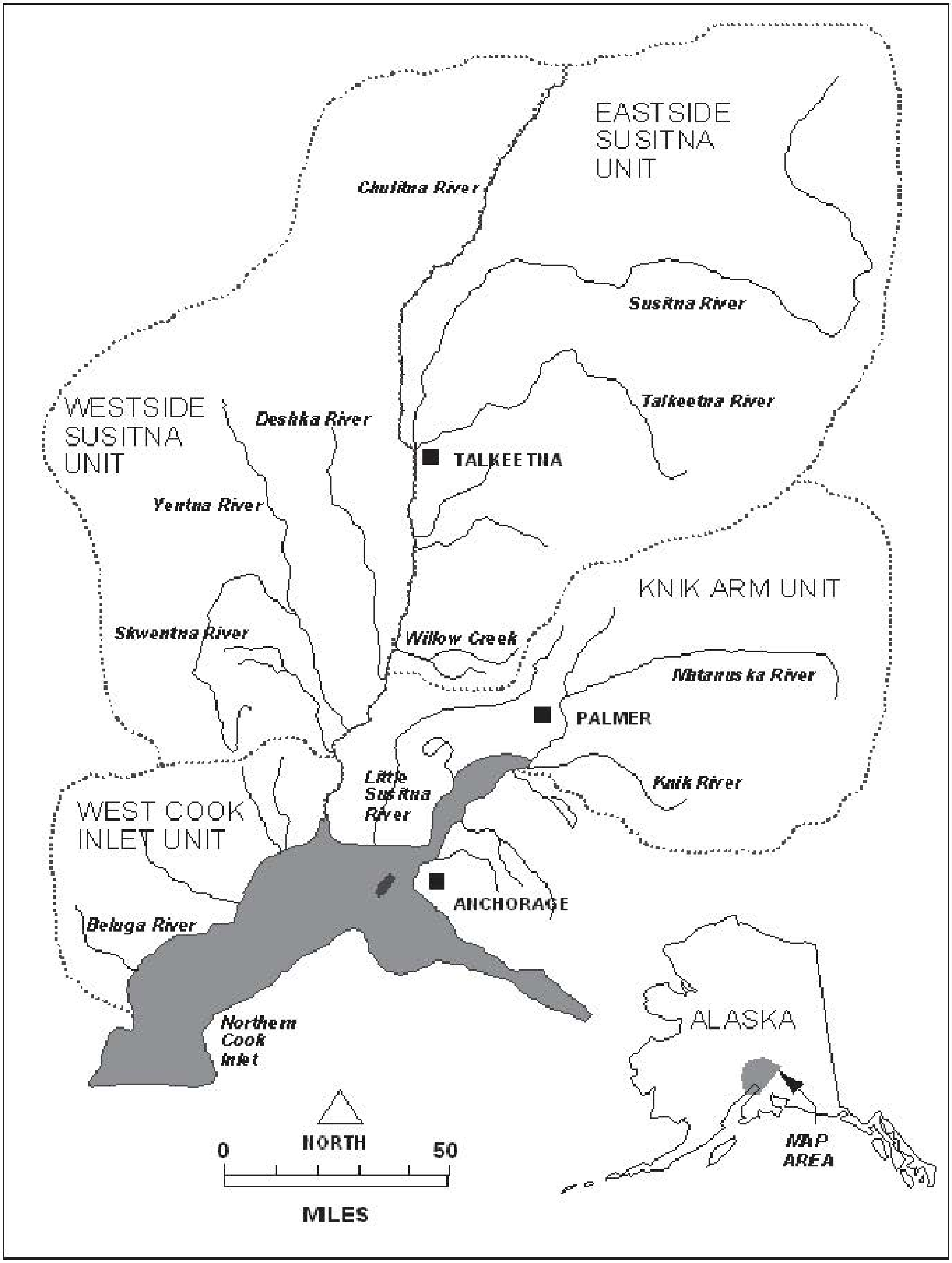

Figure 7.15-2. Northern Cook Inlet Management Area Sport Fishing Management Units (Oslund and Ivey 2010).

7.16. Eulachon Distribution and Abundance in the Susitna River Study

7.16.1. General Description of the Proposed Study

7.16.1.1. Study Goals and Objectives

The overarching goal of the study is to collect baseline information regarding eulachon (*Thaleichtys pacificus*) in the Susitna River. Eulachon are a prey species for Cook Inlet Beluga Whale (CIBW: *Delphinapterus leucas*; studies on other prey species [i.e. Pacific salmon] will be conducted under Section 7.5 Study of Fish Distribution and Abundance in the Upper Susitna River, Section 7.6 Study of Fish Distribution and Abundance in the Middle and Lower Susitna River, and Section 7.7 Salmon Escapement) and provide commercial, personal use, subsistence, and sport fisheries in the Upper Cook Inlet. Information on eulachon distribution, habitat use, and population structure in the study area will be used, along with data gathered from other studies (e.g. habitat characterization, instream flow, flow routing, water quality, Cook Inlet Beluga Whale) to assess potential Project-induced effects on these resources.

Together with existing information, the data collection described in this study plan will provide necessary baseline information to address issues identified in the Pre-Application Document and assess potential Project effects (AEA 2011).

The objectives of the eulachon study are as follows:

1. Determine the timing and duration of the spawning migration of eulachon in the Susitna River;
2. Determine eulachon spawning site distribution;
3. Identify and characterize eulachon spawning habitats;
4. Evaluate the density of eulachon at spawning habitats;
5. Document lengths, weights, and age structure of the eulachon population;
6. Collect genetic baseline samples to support ADF&G's stock analysis; and
7. Document incidental observations of marine fish species.

7.16.2. Existing Information and Need for Additional Information

7.16.2.1. Background Information

Eulachon are relatively small (<250 millimeter [9.84 inches] fork length) forage fish from the family Osmeridae (Scott and Crossman 1973). They occur on the west coast of North America from the Pribilof Islands and the eastern Bering Sea in Alaska southward to the Klamath River in California (Scott and Crossman 1973). Eulachon are anadromous, traveling short distances up river to spawn after ice-out (Scott and Crossman 1973). In most cases, a eulachon spawns once in its life; however, some individuals have been found to spawn twice (Scott and Crossman 1973).

Eulachon consist of up to 21 percent oil, thus giving them a high energetic content (Payne et al. 1999). This high energetic content, coupled with their abundance at the mouth of the Susitna

River, make them an important prey resource of CIBWs (NMFS 2008). CIBWs are opportunistic feeders and high prey densities are needed for successful foraging (NMFS 2008). Stomach content analyses from 21 CIBWs from 1995 to 2007 indicate that they consume eulachon in the spring during the eulachon's migration into Upper Cook Inlet (NMFS 2008). In 2011, NMFS formally listed eulachon as a Primary Constituent Element (PCE) essential for the conservation of CIBWs (76 FR 20180).

A small commercial and personal use fishery for eulachon has operated at the mouth of the Susitna River periodically from 1978 to 1999 and continuously from 2005 to the present (Shields and Dupuis 2012). Since 2005, the total commercial fishery for eulachon is not permitted to exceed 100 tons per year, with a six-year average of 62.4 tons per year of eulachon (Shields and Dupuis 2012). Between 2006 and 2011, the ADF&G has sampled approximately 200 eulachon each year from the commercial fisheries harvest for age, length, and sex (Shields and Dupuis 2012). ADF&G found three age classes of eulachon (3, 4, and 5), with the age-4 class consistently representing the majority of fish (Shields and Dupuis 2012). These results differ from the data collected during the 1980s Susitna Project studies, where age-3 fish constituted the dominant age class (ADF&G 1983b, 1984).

7.16.2.2. Historic Information

The Susitna River eulachon population was studied during the 1980s. At that time, it was determined that two spawning migration peaks existed in the river (approximately mid-May through late-May and early June through mid-June) (Vincent-Lang and Queral 1984). During these studies, ADF&G surveyed by boat-based electrofishing from river mile (RM) 4.5 upstream to RM 60; however, they found the uppermost extent of eulachon spawning was approximately at RM 50 (Little Willow Creek; ADF&G 1983a). Recent anecdotal reports indicate that eulachon may be present upstream to the Talkeetna area (RM 97; Mike Wood pers. comm. 2012).

Studies in the 1980s also indicated that eulachon were likely the most abundant fish species in the Susitna River (Vincent-Lang and Queral 1984). Given their high abundance, eulachon were chosen as an evaluation species for the instream flow study (ADF&G 1983a). Potential Project-related impacts to eulachon that were identified were related to decreased mainstem discharge and increased surface water temperatures during the period of the eulachon spawning migration (May through June) (Vincent-Lang and Queral 1984). During 1982 and 1983, ADF&G initiated studies to identify the relationship between naturally occurring hydrologic and water temperature and spawning migrations of eulachon (1983a, b). These studies identified eulachon spawning habitats at 20 locations between RM 8.5 and RM 44 (ADF&G 1983a). Water depth, water velocity, surface water temperature, water quality, and substrate composition were sampled and summarized (ADF&G 1983a, b; Vincent and Queral 1984). Spawning depth ranged from 0.3 feet to 4.5 feet, and water velocities ranged from 0.0 to 3.4 feet per second (Vincent-Lang and Queral 1984). Riffle habitats along the mainstem of the Susitna River were most often used for spawning (Vincent-Lang and Queral 1984). The substrate most frequently used for spawning was silt to silty sand intermixed with gravel and rubble (Vincent-Lang and Queral 1984).

During the 1983 studies, eulachon were captured with sinking gill nets at RM 2, RM 4, and RM 4.5 during a subset of high tides from May 10 to June 8 (ADF&G 1984). To determine run timing, eulachon were classified by sex and then as either inmigrating fish (pre-spawning and spawning) or outmigrating fish (post-spawning) (ADF&G 1984). In addition to gill netting at

RM 4, 100 eulachon were captured by hand dip nets to characterize sex and condition (ADF&G 1984). Age (otoliths), length (fork length to the nearest millimeter [0.04 inches]), and weight (nearest 0.1 gram) were also measured from the first 10 pre-spawning eulachon of each sex (ADF&G 1984). Age analysis indicated that three-year-old fish were the dominant age class in both peaks (ADF&G 1984). The length/weight analysis indicated that eulachon in the first peak were generally larger and weighed more suggesting a more robust structure during the first peak (ADF&G 1984).

During 1983, the main channel was sampled daily for eulachon spawning locations between RM 4.5 and RM 60 using a combination of boat electrofishing and hand operated dip nets (ADF&G 1984). A site was considered a spawning site if the following criteria were met:

1. Fish captured at the site freely expel eggs or milt;
2. Fish are in vigorously free-swimming condition; and
3. Twenty or more fish that meet Criteria 1 and 2 are caught in the initial or subsequent site sampling effort (ADF&G 1983c).

A total of 61 eulachon spawning locations were identified (ADF&G 1984).

Data on the catch per unit effort (CPUE) of eulachon indicated that the June portion of the run was composed of more fish than the first part of the run in May. During the spawning migration, there were more spawning males in the river than females, indicating that males mature earlier and spawn over a longer time period than females (ADF&G 1984).

An analysis of tidal height (feet), temperature (°C), and catch indicated that eulachon were most frequently caught when tides were between 27 and 28 feet and water temperature was between 3.5°C (38.3°F) and 10.5°C (50.9°F) (ADF&G 1984).

7.16.2.3. Need for Additional Information

Given the importance of eulachon to CIBWs, personal use, and commercial fisheries, the information on eulachon from the 1980s studies needs to be updated and expanded upon to fully evaluate potential Project impacts. Information on run timing and duration of the migration period is needed to analyze eulachon densities. Because CIBWs are opportunistic feeders and require high densities of prey, changes in eulachon densities that could potentially occur as a result of the Project may impact CIBW foraging success. Information is also needed to determine the upstream extent of eulachon spawning and to quantify the available spawning habitat. Spawning site characterization is needed to allow modelers to estimate the amount of habitat that would be available with the Project in place and operating. Biological parameters, such as age, fork length, weight, and sex are needed to provide information on the age structure and length-weight ratio to assess the energetic value of eulachon to CIBWs. Limited data from the Upper Cook Inlet Eulachon Commercial Fishery may reveal that eulachon size and age are different from what was observed in the 1980s (Shields and Dupuis 2012). Therefore, collection of age, length, and weight data is needed to reestablish the population structure baseline. Genetic samples will provide a genetic baseline to assist in determining eulachon stock structure in Cook Inlet. Finally, incidental observations of marine species may assist in documenting the remaining CIBW PCE species (i.e. Pacific cod, walleye Pollock, saffron cod, and yellowfin sole) utilizing the Lower Susitna River.

7.16.3. Study Area

The eulachon study extends upstream from the mouth of the Susitna River to the uppermost extent of spawning, which will be determined by acoustic surveys.

7.16.4. Study Methods

Eulachon studies will be conducted from May 1 (or ice out) through June 30 (or the end of the eulachon migration) during the 2013 and 2014 field seasons. Sampling will begin at the mouth of the Susitna River one hour prior to high tide. Survey teams will work upriver sampling up to 30 river miles per day or until the uppermost extent of the eulachon spawning distribution is reached. After either RM 90 or the uppermost extent of eulachon spawning is reached (whichever is less), the team will wait at least 24 hours before reinitiating surveying at the mouth.

7.16.4.1. Estimate Eulachon Run Timing and Duration

The primary method employed to collect estimates of eulachon timing and duration will be fixed station dual frequency identification sonar (DIDSON) and an EdgeTech 4125 1600 kHz high-resolution side-scan sonar. DIDSON is a high-resolution imaging sonar that provides video-type images over a 29-degree field of view. It is well suited for observing dynamic fish behavior, such as spawning, as well as enumerating fish migration. However, to collect good quality images the platform has to be stable, i.e. DIDSON is best suited for sampling from a fixed location. Because of the relatively small size of eulachon, the range over which they can be reliably detected will probably be limited to approximately 15 meters (49 feet). At 15 meters (49 feet), the beam array will cover an area that is approximately 23 feet wide.

Sampling will include approximately 10 minutes of DIDSON data and 100 meters (328 feet) of side-scan coverage per sampling event. As we collect more data and develop a better sense of the extent of data needed to determine presence or absence, we may modify the amount of data collected per sample. In the analysis we will provide station ID, location, date, time, eulachon presence/absence, description of fish behavior (i.e., moving in continuous band, discrete schools, milling, spawning).

Acoustics will be synchronized with differential GPS to map the transects and identify the acoustic targets. Data including latitude, longitude, time, water depth, and acoustic targets will be uploaded to an Access® database to allow for intra-program coordination (i.e., ArcGIS).

7.16.4.2. Estimate Eulachon Spawning Site Distribution

Estimation of the distribution of eulachon spawning sites will be based on a combination of pre-determined and adaptive sampling. The pre-determined sampling will be based on what was (and was not) sampled in the 1980s and also take into consideration existing information on depth, velocity, and substrate (ADF&G 1983a, b, 1984). Acoustic surveys will begin at the lowest (i.e., farthest downstream) potential spawning site identified and progress upstream until no spawning eulachon are found. For the adaptive sample component we will follow eulachon upstream until we encounter spawning aggregations and/or add samples where bird activity is observed. Similar to the run timing and duration sample, the spawning site distribution samples will include approximately 10 minutes of DIDSON data and 100 meters (328 feet) of side-scan average.

Sonar transects will be established to the upstream extent of eulachon spawning. Transects will be located to ensure collection of data across representative channel and/or habitat types (e.g. shoreline riffles). Acoustic surveys will begin (Day 1) one hour prior to high tide and extend up river for approximately 30 river miles per day or until the uppermost extent of eulachon spawning is located. Acoustic surveys for the subsequent day (Day 2) will begin where Day 1 ended and continue 30 river miles upstream. This pattern will continue until the uppermost extent of eulachon spawning is located. Once the upper extent of spawning is determined, surveying will cease for 24 hours and then begin at the mouth and continueupstream throughout the spawning season.

Potential spawning sites will be identified in conjunction with the acoustic survey described above. Sites will only be considered spawning sites if all three of the criteria below are met:

1. Fish captured at the site freely expel eggs or milt;
2. Fish are in vigorously free swimming condition; and
3. Twenty or more fish that meet Criteria 1 and 2 are caught in the initial or subsequent site sampling effort (ADF&G 1983c).

Eulachon will be captured either by boat electrofishing or tow net to evaluate their spawning condition.

Sites that meet the spawning criteria will be marked with a GPS unit. The data analysis will provide bounding coordinates of the areas sampled, eulachon presence/absence, fish behavior (i.e., migrating, spawning) and, if possible, a eulachon density estimate (approximate number of fish per unit area times the area occupied). These sites will be compared to the 1980s spawning locations to evaluate changes in spawning locations. These data will assist in assessing whether Project-related changes in stream flow, temperature, etc., may impact the location of suitable eulachon spawning habitat.

7.16.4.3. Estimate Eulachon Density

Acoustics will also be used to determine eulachon density. This is the preferred method for density estimation as it will require minimal handling and disruption of spawning eulachon and will be able to cover large areas on a relatively frequent basis. A two-phase approach will be used to estimate density. During 2013, preliminary data will be collected to determine the feasibility of eulachon density or biomass estimation. Depending on the outcome of the feasibility portion of the study we will attempt to provide a more comprehensive estimate in 2014. Two approaches to explore are to 1) estimate spatial densities on the spawning grounds and delineate the area of the spawning grounds or 2) estimate fish movement over time in areas where eulachon migrate through, rather than spawn.

The sum total of the fish that pass the sonar (biomass) will be collected at each spawning location and fish species verification will be conducted on a subset of spawning locations to estimate the percentage eulachon in the total biomass, which will provide a density estimate. If multiple species are collected, size measurements will be obtained to help differentiate acoustic targets. To verify species for acoustic targets, a variety of fish capture methods will be employed including seining, gill netting, trawling, hand operated dip nets, tow net, and/or boat electrofishing. Different types of sampling gear will be used in different situations; however, an effort will be made to use the same gear as much as possible for comparison. The preferred choices of gear are boat electrofishing with hand operated dip nets or tow net; however, in areas close to shore, beach seining may be more effective. Fish sampling locations will be spread throughout the lower river where sufficient acoustic targets are observed in the acoustic surveys. Total catch by species, area sampled, and measurement of effort (e.g., set times for nets and power, time, and distance for electrofishing) will be recorded for each sampling location.

7.16.4.4. Characterize Eulachon Spawning Habitat

Given that eulachon are a PCE for CIBWs, it is important to identify and characterize the eulachon's spawning habitat to determine potential changes due to the Project. For the acoustic characterization of spawning habitat, we will expand the analysis of the side scan images collected (over 100 x 10 meter sample areas) for the eulachon spawning site distribution portion of the study. Each identified eulachon spawning site will be assigned a unique identifier, GPS coordinates for the upstream and downstream extent, and time will be recorded. Aquatic habitat will be recorded to the meso-habitat level based on the Project habitat classification system (see Section 7.9).

Using acoustics, delineation of areas of substrate types will distinguish cobble, gravel, and sand/silt. The acoustic substrate classification will be compared to a ground truth of physical grab samples. If successful in 2013, the acoustic substrate classification could be expanded in 2014. Ground truthing of substrates will be conducted using an Ekman Bottom Grab Sampler. Systematic substrate samples will be taken. The overall substrate composition will be recorded based on substrate characterization protocols developed for the Project as part of the Instream Flow Study (Section 6.5). The approach will be to record the percent composition for each size category from each sample.

Representative measures of water quality (pH, water temperature [°C], dissolved oxygen in milligrams per liter [mg/L], specific conductance in micro Siemens per centimeter [µS/cm], and turbidity in nephelometric turbidity units [NTU]) and air temperature will be recorded. Water quality will be measured using a YSI® meter for pH, water temperature, dissolved oxygen, and specific conductance. Turbidity samples will be collected in the field in amber glass vials and analyzed every evening in a Hatch Turbidimeter. Water quality data will be collected once at each spawning location for each survey. Comparisons will be made within and among sites to identify trends in water quality at spawning habitats.

Water depth at spawning locations will be measured to the nearest tenth-meter with a metric stadia rod, and water velocity will be measured with a velocity flow meter in feet per second. These data will be used to characterize the water depth and velocities needed for eulachon spawning and will be averaged across the runs as well as being reported as ranges. A grid system, similar to that used by Vincent-Lang and Queral (1984) for systematic sampling, may be developed for the collection of water depth and water velocity data . The length of the grid will be equal to the length of the spawning habitat and the width of the grid will be equal to the distance from shore in which the eulachon are spawning. The size of individual cells within the grid will be determined by the total size of the grid. Water depth and water velocity will be sampled in a subset of cells. Continuous water temperature data measured at water quality monitoring sites (see Section 5.5) and USGS gages will be compared to eulachon spawning habitats. Attempts will be made to correlate water temperature and run timing data to determine if a trend exists. To the extent possible, observers will identify the upstream extent of spawning and will attempt to identify the uppermost extent of eulachon presence.

All data gathered in the spawning habitat identification study will be coordinated with the Instream Flow Study to help determine the relationship between natural flows and existing habitats.

7.16.4.5. Eulachon Population Structure

During each species verification capture, a subset of eulachon will be sampled for fork length, sex, and weight. These data will be used to develop length and weight frequency distributions by sex and run. Each day a subset of eulachon will be collected for age analysis based on otoliths. These data will be used to provide the length and weight distribution with age classes.

These data will be compared with the length, fish weight, and age class data.

The sex ratio will be determined for each survey day. The eulachon that will be sexed during each species verification capture will provide a daily indication of changes in the population structure through time.

7.16.4.6. Collect Genetic Samples for Eulachon Baseline Structure

In support of the ADF&G's development of genetic baselines for various species, genetic samples from a subset of eulachon (approximately 50) will be collected. Samples will be anal fin clips cut from the fish with scissors. While in the field, tissue samples will be preserved in ethyl alcohol in a 125-500 milliliter bulk sample bottle for each location. Upon completion of the collection, the samples will be delivered to the Gene Conservation Laboratory.

7.16.4.7. Incidental Observations of Marine Fish Species

Marine fish species venture into freshwater for limited periods, and some prefer shallow coastal water in and around river mouths (Cohen et al. 1990, Morrow 1980). Marine fish species incidentally caught in the study area during the eulachon study will be identified based on identification keys; any fish in question will be photographed and identified later by a marine species expert. The occurrence of walleye pollock, yellowfin sole, saffron cod, and Pacific cod, all of which are designated as PCE species for CIBWs, will be documented as well. All marine fish will be measured (either fork length or total length to nearest millimeter).

The observers will determine CPUE for all fish species. All information regarding marine fish species presence in the Lower Susitna River will be shared with the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River (Section 7.6).

7.16.5. Consistency with Generally Accepted Scientific Practice

The methods described in this study plan have been developed in consultation with the agencies and other licensing participants. DIDSON and side-scan sonar have been used by ADF&G for at least five years (Burwen et al. 2007). All data collection efforts will follow State of Alaska guidelines.

7.16.6. Schedule

The study team will apply for ADF&G permits in February of 2013 and 2014. The anticipated field study for both 2013 and 2014 will run from May 1 (or ice out) through June 30 (or the end of the spawning runs) during both years. Data analyses will be completed by the beginning of October of each year, except for the analyses that are outsourced to other laboratories, such as genetics and otoliths. Quality assurance/quality control (QA/QC) on the data analyses will be completed by the middle of October each year. In 2013, the Initial Study Report will be issued in December. The Updated Study Report will be completed by the middle of December 2014.

7.16.7. Level of Effort and Cost

Fieldwork will occur from May 1 or ice out until June 30 or the end of the eulachon run. A team of four will be sampling approximately 30 miles of river a day for days 1- 3. Sampling will not occur on Day 4, and the cycle will repeat for the entire sampling period.

The approximate cost for the eulachon studies is $675,000 for both 2013 and 2014. The cost estimate is based on a seven week eulachon sampling period. If the actual eulachon run is shorter, then the cost would decrease.

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7.17. Cook Inlet Beluga Whale Study

7.17.1. General Description of the Proposed Study

7.17.1.1. Study Goals and Objectives

The goals of this study are to 1) provide current information on Cook Inlet Beluga Whale (*Delphinapterus leucas*; CIBW) distribution and the importance of the Susitna River delta to the CIBW population, and 2) to correlate these data with information on the ecology of CIBW prey species. Information is needed regarding CIBWs and their prey in the Susitna River and delta to assess the potential effects of any changes in the lower river habitat that may result from the construction and operation of the Project. CIBW prey species information (i.e., eulachon and salmon) will be coordinated with fish studies both currently ongoing and those proposed for the lower river (see Sections 7.5, 7.6, 7.7, 7.9, and 7.16). This information will be used by FERC in its NEPA and licensing processes; for the NMFS Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) consultations; and for the development of any necessary protection, mitigation and enhancement (PM&E) measures.

Three objectives have been identified for this study:

1. Document the presence of all marine mammals in the Susitna River delta, focusing on CIBWs distribution within Type 1 critical habitat;
2. Determine marine mammal utilization of the Susitna River, focusing on the upstream extent of CIBWs; and
3. Evaluate the relationships between potential hydropower-related changes in the lower Susitna River, CIBW in-river movements, and CIBW prey availability.

7.17.2. Existing Information and Need for Additional Information

Cook Inlet Beluga Whales reside in Cook Inlet year-round and have been documented spending significant portions of time in Upper Cook Inlet, particularly in late summer and fall (Funk et al. 2005, NMFS 2008, Allen and Angliss 2011). The CIBW was listed as a federally-protected endangered species under the ESA in October 2008 (73 FR 62919). In April 2011, the NMFS published a final rule designating critical habitat for the CIBW (76 FR 20180; Figure 7.17-1). When determining critical habitat, the NMFS identified the following five primary constituent elements (PCEs) essential to the conservation of the Cook Inlet Beluga Whale:

1. Intertidal and subtidal waters of Cook Inlet with depths <30 feet (mean lower low water, MLLW) and within 5 miles of high and medium flow anadromous fish streams;
2. Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye, pollock, saffron cod and yellowfin sole;
3. Waters free of toxins or other agents of a type and amount harmful to Cook Inlet Beluga Whales;

4. Unrestricted passage within or between the critical habitat areas; and
5. Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet Beluga Whales.

Based on these criteria, NMFS identified two specific marine area types in Cook Inlet that contained one or more PCE. Type 1 critical habitat encompasses 1,909 square kilometers (738 square miles) of Cook Inlet northeast of a line from the mouth of Threemile Creek to Point Possession. Type 1 critical habitat has the highest concentrations of beluga whales from spring through fall. Type 2 critical habitat consists of 5,891 square kilometers (2,275 square miles) of less concentrated spring and summer beluga whale use, but known fall and winter use areas. It is located south of Type 1, and includes nearshore areas along the west side of the Inlet and Kachemak Bay on the east side of the lower inlet. Type 1 critical habitat extends into the Susitna River approximately 8.6 nautical miles from mean lower low water (MLLW) and the Susitna Flats portion of upper Cook Inlet appears to be important calving grounds for CIBWs (Huntington 2000). Due to the importance of the Susitna River delta to CIBWs, information regarding the use of the Susitna River delta compared to other high use areas (i.e., Type 1 critical habitat) is vital to understanding CIBW population dynamics.

A variety of studies have been conducted to document CIBW distribution. The NMFS-National Marine Mammal Laboratory has conducted aerial surveys annually since 1993 during June and August, primarily for abundance estimation (NMFS 2008, Hobbs et al. 2011). Additionally, aerial surveys for beluga whales were completed in 1982 and 1983 as part of the original licensing effort (Harza-Ebasco 1985). From 1999 to 2003, researchers applied satellite tags to 15 whales to examine year-round movements of CIBWs. Finally, land- and boat-based surveys focused on movement and residency patterns have been conducted in the Susitna Flats and adjacent areas to characterize distribution and habitat use by individuals and groups of whales (Funk et al. 2005; Prevel-Ramos et al. 2006, Markowitz and McGuire 2007, Markowitz et al. 2007, Nemeth et al. 2007 McGuire et al. 2008, McGuire and Kaplan 2009, McGuire et al. 2009, 2011a, b). Collectively, these surveys have documented large summer aggregations of CIBWs in the Susitna River delta. While the aforementioned studies have provided valuable information regarding CIBW distribution in Cook Inlet, fine-scale information over the entire open-water season throughout Type 1 critical habitat is lacking. These data are needed to effectively assess potential Project-related effects to CIBWs, their critical habitat, and prey availability.

During the NMFS aerial surveys, other marine mammals have been documented in Cook Inlet, particularly harbor seals (*Phoca vitulina*) and harbor porpoise (*Phocoena phocoena*). Harbor seals in Alaska are not classified as strategic or depleted stocks and are not listed as threatened or endangered under the ESA (Allen and Angliss 2012). The most recent population estimate for the Cook Inlet/Shelikof Strait stock is 22,900 (Allen and Angliss 2012). Harbor seals are distributed throughout Cook Inlet with higher concentrations in lower Cook Inlet compared to the upper inlet. However, sightings of harbor seals in the upper inlet have been increasing over the past few years. The most recent aerial survey documented approximately 1,750 harbor seals in the Susitna River delta (NMFS 2011).

Harbor porpoise in Cook Inlet belong to the Gulf of Alaska stock which is not classified as a strategic or depleted stock and is not listed as threatened or endangered under the ESA (Allen and Angliss 2012). The most recent abundance estimate is 31,046 for Gulf of Alaska harbor porpoise. Harbor porpoise have been documented throughout Cook Inlet using both visual and acoustic techniques (NMFS 2011, ADF&G 2009, 2011). While unlikely, resident killer whales (*Orcinus orca*) have also been acoustically detected in upper Cook Inlet (ADF&G 2011).

7.17.3. Study Area

To assess potential Project-related impacts to CIBWs and other marine mammals, it is necessary to determine the spatial and temporal use of the Susitna River delta by marine mammals, particularly CIBWs, compared to other high use areas in Upper Cook Inlet. Therefore, the Project study area consists of CIBW Type 1 Critical Habitat (Figure 7.17-1), with a focus on the Susitna River delta.

7.17.4. Study Methods

7.17.4.1. Document CIBW and other Marine Mammal Presence within the Susitna River Delta

Aerial surveys conducted by the NMFS occur only in June and August; therefore, the distribution of CIBWs throughout the open water season is not well-documented. Fine-scale information on CIBW seasonal distribution, particularly during times coinciding with spawning and migrations of prey species, is needed to evaluate potential project-related impacts to CIBWs, critical habitat, and prey availability. To address this current lack of information, we propose to conduct aerial surveys for CIBWs throughout Type 1 critical habitat during the entire open water season. The survey schedule will consist of seven surveys per year:

- One in late April (or ice-out)
- Two in May
- One in June (in addition to the NMFS survey)
- One in July
- One in September
- One in October

This schedule will allow for increased survey effort during the spawning season of prey species (May and June). The survey schedule is designed to avoid potential interference with the NMFS surveys in June and August. Each survey will be scheduled for two days with up to 16 flight hours to ensure adequate coverage of Type 1 critical habitat and to allow for additional time to circle around areas where CIBWs are encountered. Flights will be conducted at 1,000 feet to avoid disturbance to marine mammals and, by extension, avoid the need for a marine mammal take permit.

To the greatest extent possible, aerial survey protocols will utilize the methodology employed by the NMFS to ensure consistency with data collection and facilitate potential analyses between studies (e.g., Hobbs et al. 2011). The aerial survey team will consist of one pilot, two experienced marine mammal observers (MMOs), and one data recorder. To obtain more accurate sighting rates and correction factors for missed groups, the two MMOs will document CIBW presence independently and will not cue each other to sightings. Surveys will mainly consist of coastal tracklines conducted within 1.5 kilometers (4,921 feet) from shore due to high CIBW concentrations near tidal flats and river mouths. Saw-tooth tracklines performed across the Inlet will be flown to maximize the coverage area and survey variations in habitat. The plane will be equipped and the pilot will fly pre-programmed trackline coordinates with a GPS unit to permit precise trackline fidelity. The preplanned tracklines may be modified based on any weather-related restrictions.

Survey protocol will follow Hobbs et al. (2011) and will generally include the following steps. MMOs will scan the water visually to locate CIBWs via unaided eyes. The data recorder will enter information into a custom data acquisition program on a laptop computer interfaced with an independent GPS. This interface will allow the team to collect data in real-time. For each sighting, the time and position will be captured through the GPS-enabled data program. The recorder will enter the angle of the sighting by direction from the MMO who will use an inclinometer to obtain the degrees relative to the survey aircraft. Data for marine mammals will include location, group size, group composition (i.e., adults, juveniles, and cow-calf pairs), and behavior. Associated animals (e.g., seabirds and fish) and vessel (e.g., commercial and recreational) presence will be recorded. Environmental data will be updated every 30 minutes and for every sighting. Effort data recorded will include effort status (i.e., on-effort, off-effort, or circling), observer positions, and environmental conditions which can affect the observers' ability to sight animals (e.g., high sea state, glare, and sun position).

While all marine mammal sightings will be documented during the aerial surveys, more detailed methods will be used when a group of CIBWs is encountered. Each observer will independently count the number of animals in each group and multiple passes (up to five) may be performed to get the most accurate count of each CIBW group. All counts from both observers will be combined and the median will be used to achieve the most accurate group size and reduce the effect of outliers within counts (Hobbs et al. 2011). When possible, photographs and/or video of CIBW groups will be taken to assist with group counts and group composition. Additionally, the team will report any observations of stranded or distressed marine mammals to the NMFS.

7.17.4.2. Determine the Upstream Extent of CIBWs and other marine mammals in the Susitna River

Seasonal movement and density patterns of CIBWs, as well as site fidelity, appear to be closely linked to prey availability. These patterns coincide with seasonal salmon and eulachon concentrations (Moore et al. 2000). CIBWs have been documented upriver in Cook Inlet tributaries during spring, summer, and fall. Presence of CIBWs is confirmed at numerous rivers, including the McArthur, Beluga, Lewis, Theodore, Ivan, Susitna, and Little Susitna on the west side of Upper Cook Inlet. Historic records indicate that CIBWs have been seen in the eastern channel of the Susitna River as far as 30 to 40 miles upriver, yet are most commonly found within the first 5 miles of the Susitna River delta (Funk et al. 2005). The current utilization and the northern extent within the Susitna River are not well documented.

While aerial surveys are appropriate to document the presence of CIBWs in Upper Cook Inlet and the Susitna River delta, these surveys only represent a short time period (i.e., hours). To increase the ability to detect CIBW presence in the Susitna River, particularly to determine the current northern extent, a combination of live-feed remote video camera systems and still cameras will be utilized. Live-feed cameras can provide real-time data over long time periods (i.e., weeks to months). Remote camera systems also allow for data collection without disturbing study animals and provide details that cannot be obtained through aerial surveys. This technology was successfully used in the Little Susitna River for CIBWs in 2011 by the Alaska Sea Life Center. In addition to documenting CIBWs, this technology was also successful at identifying harbor seals within the river.

Live-feed cameras (up to four) will be established at the mouth of the Susitna River and still cameras (up to four) will be placed up to RM 10. Additional photographic data from cameras installed to monitor ice processes and in-stream flow will be examined for the presence of CIBWs. The video camera system will utilize remotely operated camera technology (see More Wildlife Systems, Homer, AK), which will allow observers to remotely manipulate the cameras (e.g., pan, zoom, capture still images, wipe lens, etc) in real-time via a microwave link. The camera systems will be mounted to 9-meter steel towers embedded in the ground. Batteries, electronics, and the recharging system to run the cameras will be located in hard cases mounted at the base of the steel towers and the live images from the cameras will be transmitted via microwave signal to a receiver.

Observer monitoring shifts will be scheduled to cover up to 7 days a week with a primary focus on high-water periods. Monitoring effort will be targeted around a range of tides with the majority of effort at high tide. Scans of the study area will be conducted every 20 minutes throughout each monitoring shift. For each scan, the observers will position the camera at the farthest south or north position and slowly move the camera through the study area. Camera movement will be incremental, not continuous. With each movement of the camera the observers will pause long enough to determine if whales were present before moving the camera. Scans will last between 10 and 15 minutes, but may be longer if belugas are present to allow for accurate data collection. During intervals between scans, the cameras will be positioned at a single location and checked frequently for opportunistic sightings. The location of the cameras between scans will be positioned towards the area with greatest possibility of having an opportunistic sighting determined by distance from the camera and visibility due to current tidal stage.

Data Collection Overview

The study area will be divided into grids to allow documentation of activity within the camera's field of view. When belugas are present, observers will log group location, size, composition, and behaviors onto data sheets which will be entered into a database. Once a group is sighted observers will continue to follow the group, as time, presence of other beluga groups, and conditions allow, with the goal being to get the most comprehensive data from the study area. For example, observers might follow a group for a shorter period of time before scanning the area for other groups if it was at the beginning of a monitoring shift, since there is less awareness of activity going on in the remainder of the study area.

Behavior Logs

Beluga behavior will be recorded by activity codes onto data sheets that allow the recording of the top three activities of each group. The primary activity will represent the activity of the group as a whole, and will be determined first (e.g., traveling). Secondary and tertiary activities occurring within only a portion of the total group location will also be noted (e.g., tail slapping). If observers are able to obtain close-up video of whales with distinctive markings, still photos of these events will be collected for potential use in photo-identification. Presence and behavior of any other marine mammals or humans (including vessel traffic), will also be recorded, and video of interesting events will be recorded and archived.

Group Counts

Two methods for group counts are possible depending on the level of camera coverage. Scenario One would replicate methods used in 2011 for a similar project in the Little Susitna River. During that study two cameras were used at a single site, but video feed could only been seen from one camera at a time. A group of belugas would be sighted and observed within a scan. As successive surveys were conducted the observer might lose sight of a group as they scanned the complete study area. In order to accurately capture the dynamic movements of whales within the study area without inflating total numbers of whales reported, a two-pronged data collection scheme was implemented. Upon sighting a group of whales for the first time the observer would keep them in view long enough to accurately assess location, composition, and behavior. After recording these data the observer would continue to scan the study area for the presence of other groups of whales. On successive scans, whales sighted were assigned a new group number and a new line of data was recorded, again documenting composition, location, and behavior, and comments made on the data sheet indicating that this was most likely the same group as previously recorded.

Within the database, whale sightings were assigned two identification numbers, a “day group” number reflecting the actual group number recorded on the data sheet and an “archive group” which would remain the same for successive sightings of the same group. For example, a group sighted on four successive scans would be assigned “day group” numbers of 1, 2, 3, and 4 for each scan, but the “archive group” number would remain the same for all four scans. If a single group of whales split into distinct segments, letters were used to denote subgroups of the same parent group (e.g. group 1 split into group 1a, 1b, etc.). Day group numbers were reset at the beginning of each new monitoring day and archive group numbers were assigned consecutively for the duration of the study period. If two distinct groups (group 1 and group 2) merged (group 1 joined group 2) the combined group was given the archive group number of the group that was joined (in this case group 2 archive number).

For reporting purposes, beluga whale “groups” are in reference to archive groups in order to accurately reflect the total number of groups and individuals observed. Beluga whale “sightings” are in reference to behavior, composition, and/or location data recorded within the confines of a single scan (day group) in order to reflect dynamic changes within the study area by a single group.

In Scenario Two, each camera site would have two cameras with the ability for independent operation for each camera, called “paths.” The two paths would allow for concurrent movement of both cameras. With this setup one camera would have a wide angle overview of the study site and could provide broad sweeps over the area to look for other groups while still maintaining the first group in view. The second camera would focus on each group for counts and observations. This would be similar to an on-site human observer that would be able to use peripheral vision to note new activity in the river while doing focal observations on a specific group. The method of tracking and recoding behaviors would remain similar to Scenario One with more accuracy in day group numbers and higher potential to capture travel up river while still collecting focused group information and behaviors.

Data can be accessed in a real-time format as needed for planned activity in the river. Post collection data will be presented in reports monthly that will reflect monitoring effort, beluga activity (presence, group size, location, composition) as well as environmental conditions.

7.17.4.3. Evaluate the Relationship among Potential Hydropower-Related Changes in the Lower River, CIBW In-River Movements, and Prey Availability

Whale movement and habitat use studies employing satellite telemetry and hydrodynamic modeling indicate that CIBW distributions are controlled not only by water temperature and ice coverage, but also by the seasonal flow patterns of various rivers (Goetz et al. 2012). This finding suggests that availability of salmon and other fish (i.e., eulachon) in river mouths influence CIBW movements (Ezer 2011). CIBWs use the Susitna River delta throughout the majority of the open water season (late-April through September; NMFS 2008). The spring timing is coincident with the spawning migrations of eulachon and Pacific salmon into the river. As a result, availability of prey species was one of the PCEs used to designate critical habitat in 2011 (76 FR 20180).

Potential Project-induced effect mechanisms related to CIBWs are anticipated to be limited to indirect effects due to impacts on prey abundance, densities, and/or run timing. Therefore, if significant Project-related impacts to prey are identified during the ongoing and proposed fish studies (Sections 7.5, 7.6, 7.7, 7.9, and 7.16), AEA will collaborate with NMFS to determine the best model to use to estimate effects to CIBWs. CIBWs could be impacted by potential Project-induced changes to sediment transport and delivery, stream temperature, water quality, stream flow, and ice processes. Project- related effects could occur if any such changes prevented, impaired or delayed CIBW access to delta or river habitats that support known prey species, including eulachon and Chinook, sockeye, chum and coho salmon. In addition, Project-related effects could occur if any such changes affect abundance, densities, and/or run timing of these prey species. Data from this study on the distribution of CIBWs will be combined with data from studies investigating potential Project-induced changes to sediment transport and delivery, stream temperature, water quality, and stream flow, as well as modifications in ice processes to assess the potential effects on salmon and eulachon habitat, productivity, abundance, and run timing. Similar modeling efforts have recently been conducted for CIBWs (Goetz et al. 2012).

7.17.5. Consistency with Generally Accepted Scientific Practices

The study methods presented are consistent with methods commonly followed in investigations of marine mammal distribution. To the greatest extent possible, aerial survey protocols will utilize the methodology employed by the NMFS to ensure consistency with data collection and facilitate potential analyses between studies. The proposed method for live-feed remote video cameras has been successfully used to document marine mammal movements and behaviors in large river systems in Alaska.

7.17.6. Schedule

The anticipated field schedule for 2013 and 2014 will run from late April (or ice-out) through the end of October. Each year, seven aerial surveys will be conducted:

- One in late April
- Two in May
- One in June (in addition to the NMFS survey)
- One in July
- One in September

- One in October

This schedule for aerial surveys will allow for increased survey effort during the spawning season of CIBW prey species (two surveys in May and two surveys in June including the NMFS survey). In addition, the survey schedule is designed to avoid potential interference with NMFS surveys in June and August. Remote cameras will be installed in late April and will operate until the end of October. Data analyses will be completed by the beginning of November of each year. Quality assurance/quality control (QA/QC) reviews on the data analyses will be completed by the end of November each year, and reporting will be completed by the middle of December 2013 (Initial Study Report) and 2014 (Updated Study Report).

7.17.7. Level of Effort and Cost

Field work will occur daily from late April through September. Aerial survey teams will consist of four people and up to four observers will be utilized for remote-camera monitoring and data analysis. Each aerial survey is scheduled for 2 days (up to 16 flight hours) for a total of 112 flight hours each year. Approximate yearly cost for aerial surveys is $300,000 and approximate cost for remote-camera equipment and operations is $300,000 per year.

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7.17.9. Figures

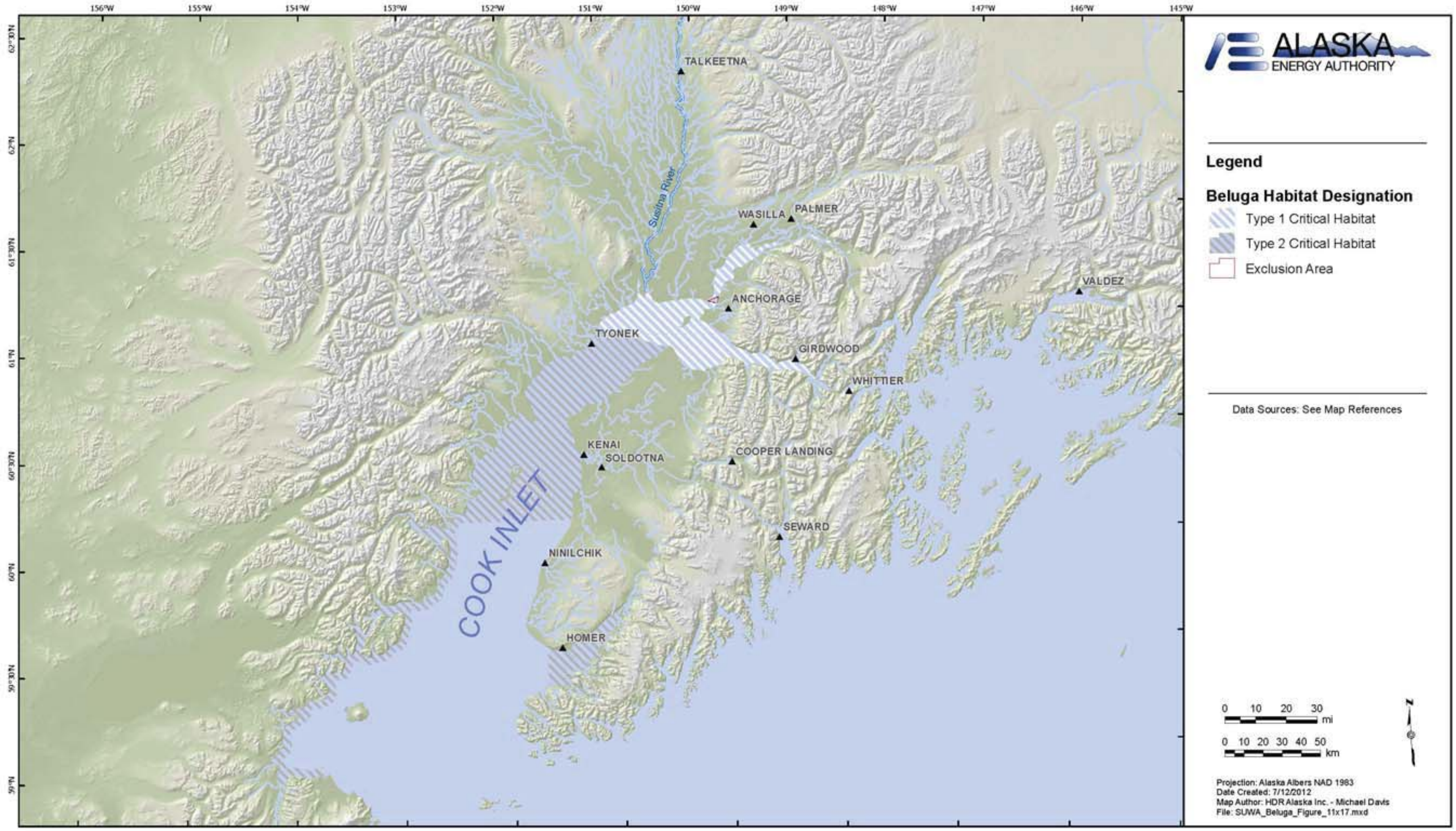

Figure 7.17-1. Designated Critical Habitat for CIBWs.

7.18. Attachments

ATTACHMENT 7-1. DOCUMENTATION OF CONSULTATION ON FISH AND AQUATIC RESOURCES STUDY PLANS

ATTACHMENT 7-1

DOCUMENTATION OF CONSULTATION ON FISH AND AQUATIC RESOURCES STUDY PLANS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

December 30, 2011

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: Proposed 2012 pre-licensing studies for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) verbal request for recommendations on pre-licensing studies in 2012 for the Susitna-Watana Hydroelectric Project. The Service has previously provided some verbal comments at project planning meetings and in conversations with AEA project and consulting staff. The Service will be better able to provide complete comments (as part of the National Environmental Policy Act scoping process), after reviewing more thorough descriptions of the proposed project and project operations anticipated in the Preliminary Application Document (PAD). The following comments and study recommendations for 2012 are considered preliminary until we review the PAD and fully understand the scope of the proposed project.

We recognize that the newly proposed Susitna-Watana project is different than the proposed Su-hydro project of the 1980s. Differences in: 1) the two proposed project designs; 2) the past and present study methodologies (due to evolving scientific technologies); and 3) the scientific rigor of previous investigations, may limit the applicability of study results from the 1980s. In many instances, the 1980s studies were limited in spatial and temporal scope, and the methodologies may have been limited, outdated, non-replicable, or lacking in resolution, potentially making them incomparable to present technologies. For these reasons, the Service is concerned about the applicability of the 1980s Su-hydro studies relative to the proposed Susitna-Watana project.

The Service appreciates that AEA recently had the 1980s studies synthesized for identification of data gaps. A reasonable next step is to review the study results for appropriateness and

applicability to the newly proposed Susitna-Watana project. Specifically, results from the 1980s studies should be reviewed for statistical validity.

The Service and other resource agencies have previously expressed concerns about the assumptions, relevance, and applicability of 30-year old studies conducted for a different project proposal, in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the upper and lower reaches (as defined by AEA) of the Susitna River for both the 1980s and in the proposed Susitna-Watana project.

To begin assessing potential impacts to fish and wildlife resources in the project area, the Service recommends the following reconnaissance level studies and reviews for 2012:

- Biometric review of biologic and hydrologic study results from the 1980s.
  Rationale: To assess the statistical validity of the 1980s Su-hydro study results for applicability to proposed studies for the Susitna-Watana project.

- Establish cross-sections for the lower reach, determine the hydraulic connection between the Susitna River and sloughs and off-channel habitats, and incorporate them into the hydrologic model.
  Rationale: To quantify and evaluate the effect of project operations on the lower reach (as climate and other conditions change within the watershed)

- Monitor flow and sediment in the Chulitna and Talkeetna Rivers, and in Gold Creek.
  Rationale: To quantify and evaluate individual tributary flow contributions and sediment loads and assess the potential effect of project operations on lower reach habitats and functions.

- Quantify distribution of fish assemblages relative to available habitat and stream temperature at channel, reach, and spatial scales (as defined by Torgersen et al. 1999).
  Rationale: To assess and quantify fish assemblages relative to available habitats that may be affected by proposed project operations; there are approximately 20 fish species in the Susitna River and little information known about their distribution.

- Collect longitudinal thermal imaging data in all Susitna River study reaches
  Rationale: Information is needed to assess and quantify important aquatic habitats (e.g., thermal refugia) that may be affected by proposed project operations

The Service considers these minimum recommendations necessary to establish a framework to identify future applicable studies throughout the licensing process. When we review the PAD we will likely revise our recommendations to reflect the integration we would like to see in the 2012 studies.

Thank you for the opportunity to provide comments on pre-licensing studies for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Acting For:

Ann G. Rappoport
Field Supervisor

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

February 10, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided some initial comments on the draft study plans during the work group meetings January 24-26, 2012, and had anticipated providing additional comments after receiving revised and more thorough descriptions of the proposed studies. Since that meeting, we have conducted an initial review of the Instream Flow, Aquatic Resource, Water Resource, and Eagle and Raptor Nest draft 2012 study plans provided at the January 24-26, 2012, meetings. Due to the short turnaround time requested for feedback (11 business days) on the study plans and their ongoing evolution, our comments should be consider cursory. The following represents our overall issues and concerns with the study plans and the enclosure provides a more detailed accounting of our comments and recommendations for each specific study plan.

Expanded Study Framework and Timeframe: The Service and other resource agencies have frequently expressed concerns about the limited temporal and spatial scale, and limited timeframe, for proposed studies in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the lower reaches (as defined by AEA) of the Susitna River for the proposed Susitna-Watana project. As part of the hierarchical framework, an ecologically meaningful space-timing scale should be identified related to project studies. As the spatial scale of studies increases, the time scale of important processes such as ice, sedimentation, and channel formation also increases, because they operate at slower rates,

time lags increase, and indirect effects become increasingly important. Studies related to these dynamic fish habitat forming processes need to be adequate (i.e., 5 years or more) to begin to understand mechanistic linkages (Wiens et al 1986; Wiens 2007). For this purpose, the Service recommends conducting fish habitat forming process studies on the minimum temporal scale of 5 years. This temporal scale equates to the typical life cycle of Chinook salmon, an Alaska Department of Fish and Game designated stock of concern.

To address these concerns, the Service expects that the 2012 studies and future project-related studies will be conducted on a hierarchical framework (Urban et al 1987; Frissell et al 1986) at a variety of scales including meso-habitat, reach, and basin wide. The Service also expects that the 2012 studies will not only help fill data gaps identified in the Preliminary Application Document (PAD), but will also be integrated between each other and with future project-related studies. This framework and integration is necessary to understand existing conditions and predicted changes to fish habitat in relation to changes in physical processes from proposed regulated flows. We recommend you establish a schedule for analysis of data obtained in 2012 and a framework for how to incorporate the 2012 data into 2013-2014 study plans. This is necessary for resource agencies to adequately assess potential project impacts to Alaska's fish and wildlife resources.

Winter Flow Regimes: At the January 24-26 work group meetings, and in the PAD, winter operations were described as load-following with flows ranging from 3,000 to 10,000 cfs in a 24-hour period. Regulated flows, including load-following operation, result in substantial changes to the natural hydrograph of a river. Dam construction and operation globally has resulted in adverse effects to anadromous and resident fish, macroinvertebrates, and their habitats. The Service is particularly concerned with the lack of study focus on Susitna River winter flows under natural and proposed flow operations. We recommend that winter base flows be assessed beginning in 2012 under the Instream Flow 2012 Study Planning, Water Resources Study Planning, and in the Aquatic Resources Study Planning. During colder winter months, glacial river base flows, such as those in the Susitna River, are derived entirely from groundwater inputs resulting in reduced habitat availability. We recommend assessing base flows as they relate to mainstem winter habitats (including adult spawning and juvenile fish overwintering locations, and the potential for stranding or increased mortality or condition related to changes in flow and water temperature), water quality conditions, ice-processes, and habitat and geomorphic processes in the Susitna River under current conditions and underthe proposed operation.

Temperature: In our December 30, 2011, letter we recommended thermal imagery (Torgerson et al. 1999) be conducted in 2012 throughout the Susitna River mainstem to identify important thermal habitats that may be utilized for spawning, refugia, or as overwintering areas. It is important to characterize the Susitna River water temperature profile as it relates to habitat because the proposed dam is expected to significantly alter the water temperatures downstream of the dam. Please review this letter as a reference for this study, as well as other Service recommendations.

Modeling Design: There is currently a lack of information in the draft study plans related to overall modeling approaches that will be used for the Susitna-Watana project. When identifying

instream flow model(s) the purpose and assumptions must be compared to Water Resources and Aquatic Resources study objectives. Model assumptions and model inputs need to be clearly stated and available for review. Spatial pattern should be one of the independent variables in the model analysis. At a minimum, we recommend using 2D hydrodynamic model(s) at a mesohabitat, reach, and basin wide scale (Crowder and Diplas 2000). We specifically recommend a 2D model be included to predict physical processes to spatially represent variation in input variables, and how those variables change temporally and spatially under differing flows. Selected model(s) should also include a sensitivity analysis (Turner et al. 2001). This information is critical to the general project understanding of existing ecological spatial patterns, and predicted spatial patterns under proposed regulated flows from the Susitna-Watana dam.

Mercury: Since the January meetings, it was brought to our attention that fish mercury concentrations frequently increase after impoundment of a reservoir, particularly boreal reservoirs. Soil flooding releases organic matter and nutrients, providing food to bacterial communities that methylate inorganic mercury. Methylation and bioaccumulation are the primary pathways for mercury accumulation in fish (Therriault, 1998). Although not identified in the 2012 draft studies, future studies should include pre- and post-impoundment mercury concentration studies.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

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Enclosure

The following comments and recommendations are based on our review of the 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project provided at the January 24-26, 2012, work group meetings.

Synthesis of Existing Fish Population Data (F-S1)

Recommend including information on seasonal distribution and abundance of anadromous and resident fish species among riverine habitat types and river reaches. As part of the spawning and incubation period for resident and anadromous species, studies need to include fry emergence periods and time (of day) information to determine potential impacts from fluctuating winter/spring flows. Potential issues include stranding of fish (by life stage and species) and downstream displacement relative to potential ramp rates. This study needs to integrate with instream flow and geomorphic studies to look at effects of daily flow fluctuations, particularly in winter, in the middle and lower river reaches.

For clarity, we recommend referring to river "reaches" as defined in the PAD rather than river "segments."

Fish persistence should be evaluated relative to spatial and temporal availability of fish habitat under existing and proposed flows. The Service recommends fish habitat studies be developed concurrent with the water resource studies to interface and characterize fish habitat as it relates to physical (hydrologic, sedimentation, and geomorphic) processes. Fish habitat metrics should be developed and integrated with modeling efforts related to physical processes and fish presence.

Chinook Salmon Presence above Devil's Canyon Study (F-S4)

Chinook salmon presence above Devil's Canyon study should include an upstream and downstream fish passage component. This 2012 study should include fish passage relative to all life stages of Chinook salmon. There is the potential to include Dolly Varden and Humpback whitefish pending results of an otolith/anadromy analysis by the Service for these species.

The Service supports the genetic component of the study (F-S4) which is necessary to determine whether the Chinook salmon meta-population in the vicinity of the proposed dam is a distinct population.

Wetland Mapping Study (B-S3)

The draft wetland study states that the methods used will be consistent with guidance in the Alaska Regional Supplement (USACE 2007), the U.S. Army Corps of Engineers (USACE) Manual (Environmental Laboratory 1987), and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Therefore, the Service recommends the use of the Cook Inlet Classification (CIC) developed by Mike Gracz. The CIC is an HGM-based wetland ecosystem classification scheme analogous to Cowardin. The Service supports the use of CIC for wetland mapping in the Cook Inlet Basin over Cowardin because CIC is regionally

specific and indicative of function (e.g., a spring fen always receives groundwater discharge; whether a palustrine emergent wetland does is unknown). CIC can be cross-walked with Cowardin if necessary. CIC methodologies and Mike Gracz' mapping protocols are described on www.cookinletwetlands.info.

In terms of compensatory mitigation related to a site that will be monitored over time using site-specific, precise functional attribution, the best functional assessment method available is the use of the HGM Regional Guidebooks. The citation for slope/flat wetlands is as follows:

- Hall, J.V., J. Powell, S. Carrick, T. Rockwell, G.G. Hollands, T. Walter and J. White. 2003. Wetland Functional Assessment Guidebook, Operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion, Alaska, using the HGM approach. State of Alaska, Department of Environmental Conservation, Juneau, Alaska.

Eagles and Raptor Nest Study (W-S3)

The Service's Migratory Bird branch is evaluating the potential for an eagle study that would compare productivity/behavior of golden eagles in disturbed areas (such as the Golden Valley Wind project, Usibelli Coal Mine, and the Susitna-Watana dam) versus undisturbed areas (Denali Park). We would like to explore the option of partnering with Watana projects to complete eagle nesting surveys. The Service could potentially provide experienced biologists to conduct the surveys. The benefits to this partnership include: 1) assistance to the project sponsors to conduct an eagle nesting survey; 2) provide cost savings to project sponsors by eliminating the need to hire a consultant to complete the survey; and 3) allow the Service to collect information valuable for our study. These surveys would not be considered compensatory mitigation, but would help meet eagle nest survey requirements. The Service generally recommends a pre-project survey with a follow-up survey just prior to construction.

Since 2009, compensatory mitigation is required for "take" or disturbance of active and inactive bald eagle nests. For golden eagles, there is a "no net loss" policy. Identifying ways to offset compensatory mitigation requirements early in the project development process can help the resource and the project sponsors. For example, a 2-year pre-construction eagle tracking study could help minimize required compensatory mitigation if the study demonstrated a "disturbance" rather than a "loss of territory."

Riparian (B-S2)

In addition to comments provided previously, we recommend riparian studies be integrated with other 2012 studies and with future project-related studies.

Beluga Prey Species Study (F-S6)

This study should identify components that specifically interface with the water resource and fish habitat studies. Anadromous prey species such as eulachon, Pacific and Arctic lamprey have been documented as present in the lower reach of the Susitna River and may be impacted by the proposed regulated flows. Relationships between natural flows and existing habitats should be

developed to best predict changes during proposed regulated flows that may impact beluga whale prey species.

Instream Flow Planning Study (F-S5)

1) Selection of a model or series of models of 1D or 2D nature will drive the type of data needs for the field studies. This discussion and selection must be made prior to finalizing habitat studies.
2) The habitat suitability curve development is a useful product. Conduct the studies in such a manner as to ensure the development uses actual suitability data and is not dominated by best professional consensus.
3) Need a better understanding of how the instream flow study relates to the routing model or uses its own calibrated flow model. Concern is that the overall routing model may have significant variation in water level between cross-sections depending on their placement in relation to the habitat cross-sections. Location in pools or riffles and within these features or braided section will vary the water level of a certain flow and may not correctly interpret the water level of a habitat cross-section.
4) Anticipate that the habitat study will have its own cross-sections and flow analysis separate from the routing model. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new spots as needed for 2013 and 2014.
5) Desire to have a large map with the routing and habitat cross-sections on it over recent aerial imagery.
6) In review of 1980s studies, were there any groundwater/surface water exchange studies?
7) Need to confirm whether the 1980s studies included mapping of groundwater upwelling areas along the river for gaining and losing reaches. We recommend at least a large-scale thermal temperature study along the river to note locations and relate it to the habitat study areas and cross-section surveys.

Reservoir and Flow Routing Model Transect Data Collection (WR-S1)

1) We recommend that the cross-section re-surveys in 2012 go beyond the forest limit but stay within the floodprone area, as there may be key floodplain elements not captured in the LIDAR data.
2) Need to evaluate appropriate model to consider ice effects as ice is a significant factor, not only for habitat but also for recreational use. We highly recommend utilizing one model that is fully dynamic and can deal with both floods and ice dynamics during winter low flows for routing. A model was recommended in the January work group discussion, created in Canada that may be appropriate. Model selection will drive data needs so this needs to be selected soon and with a full idea of the types of available models out there to select the best one.
3) Given the discussion of ice dynamics, cross-sections are likely needed in the lower reach to adequately assess ice dynamics as ice forms and slowly freezes upstream. We recommend that these cross-sections be identified and obtained in 2012 to maximize utilization of the model and potentially correlated to lower river habitat studies to reduce redundancy of effort.

4) Instream flow and habitat study cross-sections are assumed to be different than the routing cross-sections. We recommend creating a map for distribution that overlays the original routing and habitat cross-sections to begin to understand their spatial location and orientation and begin discussing 2012 study locations. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new sampling locations as needed for 2013 and 2014.
5) Flows need to be measured to calibrate routing as much as possible. We recommend that water surface and flow be captured at key cross-sections while in the field to calibrate the routing model results and to verify Manning's n assumptions.

Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations (G-S1)

1) For locations obtaining bedload data need to also do a bed pebble count to compare to transported load to calibrate for shear stress and other calculations.
2) Recommend that gravel bar sampling be part of the study to compare to transport load data obtained. This methodology must be well documented.
3) Evaluate the Chulitna and Talkeetna as well as other key tributary deltas for sediment distribution and load into the system.
4) Recommend attempting to get high flow values near bankfull stage at both Gold Creek and Watana sites to add to data.
5) Recommend sediment sampling at the Susitna-Watana dam site to demonstrate correlation to Gold Creek and/or model changes in sediment loading between the sites.
6) Evaluate 3-inch versus 6-inch bedload sampler use for 2012 field season to try to capture large fractions of bedload movement as able.

Geomorphic Assessment of Middle River Reach using Aerial Photography (G-S2)

1) Include a listing and evaluation of flood and ice conditions during and between aerial photography events, especially during breakup periods to help correlate differences to significant events in the watershed.
2) Does not address winter flows and habitat use under winter conditions; needs to come up with a plan to address this beginning winter 2012/13.
3) For geomorphic analysis and comparison to habitat studies, cross-section locations for substrate classification, large woody debris counts in floodprone width, and categorization of fluvial process (Montgomery and Buffington, Rosgen) should be determined and fieldwork performed. If location agrees with an old cross-section, it will help verify any changes over time and with flow to help determine stability and shear stress equations.

Geomorphic Assessment of Project Effects on Lower River Channel (G-S4)

1) There is a need to evaluate the hydrology and habitat use of the lower river to evaluate change over time from dam operations:
   a. Winter operations are a major concern given the need to evaluate daily flow fluctuations of 3,000-10,000 cfs in the winter. This effect must be modeled into

the lower reach to see if the magnitude of fluctuating flows in the winter extends further downstream than spring and summer flow periods. Additionally, ice and open water effects will be extended into the downstream area so modeling will need to address this by extending it downstream.

b. In the January work group meetings it was pointed out that ice is generated upstream and flows down the river to the lower reaches, beginning to form in the lower reach and slowly ice up the river upstream. This also needs modeling from a thermal standpoint, hence again, the need for cross-sections in the lower reaches.
c. Recommend that the gage at Su Station be turned on by the U.S. Geological Survey (USGS) and maintained by USGS to help calibrate lower reach modeling efforts over the next 5 years, especially for ice effects and dynamics modeling.
d. Cross-sections need to be made in the lower reach to add to an ice dynamics model as well as habitat studies – recommend selecting locations and getting these cross-sections in 2012 to facilitate modeling efforts.

2) Re-do all cross-sections at existing and past gage sites in the middle and lower reaches (including Su Station) to evaluate hydraulics, assess stability by comparing to old cross-section data and give an initial assessment of stability or changes in rating curve information. Also, it would be beneficial to do an initial evaluation of these gage sites at winter flows and with ice dynamics to begin to understand the impact winter flows will have. This will help with evaluating changes over the last 30 years in the lower reaches to determine whether additional work in 2013-2014 is needed.

Documentation of Sustina River Ice Breakup and Formation (G-S3)

1) Key elements to identify are: where ice generation occurs (production zones) and where ice lodges and begins the process of ice formation in the river.
2) Recommend that flights include an ice scientist, fishery biologist, riparian specialist and fluvial geomorphologist so that multiple observations can be made at the same time and can be stitched together to understand the processes taking place.
3) Recommend video be taken during all river flights for later reference.
4) Documentation of frazil ice generation is very important – current thought is that 80% is generated upstream of Devil's Canyon in the middle reach.
5) Daily flights might be needed during the height of breakup or freeze-up.
6) Is CRREL involved with the ice research?
7) Highly recommend utilizing our Canadian neighbors and their research and models for ice issues.

Review of Existing Water Temperature Data and Models (WQ-S1)

1) Identify appropriate temperature models to use based on new technology and understanding.
2) Evaluate MET station locations and strongly consider an additional station around the Deshka or Yentna which could help with ice studies.

3) Discuss MET station locations with NOAA Weather Forecast Center to access experts as well as potentially help with storing data.
4) Perform large-scale thermal study of the river for groundwater exchange areas over different flows.
5) At old, existing, and new gage sites, include continuous temperature monitoring; consider a water quality study at gage sites for 2012, 2013, and 2014 seasons with parameters agreed to by all parties and performed by USGS.
6) Evaluate past assumptions for temperature modeling (at least our understanding of it), i.e., summer analysis of surface water temperatures only, as this dominates habitat use, versus winter analysis of intergravel temperature only. Provide quantification of the hypothesis and assumptions made and determine if they are still relevant.
7) 2012 fieldwork in the work group meeting was discussed to primarily show how mainstem temperatures influence side channel habitat. This should be expanded to do a thermal analysis up and down the river (#4).
8) Discussed in the work group meetings that 2013-2014 work will deal with upwelling water temperatures. A thermal analysis in 2012 can help determine these sites.
9) Fieldwork needs to be performed that can help calibrate heat transfer coefficients and other assumptions in selected temperature models between mainstem and other waters.
10) Analysis of temperature effects on ice formation was not discussed and needs to be part of the scope in coordination with ice and habitat studies.
11) Ensure that solar radiation information will be collected at all MET sites as it is crucial to modeling efforts (ice, etc.) and evaluate other metrics that are needed for calibrating models.

United States Department of the Interior

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IN REPLY REFER TO:
AFWFO

February 21, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: Comments on an additional 2012 draft study plan for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided initial comments on the draft study plans during the work group meetings January 24-26, 2012, and provided additional comments in our February 10, 2012, letter. The following comments and recommendations are based on our review of an additional draft study plan for the Susitna-Watana Hydroelectric Project provided in the Request for Proposals we received February 8, 2012. As in our February 10, 2012, letter, because of the short turnaround time requested for comments on the study plans and their ongoing evolution, our comments should be considered cursory.

Adult Salmon Distribution and Habitat Utilization (F-S3): The study objectives include characterizing the spawning habitat utilization of turbid mainstem and side channel habitats by adult anadromous species as well as the spawning habitat utilization in clear water side sloughs and upland sloughs. However, the methods only mention surveys in the Middle Reach (RM 98 to 150). We recommend that study methods be expanded to ensure characterization of spawning habitat utilization in the lower river reaches of the river as well to allow for a more comprehensive assessment of potential impacts of the project on salmon spawning habitats throughout the length of the Susitna River. In addition, we recommend that this study be fully integrated with instream flow and geomorphic studies to assess the effects of daily flow fluctuations, particularly in fall and winter.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
Field Supervisor

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SUSITNA-WATANA
HYDROELECTRIC PROJECT

SUSITNA-WATANA INSTREAM FLOW STUDY (SWIFS)
Teleconference Meeting Minutes
March 15, 2012

Project: Susitna-Watana Instream Flow Study
FERC No. 14241

Meeting Date: March 7, 2012 (3-5 PM AST)

Location: Via Teleconference

Participants: Joe Klein (ADFG), Mike Buntjer (USFWS), Betsy McCracken (USFWS), Susan Walker (NMFS), Bob Henszey (USFWS), Betsy McGregor (AEA), Craig Addley (Cardno-Entrix), Steve Padula (Longview), Dudley Reiser (R2), Paul DeVries (R2), Stuart Beck (R2), Kevin Fetherston (R2), Mike Gagner (R2), Michael Link (LGL)

Purpose: Continue discussions regarding instream flow related resource issues that need to be addressed as part of 2013-2014 studies.

Dudley Reiser stated that the main purpose was to allow resource agencies an opportunity to provide more details on resource issues warranting investigation as part of 2013-2014 studies. He reminded the group that there are opportunities for some field efforts this year.

Dudley noted the email comments provided by Joe Klein and requested that he expand on the issues he presented. Some of ADFG issues include:

- Model flow vs. habitat relationships in all reaches affected by the project
- Complete a comprehensive analysis of fish habitat issues including: distribution, use, timing, and evaluation of project impacts
- Ice and potential effects on formation, breakup, etc. related to project operations
- Winter habitat use of fish
- Groundwater influences on fish distribution and how project operations may affect groundwater flows
- Water temperature and how regimes would change with project operations
- Time series analysis of habitats

Dudley acknowledged the need to focus on both mainstem and side channel habitats and that previous studies focused on side channel and slough habitats. He noted that the flow routing transects could also be used for evaluating mainstem habitat effects and that the radiotelemetry (fisheries study) studies would be used to help define main channel use.

Joe Klein indicated he would like to see more emphasis on mainstem habitats than was done in the 1980s.

Mike Buntjer requested a map displaying location of flow routing transects. Betsy McGregor noted that the location of the old ADF&G transects in lower river would need to be digitized and displayed along with flow routing transects in the middle river. This type of info will be useful in identifying data gaps and possibly high priority sampling locations.

Joetta Zablotney is going to generate a GIS map using modern coordinates and aerial photos. This map will be distributed to the group as part of 2013/2014 study plan and will need to be completed by March 20th. Betsy noted that Shawn O'Quinn – (DNR GIS) will assist with this effort.

Craig Addley said that most of the 1980s transects have been digitized and could be displayed on new maps. The group would like to have the transect locations QA/QCed on the ground.

Betsy McCracken asked whether the historic transects were based on habitat or fish use? This will need to be determined based on information review. She also would like to see a study to define unique habitat types, especially those associated with groundwater upwelling.

Dudley stated that groundwater is specifically covered under water quality, but that groundwater influences relative to spawning and rearing habitats and the effects of project operations on these habitats will need to be evaluated. One way for identifying areas of groundwater inflow is via Forward Looking Infrared (FLIR). This has been proposed for use in a test area to see if sufficient difference in temperature can be detected. If works on test area, then it would be expanded to other areas. Some limited assessment of groundwater was done in the 1980s. Dudley noted that this relates to the idea of different levels of study intensities based on resource use/sensitivity. This will be considered in developing the 2013-2014 study plans.

Craig Addley noted that extensive habitat mapping was done during 1980s studies – the majority of side channel, mainstem, and off channel habitats (sloughs) were evaluated under flows ranging from ~800-2,400 cfs. Studies identified spawning locations, juvenile fish and overwintering use of each habitat type and many of these habitat types were subsampled.

The group indicated that load following and ramping rates are a major concern. Stuart Beck described a procedure for evaluating these types of potential impacts using a varial zone analysis that would include an evaluation of stranding and trapping potential, along with redd dewatering.

The agencies requested a list of contractors that identify who is responsible for what studies/issues. Dudley indicated he will work with AEA on getting a list generated. Not all contractors are under contract yet.

Question raised: How will we study or detect channel change with flow regulation changes; i.e., change in hydrology will result in channel changes. Answer – this will be done as part of a number of studies including geomorphology, riparian analysis, ice study, and the instream flow habitat analysis. Part of these studies will evaluate bed profile and substrate compositions.

Question raised: will the flow routing model be used for channel change – Stuart Beck indicated it would be. Stuart also noted that there are ways to predict how project operations will affect changes in morphology and that this will be linked with SWIFS and riparian studies.

Question raised: can the model also be used to evaluate tributary confluences and how they will be affected? S. Beck stated the project would result in sediment supply interruptions – immediately below the dam the sediment supply will change with scour or incision, but some of this impact will be reduced by reductions in high flow events. The USGS is evaluating sediment changes.

Dudley noted that the overall goal is to try and link all of the channel and biological processes that may be affected by the project operations so that time series evaluations can be completed for each process (to the extent possible).

Question raised: will invertebrates be considered in the assessment of project effects? D. Reiser responded that changes in sediment and flow can affect invertebrates and they will be considered. May utilize varial zone analysis described by S. Beck to assess some of these impacts including area, timing, and duration of projected flow changes.

Question raised: will HSC curves be developed for invertebrates? D. Reiser noted that this has been done on other projects and will be considered as part of the SWIFS. However, it also possible that the issue of invertebrate habitats will be covered by fish habitat analysis, that may include use of guilds. Betsy McCracken is interested in potential changes that may result to invertebrate species richness and diversity.

The group noted that Project operations will alter the thermal regime related to flow releases, ADF&G would like to see HSC curves developed for multiple areas and over different time periods/flow levels. D. Reiser responded that we will conduct site-specific data collection but may need to use literature, professional opinion, enveloping and guiding to develop curve sets for some species.

Question raised: how many observations are necessary to build curves? D. Reiser noted this varies; some instances as few as 25-30 observations have been used, in others 75-100 or more have been used. Joe Klein stressed that he just wants to make sure that a good effort was going to be placed on collecting site-specific data.

Concerning the review of literature review and gap analysis/synthesis that will be undertaken this year, the agencies would like to be directed to pieces of information we identify that are especially useful to help them gain a good understanding the resources of the project area.

The group then shifted to a discussion of Riparian habitat. Bob Henszey asked about the types of studies that would be done to assess channel encroachment and the effects of project operations on cottonwood regeneration. He is concerned about potential effects of shallow groundwater table fluctuations and how that would influence cottonwood recruitment.

K. Fetherston indicated that models will be used to predict project operational effects on cottonwood/riparian veg. Joe Klein asked whether there is a published table that shows how seral stages and spp composition change over time. K. Fetherston noted that HEC-RAS and HEC-GeoRAS can be used to determine flow vs. riparian habitat relationships. This work will be coordinated with the ice assessment group and how conditions/ice sheer zones will affect cottonwood galleries. It will also be important to link riparian studies with groundwater, and fisheries at certain locations. Kevin noted that large fluctuations in flow can also increase bank erosion affecting riparian vegetation. The approach will be to intensively study small areas with the goal of being able to extrapolate results out to unsampled areas.

The teleconference adjourned at 5:00 ADT.

Notes from a meeting with ADFG Gene Conservation Lab, March 26, 2012

On phone: Betsy McGregor (AEA), Dani Evenson (R2)
In-person: ADFG: Bill Templin, Chris Habicht, Andy Barclay, Jack Erickson (briefly)
LGL: Michael Link, Bryan Nass, Jason Smith
HDR: James Brady

Looking for guidance and priorities for sampling in the middle Susitna. We can help collect the needed samples for Chinook. Tell us which samples are of greatest value to the Lab.

Sampling where? In tributaries only, or at fishwheel too? Only would do sampling at fishwheel in a future year if there was a mainstem spawning group identified.

Review Purpose and Objectives of tissue collections: baseline development, mark-recap utility, habitat use and juvenile redistribution questions, fish above Devils Canyon (are they distinct?), parental contributions above Devils, future possibility of testing water samples to indicate whether there are fish there or not. Test whether the fish above and those below Devils are genetically different.

ADFG concept: source-sink question, which deals with genetic variation. A new application for them so some aspects are uncertain, but known distribution means we probably don't need Fishwheel samples. Maybe need a netting program in tributaries to get adult samples. Protocol for sampling not defined yet and first samples will be first used for basic assessment of siblings, gauge number of adults above canyon, but want 200 from each trib. Recognizing likely limitation of number samples available. Andy to provide existing samples distribution for (preferred) live adults or very recent dead (heart tissue).

If ADFG is informed where spawning fish are, they can also go get themselves.

Samples could be processed this winter with results available next season.

Other species: opportunistic sampling of non-salmon (important sport fishery, important ecologically). Useful sample sizes 20-50 total each by area within watershed, up to 100 from around the watershed.

ADFG (Judy Berger) to provide kits. ADFG will provide information necessary to update our sampling permit (where to sample).

Axillary process as the part to sample for most fish.

Chinook, sockeye have some funding to process some samples, but not the others.

Anadromous vs. resident? size based sample collection?

AEA perspective (Betsy) - fish above Devils, are they different from those above.

To write a "study request" for 2013-14 (R2, Dani Evenson) to have a place in the cue for work to be done.

Michael Link

From: Erickson, Jack W (DFG) [jack.erickson@alaska.gov]
Sent: Thursday, March 29, 2012 5:00 PM
To: Michael Link
Subject: RE: Study plan, Susitna middle river habitat use (using telemetry and other)

Mike,

I am ~ ½ way through your plan. Can you call me Friday morning to discuss it?

From: Michael Link [mailto:MLink@lgl.com]
Sent: Wednesday, March 28, 2012 12:51 PM
To: Erickson, Jack W (DFG); Yanusz, Richard J (DFG); Willette, Mark (DFG)
Cc: Bryan Nass; Fair, Lowell F (DFG)
Subject: Study plan, Susitna middle river habitat use (using telemetry and other)

Jack, Richard, and Mark,

Here is the "final draft" study plan that we pulled together for AEA based on the earlier plan prepared by others. This document was just posted on the AEA website and, along with several other study plans, will be the topic of discussion at next Thursday's AEA fish meeting (~10am-2pm).

I look forward to hearing your feedback. The proposed effort of using side-scan/DIDSON to locate spawning fish in turbid water is an Aquacoustics (Don Degan) led initiative. We have suggested using our DIDSON for helping to position the fishwheels and make some tests of fish presence/behavior offshore and around the fishwheels. The main issue with the latter is primarily related to testing whether all Chinook are equally vulnerable to capture. Of course, we can address some of that with carcasses in Portage but I'd sooner know in-season. The mainstem stations are to characterize the comings (and goings) of the mainstem side channel/slough chum and sockeye as it changes with time of year, discharge, etc. The two sloughs will likely represent the bulk of these tagged species. Portage and Indian will probably see 90% of the tagged kings.

One thing you will no doubt take note of is the lower river aerial survey effort; agencies have urged AEA to better characterize mainstem use in the lower river (Flathorn to three rivers) and would like us to track the fish you tag in the lower river to a higher temporal and spatial resolution than currently planned. As we discussed briefly via email, this will be a challenge but we've propose an approach to accomplish what has been asked of us. If this, or something similar, were to work maybe we could save you some focused fixed-wing effort in the mainstem. I'm not suggesting you turn off when transiting, but we might create some extra time for you to focus efforts elsewhere. Just a thought; I know you guys have plenty to do across all the studies in the area.

Regarding the integration/collaboration of the telemetry data analysis, we allude to this in the study plan but as you know, we do not have a formal approach for this yet, other than an informal "agreement in principal"/goodwill/etc. Just let me know if there is anything I should be doing to catalyze the data sharing agreement or if you would like to pull back some on this aspect.

Despite it coming together in relatively short order, it has gone through a few iterations, so there is more behind many of these things than may meet the eye. Let me know if you would like to talk about any of this prior to Thursday's meeting. I suspect Thursday may only provide for fairly limited discussion.

Michael

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Michael Link*	**Name:**	*Jack Erickson*
Organization:	*LGL Alaska Research Associates*	**Organization:**	*ADFG*
Study Area:	*Fisheries Resources*	**Phone Number:**	*Telephone call*
Date:	*March 30, 2012*	**Time:**	*10:00*
Call Placed by: [x] AEA Team [ ] Other Party			

Subject: Study design for the salmon escapement study

Topics:

This call was to review the written comments provided by ADFG on the 2012 study plan for habitat utilization and salmon escapement study. ADFG provided useful comments on the efficacy and utility of the proposed methods to catch, tag, and track salmon in the Susitna. We reviewed study design protocols, and how to coordinate and collaborate with ADFG in the 2012 field studies.

The 2013-14 study plan was largely built upon the 2012 study plan, with additional components added based on ADFG's study request for additional work in the lower river on Chinook and coho salmon.

[note; please save files with agency name and date of event using YYYYMMDD]

SUSITNA-WATANA HYDROELECTRIC PROJECT

RECORD OF IN-PERSON MEETING

AEA Team Member		Other Party	
Name:	*Michael Link*	Name:	*Jack Erickson*
Organization:	*LGL Alaska Research Associates, Inc.*	Organization:	*ADFG*
Study Area:	*Fisheries Resources*	Phone Number:	*267-2398*
Date:	*March 2, 2012*	Time:	
Call Placed by: ☐ AEA Team ☐ Other Party			

Subject: 2013-14 Study Plan, Salmon Escapement and Fish Genetics

Meeting notes, March 2, 2012, In-person meeting with Jack Erickson, ADFG, and Michael Link, LGL

Purpose of meeting: to discuss the design and research techniques to characterize spawning destination and abundance of Chinook and other salmon species in the Susitna River.

Compared and contrasted the utility of genetic and traditional mark-recapture (spaghetti and radio tagging) methods for estimating abundance and stock composition (i.e., apportionment) among the different stocks of salmon.

Agreed that it would be good to evaluate the effectiveness of fishing in the lower river and distribution among streams in 2012 before deciding on whether to emphasize genetics over traditional mark-recapture approaches.

[*note; please save files with agency name and date of event using YYYYMMDD]*

Betsy McGregor

From:	Klein, Joseph P (DFG) <joe.klein@alaska.gov>
Sent:	Tuesday, April 17, 2012 11:12 AM
To:	Betsy McGregor
Cc:	Clark, Robert A (DFG); Vincent-Lang, Douglas S (DFG); eric Rothwell; betsy_mccracken@fws.gov; michael_buntjer@fws.gov; tsundlov@blm.gov; msonderg@blm.gov; susan walker; bob_henszey@fws.gov; LaCroix.Matthew@epamail.epa.gov; cassie_thomas@nps.gov; eric Rothwell; Baker, Tim (DFG); Benkert, Ronald C (DFG); Burch, Mark E (DFG); Erickson, Jack W (DFG); Fair, Lowell F (DFG); Fink, Mark J (DFG); Holen, Davin L (DFG); Lingnau, Tracy L (DFG); Miller, Monte D (DFG)
Subject:	ADF&G Comments on April 2-6 Susitna-Watana Project Meetings

Betsy-

ADF&G appreciated the meetings April 2 - 6 to discuss fish and wildlife related issues associated with the 2012 and 2013-14 study plans for the Susitna-Watana Hydroelectric project.

We offer the following comments on information presented.

<u>Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area</u>

- If the first fish survey does <u>not</u> detect any fish, we recommend a second visit be conducted.
- The Habitat Division recommends conducting site visits along the transportation corridor(s) as early as possible to enable discussion of proposed stream crossings, locations, and designs and discussion of permitting requirements associated with those crossings.

<u>Susitna-Watana Instream Flow Study</u>

- Include fish behavioral response based assessments with the study. For example, fry/juvenile distances to cover/edge of water.
- We would like to read information on previous instream flow assessments performed at the Baker and Boundary Hydroelectric Relicensing projects that were referenced during the meetings.

<u>Geomorphology</u>

- A description is needed on how channel maintenance flows will be determined to estimate the magnitude, duration, timing and rate of change.

<u>Fish</u>

- Rotary traps used to assess fish outmigration should operate for the entire period of outmigration.

- Use of underwater video cameras, radio telemetry, and/or remote operated vehicles should be considered for assessing presence/absence of overwintering habitats in the Susitna River and if successful, developing habitat suitability curves.

<u>Temperature Monitoring</u>

- After review of the latest draft 2012 study plan, the Habitat Division has determined that Fish Habitat Permits should be obtained for the temperature monitoring stations. Enough information on monitoring locations and description of temperature monitoring station design is available in the study plan to proceed with developing permits. AEA or its contractor should contact the Palmer Habitat office to discuss these stations and submit permit applications.

Habitat Mapping/Surveys/Typing

- Training on the selected protocol across disciplines needs to be integrated into the study plans to further maintain data consistency and reduce observer bias during surveys.

Regards,

Joe Klein, P.E.
Supervisor Aquatic Resources Unit
Alaska Department of Fish and Game
333 Raspberry Rd
Anchorage, AK 99518
(907) 267-2148
joe.klein@alaska.gov

Betsy McGregor

From:	Michael_Buntjer@fws.gov
Sent:	Monday, April 23, 2012 1:58 PM
To:	Betsy McGregor; MaryLou Keefe
Cc:	Ann_Rappoport@fws.gov; Lori_Verbrugge@fws.gov; Betsy_McCracken@fws.gov; Bob_Henszey@fws.gov; Jennifer_Spegon@fws.gov; joe.klein@alaska.gov; jack.erickson@alaska.gov; LaCroix.Matthew@epamail.epa.gov; Craig Addley; Steve Padula
Subject:	USFWS concerns about proposed Susitna-Watana load-following operations on fish populations

Betsy:

The U.S. Fish and Wildlife (Service) appreciates the Alaska Energy Authority's continued willingness to work collaboratively with resource agencies to identify and address concerns expressed by resource agencies about the Susitna-Watana Hydroelectric Project. This email is in response to your verbal request for comments and recommendations related to fish and wildlife resources associated with the 2012 and 2013-2014 study plans. Here we focus primarily on the proposed load-following operations, uncertainty about ramping rates or regimes, and need for winter distribution, abundance, and habitat use information for juvenile anadromous fish and resident fish.

The Service and other resource agencies have expressed concerns at previous work group meetings about the proposed load-following operations, particularly in winter (October through April). The timeframe between spawning and outmigration of juveniles is critical for anadromous species populations in terms of proposed project operations. However, much of the focus at work group meetings for fish, to date, has been on habitat modeling and developing habitat suitabilty curves.

Load-following operations and ramping regimes, particularly those proposed in winter (October through April), can disrupt fish spawning, spawning success, egg incubation, incubation success, fry emergence times, and emergence success. Post emergence, smaller juvenile fish (less than about 50 mm long) are most vulnerable to potential stranding because of a weaker swimming ability and typical preference of habitat types near shore. Therefore, it is important to know when and where fish are spawning, when fry emergence occurs (both date and time of day), and the distribution and abundance of wintering juvenile fish.

Load-following operations (specifically flow fluctuations) from hydropower operations can create a varial zone between high and low water operations where the biomass of algae and macroinvertebrates is significantly reduced. Because macroinvertebrates are a primary food source for many riverine fish (and particularly for juvenile fish in the Susitna River), extreme flow fluctuations can adversely affect fish growth if food is limiting. Changes in water temperature, emergence times, and daily flow fluctuations could also affect fish growth, fish condition (responding to constant changes in flow), outmigration (for anadromous species), and overall survival of both resident and anadromous fish species.

The rate and magnitude of flow change need to be evaluated seasonally on the displacement and potential stranding of spawning adults, dewaterating of redds, and stranding of juveniles. Because of the extreme environment, freezing of incubating eggs or freezing of fish stranded in shallow habitats could also occur with project operations. Stranded fish would also be more vulnerable to predation from eagles and bears.

The 1980s studies focused on occupied fish habitats (particularly for juveniles) and did not evaluate areas where (nor the reasons why) fish were not present. This will make extrapolating results to the overall river difficult. Therefore, it is critical this information be collected in 2012-2014.

Much of the proposed work for fish and wildlife resources appears to rely on comparing results to the 1980s, and where results are similar, concluding there is substantial baseline information to evaluate potential effects of the proposed project. However, there are substantial data gaps in biological information both seasonally and by reach. For instance, there is almost no winter distribution and abundance information for resident or juvenile anadromous fish in the Susitna River (limited observations in October and November from 1980s studies) and limited biological information in both the upper and lower reaches (as defined in the PAD) to compare with 2012-2014 study results. This also reiterates our previous concerns at both meetings and in writing that adequate information cannot be collected in 2-3 years of study.

Potential methods

ADF&G suggested considering use of underwater video for assessing presence/absence of fish in wintering habitats (per 4/17/12 Joe Klein email). In addition, we suggest that snorkelling or scuba diving techniques also be considered to assess presence/absence of fish in wintering habitats, as well as determining winter distribution and abundance. Snorkelling or diving could also be used with egg baskets to monitor egg development, egg survival, and emergence times under baseline conditions.

Mike

Mike Buntjer
US Fish and Wildlife Service, Anchorage Field Office
Conservation Planning Assistance
605 W. 4th Ave, Room G-72
Anchorage, AK 99501
(907)271-3053
(907)271-2786 FAX

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*MaryLouise Keefe*	**Name:**	*Susan Walker, see other listed below*
Organization:	*R2 Resource Consultants, Inc.*	**Organization:**	*NMFS, USFWS, ADFG, AEA*
Study Area:	*Fisheries Resources*	**Phone Number:**	*Conference call*
Date:	*April 26, 2012*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call: E. Rothwell, M. Buntjer, B. McCracken, J. Ericksen, J. Klein, M. Sondergaard, M. Cutlip, B. McGregor.

Subject: 2013-14 Study Requests

Discussion:
This conference call was set up to have open discussion of objectives and approaches that are appropriate for implementation during 2013-14 studies.

The conversation started with a discussion of the ILP process and time frame. Matt Cutlip addressed agency questions and discussed how and when it is appropriate for the agencies to have input into studies…stating basically start now and continue through the process.

The conversation turned to study requests. The group moved through the current ideas and discussed how objectives could be refined. We discussed the approaches for meeting study objectives…such as using radio-telemetry and pit tags to monitor seasonal movements of fish, use of smolt traps, the ability to snorkel or dive all seasons, and the need to collect habitat suitability data in both turbid and clear water. We talked about the need to tie barriers together with habitat and seasonal evaluations of barriers. ADFG requested habitat crew training prior to data collection.

Discussion began about potential target species to consider: eulachon, rainbow trout, Dolly Varden, whitefish, Pacific lamprey, burbot, and northern pike. The potential concern was raised that pike may find refuge in winter with increased flows in the mainstem.

A brief discussion of the macroinvertebrate study plan ensued. We discussed seasonal sampling, nesting sites within the river specific habitat classification scheme being developed, and adding a randomness element. We discussed adding a qualitative assessment of fish feeding on macros.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Michael Link*	**Name:**	*See below.*
Organization:	*LGL Alaska Research Associates, Inc.*	**Organization:**	*ADFG*
Study Area:	*Fisheries Resources*	**Phone Number:**	*Telephone call / In person meeting*
Date:	*April 26, 2012*	**Time:**	*13:00-1430*
Call Placed by: [x] AEA Team [ ] Other Party			

Notes from a meeting with ADFG Gene Conservation Lab, April 26, 2012
On phone: Betsy McGregor (AEA), Dani Evenson (R2)
In-person: ADFG: Bill Templin, Chris Habicht, Andy Barclay, Jack Erickson (briefly)
LGL: Michael Link, Bryan Nass, Jason Smith
HDR: James Brady

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AEA perspective (Betsy) - fish above Devils, are they different from those above.

To write a "study request" for 2013-14 (R2, Dani Evenson) to have a place in the cue for work to be done.

river productivity study request

MaryLou Keefe [mkeefe@r2usa.com]

Sent: Friday, May 04, 2012 11:59 AM

To: Michael_Buntjer@fws.gov

Cc: Betsy McGregor

Attachments: draft 2013-14SR River Pro~1.docx (769 KB)

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hi mike...you had indicated an interest in this one last week so here you go. fyi it is a draft of one of our more comprehensive requests...format will change from this to the formal one, but it may help you with what you are working on.

have a good, restful weekend!

MaryLou

RECORD OF MEETING

AEA Team Member		Other Party	
Name:	*James Brady*	**Name:**	*Joe Buckwalter*
Organization:	*HDR*	**Organization:**	*ADF&G, Division of Sport Fisheries, Habitat Biologist*
Study Area:	*Upper Susitna River Fisheries*	**Phone Number:**	
Date:	*5/17/2012*	**Time:**	
Meeting requested by:	X AEA Team	☐ Other Party	

Meeting Location: HDR Office, Anchorage, AK

Attendees at Meeting:
James Brady (HDR), Erin Cunningham (HDR), Joe Buckwalter (ADF&G)

Subject:
Upper Susitna River Fisheries Distribution and Abundance Study Area - Survey Area for Potential Chinook Salmon Presence

Discussion:
Joe provided valuable logistical advice for sampling fish resources within the tributaries of the Upper Susitna River including the Oshetna River, Kosina Creek, Fog Creek and others. We discussed boat electrofishing methods that he had found to improve capture success in these drainages. We also discussed the Odyssey Fisheries Database System that ADF&G has been developing over the past ten years. Joe provided us with a generalized schema and screen shots of the tablet based mobile GIS field data capturing application incorporated in the Odyssey system.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*MaryLouise Keefe*	**Name:**	*Susan Walker, see other listed below*
Organization:	*R2 Resource Consultants, Inc.*	**Organization:**	*NMFS, USFWS, ADFG*
Study Area:	*Fisheries Resources*	**Phone Number:**	*Conference call*
Date:	*May 18, 2012*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call: M. Buntjer, R. Benkert, D. Reiser, B.McGregor, J. Simon, R. Campbell

Subject: 2013-14 Winter Sampling Discussion
Meeting Notes are bulleted below.

- Objectives of study: to document winter habitat use by fish distribution & abundance, & to assess movement; bigger picture objective as it relates to ISF fish-habitat relationships & understanding potential project impacts
- Approach: need to be open to all alternatives at this time
- 1980s data in the reports, but synthesis of data may not be available until late summer
- need to move forward with FERC study plans, despite the lack of data synthesis at this point in time
- if substantial changes in flow from one year to the next, 25% of habitats sampled in first year could be resampled in 2nd year, with remaining survey area being new habitats not surveyed in the 1st year
- 1980s data has strong indications that fish are moving among macro-habitats; might be good to know when, why, etc…. especially for understanding potential operational impacts
- there are other limitations to consider & it would be interesting to know how they were addressed in the 1980s (e.g., lack of daylight; slushing over of ice openings; time of day that sampling was conducted; daily fish behavior patterns)
- effectiveness of different methods – minnow traps might be ok for presence data
- understanding role of temperature in movements & habitat use – open areas & sloughs
- may want to use multiple methods at some sites, & only select methods at others
- may want to look broadly for fish & then identify sites for more intensive sampling
- upper reach is less likely to need this level of sampling effort
- cost considerations – e.g. $50K for equipment for single PIT tag array
- Betsy wants to start sampling winter 2012-2013, for a total of 3 sampling seasons by break-up 2015
- questions about effectiveness of electrofishing
- seining & minnow trapping appeared to be most effective
- PAD mentions stable winter flows…reduced stranding – Betsy will check that for accuracy
- emergence times for chum salmon – Feb-Mar per PAD, but Mike couldn't confirm this
- what techniques were used to determine time of emergence?
- other early life history topics – Mike isn't sure how much he trusts the 1980s reports
- spawning habitat can be coupled with ISF studies; with temperature data incorporated information about incubation can be obtained; SNTEMP model is capable of calculating temps & emergence times;

ultimately can allow for assessment of potential effects on incubation & emergence; also temp changes in sloughs can be related to mainstem flows, topping over in sloughs; also consider information from inlet/outlet connectivity & temp responses in sloughs, etc.; redds above elevation x subject to dewatering, whereas other redds subject to freezing (intragravel temp loggers could be used)

- may be valuable to break-down the fish winter sampling objective into more specific objectives that target habitat use, presence/distribution, abundance, & movement, etc. separately

MLK's Fish Winter Sampling Discussion Points

1. Is it sufficient to focus sampling below RM 180, given potential for project to influence winter flows, temperature, and ice formation?

Mike: generally no; but may be species dependent; would be good to know what percent of population is u/s of the proposed dam location.

2. There are 180 miles of mainstem habitat and many more when we consider side channels and sloughs. How best stratify for winter sampling?

Mike: stratified random approach based on geomorphic reach & habitat type

-Should we sample in same locations at 1980s? Only? At least?

Mike: hesitant until we know more about the 1980s methods & data; at least going back to some sites might be a good idea (e.g., Slough 11)
Sue: thinks it should be "at least"

-Should we stratify by geomorphic reach? yes

-Should we stratify by habitat type and if so what level? yes

3. Should we spread sampling methods out to cover more habitat or co-locate where appropriate, i.e. intensive areas concept.

see bullets above

4. How much coverage is enough? Is there a certain percentage based on feature numbers or distance that we should strive for?

question was not answered

SUSITNA-WATANA HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*James Brady*	**Name:**	*Andy Barclay*
Organization:	*HDR*	**Organization:**	*ADF&G, Genetics Lab*
Study Area:	*Upper Susitna River*	**Phone Number:**	
Date:	*5/18/12*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call: HDR Study Team

Subject:
Genetic sample collection during the Upper Susitna River Fish Distribution and Abundance Study 2012 field effort

Discussion:
The purpose of the teleconference was to coordinate methods and supplies for collecting genetic tissue samples of fish species in conjunction with 2012 field activities. ADF&G will provide protocol materials by e-mail and HDR will pick up sampling kits from ADF&G around the first of July.

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*MaryLouise Keefe*	**Name:**	*Susan Walker, see other listed below*
Organization:	*R2 Resource Consultants, Inc.*	**Organization:**	*NMFS, USFWS, ADFG*
Study Area:	*Fisheries Resources*	**Phone Number:**	*Conference call*
Date:	*June 20, 2012*	**Time:**	
Call Placed by: [X] AEA Team [ ] Other Party			

Others on Call: M. Buntjer, B. McCracken, R. Benkert, J. Erickson

Subject: 2013-14 Study Requests

Discussion:
This conference call was set up to follow up on some uncertainty around semantics used in objectives that were discussed during the June 12th Fish and Aquatic TWG meeting. Discussion focused on clarifying the semantic issues regarding use of "counts" versus "escapement" and "all species" versus "all species captured".

The group also engaged in an open discussion of where and how to modify the macroinvertebrate sampling design with respect to sampling in channel margins and large wood as substrate. The conclusion was that a protocol that removed a piece of the wood and expanded the data was reasonable. In addition, it was decided that channel margins baseline sampling for macroinvertebrates should be conducted in a manner that allows for comparison post-project. This may not entail sampling in the exact same location but in at a similar depth and velocity in the same general area.

Michael Link

From:	Erickson, Jack W (DFG) [jack.erickson@alaska.gov]
Sent:	Thursday, June 21, 2012 4:25 PM
To:	Michael Link
Cc:	Klein, Joseph P (DFG); Erickson, Jack W (DFG); Templin, Bill D (DFG)
Subject:	Word version of DRAFT study request prepared by F&G
Attachments:	DRAFT study request for genetics sampling.docx

Michael

Per your request, attached is a WORD version of Study Request ADF&G submitted to FERC earlier this month. PLEASE note, this may not match up with text submitted by ADF&G in its comments to FERC. I hope it assists you with your efforts to prepare the genetics study plan.

Jack Erickson
Regional Research Coordinator
Division of Sport Fish
ADF&G
907-267-2398

SUSITNA-WATANA HYDROELECTRIC PROJECT

RECORD OF IN-PERSON MEETING

AEA Team Member		Other Party	
Name:	*Michael Link*	**Name:**	*Jack Erickson*
Organization:	*LGL Alaska Research Associates, Inc.*	**Organization:**	*ADFG*
Study Area:	*Fisheries Resources*	**Phone Number:**	*267-2398*
Date:	*June 28, 2012*	**Time:**	
Call Placed by: ☐ AEA Team ☐ Other Party			

Subject: 2013-14 Study Plan, Salmon Escapement and Fish Genetics

Purpose of meeting: review the technical approaches of the proposed study plans for proposed salmon escapement and fish genetics studies.

Discussed the results from efforts to capture and tag Chinook salmon at RM 30 and RM 120 (Curry) over the last 5 weeks.

Given the results from 2012 fishing efforts in May and June, the overall approach to the study design for the escapement study was valid and traditional mark-recapture was likely technically feasible.

Agreed that it was good to propose a continuation of the concept of assessing the feasibility of using genetics as a tool to estimate system-wide abundance.

Of course, this will depend on continued development of the Susitna Chinook baseline. There was general agreement that the PSP was built on a feasible study design.

[note; please save files with agency name and date of event using YYYYMMDD]

SUSITNA-WATANA
HYDROELECTRIC PROJECT

RECORD OF TELEPHONE CONVERSATION

AEA Team Member		Other Party	
Name:	*Scott Prevatte*	**Name:**	*Sam Ivey*
Organization:	*HDR*	**Organization:**	*ADF&G*
Study Area:	*Upper Susitna River*	**Phone Number:**	
Date:	*07/10/12*	**Time:**	
Call Placed by:	[X] AEA Team	[ ] Other Party	

Others on Call:

Subject: Coordination of Chinook Salmon Aerial Spawning Surveys

Discussion:

Scott called Sam on July 10. Scott informed Sam of AEA's intention to replicate the departments adult salmon aerial count in Indian Creek as a means of validation of results due to the anticipated limits of testing observer efficiency in the Upper River.

Sam said ADFG was beginning Susitna aerial surveys on Monday July 16 and planned to complete Indian Creek and other tributaries up river tribs during the last week of July. Scott informed Sam that HDR also plans to begin surveys in the Upper River during the last week of July. Sam noted July 26 as a tentative date for their Indian Creek survey and mentioned that the date may be flexible by a day or two because ADFG has many other tributary systems in the area to survey.

Sam requested that Scott check in with ADFG as the date gets closer for final coordination in picking the best day for both ADFG and HDR to survey Indian Creek.

From: Erickson, Jack W (DFG) [mailto:jack.erickson@alaska.gov]
Sent: Tuesday, July 10, 2012 9:33 AM
To: Michael Link; Betsy McGregor
Cc: Bryan Nass; Erickson, Jack W (DFG); Klein, Joseph P (DFG)
Subject: RE: Tuesday, project meeting, LGL/Fishwheels/Radiotagging/etc.

Gang,

I just confirmed with Palmer staff that we will be in the **air today** for the second tracking flights.

On a side note, the staff in Palmer are scheduled to start their Chinook escapement count flights next week (weather permitting). These are our annual helicopter flights on ~ 24 streams.

AEA has provided ADF&G additional funding to fly six of the streams (Willow, Little Willow, North Fork Kashwitna, Montana, Clear Creek, and Prairie Creek) three times so we can evaluate the variation/precision of the helicopter surveys.

Jack

From: Ivey, Samuel S (DFG) [mailto:samuel.ivey@alaska.gov]
Sent: Friday, July 13, 2012 8:57 AM
To: Cunningham, Erin E.; Piorkowski, Robert J (DFG)
Cc: Brady, James
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

I am OK with the requested additional samples and only request otolith for the lake trout if possible.

Thanks.

From: Cunningham, Erin E. [mailto:Erin.Cunningham@hdrinc.com]
Sent: Thursday, July 12, 2012 11:20 AM
To: Piorkowski, Robert J (DFG)
Cc: Brady, James; Ivey, Samuel S (DFG)
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Okay, great, will print this out and attach...

As far as the other issue goes, it was an add-on to this project (requested by AEA). James is actually looking into these details now, so we'll get back to you with additional information, either way.

Thanks again.

ERIN CUNNINGHAM | **HDR Alaska, Inc.**
Fisheries Biologist

2525 C Street, Suite 305 | Anchorage, AK 99503
907.644.2115
erin.cunningham@hdrinc.com| hdrinc.com

From: Piorkowski, Robert J (DFG) [mailto:robert.piorkowski@alaska.gov]
Sent: Thursday, July 12, 2012 11:10 AM
To: Cunningham, Erin E.
Cc: Brady, James; Ivey, Samuel S (DFG)
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)
Importance: High

Yo Erin,

There are now 20+ amendment requests and a similar number of FRP applications in front of yours so it will take awhile before I am formally able to write you an amendment.

As to the added sampling locations, please consider this email approval for sampling the additional sites. Print off this email and attach it to the permit.

As to the additional fish to be sampled, am I correct in assuming this is an add-on request from the contracting agency? Please confirm if so. If this is part of another project, it would be best to add you onto their permit via an amendment.

If the former, please send a page long write-up of the issue, background and methodology to be followed along with the lab that will be doing the work.

SAM—are you okay with the additional harvest of burbot and Lake trout? When lake trout are harvested in other areas the AMBs generally put strict sideboards on methodology used and the size taken along with a request for otoliths.

Thanks and cheers,

Bob Piorkowski, Ph. D.
Fish Resource Permit Program Coordinator
Alaska Department of Fish and Game-SF
Box 115526, 1255 W. 8th Street
Juneau, AK 99811-5526
(907) 465-6109 phone (907) 465-2772 fax
robert.piorkowski@alaska.gov

From: Cunningham, Erin E. [mailto:Erin.Cunningham@hdrinc.com]
Sent: Thursday, July 12, 2012 10:48 AM
To: Piorkowski, Robert J (DFG)
Cc: Brady, James
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Hi Bob,
Thanks again for your help.
I think we only need your response on two more items:

1. **Location**: Our study area will also include creeks within Devils Canyon, so the location should specify within as well as above Devils Canyon.
2. **Final Disposition**: Under the section specifying the number of fish that may be killed and sampled, we would like to add up to 10 Lake Trout and Burbot each. This is for tissue sampling used for metals analysis of species used for human consumption and species preyed upon by raptors and furbearers.

Thanks!
Erin C.

ERIN CUNNINGHAM | HDR Alaska, Inc.
Fisheries Biologist

2525 C Street, Suite 305 | Anchorage, AK 99503
907.644.2115
erin.cunningham@hdrinc.com| hdrinc.com

From: Brady, James
Sent: Monday, May 21, 2012 10:36 AM
To: 'Piorkowski, Robert J (DFG)'; Cunningham, Erin E.
Cc: Ivey, Samuel S (DFG); Lewis, Bert A (DFG); Bethe, Michael L (DFG); Daigneault, Michael J (DFG); DFG, FMPD Permit Coordinator (DFG sponsored); Boyle, Larry R (DFG); 'Betsy McGregor'
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Greetings Bob,
I have reviewed the FRP referenced above and have two additional requests/clarifications at this time.

3. **Location**: Our study area will include creeks within Devils Canyon, so the location should specify within as well as above Devils Canyon.
4. **Final Disposition**: Under the section specifying the number of fish that may be killed and sampled, we would like to add up to 10 Lake Trout and Burbot each. This is for tissue sampling used for metals analysis of species used for human consumption and species preyed upon by raptors and furbearers.

I also have a question about the reference to Appendix 1 under Department Sample Requirements... "(See Stipulation #13 and Appendix 1 for sampling details)". There was nothing labeled Appendix 1 on the permit. Is this a reference to the permit stipulations or something else.

Thanks!
James

James Brady
HDR Alaska
907-644-2011

From: Piorkowski, Robert J (DFG) [mailto:robert.piorkowski@alaska.gov]
Sent: Monday, May 14, 2012 2:01 PM
To: Brady, James; Cunningham, Erin E.
Cc: Ivey, Samuel S (DFG); Lewis, Bert A (DFG); Bethe, Michael L (DFG); Daigneault, Michael J (DFG); DFG, FMPD Permit Coordinator (DFG sponsored); Boyle, Larry R (DFG)
Subject: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Dear James:

Please find attached your ADF&G Fish Resource Permit (SF2012-151). You need to read this permit carefully not only to understand what you are authorized and required to do but also to check for mistakes that must be corrected immediately by contacting us. If your plans are modified later on (e.g. personnel changes, larger than expected collections, different sampling locations, etc), contact us as soon as you know so that an amendment to your permit can be prepared and issued in time to avert disruptions to planned field work. Failure to abide by permit requirements or to amend your permit when conditions change are permit violations that can result in a citation and/or loss of your permit.

Please be sure that you and all authorized personnel carry a copy of the permit while conducting collecting activities.

A report detailing all collections for this permit is due on or before January 31, 2013. Please use the ADF&G data submissions form for this task. If you do not have the opportunity to utilize your permit, please submit a letter or email stating that the permit was not used. A telephone message is not sufficient.

Please use the subject line in all future correspondence regarding this permit--thanks

Wishing you success with your project,

Bob Piorkowski

Bob Piorkowski-Ph.D.
Fish Resource Permit Program
(907) 465-6109
Robert.Piorkowski@alaska.gov

From: Cunningham, Erin E. [mailto:Erin.Cunningham@hdrinc.com]
Sent: Friday, July 13, 2012 3:06 PM
To: Betsy McGregor; Watana
Subject: Consultation Record: Agency coordination, HDR & ADF&G. FW: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

ERIN CUNNINGHAM | **HDR Alaska, Inc.**
Fisheries Biologist

2525 C Street, Suite 305 | Anchorage, AK 99503
907.644.2115
erin.cunningham@hdrinc.com| hdrinc.com

From: Cunningham, Erin E.
Sent: Thursday, July 12, 2012 9:27 PM
To: Habicht, Chris (DFG); Brady, James
Cc: Berger, Judy M (DFG); Barclay, Andy W (DFG)
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

thanks Chris - i really enjoyed talking to both you and judy earlier today - it was very helpful...

James Brady (here at HDR) is leading the adult salmon surveys. i spoke with him earlier and he is totally on board with keeping you guys in the loop in regards to our adult salmon surveys (and genetic sampling efforts) - sounds like he has already coordinated with Andy a bit but will be sure to include you all on his emails. i've included him on this email as well, just so we're all in the know. :)

so, stay tuned... and enjoy your summer as well!

(hopefully we get a little more sunshine before too long).

From: Habicht, Chris (DFG) [chris.habicht@alaska.gov]
Sent: Thursday, July 12, 2012 1:44 PM
To: Cunningham, Erin E.
Cc: Berger, Judy M (DFG); Barclay, Andy W (DFG)
Subject: RE: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Hi Erin,

Nice talking with you earlier today. I wish you luck collecting all the genetics samples above Devil's Canyon this year.

I've Cc'ed Judy and Andy on this email. Judy is our archivist and she can help you with sampling supplies. Andy runs all genetics projects within Cook Inlet and is specifically working on the Chinook salmon baseline. Please keep us all in the loop, especially with information for collecting Chinook salmon.

Thanks and have a great summer.

Chris.

From: Berger, Judy M (DFG)
Sent: Thursday, July 12, 2012 12:35 PM
To: Habicht, Chris (DFG)
Subject: FW: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

From: Cunningham, Erin E. [mailto:Erin.Cunningham@hdrinc.com]
Sent: Thursday, July 12, 2012 10:56 AM
To: Berger, Judy M (DFG)
Subject: FW: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Hi Judy,
Thanks for the chat. Now you have my email address so if you think of anything, feel free to shoot me an email. ☺
I'll let you know how our sampling goes upon my return...

ERIN CUNNINGHAM | **HDR Alaska, Inc.**
Fisheries Biologist

2525 C Street, Suite 305 | Anchorage, AK 99503
907.644.2115
erin.cunningham@hdrinc.com| hdrinc.com

From: Piorkowski, Robert J (DFG) [mailto:robert.piorkowski@alaska.gov]
Sent: Monday, May 14, 2012 2:01 PM
To: Brady, James; Cunningham, Erin E.
Cc: Ivey, Samuel S (DFG); Lewis, Bert A (DFG); Bethe, Michael L (DFG); Daigneault, Michael J (DFG); DFG, FMPD Permit Coordinator (DFG sponsored); Boyle, Larry R (DFG)
Subject: PERMIT: Fish Resource Permit SF2012-151 (Brady/HDR-Susitna River above Devil's Canyon-local Fish)

Dear James:

Please find attached your ADF&G Fish Resource Permit (SF2012-151). You need to read this permit carefully not only to understand what you are <u>authorized and required to do</u> but also to check for mistakes that must be corrected immediately by contacting us. If your plans are modified later on (e.g. personnel changes, larger than expected collections, different sampling locations, etc), contact us as soon as you know so that an amendment to your permit can be prepared and issued in time to avert disruptions to planned field work. Failure to abide by permit requirements or to amend your permit when conditions change are permit violations that can result in a citation and/or loss of your permit.

Please be sure that you and all authorized personnel carry a copy of the permit while conducting collecting activities.

A report detailing all collections for this permit is due on or before January 31, 2013. Please use the ADF&G data submissions form for this task. If you do not have the opportunity to utilize your permit, please submit a letter or email stating that the permit was not used. A telephone message is not sufficient.

Please use the subject line in all future correspondence regarding this permit--thanks

Wishing you success with your project,

Bob Piorkowski

Bob Piorkowski-Ph.D.
Fish Resource Permit Program
(907) 465-6109
Robert.Piorkowski@alaska.gov

8. WILDLIFE RESOURCES

8.1. Introduction

The Project area, including the Upper and Middle Susitna River subbasins, contains a diversity of wildlife and wildlife habitats that support game and non-game populations managed by the State of Alaska, primarily within Game Management Units (GMUs) 13A, 13B, 13E, 14A, 14B, 16A, and 16B. The purpose of the wildlife studies developed for the Susitna-Watana Hydroelectric Project are:

- To provide current wildlife baseline data for the Project area; and
- To provide current wildlife habitat availability and use data for habitat evaluation.

Information developed from the proposed studies will provide the basis for assessments of potential Project-related impacts; development of avoidance and protection measures; development of protection, mitigation, and enhancement measures; and development of resource management and monitoring plans.

Proposed studies are focused on wildlife and their habitats within the Project area that are important for human use, that are protected by federal and state laws, and that are potentially sensitive to Project-related activities and habitat changes.

8.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

Project construction, existence, and operation would result in five general classes of impacts on terrestrial wildlife:

- Permanent habitat loss;
- Temporary habitat loss and alteration;
- Barriers and hazards to animal movements;
- Disturbance; and
- Changes in recreational and hunting patterns (AEA 2011).

The potential Project-related impacts for wildlife are further described in the PAD (AEA 2011).

Mechanisms for Project-related impacts may include:

- Direct and indirect loss and alteration of wildlife habitats from Project construction and operation;
- Potential physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities and related indirect effects, including habitat connectivity and genetic isolation;
- Potential direct mortality due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches;

- Potential direct, indirect, and cumulative impacts on predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development;
- Potential direct behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development;
- Potential direct mortality due to vehicle strikes, exposure to contaminants, attraction to garbage and human activity, and protection of life and property; and
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development.

8.3. Resource Management Goals and Objectives

ADF&G is responsible for the game animal management, protection, maintenance, and improvement of Alaska's fish and game resources in the interest of the economy and general well-being of the state (AS 16.05.020). The mission of ADF&G is "to protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle." The guiding principles of ADF&G include providing "the greatest long-term opportunities for people to use and enjoy Alaska's fish, wildlife, and habitat resources," and maintaining "the highest standards of scientific integrity and providing the most accurate and current information possible" (ADF&G website: www.ADF&G.alaska.gov). Federal projects with potential impacts to wildlife are also subject to review under the Fish and Wildlife Coordination Act (16 U.S.C. § 661a *et seq*.) and where applicable to the Endangered Species Act (16 U.S.C. §1531).

ADF&G monitors populations and manages subsistence and sport hunting and trapping for game mammals (5 AAC 85.045 – moose; 5 AAC 85.025 – caribou; 5 AAC 85.055 – Dall's sheep; 5 AAC 85.015 and 85.020 – bears; 5 AAC 85.025 – wolf and wolverine; 5 AAC 85.065 – small game; 5 AAC 85.060 – fur animals;)) through regulations set by the Board of Game (AS 16.05.255). The Federal Subsistence Board, which comprises representatives from the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and U.S. Forest Service, oversees the Federal Subsistence Management Program (57 FR 22940; 36 CFR Parts 242.1–28; 50 CFR Parts 100.1–28) with responsibility for managing subsistence resources on Federal public lands for rural residents of Alaska.

Most of Game Management Unit (GMU) 13 (except Subunit 13D, south of the Glenn Highway), including the upper Susitna River basin, currently is managed by ADF&G under a predator control program instituted in response to the state's intensive management law, passed in 1994. Bears in GMU 13 are of interest both as predators of caribou (*Rangifer tarandus*) and moose (*Alces americanus*) and as important game species. GMU 13 is an intensive management area where predator control measures are implemented to increase caribou and moose populations. In GMU 13, predator control measures have included land-and-shoot harvest of wolves (*Canis lupus*) and liberalized regulations for the harvest of wolves and bears.

Eagles, raptors, and all migratory birds are protected by Federal laws and agreements, including the Bald and Golden Eagle Protection Act (BGEPA: 16 U.S.C. § 668) and the Migratory Bird Treaty Act (MBTA: 16 U.S.C. § 703), and a recent memorandum of understanding (MOU) concerning the implementation of Executive Order 13186 with regard to protection of migratory birds (FERC and USFWS 2011). That agreement was created to establish a voluntary framework to ensure that both agencies cooperate to conserve birds and their habitats by identifying and mitigating potential adverse effects resulting from the development of energy infrastructure. The MOU defines bird "species of concern" as those species—including several raptors—that are listed as sensitive or of conservation concern by various management agencies, agency working groups, and non-governmental conservation organizations (FERC and USFWS 2011; also see ABR, Inc. 2011 and AEA 2011).

The MBTA is enforced by the U.S. Fish and Wildlife Service (USFWS) and, in practice in Alaska, is used primarily to monitor and regulate waterfowl harvest; ensure that land-clearing activities occur outside of the bird nesting season to prevent destruction of bird nests; and to encourage development of appropriate avoidance and mitigation measures for federally regulated development projects and activities.

8.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Agencies, Alaskan Native entities, and other licensing participants were involved in developing wildlife study plans. During four terrestrial resources workgroup meetings, agencies and other entities gave input on needed wildlife studies and study methods. A meeting with U.S. Fish and Wildlife Service (USFWS) helped design the eagle and raptor survey. Comments regarding wildlife studies were received in letters from Alaska Department of Natural Resources (ADNR) Office of Project Management and Permitting (OPMP), Alaska Department of Fish and Game (ADF&G), Alaska Department of Environmental Conservation (ADEC), and the USFWS. A white paper from ADF&G and follow up emails detailed wildlife study needs. Table 8.4-1 summarizes wildlife study communications, and the meeting materials, letters, and other communications that are listed in Table 8.4-1 are presented in Attachment 8-1.

Table 8.4-1. Summary of consultation on Wildlife Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
White Paper	11/22/2011		ADF&G, Wildlife Conservation	Comments on Terrestrial Wildlife Research and Monitoring Needs
Email	12/20/2011	M. Burch	ADF&G	Comments on Terrestrial Wildlife Research and Monitoring Needs
Letter	01/12/2012	P. Bergman	USDOI	Comments regarding Bald and Golden eagles, migratory birds and consideration of BLM-Alaska Sensitive Animal and Plant Lists (Filed with FERC)
Terrestrial and Aquatic Resources Workgroup Meeting Notes	01/26/2012	Various	ADF&G, ADNR, BLM, FERC, NHI, NMFS, NPS, USFWS	Wildlife study plans (See Attachment 1-1.)
E-mail	02/02/2012	J. Klein	ADF&G	Recommend incorporating all fish and wildlife information into a user-friendly, GIS-related format
Letter	02/10/2012	A. Rappoport	USFWS	Comments on Eagle and Raptor Nest Study.
Cultural and Terrestrial Resources Workgroup Meeting Notes	02/28/2012	Various	ADF&G, ADHSS-HIA, ADNR, ADNR_OHA, BLM, EPA, FERC, NPS, USFWS	Wildlife study plans (See Attachment 1-1.)
Terrestrial Resources Workgroup Meeting Notes	04/02/2012	Various	ADF&G, BLM, NHI, NPS, USFWS	Wildlife study plans (See Attachment 1-1.)
Eagle/Raptor Technical Group Agency Meeting	04/11/2012	M. deZeeuw, J. Muir	USFWS	Eagle take permits under the Bald and Golden Eagle Protection Act (BGEPA) and 2012 study plan for surveys of eagles and other raptors
Study Requests, Letter	05/30/2012	T. Crafford, ADNR OPMP	ADNR, ADEC, ADF&G	Comments on wildlife study plans (Filed with FERC.)
Study Requests, Letter	05/31/2012	A. Rappoport	USFWS	Comments on wildlife study plans (Filed with FERC.)
Terrestrial Resources Workgroup Meeting Notes	06/06/2012	Various	ADF&G, Ahtna Native Corporation, BLM, ADNR OPMP, EPA, NHI, NPS, USFWS, Kenai Watershed Forum	Wildlife study plans (See Attachment 1-1.)
E-mail	06/12/2012	L. Verbrugge, PhD	USFWS	Study plan for wood frogs and chytrid fungus

8.5. Study of Distribution, Abundance, Productivity, and Survival of Moose

8.5.1. General Description of the Proposed Study

The moose study will be conducted by the ADF&G. The moose study was initiated in 2012 and will continue through 2013 and 2014. ADF&G will continue to survey and monitor radio-collared moose throughout the lifespan of the radiocollars that are deployed for the study (approximately 2016).

This study plan outlines the objectives and methods for characterizing moose movements, population, distribution, productivity, and habitat use in the study area through geospatial analysis. Aerial radiotelemetry surveys, via fixed-wing aircraft, will be used to monitor distribution, productivity, harvest potential, and habitat use of moose in the study area. In addition to radio collars, GPS/Argos satellite collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls. Winter surveys will be flown to assess potential loss of winter range in the inundation area. GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002, Kellie and DeLong 2006) and traditional count methods in portions of the study area will be used to generate population estimates. Browse surveys will be used to monitor habitat utilization of the inundation zone, transportation corridors, and areas downstream of the Project area.

8.5.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient population information to evaluate the potential effects of the Project on moose.

Specific study objectives include:

- Document the moose population and composition in the study area;
- Assess the relative importance of the habitat in the inundation zone, proposed transportation corridors, and the riparian area below the Project;
- Document the productivity and calf survival of moose using the study area;
- Document the level of late winter use of adults and calves in the proposed inundation area;
- Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project;
- Assess the relative importance of the habitat in the inundation zone and proposed transportation corridors to moose;
- Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement; and
- Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 moose study (AEA 2012).

8.5.2. Existing Information and Need for Additional Information

Moose studies during the early 1980s for the original APA Susitna Hydroelectric Project proposal were comprehensive and annual monitoring of moose populations in the general area has been conducted by ADF&G, but more recent data specific to this Project are needed to accurately characterize the current moose population size, distribution, and habitat use. New information is also needed to assess current issues pertaining to human use of the population in the Project region.

For management purposes, moose in Game Management Unit (GMU) 13 are monitored annually using aerial trend count surveys. Within GMU 13A, B, and E, a total of four continuous count areas (CAs) are surveyed annually (CA3, 5, 6, 13, and 14; Figure 8.5-1); additional areas are surveyed periodically. These surveys provide managers with population composition and general trend data, and have been used in this area successfully since the 1950s.

Additional areas, such as CA7 which includes Watana Creek in GMU 13E, are not surveyed regularly. CA7 was surveyed annually between 1980 and 1986, (776-1284 moose observed; 0.9-1.5 moose per square mile). The most recent aerial trend count survey in this area was conducted in 2001 (776 moose observed; 0.9 moose per square mile). An intensive population survey was also conducted in spring 2012, a year of heavy snowfall. A total of 441 moose (60 calves and 381 adults) were observed on 277.65 square miles for a density estimate of 1.59 moose per square mile. The estimated density will likely increase after the estimate is adjusted for sightability (R. Schwanke, 2012, pers. comm. 6/22/12). An additional intensive population survey will be conducted of the area downstream from the proposed dam location.

Changes in hunter access due to the proposed Project will be evaluated. Hunter demand for moose in GMU 13 is very strong and continues to grow. Due to this trend and with implementation of moose population composition objectives in the early 1990s, the GMU 13 moose population composition has been closely monitored to maintain a sustainable harvest and high hunter satisfaction rates. Existing annual monitoring efforts for moose in GMU 13A and 13E address abundance, distribution, and recruitment for the purposes of assessing annual moose population trends and related harvest regulatory strategies. These data, however, are insufficient to accurately address potential Project-related impacts, or to identify potential mitigation measures for moose. Data collected through standard Very High Frequency (VHF) radio-telemetry, satellite-linked GPS telemetry, and aerial surveys of population composition, density, and calf production will document currently used areas, as well as provide data on the timing and duration of seasonal range use and the proportion of the regional moose population that uses the Project area. Previous habitat evaluations were based on vegetation cover types that were mapped within 16 kilometers (10 mile) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). However, that vegetation mapping was conducted over 30 years ago.

Both the vegetation mapping and the habitat evaluation will be updated during Project studies (see Sections 8.19 and 9.5, respectively). The wildlife habitat evaluations completed in the early 1980s were based largely on vegetation types. This study will go beyond vegetation mapping to document the habitat utilized by moose, and the actual biomass removed by browsing. Moose locations derived from this study can be used to develop a stratified sampling design (Paragi et al. 2008) and to identify habitats that may be suitable for treatment to enhance habitat for moose and other early successional species.

The information developed will be used to inform development of appropriate protection, mitigation, and enhancement measures for the Project in support of ADF&G management objectives for moose in GMU 13.

8.5.3. Study Area

The moose study will reflect the relative use of the Project area by moose (Figure 8.5-1). The study area will include the majority of GMU 13E east of the Parks Highway and the Alaska Railroad from the Denali Highway south to upper Chunilna Creek. The study area will also include a small portion of northwest GMU 13A from Kosina Creek east to the Oshetna River drainage. This area encompasses the impoundment, access and transmission corridors, and associated Project infrastructure. To assess the relative use of these primary focus areas, the study area must be somewhat larger to fully evaluate the seasonal habitat preferences of moose likely to use the focus areas.

8.5.4. Study Methods

8.5.4.1. Moose Movements, Productivity and Survival

To assess moose movements in the Project area, as well as productivity and survival, a sample of cow and bull moose will be radio collared. Additionally, GPS/Argos satellite collars will be deployed on bulls and cows to detect fine-scale movements for both sexes.

Moose will be captured and collared in late March and November-December depending on various factors including the physical condition of moose and hunting seasons. Radio collars are expected to function for 5 to 7 years, whereas GPS collars have a 2-year lifespan. If greater than expected collar malfunctions or hunting losses occur, additional captures/collar replacement outside the outlined schedule may be required to maintain a sufficiently large sample size.

In October 2012, approximately 30 radio collars will be deployed, 20 on cows and 10 on bulls. At the same time, approximately 20 GPS collars will be deployed; 13 on cows and 7 on bulls.

Another 30 radio collars will be deployed in March 2013, 20 on cows and 10 on bulls, as well as an additional 20 GPS collars, 13 on cows and 7 on bulls. The two separate capture periods will help address the spatial variability of a migratory moose population, as well as potential loss of collared animals during the hunting season. GPS collars will be removed in November 2014 and/or March 2015.

The sample size of 60 radio-collared moose with a 2 cow to 1 bull ratio is expected to adequately record movements and productivity of moose in the study area and to evaluate the relative importance of the Project area in terms of available habitat throughout the year.

Monthly aerial radiotelemetry surveys via fixed-wing aircraft will be conducted within the study area to document the distribution of radio-collared moose. During the critical spring calving (May 10–June 15) and fall hunting seasons (September 1-20), aerial surveys will be conducted weekly to more precisely document the distribution of moose within the study area. Additionally, to accurately document productivity and associated calf loss, surveys will be conducted daily during peak calving (May 15–31). Fixed-wing PA-18 aircraft will be used for these radiotracking flights.

Fine-scale movements will be monitored with the 40 GPS collars deployed on 26 cows and 14 bulls. Due to the relatively consistent annual moose habitat use and movement patterns, the relatively short 2-year lifespan of GPS collars should be sufficient for documenting fine scale movements of moose in this area. Considering that the Project area is used year round by moose, gathering daily locations with the use of GPS collars is the only way to ensure that habitat use and travel patterns, particularly during calving, hunting season, and the rut for both sexes are accurately identified.

GPS locations of collared moose will be used to evaluate spatial distribution and movements of cows and bulls. Location, date, reproduction, and survival status will be documented for each moose located during scheduled radiotelemetry flights. Data analysis and visual representation of data will be accomplished using ArcGIS software.

8.5.4.2. Population Monitoring

Moose populations will be evaluated using three survey techniques. Conventional survey methods pertaining to optimal snow conditions, daylight, flight patterns, etc., (Ballard and Whitman 1988) will be used for all surveys to maximize survey precision, maintain consistency between surveys, and facilitate comparisons to existing datasets. To assess winter use of the inundation area, an ADF&G pilot-observer team flew the area of inundation in late winter (March 20–22) of 2012 and will do so again in 2013. Due to antler drop, it will not be possible to distinguish cows from bulls during late winter surveys, but numbers of calves and adults will be reported.

Intensive population estimates utilize GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002, Kellie and DeLong 2006) or the Gasaway Population Estimator. The timing of population estimates will depend on survey conditions, logistical concerns, and potential scheduling conflicts with other concurrent moose surveys. The preferred approach is to estimate moose populations above and below the proposed dam within the study area during one GSPE sampling event. A total of 200 or more randomly selected 6-square mile sample units will be surveyed. If this approach proves not feasible, then two separate GSPE surveys will be conducted sampling about 150 sampling units in each area above and below the dam (300 total units). If the latter approach becomes necessary, surveys conducted above and below the dam will likely occur in different years. Sample units will be flown at a high search intensity (>6.5 minutes per square mile). Counts may be corrected for sightability using established methods.

Previously established trend count Areas CA7 and CA14 will be surveyed in November of 2012, 2013, and 2014.

8.5.4.3. Moose Browse Survey and Habitat Assessment

To estimate the proportion of browse biomass removed by moose, we will employ methods developed by Seaton (2002) and described by Seaton et al. (2011) and Paragi et al. (2008). Current annual growth (CAG) of important browse species such as willow (*Salix* spp.), aspen and balsam poplar (*Populus* spp.), and Alaskan birch (*Betula neoalaskana*) will be estimated. Only plants with CAG between 0.5 meters and 3 meters will be sampled. Three plants per species at each sample plot will be selected and 10 twigs on each plant will be measured. The diameter at the base of CAG (or the point where twig is browsed, if older than last annulus) and the diameter at the point of browsing will be noted. Duration of sampling will be 8 to 10 days each year to occur in March 2013 and 2014. Sampling must occur after most of the winter browse activity has occurred but before spring green up. Small helicopters will be used to access study plots. The browse study will be conducted for two years to account for annual variation in snow depth and other conditions.

The seasonal use and importance of the inundation zone and transportation corridors will be quantified primarily by analysis of radio and satellite tracking data to determine moose movements and habitat preferences. Browse utilization surveys will further refine the relative importance of habitat within the study area by documenting the impact of moose on vegetation. Browse utilization surveys will cover available habitat above and below the dam within the extent of the GSPE survey grid. Vegetation and other studies conducted in association with the Project licensing process will be used to identify areas where potential habitat improvement may occur to mitigate for the loss of habitat in the Project area.

8.5.4.4. Impact Assessment

The primary impacts of Project construction and operation, as described in the Pre-application Document (PAD, AEA 2011), are moose habitat loss and alteration, blockage of movements, and increased mortality due to subsistence and recreational harvest facilitated by improved hunter access along transmission and access corridors. Data on the population, distribution, productivity, and habitat use of moose in the study area will be used to assess Project impacts. Location data, population data, and browse intensity data can be plotted on the wildlife habitat map that will be developed under the botanical resources study plans (see Sections 9.5, 9.6 and 9.7) to identify important moose habitats or to provide quantitative or semi-quantitative estimates of habitat value. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission corridors, and related Project infrastructure onto the habitat map and evaluating the loss of important moose habitats. Indirect habitat loss and alteration and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on moose. By incorporating population data from the various surveys into the analysis, the number of animals affected can be estimated. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on moose populations. The concurrent investigation of riparian habitats downstream of the dam site will provide additional data with which to assess impacts on moose, establishing baseline conditions and modeling riparian succession in areas in which habitat or browse availability may be affected by altered flow regimes. Harvest data collected by the ADF&G will be used to establish baseline harvest levels and to monitor increased harvest that may result from improved access. Data on the movements of radiocollared moose can be used to assess potential blockage of movements in the inundation area. Any necessary PM&E measures will be developed by examining the seasonal distribution and abundance of moose among habitats in relation to the geographic extent and seasonal timing of various Project activities.

8.5.5. Consistency with Generally Accepted Scientific Practice

Moose movement patterns and productivity and survival in the Project area will be studied by marking animals with radio and GPS satellite collars. The combination of these two collar types will provide both broad-scale and local-scale information on movement patterns in the Project area. These data will be necessary to evaluate broad (seasonal) movements and more local-scale movements within those areas expected to be affected by Project development. The use of these two collar types represents a robust approach to collecting data on moose movement patterns, productivity, and survival that are in widespread in Alaska and elsewhere. The outlined sample sizes should be more than sufficient for an accurate and precise representation of moose distribution, movements, and productivity within the study area.

The capture methods employed in this study will be standard capture, handling and monitoring techniques for moose (Schmitt and Dalton 1987). Helicopters and chemical immobilization techniques will be utilized for moose captures. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the State of Alaska for animal capture and monitoring are in-hand.

Moose population monitoring will be conducted by intensively surveying randomly located plots and extrapolating those data to the study area, a technique that is widely used in Alaska and is the appropriate sampling design for determining population levels of ungulates that are widely dispersed across the landscape (Ver Hoef 2002, Kellie and DeLong 2006).

Moose browse will be studied using methods developed by ADF&G for studies in Interior Alaska to estimate the proportion of browse biomass removed (Paragi et al. 2008, Seaton et al. 2011). These are currently thought to be the most appropriate methods for quantifying moose browse in Alaska.

8.5.6. Schedule

This is a multi-year study that was initiated in 2012. ADF&G will continue to survey and monitor radio-collared moose throughout the collar lifespan (approximately 2016) and will produce a final technical summary report. However, the three years of study information culminated in the Revised Study Report is expected to be sufficient to provide enough information to assess potential impacts of the Project on Moose.

<u>2012:</u>

October	Deploy initial radio and satellite collars and monitor at least monthly.

<u>2013:</u>

March	Deploy remaining radio and satellite collars and monitor at least monthly. Conduct adult/calf population survey of inundation zone and adjacent habitat. Conduct winter browse utilization assessment
May 10 to June 15	Monitor radio collars weekly (daily monitoring May 15 – 31)
September 1 - 20	Monitor radio collars weekly
November	Conduct post-rut aggregation composition surveys in CA7 and CA14 and follow up with GSPE for area below dam
December	Initial Study Report

<u>2014:</u>

March	Conduct winter browse utilization assessment
May 10 to June 15	Monitor radio collars weekly (daily monitoring May 15 – 31)
September 1 - 20	Monitor radio collars weekly

November	Conduct post-rut aggregation composition surveys in CA7 and CA14 Remove satellite collars
December	Updated Study Report
<u>2015:</u>	
March	Remove remaining satellite collars

8.5.7. Level of Effort and Cost

This multi-year study is estimated to cost $750,000.

8.5.8. Literature Cited

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8.5.9. Figures

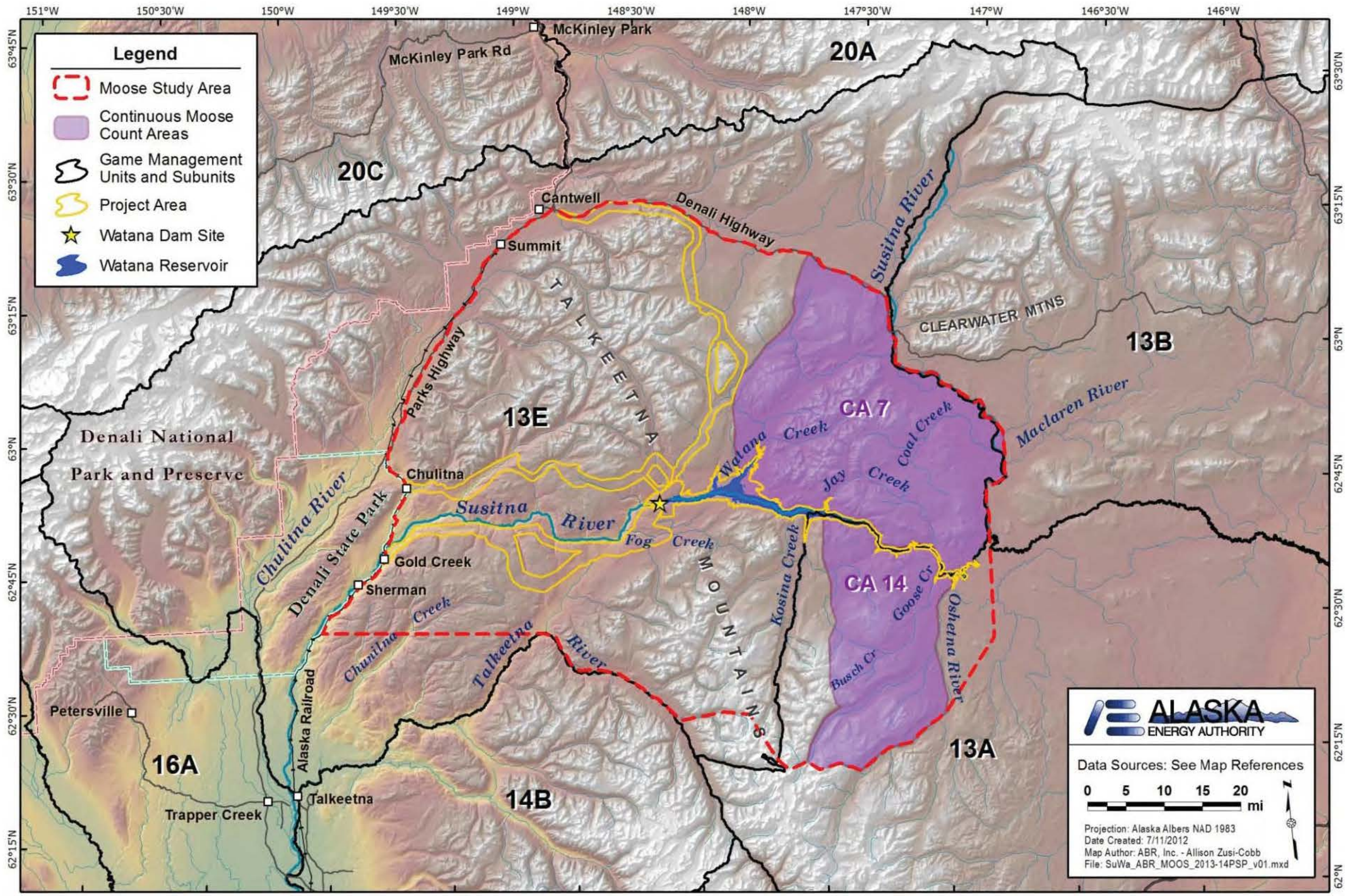

Figure 8.5-1. Moose study area.

8.6. Study of Distribution, Abundance, Movements, and Productivity of Caribou

8.6.1. General Description of the Proposed Study

This study plan outlines the objectives and methods for characterizing caribou movements, population, distribution, productivity, calf survival, group size, and density in the Project area through geospatial analysis. Aerial radiotelemetry surveys via fixed-wing aircraft will be utilized to monitor seasonal use and distribution in the study area, including characterization of calving areas, rutting areas, wintering areas, and migration/movement corridors within the study area. In addition to radio collars, GPS/Argos satellite collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls.

This is a multi-year study that is being completed by ADF&G. ADF&G initiated a caribou movement study in 2012. This study supplements ADF&G's ongoing caribou research in the region by increasing the sample size of radio-collared cows and radiocollaring bulls in both the Nelchina and Delta caribou herds to more fully delineate the seasonal movements and range use of each herd. Radio collars will be deployed in October 2012 and will be monitored for the remainder of this study. Satellite collars deployed in October 2012 will be removed in October 2014.

8.6.1.1. Study Goals and Objectives

The goal of this study is to obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors.

Four specific objectives have been identified:

- Document seasonal use of, and movement through, the Project area, as defined in Section 8.6.3) by both females and males of the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH);
- Assess the relative importance of the Project area to both the NCH and DCH;
- Document productivity and calf survival of caribou using the Project area; and
- Analyze data from historical caribou studies and synthesize with recent data for the NCH and DCH as a continuation of the caribou task of 2012 study W-S1 (AEA 2012).

8.6.2. Existing Information and Need for Additional Information

The current population objective for the NCH was established to ensure consistently high sustainable harvest levels for Alaskan hunters (Tobey and Schwanke 2009). ADF&G's management objectives for the NCH in GMU 13 and GMU subunit 14B are to maintain a fall population of 35,000 to 40,000 caribou, with minimum ratios of 40 bulls to100 cows and 40 calves to100 cows; and to provide for an annual harvest of 3,000 to 6,000 caribou (Tobey and Schwanke 2009). ADF&G's management objectives for the DCH in GMU 20A are to maintain a bull:cow ratio of greater than or equal to 30 bulls to100 cows and a large bull:cow ratio of greater than or equal to 6 large bulls to 100 cows; reverse the decline of the herd and increase the midsummer population to 5,000–7,000 caribou; and sustain an annual harvest of 300 to 700 caribou (Seaton 2009).

The caribou study for the original APA Susitna Hydroelectric Project began in 1980 and continued through 1985. The objectives of the study were to determine the population status of the NCH, delineate subherds; and identify range use, movement patterns, migration routes, and migration timing (ABR 2011). Three resident subherds were identified and the proposed reservoir was found to intersect migration routes used by pregnant cows moving to calving grounds during late April and May and cows and calves moving to summer range during late June and July (Pitcher 1982). Current caribou use of the Project area is complicated by range expansion and mixing of DCH with the NCH (Seaton 2009).

Caribou range use and movement studies during the early 1980s for the APA Susitna Hydroelectric Project are insufficient to accurately characterize current caribou use of the Project area. The NCH is a moderately large herd with 40,233 caribou in 2011 (ADF&G, unpublished data); whereas the DCH is much smaller with 2,985 caribou in 2007 (Seaton 2009). Since 1985, the number of NCH caribou has increased significantly. Both the NCH and the DCH use portions of the Project area extensively. A related change has been increased use of summer and winter range in the northwestern portion of the NCH range in subunit 13E, northwest of the Project location. Because the NCH continues to calve in the eastern Talkeetna Mountains in GMU 13A, south of the Project location, changes in summer and winter range could mean more caribou will cross through the greater Project area during seasonal migrations to and from the calving grounds.

Current annual monitoring efforts for the NCH and DCH by ADF&G identify general herd distribution, productivity, and annual survival for the purpose of assessing annual herd trends and related harvest strategies. These data are insufficient, however, to assess the potential Project-related impacts or to identify potential mitigation measures for caribou in the Project area. Mixing of the two caribou herds since the mid-1990s in the northern portion of the Project area between the Susitna River and Butte Lake has been a more recent development that adds a level of complexity to range use and importance for the two herds (Seaton 2009). In addition, established vegetation exclosures in the NCH range can be used to monitor abundance of lichens in an ungrazed area for assessment of range conditions.

Documentation of currently used areas, along with information on timing, duration, and proportion of the regional population that uses those areas, can be used to develop any necessary avoidance, minimization, and mitigation measures, including seasonal and access restrictions. This information will also be useful in preventing inadvertent disturbance from unrelated field studies for the Project.

8.6.3. Study Area

The caribou study area will reflect use of the Project area by the NCH and the DCH. The study area will include the majority of GMU 13E east of and including Broad Pass (Figure 8.6-1). The area will also include drainages into the Upper Susitna River in GMU 13B, as well as a small portion of northwest GMU 13A from Kosina Creek east to the Oshetna River. This area encompasses the reservoir impoundment zone, associated infrastructure, and potential access and transmission-line routes from the west and the north. Downstream areas in the middle Susitna River basin that could be affected by changes in stream flows, temperatures, and ice conditions that could alter conditions for river crossings traditionally used by caribou will also be included. To assess the relative use of these primary focus areas, the study area must be somewhat larger based on the history of caribou movements in this area to fully evaluate habitat preferences and migration routes of caribou.

8.6.4. Study Methods

ADF&G initiated a caribou movement study in 2012. This study supplements ADF&G's ongoing caribou research in the region by increasing the sample size of radio-collared cows and radiocollaring bulls in both herds to more fully delineate the seasonal movements and range use of each herd. In addition, Argos satellite-linked GPS collars will be deployed on bulls and cows to detect fine-scale movements for both herds. Some captures will occur in the month of April to target caribou overwintering in the Project area, with additional captures occurring in October to target migratory caribou.

Due to limited battery life, the GPS collars will need to be removed after 2 years, refurbished, and redeployed to gather enough data to adequately describe movements and range utilization and incorporate annual differences. GPS collars will be removed at the end of the study to ensure that all data stored onboard the collars is retrieved. Radio collars will be deployed with the expectation that they will remain on the animals.

Radio collars will be deployed in October 2012 and will be monitored for the remainder of this study. Satellite collars deployed in October 2012 will be removed in October 2014. Collar failures are not anticipated, although a small percentage may malfunction, requiring capture and replacement outside of the schedule outlined.

All existing NCH and DCH radio-collared caribou will be monitored within the greater project area monthly via aerial radio-telemetry. During critical spring and fall crossing periods, as well as calving, additional weekly flights will occur.

No net loss is expected to occur for existing herd monitoring programs. For those caribou currently radio-collared, if radio collars are replaced with GPS collars for purposes of this project, new or refurbished radio collars will need to be re-deployed on each of these animals at the end of the project.

To adequately address seasonal movements and range use by bull caribou, 10 radio collars have been deployed on NCH bulls, and 5 on DCH bulls, supplementing approximately 80 existing radio collars on NCH cows, and 40 existing radio collars on DCH cows. An additional 10 radio collars will be deployed on NCH bulls and 5 on DCH bulls in October 2012 as part of this project. The female segment represents the reproductive portion of the herd, as well as the leading edge of seasonal movements, supporting the higher number of collars for cows.

Radio-collared caribou must be located via fixed-wing aircraft. Monthly aerial radiotelemetry flights will provide general documentation of herd distribution and the extent of herd mixing in the greater project area. Additional weekly flights during spring and fall migrations will result in more precise documentation of use of the greater project area by both herds. The large sample of radio-collared caribou is necessary to fully evaluate the relative importance of the greater Project area in terms of available herd ranges and potential movement corridors. The outlined sample sizes should be sufficient for an accurate representation of herd-wide movement patterns and range use.

To address fine-scale movements—both temporally and geographically—a total of 60 GPS collars will be deployed (40-45 on NCH animals and 15-20 on DCH animals). Up to 70 percent of the GPS collars will be deployed on cows. Considering that the proposed impoundment area is primarily used during herd migration, gathering daily locations with the use of GPS collars is the only way to ensure that travel corridors and travel patterns are identified. Small piston-powered (Robinson R-44) helicopters and chemical immobilization techniques will be used for caribou captures and fixed-wing aircraft (Piper PA-18) will be used for radio-tracking flights.

Locations collected from satellite and GPS collars will be used to evaluate spatial distribution and movements of cows and bulls from each herd. Additional locations, reproduction, survival status, and group size will be documented for each caribou located during scheduled radio-tracking flights.

Data analysis and visual representation of data will be accomplished using a geographic information system running ArcGIS software. Population estimates based on existing data will be calculated consistent with the method used to collect the data. Density estimates will be calculated at a spatial resolution suitable to evaluate potential habitat loss and alteration from the Project. Telemetry data will be used to delineate seasonal ranges and movement corridors using techniques such as kernel density estimates (Seaman and Powell 1996) and Brownian bridge (or similar) movement model techniques (Horne et al. 2007, Sawyer et al. 2009), depending on the volume and suitability of the data for use with these techniques.

8.6.4.1. Impact Assessment

The primary impacts of the Project on caribou are likely to be from direct and indirect habitat loss and alteration, and blockage of movement corridors for portions of the range of both the NCH and the DCH. Other potential impacts include changes in mortality rates that may result from increased subsistence or recreational harvest facilitated by improved access or from changes in predator populations, and mortality from collisions with vehicles or unstable ice conditions in the impoundment. Data on the distribution, abundance, productivity, and habitat use of caribou in the study area will be used to assess Project impacts. Location data will be used to identify movement corridors. Location and abundance data can be plotted on the wildlife habitat map that will be developed under the botanical resources study plan (see Sections 9.5, 9.6, and 9.7) to identify important caribou habitats. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission facility “footprints”, and related proposed Project infrastructure onto the habitat map and evaluating the loss of important caribou habitats. Indirect habitat loss and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on caribou. Similarly, movement corridors can be compared to Project features to assess the extent to which movements and distribution may be affected. ADF&G harvest data will be used to establish baseline harvest levels and to monitor changes in harvest that may result from improved access. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on caribou populations.

8.6.5. Consistency with Generally Accepted Scientific Practices

ADF&G is the primary agency responsible for monitoring caribou populations in Alaska. The techniques used to capture, collar, and track caribou in this study have been developed by ADF&G through decades of experience working with big game species in Alaska. The methods employed in this study will consist of standard capture, handling, and monitoring techniques for cow caribou (Adams et al. 1987). In recent years, these techniques also have been used for bull caribou. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the state of Alaska for animal capture and monitoring are in-hand.

Caribou data will be analyzed according to commonly accepted statistical techniques. Spatial statistics will be conducted with commonly accepted techniques such as fixed-kernel density estimation with least-squares cross validation or plug-in bandwidth selection (Seaman and Powell 1996, Gitzen et al. 2006).

8.6.6. Schedule

This is a multi-year study that was initiated in 2012. The following schedule is for 2013-2014 activities.

2013:

January	Monitor collars deployed in 2012 at least monthly throughout study.
May/June and August/September	Monitor radio collars weekly
December	Initial Study Report

2014:

April	Remove satellite collars deployed in Apr 2012
May/June and August/September	Monitor radio collars weekly
October	Redeploy satellite collars removed in Apr 2014, remove satellite collars deployed in Oct 2012
December	Updated Study Report

8.6.7. Level of Effort and Cost

This is a multi-year study that is being completed by ADF&G. The approximate cost of the study through 2014 is $610,000.

8.6.8. Literature Cited

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8.6.9. Figures

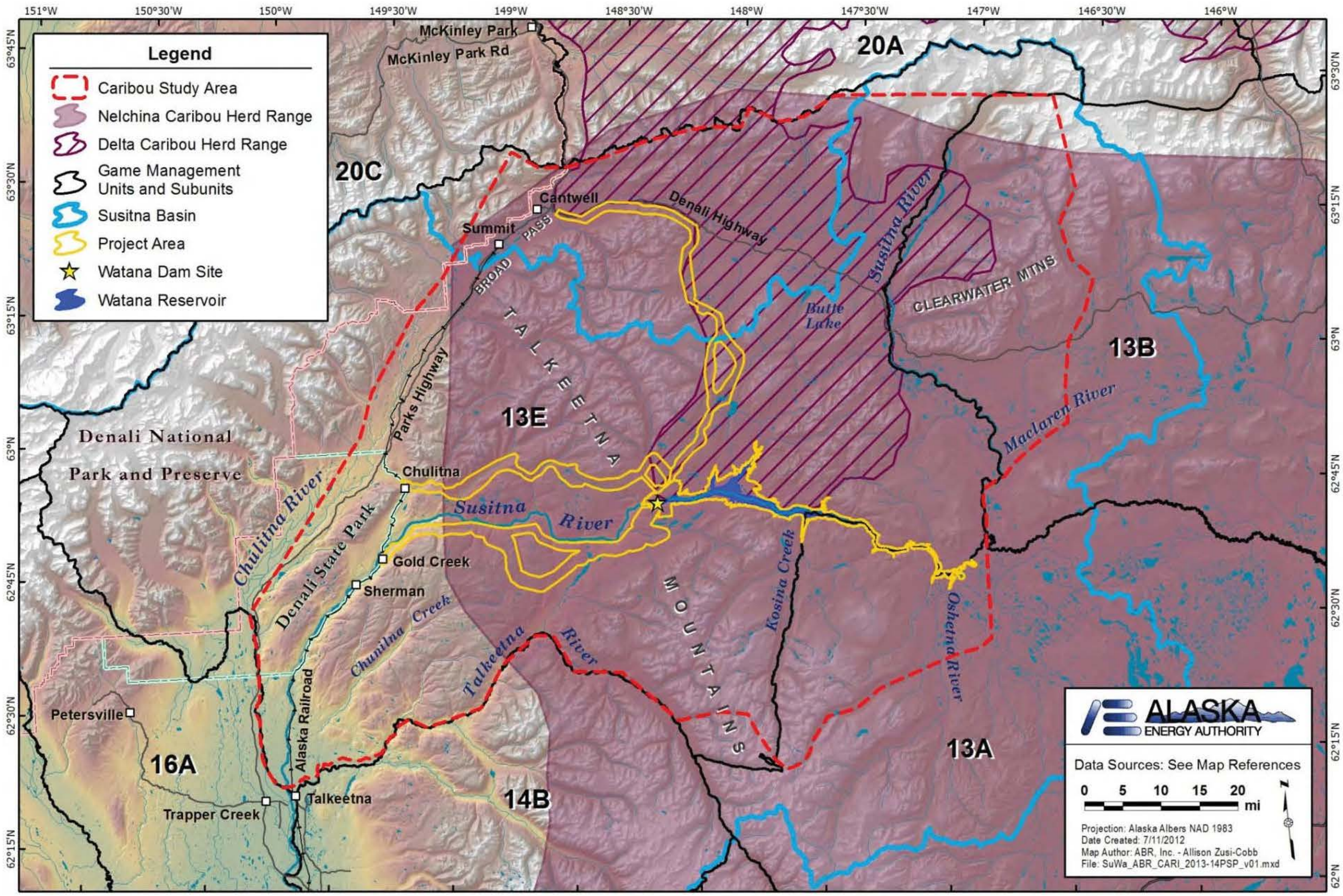

Figure 8.6-1. Study area for caribou.

8.7. Study of Distribution, Abundance, and Habitat Use of Dall's Sheep

8.7.1. General Description of the Proposed Study

The Dall's sheep study will be conducted for two years in 2013 and 2014. The study is designed to evaluate how many sheep use the Project area, where they are distributed, what habitats they occupy, and whether mineral licks in the Project area receive high levels of seasonal use by sheep.

8.7.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient information on the population, distribution, and use of mineral licks by Dall's sheep (*Ovis dalli*), an important species of big game in the Project area, to use in evaluating potential Project-related effects and identifying measures to avoid, minimize, or otherwise mitigate those effects.

Four primary objectives have been identified for this study:

- Estimate the current population size of Dall's sheep in the Project area;
- Delineate the summer range of Dall's sheep in the Project area;
- Evaluate the current condition and use of mineral licks in the Project area; and
- Analyze and synthesize data from historical and current studies of Dall's sheep in the greater Project area as a continuation of the 2012 study (AEA 2012).

Data collected through aerial surveys and ground-based monitoring of sheep habitat will document currently used areas for use in developing any necessary protection, mitigation, and enhancement measures.

8.7.2. Existing Information and Need for Additional Information

Dall's sheep were studied in the region during the early 1980s. Aerial surveys of the Watana Creek Hills counted 130–220 animals (Tankersley 1984). Later surveys of the Watana Hills counted 97 and 50 sheep (Peltier 2008). The sheep population in the larger management area has declined overall following a steep decline after the winter of 1999–2000 and additional declines during 2004–2007 (Peltier 2008). No sheep use of areas on Mount Watana (directly south of the proposed Watana impoundment) or near the Denali Highway access corridor was documented in the 1980s (Tankersley 1984).

During the 1980s research, mineral licks were identified on lower Jay Creek and upper Watana Creek (Tankersley 1984). Sheep used those licks mainly between mid-May and mid-June and at least 31 percent of the sheep population observed in the Watana Creek Hills in 1983 traveled 8 kilometers or more to the Jay Creek lick. The Watana reservoir proposed in the 1980s would not have inundated the Jay Creek lick at a normal maximum operating level of 2185 feet but may have resulted in the loss of lower areas of the Jay Creek lick and associated resting areas due to accelerated erosion, and may have inhibited sheep travel along and across Jay Creek (Tankersley 1984).

The management objectives for the Talkeetna Mountains and Chulitna–Watana Hills in Game Management Unit (GMU) Subunits 13A, 13E, 14A, and 14B are to maintain sheep populations that will sustain an annual harvest of 75 rams (Peltier 2008). This study only addresses sheep populations within portions of GMU 13A and 13E.

The Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, wildlife disturbance, and changes in human activity due to construction and operation.

New information is needed for a current enumeration of sheep abundance in the greater Project area, primarily in the Watana Creek Hills, and to evaluate the current extent of seasonal use of the Jay Creek and Watana Creek mineral licks by sheep. The primary concerns for Dall's sheep are alteration of movement patterns, changes in the use of nearby mineral licks, disturbance, and changes in harvest patterns due to increased human access. Current data on distribution, population size, and use of the Jay Creek and Watana Creek mineral licks will be important for assessing potential impacts on the local sheep population and developing any protection, mitigation and enhancement measures if necessary.

8.7.3. Study Area

The study area lies within GMU Subunits 13E and 13A, which encompasses the Project facilities, potential access and transmission-line corridors, and the inundation zone for the reservoir(Figure 8.7-1). Surveys also will be conducted in the Watana Creek Hills and other Dall's sheep habitat adjacent to the inundation zone.

8.7.4. Study Methods

The proposed Dall's sheep study would consist of three components:

- Aerial survey for summer distribution and minimum population estimation;
- Ground monitoring and photographic monitoring of mineral lick use; and
- Analysis of historical (1980s) data and synthesis with current ADF&G monitoring results.

Aerial distribution and population estimate surveys can be conducted for sheep habitat in the greater Project area following ADF&G protocols in summer after lambing (late June-early July). Ground-based surveys of the Jay Creek and Watana Creek mineral licks will be conducted by observers using spotting scopes in the mid-May to mid-June period when lick use is generally at its peak. Time-lapse cameras will also be placed at strategic locations to record the number of sheep using both licks. Results will be compared with those from ground-based surveys of mineral licks conducted in the 1980s (Tankersley 1984). The use of wildlife monitoring cameras will substantially enhance the volume of data that can be collected at a relatively low cost.

Analysis of time-lapse camera images will include enumeration of the number of sheep (including lambs) visible by date and time of day; if image quality allows, other data on sex and age composition will be recorded. Conducting surveys in both 2013 and 2014 will provide information on annual variability, and the 2013 effort will be used to modify the 2014 field effort, if necessary.

8.7.4.1. Impact Analysis

The primary type of impact mechanisms resulting from of Project construction and operation on Dall's sheep likely include:

- Direct loss and alteration of Dall's sheep habitats, including key habitat features such as mineral licks, from Project construction and operation;
- Blockage or alteration of movements and changes in distribution due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities;
- Mortality of Dall's sheep due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches;
- Changes in mortality that may result from altered abundance and distribution of sheep predators due to increased human activities and habitat changes resulting from Project development; and
- Mortality of Dall's sheep from increased subsistence and recreational harvest.

Data on the distribution and abundance of Dall's sheep and their use of mineral licks in the study area will be used to assess Project impacts through geospatial analysis, evaluation of the responses of the Dall's sheep to other similar projects, as documented in the scientific literature, and an examination of the current physical characteristics of the Jay Creek and Watana Creek mineral licks. Direct habitat loss caused by the Project can be evaluated by overlaying the impoundment, access and transmission corridors, and related infrastructure (including any predicted changes around the two mineral licks) and the summer sheep ranges delineated from aerial surveys onto the Project wildlife habitat map. Similarly, buffer zones can be delineated around the Project footprint, as determined from the available information on the expected effects, to estimate indirect impacts. Population data can be incorporated into the geospatial analysis to estimate the number of sheep that may be affected. The GIS analysis can be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on sheep. Harvest data from ADF&G and population data from aerial surveys will provide a baseline with which to assess changes in mortality rates that may result from increased harvest, lake ice conditions, increased predation, or altered access to important habitats. Information from other studies also will be pertinent to assessment of potential Project impacts on Dall's sheep, in particular the large predator studies (Section 8.8) and harvest analysis (Section 8.20).

8.7.5. Consistency with Generally Accepted Scientific Practice

Aerial surveys will provide the best indication of the minimum population of sheep in the Project area and therefore potentially impacted by the Project. These surveys will be conducted using the methods used by ADF&G for sheep in GMU 13. Monitoring the Jay Creek and Watana Creek mineral licks with a combination of ground-based observations and time-lapse photography will provide a cost-effective method of collecting data on the seasonal timing and number of sheep using the licks during the summer. Data will be analyzed in accordance with commonly accepted statistical techniques for wildlife studies.

8.7.6. Schedule

Aerial surveys of the Dall's sheep population in the study area will be conducted in June–July of 2013 and 2014. Time-lapse cameras will be deployed at mineral licks in early May and cameras will be removed in August in both 2013 and 2014. Periodic ground observations of the mineral licks will be conducted during the mid-May to mid-June period in both years. Data analysis, analysis of photographs, QA/QC, and reporting will be conducted after camera retrieval each year.

2013:

- Aerial Surveys: one week during June/July
- Mineral Lick Surveys:
  Ground observations and camera set-up and maintenance: early May, late May, early June, late June, July, August (2–3 days per visit)
- Initial Study Report: December

2014:

- Aerial Surveys: one week during June/July
- Mineral Lick Surveys:
  Ground observations and camera set-up and maintenance: early May, late May, early June, late June, July, August (2–3 days per visit, with potentially less effort depending on 2013 results)
- Updated Study Report: December

8.7.7. Level of Effort and Cost

Aerial surveys will require one observer and one pilot in a small tandem-seat fixed-wing airplane, flying daily for up to one week per summer to survey the sheep habitat in the greater Project area. The final size of the area to be surveyed will be determined in consultation with ADF&G and other resource managers.

Observations of mineral licks and set-up and maintenance of time-lapse cameras will be completed by two observers on four field visits during May and June and on two shorter trips by one observer later in the summer to check the cameras and change the memory cards. Viewing, summary, and analysis of the photographs will be conducted in the fall after camera retrieval.

Project costs in 2013 are anticipated to be less than $200,000. A similar level of effort will be required for 2014.

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8.7.9. Figures

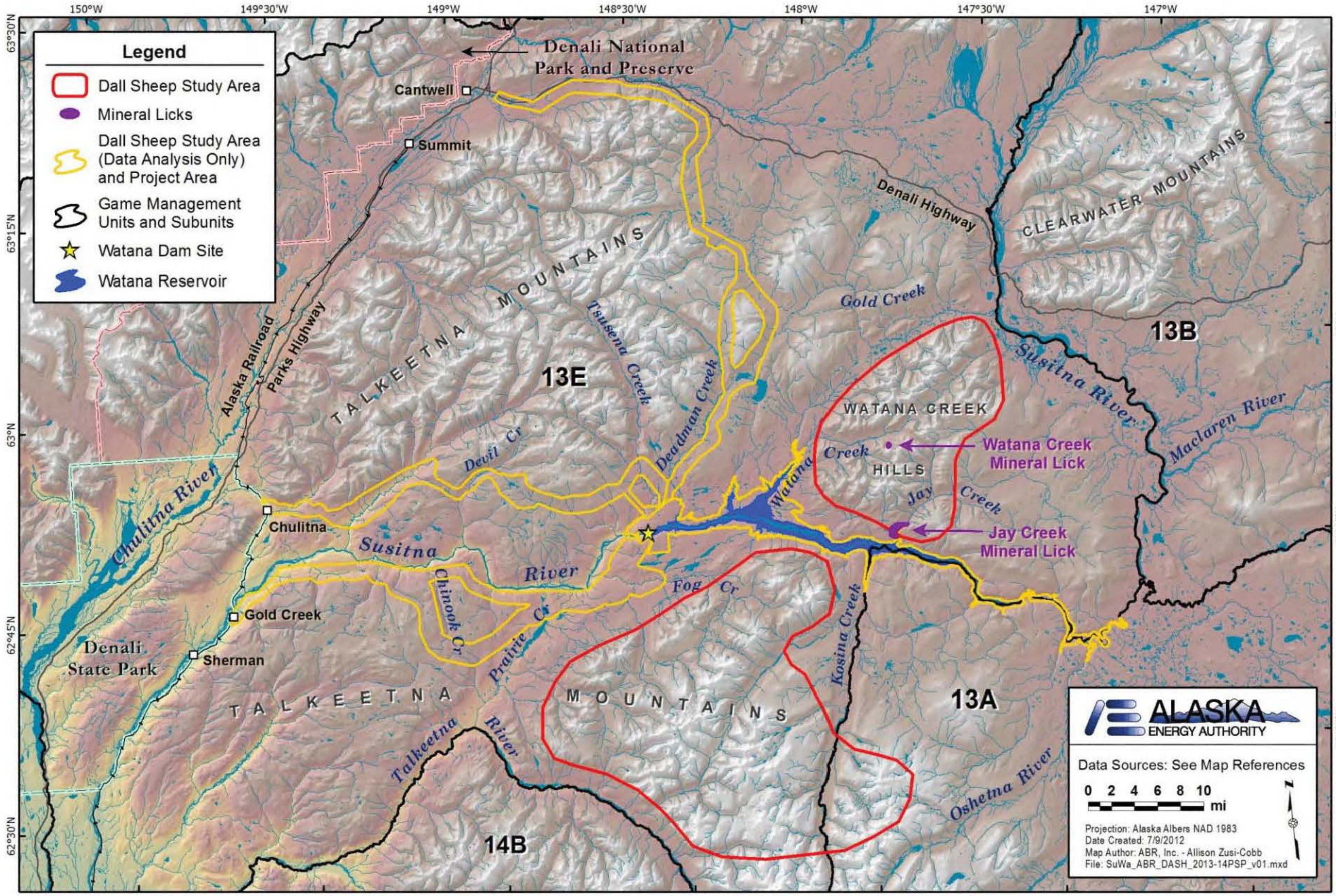

Figure 8.7-1. Dall's sheep study area.

8.8. Study of Distribution, Abundance, and Habitat Use by Large Carnivores

8.8.1. General Description of the Proposed Study

The large carnivore study is a multi-year (2012–2014) effort that relies primarily on analyses of ADF&G data from ongoing State of Alaska monitoring projects and on focused field work on bears downstream from the proposed Watana dam.

8.8.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient information on three dominant predators and game animals in the region—brown bear (*Ursus arctos*), black bear (*U. americanus*), and wolf—to use in evaluating Project-related effects and identifying any appropriate measures to avoid, minimize, or mitigate those effects.

Project development will inundate or modify habitats used seasonally by brown bears, black bears, and wolves. In addition, the associated development infrastructure and human activities in the area during construction and operation are likely to have indirect effects on bears and wolves through changes in prey populations, including moose, caribou, and salmon, and changes in disturbance and human hunting patterns. Data collected through this large-carnivore study will provide information on the value of lost, created, or altered habitats for bears and wolves in the area.

Four primary objectives have been identified for this study:

- Estimate the current populations of brown bears, black bears, and wolves in the greater Project area, using existing data from ADF&G;
- Evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may potentially be altered by the Project;
- Describe the seasonal distribution and habitat use of wolves in the greater Project area using existing data from ADF&G; and
- Synthesize historical and current data on bear movements and seasonal habitat use in the greater Project area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies (AEA 2012a).

8.8.2. Existing Information and Need for Additional Information

Existing information for bears and wolves is further detailed below. This study would supply baseline data essential to assess potential Project-induced impacts and facilitate the development of any PM&E measures, if deemed necessary. The study results would provide the following information:

- Habitat-use data for developing habitat evaluation criteria;
- Distribution data during harvest periods for the ongoing wildlife harvest analysis study initiated in 2012 (AEA 2012b);
- Abundance, productivity, and potential impacts for subsistence users; and

- Survival and mortality for predator-prey relationships to enable assessment of Project-related mortality risk.

8.8.2.1. Bears

The original APA Susitna Hydroelectric Project included studies of the population size and density, demography, seasonal movements, dispersal, den locations, and predation rates on moose calves by both brown and black bears from 1980 to 1985 (ABR, Inc. 2011). No studies of bears were conducted downstream from Devils Canyon. The density of brown bears in the upstream area was estimated to be 29.7 bears/1,000 square kilometers for an area of 12,127 square kilometers defined as the area within 1 mean brown bear home range diameter from the Susitna River (Miller 1987). Approximately 12 percent of the relocations (*n* = 1,720) of radio-collared brown bears occurred in the area that would have been inundated by the APA Susitna Hydroelectric Project Low Watana reservoir; bears used that area twice as frequently as expected both in the spring and for all months combined. This pattern of use was evident for males and most females, but not for females accompanied by cubs of the year. Bears spent the highest proportion of time in the Watana impoundment zone during June, when they foraged on south-facing slopes for roots, new vegetation, and overwintered berries, and preyed on moose calves. Females with young cubs tended to stay at higher elevations, possibly to reduce the risk of predation on cubs by male brown bears (Miller et al. 1997).

Brown bears preyed on moose calves from late May to early June, with predation rates declining substantially by mid-July (Ballard et al. 1990). In addition to moose calves, the Susitna bear population had access to salmon, which is unusual for brown bears in interior Alaska. Bears, especially males, moved to the Prairie Creek drainage, a tributary to the Talkeetna River located southwest of Stephan Lake (between the Devils Canyon and Watana dam sites), during July and early August to feed on spawning Chinook salmon (LGL 1985). Despite the availability of protein-rich animal foods, berry production appeared to be a major factor limiting brown bear productivity in the Susitna study area (LGL 1985). Miller (1987) estimated berry abundance and canopy coverage within and above both impoundment zones proposed for the original APA Susitna Hydroelectric Project. Horsetails (*Equisetum* spp.), an important spring food, were more abundant outside the impoundment zones, but some sites with abundant horsetails would have been inundated by the proposed reservoirs (Helm and Mayer 1985). An ADF&G study of brown bear movements and demography in GMU 13A is nearing conclusion; that study area is located south of the proposed reservoir inundation zone for this Project.

The density of black bears in black bear habitat comprised of spruce forest and shrub-lands along the Susitna river was estimated to be 90 bears/1000 square kilometers in the 1980s (Miller 1987); that density estimate has not been updated since (Tobey 2008). Although black bears in the upper basin occasionally ate moose calves, berries appeared to be their most important food source (LGL 1985). Black bears spent most of their time in forested areas along creek bottoms, but moved out into adjacent shrublands during late summer as they foraged for berries, particularly in the area between Tsusena and Deadman creeks (Miller 1987). In May and June, 52 percent and 46 percent, respectively, of all locations of radio-collared bears occurred in areas that would be flooded by the proposed impoundment (Miller 1987).

The ADF&G management objective for brown bears in GMU 13 is to maintain a minimum population of 350 animals (Tobey and Schwanke 2009). The management objective for black bears in GMU 13 is to maintain the existing population of black bears with a sex structure that will sustain a harvest of at least 60 percent males (Tobey 2008). Bears in GMU 13 are of interest both as predators of caribou and moose and as important game species.

The Project is likely to result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity and access due to construction and operation of the Project. Bears often pose management challenges for large development projects in Alaska because of their attraction to areas of human activity and associated waste-handling facilities; proper disposal of anthropogenic wastes is important for minimizing such problems.

8.8.2.2. Wolf

Most of GMU 13 (except Subunit 13D, south of the Glenn Highway), including the upper Susitna River basin, currently is managed by ADF&G under a predator control program instituted in response to the State's intensive management law, passed in 1994. Since 2006, the number of wolves in GMU 13 has been within the current management goal range of 135–165 wolves (3.3–4.1 wolves/1,000 square kilometers) after the end of the hunting and trapping seasons (Schwanke 2009). In neighboring GMU 14, the wolf population was estimated at 100–130 animals in fall 2004 and 145–180 in fall 2007, well above the management objective of a minimum population of 55 wolves (Peltier 2006, 2009). GMU 14 currently is not included in the State's predator control program.

The wolf study for the original APA Susitna Hydroelectric Project was conducted during 1981–1983 in the Nelchina and upper Susitna River basins, building on regional studies that began in the 1970s (see ABR 2011 for details). That study provided data on pack size, territory boundaries, den and rendezvous sites, and feeding habits, based on radio-tracking of collared animals. During the study period, 13 different packs and a lone individual used areas in or adjacent to the Devils Canyon and Watana impoundment zones proposed for the APA Susitna Hydroelectric Project. Wolf packs used almost the entire upper Susitna basin, except areas above 4,000 feet. elevation; elevational use varied seasonally, probably in response to availability of prey species. In each year, 5–6 wolf packs used the areas that would have been inundated by the APA Susitna Hydroelectric Project. Den and rendezvous sites usually were located on well-drained knolls and hillsides with sandy, frost-free soils and mixed, semi-open stands of spruce, aspen and willow. The most important potential impact on wolves from the APA Susitna Hydroelectric Project was predicted to be reduced winter availability of primary prey species (moose and caribou) in the impoundment zones. In addition, habitat loss due to inundation and facilities development would have caused wolves to adjust territory boundaries, potentially resulting in intraspecific strife.

Wolves have been studied extensively in GMU 13 since the mid-1970s and are the subject of ongoing surveys for ADF&G's intensive management program. The number of wolves and packs using the Project area currently is unknown, although it appears to be substantially lower than during the original APA Susitna Hydroelectric Project studies because of current predator control efforts in GMU 13 and 16. Research in recent years has focused on ADF&G's Nelchina study area in GMU Subunit 13A, located south of the proposed reservoir.

8.8.3. Study Area

GMU 13 is an intensive management area where predator control measures have been implemented by the State of Alaska to increase caribou and moose populations. In GMU 13, predator control measures have included land-and-shoot harvest of wolves and liberalized regulations for the harvest of wolves and bears.

Field studies of large carnivores will be limited to surveys of bear use of anadromous fish spawning streams in the middle reach of the Susitna River and its tributaries downstream from the proposed Watana dam site. The study area for bear surveys lies within GMU Subunits 13A and 13E and encompasses the proposed Project area, including the impoundment zone, the access and transmission corridors, and other Project features (Figure 8.8-1). Additional survey work would be conducted downstream from the proposed Watana Dam site, primarily in tributary drainages that contain spawning runs of anadromous fishes, as far downstream as the confluence of the Susitna River and the Chulitna River.

No field studies are proposed for wolves and the wolf study will comprise an analysis of existing ADF&G data from GMU subunits 13A, 13B, 13E, 14B, 16A and 20A.

8.8.4. Study Methods

8.8.4.1. Bears

ADF&G has concluded that adequate data generally are available for brown bears and black bears in the greater Project area to evaluate potential impacts of the Project, but “information on downstream use of habitat and the importance of salmon in bear diets in conjunction with impacts to salmon would aid in identifying potential impacts to bears downstream of the dam” (letter from M. Burch, ADF&G, to AEA dated November 22, 2011). ADF&G does not consider bear dens to be “sensitive” locations because they are seldom reused (letter from M. Burch, ADF&G, to AEA dated December 20, 2011).

A multi-faceted approach will be used to address the need for current information on bears in the Project area. Reanalysis of 1980s data and synthesis with current data from other previous or ongoing ADF&G telemetry studies and other regional management studies will provide data on bear populations, movements, and habitat use in the study area (AEA 2012a).

Surveys of bear use of anadromous fish spawning streams in the middle reach of the Susitna River and associated tributaries downstream from the proposed Watana dam site will be conducted to assess the use of those resources for bears in the Project area. The surveys would be conducted by monitoring streams using a combination of ground-based stream surveys incorporating time-lapse photography and DNA sampling from hair snares to quantify the bear population using the downstream area. Hair-snag stations would be deployed along game trails and scent stations in a grid pattern centered on the Susitna River (downstream from the dam site and upstream from Talkeetna). The size and design of the hair-snag grid will be based on the expected densities of bears, logistical considerations for access to the area, and comparison with similar studies in central Alaska.

DNA analysis of bear hair samples would provide information on the sex and species of bear, a minimum estimate of the number of different individuals in the area, and stable isotope signatures. The isotopic signature would be used to classify the proportion of the diet made up of salmon, terrestrial meat, or vegetation (Fortin et al. 2007). If adequate samples can be obtained, mark-recapture analysis of the hair samples would provide a population estimate of the number of bears using the sampling area (Immel and Anthony 2008, Gardner et al. 2010).

Evaluation of berry resources in the reservoir inundation zone can be accomplished during the concurrent mapping efforts for vegetation, wetlands, and wildlife habitats to assess the distribution and abundance of berry plants as forage for bears.

8.8.4.2. Wolf

ADF&G's Division of Wildlife Conservation has expressed the opinion that ongoing monitoring work would be sufficient (ADF&G memorandum to AEA, 22 November 2011), so no additional field surveys are deemed necessary for the Project. Hence, desktop analyses of existing ADF&G data would be used to meet the study objectives for wolves.

Historical reports from the original APA Susitna Hydroelectric Project study will be reviewed and synthesized, where possible, with data from other recent and current monitoring by ADF&G of wolves in GMU subunits 13A, 13B, 13E, 14B, 16A and 20A, as a continuation of AEA's wildlife studies (AEA 2012), initiated in 2012 . Mapping of wolf pack territories and movements from existing ADF&G telemetry datasets would provide useful background information, although delineation of current pack territories will not be possible without tracking collared individuals, and the applicability of the available data to the greater Project area need to be evaluated. Although the findings of the wolf study conducted for the original APA Susitna Hydroelectric Project program remain relevant and could be used for the current Project analyses, the original telemetry data for wolves are no longer available and therefore cannot be reanalyzed using newer geospatial techniques.

8.8.4.3. Impact Assessment

The ;primary impacts on bears are expected to be direct loss of habitat, changes in prey density and distribution, changes in berry production, changes in human use and hunting effort, and increased potential of mortality due to defense of life or property (DLP), or availability of anthropogenic food sources. Impacts on bears will depend, in part, on the proposed plan to control anthropogenic food sources. The primary impacts on wolves are likely to be direct loss of habitat, changes in prey distribution and density, disturbance, and changes in hunting effort.

Telemetry data from the ADF&G will be used, in conjunction with bear survey data described above, to identify important habitats and high-use sites for bears and wolves in the Project area. Data on the distribution, abundance, movements, and habitat use by bears and wolves will be used to assess Project impacts. Direct habitat loss can be estimated through geospatial analysis by overlaying the impoundment, access and transmission corridors, and other project infrastructure on the Project habitat map (Sections 9.5, 9.6 and 9.7) to identify important habitats that would be lost. Additional indirect habitat loss and avoidance effects can be similarly estimated by applying various buffer distances, as determined from available information on anticipated effects. Data from the bear DNA study can be used to estimate the number of animals that might be affected at various high-use areas and to assess the dietary importance of those streams to the bear population downstream of the Watana dam. Harvest data from ADF&G will provide baseline data for evaluation of changes in harvest and other mortality that may result from improved access. Data on the seasonal distribution, abundance, and movements of bears and wolves among habitats in relation to the geographic extent and seasonal timing of various Project activities can be used to identify necessary avoidance and minimization measures.

8.8.5. Consistency with Generally Accepted Scientific Practice

Mark-recapture analysis of genetic markers and stable isotopes analysis of hair samples have been widely used in recent years. Analysis of hair samples to determine bear diet and population size has been previously used (Fortin et al. 2007, Gardner et al. 2010).

8.8.6. Schedule

This is a multi-year study that was initiated in 2012. Reanalysis and synthesis of existing bear and wolf data through 2011 is currently being conducted (AEA 2012a). Incorporation of new data and additional analyses will be conducted incrementally as recent and current data are obtained from ADF&G databases. Field surveys of bear use of salmon streams downstream from the proposed dam site will be conducted during mid- to late summer in 2013 and 2014 to coincide with the timing of spawning runs of salmon. Evaluation of berry resources in the reservoir inundation zone would be accomplished during concurrent mapping efforts for vegetation, wetlands, and wildlife habitats. Data analysis, QA/QC, and reporting would be conducted in the fall and winter months after recent and current data are transferred from ADF&G and field work is completed in late summer. The Initial Study Report and Updated Study Report will be prepared in December 2013 and 2014, respectively.

8.8.7. Level of Effort and Cost

Sightability of bears from aerial surveys over forests is low and the large Project area makes direct observations from the ground problematic. Stable-isotope analysis of bear hair provides an indirect estimate of the major components of bear diets without requiring capture and handling of bears. Approximately 1 to 2 weeks of field time by a crew of two biologists would be required in mid-summer to establish the hair-snag grid between the proposed dam site and Talkeetna. The hair-snag stations then would be checked at weekly intervals during late summer, when use of the area is expected to be highest.

Collection of data on berry distribution and abundance in the reservoir impoundment zone would be conducted during the vegetation and wetland field surveys, eliminating the need for separate field surveys.

Project costs in 2013 are anticipated to be less than $250,000. A similar level of effort will be required for 2014.

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8.8.9. Figures

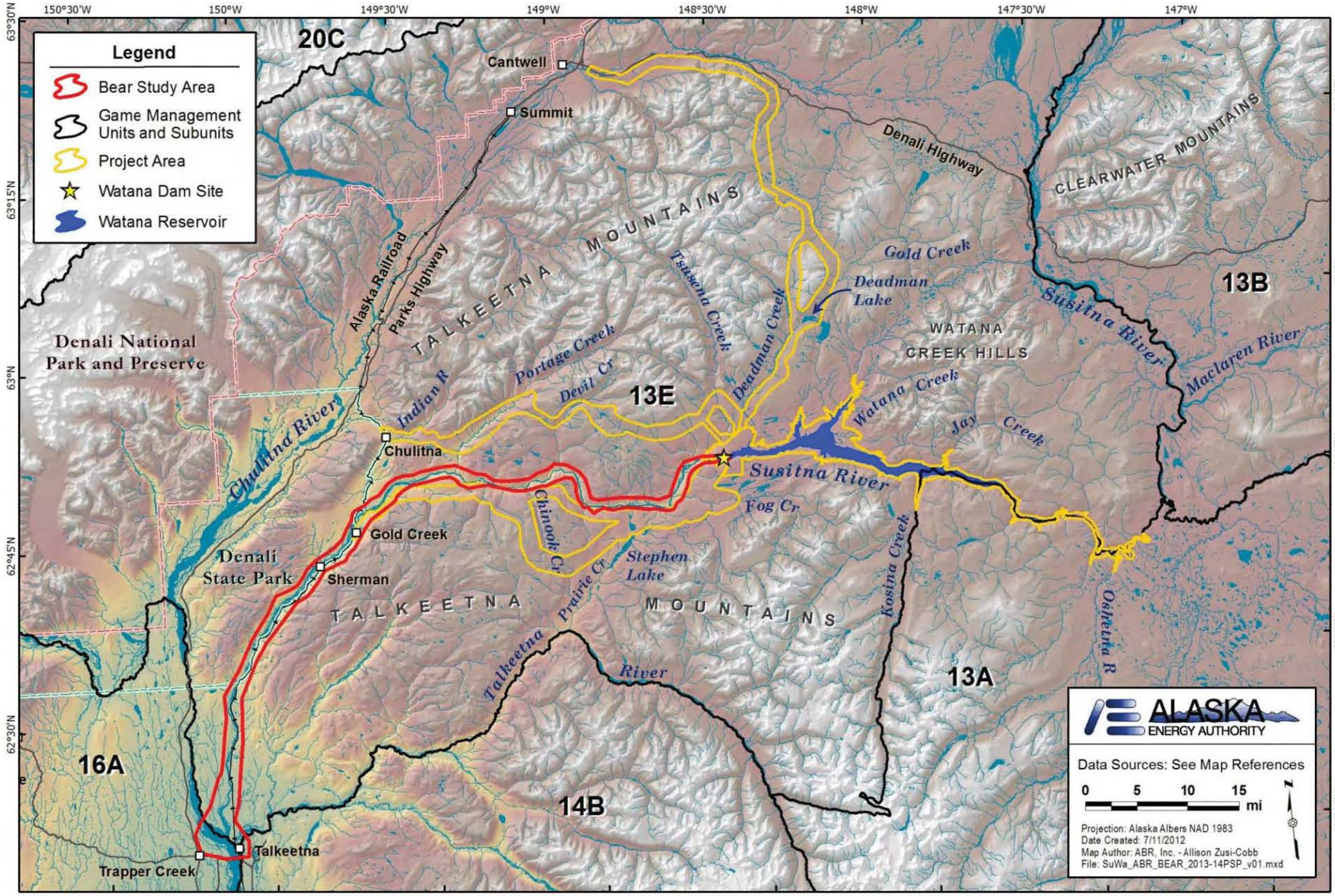

Figure 8.8-1. Study area for bears.

8.9. Study of Distribution and Abundance of Wolverines

8.9.1. General Description of the Proposed Study

The wolverine study is a multi-year study that was initiated in 2012 as a desktop exercise and will be completed in 2013. Data on wolverine monitoring efforts in the study area prior to 2012 will be obtained from ADF&G in 2012 and a single aerial survey will be conducted in late winter 2013.

8.9.1.1. Study Goals and Objectives

The overall goal of this study is to collect preconstruction baseline population data on wolverines (*Gulo gulo*) in the greater Project area (reservoir impoundment zone; facilities, laydown, and storage areas, access and transmission-line routes) to enable assessment of the potential impacts from development of the proposed Project. This information will be used to estimate the number of wolverines that may be affected by the Project and to evaluate impacts on habitats used seasonally by wolverines.

Three specific objectives have been identified for this study:

1) Describe the winter distribution of wolverines;
2) Describe winter habitat use by wolverines; and
3) Estimate the current population size of wolverines.

8.9.2. Existing Information and Need for Additional Information

The Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity due to construction and operation of the Project. The Project may result in habitat loss, reduced access, or displacement from seasonally used sensitive habitats in the middle and upper Susitna River basin such as denning areas, or prey calving and wintering areas, caused by increased human activity.

The wolverine study would provide baseline data for the Project area, including winter habitat-use data for development of habitat evaluation criteria. The study would provide a basis for impact assessments; for developing any appropriate protection, mitigation, and enhancement measures, which may include resource management and monitoring plans.

ADF&G conducted a mark–recapture study of radio-collared wolverines in the upper Susitna River basin for the original APA Susitna Hydroelectric Project to investigate population density and distribution, habitat selection, home-range size, and seasonal movements from 1980 to 1983 (see details in ABR 2011). A sample of 22 wolverines was equipped with VHF radio-collars between April 1980 and April 1983. Sufficient data to estimate home-range size were obtained for only four males and three females, however. Harvest records, track data, and incidental sightings also were used to help estimate distribution, population size, and food habits of wolverines in the Susitna basin. In addition to collared animals, the carcasses of 136 wolverines that had been harvested in or near the study area were examined. Habitat use by wolverines varied among seasons, with respect to both elevation and vegetation types. Wolverines were located at higher elevations in summer and lower elevations during winter (Whitman et al. 1986). Collared wolverines avoided tundra habitats in winter and forested habitats in summer, probably because of seasonal changes in prey availability, and used other habitats in proportion to their availability. The most notable potential impact of the original APA Susitna Hydroelectric Project on wolverine was considered to be permanent loss of winter habitat. A potential decrease in the regional moose population as a result of the project would have reduced the amount of carrion available to wolverines during winter. Whitman and Ballard (1983) estimated that 45 percent of the wolverines in the Susitna basin used the impoundment zone, and therefore, would have been affected to some degree by the reservoir. Improved access and a greater human presence in the region would have increased the potential for higher harvest rates of wolverines.

No recent estimate of the wolverine population is available for the Project area. Because the relative inaccessibility of much of the Project area may make it a refugium (population source area) for the wolverine population in Game Management Unit (GMU) 13, ADF&G requested the wolverine population to be estimated (ADF&G memorandum to AEA, 22 November 2011).

8.9.3. Study Area

The study area encompasses the proposed Project area, including the impoundment zone, dam site, access and transmission-line corridors, and other project infrastructure and adjacent areas as illustrated in Figure 8.9-1. Most of the area is within Game Management Unit (GMU) Subunits 13E and 13A. The exact boundaries will be defined after consultation with ADF&G who have offered to help plan the survey, drawing on the expertise of their furbearer biologists, who have developed the method that is proposed for use in this study (Golden et al. 2010).

8.9.4. Study Methods

An aerial survey using snow-tracking in winter and a sample-unit probability estimator (SUPE; Becker et al. 2004, Golden et al. 2007) would be used to estimate the number and density of wolverines in the Project area. With this method, the survey area is stratified based on predicted density and is divided into sample units (e.g., 25-square kilometers for wolverines; Golden et al. 2007). Sample units are selected at random from each stratum and are surveyed soon after a significant snowfall, until all tracks within selected sample units are located. Tracks are then followed in both directions to map the entire movement path since the last snowfall and the number of animals in the group is estimated. Data are analyzed using program SUPEPOP and formulas from Becker et al. (1998). Surveys sampling 65–70 percent of high-density sample units and 45–50 percent of medium- and low-density sample units should result in a density estimate with a coefficient of variation (CV) of <10 percent.

Historical reports from the original APA Susitna Hydroelectric Project study will be reviewed and synthesized, where possible, with data from other recent and current monitoring by ADF&G in GMU Subunits 13A, 13B, 13E, 14B, 16A and 20A, as a continuation of the wildlife harvest study (AEA 2012), which began in 2012 . Although the findings of the wolverine studies conducted for the original APA Susitna Hydroelectric Project remain relevant and can be used for current Project analyses, the original telemetry data for wolverines are no longer available (R. Strauch, ADF&G, 2012 pers. comm.), so cannot be reanalyzed using newer geospatial techniques.

8.9.4.1. Impact Assessment

Potential impact mechanisms of the proposed Project on wolverine include:

- Direct and indirect loss and alteration of wildlife habitats from Project construction and operation;
- Physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities and related indirect effects, including habitat connectivity and genetic isolation;
- Direct and indirect impacts on predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development;
- Behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development;
- Direct mortality due to vehicle strikes, exposure to contaminants, and protection of life and property; and
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development.

Wolverines typically occur at lower densities near human development (May et al. 2006, Gardner et al. 2010) and this may be the primary impact of the Project on wolverines. Data on the winter distribution, abundance, and habitat use by wolverines in the study area will be used to assess Project impacts of habitat loss and behavioral avoidance. Observed locations of wolverines and, where feasible, abundance data will be plotted on the wildlife habitat map of the Project area that will be developed under the botanical resources study plans and each habitat ranked by level of use. Direct loss of preferred or important habitats can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the Project habitat map. Indirect loss and avoidance estimates can be made by applying various buffer distances, as determined from the available information on the anticipated effects. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on wolverines. ADF&G harvest data will provide a baseline against which to assess impacts of changes in level of harvest. Any necessary PM&E measures will be developed by examining the seasonal distribution and abundance of wolverines among habitats in relation to the geographic extent and seasonal timing of various Project activities.

8.9.5. Consistency with Generally Accepted Scientific Practice

The sample-unit probability estimator (SUPE) is used by ADF&G for wolverine studies. Golden et al. (2007) used a SUPE to estimate wolverine density in two areas of Alaska. The ADF&G Division of Wildlife Conservation supports the use of a SUPE survey for estimating the wolverine population (letter from ADNR [representing State agencies, including ADF&G] to AEA dated May 30, 2012).

8.9.6. Schedule

This is a multi-year study that was initiated in 2012. Data on wolverine monitoring efforts in the study area prior to 2012 will be obtained from ADF&G in 2012 (AEA 2012). A single aerial SUPE survey will be conducted in late winter 2013 after a significant snowfall. Additional wolverine data for 2012–2013, if any, will be added if it becomes available from ADF&G, following completion of data entry, verification, and QA/QC checks. An Initial Study Report will be prepared in December 2013. An Updated Study Report will be issued in December 2014.

8.9.7. Level of Effort and Cost

It is anticipated that a single aerial survey in late winter (February/March 2013) will be adequate to provide a population estimate of wolverines in the Project area. Multiple pilot/observer teams would be used to cover as much of the Project area as possible within as short a time period as possible once suitable survey conditions are achieved following a fresh snowfall. It is estimated that 48–72 hours of flight time would be required, using small aircraft. ADF&G has offered to help plan the survey, drawing on the expertise of their furbearer biologists, who have developed the method that is proposed for use in this study (Golden et al. 2010).

Project costs in 2013 are anticipated to be less than $120,000. There is no field work planned for 2014.

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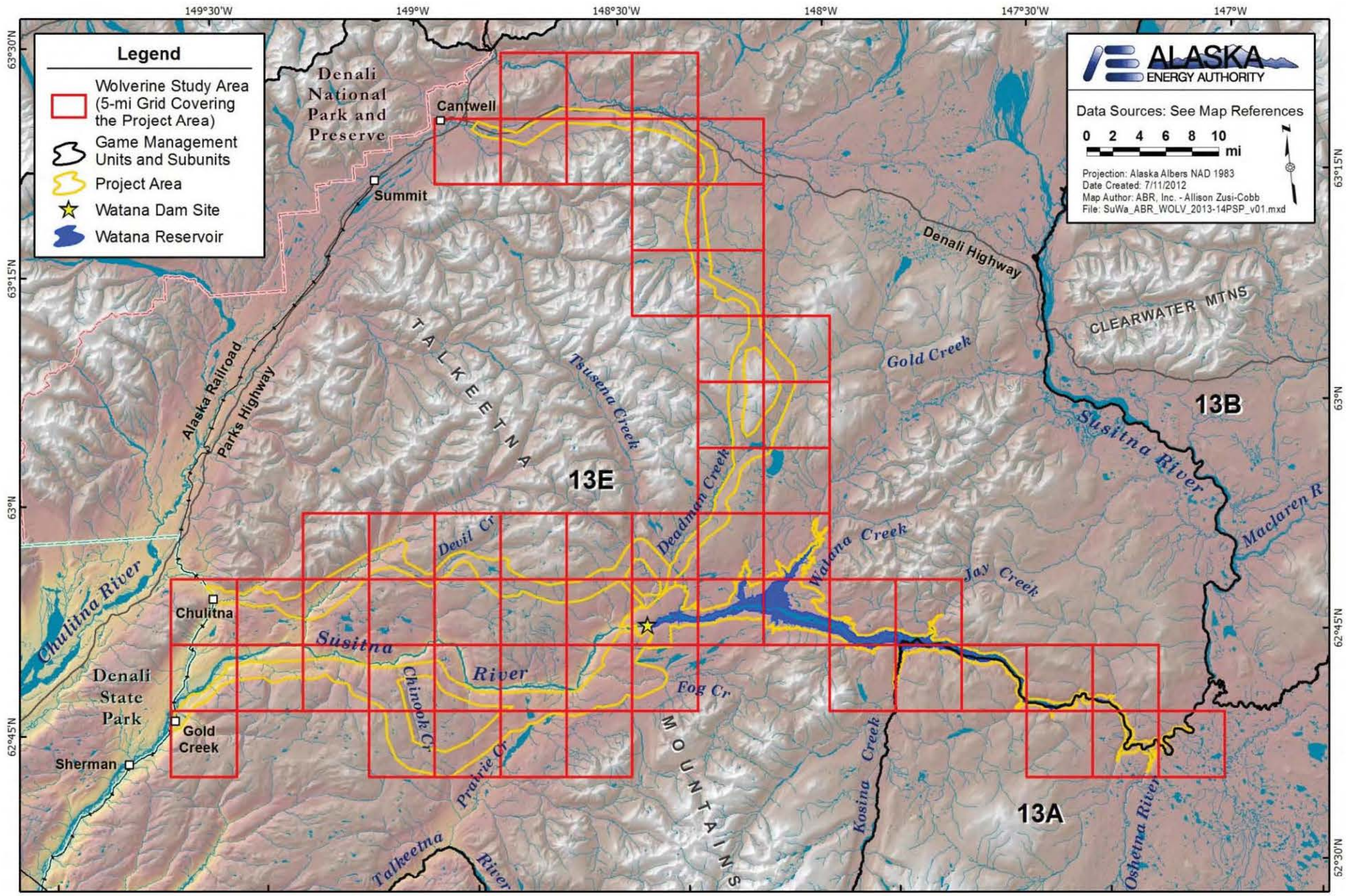

Figure 8.9-1. Wolverine study area.

8.10. Study of Terrestrial Furbearer Abundance and Habitat Use

8.10.1. General Description of the Proposed Study

Terrestrial furbearer studies were initiated in 2012 and, as outlined here, will continue in 2013 and 2014. The terrestrial furbearer studies will be conducted as part of a thesis project by UAF Professor Laura Prugh and her graduate student. Data and reports pertinent to the goals of this Project will be provided by Dr. Prugh; elements of the larger UAF thesis project lie outside the context of impact assessment and mitigation and are not included in this study plan or in the FERC licensing process.

8.10.1.1. Study Goals and Objectives

The goal of this study is to provide current information on the abundance and habitat use of terrestrial furbearers (coyote [*Canis latrans*], red fox [*Vulpes vulpes*], lynx [*Lynx canadensis*], and marten [*Martes americana*]) for use in evaluating potential Project-related impacts and identifying appropriate mitigation. The potential impacts of the Project include habitat loss and fragmentation, increased human harvest and disturbance, and changes in prey populations (AEA 2011). Accurate population estimates and habitat-use data are important for adequately determining the amount of habitat loss and identifying the relative likelihood and magnitude of changes in harvest. This information will be used to assess the potential effects of the Project on furbearer populations, which will inform development of any necessary protection, mitigation, and enhancement measures, which may include management and monitoring plans.

Red fox, lynx, and marten are ecologically important and valuable furbearers; coyotes are also ecologically important but they are not as highly valued as furbearers. Although coyotes are widely distributed throughout Alaska, little is known about their abundance or ecological effects. The coyote is considered to be a "human commensal" species, benefiting from human activities such as road construction and agriculture (Young and Jackson 1951). Coyotes may increase in abundance as a result of the Project, and because they prey on a wide variety of large and small game, and compete with and prey on foxes and lynx, changes in coyote abundance could have substantial effects on other wildlife resources. Trapper surveys show that Alaskans who trap in GMUs 11 and 13 are particularly concerned about the impact of coyotes on Dall's sheep populations (Schwanke 2010) and several studies have found that coyotes are a major predator of Dall's sheep lambs (Hoefs and McTaggart-Cowan 1979, Scotton 1998, Arthur and Prugh 2010).

This study has seven specific objectives:

1) Develop population estimates of coyotes and red foxes through collection of scats along trails and rivers throughout the study area during winter months (January–March) in 2013 and 2014;
2) Develop a population estimate of marten through collection of hair samples in the reservoir inundation zone using hair snag tubes;
3) Develop a population estimate of lynx through collection of hair samples throughout the study area using hair snag plates;
4) Develop indices of prey abundance in the study area by recording snowshoe hare (*Lepus americanus*) sign and estimating vole abundance;

5) Conduct genetic analyses of fecal and hair samples to confirm species identity and to differentiate individual animals;
6) Calculate furbearer population estimates using genotype data and capture–mark–recapture statistics; and
7) Compile habitat-use data for the furbearer species being studied.

The habitat-use data and species population estimates will be used to assess the potential impacts of the Project on these populations, and for use in developing any necessary potential PM&E measures.

8.10.2. Existing Information and Need for Additional Information

The original APA Susitna Hydroelectric Project study program collected data on use of the Project area by marten (Gipson et al. 1982, 1984; Buskirk 1983, 1984; Buskirk and MacDonald 1984; Buskirk and McDonald 1989) and red fox (Hobgood 1984), but no information was collected on coyotes or lynx, aside from incidental sightings. The APA Susitna Hydroelectric Project studies indicated that marten may be especially impacted by the reservoir, because a substantial amount of their preferred habitat (mature spruce forest) occurs within the inundation zone. ADF&G has not conducted population estimates of small furbearers in GMU 13. Trapping reports indicate that populations have experienced normal annual and cyclic fluctuations, but no indications of long-term increases or decreases have been apparent (Schwanke 2010).

Major advances in the estimation of predator population sizes have occurred since the original APA Susitna Hydroelectric Project studies were conducted in the 1980s. A large body of literature has accumulated on the use of noninvasive genetic techniques to obtain population estimates for numerous species around the world. Many studies of wolves, bears, wolverines, coyotes, foxes, lynx, marten, river otters (*Lontra canadensis*), and other species have successfully used noninvasive techniques to estimate population sizes (Mowat and Paetkau 2002, Waits and Paetkau 2005, Petit and Valiere 2006, Long et al. 2008).

Marten is the most economically valuable furbearer in GMU 13 (Schwanke 2010). Loss of habitat combined with increased access could lead to unsustainable levels of harvest and population declines in marten and other furbearers. Thus, current population estimates are needed to serve as a baseline for assessing the impact of Project activities and for developing any necessary protection, mitigation, and enhancement methods, as well as management and monitoring plans.

The wildlife data gap analysis completed for the Project (ABR 2011) recommended using a combination of aerial track surveys and non-invasive capture–mark–recapture surveys to determine current habitat use, movement patterns, and population sizes of furbearer species. In general, aerial track surveys techniques are appropriate and will be adopted, in particular for assessing habitat use. However, aerial tracking methods may be inappropriate for estimating population sizes of small terrestrial furbearers and mark-recapture studies are preferred. The aerial snow-track survey method that provides estimates of population size is known as the survey-unit probability estimator (SUPE; Becker et al. 1998, 2004) and the SUPE model was recommended by the ADF&G for the Project to obtain population information on wolverines. The method is appropriate and has been well-tested for large furbearers such as wolves and wolverines, which often travel over long distances in open habitats where tracks are possible to follow from the air. Similarly, beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) sign are also easy to see from the air. However, the SUPE method has several assumptions and requirements that make it impractical for population surveys of smaller terrestrial furbearers and the ADF&G, in comments on the gap analysis and preliminary study plans, recommended against its use for species other than wolverine for the following reasons. First, the method requires following the full length of a track from its end, where the animal is seen, back to its start, when the last snowfall ended. Small furbearers often travel in tightly meandering routes within dense brush or forests and their tracks can be obscured by snowshoe hare tracks. Coyotes prefer to travel on trails broken by other species (e.g., wolf and moose trails) because they have high foot loading and avoid traveling in deep snow (Murray and Boutin 1991), making their tracks easy to lose. Second, aerial tracking relies on weather conditions that are uncommon (a fresh snowfall followed by several days of calm weather) and an SUPE survey can take several days per species to conduct (Becker et al. 1998). Therefore, it is unlikely that weather conditions and availability of experienced personnel would allow sufficient time to complete SUPE estimates for other furbearers in the study area in addition to the planned SUPE estimates for wolves and wolverines. In addition, the SUPE has not been tested on smaller furbearers. Validations of SUPE population estimates in areas with known population sizes have occurred for wolves and cougars (*Puma concolor*) only, with mixed results (Vansickle and Lindzey 1991, Patterson et al. 2004, Choate et al. 2006). Thus, although aerial track transects may be useful for obtaining information on habitat use and movement patterns of smaller furbearer species, accurate estimation of population sizes requires different methods. As outlined below, mark-recapture methods are preferred for estimating population size of terrestrial furbearers smaller than wolves or wolverine.

8.10.3. Study Area

The terrestrial furbearer study area (Figure 8.10-1) will include all terrestrial areas that are safely accessible by snowmachine within a 10-kilometer (6.2-mile) buffer zone surrounding the areas that will be directly altered or disturbed by Project construction and operations, including facility sites, laydown/storage areas, the reservoir inundation zone, and access road and transmission-line corridors. Carnivores are wide-ranging animals that occur in low densities, so sampling will need to extend upstream on the Susitna River above the inundation zone and as far as 10 kilometer on either side of the inundation zone and access/transmission corridors. This wider sampling is needed to obtain adequate sample sizes to calculate population density estimates of furbearers. While density estimation of furbearers requires wide sampling, all samples will be georeferenced so that a total count of furbearers occupying the Project-affected areas can be determined.

8.10.4. Study Methods

The methods for the study components are described below.

8.10.4.1. Sample Collection

Snowmachine trails will be established along creeks and rivers throughout the study area (i.e., along road and transmission corridors and the inundation zone). Trails will be traveled approximately every 2 weeks during January–March in 2013 and 2014, and all canid and felid scats will be collected. Scats will be collected with ziplock bags and then placed within autoclave bags to prevent cross-contamination. Scats will be stored frozen, which preserves DNA for analysis.

Unlike canids, lynx and marten do not preferentially travel on rivers and trails. Therefore, hair snags will be used to obtain genetic material from those species. Lynx habitat within the study area (i.e., areas with tree or shrub cover) will be divided into approximately 50 blocks. Each block will be 25 square kilometers (9.65 square miles) in size, approximately the average size of a lynx home range (Slough and Mowat 1996, Vashon et al. 2008). Two hair snag plates will be placed in each block, in locations that are accessible and likely to be encountered by any lynx occurring in the area. Hair snag plates will consist of an attractant that will cause lynx to rub and a barb to collect a hair sample (Zielinski et al. 2006). Hair-snag stations will be checked monthly during January–March in 2013 and 2014, and all hairs found on barbs will be placed in coin envelopes and stored in a dry location to preserve the DNA. Because marten home ranges are small and a survey of the entire study area would be impractical, the marten survey will be restricted to the inundation zone. This zone, which is approximately 125 square kilometers (48.26 square miles) in size, will be divided into 25 5-square kilometer (1.93-square mile) blocks, roughly corresponding in size to the 3 to 6 square-kilometer (1.16 to 2.32 square-mile) home range of female marten reported in this area during the 1980s (Buskirk 1983). Two hair-snag tubes will be placed within each block in locations likely to be used by marten, as described by Williams et al. (2009).

Snowshoe hare abundance will be determined by counting their fecal pellets in 8–10 plots within the Project area. Pellet counts have been shown to correspond closely to snowshoe hare density (Krebs et al. 1987). The Project area will be stratified into 4–5 blocks, and two pellet count plots will be randomly placed within each block, one in spruce forest and one in riparian habitat. Fifty circular plots with a radius of 0.5 meters (1.64 feet) will be spaced 15 meters (49.21 feet) apart at each site, and all pellets will be counted and cleared from the plots. In the first year of the study, pellets will be aged, based on appearance, to estimate whether they are more or less than a year old (Prugh and Krebs 2004).

The abundance of voles will be estimated by using live-trapping and mark–recapture methods in 8–10 plots. Two trapping grids will be established in spruce forest and in grassy meadow habitats. Each grid will consist of 50 live-trap sites spaced 10 meters (32.81 feet) apart. The traps will be operated for 1–3 nights. Captured voles will be weighed, ear-tagged, identified to species and sex, and released. The proportion of recaptured tagged individuals to unmarked individuals will be used to calculate an estimate of population abundance.

8.10.4.2. Genetic Analyses

The outer surface of each frozen scat will be scraped with a scalpel, and shavings will be placed in 2-mL vials. DNA from hair samples will be extracted using Qiagen® kits (a commercially available DNA assay). Mitochondrial analyses will be used to determine the species identification and sex of individuals that deposited each hair and scat sample. Genotypes will be determined by amplifying DNA at 6 loci. Amplification will be repeated 2–3 times to verify accuracy because DNA from feces and hairs sometimes are degraded and errors can occur (Miller et al. 2002).

8.10.4.3. Habitat Use

Habitat use will be evaluated by conducting aerial surveys of tracks in snow. Experienced observers (such as ADF&G biologists) will fly pre-determined transect lines and record GPS receiver locations of tracks encountered. These locations will be overlaid on habitat maps using ArcGIS® software (ESRI, Redlands, California) to examine patterns of habitat use in the Project area for each furbearer species.

8.10.4.4. Statistical Analyses and Data Interpretation

Once reliable genotypes are obtained, each genotyped sample is considered to be a "capture" event. Mark–recapture population estimates and confidence intervals will be obtained using the program *rMark* (Laake and Rexstad 2008). Survival, recruitment, and population growth rates will be estimated between years using open mark-recapture estimators such as Pradel models (Laake and Rexstad 2008).

Natural cycling of snowshoe hare numbers and wolf control efforts by ADF&G in the Project area may influence furbearer abundance in the study area, making it difficult to isolate the effects of Project activities. To assess these confounding factors, abundance estimates and trends found in this study will be compared with findings from a similar study in nearby Denali National Park and Preserve (DNPP). Trends found in DNPP will indicate how furbearer populations are fluctuating in response to the hare cycle in the absence of wolf control and in the absence of Project activities. Hare pellet counts will be conducted in DNPP as well as in the Project area. Comparing baseline furbearer surveys in the Project area with surveys in DNPP will indicate how wolf control is affecting furbearers in the Project area. This comparison will be useful in subsequently determining which changes in furbearers may be due to the Project activities and which changes may have occurred due to other factors.

8.10.4.5. Data Products

This terrestrial furbearer study will provide preconstruction baseline data for the Project area, including habitat-use data for use in developing habitat evaluation criteria. The terrestrial furbearer study will provide a basis for impact assessment; developing appropriate protection, mitigation, and enhancement measures as needed; and developing resource management and monitoring plans.

The following data will be produced from this study:

1) Population estimates, with confidence intervals, for coyote, red fox, lynx, and marten in 2013 and 2014;
2) Estimates of survival, recruitment, and population growth for coyotes, red foxes, lynx, and marten between 2013 and 2014;
3) Habitat use and selection data based on aerial track surveys;
4) Snowshoe hare pellet-count data in spruce and willow habitats; and
5) Genetic samples from furbearers in the study area, which will be stored for at least 5 years after the study is completed.

A final report presenting all study results will be produced that includes an examination of the population dynamics and habitat use of terrestrial furbearers in the study area. GIS mapping with layers showing the locations of study transects, furbearer snow tracks, and genetic samples collected during the study will also be created.

8.10.4.6. Impact Assessment

All four species of terrestrial furbearers are predators and would be affected both directly by Project activities and features and indirectly by effects on prey species. The primary impacts of the Project on terrestrial furbearers include:

- Direct and indirect habitat loss and alteration, including potential effects on prey species,
- Potential direct behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation,
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development,
- Potential direct mortality due to vehicle strikes, exposure to contaminants, and attraction to garbage and human activity,
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development, and
- Potential physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions.

For terrestrial furbearers, all impacts including direct and indirect habitat loss and alteration, behavioral effects, altered movements, and mortality primarily will occur in the impoundment area, access and transmission corridors, and other facility footprints.

Data on the distribution, abundance, and habitat use of terrestrial furbearers in the study area can contribute to the assessment of Project impacts. Using GIS software, species abundance data recorded among different habitat types can be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans. The direct impacts of habitat loss and alteration by the Project can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map and then calculating direct impacts. Indirect impacts also can be assessed by applying various buffer distances, estimated from the available information on the anticipated effects. Data collected in this study of terrestrial furbearers can be used in combination with information from the literature conduct a GIS analysis of the geographic extent, frequency, duration, and magnitude of Project effects on terrestrial furbearer populations. For coyotes, foxes, lynx, and marten, population data from the terrestrial furbearers study will allow an assessment of population-level impacts of direct and indirect habitat loss. For snowshoe hares, pellet counts conducted by the terrestrial furbearer study will provide semi-quantitative assessment of population effects. Any necessary PM&E measures will be developed by examining the distribution and abundance of species among habitats in relation to the geographic extent and seasonal timing of various Project activities.

Separate studies of prey species ion the Project area, including Dall's sheep, ptarmigan, and small mammals, will provide additional information on the impact of predatory terrestrial furbearers on prey species and will improve the assessment of potential Project-related impacts for all species. Surveys to estimate wolf numbers will improve our understanding of the relationship between large and small furbearer populations and will help to determine whether future changes in furbearer abundance may be related to changes in wolf density, prey availability, or Project-related impacts.

8.10.5. Consistency with Generally Accepted Scientific Practice

Noninvasive genotyping is a well-established technique to obtain reliable population estimates of coyotes, red foxes, lynx, and marten. Fecal genotyping has successfully been used to monitor coyote population dynamics from 2000 to 2002 in the central Alaska Range (Prugh and Ritland 2005, Prugh et al. 2005, Prugh et al. 2008).

8.10.6. Schedule

This is a multi-year study that includes data collection 2012–2014.

2012:

August — Fieldwork to collect prey abundance data.

- Establish 8–10 hare pellet plot grids
- Conduct hare pellet counts
- Establish vole trapping grids
- Conduct vole trapping for population estimates

2013:

January–March — Final selection of sampling sites; fieldwork to collect genetic samples.

April–August — Preliminary genetic analyses.

June — Snowshoe hare pellet counts.

December — Initial Study Report

2014:

January–March — Fieldwork to collect genetic samples.

April–October — Final genetic analyses.

June — Snowshoe hare pellet counts.

December 2014 — Updated Study Report

8.10.7. Level of Effort and Cost

This study will require at least two field seasons to adequately assess furbearer abundance prior to Project construction. Fieldwork will be conducted by a crew of two personnel. Supervision, data analysis, writing reports, and attending meetings are expected to require one month of the study lead's time per year. Genetic analyses will be conducted by an experienced technician. Several fixed-wing airplane trips will be needed during each winter field season for access to field sites and to conduct aerial track surveys and to haul snowmachine fuel and miscellaneous field supplies. Materials to make hair snag stations and other consumables for genetic analyses will be required. Genetic analyses for fecal and hair samples cost more than traditional genetic analyses (~$50/sample instead of ~$30) because samples need to be analyzed 2–3 times to check for errors due to low DNA quality or quantity. The total cost for the study is estimated to be $350,000–375,000.

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8.10.9. Figures

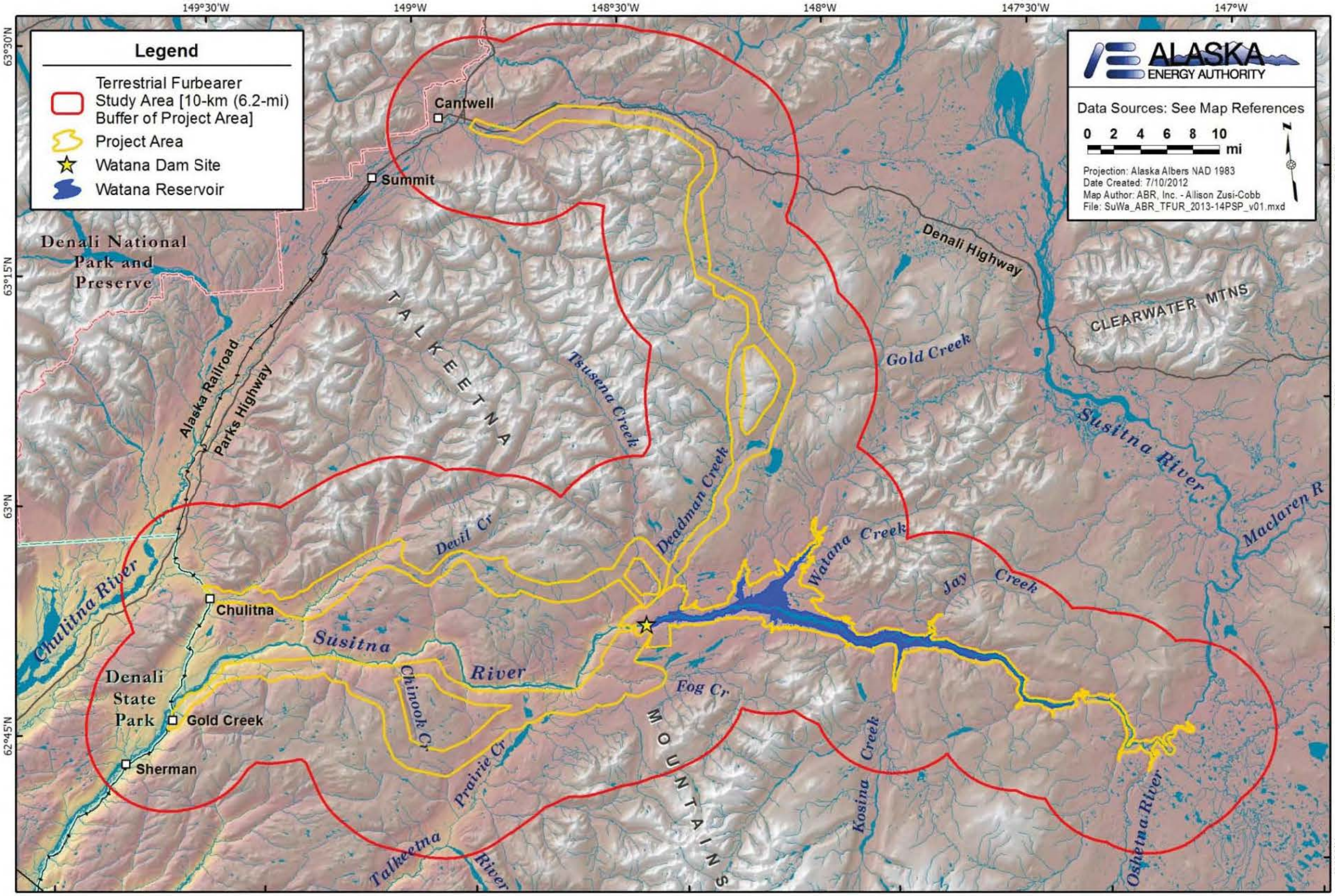

Figure 8.10-1. Terrestrial furbearer study area.

8.11. Study of Aquatic Furbearer Abundance and Habitat Use

8.11.1. General Description of the Proposed Study

The aquatic furbearer study will be conducted in 2013 and 2014. The study was designed to determine the distribution of aquatic furbearers among habitats, to estimate population sizes for beavers and relative abundance of other aquatic furbearers. Additional effort will be made to provide information on food habits and diets of piscivorous furbearers to the Project assessment of mercury bioaccumulation.

8.11.1.1. Study Goals and Objectives

The goal of the aquatic furbearer study is to collect baseline data on aquatic furbearers in the Project area to enable assessment of potential Project-related impacts. This information will be used to develop appropriate mitigation measures. Four species of aquatic furbearers occur in the Project area. The beaver is the most prominent aquatic furbearer statewide in terms of ecological and economic importance. Other aquatic furbearers in the Project area include river otter, mink (*Neovison vison*), and muskrat (AEA 2011).

Five specific objectives have been identified for this study:

1) Delineate the distribution and estimate the current population size of beavers;
2) Describe the distribution and relative abundance of river otter, mink, and muskrat;
3) Document habitat use by aquatic furbearers;
4) Review available information on food habits and diets of piscivorous furbearers (river otter and mink) as background for the Mercury Assessment and Potential for Bioaccumulation Study (See Section 5.12); and
5) Collect and analyze fur samples from river otters and mink to characterize baseline tissue levels of mercury for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.12).

8.11.2. Existing Information and Need for Additional Information

Studies of aquatic furbearers for the original APA Susitna Hydroelectric Project proposed in the 1980s focused primarily on beavers and secondarily on muskrats; limited track surveys were conducted for river otters and mink. Beavers, which were selected to predict downstream impacts of the APA Susitna Hydroelectric Project on furbearers, were studied mainly downstream of the proposed dam site (Gipson et al 1982, 1984; Woolington et al. 1984, 1985; Woolington 1986). Aerial surveys were used to locate lodges and caches and to estimate population levels and overwinter survival, and boat surveys in summer were used to detect beaver sign. Surveys were conducted using boats and airplanes between Devils Canyon and Cook Inlet during summer 1980 and 1982; in general, beaver sign increased substantially with distance downriver from Devils Canyon (Gipson et al. 1982, 1984). Side channels and sloughs were the habitat types used most often. Caches, lodges, and dens were found most often in habitats that had silty banks, willows, and poplars nearby. Little or no sign of beaver activity was found in the mainstem Susitna River during summer surveys (Gipson et al. 1984). Away from the Susitna River, beaver sign was found along slow-flowing sections of most tributaries, including Portage Creek, Indian River (especially along a tributary flowing out of Chulitna Pass), streams along the access-road route alternative between Gold Creek and Devils Canyon, and Prairie Creek (Gipson et al. 1984).

Fall and spring counts of beaver lodges and food caches were conducted between Devils Canyon and Talkeetna (Gipson et al. 1984; Woolington et al. 1984, 1985; Woolington 1986). Fall counts were conducted annually during 1982–1985 and spring counts were conducted in 1984 and 1985. Between 1982 and 1985, the population in that area was estimated at 70–220 beavers. Aerial surveys for beavers (and muskrats) were conducted in the upstream study area during spring and summer 1980 (Gipson et al. 1982). Beaver colonies in the APA Susitna Hydroelectric Project impoundment zones occurred mostly in lakes between 610 and 730 meter (2,000 and 2,400 feet) elevation. Colonies also were present in slow-moving sections of most of the larger tributaries, particularly Deadman Creek. No active beaver lodges or bank dens were found on the Susitna River upstream of Devils Canyon (Gipson et al. 1982), however.

Aerial surveys for muskrat pushups were flown upstream from Gold Creek during spring 1980 (Gipson et al. 1982). Muskrat sign was observed most often in lakes on plateaus above the river valley, at 610–730 meter (2,001–2,395 feet) elevation. Muskrats in the upstream area appeared to depend on fairly small, isolated areas of wetland habitats. Muskrats also were seen along slow-moving sections of creeks and at locations where creeks drained into larger streams, particularly near the Stephan Lake–Prairie Creek and Deadman Lake–Deadman Creek drainages.

Tracks of river otters and mink were recorded in the upper Susitna basin during the APA Susitna Hydroelectric Project studies in the 1980s, but the number of animals present was not estimated. Tracks were widespread but not abundant, although several unusually heavy concentrations of tracks (presumably representing a small number of animals spending an extended period in one area) were noted near river ice in early winter, the time of year when track surveys were conducted.

Data on distribution, population densities, and movements of aquatic furbearers in GMU 13 is limited to that collected for the APA Susitna Hydroelectric Project, and that information is now 25–30 years old. Annual furbearer reports produced by ADF&G contain general abundance information obtained from trapper questionnaires (Schumacher 2010), but reports do not include drainage-specific population data. Current data on the abundance and distribution of aquatic furbearers is unavailable for GMU 13.

Current data on the abundance, distribution, and habitat use of aquatic furbearers is needed to enable analysis of Project impacts. A large body of research demonstrates that the beaver is a keystone species that exerts profound ecological effects on hydrology, geomorphology, vegetation, nutrient cycling, the productivity of aquatic and riparian habitats, and the distribution and abundance of fishes and other aquatic organisms (Butler 1995, Collen and Gibson 2001, Müller–Schwarze and Sun 2003, Rosell et al. 2005). As was the case for the APA Susitna Hydroelectric Project, current information on the abundance and distribution of beavers will be required. Additional data also will be needed to assess the current abundance and distribution of river otter and mink, including an effort to enumerate individual animals, particularly along the mainstem Susitna River and its clearwater tributaries. These baseline data are collected as input for the *Mercury Assessment and Potential for Bioaccumulation Study* (Section 5.12), which was recommended by the USFWS in response to the request for comments and study requests on the

Pre-Application Document/FERC Scoping Document 1 for the Project (letter from USFWS to AEA dated 31 May 2012).

8.11.3. Study Area

The study area for aquatic furbearers will vary according to the species being surveyed (see Figure 8.11-1). Because of their ecological importance to riparian habitats, beavers will be surveyed from the reservoir impoundment zone downstream to the confluence of the Susitna and Chulitna rivers, as well as along access road corridors. In contrast, surveys of muskrats will be restricted to waterbodies and wetland areas likely to be affected by Project facilities and activities in the area of the dam and associated infrastructure, including the impoundment area. Surveys for river otters and mink will focus on the reservoir impoundment and nearby river stretches downstream from the proposed dam site, potentially using the same transect locations that were surveyed in the 1980s to obtain comparative data. Surveys will extend upstream along tributaries to provide comparative data on the extent of use of those drainages in comparison with the Susitna mainstem.

8.11.4. Study Methods

Aerial surveys of beaver lodges and food caches would be conducted in a small helicopter to assess the abundance and distribution of beaver in the middle reach of the Susitna River below the proposed dam site (downstream extent to be informed by instream flow modeling), the reservoir impoundment zone in the upper basin, the proposed facilities and laydown/storage areas, and access road and transmission-line corridors. Surveys would be flown in fall shortly before freeze-up to document the distribution and abundance of active colonies, as indicated by lodges and food caches (Hay 1958, Payne 1981). Aerial surveys of active colonies would be flown again in spring to estimate the overwinter survival of those colonies.

Aerial surveys of ponds and lakes would be conducted in winter to enumerate muskrat pushups in the portions of the Project area in the upper basin that would be affected directly by Project infrastructure and activities.

Aerial surveys in a small helicopter would focus on winter snow-tracking of river otters and mink soon after fresh snowfalls by adapting the methods of Reid et al. (1987) and Sulkava and Liukko (2007) for aerial surveys. Tracks of river otters would be followed to obtain an accurate count of group size, to delineate the length of river and streams traversed by the group, and to evaluate the extent of use of the mainstem river and tributaries. All sightings of aquatic furbearers would be recorded with Global Positioning System (GPS) receivers for entry into a geospatial database for use in the wildlife habitat evaluation for the Project.

Additional data on aquatic furbearers (primarily river otter and mink) would be collected during winter track surveys of terrestrial furbearers being conducted for that separate study. In addition, historical and current data on harvest of aquatic furbearers in GMU Subunits 13A, 13B, 13E, 14B, 16A and 20A will be synthesized for the separate wildlife harvest study, beginning in 2012 (AEA 2012) and continuing in 2013 and 2014. Details of incidental sightings of aquatic furbearers would be requested from other Project researchers working on fish and aquatic resources studies.

ADF&G management objectives are to maintain accurate annual harvest records based on sealing documents for those species that require sealing of hides and to develop specific population and harvest objectives. ADF&G requires that the pelts of river otters be sealed by an authorized ADF&G representative. This pelt-sealing requirement would provide an ideal opportunity to obtain hair samples from otters harvested in the study area for characterization of baseline mercury levels in tissues. Small amounts of hair will be taken from otter pelts for which reliable location information is available and will be sampled for methylmercury. Hair samples from mink would be more difficult to obtain, unless local trappers are working in the Project area. Another possibility for obtaining mink hair samples would be as incidental snags from the sampling being conducted for marten as part of the terrestrial furbearer study.

In addition to fur sampling, the scientific literature will be reviewed to locate and synthesize information on the food habits and diets of river otters and mink in freshwater aquatic systems, to support the pathways analysis being planned for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.12).

8.11.4.1. Impact Assessment

The primary impact mechanisms of the proposed Project on aquatic furbearer populations would likely involve

- direct and indirect habitat loss and alteration, and
- changes in mortality rates that may result from increased subsistence and recreational harvest facilitated by the improved access.

For aquatic furbearers, direct and indirect habitat loss and alteration will occur in the impoundment area, access and transmission corridors, and other facility footprints as well as downstream of the dam site, where altered flow regimes will alter riparian habitats. Variable winter flows in the Susitna River may result in direct or indirect mortality of beavers. Other potential impacts, including death or injury due to vehicle strikes or exposure to contaminants, may affect relatively small numbers of aquatic furbearers.

Data on the distribution, abundance, and habitat use of aquatic furbearers in the study area can be used to assess Project impacts. Location data that are collected for all four species of aquatic furbearers will identify important habitats in the Project area for each species. For beavers and muskrats, additional quantitative data on the abundance of beaver colonies, muskrat pushups, and river otter groups can be used to obtain estimates of the number of animals potentially affected by Project development. For all four species, direct habitat loss and habitat alteration that would result from the Project can be evaluated by overlaying furbearer location data and the Project features (including the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors) onto the habitat map that will be developed under the botanical resources study plans (See Sections 9.5, 9.6, and 9.7). Additional indirect habitat loss and alteration also can be estimated by applying various buffer distances from proposed Project features, as determined from the available information on the anticipated effects. In this way, the GIS analysis can incorporate information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on aquatic furbearers. Any necessary PM&E measures will be developed by examining the distribution and abundance of species among habitats in relation to the geographic extent and seasonal timing of various Project activities.

An analysis of harvest data that are collected by ADF&G (described in Section 8.20) can provide baseline information with which to assess the potential effects of increased subsistence and recreational harvest of aquatic furbearers.

Documentation of the distribution and relative abundance of piscivorous furbearers and characterization of their dietary habits will provide information for the pathways analysis being planned for the Mercury Assessment and Potential for Bioaccumulation Study.

8.11.5. Consistency with Generally Accepted Scientific Practice

Aerial survey methods for beaver colonies and winter track surveys will follow standard practices for recording aquatic furbearers and their sign and will be largely similar to surveys conducted for the APA Susitna Hydroelectric Project during the 1980s (Hay 1958, Payne 1981, Reid et al. 1987, Sulkava and Liukko 2007). Habitat availability and use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration.

8.11.6. Schedule

This study will be conducted in 2013 and 2014, as described below:

<u>2013:</u>

February–April	Monthly aerial surveys of river otters and mink (following fresh snowfall); literature review of food habits and diets of piscivorous furbearers in freshwater aquatic systems; collection of furbearer hair samples for mercury analysis
April	Aerial survey of muskrat pushups
May	Aerial survey of beaver colonies to assess overwinter survival; preliminary report on first winter survey results and literature review
October	Aerial survey of active beaver colonies
November	Aerial track survey of river otters and mink (following fresh snowfall)
December	Initial Study Report

<u>2014:</u>

February–April	Monthly aerial surveys of river otters and mink (following fresh snowfall); collection of furbearer hair samples for mercury analysis
April	Aerial survey of muskrat pushups
May	Aerial survey of beaver colonies to assess overwinter survival
October	Aerial survey of active beaver colonies
November	Aerial track survey of river otters and mink (following fresh snowfall)
December	Data analysis
	Updated Study Report

8.11.7. Level of Effort and Cost

Aerial surveys using a small helicopter would be conducted in fall, winter, and spring beginning in 2013 and extending through 2014 to assess the relative abundance and habitat use of aquatic furbearers in the Project area.

Beaver surveys would require up to a week of survey effort in October each year. Winter track surveys, estimated to require approximately 3–5 days each, would be conducted in early winter (November) and monthly in mid- to late winter (February to April), pending the availability of suitable fresh snowfall for tracking. Surveys of muskrat pushups would be conducted in late winter (April) each year.

Collection of hair samples from river otters would be solicited from ADF&G as part of their required pelt-sealing procedure. Collection of hair samples from mink would be more challenging, involving collection of hair samples from marten traps during the terrestrial furbearer survey, or through direct contact with local trappers, or both.

Annual Project costs in 2013 and 2014 are anticipated to be less than $150,000.

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8.11.9. Figures

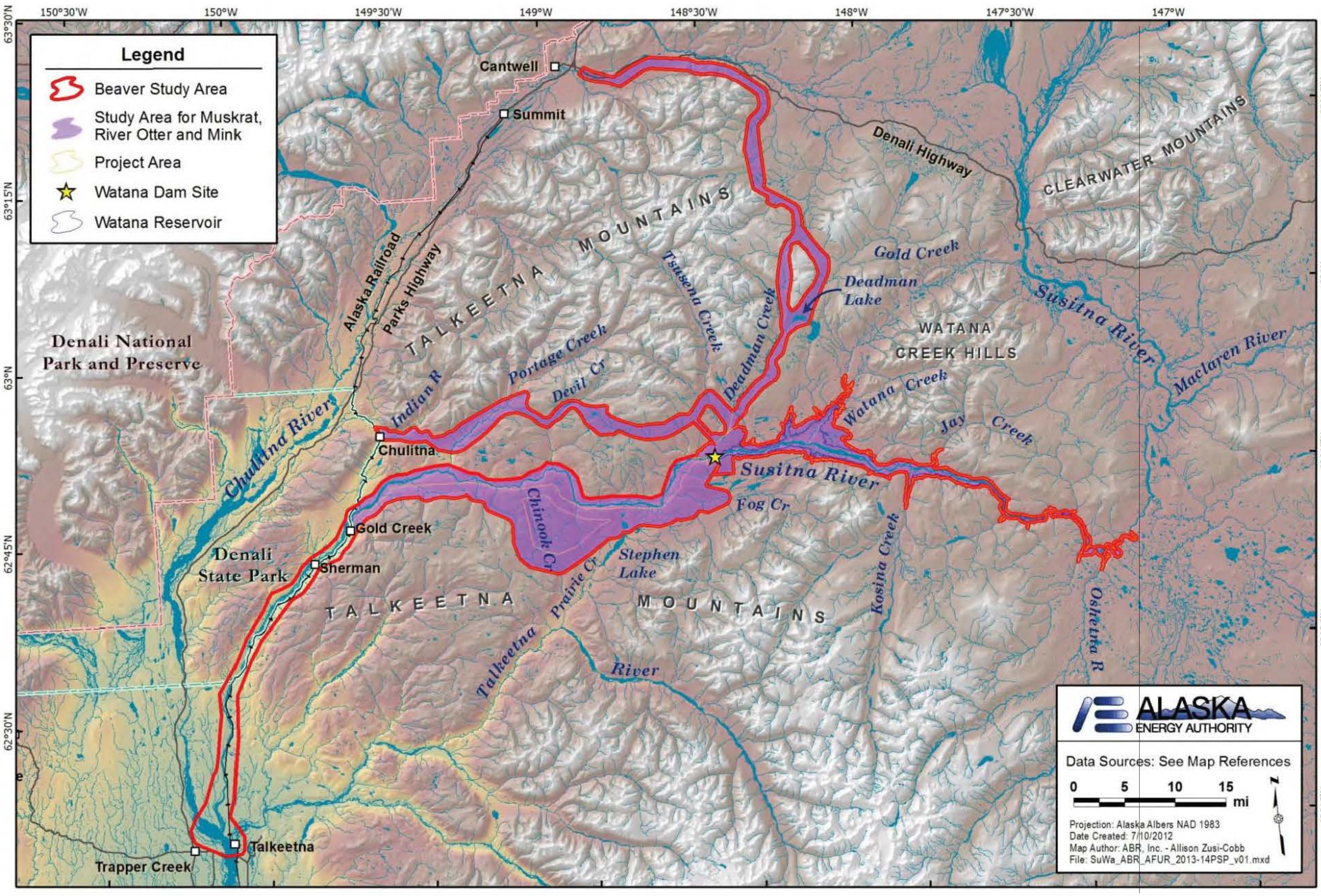

Figure 8.11-1. Aquatic furbearer study areas.

8.12. Study of Species Composition and Habitat Use of Small Mammals

8.12.1. General Description of the Proposed Study

The small mammal study will be a one-year effort (2013), with an option of a second year of sampling in 2014 if it is determined that more data are needed to adequately describe baseline conditions. The study was designed to determine what species of small mammals occur in the project area, where they occur in relation to proposed Project infrastructure, and what habitats they are using. Other small mammals, including snowshoe hares (Section 8.10) and little brown bats (*Myotis lucifugus*; Section 8.13) are covered in other study plans.

8.12.1.1. Study Goals and Objectives

The goal of the small mammal study is to collect baseline data on small mammals in the Project area to enable habitat-based assessments of the impacts expected to occur from development of the Project.

Two specific objectives have been identified for the small mammal study:

- Describe the species composition and relative abundance of small mammals in the Project area; and
- Describe the habitat associations of small mammals within the Project area.

8.12.2. Existing Information and Need for Additional Information

Small mammal species in the Susitna River basin include porcupine (*Erethizon dorsatum*), hoary marmot (*Marmota caligata*), arctic ground squirrel (*Spermophilus parryii*), red squirrel (*Tamiasciurus hudsonicus*), collared pika (*Ochotona collaris*), and several species each of voles, mice, and shrews. Species composition, relative abundance, and habitat use by small mammals were studied for the APA Susitna Hydroelectric Project in 1980 and 1981 along 49 trapline transects (using both snap-traps and pitfall traps) located in a variety of different habitat types in the middle and upper Susitna River basin (Kessel et al. 1982). The APA Susitna Hydroelectric Project study area for small mammals (Kessel et al. 1982) extended from Sherman (near Gold Creek) on the west to the mouth of the Maclaren River on the east and for approximately 16 km (10 miles) on each side of the Susitna River; no surveys of small mammals were conducted downstream from Sherman.

Since completion of the APA Susitna Hydroelectric Project studies in the 1980s, a new species of small mammal—the Alaska tiny shrew (*Sorex yukonicus*)—was recognized and described (Dokuchaev 1997, MacDonald and Cook 2009). The earliest specimen known was trapped in 1982 near the upper Susitna River during the APA Susitna Hydroelectric Project study. By 2007, the total number collected statewide had increased to 38 specimens from at least 22 widely separated locations (Cook and MacDonald 2009), indicating the species was more widespread than originally thought. Early information indicated it occurred primarily in riparian habitats but, as trapping efforts expanded, it also was captured in scrub habitats. The Alaska Natural Heritage Program classified the Alaska tiny shrew as “unrankable” globally (GU), presumably because little information was available, and as “vulnerable” in the state (S3; AKNHP 2011), probably due to restricted range and relatively few populations. The species was included on BLM's Alaska list of sensitive species (2010).

No recent reports on small mammal studies in the middle or upper Susitna basin are available. Other studies in surrounding regions included species inventories in Denali National Park and Preserve (Cook and MacDonald 2003) and on Fort Richardson near Anchorage (Peirce 2003), and long-term population monitoring (1992–2005) of three species of voles that was conducted in Denali National Park and Preserve by Rexstad and Debevec (2006).

The APA Susitna Hydroelectric Project studies provided a thorough sampling of the small mammal populations in the Project area. Although 30 years have elapsed since those studies, it is unlikely that species distributions or habitat-use patterns have changed significantly in the interim. Because of the often cyclical population fluctuations of small mammals and the lack of effective mitigation to offset population losses in the impoundment zone, the wildlife data gap analysis report (ABR 2011) questioned whether additional studies are warranted for the Project. However, a current field survey of small mammals, focused on the reservoir impoundment zone, access and transmission corridors, and associated areas of infrastructure, would provide useful information for evaluating the direct effects of habitat loss on small mammals to the Project.

8.12.3. Study Area

Field trapping surveys for small mammals will be conducted in the reservoir impoundment zone, access and transmission corridors, and areas of associated infrastructure (Figure 8.12-1).

8.12.4. Study Methods

8.12.4.1. Field Surveys

In combination with the wildlife habitat mapping effort (see Section 9.5), the small mammal survey would provide data with which to evaluate the potential impacts of the Project. As in the landbird and shorebird study, sampling locations would be distributed across the landscape and allocated by habitat type to ensure that all the prominent habitats are sampled. Sampling locations would be allocated using a pseudo-stratified random plot allocation procedure, using aerial photosignatures as the sampling strata because a current and complete habitat map likely will not be available by the time sampling would begin in 2013. Alternatively, the field survey could be postponed until 2014 to take advantage of the vegetation and habitat mapping that will have advanced by that time.

Standard trapping and survey methods for small mammals would be used (e.g., Jones et al. 1996), including both pitfall traps and snap-traps for voles, lemmings, and shrews. Pitfall traps will be plastic, as opposed to metal, to improve trapping success for the Alaska tiny shrew. Trapping data will include the relative abundance of each species in each habitat, allowing a quantitative assessment of habitat loss and habitat connectivity.

Additional information on small mammals will be collected in support of the terrestrial furbearer study (Section 8.10). Beginning in fall 2012, the abundance of voles will be estimated by using live-trapping and mark–recapture methods in 8–10 plots. Two trapping grids will be established in spruce forest and in grassy meadow habitats. Each grid will consist of 50 live-trap sites spaced 10 meters (32.81 feet) apart. The traps will be operated for 1–3 nights. Captured voles will be weighed, ear-tagged, identified to species and sex, and released. The proportion of recaptured tagged individuals to unmarked individuals will be used to calculate an estimate of population abundance.

8.12.4.2. Impact Assessment

All small mammals would be affected both directly by Project activities and features and indirectly by effects on predator species. The primary impacts of the Project on small mammals include:

- Direct and indirect habitat loss and alteration,
- Potential direct mortality due to vehicle strikes, exposure to contaminants, and attraction to garbage and human activity,
- Potential changes in mortality due to changes in the abundance or distribution of predators,
- Potential physical and/or behavioral blockage of movements due to reservoir water and ice conditions.

For small mammals, the primary impact of direct and indirect habitat loss and alteration will occur in the impoundment area, access and transmission corridors, and other facility footprints. To the extent that regional predator abundance may be altered by the project (as determined by other studies, including the large carnivore, terrestrial and aquatic furbearer, and raptor studies, Sections 8.8, 8.9, 8.10, 8.11, and 8.14), small mammal populations would also be affected over a larger region.

Data on the distribution, relative abundance, and habitat use of small mammals in the study area can be used to assess Project impacts on these populations through geospatial analysis and evaluation of the responses of the study species to other similar projects, as documented in the scientific literature. Using GIS software, species presence/absence data or relative abundance data recorded among different habitat types can be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans (see Sections 9.5, 9.6, and 9.7). The direct and indirect impacts of the Project can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to evaluate direct impacts and indirect impacts on preferred habitats. The GIS analysis can be combined with information from the literature to estimate the potential geographic extent, frequency, duration, and magnitude of Project effects on small mammal populations. For those habitats in which mark-recapture population estimates are available (spruce forest and grassy meadow habitats, as described above for the Terrestrial Furbearer study), it will be possible to estimate the number of animals affected. Additional information collected for the various studies of predators can be used to evaluate the potential area over which small mammal populations may be affected by changes in predation rates.

8.12.5. Consistency with Generally Accepted Scientific Practice

The small mammal study will be conducted using standard trapping techniques as described in Jones et al. (1996). Habitat availability and use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration.

8.12.6. Schedule

Small mammal trapping will be conducted in late summer 2013 during a 1–2 week period in late summer. After vegetation habitat mapping is complete, the sampling will be reviewed to determine if it adequately represents the habitat types present in the study area. If deemed necessary, additional sampling will occur in 2014. Two field crews of two biologists working for 10–14 days would ensure adequate spatial and habitat coverage.

Data management will be ongoing during the field season but will be finalized after all sampling has been completed in late summer. Initial and Updated Study Reports will be issued in December 2013 and 2014, respectively.

8.12.7. Level of Effort and Cost

Detailed estimates of effort have not yet been developed, but a single season of trapping effort, consisting of 1 to 2 weeks of field trapping by two crews (two biologists each) in late summer 2013 or 2014 (when small mammal populations should have reached their highest seasonal levels), would be adequate to satisfy the study objectives for most small mammals. The study area would consist of the same area covered by the vegetation mapping effort to provide a landscape context in which to evaluate the study results.

Total study costs are anticipated to be approximately $150,000.

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8.12.9. Figures

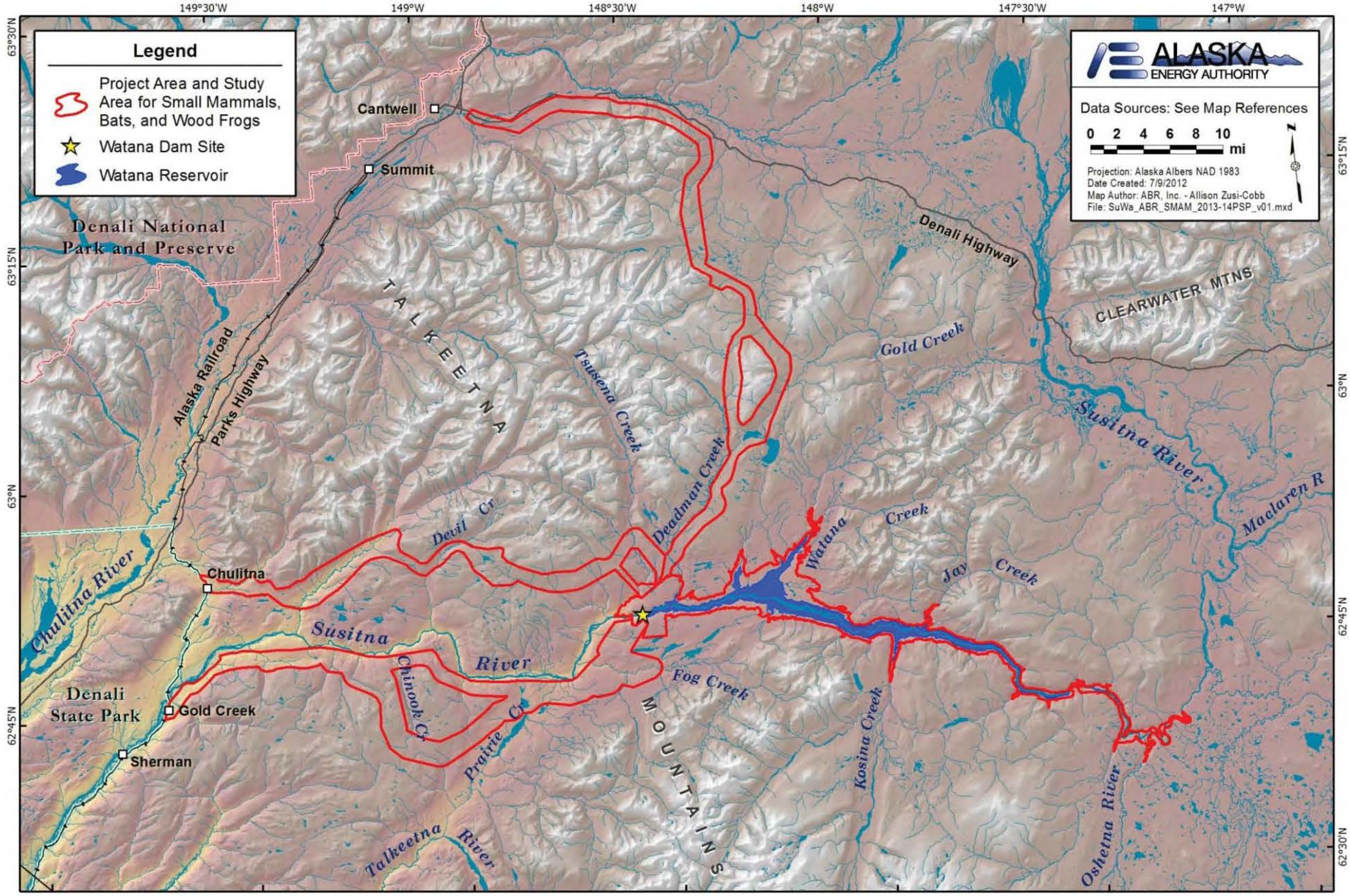

Figure 8.12-1. Study area for small mammals, little brown bats, and wood frogs.

8.13. Study of Distribution and Habitat Use of Little Brown Bat

8.13.1. General Description of the Proposed Study

The little brown bat study will be a one-year effort (2013) to determine whether bats occur in the Project area and, if so, their patterns of habitat use. Biologists will also look for evidence of breeding and overwintering to better understand how bats might be affected by the Project. Bats are small mammals and although this study shares similar objectives to the small mammal study (see Section 8.12), the two studies require substantially different methodologies and require separate efforts. AEA is proposing the following study plan for little brown bats but AEA would like to consult further with licensing participants to re-evaluate the level of effort based on more discussions regarding the potential presence of this species.

8.13.1.1. Study Goals and Objectives

The overall goal of the bat study is to collect baseline data on little brown bats in the Susitna-Watana Hydroelectric Project (Project) area to evaluate potential impacts to little brown bats from development of the proposed Project.

The specific objectives of the bat baseline study are to:

- Assess the occurrence of little brown bats and the distribution of habitats used by bats within the impoundment zone and infrastructure areas for the Project;
- Review geologic and topographic data for potential roosting and hibernacula sites; and
- Examine human-made structures (bridges and buildings) for potential roosting or hibernacula.

This information will be used to assess the potential impacts of the Project.

8.13.2. Existing Information and Need for Additional Information

Sampling for bat activity was not conducted during the APA Susitna Hydroelectric Project in the 1980s, and no bats were captured during the small-mammal study for that project. The little brown bat was included in the list of mammal species in the Project area on the basis of a single sighting (Kessel et al. 1982). No other documentation of bats in the Project area is known to exist, but this species is distributed throughout Southcentral Alaska (Parker et al. 1997).

Implementation of the proposed study will document bat occurrence (passes/detector-night) in the study area and contribute to identification of potential roosting and hibernation locations present in the Project area.

8.13.3. Study Area

Field surveys will be conducted in the reservoir impoundment zone, access and transmission corridors, and associated areas of anticipated infrastructure (see Figure 8.12-1).

8.13.4. Study Methods

8.13.4.1. Field Surveys and Data Management

Acoustic surveys of bats using echolocation detectors are used to assess bat activity patterns and habitat associations (O'Farrell and Gannon 1999, Hayes 2000, Parsons and Szewczak 2009). Anabat® broadband acoustic detectors (Titley Electronics, Ballina, New South Wales, Australia) are used to detect and produce audible output from the ultrasonic sounds generated by bats to echolocate. These detectors are widely used for passive detection of free-ranging, echolocating bats (O'Farrell et al. 1999). Interpretation of bat acoustic data is subject to several important caveats. The number of recorded "bat passes" is an index of relative activity, but may not correlate to individual numbers of bats (e.g., 10 bat passes may represent a single bat recorded 10 different times or 10 bats each recording a single pass; Hayes 1997). Activity also may not be proportional to abundance because of variability attributable to (1) detectability (loud vs. quiet species); (2) species call rates; (3) migratory vs. foraging call rates; and (4) attraction to or avoidance of the sampling area by bats (Kunz et al. 2007, Hayes et al. 2009). However, interpreted properly, the index of relative activity may provide critical information of bat use by characterizing temporal (hourly, nightly, and seasonal) and spatial (height and location) patterns of bat activity (Parsons and Szewczak 2009).

To the extent possible during June–September 2013, bat activity will be monitored during crepuscular and nocturnal hours (~1 hour before sunset to ~1 hour after sunrise), providing data when bats are most active (Hayes 1997). What constitutes crepuscular and nocturnal times of day fluctuates throughout summer Alaska, so the duty cycle of the detectors will be adjusted periodically. Anabat detectors are regularly used in Southeast Alaska where bats are more prevalent. Data will be downloaded and analyzed using Anabat CFC Read and AnalookW software (Corben 2011). A bat pass will be defined as a search-phase echolocation sequence of ≥2 echolocation pulses with a minimum pulse duration of 10 milliseconds (ms) within each sequence separated by >1 second (Fenton 1970, Thomas 1988, Gannon et al. 2003). Bat activity will be reported as bat passes/detector-night, the standard metric for measuring bat activity (Kunz et al. 2007). The spatial and habitat relationships among detectors will likely be compared statistically using non-parametric (Kruskal-Wallis) techniques.

To maintain quality assurance and quality control (QA/QC), acoustic monitoring equipment will be checked and data cards downloaded into a database every 1–2 weeks to minimize data loss from equipment failures or other factors. The database will be checked periodically by the study project manager for inconsistencies and errors, and the entire database will be proofed again for errors before data analyses. All data will be stored on a network server with frequent backups to prevent loss of data.

Results of bat surveys will be used in conjunction with habitat data to evaluate habitat use and activity levels across the study area, allowing a quantitative assessment of habitat loss for little brown bats.

The potential for roosting sites and winter hibernacula to occur in the Project area will be assessed by reviewing geological literature regarding the occurrence of suitable bedrock (e.g., limestone) in the Project area that would be conducive to the formation of caves, which are favored by little brown bats during hibernation (Parker et al. 1997). Forest inventory information will be gathered from respective landowners if available, to assess presence of large diameter dead trees for roosting habitat. Human-made structures (buildings, bridges) will also be investigated for potential roosting sites. Due to the extremely limited number of human-made structures within the Project area, identification and location of potential search areas will be coordinated with the findings of the historic properties surveys (Section 11).

Anticipated work products include characterization of overall bat activity, identification of areas of concentrated bat activity, and documentation of locations of potential maternity roosts or hibernacula.

Through the successful completion of the proposed study, AEA will document bat use (passes/detector-night) and identify potential roosting and hibernating structures present in the Project area.

ADF&G's review of the study request for the bat study includes recommendations for better documentation of seasonal variation in bat occurrence and activity, expanded sampling that would provide habitat-specific indices of abundance, and more thorough searching for naturally occurring roosts, maternity colonies, and hibernacula. Because we share ADF&G's opinion that "The Watana development is unlikely to impact large numbers of bats or affect a significant portion of the population either directly or indirectly," it would be appropriate to initiate the bat study with the more limited objectives for 2013, as described above. If seasonal concentration areas such as maternity colonies or hibernacula are located, a second season of field work would be conducted in 2014, and further consideration of ADF&G's recommendations for an expanded field effort could be made at that time.

8.13.4.2. Impact Assessment

Data on the distribution of bats and their presence/absence in various habitats in the study area will be used to assess Project impacts through geospatial analysis and evaluation of the responses of the study species to other similar projects, as documented in the scientific literature. Using GIS software, species presence/absence recorded in different habitat types will be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans (Sections 9.5, 9.6 and 9.7). Although the wildlife habitats defined for this study will not be at a scale to include caves or structures used for hibernacula, we will include known locations of concentrated bat activity on the map. The direct and indirect impacts of the Project will be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate direct impacts of habitat loss and alteration and by applying various buffer distances, as determined from the available information on the expected effects, to estimate indirect impacts. The GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on bat populations. Any necessary PM&E measures will be developed by examining the distribution and abundance of bats and their habitats in relation to the geographic extent and seasonal timing of various Project activities.

8.13.5. Consistency with Generally Accepted Scientific Practice

The bat study will be conducted using standard acoustic monitoring techniques as described in Hayes et al. (2009). The USFWS endorses the use of acoustic monitoring to help predict impacts to bats at other industrial developments (i.e., wind energy sites [USFWS 2012]). Anabat®

broadband acoustic detectors are proposed for use in this study, and they are widely used for passive detection of free-ranging, echolocating bats (O'Farrell et al. 1999).

8.13.6. Schedule

Acoustic monitoring would commence by the beginning of June 2013 and continue through September 2013. Evidence of reproductive females (e.g., pregnant or lactating) in Alaska have been documented in mid-June (Parker 1996) and swarming behavior (high concentrations of bat activity) in September can be indicative of the presence of hibernacula. The proposed study duration will capture activity patterns during these important life cycle stages.

Data management will be ongoing during the field season, but will be finalized after all sampling has been completed in September. Data analyses will be conducted in October and November. The Initial Study Report will be submitted in December 2013. An Updated Study Report that incorporates data gathered from other ongoing studies (e.g. botanical studies) will be issued in December 2014.

8.13.7. Level of Effort and Cost

Development of a preliminary wildlife habitat map in 2012 (see Section 9.5) will help with designing a stratified acoustic monitoring plan based on major habitat types. Up to 20 Anabat detectors will be deployed between June and September 2013 to ensure adequate spatial coverage.

After initial deployment in June, field crews will service each Anabat detector approximately twice per month during the anticipated 4-month field season. Hence, eight helicopter-supported site visits will be scheduled, in addition to employing the services of other field crews to download and inspect the detectors when possible to reduce program costs. Up to two additional field days will be scheduled for a helicopter-supported survey of sites determined to have potential for supporting hibernating bats.

Project costs in 2013 are anticipated to be less than $200,000.

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8.14. Waterbird Migration, Breeding, and Habitat Study

8.14.1. General Description of the Proposed Study

The waterbird study will be conducted for two years, 2013 and 2014, and will include staging and migration surveys, breeding waterbird surveys, Harlequin Duck (*Histrionicus histrionicus*) surveys, and brood-rearing surveys. Waterbirds may use lakes, ponds, rivers, and flooded wetland areas throughout the Project area during migration. Aerial surveys for staging and migration will follow a lake-to-lake pattern and also will parallel river courses. Surveys for breeding waterbirds, primarily waterfowl, would follow the current USFWS Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys (USFWS and CWS 1987). Aerial surveys for Harlequin Ducks will focus on river habitats during the pre-nesting and brood-rearing seasons. Brood-rearing surveys will be conducted by observation of open water and shoreline habitats of lakes and ponds by ground-based biologists in the Project area.

8.14.1.1. Study Goals and Objectives

The goal of the waterbird study is to collect baseline data on waterbirds migrating through and breeding in the Susitna-Watana Hydroelectric Project (Project) area to enable assessment of the potential impacts of the Project and to inform the development of appropriate protection, mitigation, and enhancement measures. As used here, "waterbirds" is applied broadly to include swans, geese, ducks, loons, grebes, cranes, cormorants, herons, gulls, and terns. Shorebirds frequently are included in the general category of waterbirds, but they are addressed separately for this Project under the landbird and shorebird study plan (Section 8.16) because the field survey methods for shorebirds are ground-based and they can be surveyed along with landbirds. This study plan includes breeding surveys for the Harlequin Duck, a species of conservation concern that requires specific stream-survey techniques.

The specific objectives of this study are to:

- Document the occurrence, distribution, abundance, productivity, and habitat use of waterbirds breeding in the Project area;
- Document the occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds migrating through the Project area in spring and fall; and
- Review available information to characterize food habits and diets of piscivorous waterbirds documented in the study area as background for the *Mercury Assessment and Potential for Bioaccumulation Study* (Section 5.12).

The information gained from this study will be used to evaluate waterbird habitat loss and alteration quantitatively, in conjunction with the separate wildlife habitat mapping and habitat evaluation studies (see Sections 9.5 and 8.19, respectively), and to estimate the number of migrating and breeding waterbirds that may be affected by the Project.

8.14.2. Existing Information and Need for Additional Information

Existing information on the distribution and abundance of waterbirds in the Project area during the breeding and migration seasons is mostly based on studies conducted in 1980 and 1981 for the APA Susitna Hydroelectric Project (Kessel et al. 1982). Data from those studies were used to quantify the level of use of waterbodies by migrating and breeding waterbirds. A relative "importance value" was determined for each waterbody surveyed in each migration season, incorporating the number of species, the number of birds, and the density of birds found on the waterbody in relation to the overall numbers and densities recorded on the surveys (Kessel et al. 1982). Those study results provide a good knowledge base concerning waterbird use of the Project area three decades ago but, because the population numbers of numerous species have changed in the past 30 years, new waterbird surveys are needed to elucidate the current distribution and abundance of breeding and migrating waterbirds in the Project area.

More recent survey data on breeding waterbirds in the upper Susitna River basin has been collected annually during USFWS waterfowl breeding population surveys (Mallek and Groves 2011a), but only a few transects of the Stratum 2–Nelchina survey area (Mallek and Groves 2011b) are located within the Project area. Those transects occur east of the proposed Watana reservoir near the Oshetna River, where the density of lakes and wetlands is relatively high.

The population of Trumpeter Swans (*Cygnus buccinator*) is an example of a waterbird species whose population has changed substantially in the last 30 years (Conant et al. 2007). A complete census of Trumpeter Swans on their breeding grounds in Alaska began in 1968 and was repeated at 5-year intervals between 1975 and 2005 (Conant et al. 2007). Together, two survey areas (Unit 3–Gulkana and Unit 5–Cook Inlet) include the entire Susitna River basin (Conant et al. 2007). The population of Trumpeter Swans summering in Alaska has increased since 1975 and breeding has expanded into peripheral habitat. No census was conducted in 2010, so information on the distribution and abundance of Trumpeter Swans in the Project area is out of date and new surveys are needed.

Waterbird productivity was evaluated in 1981 using ground surveys of waterbodies within proposed impoundment areas and access routes associated with the APA Susitna Hydroelectric Project. Those surveys provide historical data for the area 30 years ago, but need to be updated. Current surveys addressing waterbird productivity need to be conducted in areas of proposed facility locations, road and transmission corridors, and any areas affected by the Project within and near the inundation zone.

No existing information exists on the distribution and abundance of Harlequin Ducks in the rivers of the Susitna River drainage. The Harlequin Duck is a species of conservation concern that nests and raises broods almost exclusively in mountain stream drainages. New surveys need to be conducted to assess the distribution and abundance of Harlequin Ducks in the Project area.

8.14.3. Study Area

The study area for waterbirds will include all rivers, lakes, ponds, and wetland habitats that could be affected by the Project within the inundation zone and a 3-mile buffer area around this affected area (Figure 8.14-1). Additionally, all waterbody habitats occurring in areas of proposed Project facility locations and along proposed road and transmission corridors will be included in the study area for waterbirds. All rivers and streams that are part of the affected and buffered areas will be surveyed for staging waterbirds and breeding Harlequin Ducks, including the Oshetna River and Kosina, Watana, Deadman, Prairie, and Devil creeks. These features all occur within the study area boundary proposed to be used for the mapping of vegetation and wildlife habitats (see Section 9.5, Figure 9.5-1).

8.14.4. Study Methods

8.14.4.1. Migration Surveys

The most effective means of assessing the distribution and abundance of waterbirds over a large area is through aerial surveys. Waterbirds may use lakes, ponds, rivers, and flooded wetland areas throughout the Project area during migration.

Standard methods for surveying staging waterbirds in an area where waterbodies are irregularly spaced, like in the Project area, is a lake-to-lake pattern, where each lake is circled to count waterbirds on the shore and in the lake. Waterbirds often use rivers for staging during spring because nearby lakes can be covered with ice. Surveys of rivers are flown parallel to the river course to allow observers to view waterbirds on the water and along the shoreline.

Aerial surveys of staging waterbirds in Alaska are conducted with either a fixed-wing aircraft or a helicopter and the platform used can depend, in part, on the topography of the survey area. Because of the canyon and mountain terrain of the Project area, a helicopter is the recommended survey platform for waterbird migrations surveys to ensure good visibility and for maneuvering safely.

To determine the period of peak of migration, surveys will be conducted at 7-day intervals during the spring (May–early June) and fall (late August–October) migration periods, resulting in about 4 surveys in spring and about 10 surveys in fall. Each survey is expected to take approximately two days to complete. A single observer will record all data on a hand-held digital recorder, which is later transcribed into a computer database for analysis. Data can be summarized by species, species-group, lake-group or river segment, date of survey, and survey area. Surveys results determine species composition, the timing of migration, and identify areas important to migrating waterbirds.

8.14.4.2. Breeding Population Surveys

Surveys for breeding waterbirds, primarily waterfowl, would follow the current USFWS Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys (USFWS and CWS 1987). The survey is designed to follow transect lines that are spaced approximately 800 meters (2,625 feet) apart and aligned to cover the largest possible number of waterbodies and wetlands. The placement of the transect lines are determined prior to the survey using aerial imagery or topographic maps.

The survey is traditionally conducted in a fixed-wing aircraft; however, if the canyon and mountain terrain of the Project area proves to be too difficult to maneuver a fixed-wing aircraft safely and for acquiring survey data effectively, a helicopter may be used. Two observers, one on each side of the aircraft, will look for waterbirds in a 400-meter (1,312 feet) swath on either side of the aircraft while the pilot navigates the transect line using a GPS. Observations will be recorded on hand-held digital recorders and with a GPS waypoint, and will later be transcribed into a computer database for analysis. Survey data will be used to calculate annual densities for each species of waterfowl and identify areas important to breeding waterfowl.

Surveys will be flown in early June when breeding pairs are visible on territories and not yet on nests. Survey timing can affect survey results because the nesting phenology of dabbling ducks is slightly earlier than diving ducks, and some dabbling duck species can be missed if the survey occurs too late, after the cryptically colored females are on nests and more brightly colored males have left the area. Two surveys, spaced about two weeks apart, will be conducted to target the peak timing of breeding for dabbling and diving ducks. Each survey is expected to take approximately two days to complete.

8.14.4.3. Harlequin Duck Surveys

Harlequin Ducks predominantly use streams for foraging and they nest in adjacent shoreline habitats. Male Harlequin Ducks are only present on breeding streams during a short period in spring when courting females. Accordingly, a pre-nesting survey is scheduled at that time to quantify the number of nesting pairs occupying a stream. After nesting, successful females are visible on streams with their broods, and failed breeders often group together.

Surveys for pre-nesting and brood-rearing Harlequin Ducks will be flown in a helicopter with two observers seated on the same side. Surveys will be generally flown in an upriver direction with the helicopter positioned over the bank of the river to give the observers an unobstructed view of the entire width of the watercourse. Observations will be recorded on hand-held digital recorders and with a GPS waypoint, and will later be transcribed into a computer database for analysis. Survey data will be used to calculate linear densities (ducks per kilometer) and to identify streams important to breeding Harlequin Ducks.

To account for the annual variation that may occur in the occurrence of the peak number of breeding pairs and brood-rearing females on a stream, two years of pre-nesting and brood-rearing surveys will be conducted. Two pre-nesting surveys, spaced 7–10 days apart, will be flown in late May–early June each year and two brood-rearing surveys, spaced 7–10 days apart, will be conducted in late July–early August each year. Each survey is expected to take approximately two days to complete.

8.14.4.4. Brood-rearing Surveys

Information on waterbirds breeding in specific areas that would be directly affected by the Project infrastructure or activities will be collected by biologists conducting foot surveys at suitable lakes, ponds, and wetlands. These surveys will be conducted in midsummer during the brood-rearing period to record the presence of adults accompanied by broods of juveniles. The study area will be determined based on the location of proposed Project infrastructure.

Two to four observers will traverse all wetlands and circumnavigate all ponds and lakes on foot within the study area to search for waterbirds, particularly ones with broods. All waterbirds observed will be recorded on field data sheets and brood ages for waterfowl (primarily ducks) will be classified into one of seven age classes based on chick plumage patterns. Survey data will be used to calculate densities of broods and to determine nest initiation dates by back-dating (subtracting the age of young and the incubation period).

8.14.4.5. Review of Food Habits and Diets of Piscivorous Waterbirds

The scientific literature will be reviewed to locate and synthesize information on the food habits and diets of piscivorous waterbirds (e.g., loons and grebes) in freshwater aquatic systems to support the pathways analysis being conducted as part of the *Mercury Assessment and Potential for Bioaccumulation* (Section 5.12), which was recommended by the USFWS in response to the request for comments on the Pre-Application Document for the Project (letter from USFWS to AEA dated 31 May 2012).

8.14.4.6. Impact Assessment

The primary impact mechanisms of the Project on waterbirds may include:

- Permanent direct and indirect habitat loss and alteration;
- Temporary direct and indirect habitat loss and alteration;
- Direct behavioral impacts, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development;
- Mortality due to increased subsistence and recreational harvest that may be facilitated by improvements in human access that result from Project development;
- Changes in mortality due to predation that may result from changes in the abundance and distribution of waterfowl predators, including both mammalian and avian carnivores; and
- Direct mortality due to strikes with vehicles, powerlines, towers, or other project facilities; exposure to contaminants; and attraction to garbage and human activity.

Impacts associated with habitat loss and alteration, attraction and avoidance, and direct mortality will occur primarily in the Project area, including the impoundment area, access and transmission corridors, and other facility footprints. Impacts associated with increased harvest\ and changes in predator abundance may occur over a larger area in which changes in both competing mammalian predators and prey species abundance may occur.

Data on the distribution, abundance, productivity, and habitat use of waterbirds in the study area will be used to assess Project impacts on these populations. Impacts of direct and indirect habitat loss and alteration can be assessed through geospatial analysis. When plotted on the wildlife habitat map, developed under the botanical resources study plans, the locations of breeding, brood-rearing, and staging waterbirds will allow identification of high value or critical seasonal habitats for each species. Using GIS software, the direct and indirect impacts of the Project can be evaluated for each waterbird species by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate loss of preferred or critical habitats. Additional indirect impacts of habitat loss and alteration and behavioral reactions (such as avoidance) can be estimated by applying various buffer distances, as determined from the literature on the effects of similar projects. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on waterbird populations. Density estimates for breeding and brood-rearing waterbirds in each habitat and linear densities of Harlequin Ducks can be used to estimate numbers of birds potentially affected by habitat loss and alteration and by behavioral reactions that may result in avoidance. Location data for each species can be used to assess risks from powerline and other bird strikes for various alternative Project configurations. Any necessary PM&E measures will be developed by examining the distribution and abundance of species among habitats in relation to the geographical extent and seasonal timing of various Project activities.

8.14.4.7. Reporting and Deliverables

Study products will include:

- **Electronic copies of field data.** A geospatially-referenced relational database will be developed that incorporates all historic and current data, including nesting and brood-rearing locations for each species. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Study Reports.** In December 2013, an Initial Study Report, and in December 2014, the Updated Study Report, will be provided. The Updated Study Report will summarize the results for both years.

8.14.5. Consistency with Generally Accepted Scientific Practice

The Waterbird Study will be conducted using standard waterfowl aerial survey techniques including those described in the current USFWS Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys (USFWS and CWS 1987). These same techniques have been successfully used to survey for migrant and breeding waterbirds on other large-scale projects (PLP 2011).

8.14.6. Schedule

The same seasonal schedule will be followed in both 2013 and 2014. The timing of some surveys, particularly in spring and summer, will depend on ice break-up and the nesting phenology for the year.

May:	Up to 4 migration surveys at intervals of 7–10 days (depending on time of river breakup and lake moat formation); 2 Harlequin Duck pre-nesting surveys in second half of month.
June:	Up to 2 breeding population surveys in first half of month.
July:	Brood-rearing survey (2nd week); Harlequin Duck brood-rearing survey (4th week).
August:	Harlequin Duck brood-rearing survey (1st week); 2 migration surveys in second half of month.
September:	Migration surveys at intervals of 7–10 days.
October:	Migration surveys at intervals of 7–10 days.
November:	All survey data are reviewed and checked after each survey. During the data collection period from April through October, data is entered into a computer database program and reviewed and checked again. Data analysis would be ongoing throughout the summer and fall, and completed by November of the survey year.
October - December:	Data analysis and report preparation.
December	Initial Study Report (2013) and Updated Study Report (2014) issued by AEA.

8.14.7. Level of Effort and Cost

The waterbird field surveys will require an estimated minimum of 72 person days, not including weather delays or changes in project study design, as indicated below.

- Migration Surveys = 28 person days
- Breeding Waterfowl Population Surveys = 8 person days (assuming 2 surveys per year)
- Harlequin Duck Pre-nesting Surveys = 8 person days
- Harlequin Duck Brood-rearing Surveys = 8 person days
- Waterbird Brood-rearing Survey = 20 person days

The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $250,000, for an approximate estimated total of $500,000 for both years.

8.14.8. Literature Cited

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8.14.9. Figures

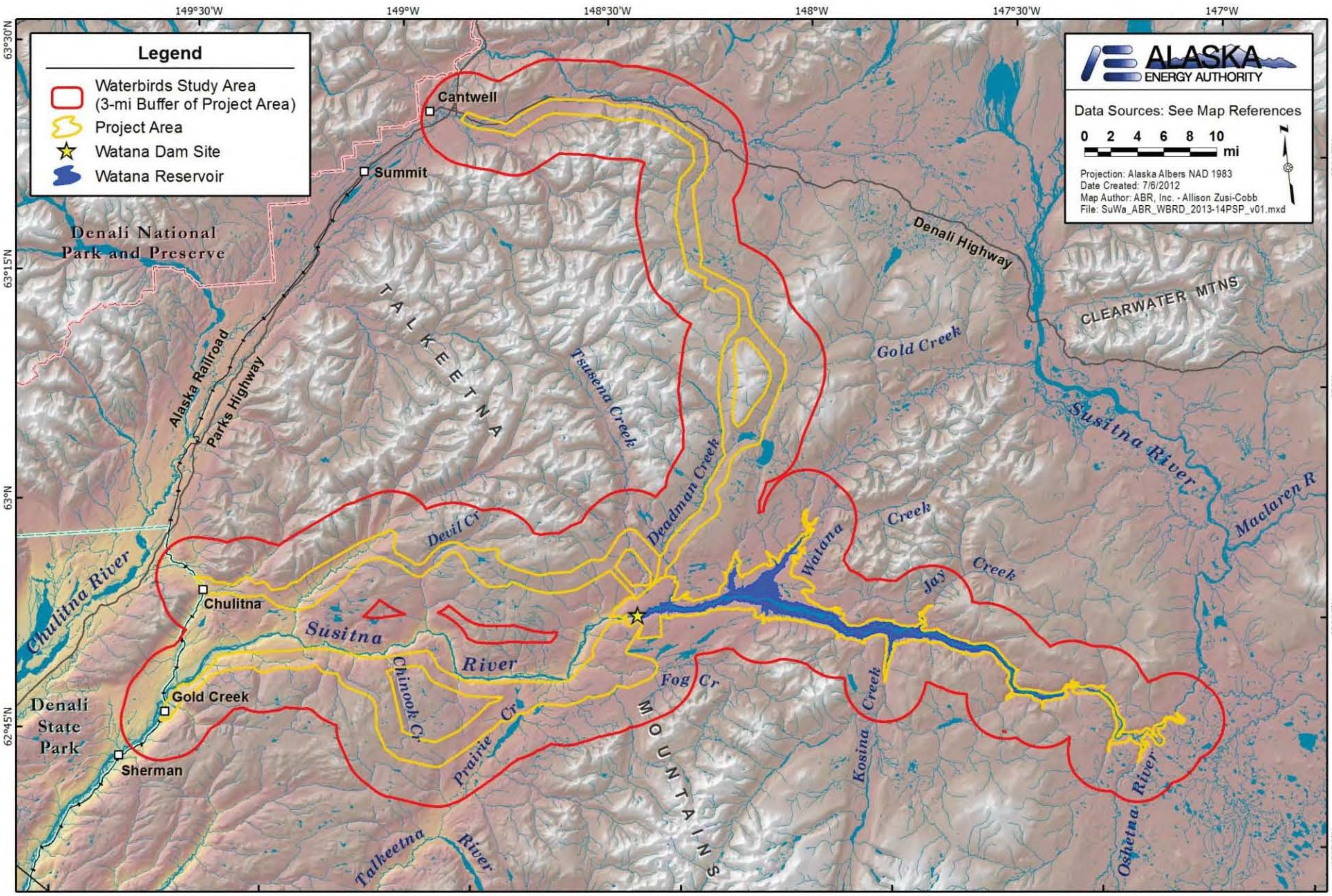

Figure 8.14-1. Waterbird study map.

8.15. Survey Study of Eagles and Other Raptors

8.15.1. General Description of the Proposed Study

The raptor study was initiated in 2012 to prevent inadvertent take of raptors by providing information on raptor avoidance zones to Project personnel in the field in 2012. The raptor study will continue in 2013 and 2014, providing data both for the avoidance of raptor take and for the assessment of Project impacts.

8.15.1.1. Study Goals and Objectives

The goal of the raptor study is to characterize population size, productivity, nesting phenology, and habitat use of local raptor species to (1) inform the prediction and quantification of impacts that may result from the proposed Project, and (2) provide information required for a possible application(s) for federal Eagle Take (lethal or disturbance take, see below) and/or Eagle Nest Take Permits. Common and scientific names of raptors that may occur in the Project area are listed in Table 8.15-1.

The specific study objectives are:

- Enumerate and identify the locations and status of raptor nests and territories that could be affected by Project construction and operations. Specific tasks associated with this objective include:
  — Review and synthesize existing nest data for eagles and other raptors: Identify and determine status of previously-recorded nest locations of various species, including geographic coordinates, annual nest activity, descriptions of nest site characteristics, and general descriptions of cliff habitat in proximity of each site;
  — Conduct field surveys to locate and characterize nests: Locate and map all existing Bald Eagle and Golden Eagle nests in the Project study area, identifying all active and inactive nests and alternative nest sites. Locate and map all existing active and inactive nests of other tree- and cliff-nesting raptor species (as well as Common Ravens) in the inundation area;
  — Create a geospatial database of all nests and territories: The database will be used to calculate inter-nest distance, estimate local average territory size, and, with overlays of project footprint and habitats, determine number of nests and territories potentially affected; and
  — Calculate local average territory size for Bald Eagle and Golden Eagle: Estimates of average territory sizes (and mean inter-nest distance) are required for application for federal Eagle Nest Take permits.
- Estimate Project effects on productivity of raptors. Specific tasks associated with this objective include:
  — Review existing productivity data (if any);
  — Determine the average and range of productivity of nests of each eagle/other raptor/raven species; and
  — Consider impacts on productivity at the local and larger population level using current and historical data.
  — Additionally, an Eagle Take permit for disturbance would require pre- and post-construction productivity comparisons to determine if realized take is consistent with

the permitted take, and to ensure that the level of take is compatible with the preservation of eagle populations.

- Estimate effects on nesting and foraging habitats by delineating suitable habitat features in a GIS (this work will be conducted in the habitat-use evaluation study, see Section 8.19). Characterize and map the habitat as suitable or not suitable for nesting and foraging for the various raptor species. These characterizations will be used to:
  - Calculate percent local habitat lost;
  - Calculate numbers of breeding pairs and productivity;
  - Determine whether or not a partial loss of a territory may functionally result in abandonment of the entire territory; and
  - Identify whether or not habitats adjacent to the project area may potentially be available for displaced nesting birds.
- Conduct field surveys and literature reviews to identify, map, and characterize the habitat-use patterns at any fall and winter communal roost sites and foraging sites of Bald and Golden eagles and other raptor species. Describe seasonal habitat use, highlighting areas or conditions which may result in impacts on raptors.
- Conduct a risk assessment study to determine if any section of planned overhead transmission lines may pose a collision risk to migrating or nesting raptors and to identify any nests and/or migratory corridors (including altitudes of raptor movements) in the areas planned for overhead power transmission lines.
- Provide information on distribution, abundance, and diet of piscivorous (fish-eating) raptors and information on known effects of mercury on raptors to the *Mercury Assessment and Potential for Bioaccumulation Study* (see Section 5.12).

8.15.2. Existing Information and Need for Additional Information

Historical information from aerial surveys of raptors in the early 1980s provided the first assessment of the distribution, abundance, and vulnerability of many raptor nests located within the proposed Project impoundment zone. Those surveys highlighted Bald and Golden eagles and Common Ravens, and, to a lesser extent, other raptors such as Northern Goshawks. Extensive information on raptors was collected during the 1980s for the original APA Susitna Hydroelectric Project and for other surveys in the region (discussed in ABR 2011). Hard-copy maps are available of eagle nests located during the APA Susitna Hydroelectric Project studies in the early 1980s (LGL 1984). Other nest site records may exist in the files of the University of Alaska Museum of the North (AEA 2011). Other investigators and agency personnel may have information on raptor nest sites and important habitats, such as roosting sites, in or near the Project area. Similar regional databases of nest site information have been developed (Wildman and Ritchie 2000).

Surveys completed in the middle and upper Susitna area during the 1980s identified 23 Golden Eagle, 10 Bald Eagle, 3 Gyrfalcon, 3 Northern Goshawk, and 21 Common Raven nest sites (some sites include more than one nest site, if they are close together) (APA 1985). Although Common Ravens are not raptors, they construct both cliff and tree nests similar to raptors, are culturally significant, and are protected by the MBTA. Of the eagle nest sites identified in the 1980s, five Golden Eagle and three Bald Eagle sites were expected to be completely inundated by the original APA Susitna Hydroelectric Project, Phase 1 Watana Impoundment (LGL 1984).

New raptor studies are needed because most of the existing information is almost 30 years old and it is unknown how distribution, status, or other conditions may have changed. Also, historical surveys did not cover the entire area of current interest including access roads and power transmission corridors. More sophisticated geospatial analyses are now available that allow for more accurate assessments of the potential effects of the Project on raptors and their habitats. Finally, current data will be necessary for compliance with Federal laws, especially the BGEPA and the MBTA, as well as the FERC–USFWS MOU (2011).

A limited field survey for raptors was conducted in 2011 (ABR 2011) and more extensive surveys of the Project area were initiated in 2012 (AEA 2012) to provide current information needed to protect raptors by restricting project activities near active raptor nests during pre-license field studies and construction. In 2011, surveys on 27 June were limited to the area near borehole sites drilled for the geotechnical program in the vicinity of the proposed Watana dam. In 2012, occupancy surveys for nesting raptors were performed twice in May and productivity surveys were performed twice in July. The 2012 survey area comprised the area within a 2-mile buffer of the Project area (impoundment, access and transmission corridors, and facilities/infrastructure). Surveys were conducted from a Robinson R44 “Raven II” helicopter (Quicksilver Air). Dozens of raptor nests were observed and occupied nest sites were located and mapped. Nest of four species of raptors were identified in the project area: Golden Eagle, Bald Eagle, Peregrine Falcon, Red-tailed Hawk, and Merlin. GPS files, PDF maps, and avoidance guidelines were distributed to Project personnel and contractors to avoid “take” of nests by disturbance.

Although some transmission lines are a persistent source of raptor and eagle mortality by electrocution and collision, it is assumed that all new transmission lines and power transfer stations for the Project will be built to the “eagle-safe” standards developed by the Avian Power Line Interaction Committee (APLIC 2006), and therefore will not likely constitute a significant source of electrocution risk for raptors. However, significant lengths of new transmission lines will be constructed across the previously open and undisturbed landscape. As discussed in the Avian Protection Plan (APP) Guidelines (APLIC and USFWS 2005), collision risk assessments are recommended in the siting of overhead power transmission lines.

Some survey protocols recommend searching for Golden Eagle nests within 10 miles of a project boundary (Pagel et al. 2010). The resulting search area for the Susitna-Watana Hydroelectric Project may be unreasonably large, costly, and logistically difficult to complete during the optimal survey window for nesting phenology, however. Because the 10-mile survey area recommendation was developed by USFWS primarily for projects that may cause regular mortalities, such as collisions with wind turbines, a survey area within 2–3 miles of Project facilities has been deemed adequate for the 2012 survey effort, in consultation with USFWS (see consultation record of the 12 April 2012 Eagle/raptor Agency Technical Group Meeting in Section 8.4, Table 8.4-1, and Appendix 8-1). The 2013–2014 survey area will be expanded to 10 miles surrounding the reservoir impoundment zone, as described earlier.

8.15.3. Study Area

The survey area for occupancy and productivity of eagles consists of all appropriate habitat within a 10-mile radius around the reservoir impoundment zone, and within a 3-mile radius of proposed facilities and the centerlines of the potential access road and transmission-line corridors (Figure 8.15-1). Ten miles is the USFWS’s interim recommendation for survey radius for

Golden Eagles (Pagel et al. 2010) in areas with suitable habitat (i.e., the middle Susitna River basin), and is necessary also for Bald Eagles around the impoundment zone to get an adequate determination of mean inter-nest distance. For species besides eagles, and for foraging and roost sites of eagles and other raptors, a radius of 3 miles around the reservoir impoundment zone, proposed facilities and centerlines of the potential access road and transmission-line corridors is sufficient.

All Bald and Golden eagle habitat within the study area boundary will be surveyed. For Bald Eagles, surveys will cover the area within a half-mile of the centers of all drainages with suitable timber and within a half-mile of all shorelines of lakes with similar characteristics in the impoundment zone and wherever these habitats cross proposed road and transmission-line corridors. Information on other large tree-nesting birds will also be collected. Survey routes for cliff-nesting raptors will be flown in a cliff-to-cliff survey pattern focused on cliffs suitable for Golden Eagle nests during this period.

The survey methodology will obtain information for an area larger than the 1980s survey coverage, will gather information on key species in a more well-defined study impact area, and will provide AEA with information potentially needed for eagle permitting and to develop avoidance areas and mitigation protocol to reduce the potential disturbance of nesting raptors from Project construction and operations activities. The nesting survey may be sectioned to include segments that match the extent of the 1980s survey to the extent appropriate for comparison purposes to evaluate trends in raptor populations and/or habitat use.

The study area for migration route surveys may be limited to specific locations along planned transmission line routes that may pose risks to migrating birds (e.g., ridgelines). These study areas will be determined in consultation with the USFWS and based on review of existing raptor migration data, topographical and wind current information, and other relevant factors.

8.15.4. Study Methods

8.15.4.1. Field Surveys

Inventory and monitoring methodologies for nest occupancy and productivity surveys will follow established aerial and ground-based protocols for eagle nest surveys (USFWS 2007, Pagel et al. 2010), using appropriately trained observers and suitable survey platforms (helicopter, fixed-wing aircraft). Modifications may be necessary to extend to the objective (1.3.1 A.2.a., above) of identifying and monitoring the nests of other raptors. Cliff-nesting raptors (including Golden Eagle, Peregrine Falcon, Gyrfalcon, as well as Common Raven and potentially Bald Eagle) and raptors using large stick nests (including Bald Eagle, Great Horned Owl, Northern Goshawk, Red-Tailed Hawk, Osprey, Common Raven, and potentially Golden Eagle) will be inventoried and monitored. Small to medium-sized raptor species (e.g., Short-eared Owl, Boreal Owl, Northern Hawk Owl, Northern Harrier, American Kestrel, Merlin, and Sharp-shinned Hawk) will require ground-based surveys (these studies can be integrated with landbird point counts and shorebird surveys). Details regarding survey extent and methods will be developed in coordination with the USFWS prior to initiating surveys.

Nest occupancy surveys will begin in spring before leaf-out (late April to late May), focusing on primary habitats for Bald and Golden eagles, but also considering primary habitat of resident species nesting in woodland (e.g., Great Horned Owl and Northern Goshawk) and on cliffs (e.g., Gyrfalcon and Peregrine Falcon).

The nest productivity survey period will occur during mid-June to late July for surveys to verify and monitor nesting activity and to search for additional nests of later nesting raptors. Because of the wide range of breeding dates for all raptors considered in the study (mid-February for resident owls through early September for dispersal of Bald Eagles from nesting areas), the second survey period will encompass a broad timing window from mid-June through mid-July. The nesting chronology of each focal raptor will be considered during survey scheduling. Helicopter protocols described for the spring nest occupancy surveys would be employed during these occupancy and productivity surveys.

A helicopter will be used, carrying two observers in addition to the pilot. Flight altitude and speed will follow standard survey protocols for each habitat type (Pagel et al. 2010). Observers will be seated on the same side of the aircraft during surveys. Location and nest attribute data including substrate, nest species, and status will be collected for inclusion in the geodatabase.

In any aerial survey, a key concern is quantifying the sightability of the target species to adjust density estimates for targets missed. The actual sightability of nests depends on many factors, including nest size, location, survey weather/light conditions, substrate and tree density, habitat type, observer experience, and survey platform. Although Golden and Bald eagles often construct large, conspicuous stick nests, some inconspicuous nests are still likely missed when conducting surveys. Resurveys of subsamples of the survey area will be performed to assess the sightability of raptor nests in the project area.

To prevent disturbance to Dall's sheep during the lambing period, or near the Jay Creek and Watana Creek mineral lick sites, standard eagle survey protocols may need to be modified (Pagel and Whittington 2011) and helicopter surveys will avoid these areas. If necessary, additional ground surveys for nesting raptors will be conducted in these areas. Observations would be completed during the nest occupancy and nest productivity periods described above, but would be made at safe distances from sheep lambing areas. Spotting scopes would be required to search cliff areas; in addition, broadcast calls may be used to help determine the use of cliffs by Peregrine Falcon and Gyrfalcon. Helicopters would be used to drop off and pick up observers.

Intensive winter surveys would be required for early nesting owls but are not likely practicable because they would require logistically difficult and potentially dangerous winter work in remote areas. Additionally, they would only yield information on two species (Boreal Owl and Northern Hawk Owl) that are relatively rare/uncommon and not species of high concern. Instead, utilizing the wildlife habitat map, results from landbird surveys (point-counts and shorebird surveys) in concert with thorough literature review could be used to estimate distribution and abundance and habitat use and potential habitat loss for these species. Final details regarding survey methods will be developed in coordination with the USFWS prior to initiating any surveys.

Surveys for foraging and roost locations will be conducted primarily in winter. Repeated surveys of suitable protected forest stands may be necessary due to the high mobility of wintering Bald Eagles. Three to five aerial surveys of foraging habitat and communal roosts, primarily for Bald Eagles, will be conducted each year at intervals of 7 to 21 days between mid-October and early December. Survey numbers and timing may be adjusted in 2014, based on the results of the surveys planned for 2012. A helicopter or a fixed-wing aircraft carrying two observers will be used for these surveys. Surveys will be conducted near dawn or dusk. Information on fall fishery concentrations will be requested from Project fisheries researchers and from agency biologists to more effectively monitor potential Bald Eagle concentration areas.

Surveys to determine if migration routes exist that may put migrating raptors at risk for collision with Project power transmission lines would generally follow the USFWS's recommended point count protocol, based on standard hawk migration counting protocols as described in Appendix C of the Draft Eagle Conservation Plan Guidance (USFWS 2011).

8.15.4.2. Reporting

Reporting of inventory and monitoring data will comply with the protocols and standards described in the Memorandum of Understanding between the Federal Energy Regulatory Commission and the USFWS (FERC and USFWS 2011). Survey reports will include:

- Maps and associated metadata for historical eagle and other raptor nest and communal roost locations with survey extents to compare to current survey data.
- Maps and associated metadata with coordinates for current nest locations, nest activity status, fall and winter communal roost areas, and migration routes.
- Summary and mapping of suitable forest, riparian, and cliff habitats to evaluate extent of suitable nesting habitats and facilitate nest searches within the Project area.

Observations will be recorded and geo-referenced with associated habitats during surveys. Raptor nests and observations will also be recorded during landbird and shorebird point-count surveys and all raptor observations will be plotted on wildlife habitat maps using a Geographic Information System (GIS) and Global Positioning System (GPS) receiver coordinates. Nest characteristics will be recorded according to protocol developed in consultation with the USFWS, including the protocol of the USFWS Alaska Bald Eagle Nest Atlas (http://alaska.fws.gov/mbsp/mbm/landbirds/alaskabaldeagles/default.htm).

The wildlife habitat maps will provide the basis for an ecosystem approach to assessing the effects of development-related habitat impacts on raptors. The habitat maps will facilitate quantitative analyses of raptor habitat availability and changes therein that result from development; and, in combination with raptor survey data, will allow a means to assess the potential for changes in local raptor populations during construction and operations. The maps will help in calculations of percent local habitat lost; calculations of numbers of breeding pairs and productivity; determination of whether or not a partial loss of a given territory may functionally result in abandonment or failure of the entire territory; identification of whether or not habitats adjacent to the project area may potentially be "available" (notwithstanding occupancy) for displaced nesting birds; and risk assessments for collisions with overhead transmission lines.

8.15.4.3. Data Analysis

A geo-spatially referenced relational database will be developed which incorporates the historic and current data, including nest and roost locations for each species, occupancy/activity/productivity, nest type and characteristics, stand characteristics, and photographs. Suitable raptor nesting habitat will be delineated using ArcGIS software. Existing nest locations and distribution of timber stands with suitably sized nest trees in coordination with Project studies involving vegetation surveys and mapping and three dimensional topographic modeling will be incorporated into the identification and delineation of suitable raptor nesting habitats. Foraging habitats will also be delineated whenever possible. Distribution of spawning salmon as determined by collaborating with Project salmon studies will be used to identify Bald Eagle foraging locations and potential fall eagle aggregation areas. Distribution of fall waterfowl staging areas as determined in coordination with the waterfowl Project study will provide information valuable for locating fall Bald Eagle foraging locations and potential communal roost areas. Distribution of Dall's sheep lambing areas and caribou calving areas as determined in coordination with the terrestrial wildlife Project studies will provide information for Golden Eagle foraging habitat analyses.

Local Bald Eagle and Golden Eagle territory sizes will be estimated using inter-nest distances as described in the Draft Eagle Conservation Plan Guidance (USFWS 2011). Recommendations will be developed for future data gathering needs and analyses designed to evaluate potential Project-related impacts to eagles and other raptors.

As noted above, pertinent data gathered from other studies will be incorporated into the evaluation of potential Project-related impacts to eagles and other raptors.

8.15.4.4. Impact Assessment

The primary impact mechanisms of the Project on raptors may include:

- Permanent direct and indirect habitat loss and alteration, including loss of nesting sites and loss and alteration of foraging habitat;
- Temporary direct and indirect habitat loss and alteration, including indirect impacts resulting from altered distribution and abundance of prey;
- Potential direct behavioral impacts, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation;
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development; and
- Potential direct mortality due to strikes with vehicles, powerlines, towers, or other project facilities; exposure to contaminants; and attraction to garbage and human activity.

Impacts associated with habitat loss and alteration, attraction and avoidance, and direct mortality will occur primarily in the Project area, including the impoundment area, access and transmission corridors, and other facility footprints. Impacts associated with altered distribution and abundance of prey may occur over a larger area in which changes in both competing mammalian predators and prey species abundance may occur.

Data on the distribution, abundance, productivity and habitat use of raptors in the study area will be used to assess Project impacts. Impacts of direct and indirect habitat loss and alteration can be assessed through geospatial analysis. When plotted on the wildlife habitat map, developed under the botanical resources study plans, raptor nest location data will allow the identification of critical or high value breeding habitats. Similarly, important habitats for prey species, identified in association with parallel studies of prey distribution and abundance, also will be identified. Using GIS software, the direct impacts of habitat loss can be evaluated for each raptor species by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate loss of preferred or critical habitats. Additional indirect impacts of habitat loss and alteration and behavioral reactions (such as avoidance) can be estimated by applying various buffer distances, as determined from the literature on the effects of similar projects, including responses of both raptor and their prey. In this way, the GIS analysis can be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on raptor populations. Data from studies of prey populations also can be incorporated into the impact assessment for raptors, including distribution and abundance data from the aquatic furbearer, small mammal, waterbird, landbird/shorebird, and ptarmigan studies. Any necessary PM&E measures will be developed by examining the distribution and abundance of raptor species and habitats in relation to the geographic extent and seasonal timing of various Project activities. PM&Es will be developed to minimize impacts to raptors, with particular emphasis on eagles.

Data collected for the raptor study will allow calculation of the numbers of nests and territories that will be lost per species per sub-area; the numbers of nests and territories otherwise affected per sub-area; the type and level of impacts to forage and roost areas; the locations of any potential collision hazard areas for migrating raptors; and other potential impacts, including large increases in the availability of open water habitats created by the impoundment.

8.15.4.5. Deliverables

Study products will include:

<u>Geospatially-Referenced Relational Database.</u> A geospatially-referenced relational database will be developed that incorporates all historic and current data, including nest, forage and roost locations for each species, occupancy/activity, nest type and characteristics, stand characteristics, and photographs. This database will be expanded from the work done for the 2012 Raptor Study. All field data must be associated with location information collected using a Global Positioning System (GPS) receiver in unprojected geographic coordinates (latitude/longitude) and the NAD 83 datum (or convertible as such). Migratory corridor information will be included for specific areas of concern as discussed above.

<u>Delineation of Suitable Eagle and Raptor Nesting and Foraging Habitats.</u> Habitat delineation will be completed using ArcGIS software as part of the wildlife habitat mapping study (see Section 9.5) and the habitat use evaluation study (see Section 8.19).

<u>Study Reports.</u> In 2012, a Technical Memorandum summarizing the 2012 results will be provided. In 2013, an Initial Study Report, and in 2014, the Updated Study Report will be provided. The Updated Study Report will summarize the results for all three years. These reports will include:

- Discussion of nest mapping results
- Calculations of:
    - — Local average territory size for Bald Eagle and Golden Eagle; and
    - — Productivity (annual, mean, ranges of) per raptor species and Common Raven, per Project sub-area (reservoir impoundment zone, access roads, power transmission corridors)
- Discussion of migration corridor results

- Preliminary discussions and calculations of potential Project impacts including:
  - Numbers of nests and territories that will be lost per species per sub-area;
  - Numbers of nests and territories otherwise affected per sub-area;
  - Type and level of impacts to forage and roost areas;
  - Locations of any potential collision hazard areas for migrating raptors;
  - Other potential impacts, including large increases in the availability of open water habitats created by the impoundment.

8.15.5. Consistency with Generally Accepted Scientific Practice

The study methods described above are consistent with generally accepted scientific practice. The field protocols may be modified to address logistic constraints imposed by the size and remoteness of the study area. The field protocols for raptor surveys will generally follow established techniques for cliff- and tree- nesting raptors in North America (e.g., Anderson 2007). In addition, survey protocols and study areas will be tailored for specific species. For example, inventory and monitoring methodologies for nest occupancy and productivity surveys will follow established aerial and ground-based protocols for eagle nest surveys (USFWS 2007, Pagel et al. 2010), using appropriately trained observers and suitable survey platforms (helicopter, fixed-wing aircraft). Nest characteristics will be recorded according to protocol developed in consultation with the USFWS, including the protocol of the USFWS Alaska Bald Eagle Nest Atlas (http://alaska.fws.gov/mbsp/mbm/landbirds/alaskabaldeagles/default.htm). Local Bald Eagle and Golden Eagle territory sizes will be estimated using inter-nest distances as described in the Draft Eagle Conservation Plan Guidance (USFWS 2011). Surveys to determine if migration routes exist that may put migrating raptors at risk for collision with Project power transmission lines would generally follow the USFWS's recommended point count protocol, based on standard hawk migration counting protocols as described in Appendix C of the Draft Eagle Conservation Plan Guidance (USFWS 2011).

8.15.6. Schedule

This is a multi-year study that was initiated in 2012 and will continue through 2014. The data gathering and reporting schedule is described below.

- <u>Draft Technical Memorandum: November 30, 2012.</u> A brief interim report, including updated locations of all nests located to date, will be prepared and presented to AEA and the licensing participants to describe the status and progress of the study and identify any issues that have occurred.
- <u>Field Surveys: Early May through late July 2013 and 2014.</u> Surveys will be conducted in early to mid-May and early to late July. A minimum of two aerial surveys at least 30 days apart are recommended for the Golden Eagle protocol (Pagel et al. 2010). Early reporting of potentially active raptor nest sites after the initial surveys in May (or potentially earlier depending on USFWS recommendations) will be used to develop avoidance timing and areas for Project-related field activities that could potentially disturb active nests. Active eagle and other raptor nest sites will be reported to AEA as soon as they are found to develop avoidance areas for field studies.
- <u>Update the geospatially referenced, relational database of historical and current data: August 2013 and 2014.</u>

- Update the delineation of suitable eagle and raptor nesting habitat, old and active nest locations, historical fall and winter roost locations in ArcGIS software: August 2013 and 2014.
- Conduct roosting and staging surveys: Mid-October through early December 2013 and 2014. Surveys will be conducted periodically to identify use of winter foraging and communal roost sites along the Susitna River. Four aerial surveys will be flown at intervals of 2 to 3 weeks, depending on weather and the results of preceding surveys.
- Initial Study Report and Updated Study Report: December 2013 and 2014, respectively. The Initial and Updated Study Reports will include a summary of the study results to date.

8.15.7. Level of Effort and Cost

Occupancy/productivity and winter roost/forage surveys for nesting raptors in 2013–2014 will take an additional ~10–12 days of field work beyond the 2012 surveys due to the extended study area, therefore costs for these surveys (including helicopter time, analysis and reporting) will be approximately $500,000 per year.

Transmission line collision risk surveys for migrating raptors in 2013–2014 will take approximately 30 field days, and estimated costs for these (with helicopter drop-offs, literature search, analysis and reporting) will be approximately $80,000.

8.15.8. Literature Cited

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8.15.9. Tables

Table 8.15-1. Raptors in the Vicinity of the Middle Basin of the Susitna River (adapted from Tables 4.6-2 and 4.8-2 in AEA 2011).

Common Name	Scientific Name	Conservation Status[1]	Seasonal Status[2]	Relative Abundance[3]
Bald Eagle	*Haliaeetus leucocephalus*	FS	B	uncommon
Boreal Owl	*Aegolius funereus*	PIF, FS	R	rare
Golden Eagle	*Aquila chrysaetos*	BLM, FS	B	fairly common
Great Gray Owl	*Strix nebulosa*	PIF, FS	?	rare
Great-horned Owl	*Bubo virginianus*	FS	R	uncommon
Gyrfalcon	*Falco rusticolus*	PIF, FS	R	uncommon
Merlin	*Falco columbarius*	FS	B	uncommon
Northern Harrier	*Circus cyaneus*	FS	B	fairly common
Northern Goshawk	*Accipiter gentilis*	FS	B	uncommon
Northern Hawk Owl	*Surnia ulula*	FS	R	uncommon
Osprey	*Pandion haliaetus*	FS	M	rare
Peregrine Falcon	*Falco peregrinus anatum*	BCC, FS	M	unknown
Red-tailed Hawk	*Buteo jamaicensis*	FS	B	uncommon
Short-eared Owl	*Asio flammeus*	BLM, FS	B?, M, S	uncommon
Sharp-shinned Hawk	*Accipiter striatus*	FS	B	uncommon

Notes:

1 Conservation Status: FS = Featured Species (ADF&G 2006); BCC = Birds of Conservation Concern (USFWS 2008); BLM = BLM Sensitive Species (BLM 2010); PIF = Boreal Partners in Flight Working Group (BPIF 1999).

2 Seasonal Status: M = migrant (transient); B = breeding; S = summering; R = resident; ? = uncertain (Kessel et al. 1982; APA 1985: Appendices E5.3 and E6.3).

3 Relative Abundance: From Kessel et al. (1982) and APA (1985: Appendices E5.3 and E6.3).

8.15.10. Figures

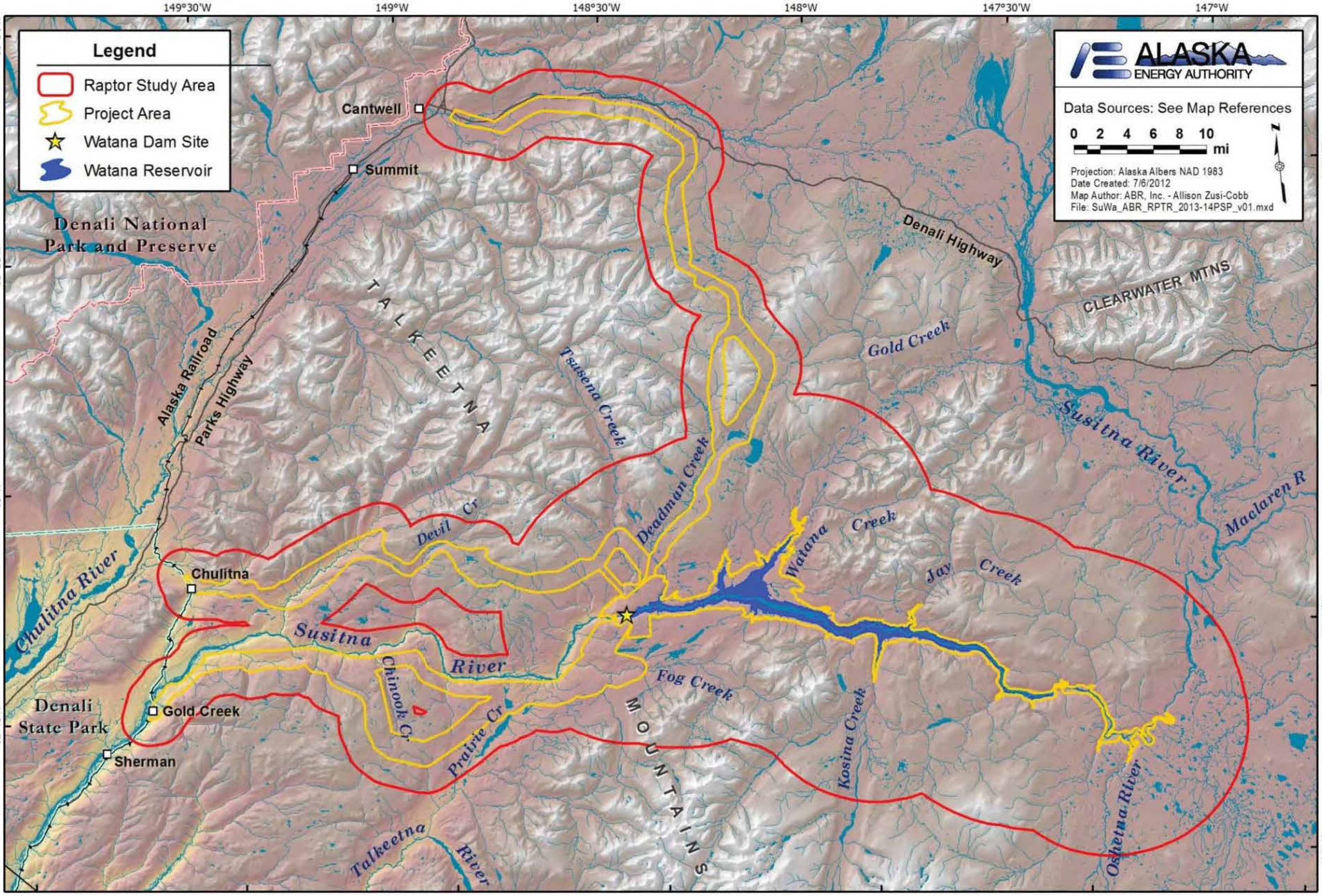

Figure 8.15-1. Raptor study area.

8.16. Breeding Survey Study of Landbirds and Shorebirds

8.16.1. General Description of the Proposed Study

The landbird and shorebird study is planned as a two-year study (2013–2014) and will be formally initiated in 2013. Results from the first year of work in 2013 will be used to update existing information and fine-tune the field survey methods and survey areas. The proposed methods for the breeding landbird and shorebird study are ground-based point-count surveys, in which all birds seen or heard are recorded, along with the horizontal distance to each bird observed. Point-count surveys, which were designed for counting singing male passerine birds, are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004, ALMS 2010). These methods have been adopted for shorebirds (ASG 2008), and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations even with a relatively large survey effort.

8.16.1.1. Study Goals and Objectives

The goal of this study is to collect baseline data on the occurrence and habitat use of breeding landbirds and shorebirds in the Project area to enable assessments of the direct, indirect, and cumulative impacts on these birds from construction and operation of the proposed Project. This study will address several species of conservation concern, both landbirds and shorebirds, that are known or expected to occur in the Project area (see AEA 2011), as well as numerous other species that are protected under the federal Migratory Bird Treaty Act (see Section 8.3).

The specific objectives of the study are to:

- Conduct point-count surveys to collect field data on the distribution and abundance of landbirds and shorebirds in the Project area during the summer breeding season;
- Collect habitat-use data for landbirds and shorebirds during the point-count surveys to feed into the habitat-use evaluation study, which will be the first step in quantifying habitat change (i.e., gain/loss and alteration for landbirds and shorebirds from the proposed Project (see Section 9.5);
- Conduct additional habitat-specific point-count surveys in riverine and lacustrine areas to collect distribution and abundance data on piscivorous species and other species typical of fluvial habitats, which are often under-represented in standard point-count surveys;
- Review the literature on the foraging habits and diets of piscivorous landbird species (e.g., Belted Kingfisher; *Cerryle alcyon*), which will be used by researchers conducting the mercury risk-assessment study (see Section 5.12 *Mercury Assessment and Potential for Bioaccumulation*); and
- Review historical (APA Susitna Hydroelectric Project) data on landbirds and shorebirds for comparison with the current data from this study, to evaluate any changes in distribution, abundance, and habitat use over the intervening 30-plus years. Many species of migratory birds have suffered population declines in recent decades, so these comparisons will provide information on the population trends for these species in the Project area.

8.16.2. Existing Information and Need for Additional Information

In 1981, breeding landbirds and some shorebirds were surveyed for the APA Susitna Hydroelectric Project using modified territory-mapping methods, which involved repeated visits between May 20 and July 3 to 12 study plots, each 10 hectares (24.7 acres) in size (Kessel et al. 1982, AEA 2011). Each plot was placed in an area of homogeneous habitat, as defined using Kessel's avian habitat classification (Kessel 1979). At that time, territory mapping was the standard method for surveying landbirds. Because each plot was surveyed repeatedly, substantial information on bird occurrence and habitat use was obtained for the limited area encompassed by those 12 plots. However, because only 12 plots were sampled in homogeneous habitats, the data do not adequately address variability in bird occurrence and habitat use across the broader study area. Some additional information on shorebird occurrence was obtained during ground-based surveys of lakes, ponds, and wetlands for waterbirds (Kessel et al. 1982), but focused surveys for breeding shorebirds were not conducted. No studies of landbirds or shorebirds have been conducted more recently in the Project area (AEA 2011).

Because of the limitations in extrapolating results from intensive surveys of territory-mapping plots to the larger Project area, it will be necessary to study these species groups again using currently accepted protocols (point-count surveys), which allow large landscapes to be sampled adequately and which provide more data on variability in habitat use. Because the most recent surveys for landbirds and shorebirds were conducted over 30 years ago, and because populations of these birds and their habitats have likely changed during that period, new studies are recommended. Current data on the distribution, abundance, and habitat use of landbirds and shorebirds is necessary to be able to adequately assess the impacts from the proposed Project on these species.

8.16.3. Study Area

The proposed study area is the same as that for the mapping of vegetation and wildlife habitats (see Section 9.5, Figure 9.5-1), which will allow the field data for landbirds and shorebirds to be tied directly to the mapped wildlife habitats in this study area (also see Figure 8.16-1). The affected areas include the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites. All direct and indirect effects of the proposed Project on landbirds and shorebirds and their habitats in the upper Susitna basin are expected to be encompassed in a 5-mi buffer on each side of those affected areas. Changes in riparian vegetation and wildlife habitats in areas downstream of the proposed dam also are possible, and will be addressed in the riparian study (see Section 9.6).

8.16.4. Study Methods

The proposed methods for the breeding landbird and shorebird study are ground-based point-count surveys, in which all birds seen or heard are recorded, along with the horizontal distance to each bird observed. Point-count surveys, which were designed for counting singing male passerine birds, are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004, ALMS 2010). These methods have been adopted for shorebirds (ASG 2008), and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations even with a relatively large survey effort.

Point-count surveys are appropriate for large development projects which cover a large area and that include many different types of habitats. The sample points can be spread across the landscape and allocated by habitat type to ensure that all the prominent habitat types are sampled. In 2013, point-count sampling locations will be distributed using a pseudo-stratified random plot allocation procedure based on aerial photosignatures as the sampling strata (because a current and complete habitat map likely will not available by spring 2013. The plot allocation methods may be changed in 2014 (see below). This procedure will result in adequate sampling of habitats, over 2 years of surveys, so that habitat-use evaluations for landbirds and shorebirds will be supported sufficiently by Project area-specific data. These habitat-use evaluations (see Section 8.5) are a critical link in conducting quantitative assessments of habitat loss and alteration for breeding landbirds and shorebirds.

Because several species of landbirds and shorebirds are not commonly recorded in standard point-count surveys allocated randomly across available habitats, but are known to be closely associated with riverine and lacustrine habitats which will be lost during Project development, (e.g., Belted Kingfisher, American Dipper [*Cinclus mexicanus*], Semipalmated Plover [*Charadrius semipamatus*], Solitary Sandpiper [*Tringa solitaria*], Spotted Sandpiper [*Actitus macularia*], Wandering Tattler [*Heteroscelus incanus*]), an additional set of point-count surveys will be conducted specifically in riverine and lacustrine habitats that are expected to be affected by Project development. In these surveys, the Belted Kingfisher is of additional interest because it is a piscivorous species (see below). These additional surveys were recommended by the USFWS (see Section 8.4, Table 8.4-1).

Point-count survey data with distance estimates (which equate to variable circular plots) can be used to calculate densities for breeding landbirds and shorebirds using distance-sampling methods, which are based on detection functions calculated for each species (Buckland et al. 2001, Rosenstock et al. 2002). Those detection functions, however, are reliable only when a sufficient number of species-specific observations are obtained for analysis (i.e., sufficient data may be available to calculate densities for the more common species in the Project area, but for rare species, with few observations, it will not be possible to calculate reliable densities). Moreover, there is evidence that, because of the difficulty in estimating accurate distances to vocalizing birds, that the resulting density estimates can be unreliable (Alldredge et al. 2007a,b, 2008, Efford et al. 2009). For these reasons, AEA is not proposing to calculate densities of landbirds and shorebirds, and will rely on assessments of the amount of habitat expected to be lost and altered for each species when conducting impact assessments.

The landbird and shorebird study will be coordinated with the other wildlife studies being performed for the Project, especially the raptor and waterbird studies, so that sightings of bird species that apply to other studies can inform the survey and reporting efforts for all studies.

8.16.4.1. Field Surveys

Point-count field surveys will be conducted following standardized protocols for point-counts in Alaska (Handel and Cady 2004, ALMS 2010). These methods are based on the variable circular-plot point-count methods described by Ralph et al. (1995) and Buckland et al. (2001). As prescribed, the surveys will be conducted during the early morning hours to maximize the detection of breeding species, especially singing male passerines. Standard 10-minute observation periods will be used and, to facilitate the collection of habitat-use data, the specific habitat being used by each bird observed will be recorded whenever possible.

As noted above, in 2013, it is expected that the point-count plot locations will be selected using a pseudo-stratified random plot allocation procedure based on aerial photosignatures as the sampling strata (because it is unlikely a current and complete habitat map will be available by spring 2013). In 2014, point-count locations will be selected again using a pseudo-stratified random plot allocation procedure, but in this case, based on the mapped wildlife habitat types as the sampling strata (to the extent the wildlife habitat mapping is complete by spring 2014). In both cases, the plot allocation will be constrained so that an adequate number of plots are placed in each mapped habitat or photosignature type. Without this constraint, an excessive number of plots would be located in the most common habitat types and far fewer would occur in the uncommon types, resulting in an undersampling of uncommon habitat types. In all cases, sample points will be located in a random fashion (using GIS) within each mapped habitat or photosignature type, subject to the restriction of maintaining a minimum distance of 500 meters (1,640 feet) between sample points in open habitats and 250 meters (820 feet) in closed habitats. This sampling scheme will result in a selection of point-count locations that is unbiased with respect to the distribution of breeding birds on the landscape. The goal in the plot allocation procedure is to derive a set of sample points that are spread broadly across the study area and are replicated within each photosignature/habitat type to try to capture any spatial variability in habitat use by breeding birds. Replicate sampling also is important to be able to locate the often patchy occurrences of the less common species of conservation concern.

Two field surveys are planned in each summer season (2013 and 2014). The first survey will be conducted in mid-May with a focus on breeding shorebirds and early nesting landbirds (e.g., Rusty Blackbird (*Euphagus carolinus*), which is a species of conservation concern for Alaska [USFWS 2008]). It is likely that data on early nesting resident birds also can be collected in this first survey because nesting should start a bit later at the higher elevations in the Project area. The second survey will be conducted in early June and will be focused on neotropical migrant landbirds. These surveys are scheduled for early June so that the late arriving flycatchers (e.g., Alder Flycatcher; *Empidonax alnorum*) will be present. In practice, however, some data on nesting resident birds and shorebirds can be collected during early June as well.

For the mid-May survey, point-count plots will be allocated preferentially in open habitats that are used by breeding shorebirds. These include open, wetland habitats in forested areas as well as open, dwarf-scrub dominated habitats in upland and alpine terrain. Woodland bog and tall-scrub habitats in poorly drained lowland terrain also will be sampled as these areas are used by breeding shorebirds and Rusty Blackbirds. During the mid-May surveys, an additional set of point-count plots will be allocated specifically in riverine and lacustrine habitats that are expected to be affected by Project development. These surveys will be conducted to address those species that are known to use riverine and lacustrine habitats, but are not often recorded on point counts allocated randomly across all available habitats. In addition to the point-count surveys, researchers will walk the length of the stream drainages and lake/pond shorelines sampled as they move between point-count locations, and all birds observed in transit will be recorded. An additional goal of these surveys will be to collect data on the distribution and abundance of piscivorous species (Belted Kingfisher) in the inundation zone and immediately below the location of the proposed dam. This information will be used in the mercury risk-assessment study (see Section 5.12 *Mercury Assessment and Potential for Bioaccumulation*).

For the early June survey, point-count plots will be allocated across all available habitats in the study area. As noted above, this survey will be focused on neotropical migrant landbirds.

8.16.4.2. Integration of Existing Information with Current Study

The landbird and shorebird data collected in the APA Susitna Hydroelectric Project area in the 1980s (Kessel et al. 1982, AEA 2011) will be reviewed and incorporated into the analyses of habitat use by these species presented in the Initial Study and Updated Study reports (see below). The primary focus will be to evaluate the habitat-use patterns in the historical data and determine whether those patterns are consistent with those found in analyses of current data. The abundance and distribution information for landbirds and shorebirds from the work of Kessel et al. (1982) also will be reviewed to evaluate any changes in abundance and distribution over the intervening 30-plus years. These historical comparisons will provide information on the recent trends for these species in the Project area, which will be useful for impact predictions and assessments.

8.16.4.3. Mercury Risk Assessment

To assist in the mercury risk assessment study (see Section 5.12 *Mercury Assessment and Potential for Bioaccumulation*), and to complement the field data gathered on the distribution and abundance of piscivorous landbird species (Belted Kingfisher) in the study area (see above), the scientific literature on the foraging habits and diets of Belted Kingfishers will be reviewed. As much as possible, the information gathered will be focused on data from Alaska studies.

8.16.4.4. Impact Assessment

Landbirds and shorebirds are expected to be affected indirectly primarily by the loss of breeding habitat from the placement of fill and from the conversion of terrestrial habitats to lacustrine habitats in the proposed reservoir. Additional indirect impacts could occur from the alteration of habitats due to erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Disturbance effects (displacement from breeding habitats) from construction and operations activities represent another source of indirect impacts. Direct impacts could occur through injury and mortality in various ways (e.g., if exposed to fuel from accidental spills or from in-flight collisions with infrastructure). Alterations in riparian wildlife habitats downstream of the proposed dam due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River also are possible. These downstream effects on wildlife habitats will be addressed in the Riparian Study (see Section 9.6).

The impact assessment for landbirds and shorebirds will be conducted by first conducting habitat-use evaluations (see Section 8.19 and 9.5) to determine habitat values for each landbird and shorebird species for each of the wildlife habitats mapped in the vegetation and wildlife habitat mapping study (see Section 9.5). Then the Project footprint will be overlayed, in GIS, on the mapped wildlife habitat types to quantify the acreages of important breeding habitats for each species that would be lost directly to fill. The determination of acreages of landbird and shorebird habitats that could be affected by habitat alteration and behavioral disturbance will be conducted similarly by overlaying habitat alteration and disturbance buffers (surrounding the proposed Project infrastructure) to identify which habitats are likely to be affected by ancillary impacts associated with Project construction, operations, and maintenance. The size and number of habitat alteration and disturbance buffer(s) to be used will be determined based upon the final specifications for Project construction, operations, and maintenance activities, which will be provided in the Project description. Direct impacts to landbirds and shorebirds will be assessed qualitatively by evaluating the likelihood of injury and mortality from various sources during Project construction and operations.

Cumulative effects on landbirds and shorebirds in the region of the proposed Project will be assessed by evaluating the extent of the direct and indirect impacts expected from the Project in conjunction with the existing impacts to landbirds and shorebirds in the region.

8.16.4.5. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of historic (APA Project) data and data collected during the 2013 and 2014 field seasons, including representative photographs of breeding bird habitats at point-count plots will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The landbird and shorebird study results will be presented in the Initial and Updated Study reports, according the schedule indicated below. The reports will include descriptions of the field methods, a map of the point-count locations surveyed, and results of the point-count surveys with tables indicating abundance by species and habitat type.

8.16.5. Consistency with Generally Accepted Scientific Practice

The landbird and shorebird study will involve point-count surveys, and will be conducted following the currently accepted standardized protocols for the monitoring of landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004, ALMS 2010). In recent years, these methods also have been adopted for shorebird surveys in Alaska (ASG 2008), and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations even with a relatively large survey effort.

8.16.6. Schedule

This is a two-year study. The schedule for the 2013 and 2014 activities is presented below.

<u>2013:</u>

- Review of aerial imagery and point-count site selection: March–April
- Field survey: May 12-17 and June 5-12 (four crews of two persons each); survey timing and duration may need to be modified depending on the extent of the shorebird nesting habitats available and the snow melt and plant phenological findings from the 2012 field surveys for botanical studies in the Project area
- Data analysis: September–October
- Delivery of electronic copies of field data: November

- Initial Study Report: December

2014:

- Review of habitat mapping, aerial imagery, and point-count site selection: March–April
- Field survey: May 12–17 and June 5–12 (four crews of two persons each); survey timing and duration may need to be modified based on the findings in the 2013 studies
- Data analysis: September–October
- Delivery of electronic copies of field data: November
- Updated Study Report: December

8.16.7. Level of Effort and Cost

The landbird and shorebird study is planned to be conducted over two years (2013–2014). Two field survey efforts (late spring and early summer) will be conducted each year by a crew of eight observers (four crews of two persons each). Point-count surveys would be conducted for approximately 14 days each year, with the goal of obtaining at least 400 point-count samples each year. Helicopter-support will be required for this study with drop-off and pick-ups each day in the field. The surveys will start at first light in the morning, which in the Project area will mean approximately 3:30 a.m. The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $250,000, for an approximate estimated total of $500,000 for both years.

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8.16.9. Figures

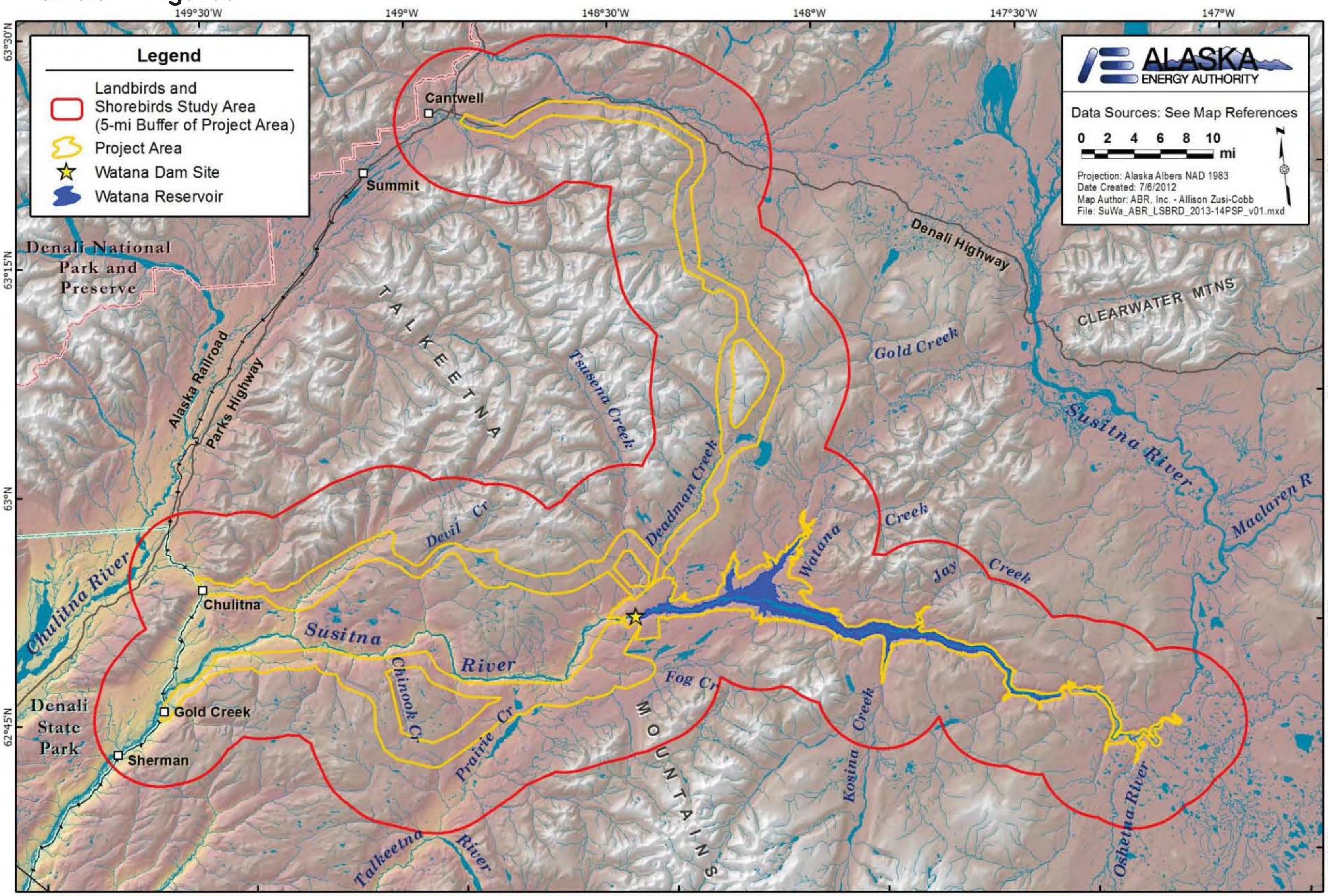

Figure 8.16-1. Landbird and shorebird study area.

8.17. Study of Population Ecology of Willow Ptarmigan in Game Management Unit 13, Southcentral Alaska

8.17.1. General Description of the Proposed Study

The ptarmigan study will be conducted by ADF&G. The ptarmigan study will be a two-year investigation, initiated in spring 2013 and continuing through winter 2014. ADF&G may continue the study through 2016, corresponding to the anticipated lifespan of the radiotelemetry necklaces. AEA is proposing the following study plan for ptarmigan, but AEA would like to consult further with licensing participants to re-evaluate the level of effort.

8.17.1.1. Study Goals and Objectives

The goal of this study is to provide the necessary data to evaluate the potential effects of the proposed Susitna-Watana Project on Willow Ptarmigan (*Lagopus lagopus*), the predominant species of upland game bird in the Project area and surrounding areas. The area of interest consists of Subunits 13A and 13E of Game Management Unit (GMU) 13 (Figure 8.17-1).

The study has four objectives:

- Determine the seasonal distribution of Willow Ptarmigan in the Project area;
- Determine the seasonal migratory patterns of Willow Ptarmigan that occur in the Project area;
- Estimate the abundance of ptarmigan in the Project area during the breeding season and during the fall; and
- Estimate seasonal survival of Willow Ptarmigan.

The data gathered during the study will be integrated to determine potential effects of the Project on Willow Ptarmigan.

8.17.2. Existing Information and Need for Additional Information

The Willow Ptarmigan is the most common and widespread ptarmigan in Alaska, constituting an estimated 65–70 percent of all ptarmigan statewide, followed by Rock Ptarmigan *(L. mutus*) at 25–30 percent, and White-tailed Ptarmigan (*L. leucurus*) at <10 percent (Taylor 1994). All three ptarmigan species occur in GMU 13 (Taylor 2000).

Ptarmigan hunting is a very popular activity in the fall and winter months in GMU 13 due to the accessibility of the unit from the state highway system. Since 1997, the Alaska Department of Fish and Game (ADF&G) has conducted ptarmigan surveys in spring along the Denali, Parks, and Richardson highways to quantify the relative abundance of territorial males. All survey efforts have centered on road-accessible areas within GMU 13. Those surveys suggested that Willow Ptarmigan along the road system portions of GMU 13 are declining in abundance or have remained at low abundance since 2000 (Bill Taylor, pers. comm.). Due to this continued low abundance, ADF&G recommended that the Alaska Board of Game reduce the bag limit of ptarmigan from 10 per day to 5 per day in Subunits 13A, 13B, and 13E between December 1 and March 31, and this recommendation took effect during the 2005–2006 regulatory year. Continued low abundance resulted in further harvest restrictions in Subunit 13B, and beginning in 2009, the ptarmigan season has been closed after November 30 each year. ADF&G has been unable to commit additional resources to better understand the life history of GMU 13 ptarmigan populations and there is little information on the habitat value of the Project area for ptarmigan.

Ptarmigan that winter in the Project area may be either resident or migratory birds. To better predict the potential effects of the proposed Project on Willow Ptarmigan, information needs to be collected to determine the annual ranges of ptarmigan that may use habitats in GMU 13. In particular, information is needed to evaluate the relative importance of the Project area to resident and to migratory ptarmigan and the seasonal ranges of migratory birds need to be determined.

8.17.3. Study Area

Willow Ptarmigan will be captured within a 15-mile buffer around the proposed dam site and reservoir and the access and transmission corridor alternatives (Figure 8.17-1). Capture locations will be in the headwaters of several major river drainages. The study area is composed of alpine habitats at higher elevations and subalpine spruce habitats at lower elevations. Areas in which Willow Ptarmigan will be captured are roadless, although periodic, but infrequent, all-terrain vehicle use can occur year-round.

The areas selected for capture have been identified previously as locations with relatively high breeding densities of Willow Ptarmigan. Initial capture efforts will focus on three areas, including upper Fog Creek (tributary to the upper Susitna River), upper Busch Creek (tributary to Goose Creek), and the pass between upper Jay and Coal creeks.

Radio-tagged Willow Ptarmigan are expected to remain within 50 miles of the original capture site, although, in some cases, movements may exceed that distance (Irving et al. 1967). Aerial surveys to locate birds with radios will be conducted in appropriate habitats within 50 miles of the original capture locations.

8.17.4. Study Methods

8.17.4.1. Capture of Ptarmigan

Beginning in April 2013, 50–100 Willow Ptarmigan will be captured annually at three sites within Subunits 13A and 13E (Figure 8.17-1) and fitted with radiotransmitter-equipped necklaces. All three sites are within 15 miles of either the proposed reservoir or alternative access corridors (AEA 2012). Alternative capture sites may be needed based on conditions each spring, depending on factors such as ptarmigan abundance, snow depth, and fixed-wing airplane access. Potential alternative capture sites (Figure 8.17-1) will be considered during ADF&G field operations in the spring and summer of 2013.

Capture sites and future alternative sites have and will be identified based on several criteria.

- Willow Ptarmigan abundance;
- Proximity to the future reservoir or access routes;
- Ease of access using either fixed-wing or helicopter; and
- Observed springtime conditions (i.e., snow depth, and habitat availability during the capture time period).

During the breeding season in April and May of each year, several 2-person teams will be deployed to various capture locations using wheel-ski equipped fixed-wing aircraft. Teams will attempt to capture 25–50 Willow Ptarmigan during the spring effort. Several teams will again be deployed in mid-August to September, using fixed-wing aircraft, in an effort to capture an additional 25–50 adult and fledged juveniles before brood dispersal occurs (Weeden and Watson 1967).

When capture efforts begin in April, male Willow Ptarmigan will be located visually or by using a playback recording of a territorial male Willow Ptarmigan (Taylor 1999, Peyton 1999, Savage et al. 2011). Playback recordings will be used effectively under low wind conditions (≤ 5 miles per hour) with no precipitation during early morning or late evening hours. Once ptarmigan are known to be in the vicinity, a Styrofoam decoy and remotely powered caller will be placed within the defensive range (<100 meter [328 feet]) of a territorial male. A mist net will be deployed around the decoy and remotely powered caller in an attempt to capture the territorial male when he responds defensively to the call and decoy. Mist nets designed by Avinet (www.avinet.com) for capturing small hawks and large shorebirds will be used (Silvy and Robel 1968). These black nylon nets have a 100-millimeter (~4-inch) mesh and are 2.6 meters (8.5 feet) tall, with 4 shelves (Browers and Connelly 1986). When circumstances allow during spring capture efforts, a handheld Coda net gun (www.codaenterprises.com) with a 12-square foot net and 3-inch mesh also will be used opportunistically to capture territorial male birds on the ground, primarily as a backup to the mist net method. This method has been used from a helicopter to capture short-eared owls (*Asio flammeus*) in northern Alaska and has proven to be safe and effective (T. Booms, ADF&G, pers. comm.). The use of decoys and calls is a novel adaptation to attempt to increase the number of captures typical of previous netting methods (>30 ptarmigan annually; Skinner et al 1998, Kaler et al. 2010). No attempt to capture nesting or brood-rearing females will occur.

Post-breeding resident and migrant birds will be targeted for capture during a second annual capture effort in mid-August through September. Flocks of ptarmigan will be located visually, mist nets will be strategically placed around or in the vicinity, and ptarmigan of all age/sex classes will be flushed into the mist nets. Fall captures will be similarly outfitted with radiotransmitter necklaces.

At least two people will be present for any single capture event to remove birds from mist nets, handle, and release birds as quickly as possible. After capture, Willow Ptarmigan will be restrained in a capture bag or by holding their wings against their bodies. Birds will be instrumented with a necklace-mounted A3950 VHF radio transmitter with a 10-inch whip antenna (Raymond 1999, Paragi et al. 2012; Figure 8.17-2) from Advanced Telemetry Systems (ATS, www.atstrack.com). The entire radio and necklace package will weigh up to 10.7grams (0.4 ounce) (1.7 percent of the body mass based on known weights of hunter-harvested Willow Ptarmigan; Hudson 1986, Thirgood et al. 1995). Radios will transmit on a frequency of 148.000 Mhz. The transmitter is secured by a rubber-sheathed wire fitted over the bird's neck and crimped on either end to ensure its fit (Figure 8.17-2). The transmitter will be adjusted to compensate for crop expansion. No tissue samples will be collected from captured Willow Ptarmigan. Birds will be handled for 5–10 minutes and released at their point of capture.

Age and sex, based on plumage characteristics (Bergerud et al. 1963, Weeden and Watson 1967, Braun and Rogers 1971, Hudson 1986) will be recorded for each bird captured. Individually numbered leg bands will be placed on each radio-tagged bird. These tags will be useful for ground observations and to identify human-harvested birds or prey remains that may be found during field efforts. A GPS will be used to record the location of capture. Date, time, and weather conditions also will be recorded. If a territorial male is captured, an attempt will be made to identify and record the location(s) of his territory post(s).

Radio tags will not be removed at the conclusion of the study, nor will tags drop off. There is little evidence to suggest that radio tags have a negative effect on the survival or breeding success of ptarmigan and other galliformes (Thirgood et al. 1995, Palmer and Wellendorf 2007, Terhune et al. 2007). Radio-tagged Willow Ptarmigan will be closely monitored within 24 hours of capture to document capture myopathy or other obvious handling-induced stresses. All potential capture and marking methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee (IACUC) certification. ADF&G will ensure compliance with all IACUC policies.

8.17.4.2. Relocation of Radio-tagged Ptarmigan

Radio-tagged ptarmigan will be relocated during aerial surveys conducted throughout the year to record habitat use, movements, and mortality. Birds will be tracked and relocated using a fixed-wing airplane equipped with wheel-skis, which will decrease search time and increase the area that can be covered. The first aerial survey will be performed within 10 days of capture to document survival rates of the birds recently radio-tagged. At least six additional aerial surveys will be performed annually: two in late summer (August–September), two in mid-winter (November–February), and two in early spring (late March to mid-April).

Range of radio tags will be tested before deployment. However, temperature may affect transmission range (T. Paragi and B. Taylor, ADF&G, pers. comm.). Therefore, to ensure a systematic search pattern, aerial surveys will be flown using a preselected 5-mile grid and flown at an altitude of 1,500–2,000 feet within Subunits 13A and 13E.

An ATS 4520 receiver will be used to locate radio-tagged birds. Two 4-element Yagi antennas will be mounted to each strut of the aircraft. A GPS receiver mounted at the windshield of the aircraft and connected to the 4520 receiver will provide a location for each data record. Upon completion of each aerial survey, receivers will be downloaded to a field laptop or Local Area Network (LAN) at the ADF&G office in Palmer for future analysis and specific location determination of each tagged bird.

During September and March, aerial transect surveys will be flown to estimate distribution and abundance using line-transect or repeat-count techniques (Royle and Dorazio 2008, Thomas et al. 2010). In addition to abundance, these surveys will provide data on the overall distribution of ptarmigan in Subunits 13A and 13E.

8.17.4.3. Analysis of Radiotelemetry Data

After the radio receivers have been downloaded, data will be transferred into a Microsoft Access database for analysis. Maps will be created using GIS software (ArcMAP) for each aerial survey day, indicating the location of each relocated Willow Ptarmigan. These data will be catalogued and used for spatial analyses.

Movement and survival rates of tagged birds will be estimated using multistate models (Brownie et al. 1993). Occupancy models of aerial survey data will be used to estimate the probability that an area is used and to identify changes in the probability of use between fall and spring surveys (Nichols et al. 2008).

The combination of telemetry transmitters and large-scale aerial surveys will provide both specific information on individual movements and habitat use and general information on species distribution. These survey techniques are being developed and implemented for another study of ptarmigan north of the Brooks Range (K. Christie, pers. comm.)

8.17.4.4. Impact Assessment

The ptarmigan study is designed to provide relevant information to be able to assess potential direct, indirect, and cumulative effects, which may include the following:

- Permanent habitat loss caused by project facilities, including the reservoir, powerhouse, and other permanent Project facilities;
- Temporary loss or alteration of habitats affected by clearing, dust fallout, gravel spray, persistent snow drifts, impoundments, thermokarst, contaminant spills, and other indirect effects of project construction and operation;
- Behavioral disturbance of ptarmigan by project construction and operation activities, including vehicle and heavy equipment traffic, geophysical investigations, and other human activities in the Project area;
- Indirect habitat loss through displacement of birds that avoid project facilities or transportation routes;
- Increase predation of birds or their eggs that may result from attraction of predators to anthropogenic foods or artificial structures (such as perches on power poles or powerlines, for example);
- Injury and mortality of birds from collisions with aircraft, vehicles, or structures (such as powerlines, for example);
- Injury and mortality of birds due to contact with or ingestion of contaminants (including fuels), including potential indirect effects of forage plants;
- Increased harvest of ptarmigan resulting from improvements in access to humans.

Data on the distribution, abundance, movements, productivity, and habitat use of Willow Ptarmigan in the study area will be used to assess Project impacts through geospatial analysis and evaluation of the responses of the species to other similar projects, as documented in the scientific literature. Using GIS software, species abundance data recorded among different habitat types will be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans to assess direct and indirect impacts of habitat loss and alteration and behavioral disturbance. The direct and indirect impacts of the Project will be evaluated by overlaying the Project features (including the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors), and the seasonal ranges of ptarmigan on the Project habitat map. Seasonal ranges will be delineated with radiotelemetry, using the recorded movements of a sample of birds to which radios have been attached. By plotting ptarmigan locations on the habitat map, high-value or high-density habitats can be identified. Indirect impacts will be estimated by applying various buffer distances on Project features, as determined from the available information on the anticipated effects of construction disturbance and habitat-related changes due to infrastructure and development and identifying areas of high-value habitats that are affected. The GIS analysis will be combined with results from the telemetry study and transect surveys, as well as from the scientific literature, to estimate the geographic extent, frequency, duration, and magnitude of

Project effects on ptarmigan. Any necessary PM&E measures will be developed by examining the distribution and abundance of Willow Ptarmigan among habitats in relation to the geographic extent and seasonal timing of Project activities.

8.17.5. Consistency with Generally Accepted Scientific Practice

Habitat availability and use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration. Ptarmigan captures will be conducted by adapting fairly standard capture methods to the situation. With continuous improvements in technology, particularly in battery and transmitter weights, radiotelemetry is an important and increasingly standard method of obtaining movement data even for small birds and mammals. All potential capture and marking methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee (IACUC) certification. ADF&G will ensure compliance with all IACUC policies. There is little evidence to suggest that radio tags have a negative effect on the survival or breeding success of ptarmigan and other galliformes (Thirgood et al. 1995, Palmer and Wellendorf 2007, Terhune et al. 2007). Radio-tagged Willow Ptarmigan will be closely monitored within 24 hours of capture to document capture myopathy or other obvious handling-induced stresses.

8.17.6. Schedule

Field work will begin April 2013 and continue through late winter of 2014. ADF&G may continue the study through 2016, corresponding to the anticipated lifespan of the radiotelemetry necklaces. Project milestones will follow the schedule below:

2013:	
April–May, August	First field season – capture and tag ptarmigan
August–December	Conduct aerial surveys (through May 2014)
December	Initial Study Report
2014:	
January–May	Conduct aerial surveys birds collared in 2013 season
April–May, August	Second field season – capture and tag ptarmigan
August–December	Conduct aerial surveys
December	Updated Study Report

8.17.7. Level of Effort and Cost

This is a multi-year study that will be conducted by ADF&G. The estimated cost of the study from 2013-2014 is $415,000.

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8.17.9. Figures

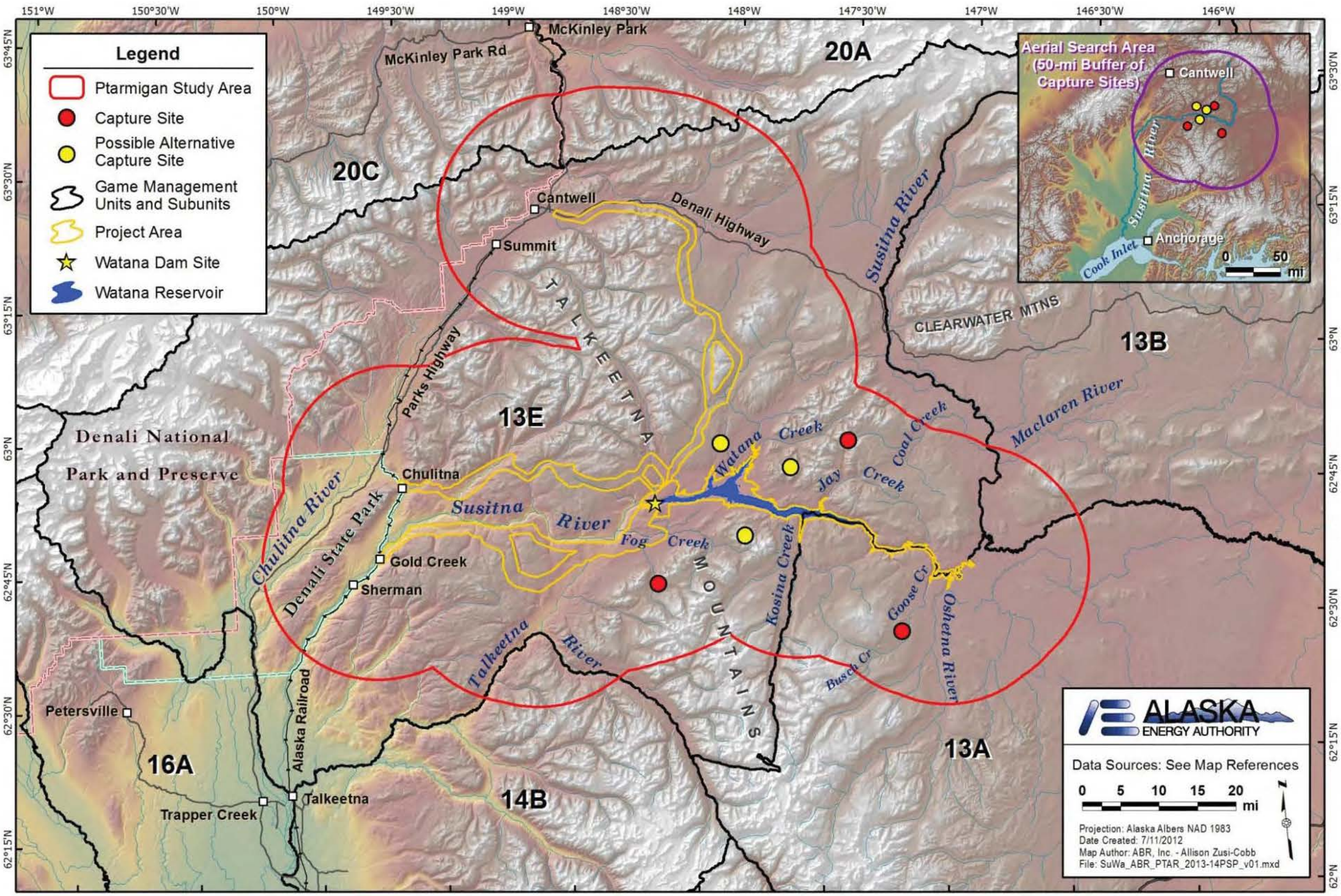

Figure 8.17-1. Ptarmigan study area, capture sites (red circles), and possible alternative capture sites (yellow circles) under consideration in summer 2012.

8.18. Study of Distribution and Habitat Use of Wood Frogs

8.18.1. General Description of the Proposed Study

The wood frog (*Rana sylvatica*) study will be conducted over two years in 2013 and 2014, with field work scheduled for May of each year. The study will focus on evaluating the distribution of wood frogs in the Project area using both field surveys and habitat modeling. AEA is proposing the following study plan for wood frogs, but AEA would like to consult further with licensing participants to re-evaluate the level of effort based on more discussions regarding the potential for a Project nexus to this species as well as whether the chytrid fungus is a factor for this species so far north of the Kenai.

8.18.1.1. Study Goals and Objectives

The goal of the wood frog study is to characterize the use of the Project area by breeding wood frogs to facilitate an assessment of potential impacts on wood frogs from development of the proposed Project.

The specific objectives of the study are to:

- Compile and review existing habitat use and distribution data for breeding wood frogs (*Rana sylvatica*) in a broad region surrounding the Project area;
- Determine the current distribution of breeding wood frogs in the Project area through a combination of field surveys and habitat-occupancy modeling; and
- Use information on current habitat use and distribution to estimate the habitat loss and habitat alteration expected for the species from development of the Project.

The wood frog study is planned as a two-year study (2013–2014). Results from the first year of work in 2013 will be presented in the Initial Study Report and will be used to update this study plan for 2014, as needed, to fine-tune the field survey methods and survey areas, based on comments on the Initial Study Report by FERC, resource agencies, and other licensing participants.

8.18.2. Existing Information and Need for Additional Information

Because amphibians were not included in the original APA Susitna Hydroelectric Project environmental program studies in the 1980s, data on the occurrence of wood frogs in the upper Susitna drainage is lacking. It is likely that wood frogs occur in the Project area because they occur in suitable habitats throughout southern Alaska and in the interior north to the southern slopes of the Brooks Range; they have also been documented in Denali National Park and Preserve, near Healy, and in the lower Susitna drainage (Cook and MacDonald 2003; Anderson 2004; Gotthardt 2004, 2005; Hokit and Brown 2006; MacDonald 2010). Amphibian populations appear to have been declining worldwide for several decades (Blaustein and Wake 1990, McCallum 2007) and, although populations may be healthy in Alaska (Gotthardt 2004, 2005), concern has been expressed about the conservation status of wood frogs in Alaska (ADF&G 2006). Because of this and because their status in the Project area is unknown, field surveys for wood frogs will be conducted in areas likely to be affected by Project facilities and activities.

Batrachochytrium dendrobatidis (Bd) is a chytrid fungus that causes the disease chytridiomycosis in amphibians. Since it was first discovered in amphibians in 1998, it has devastated amphibian populations around the world, including in North America. Bd is sometimes a non-lethal parasite and some amphibian species and some populations of susceptible species are known to survive infection. The fungus is widespread and ranges from lowland forests to cold mountain tops, and is typically associated with host mortality in high altitude environments and during winter, with greater pathogenicity at lower temperatures. Wood frogs have been identified as a frog species susceptible to infection by Bd and Bd was first detected in a dead wood frog in Kenai National Wildlife Refuge in 2002 (Reeves 2008). The only other positive detection of Bd was near Dyea in southeast Alaska in 2006 and was associated with the apparent die-off of western toads in southeast Alaska (Sunday 21 May 2006 Juneau Empire). No sampling for Bd has occurred in the Project area. Bd is believed to spread mainly through contact between infected frogs or with infected water. In comments on Study Requests for the Project, the ADF&G requested that water or frogs at survey locations be tested for the presence of Bd.

8.18.3. Study Area

The proposed study area includes those waterbodies in and adjacent to those portions of the Project area in which habitat loss and disturbance/alteration will occur, consisting of the reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites (see Figure 1.2-1 and 8.19-1).

8.18.4. Study Methods

8.18.4.1. Field Surveys and Occupancy Modeling

Potential waterbodies to survey for wood frogs within the Project area boundary will be identified from photointerpretation of aerial photos or remote-sensed imagery and from the preliminary mapping of vegetation, wildlife habitats, and wetlands (see Sections 9.5 and 9.7). If applicable to the specific waterbodies in the preliminary Project area boundary, data from the Alaska Gap Analysis Project (AKNHP 2012) also will be used to identify the characteristics of individual waterbodies associated with breeding wood frogs. Use of the Alaska Gap Analysis Project data was recommended by the ADF&G in their comments on the wood frog study request. Additional information on habitat use of wood frogs will be gleaned from review of the literature on wood frog studies in Alaska. One important waterbody characteristic for wood frogs is the presence of emergent vegetation (which frogs use for egg laying), and which can be assessed by photointerpretation of high-resolution aerial photos or remote-sensed imagery. With a set of waterbodies identified that have the potential to support wood frogs, a random subset of waterbodies will be selected to survey for breeding frogs. In addition, incidental detections of wood frogs will be documented during data collection efforts for other resources (e.g., fisheries, wetlands).

Ground-based auditory surveys of the randomly selected waterbodies in the study area will be conducted in mid to late May in 2013 and 2014 using standard methods developed by the USGS (2010). These surveys involve auditory detection of frogs calling during the breeding season to detect presence or absence of wood frogs at each waterbody sampled. A double-observer occupancy survey design with independent (i.e., "blind") observations made by two observers at each waterbody will be used to estimate the detectability of wood frogs; a single visit with two observers will be made to each waterbody. This design will allow a greater number of waterbodies to be surveyed within a given time period and will save on resources. With estimates of the detectability of wood frogs, the observed occupancy rate of frogs in waterbodies in the study area will be corrected (to account for those frogs present but not detected) to yield a corrected occupancy rate.

Habitat characteristics (e.g., size and depth, presence of emergent aquatic vegetation, presence of fish, beaver activity) would be recorded for each sampled waterbody to facilitate the development of a Project-specific occupancy estimation model based on the habitat characteristics of the occupied waterbodies. Data from the vegetation and wetland mapping and wetland functional assessment studies (see Sections 9.5 and 9.7), and the literature (e.g., Stevens et al. 2006) would be assessed as potential model variables to characterize wood frog habitat. The model's predictive accuracy would be evaluated, if possible, during the 2014 field surveys. If the model is deemed reliable, it would be used to classify all waterbodies in the study area with respect to their probability of supporting breeding wood frogs. Spatial analyses using model results then could be used to more accurately predict Project impacts on wood frogs.

8.18.4.2. Bioassays for Batrachochytrium dendrobatidis (Bd)

The specific assay and sampling methods for Bd will be determined through consultation with commercial or research laboratories. Currently available information indicates that no standard methods for bioassay of Bd have been proffered or certified by the EPA or other regulatory or standards agencies. The currently proposed strategy is to assess the presence/absence of Bd in water samples, but further consultations may suggest that swabs of frog skin or frog tissue samples would be preferred. Water (or frogs) will be collected from each waterbody at which frogs are detected during the auditory surveys described above.

Water samples will be collected in pre-cleaned I-Chem Certified ® high-density polyethylene 125 mL bottles, certified by EPA for metals analysis and water-quality testing. Three samples will be collected from each waterbody, all from approximately two inches below the water surface. Samples will be refrigerated and shipped to a commercial or research laboratory, depending on the availability of lab services, within required holding times (if any are specified).

A frog skin swab method also has been described. By this method, a non-destructive Polymerase Chain Reaction (PCR) technique is used to test for chytrid fungus. Frogs are captured and the skin of the abdomen and/or foot webbing is swabbed 25 times with a sterile cotton swab, after which the frog is released unharmed. The samples are then sealed and refrigerated and later laboratory tested for the presence of chytrid DNA.

8.18.4.3. Impact Assessment

Wood frogs are expected to be affected primarily by direct mortality during construction and by the loss of breeding waterbodies from the placement of fill and from inundation in the reservoir impoundment zone. Additional impacts could occur from the alteration of habitats due to erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Aquatic habitats created by the impoundment will not be suitable for wood frogs due to their preference for small ponds.

The impact assessment for wood frogs will be conducted by employing the habitat classification for waterbodies from the occupancy modeling (above) to categorize waterbodies according to their known or predicted probability of supporting breeding wood frogs. Then the project footprint will be overlain, in GIS, on the mapped waterbody types to quantify the acreages of waterbodies that would be lost directly to fill or inundation. The determination of acreages of waterbody habitats that could be affected by habitat alteration will be conducted similarly by overlaying habitat alteration buffers (surrounding the proposed Project infrastructure) to identify which waterbodies are likely to be affected by ancillary impacts associated with Project construction and operations. The size and number of habitat alteration buffer(s) to be used will be determined based upon the final specifications for Project construction and operations activities, which will be provided in the Project description.

Sampling for Bd in 2013 and 2014 will establish a baseline for comparison of occurrence in ponds in the Project area before and after construction of the Project.

Cumulative effects on wood frogs in the region of the proposed Project will be assessed by evaluating the extent of the direct and indirect impacts expected from the Project in conjunction with the existing impacts to wood frogs in the region. Any necessary PM&E measures will be developed based on the acreage of waterbodies with a high probability of supporting wood frogs affected by Project construction and seasonal timing of Project activities.

8.18.4.4. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of field data collected during the 2013 and 2014 field seasons, including representative photographs of waterbody habitats occupied by wood frogs, will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The wood frog study results will be presented in the Initial and Updated study reports, according the schedule indicated below. The reports will include descriptions of the field methods, a map of the waterbodies surveyed, results of the occupancy surveys, and descriptions of the potential impacts to wood frogs from development of the Project.

8.18.5. Consistency with Generally Accepted Scientific Practice

The wood frog study will involve occupancy surveys of randomly selected waterbodies, and will be conducted following the currently accepted standardized protocols for the monitoring of amphibians (USGS 2010). A similar occupancy survey of wood frogs in randomly selected waterbodies was successfully conducted by ABR in 2007 on another large-scale project in southwest Alaska (see PLP 2011).

8.18.6. Schedule

The wood frog study is planned to be conducted over two years. The activities for each year are described below.

2013:

- Review of aerial imagery and Alaska Gap Analysis data, and selection of waterbodies to survey: March–April
- Field survey: May 10–19 (one crew of two biologists); survey timing and duration may need to be modified depending on the snow-melt and lake-thaw findings from the 2012 field surveys for other wildlife resources in the Project area
- Data analysis: September–October
- Delivery of electronic copies of field data: November
- Initial Study Report: December

<u>2014:</u>

- Review of aerial imagery and Alaska Gap Analysis data, and selection of waterbodies to survey: March–April
- Field survey: May 10–19 (one crew of two biologists); survey timing and duration may need to be modified based on the findings in the 2013 studies
- Data analysis: September–October
- Delivery of electronic copies of field data: November
- Updated Study Report: December

8.18.7. Level of Effort and Cost

The wood frog study is planned to be conducted over two years (2013–2014). A single field survey effort will be conducted each year in late spring by a crew of two biologists. Occupancy surveys will be conducted for approximately 10 days each year. Helicopter support will be required for this study with multiple drop-offs and pick-ups each day in the field (i.e., a dedicated helicopter likely will be required). The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $100,000, for an approximate estimated total of $200,000 for both years.

8.18.8. Literature Cited

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8.19. Evaluation of Wildlife Habitat Use Study

8.19.1. General Description of the Proposed Study

The wildlife habitat evaluation study is an office-based evaluation of existing information and new survey data to be collected for the Project, which will be used in association with the specific wildlife habitat types to be mapped for the Project (see Section 9.5), to categorically rank habitat values for the mapped habitat types for each bird and mammal species of concern that will be addressed in the impact assessments prepared during the FERC licensing process.

8.19.1.1. Study Goals and Objectives

The goal of the wildlife habitat evaluation study is to provide Project-specific habitat-use information for birds and mammals to facilitate quantitative assessments of the impacts to wildlife habitats from development of the proposed Project.

The specific objectives of the wildlife habitat evaluation study are to:

- Use Project-specific survey data and the scientific literature to determine local habitat associations for those bird and mammal species occurring in the Project area that are of conservation and/or management concern to federal and state management agencies and that are specific to the wildlife habitat types to be mapped in the Project area; and
- Categorically rank habitat-values for each bird and mammal species of conservation and/or management concern for each of the wildlife habitat types that will be mapped in the Project area.

The habitat-association data to be developed in this study, along with the wildlife habitats that will be mapped digitally in the vegetation and wildlife habitat mapping study (see Section 9.5), will be used in quantitative, GIS-based assessments to determine habitat loss, habitat alteration, and disturbance effects for birds and mammals (see below). These assessments will play an important role in the overall evaluations of impacts to wildlife during the FERC licensing process.

8.19.2. Existing Information and Need for Additional Information

Wildlife habitat evaluations for the Susitna basin were conducted in several studies in the early 1980s for the APA Susitna Hydroelectric Project and for another study effort in the lower portions of the drainage (AEA 2011). Those habitat evaluations were based on vegetation cover types that were mapped within 16 km (10 mi) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). That vegetation mapping was conducted over 30 years ago and the subsequent habitat evaluations were conducted at least 27 years ago.

Both the vegetation mapping and the habitat evaluations should be updated for the current Project, for three primary reasons. First, the wildlife habitat evaluations completed in the early 1980s were based on vegetation types, not wildlife habitat types. Wildlife habitat maps provide land cover classifications that are better suited to evaluations of habitat use by birds and mammals than a vegetation map alone, primarily through the incorporation of physiography, landform, and vegetation structure information (see Section 9.5). Second, many populations of wildlife species have undoubtedly fluctuated in size since the early 1980s, and it is known that habitat use by birds and mammals can be influenced by density (a greater diversity of habitats often is used when densities are high). Third, vegetation cover, structure, and even landforms are likely to have changed to some degree within the Project area because of landslides, erosion, thermokarst, fire, forest succession, expansion/contraction/decadence of birch and aspen clones, and increases in woody shrub cover associated with increased summer temperatures. To provide accurate information to use in assessing the impacts of habitat loss and alteration for wildlife species during the FERC licensing process, it will be imperative that wildlife habitat evaluations be updated for the currently proposed Project, and that those habitat evaluations are based on a recently prepared wildlife habitat map for the Susitna basin.

8.19.3. Study Area

The wildlife habitat evaluation study area will coincide with the area to be mapped for vegetation and wildlife habitats for the Project (Section 9.5, Figure 9.5-1). The study area encompasses a 5-mi buffer surrounding those areas that would be directly affected by Project construction and operations (the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites).

8.19.4. Study Methods

8.19.4.1. Habitat Evaluation Procedures

The proposed methods for the wildlife habitat evaluation study involve the use of current and Project-specific survey data for birds and mammals in coordination and conjunction with the preparation of a current wildlife habitat map for the Project area. This study would be an office-based effort, performed after the wildlife habitat mapping for the Project area is completed. The methods to be used will follow those outlined in ABR (2008) and Schick and Davis (2008).

The first task in the wildlife habitat evaluation study is the selection of a set of birds and mammals of concern, which would be assessed for habitat impacts for the Project. The procedure for determining which animals are included will be made through consultation with the federal and state resource management agencies and other interested licensing participants. Criteria will be established for the species-selection process, and it is likely that a species will be selected if it meets one or more of the following criteria:

- A federal or state-protected species;
- A species of conservation concern as determined by various management agencies, agency working groups, and non-governmental conservation organizations (see FERC and USFWS 2011);
- A species of management concern for federal and/or state management agencies;
- A species that is an important subsistence resource or is culturally significant for Alaska Natives;
- A sensitive species that can reflect environmental effects through changes in distribution and/or abundance; and
- An ecologically important species (such as a prominent predator or prey species or one with demonstrable ecosystem effects).

For each species of concern selected and for each wildlife habitat type mapped in the Project area, a habitat-value ranking will be assessed. As with the species-selection process, this procedure will be developed through consultation with the federal and state resource management agencies and other interested licensing participants, but it is likely that a habitat-value categorization system would be used (e.g., negligible, low, moderate, and high value). The habitat-value rankings for various bird and mammal groups will be derived in different ways depending on the level of Project-specific data that are available to assess habitat use within each of the mapped wildlife habitat types. Observations of wildlife species will be tagged to mapped habitats in a GIS and the data quality will be assessed for each species and mapped habitat type (e.g., adequately sampled, undersampled, or not sampled). Quantitative evaluations of the observations of the use of mapped habitats will be used whenever possible to discern rankings among the habitat-value categories used, but in cases in which the habitats in question were under sampled or not sampled, habitat-use information from the scientific literature and/or from field experience with the species will be used to derive habitat-value rankings.

Habitats will be ranked for the various life-history stages of each of the species of concern addresssed (e.g., breeding/calving, post-calving, spring and fall migration, overwintering) to encompass the complete use of habitats by those species in the Project area. Additionally, specific habitat-use maps can be prepared for high-value game animals such as caribou, moose, and bears that will illustrate specific use areas and seasons of use in addition to the identification of habitats of importance to those species.

8.19.4.2. Impact Assessment

Data from the wildlife habitat evaluation study will be used directly in quantitative assessments of habitat loss and habitat alteration for each of the bird and mammal species of concern to be addressed in the FERC licensing process. With habitat-value rankings for each bird and mammal species of concern for each mapped habitat type, the areas within the Project footprint which are important for each species of concern can be identified, and the total areas of each to be directly affected (e.g., habitat loss and habitat alteration) by development of the Project can be determined quantitatively in GIS. Similarly, the indirect affects of disturbance will be assessed by applying species-specific disturbance buffers to the Project footprint and determining quantitatively the total areas of important habitats for each species of concern that could be influenced indirectly by disturbance effects during Project construction and operations. Data from the wildlife habitat evaluation study also will be used to help address the potential for fragmentation of habitat patches for species of concern because of Project development.

8.19.4.3. Reporting and Deliverables

The reports and deliverables for this study include:

Study Reports. Because the wildlife habitat evaluation study can be initiated only after the wildlife habitat mapping for the Project area is completed in October 2014, a brief Initial Study Report will be prepared in 2013 and the Updated Study report will be issued in December 2014. The report will include descriptions of the methods used, including summaries of habitat use for each bird and mammal species assessed, and tables indicating habitat-values by species and habitat type.

8.19.5. Consistency with Generally Accepted Scientific Practice

The study methods discussed above have been successfully used for recent wildlife habitat evaluations on several projects in Alaska (e.g., ABR 2008, Schick and Davis 2008, PLP 2011). The methods have been favorably received by agency reviewers.

8.19.6. Schedule

The wildlife habitat evaluation study can be initiated in full only after the wildlife habitat mapping for the Project area is completed in October 2014.

2013:

- Initial selection of species for analysis: November
- Initial Study Report: December

2014:

- Final selection of species for analysis: September
- Data analysis and habitat-value ranking: October–December
- Updated Study Report: December

8.19.7. Level of Effort and Cost

The wildlife habitat evaluation study will be an office-based study, and it is expected to be completed relatively quickly once the wildlife habitat mapping task is finalized. The wildlife habitat evaluation study likely can be completed in several months depending on the size of the area that will be mapped for wildlife habitats (to be determined in consultation with agency reviewers). The habitat evaluation study will be conducted by up to 2 vegetation ecologists and 4 wildlife biologists (with specific expertise with various bird and mammal species groups). The overall cost for this study is on the order of $200,000.

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8.20. Wildlife Harvest Analysis Study

8.20.1. General Description of the Proposed Study

The wildlife harvest anaylsis study is an office-based study of ADF&G and USFWS harvest records for large mammals and furbearers, and small mammals and upland gamebirds (if data are available). In this study, AEA will characterize the past and current hunter effort and harvest levels in the region of the proposed Project by summarizing and analyzing data from the ADF&G harvest database for Alaska, which also includes some harvest data from subsistence users reported to the USFWS.

8.20.1.1. Study Goals and Objectives

Construction and operation of the Project will alter human access to the region through construction of the access road and power transmission corridors, and through the creation of the reservoir. Much of Alaska GMU 13, which encompasses the Project area, is readily accessible by road and provides hunting opportunities for many Alaskans. Creating access points to the project site from the Denali Highway to the north or from the rail corridor to the west may result in increased motorized vehicle access for hunters and recreational users to portions of GMU 13 that are currently remote. The potential for increased human access and activity within GMU Subunits 13A and 13E without additional understanding of the implications for game populations has been identified as a resource management concern by the ADF&G.

The goal of this study is to compile and analyze information on the distribution of big game, furbearers, and small game (including both small mammals and upland gamebirds, assuming data are available) in and near the Project area and to understand patterns of hunting effort and harvest in the area. These data will provide information on identification of past and current trends in hunter access modes, hunting locations, and harvest locations and identify potential Project-induced changes that are likely to alter hunter access or harvest patterns. These findings will help to predict the impacts of those changes on wildlife harvests. This is a multi-year study that was initiated in 2012 (AEA 2012).

Specifically, this study has three primary objectives:

- Identify past and current harvest effort for large and small game including furbearers, harvest locations, access modes and routes;
- Compare current harvest locations of large and small game, including furbearers, with data on the seasonal distribution, abundance, and movements of harvested species, using the results of other, concurrent Project studies on big game and furbearers; and
- Provide harvest data for use in the analyses to be conducted for the recreational study, and, if needed, the socioeconomic and subsistence studies.

The information developed in this study will be used to help develop any necessary measures to address Project impacts on hunting opportunities, hunter distribution, and impacts to game species abundance.

8.20.2. Existing Information and Need for Additional Information

The wildlife data-gap analysis conducted for the Project (ABR 2011) identified the need for an updated drainage-specific compilation of subsistence, sport hunter, and trapper harvest data for big game and furbearers. Hunter access to this region has changed since the 1980s, but potential changes in patterns of harvest at this scale have not been evaluated or compared with distribution of harvested species. Compilation of historic data may be useful for identifying trends in human access and harvest locations over the past decades and will provide information that may inform ADF&G's management goals for big game and furbearers in the Project area.

ADF&G documents legal sport hunting and trapping in Alaska through the collection of harvest reports and sealing records of hides for certain furbearers. Harvest reports are required to be submitted by hunters for some big game species. Hunting effort and harvest success are summarized from harvest reports and sealing records by GMU, subunit, and, when possible, by smaller Uniform Coding Units (UCU) that are delineated based on watersheds at a sub-basin level. These data are compiled and stored by ADF&G in a statewide harvest database. In addition, a trapper questionnaire is issued annually to compile trapper's views of various wildlife species in their area (Schumacher 2010) and some subsistence hunting activity is summarized based on household surveys. Information on harvest as a part of Federal subsistence hunts on Federal land is maintained by USFWS and will need to be obtained through a separate data sharing agreement.

This information from ADF&G is available to be summarized and analyzed to determine spatial and temporal patterns of hunting effort and harvest success. It also provides some information on access types, use of guides, and residency of hunters. These data can be compared with data on the distribution of game mammals and the analyses can be used to help predict the impact of the Project on hunting opportunities, hunter distribution, and impacts on game mammals. Subsistence surveys will be conducted by ADF&G in 2012 and 2013 to gather current information for communities near the project area. Additional information on subsistence harvest will also be available from planned studies.

The following issues identified in the Pre-Application Document (PAD) (AEA 2011) will be address in this study:

- W4: Potential impact of changes in predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development; and
- W5: Potential impacts to wildlife from changes in hunting, vehicular use, noise, and other disturbances due to increased human presence resulting from Project development.

8.20.3. Study Area

The study area (Figure 8.20-1) includes GMU Subunits 13A, 13B, 13E, 14B, 16A and portions of 20A. These GMUs were selected because hunting and trapping activities in portions of each of these GMUs may be influenced directly or indirectly by Project construction and operations, including the reservoir inundation zone, associated facility sites, laydown/storage areas, and access road and power transmission corridors. The study area is based on GMUs to conform with the harvest data available (which is recorded by GMU) and because hunting and trapping in the region of the Project is managed by GMU.

8.20.4. Study Methods

In this project, AEA will use existing data, as well as new data to be collected during concurrent studies, to assess the spatial and temporal patterns and success of hunting and trapping efforts and to examine relationships between effort, harvest, and the distribution of wildlife, as indicated by telemetry studies and other surveys. Existing data from harvest reports will be compiled and reviewed to assess their adequacy to address Project-related changes in human access. These data will be shared with researchers conducting the recreation, socioeconomics, and subsistence studies. The methods used in this study will include the following:

- Compilation and analysis of ADF&G harvest database records;
- Review of ADF&G management reports;
- Review of ADF&G trapper questionnaires;
- Review of ADF&G small game outlook and harvest surveys;
- Review of ADF&G and USFWS subsistence surveys and harvest reports;
- Interviews with regional biologists; and
- Comparison of harvest patterns with development plans and the distribution of game mammals and birds.

Initial efforts will focus on compilation and analysis of hunter effort and harvest success within harvest report units contained within the ADF&G harvest-record database. The spatial resolution, adequacy, and completeness of the harvest data record for detecting potential changes in use of wildlife resources in the Project area will be evaluated.

The study will build on results of the wildlife harvest data analysis initiated in 2012 and will incorporate new harvest data as they become available, as well as the results of the ADF&G moose, caribou, and ptarmigan telemetry studies begun in 2012. Harvest patterns will be compared with seasonal distribution and movements revealed by the telemetry data on moose, caribou, and ptarmigan.

Subsistence surveys will be conducted by ADF&G over several years, beginning in 2012; the questionnaires will be reviewed and modified to incorporate data needs for this analysis.

A relational database of harvest and effort data used in the analysis will be prepared. Naming conventions of files, data fields and metadata descriptions will meet the ADNR standards established for the Project. Hunter effort and harvest success maps showing big game and furbearer species will be developed for UCUs based on the relational database developed from the ADF&G harvest database. 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.

Harvest effort and success will be calculated at the highest spatial resolution possible given the quality of the data (GMUs, Subunits, or UCUs) and compared with the best available estimates of game populations, hunting regulations, and access. If possible, a predictive model will be conducted to assess the potential change in harvest effort and harvest success in the project area given potential changes in game populations and hunter access.

8.20.4.1. Impact Assessment

Data on the current distribution of harvest effort and harvest success in the study area will be used to assess potential Project impacts on hunting and trapping effort and harvest success. The assessment of impacts on hunting and trapping effort and harvest success will be coordinated with other Project studies focused on the human dimension (recreation, socioeconomics, and subsistence) to assess how the expected changes in land use and access in the Project area will affect patterns of hunting and trapping.

The impacts of the Project on game animal populations will be assessed by conducting geospatial analyses and evaluation of the responses of the study species to other similar development projects, as documented in the scientific literature. For most game species (bears, moose, caribou, dall's sheep, wolverine, furbearers, small mammals, and ptarmigan), the impacts of the Project on populations in the region will be conducted in other wildlife studies (see Sections 8.5, 8.6, 8.7, 8.8, 8.9, 8.10, 8.11, 8.12, and 8.17) for which more thorough field data will be collected than can be obtained from harvest records. In those studies, game species occurrence will be assessed in each of the wildlife habitat types to be mapped in the Project area (see Section 9.5) via the habitat-value rankings for each habitat type conducted in the habitat evaluation study (see Section 8.19). Using GIS software, the direct and indirect impacts of the Project will then be evaluated by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers onto the habitat map to compare to habitats of importance for each species. In this way, quantitative measures of habitat loss, habitat alteration, and disturbance to habitats of importance for each species will be determined. Additional information in the impact assessments will be obtained by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers on the known locations of use for these species, as determined from Project-specific survey data.

Similar GIS analyses of impacts on hunting and trapping effort and harvest success will be conducted by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers on the known locations of harvest data obtained in this study.

8.20.5. Consistency with Generally Accepted Scientific Practices

Harvest data will be analyzed according to commonly accepted statistical techniques. Spatial statistics will be conducted with commonly accepted techniques such as fixed-kernel density estimation with least-squares cross validation or plug-in bandwidth selection (Seaman and Powell 1996, Gitzen et al. 2006).

8.20.6. Schedule

This is a multi-year study that was initiated in 2012. The following schedule is anticipated for 2013-2014 activities:

- Transfer of 2012 harvest and subsistence data in July 2013;
- Report and analysis harvest data through 2012 and 2013 activities will incorporated into 2013 Initial Study Report, to be issued December 2013;
- Transfer of 2013 harvest and subsistence data in July 2014; and
- Report analysis of harvest data through 2013 incorporated into Updated Study Report, to be issued December 2014.

8.20.7. Level of Effort and Cost

This study will focus on analyzing existing harvest data and new data collected for other wildlife, subsistence, and recreational studies to maximize the information gained from these data. Thus, basic questions associated with human harvest of game animals in and near the Project area can be analyzed in a cost-effective manner. The total anticipated cost for the study is approximately $100,000.

8.20.8. Literature Cited

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AEA. 2012. Past and current big game and furbearer harvest study for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241. Draft final version (March 21, 2012). Alaska Energy Authority, Anchorage.

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Seaman, D. E. and R. A. Powell. 1996. An evaluation of the accuracy of kernel density estimators for home range analysis. Ecology 77:2075–2085.

8.20.9. Figures

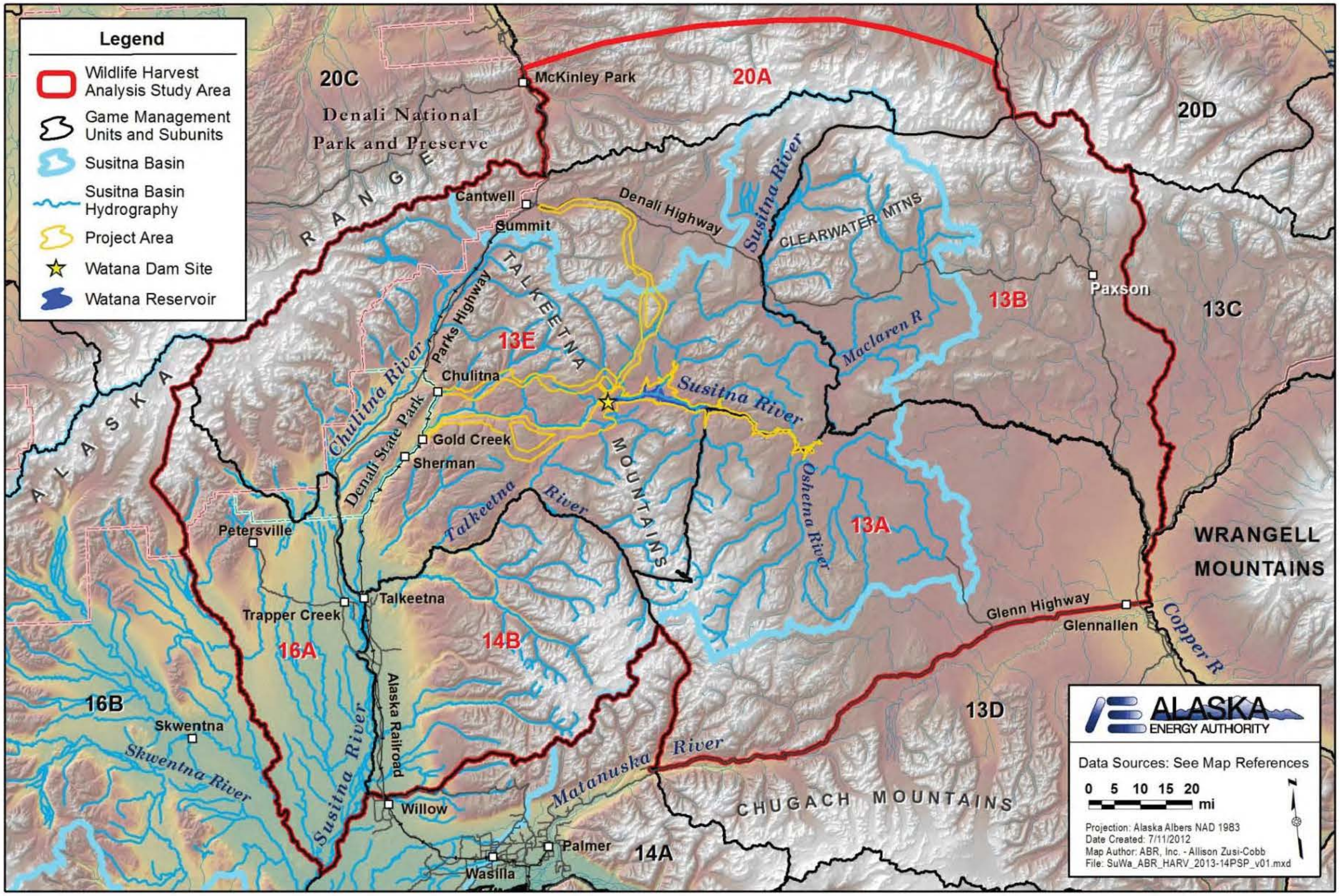

Figure 8.20-1. Wildlife harvest analysis study area.

8.21. Attachments

ATTACHMENT 8-1. DOCUMENTATION OF CONSULTATION ON WILDLIFE RESOURCES STUDY PLANS

ATTACHMENT 8-1

DOCUMENTATION OF CONSULTATION ON WILDLIFE RESOURCES STUDY PLANS

Watana Dam Project Terrestrial Wildlife Research and Monitoring Needs

November 22, 2011

Division of Wildlife Conservation staff identified items #'s 1 – 4 below, as high priority studies or information that staff felt definitely needed to be done and that the ADF&G should do or be involved in. Staff think that items 5 - 7 bear looking at but were of a lower priority. For the most part staff are comfortable with items 5 - 7 being done by other entities and further discussion would be needed to determine if these, or other studies, were items that Wildlife Conservation staff would want to take on.

1) **Moose.** These would be done by ADF&G Region IV staff if funded under an RSA.
    a. Full population estimates upstream and downstream from the dam site. Staff agree with this particularly in the area of the dam and upstream.
    b. Radio-collaring for information on seasonal moose movements and distribution to, from and across the proposed area of inundation, as well as to document baseline moose productivity and survival in the area. No moose are currently collared in the vicinity of this proposed project. GPS collars may also be added to provide more complete information regarding fine-scale seasonal movements.
    c. Hunter access has changed in the years since the original Su-Hydro research and this also likely effects moose movements, so updated info on hunter use and access in the area tied back to moose movements and distribution is warranted.
2) **Caribou.** These would be done by ADF&G Region IV staff if funded under an RSA.
    a. Watana site is on the north border of the Nelchina Caribou calving grounds and the herd moves right through this area during annual migrations. There has been considerable change in the distribution of the Delta Caribou herd since the earlier Su-Hydro research and the 1999-2003 Nelchina movement and distribution work. Evaluation of herd identification, movements, distribution, and mixing is necessary for Watana mitigation as well as pre-, post and construction management of these important resources. This work will require collaring (VHF) additional animals and increasing monitoring flights supplemental to existing monitoring efforts. GPS collars may also be added to provide more complete information regarding fine-scale seasonal movements.
3) **Wolverine.** These would be done by ADF&G Region IV staff if funded under an RSA.
    a. A onetime Sample Unit Probability Estimator (SUPE) and/or occupancy modeling is warranted as this area has been identified as an area of refugia with minimal harvest. Access to this area, general disturbance, and harvest levels will likely change with development.
4) **Small Game - Birds**. ADF&G staff would be interested in doing this if funded under an RSA.
    a. Ptarmigan movement and harvest surveys. Changes in access may increase general disturbance and harvest in this area which is currently lightly

harvested. The area also may provide refugia for adjacent accessible areas with higher harvests. Population studies and relevant ecological studies may be useful. Additionally, staff are interested in studying the effects of increased human access on these small game resources. The area currently has poor to limited access and measuring the rate and extent of human growth in the area as it relates to small game resources and harvests would be useful.

5) **Non game species**. Alaska Natural Heritage Program (AKNHP) is in the latter stages of completing GAP analyses for all terrestrial vertebrates for the entire state of Alaska, and as part of this endeavor, they are modeling species distributions based on known locations using both inductive and deductive modeling approaches. They will have the most up to date distribution data for a number of species, including small non-game species. These would be useful for determining impacts to wildlife species that may be impacted by the Watana development. The Alaska Natural Heritage program will be contacted to request all wildlife species potentially impacted by the project. They will also be asked about the timeline of completion of the Alaska GAP project, and potential access to the Alaska GAP products (species distribution maps) if the information is needed prior to finalization of AK GAP.
6) **Bears.**
    a. A brown bear study in GMU 13 (the proposed Watana lake is the north border of the study area) is ending and does not need to continue. Staff felt the existing historic data from Su-Hydro research and subsequent research (2006-present) is adequate to evaluate impacts.
    b. Information on downstream use of habitat and the importance of salmon in bear diets in conjunction with impacts to salmonids would aid in identifying potential impacts to bear downstream of the dam. Staff are comfortable with this being done through an outside contractor or the University of Alaska. Population estimates are probably not warranted as adequate information exists especially in adjacent areas.
    c. For black bears, staff felt the existing historic data from Su-Hydro research is adequate to evaluate impacts.
7) **Sm. Furbearers / Marten.** Watana impoundment would inundate a central block of marten habitat potentially creating barrier between upstream and downstream populations. This is also likely a problem common to other terrestrial furbearers and small mammals utilizing this old timber block. Staff, however, were not clear that research could be done to avoid or correct it other than just documenting the lost habitats.
8) **Wolves.** Ongoing monitoring work will be sufficient.

Betsy McGregor

From:	Burch, Mark E (DFG) <mark.burch@alaska.gov>
Sent:	Tuesday, December 20, 2011 4:06 PM
To:	Betsy McGregor
Cc:	Dale, Bruce W (DFG); Schwanke, Becky A (DFG); Butler, Lem G (DFG); Klein, Joseph P (DFG); Weiss, Edward W (DFG)
Subject:	FW: Additional Comments on proposed 2012 projects

Hi Betsy,

We recently figured out there were some additional comments that basically slipped through the cracks. I hope these are still helpful at this point.

9 – Vegetation – it notes moose browse survey area establishment, then it should also mention caribou range survey areas as well (especially considering there are historic habitat exclosures out there for caribou that we really could use $ to update and analyze).

As we begin to think about mitigation, we would note that we have a moose habitat controlled burn plan on the books for the SW corner of the Alphabet Hills (sits just east of the Watana dam site, along the upper edge of the West Fork Gulkana River (Alphabet Hills Prescribed Burn Area)). We were able to get 40,000 acres burned in 2003 and 2004, and we would like to have more acreage burned in future years as an ongoing part of our intensive management plan. These areas are close to each other, and prescribed burning is a priority for F&G for this area.

#10 – Habitat use / movement – under sensitive habitats – Should remove the reference to wolf dens. The Susitna River in this area provides a consistent year to year boundary between wolf packs. Considering wolves typically den towards the center of their home ranges, denning locations would not be expected in the inundation area. This is also in the middle of an intensive wolf management area, and wolf den sites aren't something we consider as sensitive in terms of the long-term overall predator/prey management of the area. Likewise, bear dens do not need to be on this list (they aren't). These are very difficult to document, radio/gps collars are necessary, they often change year to year.

We are concerned with general disturbance of all wildlife in some capacity, but wolf and bear dens do not rise to the level of "sensitive" locations in the grand scheme of things, like concentrated caribou calving grounds might. Wolf den sites are sometimes re-used by the same pack year after year, but they are extremely prolific animals regardless of general disturbance. They have the ability to easily find a new den site. Bears re-use their dens even less often. Moose calving sites would be similar to wolf/bear dens. While cow moose may return to the same general location to calve each year – if it's unavailable, they will find somewhere else. They are scattered enough, we can't pinpoint any high-density "sensitive" areas.

We don't have plans to collar bears, sheep, beaver, wolves, wolverine, owls or other species of concern, so the "establish appropriate ... telemetry samples" statement seems inappropriate for most of the species listed. It should only refer to moose and caribou. We should say that we'll "develop or refine monitoring programs and techniques for wildlife species of concern (moose, wolves, wolverine, sheep, etc)

Robin Reich

From:	Klein, Joseph P (DFG) <joe.klein@alaska.gov>
Sent:	Thursday, February 02, 2012 9:38 AM
To:	Betsy McGregor
Cc:	Clark, Robert A (DFG); Vincent-Lang, Douglas S (DFG); Benkert, Ronald C (DFG); Burch, Mark E (DFG); Erickson, Jack W (DFG); Fair, Lowell F (DFG); Fink, Mark J (DFG); Holen, Davin L (DFG); Lingnau, Tracy L (DFG); Miller, Monte D (DFG)
Subject:	Comments on January Study Planning Meetings

Betsy- We appreciate Alaska Energy Authority conducting Study Planning Meetings last week to provide the latest project and resource information and we offer the following comments.

General

- We recommend a plan to incorporate all fish and wildlife information and data results into a user-friendly, GIS-related format that can be used by anyone with little to no GIS experience. We believe it is important to initiate these efforts early in the licensing process in order to coordinate data collection, formatting, storage and other issues with the upcoming studies.

Water Resources

- We support documentation of ice break up along the Susitna River in the spring 2012 and the objectives identified at the meeting. We recommend the use of high quality photographs and videos that are geo-referenced to help facilitate analyses of these processes.
- We recommend a summary listing of peak floods and associated recurrence intervals that have occurred on the Susitna River between the 1980 studies and the present be included with the "Geomorphic Assessment of Middle River Reach Using Aerial Photography" study. We also recommend a search and analysis of any pre-1980's photographs and an evaluation of potential streambed changes over time at long-term USGS gaging stations on the river.
- Although we were informed from previous discussions that USGS was/will be conducting a comprehensive hydrologic assessment for the Susitna River basin, we did not receive any updates or summary of products to be provided so we are reiterating an earlier request for summaries of seasonal and long-term streamflow characteristics at key locations along the river.

Aquatic Resources

- One of the challenges facing this project will be quantifying flow-habitat relationships for identified target species and associated range of habitats. We support AEA's strategy to synthesize the 1980's instream flow studies and develop preliminary study approaches to facilitate stakeholder discussion and recommendations.

Let me know if you have any questions.

Regards, Joe

Joe Klein, P.E.
Supervisor Aquatic Resources Unit
Alaska Department of Fish and Game
333 Raspberry Rd
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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

IN REPLY REFER TO:
AFWFO

February 10, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided some initial comments on the draft study plans during the work group meetings January 24-26, 2012, and had anticipated providing additional comments after receiving revised and more thorough descriptions of the proposed studies. Since that meeting, we have conducted an initial review of the Instream Flow, Aquatic Resource, Water Resource, and Eagle and Raptor Nest draft 2012 study plans provided at the January 24-26, 2012, meetings. Due to the short turnaround time requested for feedback (11 business days) on the study plans and their ongoing evolution, our comments should be consider cursory. The following represents our overall issues and concerns with the study plans and the enclosure provides a more detailed accounting of our comments and recommendations for each specific study plan.

Expanded Study Framework and Timeframe: The Service and other resource agencies have frequently expressed concerns about the limited temporal and spatial scale, and limited timeframe, for proposed studies in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the lower reaches (as defined by AEA) of the Susitna River for the proposed Susitna-Watana project. As part of the hierarchical framework, an ecologically meaningful space-timing scale should be identified related to project studies. As the spatial scale of studies increases, the time scale of important processes such as ice, sedimentation, and channel formation also increases, because they operate at slower rates,

time lags increase, and indirect effects become increasingly important. Studies related to these dynamic fish habitat forming processes need to be adequate (i.e., 5 years or more) to begin to understand mechanistic linkages (Wiens et al 1986; Wiens 2007). For this purpose, the Service recommends conducting fish habitat forming process studies on the minimum temporal scale of 5 years. This temporal scale equates to the typical life cycle of Chinook salmon, an Alaska Department of Fish and Game designated stock of concern.

To address these concerns, the Service expects that the 2012 studies and future project-related studies will be conducted on a hierarchical framework (Urban et al 1987; Frissell et al 1986) at a variety of scales including meso-habitat, reach, and basin wide. The Service also expects that the 2012 studies will not only help fill data gaps identified in the Preliminary Application Document (PAD), but will also be integrated between each other and with future project-related studies. This framework and integration is necessary to understand existing conditions and predicted changes to fish habitat in relation to changes in physical processes from proposed regulated flows. We recommend you establish a schedule for analysis of data obtained in 2012 and a framework for how to incorporate the 2012 data into 2013-2014 study plans. This is necessary for resource agencies to adequately assess potential project impacts to Alaska's fish and wildlife resources.

Winter Flow Regimes: At the January 24-26 work group meetings, and in the PAD, winter operations were described as load-following with flows ranging from 3,000 to 10,000 cfs in a 24-hour period. Regulated flows, including load-following operation, result in substantial changes to the natural hydrograph of a river. Dam construction and operation globally has resulted in adverse effects to anadromous and resident fish, macroinvertebrates, and their habitats. The Service is particularly concerned with the lack of study focus on Susitna River winter flows under natural and proposed flow operations. We recommend that winter base flows be assessed beginning in 2012 under the Instream Flow 2012 Study Planning, Water Resources Study Planning, and in the Aquatic Resources Study Planning. During colder winter months, glacial river base flows, such as those in the Susitna River, are derived entirely from groundwater inputs resulting in reduced habitat availability. We recommend assessing base flows as they relate to mainstem winter habitats (including adult spawning and juvenile fish overwintering locations, and the potential for stranding or increased mortality or condition related to changes in flow and water temperature), water quality conditions, ice-processes, and habitat and geomorphic processes in the Susitna River under current conditions and underthe proposed operation.

Temperature: In our December 30, 2011, letter we recommended thermal imagery (Torgerson et al. 1999) be conducted in 2012 throughout the Susitna River mainstem to identify important thermal habitats that may be utilized for spawning, refugia, or as overwintering areas. It is important to characterize the Susitna River water temperature profile as it relates to habitat because the proposed dam is expected to significantly alter the water temperatures downstream of the dam. Please review this letter as a reference for this study, as well as other Service recommendations.

Modeling Design: There is currently a lack of information in the draft study plans related to overall modeling approaches that will be used for the Susitna-Watana project. When identifying

instream flow model(s) the purpose and assumptions must be compared to Water Resources and Aquatic Resources study objectives. Model assumptions and model inputs need to be clearly stated and available for review. Spatial pattern should be one of the independent variables in the model analysis. At a minimum, we recommend using 2D hydrodynamic model(s) at a mesohabitat, reach, and basin wide scale (Crowder and Diplas 2000). We specifically recommend a 2D model be included to predict physical processes to spatially represent variation in input variables, and how those variables change temporally and spatially under differing flows. Selected model(s) should also include a sensitivity analysis (Turner et al. 2001). This information is critical to the general project understanding of existing ecological spatial patterns, and predicted spatial patterns under proposed regulated flows from the Susitna-Watana dam.

Mercury: Since the January meetings, it was brought to our attention that fish mercury concentrations frequently increase after impoundment of a reservoir, particularly boreal reservoirs. Soil flooding releases organic matter and nutrients, providing food to bacterial communities that methylate inorganic mercury. Methylation and bioaccumulation are the primary pathways for mercury accumulation in fish (Therriault, 1998). Although not identified in the 2012 draft studies, future studies should include pre- and post-impoundment mercury concentration studies.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
Field Supervisor

cc: S. Walker, NOAA, susan.walker@noaa.gov
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References:

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Urban, D. L. R. V. O'Neill, and H. H. Shugart, Jr. 1987. Landscape Ecology.

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Enclosure

The following comments and recommendations are based on our review of the 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project provided at the January 24-26, 2012, work group meetings.

Synthesis of Existing Fish Population Data (F-S1)

Recommend including information on seasonal distribution and abundance of anadromous and resident fish species among riverine habitat types and river reaches. As part of the spawning and incubation period for resident and anadromous species, studies need to include fry emergence periods and time (of day) information to determine potential impacts from fluctuating winter/spring flows. Potential issues include stranding of fish (by life stage and species) and downstream displacement relative to potential ramp rates. This study needs to integrate with instream flow and geomorphic studies to look at effects of daily flow fluctuations, particularly in winter, in the middle and lower river reaches.

For clarity, we recommend referring to river "reaches" as defined in the PAD rather than river "segments."

Fish persistence should be evaluated relative to spatial and temporal availability of fish habitat under existing and proposed flows. The Service recommends fish habitat studies be developed concurrent with the water resource studies to interface and characterize fish habitat as it relates to physical (hydrologic, sedimentation, and geomorphic) processes. Fish habitat metrics should be developed and integrated with modeling efforts related to physical processes and fish presence.

Chinook Salmon Presence above Devil's Canyon Study (F-S4)

Chinook salmon presence above Devil's Canyon study should include an upstream and downstream fish passage component. This 2012 study should include fish passage relative to all life stages of Chinook salmon. There is the potential to include Dolly Varden and Humpback whitefish pending results of an otolith/anadromy analysis by the Service for these species.

The Service supports the genetic component of the study (F-S4) which is necessary to determine whether the Chinook salmon meta-population in the vicinity of the proposed dam is a distinct population.

Wetland Mapping Study (B-S3)

The draft wetland study states that the methods used will be consistent with guidance in the Alaska Regional Supplement (USACE 2007), the U.S. Army Corps of Engineers (USACE) Manual (Environmental Laboratory 1987), and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Therefore, the Service recommends the use of the Cook Inlet Classification (CIC) developed by Mike Gracz. The CIC is an HGM-based wetland ecosystem classification scheme analogous to Cowardin. The Service supports the use of CIC for wetland mapping in the Cook Inlet Basin over Cowardin because CIC is regionally

specific and indicative of function (e.g., a spring fen always receives groundwater discharge; whether a palustrine emergent wetland does is unknown). CIC can be cross-walked with Cowardin if necessary. CIC methodologies and Mike Gracz' mapping protocols are described on www.cookinletwetlands.info.

In terms of compensatory mitigation related to a site that will be monitored over time using site-specific, precise functional attribution, the best functional assessment method available is the use of the HGM Regional Guidebooks. The citation for slope/flat wetlands is as follows:

- Hall, J.V., J. Powell, S. Carrick, T. Rockwell, G.G. Hollands, T. Walter and J. White. 2003. Wetland Functional Assessment Guidebook, Operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion, Alaska, using the HGM approach. State of Alaska, Department of Environmental Conservation, Juneau, Alaska.

Eagles and Raptor Nest Study (W-S3)

The Service's Migratory Bird branch is evaluating the potential for an eagle study that would compare productivity/behavior of golden eagles in disturbed areas (such as the Golden Valley Wind project, Usibelli Coal Mine, and the Susitna-Watana dam) versus undisturbed areas (Denali Park). We would like to explore the option of partnering with Watana projects to complete eagle nesting surveys. The Service could potentially provide experienced biologists to conduct the surveys. The benefits to this partnership include: 1) assistance to the project sponsors to conduct an eagle nesting survey; 2) provide cost savings to project sponsors by eliminating the need to hire a consultant to complete the survey; and 3) allow the Service to collect information valuable for our study. These surveys would not be considered compensatory mitigation, but would help meet eagle nest survey requirements. The Service generally recommends a pre-project survey with a follow-up survey just prior to construction.

Since 2009, compensatory mitigation is required for "take" or disturbance of active and inactive bald eagle nests. For golden eagles, there is a "no net loss" policy. Identifying ways to offset compensatory mitigation requirements early in the project development process can help the resource and the project sponsors. For example, a 2-year pre-construction eagle tracking study could help minimize required compensatory mitigation if the study demonstrated a "disturbance" rather than a "loss of territory."

Riparian (B-S2)

In addition to comments provided previously, we recommend riparian studies be integrated with other 2012 studies and with future project-related studies.

Beluga Prey Species Study (F-S6)

This study should identify components that specifically interface with the water resource and fish habitat studies. Anadromous prey species such as eulachon, Pacific and Arctic lamprey have been documented as present in the lower reach of the Susitna River and may be impacted by the proposed regulated flows. Relationships between natural flows and existing habitats should be

developed to best predict changes during proposed regulated flows that may impact beluga whale prey species.

Instream Flow Planning Study (F-S5)

1) Selection of a model or series of models of 1D or 2D nature will drive the type of data needs for the field studies. This discussion and selection must be made prior to finalizing habitat studies.
2) The habitat suitability curve development is a useful product. Conduct the studies in such a manner as to ensure the development uses actual suitability data and is not dominated by best professional consensus.
3) Need a better understanding of how the instream flow study relates to the routing model or uses its own calibrated flow model. Concern is that the overall routing model may have significant variation in water level between cross-sections depending on their placement in relation to the habitat cross-sections. Location in pools or riffles and within these features or braided section will vary the water level of a certain flow and may not correctly interpret the water level of a habitat cross-section.
4) Anticipate that the habitat study will have its own cross-sections and flow analysis separate from the routing model. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new spots as needed for 2013 and 2014.
5) Desire to have a large map with the routing and habitat cross-sections on it over recent aerial imagery.
6) In review of 1980s studies, were there any groundwater/surface water exchange studies?
7) Need to confirm whether the 1980s studies included mapping of groundwater upwelling areas along the river for gaining and losing reaches. We recommend at least a large-scale thermal temperature study along the river to note locations and relate it to the habitat study areas and cross-section surveys.

Reservoir and Flow Routing Model Transect Data Collection (WR-S1)

1) We recommend that the cross-section re-surveys in 2012 go beyond the forest limit but stay within the floodprone area, as there may be key floodplain elements not captured in the LIDAR data.
2) Need to evaluate appropriate model to consider ice effects as ice is a significant factor, not only for habitat but also for recreational use. We highly recommend utilizing one model that is fully dynamic and can deal with both floods and ice dynamics during winter low flows for routing. A model was recommended in the January work group discussion, created in Canada that may be appropriate. Model selection will drive data needs so this needs to be selected soon and with a full idea of the types of available models out there to select the best one.
3) Given the discussion of ice dynamics, cross-sections are likely needed in the lower reach to adequately assess ice dynamics as ice forms and slowly freezes upstream. We recommend that these cross-sections be identified and obtained in 2012 to maximize utilization of the model and potentially correlated to lower river habitat studies to reduce redundancy of effort.

4) Instream flow and habitat study cross-sections are assumed to be different than the routing cross-sections. We recommend creating a map for distribution that overlays the original routing and habitat cross-sections to begin to understand their spatial location and orientation and begin discussing 2012 study locations. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new sampling locations as needed for 2013 and 2014.
5) Flows need to be measured to calibrate routing as much as possible. We recommend that water surface and flow be captured at key cross-sections while in the field to calibrate the routing model results and to verify Manning's n assumptions.

Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations (G-S1)

1) For locations obtaining bedload data need to also do a bed pebble count to compare to transported load to calibrate for shear stress and other calculations.
2) Recommend that gravel bar sampling be part of the study to compare to transport load data obtained. This methodology must be well documented.
3) Evaluate the Chulitna and Talkeetna as well as other key tributary deltas for sediment distribution and load into the system.
4) Recommend attempting to get high flow values near bankfull stage at both Gold Creek and Watana sites to add to data.
5) Recommend sediment sampling at the Susitna-Watana dam site to demonstrate correlation to Gold Creek and/or model changes in sediment loading between the sites.
6) Evaluate 3-inch versus 6-inch bedload sampler use for 2012 field season to try to capture large fractions of bedload movement as able.

Geomorphic Assessment of Middle River Reach using Aerial Photography (G-S2)

1) Include a listing and evaluation of flood and ice conditions during and between aerial photography events, especially during breakup periods to help correlate differences to significant events in the watershed.
2) Does not address winter flows and habitat use under winter conditions; needs to come up with a plan to address this beginning winter 2012/13.
3) For geomorphic analysis and comparison to habitat studies, cross-section locations for substrate classification, large woody debris counts in floodprone width, and categorization of fluvial process (Montgomery and Buffington, Rosgen) should be determined and fieldwork performed. If location agrees with an old cross-section, it will help verify any changes over time and with flow to help determine stability and shear stress equations.

Geomorphic Assessment of Project Effects on Lower River Channel (G-S4)

1) There is a need to evaluate the hydrology and habitat use of the lower river to evaluate change over time from dam operations:
   a. Winter operations are a major concern given the need to evaluate daily flow fluctuations of 3,000-10,000 cfs in the winter. This effect must be modeled into

the lower reach to see if the magnitude of fluctuating flows in the winter extends further downstream than spring and summer flow periods. Additionally, ice and open water effects will be extended into the downstream area so modeling will need to address this by extending it downstream.

b. In the January work group meetings it was pointed out that ice is generated upstream and flows down the river to the lower reaches, beginning to form in the lower reach and slowly ice up the river upstream. This also needs modeling from a thermal standpoint, hence again, the need for cross-sections in the lower reaches.
c. Recommend that the gage at Su Station be turned on by the U.S. Geological Survey (USGS) and maintained by USGS to help calibrate lower reach modeling efforts over the next 5 years, especially for ice effects and dynamics modeling.
d. Cross-sections need to be made in the lower reach to add to an ice dynamics model as well as habitat studies – recommend selecting locations and getting these cross-sections in 2012 to facilitate modeling efforts.

2) Re-do all cross-sections at existing and past gage sites in the middle and lower reaches (including Su Station) to evaluate hydraulics, assess stability by comparing to old cross-section data and give an initial assessment of stability or changes in rating curve information. Also, it would be beneficial to do an initial evaluation of these gage sites at winter flows and with ice dynamics to begin to understand the impact winter flows will have. This will help with evaluating changes over the last 30 years in the lower reaches to determine whether additional work in 2013-2014 is needed.

Documentation of Sustina River Ice Breakup and Formation (G-S3)

1) Key elements to identify are: where ice generation occurs (production zones) and where ice lodges and begins the process of ice formation in the river.
2) Recommend that flights include an ice scientist, fishery biologist, riparian specialist and fluvial geomorphologist so that multiple observations can be made at the same time and can be stitched together to understand the processes taking place.
3) Recommend video be taken during all river flights for later reference.
4) Documentation of frazil ice generation is very important – current thought is that 80% is generated upstream of Devil's Canyon in the middle reach.
5) Daily flights might be needed during the height of breakup or freeze-up.
6) Is CRREL involved with the ice research?
7) Highly recommend utilizing our Canadian neighbors and their research and models for ice issues.

Review of Existing Water Temperature Data and Models (WQ-S1)

1) Identify appropriate temperature models to use based on new technology and understanding.
2) Evaluate MET station locations and strongly consider an additional station around the Deshka or Yentna which could help with ice studies.

3) Discuss MET station locations with NOAA Weather Forecast Center to access experts as well as potentially help with storing data.
4) Perform large-scale thermal study of the river for groundwater exchange areas over different flows.
5) At old, existing, and new gage sites, include continuous temperature monitoring; consider a water quality study at gage sites for 2012, 2013, and 2014 seasons with parameters agreed to by all parties and performed by USGS.
6) Evaluate past assumptions for temperature modeling (at least our understanding of it), i.e., summer analysis of surface water temperatures only, as this dominates habitat use, versus winter analysis of intergravel temperature only. Provide quantification of the hypothesis and assumptions made and determine if they are still relevant.
7) 2012 fieldwork in the work group meeting was discussed to primarily show how mainstem temperatures influence side channel habitat. This should be expanded to do a thermal analysis up and down the river (#4).
8) Discussed in the work group meetings that 2013-2014 work will deal with upwelling water temperatures. A thermal analysis in 2012 can help determine these sites.
9) Fieldwork needs to be performed that can help calibrate heat transfer coefficients and other assumptions in selected temperature models between mainstem and other waters.
10) Analysis of temperature effects on ice formation was not discussed and needs to be part of the scope in coordination with ice and habitat studies.
11) Ensure that solar radiation information will be collected at all MET sites as it is crucial to modeling efforts (ice, etc.) and evaluate other metrics that are needed for calibrating models.

Susitna–Watana Hydroelectric Project

Agency Meeting Record

Subject:	Eagle take permits under the Bald and Golden Eagle Protection Act (BGEPA) and 2012 study plan for surveys of eagles and other raptors
Location:	U.S. Fish and Wildlife Service (USFWS) office, West 4th Ave, Anchorage
Date/Time:	11 April 2012, 10:00–14:16
Attendees:	Maureen deZeeuw (USFWS), Jordan Muir (USFWS), Betsy McGregor (AEA), John Shook (ABR, Inc.); Brian Lawhead (ABR, Inc., via telephone)

Eagle permitting discussion (Maureen & Jordan):

Eagle surveys should focus on obtaining information needed for the permitting process.

Two new permit types under the BGEPA (USFWS will provide web link for eagle permitting):

1) Nest take (intentional or unintentional) — No taking of active nest allowed except in emergency; uninhabited nest is defined as no adult, egg, or chick within 10 days; unoccupied nests are assumed to be usable unless in very poor shape.

2) Eagle take permit — Incidental take only; not limited to lethal take, so includes disturbance (anything that may affect productivity)

Standard and programmatic permits are issued, depending on whether specific numbers can be identified for take; Jordan envisions a standard permit for this project (no programmatic permits have been issued yet for Golden Eagle [GOEA])

- If disturbance is likely, permit will be needed.
- If avoidance measures are adequate, then no permit will be required.
- See web site for Bald Eagle (BAEA) disturbance-buffer zones; no comparable buffer zones have been established yet for GOEA.
- BAEA take allowance is robust in Alaska (555/yr).
- GOEA take threshold is 0/yr, but this does not preclude a take permit from being issued. Any take (including disturbance) will need to be mitigated for. GOEA take permit standards are still being worked out but will be stricter than for BAEA and will require no net loss for take of a nest or a territory—USFWS will want to know average territory size in affected area.
- Territory take will apply to inundation zone, access routes, transportation-line corridors.

- Permit is generally issued for 5 years and is renewable; should focus on specific activity types and can be amended, if necessary, to add new activities.
    - 2012–2017 Surveys: might need a permit depending on proximity, timing w/ breeding season and disturbance levels
    - 2017–2022/23 Construction: need a permit
    - 2023+ Operation: need a permit
- Any GOEA permit will be precedent-setting, so will require national review and should expect it to be a very high profile, controversial issue.
- BAEA permit will require 60–90 days at minimum, but likely will take longer (expect 120 days), but only if compensatory mitigation is figured out before permit application (compensatory mitigation is the difficult part).
- Mitigation requires that stable or increasing population be maintained.
- Only compensatory mitigation used thus far has been retrofitting of problem poles that kill Golden Eagles; this is a challenge in Alaska because no power poles have been identified as a mortality source (nothing has been identified as a mortality source in AK). Other options are being considered, such as: identifying and retrofitting high-risk poles in Alaska (based on proximity to GOEA habitat and pole configuration), blasting new cliff areas, and USFWS is open to any suggestions for new mitigation.
- Jordan and Maureen emphasized that we document everything that shows avoidance/minimization of disturbance (this includes 2011 surveys).
- Discussion of territory take and considerations of value of affected area—they really emphasize average territory size calculation.

Betsy briefly reviewed project description: construction to start in 2017, first on corridors, then dam; construction period would be 5 years; dam construction would be finished in 2022; dam would begin operating in 2023 (takes a year to fill). They are leaning away from the Gold corridor (southern) because of all the stream crossings w/ ravines). The project will likely have 2 transmission corridors, one of which will also have the road (2 separated transmission lines may be needed to attenuate the power as it is fed into the intertie powerlines)

- Project studies will be operating some fish wheels at Curry. Make sure they do not attract Bald Eagles or other wildlife (Common Raven, Bears etc).

John reviewed historical data on eagle nests from the 1980s Susitna Hydroelectric Project.

Jordan suggested that expanding the survey area away from the reservoir inundation zone may detect additional nests that could reduce the average territory size for mitigation calculations (which uses 1/2 of the mean inter nest distance as the territory radius).

- If up to 50% of territory overlaps with project footprint, then that territory is considered to be taken.
- Jordan recommended surveying suitable nesting habitats within 10 miles, then applying the average territory size calculation—but possibly could use other data from comparable nesting habitat (e.g., Alaska Range GOEA) if its applicability can be demonstrated.
- Should not need a disturbance permit this year (2012) for geotechnical borehole drilling program because of temporal avoidance (August–September timing), or for study activities because they will be on foot and by boat; but, plan to provide them with description of measures taken and activities conducted.
- Determine whether nest sites are visible from drilling locations.
- 2-mi buffer distance around access corridors is consistent with USFWS guidance for avoidance/minimization of disturbance for Golden Eagles for linear infrastructure ("2 to 3 miles from linear projects such as pipelines and roads etc.").
- Jordan would prefer that surveys be conducted within 10 miles of inundation zone, rather than simply applying an average territory radius based on other Alaska work nearby.
- USFWS will need to conduct an internal environmental assessment (EA) for the GOEA territory take permit, so Jordan wants to know if that can be incorporated into the FERC NEPA review—Betsy encouraged USFWS to get any such ideas incorporated into the 2013/2014 FERC study request, due May 31. The EA will focus on the impacts on local populations, defined as GOEA nesting within a 140-mile radius and BAEA nesting within a 43-mile radius (based on median juvenile dispersal distances), and on regional populations, defined as USFWS Region VII (Alaska) for BAEA and Bird Conservation Region (BCR) 4 for GOEA.
- 2012: We agreed that 2–3 mile buffer for corridors and inundation area is sufficient
- 2013–2014: We agreed that 2–3 mile buffer for corridors and 10 mi buffer for inundation area is sufficient.

Break at 12:50–12:58 (Betsy left for another meeting).

- Resume on BAEA nesting surveys; Jordan stated that the 10-mile radius for GOEA surveys around the inundation zone will give sufficient information on BAEA territory sizes. And the 2–3 miles for corridors is sufficient.
- More mitigation options are available for BAEA than for GOEA.
- No need to go out to 10 miles from access and transportation line corridors for BAEA territory mapping; plan to identify nests within the 2–3-mile corridors, including active and alternative nests.
- Maureen said to expect a study request on mercury levels in fish eaters (from the USFWS contaminants specialist).
- Discussion of downstream extent of surveys for BAEA—no particular concern about territory loss, but perhaps some about effects on food resources (fish); need to know how much of diet consists of fish vs. birds; and how far downstream to extend surveys (topic tabled for now)—Maureen will discuss with others at USFWS.
- Productivity aspect—Maureen suggests it should be added explicitly to the objectives of the study plan.
- Post-construction monitoring will be required.
- Maureen asked how study needs can be incorporated into the FERC process if additional impacts are identified in the future.

Jordan departed at 13:35.

- Maureen then discussed other raptors/species of concern, wanting more information on how they will be covered in the eagle/raptor surveys.
- John described the applicability of the survey methods to detect nests of Red-tailed Hawk, Northern Goshawk, Gyrfalcon, Peregrine Falcon, Great-horned Owl, Great Gray Owl, Common Raven.
- Also discussed nesting landbirds and shorebirds briefly: How many of these would be affected? What are the implications for the populations in BCR 4? Rare species? Are they at the edges or in the middle of their ranges? What are the implications of nesting habitat loss for local populations (Olive-sided Flycatcher and Rusty Blackbird were species Maureen mentioned

specifically). Is there stopover habitat for shorebirds or waterfowl? As the reservoir fills during the breeding season, will it inundate nests?

- Also discussed shorebirds, fish-eaters (loons, Belted Kingfisher), mercury issues, lighting of towers (FAA likes steady red glowing lights, which may be a problem for collisions), and possible collision risks for nocturnal migrants, swans and cranes.

Betsy McGregor

From:	Lori_Verbrugge@fws.gov
Sent:	Tuesday, June 12, 2012 8:41 AM
To:	lawhead@abrinc.com
Cc:	Betsy McGregor; Michael_Buntjer@fws.gov; Jennifer_Spegon@fws.gov
Subject:	Fw: Meg's answers to chytrid questions

Hi Brian,

Meg has responded to our preliminary questions about wood frogs, chytrid fungus and project development - please see below.

Please don't hesitate to follow up with her (or her contacts) if you have more questions!

Lori Verbrugge, PhD
Contaminants Biologist
US Fish and Wildlife Service
605 W 4th Avenue, Room G-61
Anchorage, AK 99501
Phone: (907) 271-2785
FAX: (907) 271-2786
lori_verbrugge@fws.gov

----- Forwarded by Lori Verbrugge/R7/FWS/DOI on 06/12/2012 08:36 AM -----

Margaret Perdue/R7/FWS/DOI	To Lori Verbrugge/R7/FWS/DOI@FWS
06/11/2012 09:10 PM	cc
	Subject Re: Fw: Meg's contact info

Hey Lori ---

Yes chytrid has been found infecting frogs in Alaska. We have had positive results for a number of frogs down here in the Kenai - 17 sites last year had frogs that came back positive for *Batrachochytrium dendrobatidis* (Bd) the species of chytrid fungus that causes the disease chytridiomycosis. There is also a USGS person / doctoral student, Tara Chestnut who is doing here dissertation on its distribution and has found it elsewhere up here (not sure exactly where, Tara doesn't want to give out too much info until she completes here research) and I also believe another researcher found it in Denali NP.

As far as how it might be spread and whether a project like Su-Watana could be a potential means of spread is one of the big questions but it certainly seems possible that the associated traffic to an area that comes with development of any sort at least raises the possiblity for increased incidence.

Mari tested for it down here and in a couple of the other refuges where she did the amphibian survey work and she found it down here then (2006) but not in Innoko or Tetlin (the other places where she tested) leading to speculation that road proximity like with the malformations could be a factor.

Lori Verbrugge/R7/FWS/DOI

06/07/2012 02:57 PM

To Brian Lawhead

cc

Subject Meg's contact info

Nice meeting you in person yesterday, Brian! Always nice to be able to put a face to a name.

As promised, here is the contact information for my co-worker, who is an expert in Alaskan wood frogs. She is doing field research on the Kenai all summer, but she keeps up on her email and is sometimes in the office on Fridays. She may be able to answer your questions about the chytrid fungus, and whether there are potential links to the Project.

Meg Perdue, Biologist
U. S. Fish & Wildlife Service
Environmental Contaminants Program
Anchorage Field Office
605 W. 4th Ave., Rm G-61
Anchorage, AK 99501
phone: 907-271-6647
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margaret_perdue@fws.gov

Talk to you soon -

Lori

9. BOTANICAL RESOURCES

9.1. Introduction

The botanical resources section describes the studies proposed to collect necessary baseline data to evaluate the potential impacts to vegetation, wildlife habitat, wetland, and vascular-plant resources in the Project area. Five proposed study plans are presented in this section. Two of these studies will involve the mapping of vegetation, wildlife habitats, and wetlands in the upper and middle Susitna basin where the Project dam, reservoir, supporting infrastructure, transmission lines, and access road are proposed to be built. A third study involves the mapping of successional vegetation, wildlife habitats, and wetlands in riparian areas along the Susitna River downstream of the proposed dam site, and also will involve modeling efforts to predict the potential changes in downstream riparian areas from Project development. A fourth study will involve surveys for rare vascular plant populations in those portions of the Project area where fill, inundation for the reservoir, or disturbance to plant populations would occur, and a fifth study will involve surveys for invasive vascular plants in currently disturbed areas that could serve as source areas for the spread of invasive plants in the Project area.

9.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

Project construction and operations activities would directly and indirectly affect vegetation, wildlife habitats, and wetlands in and adjacent to those areas where physical alteration of the landscape would occur (the site of the proposed dam, the reservoir, and in those areas where supporting infrastructure, the access road, and transmission-lines are proposed). Project development also would indirectly affect vegetation, wildlife habitats, and wetlands downstream of the proposed dam in riparian areas because of alterations in patterns of river flow, sediment transport and ice scour, and subsequent changes in riverine geomorphology. In addition to direct and indirect effects, development of the Project also would contribute to cumulative effects on vegetation, wildlife habitats, and wetlands in the region surrounding the Project. Three of the botanical resources studies (the vegetation and wildlife habitat mapping study, wetland mapping study, and riparian study) will provide the information necessary to:

- Quantify the potential direct loss and alteration of vegetation types, wildlife habitats, and wetlands (including alterations in wetland functions) from development of the proposed Project;
- Evaluate the potential indirect and cumulative effects of Project development on vegetation, wildlife habitats, wetlands, and wetland functions; and
- Prepare a Clean Water Act Section 404 wetlands permit application for the Project, which will include proposed measures to avoid and minimize impacts to wetlands as much as practicable.

Project development could directly or indirectly result in the loss or degradation of habitats that support rare vascular plant species through the clearing of areas for fill and through disturbance to habitats adjacent to areas within the Project footprint. Similarly, disturbance to habitats from Project construction and operations activities could create opportunities for invasive vascular plant species to become established in the Project area. Project construction and operations activities also could provide vectors for the movement of invasive plant propagules into the Project area (e.g., construction equipment, vehicles, worker's boots, plant seed mixes). Two of the botanical resources studies (the rare plant study and invasive plant study) will provide the information necessary to:

- Quantify the potential direct loss or disturbance to habitats supporting individuals or populations of rare plants from development of the proposed Project;
- Evaluate the potential indirect and cumulative effects of Project development on individuals or populations of rare plants; and

Evaluate the potential for invasive plant species to become established in the Project area and the level of ecological threat from establishment.

9.3. Resource Management Goals and Objectives

There are no specific management goals for vegetation and wildlife habitats in Alaska. Federal and state management goals for bird and mammal species in Alaska are described in Section 8.3 of this study plan, and most of those management goals have a habitat component, in which the maintenance of habitats for the species or species group in question is part of the overall management goal(s).

Wetlands in Alaska are regulated under jurisdiction of the Environmental Protection Agency (EPA) 40 CFR Part 230 Section 404(b)(1) and Section 10 of the Rivers and Harbors Act of 1899 33 USC 403 regulations under the Clean Water Act. These regulations were developed "…to restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material." The Section 404 program is designed to minimize the loss or negative impact to the nation's waters and wetlands. Mitigation for the loss of wetlands in Alaska must be done in compliance with the compensatory mitigation regulations of the U.S. Army Corps of Engineers (USACE) 33 CFR Parts 325 and 332 and EPA 40 CFR Part 230 ruling, Compensatory Mitigation for Losses of Aquatic Resources. The compensatory mitigation rule was enacted to improve the planning, implementation, and management of compensatory mitigation projects by requiring measurable, ecosystem-based performance standards and effective monitoring for all types of compensation.

The Aleutian shield fern (*Polystichum aleuticum*) in the only plant species listed as endangered under the federal Endangered Species Act (ESA) (USFWS 2010), and it is restricted to two islands (Adak and Atka) in the central Aleutian Island chain. The State of Alaska does not list any plant species as threatened or endangered (ADF&G 2010). Portions of the Project area, however, are managed by the Bureau of Land Management (BLM), and the BLM maintains a Special Status Species list, which was created from the Alaska Natural Heritage Program's Rare Vascular Plant List (AKNHP 2012). The BLM list is designed to identify species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA.

Resource agencies have become increasingly concerned about invasive plants in Alaska because of their potential to negatively impact wildlife habitat, recreational values, rare plant populations, and native plant species diversity. In addition, they can greatly increase land management costs as financial resources are diverted from other resource management needs to control the spread of invasive species. As a result, the Alaska Department of Natural Resources, in cooperation with the Division of Agriculture, has been developing plans to help with prevention, regulation, and enforcement of policies for the prevention and control of the spread of invasive species (Herbert 2001, Graziano 2011). Planning tools already in place include the authority to declare pests, conduct inspections, quarantine infested areas, and control (eradicate) infested areas.

9.3.1.1. Literature Cited

ADF&G (Alaska Department of Fish and Game). 2010. State of Alaska endangered species list. Available online (accessed 29 October 2010): http://www.ADF&G.state.ak.us/special/esa/esa_home.php.

AKNHP. 2012b. 2012 Rare Vascular Plant List. Alaska Natural Heritage Program, University of Alaska, Anchorage. Available online (accessed 15 June 2012): http://aknhp.uaa.alaska.edu/botany/rare-plants-species-lists/2012-rare-vascular-plant-list.

Graziano, G. 2011. Strategic plan for invasive weed and agricultural pest management and prevention in Alaska. Alaska Department of Natural Resources, Division of Agriculture, Alaska Plant Materials Center, Palmer. 36 pp.

Hebert, M. 2001. Strategic plan for noxious and invasive plants management in Alaska. Cooperative Extension Service, University of Alaska Fairbanks. 20 pp.

USFWS (U.S. Fish and Wildlife Service). 2010. Endangered, threatened, proposed, candidate, and delisted species in Alaska. Anchorage Fish and Wildlife Field Office. 2 pp. Available online (accessed 12 July 2011): http://ecos.fws.gov/tess_public/pub/stateOccurrenceIndividual.jsp?state=AK.

9.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Consultation efforts to date include discussions with agency representatives, Alaska Native entities, and other licensing participants at the Project Technical Workgroup Meetings and other meetings with agencies and interested parties held in between January and June 2012 (Table 9.4-1). Documentation of these meetings are found in Attachment 9-1 of this PSP.

Table 9.4-1. Summary of consultation on Botanical Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Letter	01/12/2012	P. Bergman	USDOI	Comments regarding wetlands methodology and consideration of BLM-Alaska Sensitive Animal and Plant Lists (Filed with FERC)
Terrestrial and Aquatic Resources Workgroup Meeting Notes	01/26/2012	Various	ADF&G, ADNR, BLM, FERC, NHI, NMFS, NPS, USFWS	Botanical study plans (See Attachment 1-1.)
Letter	02/10/2012	A. Rappoport	USFWS	Request USACE and Alaska Regional Supplement wetland methodology and Cook Inlet Classification system.
Cultural and Terrestrial Resources Workgroup Meeting Notes	02/28/2012	Various	ADF&G, ADHSS-HIA, ADNR, ADNR_OHA, BLM, EPA, FERC, NPS, USFWS	Botanical study plans (See Attachment 1-1.)
Terrestrial Resources Workgroup Meeting Notes	04/02/2012	Various	ADF&G, BLM, NHI, NPS, USFWS	Wetland delineation and functional assessment methodology (See Attachment 1-1.)
Wetland Technical Group Agency Meeting Notes	04/18/2012	Various	EPA, USACE, USFWS	Wetland delineation and functional assessment methodology
Telephone Call	04/19/2012	M. Gracz	Kenai Watershed Forum/University of Minnesota	Use of the Cook Inlet Wetland Classification for mapping the Susitna-Watana study area
E-mail	04/27/2012	M. Gracz	Kenai Watershed Forum/University of Minnesota	Information on the Cook Inlet Wetlands Classification System field methods
Wetland Technical Group Agency Meeting Notes	05/02/2012	Various	EPA, USACE, USFWS	Wetland delineation and functional assessment methodology
E-mail	05/02/2012	M. Gracz	Kenai Watershed Forum/University of Minnesota	Information on the Cook Inlet Wetlands Classification System
Letter	05/24/2012	J. Darnell	NPS	Comments on botanical study plans (E-filed with FERC P-14241-001)
Study Requests, Letters	05/30/2012, 05/31/2012	Various	Various	Comments on botanical study plans (Filed with FERC.)
Terrestrial Resources Workgroup Meeting Notes	06/06/2012	Various	ADF&G, Ahtna Native Corporation, BLM, ADNR OPMP, EPA, NHI, NPS, USFWS, Kenai Watershed Forum	Wetland delineation and functional assessment methodology Study Plan (See Attachment 1-1.)

9.5. Vegetation and Wildlife Habitat Mapping Study

9.5.1. General Description of the Proposed Study

In the vegetation and wildlife habitat mapping study, AEA will update the vegetation mapping prepared for the Alaska Power Authority's Susitna Hydroelectric Project (APA Project) in the 1980s, and identify and map current vegetation and wildlife habitat types in the Project area using current, high-resolution aerial photography and remote-sensed imagery. The study will involve field surveys to collect ground-reference data to "tag" the photosignatures in the Project area to known vegetation and wildlife habitat types, and in the office, the boundaries for the identified vegetation and wildlife habitat types will delineated by on-screen digitizing in GIS using the aerial photography and remote-sensed imagery for the Project area as the base data layers.

9.5.1.1. Study Goals and Objectives

The overall goals of the vegetation and wildlife habitat mapping study are to prepare baseline maps of the existing vegetation and wildlife habitats in the Project area. This mapping information will be used in assessing impacts to both vegetation and wildlife resources from the proposed Project, and to develop any necessary protection, mitigation, and enhancement (PM&E) measures. The wildlife habitat maps will be used to quantitatively assess the impacts of habitat loss and alteration for all bird and mammal species evaluated during the FERC licensing process. This is the primary basis for evaluating impacts to wildlife species.

The specific objectives of the vegetation and wildlife habitat mapping study are to:

- Identify, delineate, and map vegetation and wildlife habitat types in the Project area using the vegetation map prepared in the 1980s for the APA Project by Kreig and Associates (1987) as a starting point, and updating that mapping to reflect current conditions as indicated on recent aerial imagery for the Project area; and
- Quantify the potential direct, indirect, and cumulative impacts to vegetation and wildlife habitats from Project construction and operations.

This multi-year study is being initiated in 2012 and will be re-initiated, and continued in 2013 and 2014 follow this study plan as approved by the FERC. Results from the 2012 work will be used to: (1) fine-tune the field investigations and mapping efforts for the existing conditions found in the Project area, and (2) customize the mapping work (e.g., study area) to reflect further refinements in the design of the Project.

9.5.2. Existing Information and Need for Additional Information

Wildlife habitats were not specifically mapped in the 1980s, although information on vegetation types important for moose browse was incorporated in the vegetation mapping data prepared by Kreig and Associates (1987; see below). All vegetation mapping for the APA Project was based on field ground-reference data, and vegetation types were delineated by aerial photo interpretation based on aerial photography acquired in the early 1980s; map polygons were hand-drawn on mylar or acetate over aerial photos and topographic maps.

During 1980–1982, researchers from the University of Alaska Agricultural Experiment Station (UAAES) mapped vegetation communities classified to the Level III of the first version of the Alaska Vegetation Classification (AVC; Viereck and Dyrness 1980); this mapping made use of field ground-reference data collected in 1980 (McKendrick et al. 1982). The UAAES mapping covered a narrow corridor confined to the Susitna River floodplain upstream from Talkeetna, expanded outward to the river basin level at Devils Canyon, and continued upstream from there at the river basin level (AEA 2011). Map scales were 1:24,000 for the areas that would have been affected directly and 1:250,000 for the remainder of the Susitna basin. In addition, the area extending 10 miles in all directions from the upper Susitna River between Gold Creek and the mouth of the Maclaren River was mapped at a scale of 1:63,360. A 1:24,000-scale map of "apparent wetlands" also was prepared, as well as two other 1:63,360-scale maps for two of the three proposed APA Project transmission-line corridors: the northern (Healy to Fairbanks) and the southern (Willow to Cook Inlet) corridors. Both of the northern and southern transmission-line corridors are outside of the current Project area. The 1:63,360-scale vegetation map encompassed the APA Project central transmission-line corridor, which ran along both sides of the Susitna River between the originally proposed Watana Dam site to Gold Creek.

Additional vegetation mapping prepared by Kreig and Associates (1987) covered parts of the upper and middle Susitna basin, from near the mouth of the Oshetna River (upstream of the Watana Dam site) to just downstream of the Devils Canyon Dam site. The Kreig and Associates mapping effort was focused, in part, on vegetation types important for moose browse. Vegetation types with high forage values for moose (mainly shrub and forest types) were mapped to the AVC Level IV (vegetation structure combined with dominant plants). In addition, each map polygon was assigned values for understory cover of willows, shrub birch, and alder; a limited ground-truth survey was conducted to verify understory shrub cover values. Mapping was performed at the 1:63,360 scale and incorporated the previous vegetation mapping prepared by McKendrick et al. (1982). Existing ground data and photography provided by the Alaska Department of Fish & Game (ADF&G), Bureau of Land Management (BLM), and U.S. Forest Service (USFS), as well as newly obtained ground and aerial data also were used in the mapping effort. A relational database of attributes for each polygon was developed and exported in digital format to floppy disk; those data were provided to ADF&G. The mapping data of Kreig and Associates (1987), in ArcGIS format, will updated to reflect current conditions in the Project area (see Section 9.5.4).

Although the vegetation mapping conducted for the APA Project in the 1980s provides an overview of the vegetation types that occur in the Project area, the map polygons delineated in the 1980s are likely to be outdated in some areas because of changes in landscape characteristics over the intervening 25-plus years. Vegetation and habitat changes may have occurred in response to fire, insect outbreaks, development, and climate change. In particular, increases in woody shrub habitats, reductions in forest cover from fires and insect outbreaks, and permafrost degradation have been documented in recent decades in interior Alaska. In this study, recent aerial imagery will be used to update the vegetation mapping developed in the 1980s.

In addition, the vegetation maps from the 1980s do not include landscape context and physical habitat information necessary to adequately describe wildlife habitats. The vegetation and wildlife habitat mapping study proposed here will involve an integrated approach to the mapping of wildlife habitats and will include the mapping of several different terrain units in addition to vegetation (see Section 9.5.4).

As described below in Study Methods (Section 9.5.4), the vegetation mapping of Kreig and Associates (1987) will be overlain on recent aerial imagery and the vegetation polygon boundaries will be updated to reflect the current extent of each vegetation type in the study area (mapped to the Level IV of the AVC; Viereck et al. 1992). The 1980s vegetation mapping will also be used as a planning tool to develop a list of vegetation types to survey in the field.

9.5.3. Study Area

The final study area for the mapping of vegetation and wildlife habitats will be defined in consultation with resource agencies, FERC staff, Alaska Natives, and other licensing participants during 2012. In the interim, a working proposed study area is based upon using a 5-mile buffer zone surrounding those areas that would be directly altered or disturbed by Project construction and operations (Figure 9.5-1). The affected areas include the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites.

The alteration of successional vegetation and wildlife habitats downstream of the dam (due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River) will be specifically addressed in the Riparian Study, which will be developed in coordination with the proposed studies of riverine physical processes, most notably instream flow, ice processes, and riverine geomorphology (see Section 9.6).

9.5.4. Study Methods

AEA proposes an integrated approach to the mapping of vegetation and wildlife habitats based on methods developed for Ecological Land Surveys (ELS) studies conducted in tundra, boreal forest, and coastal regions in Alaska (see Jorgenson et. al. 2002 for an example study in Southcentral Alaska). This integrated mapping approach involves mapping terrain units such as vegetation type, physiography, surface form, and disturbance type, and then combining them into units with ecological importance (in this case wildlife habitats).

The method of combining various ITUs allows for the preparation of a number of thematic maps depending on the specific study needs. For the Project, a vegetation map at Level IV of the Alaska Vegetation Classification (Viereck et al. 1992), and a wildlife habitat map based on the best combination of ITUs will be produced to yield a habitat map that accurately reflects use by wildlife. A concerted effort will be made to use data from existing vegetation maps prepared for the APA Project (e.g., McKendrick et. al. 1982, but especially Kreig and Associates 1987 because the latter incorporates the mapping of McKendrick et al., and is available in digital form).

9.5.4.1. Develop Mapping Materials from Historical and Current Data

All available historical and current data layers that can be used to facilitate the mapping of vegetation and wildlife habitats have been compiled and are being managed in an ArcGIS geodatabase. These data include existing high-resolution aerial photography (for part of the study area), National Wetland Inventory (NWI) mapping, and existing (1987) vegetation mapping for the Project area. The existing vegetation map layer produced by Kreig and Associates (1987) has been updated to ArcGIS 10.0 format for review and updating (see below). Additional, fine-scale, recent imagery will be needed to complete the mapping of vegetation and wildlife habitats in this multi-year study, and it is expected that imagery will be available in late 2012.

9.5.4.2. ITU Mapping and Derivation of Wildlife Habitats

The existing vegetation map data (Kreig and Associates 1987) will be assessed for accuracy within the portions of the study area for which there is recent, high-resolution digital imagery, and map polygons will be updated to reflect Level III or IV vegetation types as defined by Viereck et al. (1992). The assignment of Level III (largely reflecting vegetation structure) or Level IV (vegetation structure plus dominant species) vegetation types will depend on how accurate the 1987 mapping is when compared to recent imagery. The accuracy assessment will focus on the extent of registration errors, match-line errors between adjoining mapping blocks, and on accuracy of map polygon vegetation codes in comparison to recent imagery. As much as possible, the 1987 vegetation mapping will be used initially during the 2012 field studies as a planning tool to develop a list of target vegetation types to document during the field work. The 1987 mapping, if not highly accurate at the Level IV of Viereck et al. (1992), may be modified (aggregated) into broader-scale vegetation types (Level III). These broad-scale vegetation map polygons would then serve as the basis from which finer-scale map polygons would be developed. When modifying the 1987 vegetation map layer, a minimum mapping size of 1.0 acre for vegetated areas and 0.25 acres for waterbodies will be used. Each vegetation map polygon will be updated and coded with preliminary Level III or IV vegetation types (Viereck et al. 1992), as well as preliminary physiography, surface form, and disturbance types.

After the field season in 2012, the preliminary mapping will be revised so that it accurately reflects the field-verified occurrences of Level IV vegetation types, physiography, surface form, and disturbance types. This process of revising preliminary map polygons is expected to be repeated after the field seasons in 2013 and 2014 until the mapping is completed and finalized for the full study area. Once substantial progress has been made on the ITU mapping, a preliminary set of vegetation and wildlife habitat types will be prepared and presented for comment in the Initial Study Report and Updated Study Report.

To derive wildlife habitat types, the ITU attributes assigned to each map polygon (vegetation, physiography, surface form, and disturbance type) will be combined to produce a large number of multivariate habitat types. These initial multivariate habitats then will be aggregated into a smaller set of derived habitat types that share similar characteristics considered important to the wildlife species that occur in the Project area, such as the expected levels of available (plant) food sources and cover for escape and/or shelter. These factors can be directly related to the quantity and quality of vegetation, physiographic position, surface form, microtopography, soils, hydrology, and/or microclimates present. In the derivation of wildlife habitats, vegetation, physiography, surface form, and disturbance types will be used as the primary factors representing wildlife habitat quality, but information on soil drainage will be added as needed.

9.5.4.3. Field Surveys

Ground-reference plots to be surveyed during summers of 2012–2014 will be selected to cover the range of mapped types identified during the preliminary mapping (above). During the 2012 field season, if the 1987 vegetation mapping proves to be accurate only at the Level III of Viereck et al. (1992), ground-reference plots will be selected based initially upon the Level III map polygons and then finer-scale photosignatures will be selected to sample within the Level III polygons, to acquire the field data necessary to map vegetation to the Level IV of Viereck et al. (1992). In 2013 and 2014, ground-reference plots will be allocated directly to map polygons representing Level IV vegetation types and the aggregated set of preliminary wildlife habitat types.

Since high-resolution imagery for the entire mapping study area will not be available in 2012 for either the preliminary mapping phase or the field season, field sampling will be focused on the Project footprint areas that are currently covered by 1-foot pixel resolution imagery (obtained by the Matanuska-Susitna Borough LIDAR mapping project and publicly available on AlaskaMapped.org). Areas not covered by preliminary mapping or high-resolution digital imagery also will be sampled during summer 2012, but on a more limited basis. In such areas, the plot sampling will be focused on the prominent land cover types identifiable on moderate-resolution imagery. After high-resolution imagery is obtained during summer 2012, field sampling will be expanded to adequately sample all regions in the study area in 2013 and 2014.

Ground-reference plots will be sampled along transects that will be located within major physiographic types, including riverine, lacustrine, lowland, and upland areas. If possible, plots for which vegetation data were collected in the 1980s will be resampled (these data will be valuable for assessing the extent to which landscape characteristics have changed in the intervening 25-plus years). To maximize efficiency in data collection, at each ground-reference plot data will be collected as necessary for vegetation and wildlife habitat mapping as well as wetlands mapping. Wetlands data collection efforts will be consistent with U.S. Army Corps of Engineers (USACE) requirements for wetland delineations (Environmental Laboratory 1987, USACE 2007; see Section 9.7). Vegetation and wildlife habitat data elements will be recorded digitally in the field on an Android tablet computer using a customized data entry form designed to link directly to a relational database (Microsoft Access). At each ground-reference plot, visual cover estimates will be made for all vascular plant species present. Site characteristics to be recorded will include: plant community structure (for vascular and nonvascular plants), physiography, surface form, microtopography, site disturbances, and plant phenological observations. The USACE wetlands determination methodology requires a 10-meter (33-foot) radius plot size in which visual cover estimates are made for individual plant species. During field visits, the locations of all incidental observations of rare plants, invasive plants, wildlife species, or significant wildlife habitat features (e.g., raptor nests) will be documented and communicated to the Botanical and Wildlife Resources Program leads. At each plot, a small soil pit will be dug to evaluate soil characteristics.

9.5.4.4. Impact Assessment

Direct impacts to vegetation and wildlife habitats are expected to occur in the form of initial and possibly long term habitat loss from the placement of fill and from the conversion of vegetation and terrestrial wildlife habitats to lacustrine habitats in the proposed reservoir. Indirect impacts could occur from erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Indirect impacts are also anticipated to riparian vegetation and wildlife habitats downstream of the proposed dam due to some changes in instream flow, ice processes, and riverine geomorphology in the Susitna River. These downstream effects will be addressed in the Riparian Study (see Section 9.6).

The fundamental impact assessment for vegetation and wildlife habitats will be conducted in GIS by overlaying the project footprint on the final map polygons to determine which specific patches of vegetation and wildlife habitats would be affected directly by fill or ground disturbance. The determination of which polygons could be indirectly affected will be conducted similarly by overlaying disturbance buffers (surrounding the proposed Project infrastructure) to identify which areas are likely to be affected by ancillary impacts associated with Project construction, operations, and maintenance. The size and number of disturbance buffer(s) to be used will be determined based upon the updated specifications for Project construction, operations, and maintenance activities, which will be updated throughout 2013-14.

The potential impacts to vegetation and wildlife habitats will be assessed by quantifying the acreage of each vegetation and wildlife habitat type that would be lost from the development of the Project.

The wildlife habitat types identified in this study also will be used to quantitatively assess the impacts of habitat loss and habitat alteration for each bird and mammal species of concern evaluated for impacts during the FERC licensing process (see Section 8.19). The first step in conducting impact assessments for habitat loss and alteration for wildlife species will be to conduct wildlife habitat-use evaluations for the bird and mammal species of concern. In that effort, each wildlife habitat type mapped in the study area will be categorically ranked for habitat value for each of the bird and mammal species of concern (see Section 8.19).

9.5.4.5. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of historic (APA Project) data and data collected during the 2012–2014 field seasons, including representative photographs of vegetation and wildlife habitat types will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Vegetation and wildlife habitat maps in ArcGIS and PDF formats.** The preliminary and final maps of vegetation and wildlife habitats will be developed and delivered according to the schedule indicated below. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The vegetation and wildlife habitat mapping study results will be presented to licensing participants in the Initial and Updated study reports, according the schedule indicated below. The reports will include descriptions of the vegetation and wildlife habitats identified, a summary table (acreages) of the vegetation and wildlife habitats represented in the mapping effort, and descriptions of the potential impacts to vegetation and wildlife habitats from development of the Project. In the Initial Study Report, recommendations will be made for the 2014 field survey effort. Both reports also will include field plot photos including site, ground, and soil photographs for each plot surveyed.

9.5.5. Consistency with Generally Accepted Scientific Practice

The vegetation and wildlife habitat mapping study will be conducted using standard methods for the mapping of vegetation and terrain features (onscreen digitizing in GIS over digital aerial imagery). The mapping will be based on intensive ground-reference information, focused especially in the Project footprint areas where most impacts will occur. A multivariate, ITU mapping approach (following Jorgenson et al. 2002) will be used for the mapping of wildlife habitats, and the derivation of wildlife habitats will be conducted follow the methods successfully used for the mapping of wildlife habitats for other recent projects in Alaska (e.g., ABR 2008, Schick and Davis 2008, PLP 2011).

9.5.6. Schedule

2013:

- Vegetation/habitat mapping and field plot selection: January–May
- Field surveys: June 20–30 and July 20–30 (four 2-person crews each survey)
- Vegetation/habitat map revisions: August–October
- Initial Study Report: December
- Delivery of field data and preliminary vegetation and habitat maps: December

2014:

- Vegetation/habitat mapping and field plot selection for remaining unmapped areas: January–May
- Field surveys: June 20–30 and July 20–30 (one 2-person crew in June and two 2-person crews in July)
- Final vegetation/habitat map revisions: August–October
- Updated Study Report: December
- Delivery of final field data and final vegetation and habitat maps: December

9.5.7. Level of Effort and Cost

The vegetation and wildlife habitat mapping study is planned as a three-year effort; work will begin in 2012 with initial work before this study plan is finalized and will continue in 2013 and 2014. Field sampling will be conducted each year during the growing season by four to eight observers (working in crews of two). Surveys will be conducted for approximately 20 days in each year. The level of effort for 2013 is expected to be considerably greater than in 2012, because the 2012 effort will be focused only on those portions of the study area that have aerial photography coverage of sufficient resolution for preliminary mapping and field sampling. In 2013, high-resolution imagery should be available for the entire project area, so the number of person-days dedicated to the field effort will be doubled. The mapping effort also is expected to be much greater in 2013 relative to 2012. In 2014, less extensive field surveys and mapping may be needed as the mapping of the study area progresses. Field surveys will be conducted in conjunction with the wetland mapping study to maximize efficiency and reduce costs. The study will involve extensive, office-based activities to delineate the boundaries of various ITUs (vegetation, physiography, surface form, disturbance type) in a GIS and to prepare study reports.

Total costs in 2013 are estimated to be on the order of $500,000. The more limited 2014 field survey, which will be focused on problem areas or areas where the field survey coverage is insufficient, is estimated to cost approximately $300,000.

9.5.8. Literature Cited

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9.5.9. Figures

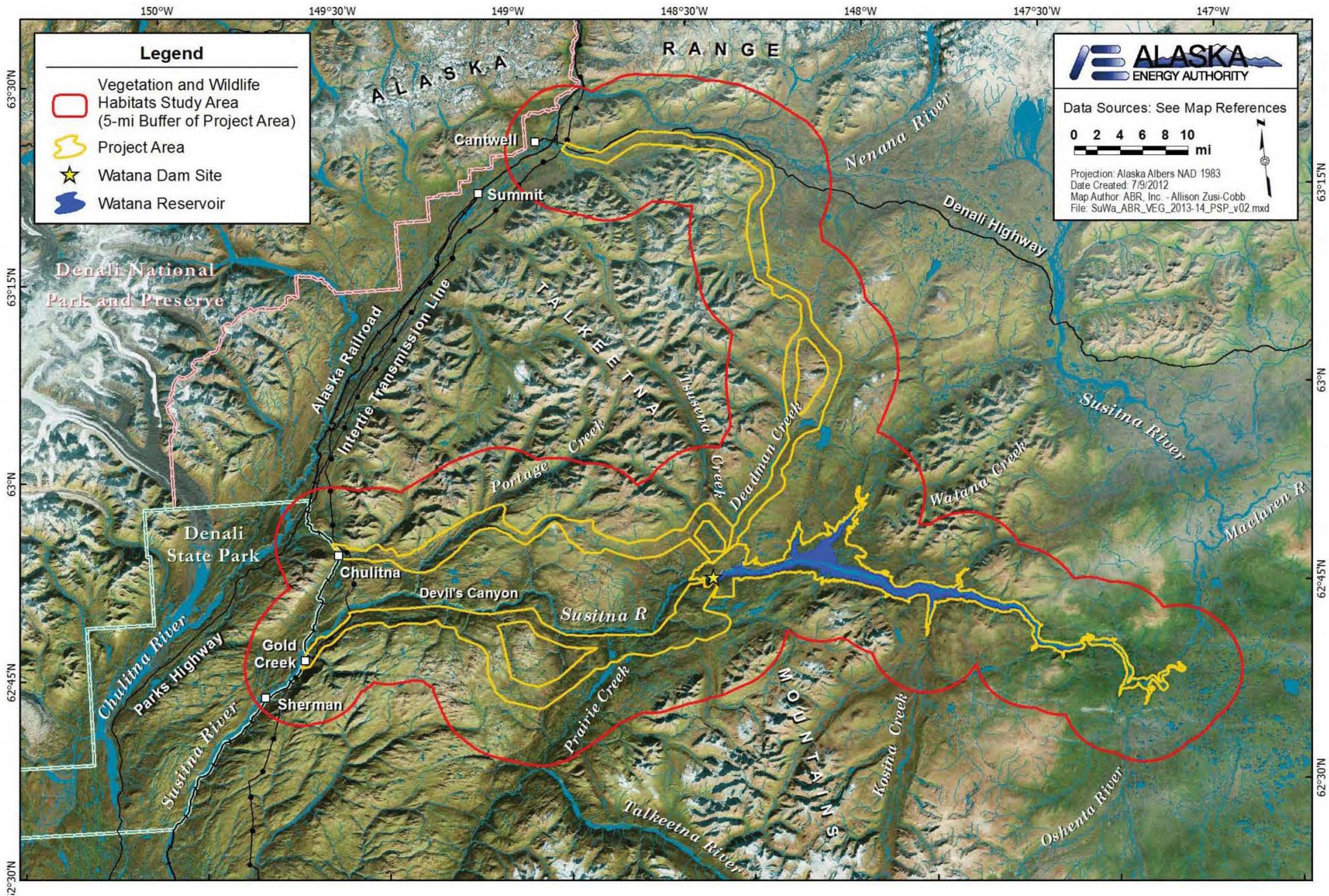

Figure 9.5-1. Study area for vegetation and wildlife habitat mapping for 2013 and 2014 in the Susitna-Watana Hydroelectric Project area.

9.6. Riparian Study

9.6.1. General Description of the Proposed Study

The riparian study involves two primary activities. First, AEA will identify and map current riparian (successional) vegetation, wetlands, and wildlife habitat types in riparian areas along the Susitna River downstream from the proposed Project dam site. This activity will involve both a field effort (to ground-truth the photosignatures on the aerial photography and remote-sensed imagery to be used in the mapping), and an office-based effort to map riparian vegetation, wetlands, and wildlife habitats digitally in GIS. Secondly, the riparian study will be coordinated with studies of physical processes in downstream areas of the Susitna River (primarily the instream flow, ice processes, and riverine geomorphology studies) so as to collect the necessary data to enable predictions of how development of the Project could alter downstream riparian areas. This second activity will involve resurveying, if possible, sites that were studied for successional vegetation along the Susitna River in the 1980s and 1990s, and collecting current information on successional dynamics at sites that also will be studied for physical processes (as above). In the riparian study, AEA will use both biological and physical data to predict and assess the extent to which riparian vegetation, wetlands, and wildlife habitats could be affected in areas downstream from the proposed dam.

9.6.1.1. Study Goals and Objectives

The overall goals of the riparian study are to prepare baseline maps of local-scale riparian ecosystems (riparian ecotypes), wetlands, and wildlife habitat types in areas downstream from the proposed for the Project dam site, and to assess the extent to which the Project will alter vegetation succession, wetlands, and wildlife habitats in riparian areas of the Susitna River. The riparian study will be closely coordinated with other studies of downstream effects (instream flow, ice processes, and riverine geomorphology) to enable predictions of change in riparian areas. The mapping prepared in this study will be used in assessing impacts to riparian ecotypes, wetlands, and wildlife resources (see Section 8.19) in areas downstream from the proposed dam, and in considering any possible protection, mitigation, and enhancement (PM&E) measures to address the expected effects.

The specific objectives of the riparian study are to:

- Identify, delineate, and map riparian ecotypes, wetlands, and wildlife habitats downstream from the Watana Dam site;
- In coordination with the instream flow, ice processes, and riverine geomorphology studies, characterize the physical and ecological processes downstream from the Watana Dam site that are likely to affect vegetation succession in riparian areas; and
- Predict potential changes in riparian areas due to Project construction and operations, including changes to vegetation successional pathways, riparian ecotypes, wetlands, and wildlife habitats, which could result from alterations in instream flow, ice processes, and riverine geomorphology.

This multi-year study in being initiated in 2012 and will re-initiated and continue in 2013 and 2014. Results from the 2012 work will be used to: (1) fine-tune the field investigations and mapping efforts for the existing conditions found in the Project area, and (2) customize the mapping work (e.g., study area) and change-prediction models to reflect further refinements in the design of the Project.

9.6.2. Existing Information and Need for Additional Information

Several riparian and vegetation mapping resources for the Project area were identified in the Pre-Application Document (PAD) (AEA 2011). Of primary importance to the riparian study are the previous vegetation mapping and vegetation successional dynamics studies by McKendrick et al. (1982), UAFAFES (1985), Collins and Helm (1997), and Helm and Collins (1997), which provide information on vegetation successional processes in areas downstream of the two dams proposed in the APA Project in the 1980s. Summary information on riparian processes in those downstream areas, derived from McKendrick et al. (1982) and UAFAFES (1985), is found in APA (1985). These previous studies will serve as a baseline for developing a sampling scheme for the riparian study proposed here (study plots from the 1980s and 1990s will be resampled if possible; see Section 9.6.4), and will provide a conceptual framework upon which to build a vegetation succession classification and develop predictive models for assessing the downstream effects of the proposed Project on riparian habitats.

Wetlands were mapped for the APA Project in the 1980s through a cooperative agreement between U.S. Fish and Wildlife Service (USFWS) and the APA to produce a preliminary wetlands map for the APA Project area. Those wetlands map data were based on the vegetation mapping completed by McKendrick et al. (1982), with some additional modification using stereoscopic photo-interpretation, and are now a part of the National Wetlands Inventory (NWI; USFWS 1984). The Alaska Vegetation Classification (AVC; Viereck and Dyrness 1980) vegetation classes that were mapped in the early 1980s were cross-referenced and converted into wetlands classes using the classification scheme of Cowardin et al. (1979). The NWI data from the 1980s cover the current Project area and are expected to be available in digital format sometime in 2012. Those NWI data will help in understanding the types of wetlands that occur in the riparian study area, but the mapping is coarse-scale (1:63,360 scale) and will not be sufficient for determining effects on wetland resources (e.g., when mapping at the 1:63,360 scale, small drainages and other small wetland habitats are often overlooked). Because those NWI data are nearly 30 years old, and because riparian conditions have almost certainly changed in specific areas over that period, an updated map of riparian wetlands will be needed for the current Project.

Current, high-resolution orthophoto imagery, which will be used for the on-screen mapping work, is available for most of the riparian study area. Moderate-resolution imagery (to support the allocation of transects and study plots during field studies in 2012) will fill the remaining gaps in the study area. Additional high-resolution aerial photography or satellite imagery for the Project area, which will be needed for the mapping of riparian ecotypes and wildlife habitats, is expected to be acquired in summer 2012, and that imagery likely will be available in late 2012.

9.6.3. Study Area

The riparian study area will overlap with the vegetation, wildlife habitat, and wetlands mapping study areas near the proposed dam site, but the main focus for the riparian study will be on riparian areas along the Susitna River and its tributaries below the dam site, which are expected to be altered by changes in stream flow, ice processes, and riverine geomorphology from construction and operation of the proposed dam.

The final study area for the mapping of riparian ecotypes, wetlands, and wildlife habitats in the riparian study will be defined in consultation with licensing participants over the course of developing this study plan in 2012. It is anticipated that the study area will include those riparian areas downstream of the proposed dam site to a point at which the effects of altered flow regimes expected in the Susitna River would not be measureable or would be overridden by the effects of tidal fluctuations from Cook Inlet. This downstream location will be determined following analysis of the results of the 2012 instream flow studies. In 2012, the riparian study will focus on those downstream areas in which altered flow regimes are most likely to occur, including from the proposed dam site downstream to the town of Willow (Figure 9.6-1). At this time, AEA proposes that the width of the riparian study area will cover all riverine areas in the active floodplain of the Susitna River. In 2012, the interim study area for the riparian study will extend laterally from approximately the edge of flowing waters in the Susitna River to 200 meters into adjacent upland terrain. In 2013, the width of the study area will be expanded to encompass the areas of hydrologic influence in the floodplain (the areas of hydrologic influence will be determined based on the results of the 2012 instream flow studies).

9.6.4. Study Methods

An integrated approach to the mapping of riparian ecotypes, wetlands, and wildlife habitats will be used based on methods developed for Ecological Land Surveys (ELS) studies conducted in tundra, boreal forest, and coastal regions in Alaska over the past 15 years (see Jorgenson et. al. 2002 for an example study in Southcentral Alaska). This integrated mapping approach involves mapping terrain units such as vegetation type, successional stage, geomorphology, and surface-form type, and then combining them into units with ecological importance (in this case riparian ecotypes, wetlands, and wildlife habitats, see below).

The method of combining various ITUs allows for the preparation of a number of thematic maps depending on the specific study needs. For the Riparian Study, a riparian ecotype map, a wetlands map, and a wildlife habitat map, each based on the best combinations of ITUs, will be prepared. The mapping of wildlife habitats in the riparian study will be conducted in coordination with the vegetation and wildlife habitat mapping study (see Section 9.6) to derive a seamless map of wildlife habitats that apply project-wide. Similarly, the mapping of wetlands will be conducted in coordination with the wetland mapping study so that wetlands in the riparian study can be classified in the same manner as those in the Wetland Mapping Study (see Section 9.8), resulting in a single Project-wide wetland map. In the mapping of riparian ecotypes and in the study of riparian vegetation succession, the vegetation succession study plots studied in the 1980s and 1990s by McKendrick et al. (1982), UAFAFES (1985), Collins and Helm (1997), and Helm and Collins (1997) will be relocated where possible and sampled. The sampling of previously studied sites will help inform our interpretation of successional dynamics in the Susitna River floodplain.

9.6.4.1. Develop Mapping Materials from Historical and Current Data

Data sources that may be used for the mapping of riparian ecotypes and wildlife habitats include vegetation mapping and vegetation succession studies conducted in the Susitna River drainage by McKendrick et al. (1982), UAFAFES (1985), Collins and Helm (1997), Helm and Collins (1997). For wetlands, NWI data for the Project area, which was developed in the 1980s, should be available sometime in 2012. Additional data include soil surveys, digital elevation data, the National Hydrography Dataset (USGS 1999), and other map products that may have been produced for the area as part of other studies. These data will be compiled and reviewed and, if possible, included as a map layer in ArcGIS to assist the mapping efforts.

The available, high- and moderate-resolution aerial imagery for the project area will be acquired and evaluated for quality and geodetic control. As noted above, for those portions of the study area that are not covered by high-resolution aerial imagery (needed for mapping), moderate-scale imagery will be used to support the field sampling efforts in summer 2012. Additional, fine-scale, recent imagery will be needed to complete the mapping in this multi-year study, and it is expected that imagery will be available in late 2012.

9.6.4.2. Field Surveys

Ground-reference plots to be surveyed during summer 2012 will be selected to cover the range of riparian habitats identified by photointerpretation of aerial imagery signatures on the high- and moderate-resolution imagery noted above. For the 2013 and 2014 field seasons, the preliminary mapping of riparian ecotypes, wetlands, and wildlife habitats (see Section 9.7.4.3) will be used to design a stratified random sampling scheme to preselect potential study plots within riparian habitats. The objective will be to sample multiple map polygons for each riparian, wetland, and wildlife habitat type, incorporating as much replication as possible within the time and funding constraints for this work. Study plot selection will also be coordinated with researchers conducting the instream flow, ice processes, and riverine geomorphology studies to try to co-locate study plots, as much as possible, so that the measured riparian habitat parameters can be related to existing conditions for instream flow, ice processes, and geomorphology on a site-by-site basis. These coordinated baseline data will help in the prediction of changes in riparian habitats due to construction and potential Project operations. Additionally, when selecting study plots, as many of the historical (1980s and 1990s) vegetation succession study plots will be relocated and sampled as possible (see below).

In 2012, the field ground-reference work will be completed in two phases. In Phase 1, a helicopter-assisted reconnaissance of the Susitna River from Talkeetna to Willow will occur in mid-June. The primary objective of the reconnaissance survey is to determine the feasibility of relocating the vegetation succession study plots originally established by McKendrick et al. (1982) and Collins and Helm (1997) for potential resampling, and to identify new study plots for additional sampling. Based on the results of the reconnaissance survey, the sampling scheme will be adjusted, as needed, and the second phase of field sampling prepared.

Phase 2 of the 2012 field sampling will occur in late June–early July and will include sampling of preselected study plots in conjunction with the data collection efforts for the Instream Flow Study. Riparian habitats will be sampled using two types of transects: ITU mapping transects and intensive successional study transects. When sampling ITU transects, the data necessary to describe the ecosystem components used in the subsequent ITU mapping will be collected. ITU transects will be located so as to cross patches of riparian vegetation in different successional stages, and circular plots of 10-meter (33-foot) radii will be sampled along each transect. The following variables will be recorded at each ITU plot:

- Geo-referenced plot location (<3-m accuracy);
- Site variables, including physiography, geomorphic unit, surface form, elevation, aspect, and slope;
- Vegetation structure and plant community composition to classify vegetation types to Level IV of the AVC (Viereck et al. 1992);
- Ages (cross section cuttings or cores) and height of dominant woody plants (three representative samples from the modal size class of the dominant species in the stand);
- Shallow soil pits will be dug to categorize drainage and soil moisture; soil hydrologic variables, including depth of water above or below ground surface, depth to saturated soil, pH, and electrical conductivity (EC); and soil depositional profiles; and
- Wildlife sign such as winter or summer browse marks, nests, dens, droppings, singing birds, carcasses, tracks, and burrows.

In 2012, the adequacy of the intensive successional study transects for collecting the data necessary to describe vegetation successional stages will be tested. In late 2012/early 2013, the intensive successional study transects methods will be modified, as needed, and will be implemented in full in 2013 and 2014 at each of the intensive study stream reaches to be sampled by the instream flow and riverine geomorphology studies. The intensive successional study transects will be located so as to cross patches of riparian vegetation in different successional stages, and circular plots will be sampled along each transect. Circular study plots will be a minimum of 500 m^2 in forested areas and 50 m^2 in non-forest areas. On intensive successional study plots, all of the information collected at each ITU plot (above) plus detailed data on vegetation structure, successional dynamics, plant phenology, and soils will be collected. The following variables will be recorded at each intensive successional study plot:

- Geo-referenced plot location (<3-m accuracy);
- Site variables, including physiography, geomorphic unit, surface form, elevation, aspect, and slope;
- Vegetation structure and plant community composition to classify vegetation types to Level IV of the AVC (Viereck et al. 1992); vegetation type will be determined in each distinct geomorphic unit that encompasses ≥25 percent of the plot area;
- Vegetation cover by species in each of 7 height categories (0.0–0.1 m, 0.4–1 m, 1–2 m, 2–4 m, 4–8 m, 8–16 m, and >16 m) based on point-intercept sampling along intra-plot transects;
- Density by size class for woody species (<4 cm, <0.4 m, 0.4–2 m, 2–4 m, and >4 m DBH); and size-class groupings (<4 m and >4 cm DBH; and >4 m and <4 cm DBH);
- Ages (cross section cuttings or cores) and height of dominant woody plants (three representative samples from the modal size class of the dominant species in the stand);
- Crown dominance for each woody species;
- Phenological attributes for selected plant species;
- Shallow soil pits will be dug to categorize drainage and soil moisture; soil hydrologic variables, including depth of water above or below ground surface, depth to saturated soil, pH, and electrical conductivity (EC); and soil depositional profiles;
- Additional soils data to be collected includes dominant soil texture in upper 40 cm, thickness of surface organics, cumulative thickness of organic material in upper 40 cm, depth to water table, and thaw depth; and

- Wildlife sign such as winter or summer browse marks, nests, dens, droppings, singing birds, carcasses, tracks, and burrows.

The shape of the study plots on both the ITU and intensive successional study transects may vary depending on the shape of the vegetation stand being sampled. Field methods provided by McKendrick et al. (1982), Collins and Helm (1997), and Helm and Collins (1997) will be followed. All field data will be recorded digitally in the field using a standardized data entry form on an Android tablet computer designed to link directly to a relational database (Microsoft Access).

9.6.4.3. ITU Mapping of Downstream Riparian Areas

Following the field surveys in 2012, preliminary mapping of local-scale riparian ecosystems (riparian ecotypes) will be conducted by photointerpretation of the current aerial imagery available for the study area, and by making use of the ground-reference data collected in summer 2012. As noted above, riparian ecotypes are proposed to be mapped using an ITU approach. A minimum mapping size of 1 acre for terrestrial polygons and 0.25 acres for waterbodies is proposed. ITU map polygons will be attributed with geomorphology (e.g., Braided Active Overbank Deposit); surface form (e.g., Mid-channel Bar); vegetation class (e.g., Open Balsam Poplar Forest), and successional stage (e.g., young poplar, old poplar). Riparian vegetation in this study will be mapped to the Level IV of the AVC (Viereck, et al. 1992) with adjustments, as needed, for early successional riparian stages following Helm and Collins (1997). Following the mapping, the ITU codes will be aggregated into a set of preliminary riparian ecotypes based on the combination of ITUs that best represents the local-scale riparian habitats in the areas mapped.

Preliminary mapping of local-scale wetland ecosystems (wetland ecotypes) also will be mapped using the ITU approach in late 2012, but wetland ecotypes will be delineated separately, if needed, by photointerpretation so as to fit the wetland classification that will be used for the rest of the Project area (see Section 9.8). In particular, if there are wetlands in the floodplain of the Susitna River downstream of the proposed dam that are not represented in the wetlands mapping conducted in the upper Susitna basin, the existing wetlands mapping for lower elevations in the Matanuska-Susitna Borough (see http://cookinletwetlands.info/) will be consulted so as to map similar wetland types.

The objective of the wetlands mapping in the riparian study is to prepare a map of wetlands for downstream riparian areas following the same classification system used in the upper Susitna basin, and which can be cross-walked to the existing wetlands mapping for other areas in the Matanuska-Susitna Borough (see Section 9.7 for more information). During consultation with resource management agencies (see Section 9.4 and Attachment 9.1), AEA agreed to map wetlands as part of the riparian study, but does not propose to conduct formal field wetland determinations. The U.S. Army Corps of Engineers has determined that no wetlands will be filled in the riparian areas downstream of the dam; therefore, wetlands mapping will not be needed for the Clean Water Act Section 404 dredge and fill permit. The wetlands mapping in the riparian study will be prepared to help in understanding how the downstream effects of alterations in instream flow, ice processes, and riverine geomorphology may affect wetlands in the floodplain of the Susitna River.

In late 2012, preliminary wildlife habitat types in downstream riparian areas will be mapped based on the ITU mapping described above, but will be derived using a separate aggregation of

ITU parameters that specifically addresses the important elements of wildlife habitat use (see Section 9.6 for more information).

All the mapping of riparian areas will be conducted on-screen in GIS and will make extensive use of the field ground-reference data so that photosignatures are accurately interpreted. This mapping will be an on-going process and is expected to occur in 2012, 2013, and 2014. It is possible that the mapping of the full study area may not be completed until 2014. Once substantial progress has been made on the ITU mapping, however, a preliminary set of riparian ecotypes, wetland ecotypes, and wildlife habitat types will be prepared for review. This review will occur in both 2013 and 2014, and the preliminary set of riparian ecotypes, wetland ecotypes, wildlife habitat types will be presented in the Initial Study Report and Updated Study Report for review before being finalized.

9.6.4.4. Impact Assessment: Predicting Changes in Riparian Areas

Impacts in riparian areas are expected to occur in the form of spatial and temporal changes in riparian habitats because of changes in instream flow, ice processes, and riverine geomorphology in the floodplain of the Susitna River downstream of the proposed dam. Potential impacts could include alterations in hydrology (reduced or increased flooding), reduced or increased sediment deposition/erosion, and reduced or increased ice scour during buildup and breakup. These effects could then result in changes in geomorphic features, plant species diversity, vegetation composition, and vegetation succession. These effects would all be considered indirect impacts of the construction and operation of the dam.

In the riparian study, AEA proposes to sample intensive successional study plots in the same stream reaches in which intensive sampling will occur in both the instream flow and riverine geomorphology studies. In sampling these co-located study plots, a multidisciplinary data set will be established that will be used to correlate existing conditions of flow and geomorphology with riparian habitats. These data will provide the baseline from which predicted changes in flow, ice processes, and riverine geomorphology can be used to predict changes in riparian habitats. In large measure, the prediction of changes in riparian habitats will involve determining, from the expected patterns of change in flooding and ice scour, how much of the riparian zone will transition from one successional stage to another. For example, with reduced flooding and ice scour (which are possible from moderated flows below the dam during the summer), the proportion of the river floodplain in the early stages of plant succession would be expected to be reduced while areas in the mid and late successional stages would increase in occurrence. In the riparian study, data will be collected in those portions of the Susitna River in which changes in flow, ice processes, and riverine geomorphology are expected to occur, and this information will be used to map the predicted changes in vegetation successional stages by river segment. This same approach will be used to map the predicted changes in wetlands and wildlife habitat types due to changes in flow, ice processes, and riverine geomorphology. The timing of these changes also will be predicted based on the intensity of the expected physical alterations in riparian areas and the time periods for persistence of the various vegetation successional stages.

9.6.4.5. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of historic data and data collected during the 2012–2014 field seasons, including representative photographs of riparian ecotypes, wetland ecotypes, and wildlife habitat types will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Vegetation and wildlife habitat maps in ArcGIS and PDF formats.** The preliminary and final maps of riparian ecotypes, wetland ecotypes, and wildlife habitat types will be developed and delivered according to the schedule indicated below. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The riparian study results in the Initial and Updated study reports will be presented according the schedule indicated below. The reports will include descriptions of the riparian ecotypes, wetland ecotypes, and wildlife habitat types identified; a summary table (acreages) of the riparian ecotypes, wetland ecotypes, and wildlife habitat types represented in the mapping effort; and predictions of the expected changes in riparian areas due to Project development. The Initial Study Report will include recommendations for the 2014 field survey effort. Both reports also will include field plot photos including site, ground, and soil photographs for each plot surveyed.

9.6.5. Consistency with Generally Accepted Scientific Practice

The riparian study will be conducted using standard methods for the mapping of vegetation, wetlands, and terrain features (onscreen digitizing in GIS over digital aerial imagery). The mapping will be based on intensive ground-reference information, and the field data will be collected using the same methods used in the 1980s and 1990s so that the current data are comparable. These field methods are still appropriate for classifying successional vegetation types. A multivariate, ITU mapping approach (following Jorgenson et al. 2002) will be used for the mapping of wildlife habitats, and the derivation of wildlife habitats will be conducted follow the methods successfully used for the mapping of wildlife habitats for other recent projects in Alaska (e.g., ABR 2008, Schick and Davis 2008, PLP 2011). The prediction of change in riparian areas will be done in coordination with other studies of physical processes in riverine areas to help determine accurate relationships between physical changes and alterations in riparian habitats.

9.6.6. Schedule

2013:

- Riparian/wetland/habitat mapping and field plot selection: January–May
- Field surveys: June 25–July 12 (two 2-person crews)
- Riparian/wetland/habitat map revisions: August–October
- Initial Study Report: December
- Delivery of field data and preliminary riparian/wetland/habitat maps: December

2014:

- Riparian/wetland/habitat mapping and field plot selection for remaining unmapped areas: January–May
- Field surveys: June 25–July 8 (two 2-person crews)
- Final riparian/wetland/habitat map revisions: August–October
- Updated Study Report: December
- Delivery of final field data and final riparian/wetland/habitat maps: December

9.6.7. Level of Effort and Cost

The riparian study is planned as a three-year effort, with field sampling conducted each year by four observers (two crews of two each) during the summers of 2012, 2013, and 2014. Surveys would be conducted for 14 to 18 days in each year, depending on the needs for additional ground-verification data (less extensive field surveys may be needed in 2014 as the mapping of the study area progresses). The riparian study will involve extensive, office-based activities to delineate the boundaries of various ITUs (e.g., vegetation, geomorphic type, surface form, disturbance type) in a GIS and to prepare study reports.

Total costs in 2013 are estimated to be on the order of $500,000. In 2014, a more limited field survey is expected, to focus on complex areas or areas where the field survey coverage is insufficient. Total costs in 2014 are estimated to be roughly $400,000.

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9.6.9. Figures

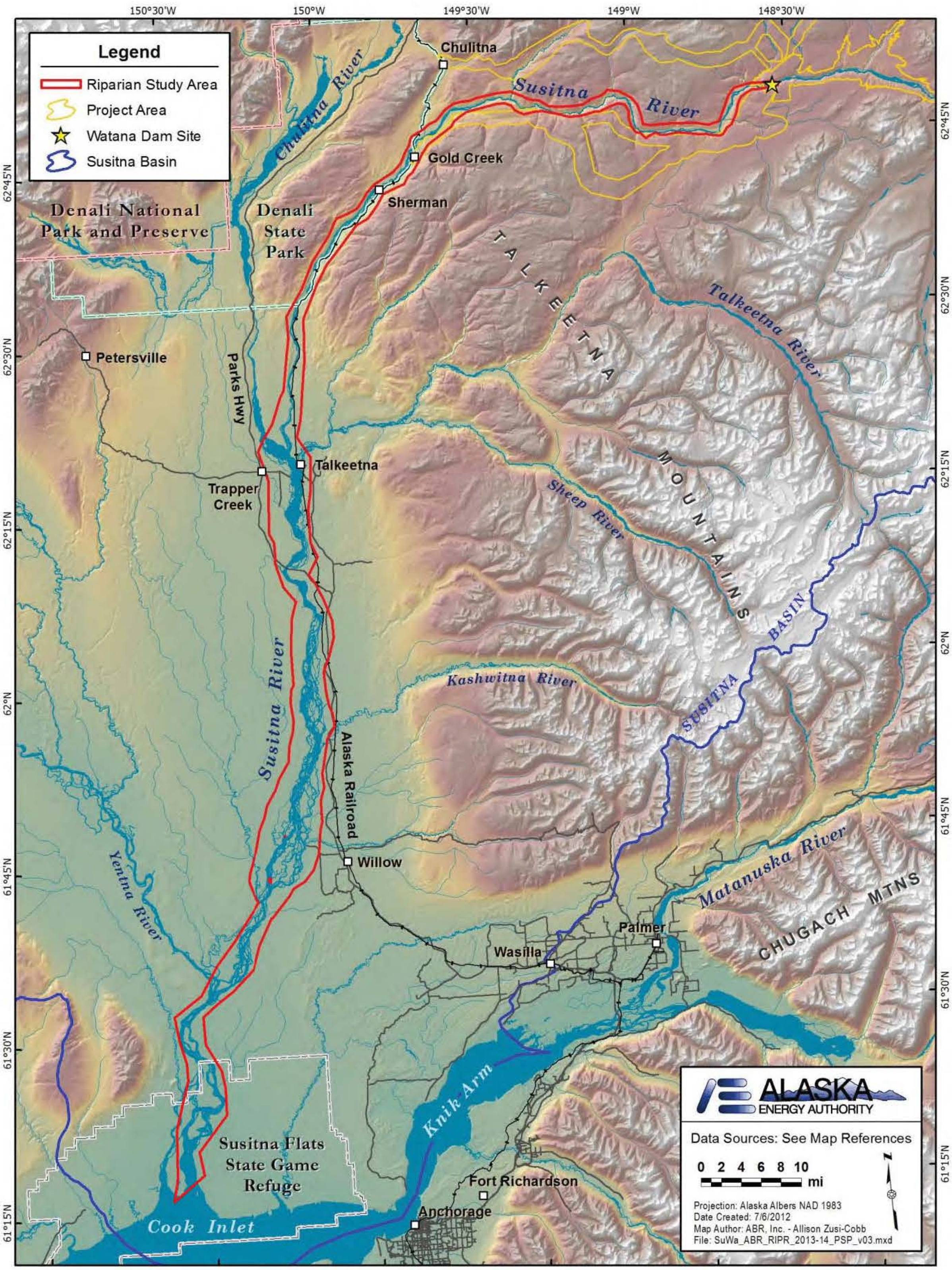

Figure 9.6-1. Riparian study area for 2013 and 2014 in the Susitna basin.

9.7. Wetland Mapping Study

9.7.1. General Description of the Proposed Study

In the wetland mapping study, AEA will identify and map the extent of wetlands in the Project area using current, high-resolution aerial photography and remote-sensed imagery. The study will involve field surveys to collect ground-reference data to "tag" the photosignatures in the Project area to known wetland types, and in the office, the boundaries for the identified wetland types will delineated by on-screen digitizing in GIS using the aerial photography and remote-sensed imagery for the Project area as the base data layers. The wetland classification to be used in the study will be a hybrid classification specific to the wetlands in the Project area, but it will be compatible with existing wetland classification systems used elsewhere in Alaska, especially the system used by the Matanuska-Susitna Borough. A wetland functional assessment also will be conducted in the study to determine the specific functions that the wetlands in the Project area provide.

9.7.1.1. Study Goals and Objectives

The overall goal of the wetland mapping study is to prepare a baseline map of the existing wetland habitats in the Project area. This mapping information will be used to assess impacts to wetland resources from the proposed Project, and to develop any protection, mitigation, and enhancement (PM&E) measures to address the expected impacts.

The specific objectives of the wetland mapping study are to:

- Identify, delineate, and map wetlands in the Project area in GIS;
- Determine functional values for the mapped wetland types; and
- Quantify the potential direct, indirect, and cumulative impacts to wetlands and wetland functions from Project construction and operations activities, which will include any new wetlands that may be created by the proposed reservoir.

This multi-year study is being initiated in 2012 and will be continued in 2013 and 2014. Results from the first year of work in 2012 will be used to update future versions of this study plan, as needed, to (1) fine-tune the field investigations and mapping efforts for the existing conditions found in the Project area, and (2) customize the mapping work (e.g., study area) to reflect further refinements in the design of the Project.

9.7.2. Existing Information and Need for Additional Information

Wetlands were mapped for the Alaska Power Authority's Susitna Hydroelectric Project (APA Project) in the 1980s through a cooperative agreement between U.S. Fish and Wildlife Service (USFWS) and the APA to produce a preliminary wetlands map for the APA Project area at a scale of 1:63,360. Those wetlands map data were based on the vegetation mapping completed by McKendrick et al. (1982), with some additional modification using stereoscopic photo-interpretation, and are now a part of the National Wetlands Inventory (NWI; USFWS 1984). The Alaska Vegetation Classification (AVC; Viereck and Dyrness 1980) vegetation classes that were mapped in the early 1980s were cross-referenced and converted into wetlands classes using the classification scheme of Cowardin et al. (1979).

Existing NWI data, which were developed in the 1980s (above) and cover the current Project area, are expected to be available in digital format sometime in 2012. Those NWI mapping data will help in understanding the types of wetlands that occur in the study area, but the mapping was not conducted at a scale sufficient for determining Project impacts on wetland resources. When mapping at the 1:63,360 scale, small drainages and other small wetland habitats are often overlooked. Additionally, ground verification of NWI wetlands maps typically is fairly limited. Because those NWI data are nearly 30 years old, and because vegetation, hydrology, and soil conditions likely have changed over that period (see below), an updated map of wetlands will be needed for the current proposed Project. NWI maps from the 1980s will not reflect recent landscape changes due to fire, insect outbreaks, development, and climate change. In particular, increases in woody shrub habitats, reductions in forest cover from fires and insect outbreaks, and permafrost degradation have been documented in recent decades in interior Alaska. These recent landscape changes will not be represented in wetlands mapping data from the 1980s.

9.7.3. Study Area

The study area for wetlands mapping will be formally defined in consultation with resource management agency personnel over the course of developing this study plan in 2012. In the interim, a working study area is proposed which includes a 2-mile buffer surrounding those areas that would be directly altered or disturbed by development of the Project (Figure 9.7-1). All direct and indirect effects of the proposed Project on wetlands are expected to be encompassed in a 2-mi buffer surrounding the Project infrastructure. The area to be used to evaluate cumulative impacts for the Project license application may be substantially larger, but it would be infeasible to map wetlands for an area of the size needed to assess cumulative impacts. This interim study area includes three possible alternatives for road and transmission lines, the proposed reservoir inundation area, and supporting facilities. The Chulitna Corridor includes east-west running transmission lines and a road north of the Susitna River connecting to the Alaska Intertie and the Alaska Railroad near the Chulitna station. Another east-west configuration would follow a corridor south of the Susitna River running to Gold Creek station. A third corridor, the Denali Corridor, runs north, and would connect the dam site to the Denali Highway by road over a distance of about 44 mi. If transmission lines are run north up the Denali corridor, they would need to also run west along the existing Denali Highway to connect to the Anchorage-Fairbanks Intertie Transmission lines near Cantwell.

The alteration of wetland habitats downstream of the dam (due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River) will be addressed in the riparian study (see Section 9.6). No placement of fill in wetlands is expected to occur downstream from the proposed dam; thus, a wetlands map will not be needed for the Clean Water Act Section 404 wetlands permit application for the Project (this has been confirmed by the U.S. Army Corps of Engineers [USACE]; see Section 9.4 and Attachment 9-1). In the riparian study, successional vegetation, wetlands, and wildlife habitats will be mapped and, mapping and prediction of changes in riparian habitats from construction of the Project will be developed in collaboration with the AEA study teams for riverine physical processes, most notably instream flow, ice processes, and riverine geomorphology (see Section 9.6).

9.7.4. Study Methods

In general, the wetlands mapping for the Project area will follow the protocols for preparing wetland maps that have been developed by the USFWS NWI program (National Wetlands Inventory Center 1995, Dahl et al. 2009), but wetlands will be classified using the elements of three different wetland classification systems: NWI, hydrogeomorphic (HGM) classes, and a regional system developed for lowlands in the Cook Inlet basin. The use of these three wetland classification systems was agreed to during meetings with resource management agencies regarding the wetland mapping study in spring 2012 (see Section 9.4 and Attachment 9-1). Wetland types will be defined based on a number of landscape, geomorphic, hydrological, and biological variables, including the wetland classification systems above, and will be categorized as local-scale wetland ecosystems (wetland ecotypes).

In addition to the wetlands mapping needed for supporting a Clean Water Act Section 404 dredge and fill permit application, a wetland functional assessment for the mapped wetland ecotypes will be prepared to (1) evaluate the functional significance of wetland impacts that may occur as a result of the Project, and (2) use in compensatory mitigation planning for unavoidable wetland losses. As agreed to with resource management agencies (see Attachment 9-1), the set of wetland functions to be assessed will be tailored to those expected to be of most importance in remote regions of Alaska in which landscape disturbances are few. The wetland functional assessment will be based on hydrogeomorphic (HGM) principles. Although draft HGM guidebooks have been prepared for the Cook Inlet basin (Hall et al. 2003) and Interior Alaska (Alaska Department of Environmental Conservation and USACE 1999), the models are confined to a small set of HGM classes and are regionally specific; thus, they are unlikely to be applicable to the Susitna basin, which lies in the transition zone between Interior Alaska and Cook Inlet and includes montane environments. As a result, the rapid assessment procedure developed by Magee and Hollands (1998) is proposed to be used as the basis for assessing wetland functions, but the procedure (and parameters measured) will be modified as needed to evaluate wetland functions unique to the Project area. The functional assessment method to be used is currently under discussion with resource management agencies, and will be finalized during the development of this study plan in 2012.

At a minimum, the wetland mapping study will include the following components:

- Revise 2012 wetlands mapping as needed using data collected during field surveys in summer 2012 and begin preliminary mapping of wetlands that will be verified with field surveys in 2013 and 2014;
- Preselect 2013 and 2014 field sampling locations and conduct field wetland determination and functional assessment surveys;
- Resample any vegetation field plots from the 1980s studies that were identified during the 2012 field study effort;
- Incorporate data from the Vegetation and Wildlife Habitat Mapping Study and available data on natural fire patterns along the reservoir reach of the Susitna River into the mapping of wetland ecotypes; and
- Reports on the 2013 study results (Initial Study Report), 2014 study results (Updated Study Report).

9.7.4.1. Wetlands Classification and Mapping

Prior to the 2013 field season, the preliminary map of wetland and upland boundaries prepared in 2012 will be updated using ArcGIS 10.0 and on-screen digitizing. The ground-reference survey data collected in 2012 will be used to facilitate the revisions to the preliminary wetland mapping. Although suitable high-resolution imagery is not yet available for the entire study area, the imagery needed is expected to be acquired during the 2012 field season. The goal of the preliminary mapping is to map a reasonable set of characteristic wetland ecotypes that occur in the mapping study area. This information will then be used to guide the field wetland-determination and ground-verification survey efforts in 2013 and 2014.

Classification and mapping of the Project area will follow the protocols for preparing wetland maps that have been developed by the USFWS National Wetland Inventory (NWI) program (National Wetlands Inventory Center 1995, Dahl et al. 2009). These protocols describe requirements for boundary delineation, polygon size, classification, and NWI annotation. The minimum mapping polygon size for most upland and wetland habitats will be 0.5 acres, with smaller polygons (0.1 acre) delineated for water bodies and other wetlands of ecological importance. Wetland and upland boundaries will be delineated based on color signature, plant canopy, and surface relief, along with hydrological indicators such as drainage patterns and surface water connections. As noted above, the classification of wetlands will incorporate elements of three different wetland classification systems: NWI, hydrogeomorphic (HGM) classes, and a regional classification for the Cook Inlet basin sponsored by the Kenai Watershed Council (http://cookinletwetlands.info/). The Cook Inlet system, developed by Mike Gracz, improves on the Cowardin system (Cowardin 1979) by incorporating region-specific landscape, geomorphic, and wetland function features into the classification. In the mapping of wetlands for the Project, wetland ecotypes will be defined specifically for the Susitna basin using methods consistent with the Cook Inlet lowlands wetland classification system. Wetlands also will be classified into Viereck Level IV vegetation types (where possible) using The Alaska Vegetation Classification (Viereck et al. 1992), which includes canopy classes for shrub, dwarf tree, and tree lifeforms.

Final wetlands mapping will be completed in 2013 and 2014 following completion of the field surveys. The mapping will undergo a rigorous QA/QC review using tools developed by ABR and the Wetlands Data Verification Toolset developed by the NWI program to identify incorrect codes, digital anomalies, unattributed (null) polygons, adjacent polygons with the same coding, and digital slivers (<0.01 acre). The NWI toolset was created using Environmental Systems Research, Incorporated's (ESRI) ModelBuilder (http://www.fws.gov/wetlands/Data/Tools-Forms.html).

9.7.4.2. Field Surveys

The wetland field surveys will be organized to collect data from as many wetland ecotypes as possible in a way that maximizes safety and efficiency. The preliminary mapping effort described above will be used to preselect sampling transects and wetland-determination plots, although additional plots may be established in the field when additional field data are needed for a given area or a particular wetland ecotype. Field plots will be sampled along transects that will be located within major physiographic types, including riverine, lacustrine, lowland, and upland areas. If possible, plots for which vegetation data were collected in the 1980s will be resampled (these data will be valuable for assessing the extent to which landscape characteristics have changed in the intervening 25-plus years).

Wetland determinations will be made using the standard three-parameter approach described in the 1987 Corps of Engineers Wetlands Delineation Manual (Environment Laboratory 1987) and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0) (USACE 2007). Field surveys will be conducted between June 15 and September 15, which is well within the median dates of the onset of vegetation green-up in spring and vegetation senescence in fall, as specified in the 2007 Regional Supplement for the Project area. To be classified as a wetland, a site must be dominated by hydrophytic plants, have hydric soils, and show evidence of a wetland hydrologic regime. At each wetland determination plot, percent areal cover of plant species within each stratum (herb, shrub, and tree) will be visually estimated, generally within a 10-m (33-ft) radius of relatively homogeneous vegetation as specified in the 1987 Manual. The size and dimensions of the plots may be modified, however, depending on the site characteristics of the plant community (e.g., narrower plots in riparian fringe habitats). Additional documentation at each plot will include observations of wildlife use (stick nests, dens) and other site characteristics that reflect habitat quality and wetland function. Additional vegetation structure information for both vascular and nonvascular plants will be recorded to assist in evaluating use of the wetland ecotypes by birds and mammals.

In addition to wetland determination plots, ground-verification plots will be established for improving the accuracy of the overall mapping effort. At these plots, the dominant plant species will be recorded, and wetland ecotype and Viereck Level IV vegetation classes (Viereck et al. 1992) will be assigned. These verification assessments will be performed in areas where the wetland or upland status has been well documented in determination plots elsewhere, and will be used to improve map accuracy by increasing the number of documented wetland ecotypes tagged to particular aerial photosignatures.

A mobile Trimble® Nomad™ series GIS unit will be used to record the field wetlands data (using the WetForm database), record GPS location (as back-up to handheld GPS receivers), and provide field access to aerial imagery and the preliminary mapping performed prior to the field survey. WetForm is a proprietary relational database used to enter wetlands site data in the field, and it facilitates the preparation of electronic copies of the USACE 2007 Regional Supplement dataform for each wetland determination plot. Additional data will be collected to support the wetland classification and functional assessment efforts electronically at each plot using an Android tablet computer.

9.7.4.3. Wetland Functional Assessment

Based on discussions with resource management agencies while planning the 2012 Wetlands Mapping Study (see Attachment 9.1), wetland functions in the study area will be assessed using HGM principles. The rapid assessment procedure developed by Magee and Hollands (1998) provides a means for collecting field data within a time frame compatible with the schedule for the Project. The procedure also has several key elements that make it suitable for use in this Project:

- It provides the flexibility needed for developing HGM models that are relevant to the Susitna basin;

- The rule-based, qualitative approach to assessing wetland function is important because due to its remoteness, virtually no multi-year, quantitative data on wetland ecosystem parameters are available for the Susitna basin;
- Incorporates landscape, hydrologic, soil, and vegetation variables into the model;
- The method has a high degree of repeatability, which helps ensure consistency in recording field observations by multiple observers; and
- New functional assessment parameters can be added as needed

Similar to formal HGM methodologies, the six HGM classes (categories) that define the various wetland ecosystems (depressional, slope, lacustrine fringe, extensive peatland, flat, and riverine) will be used. In 2012, the set of wetland functions to be evaluated will be finalized in consultation with the resource management agencies. Currently, evaluation of the following functions is proposed:

- Modification of groundwater discharge;
- Modification of groundwater recharge;
- Storm and flood-water storage;
- Modification of stream flow;
- Modification of water quality;
- Export of detritus;
- Contribution of abundance and diversity of wetland vegetation;
- Contribution of abundance and diversity of wetland fauna;
- Consumptive uses; and
- Uniqueness.

Functional indices will be developed to identify the level of function each HGM class provides in the study area, and the scores derived for each function for each HGM class will be compared to other wetlands in the same class. This information will help guide the analysis of wetland impacts anticipated by the project and the development of PM&E measures for protecting wetland resources.

9.7.4.4. Wetland Impact Assessment

Direct impacts to wetlands and water bodies are expected to occur in the form of habitat loss from the placement of fill and from the conversion of palustrine wetlands to lacustrine habitats in the proposed reservoir. Indirect impacts could occur from erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Indirect impacts to riparian habitats (including wetlands) are also anticipated downstream of the proposed dam due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River (hydrology, plant species diversity, and vegetation composition have the potential to be altered). These downstream effects, however, will not be addressed in this study; instead they will be treated in the riparian study (see Section 9.6).

The wetland impact assessment will be conducted in GIS by overlaying the project footprint on the final wetland map polygons to determine which wetland polygons would be affected directly by fill. The determination of which wetland polygons could be indirectly affected will be conducted similarly by overlaying disturbance buffers (surrounding the proposed Project infrastructure) to identify which areas are likely to be affected by ancillary impacts associated with Project construction, operations, and maintenance. The size and number of disturbance buffer(s) to be used will be determined based upon the final specifications for Project construction, operations, and maintenance activities, which will be provided in the Project description.

In the wetlands impact assessment, the potential impacts to wetlands and wetland function will be evaluated by quantifying the direct loss of wetlands (measured in acres) and identifying the acreage of high-value (high-function) wetlands that would be lost for each development alternative. The assessment will also identify which alternatives have the greatest potential for indirect impacts (acreages of wetlands in the disturbance buffers noted above) and identify which wetland ecotypes are particularly sensitive to disturbance. Other Project study teams for permafrost and hydrology will be consulted to help identify sensitive wetland terrain.

Lastly, cumulative effects on wetlands in the region of the proposed Project will be assessed by evaluating the extent of the direct and indirect wetland impacts expected from the Project in conjunction with the existing wetland impacts in the region and the impacts that could occur from other projects anticipated to occur in the reasonably foreseeable future.

9.7.4.5. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of historic (APA Project) data and data collected during the 2012–2014 field seasons, including representative photographs of wetland ecotypes will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Wetland map in ArcGIS and PDF formats.** The preliminary and final wetland maps will be developed and delivered according to the schedule indicated below. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The wetland mapping study results will be presented in the Initial and Updated study reports, according the schedule indicated below. The reports will include descriptions of the wetland ecotypes identified; a summary table (acreages) of the wetland ecotypes and upland areas represented in the wetlands mapping effort; a description of the vegetation, hydrology, and soils of the wetland functional groups identified; the model used for the functional assessment; and descriptions of the potential impacts to wetland ecotypes from development of the Project. The Initial Study Report will include recommendations for the 2014 field survey effort. Both reports also will include field wetland dataforms for each plot surveyed, and field plot photos including site, ground, and soil photographs.

9.7.5. Consistency with Generally Accepted Scientific Practice

Wetlands in the Project area will be identified using standard and accepted methods for the determination of wetlands in Alaska (Environment Laboratory 1987, USACE 2007). Similarly, the mapping of wetlands will follow standard procedures for mapping wetlands across broad areas (onscreen digitizing in GIS over digital aerial imagery). The mapping will be based on intensive ground-reference information, focused especially in the Project footprint areas where most impacts will occur. The classification of wetlands in the Project area will be done using a customized procedure based on several different wetland classification systems. The procedure to be used has been agreed to by licensing participants interested in wetlands mapping for the Project, and will provide data compatible with the mapping of wetlands in other areas surrounding the Project area.

9.7.6. Schedule

2013:

- Wetland mapping and field plot selection: January–May
- Field surveys: June 20–30 and July 20–30 (four 2-person crews each survey)
- Wetland map revisions: August–October
- Initial Study Report: December
- Delivery of field data and preliminary wetland map: December

2014:

- Wetland mapping and field plot selection for remaining unmapped areas: January–May
- Field surveys: June 20–30 and July 20–30 (one 2-person crew in June and two 2-person crews in July)
- Final wetland map revisions: August–October
- Wetland functional analysis: August–October
- Updated Study Report: December
- Delivery of final field data and final wetland map: December

9.7.7. Level of Effort and Cost

The wetland mapping study is planned as a three-year effort; work began in 2012 and will continue in 2013 and 2014. Field sampling will be conducted each year during the growing season by four to eight observers (working in crews of two). Surveys will be conducted for approximately 20 days in each year. The level of effort for 2013 is expected to be considerably greater than in 2012, because the 2012 effort is focused only on those portions of the study area that have aerial photography coverage of sufficient resolution for preliminary mapping and field sampling. In 2013, high-resolution imagery should be available for the entire project area, so the number of person-days dedicated to the field effort will be doubled. The mapping effort also is expected to be much greater in 2013 relative to 2012. Then in 2014, less extensive field surveys and mapping may be needed as the mapping of the study area progresses. Field surveys will be conducted in conjunction with the vegetation and wildlife habitat mapping study to maximize efficiency and reduce costs. The study will involve extensive, office-based activities to delineate wetland boundaries in a GIS and to prepare study reports.

Total costs in 2013 are estimated at $500,000. A more limited field survey will be conducted in 2014 focusing on problem areas or areas where the field survey coverage to date is insufficient. Additional field data needed to support the wetland functional analysis will also be collected in 2014. Total costs in 2014 are estimated at $300,000.

9.7.8. Literature Cited

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9.7.9. Figures

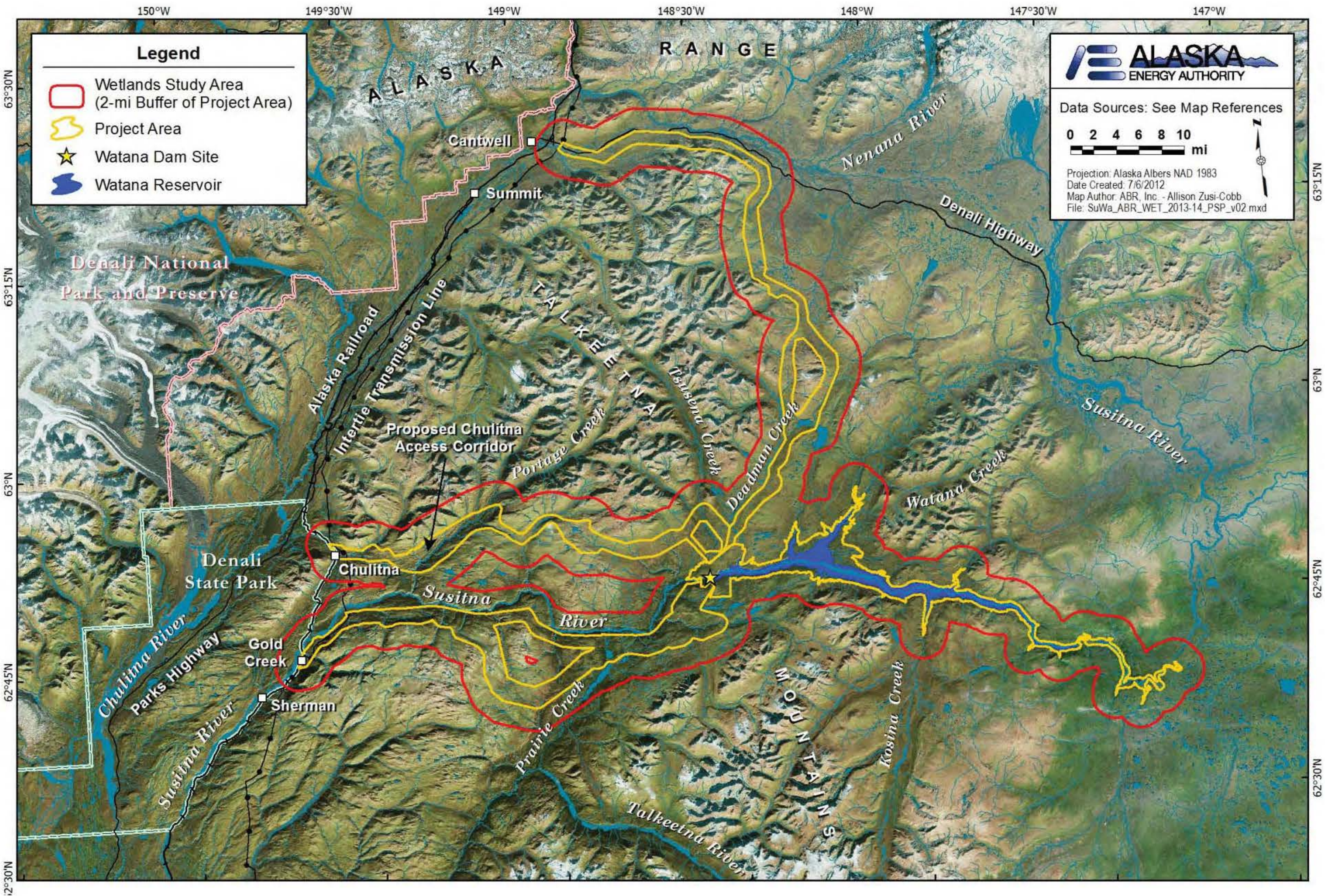

Figure 9.7-1. Study area for wetlands mapping in 2013 and 2014 in the Susitna-Watana Hydroelectric Project area.

9.8. Rare Plant Study

9.8.1. General Description of the Proposed Study

The rare plant study is a field-based investigation in which AEA will identify appropriate habitats for a set of rare vascular species likely to occur in the Project area, and will conduct field surveys to search for any populations of rare plants that may occur. The focus of the surveys will be limited to those areas in which rare plant populations could be directly or indirectly affected by Project development activities.

9.8.1.1. Study Goals and Objectives

The primary goal of the rare plant study is to locate populations of rare vascular plant species that may occur in the Project area and which may be affected by the Project. Rare vascular plant species in Alaska currently are being tracked in a database maintained by the Alaska Natural Heritage Program (AKNHP 2012a); this database will be used as the source list for possible rare species in the Project area. The rare plant study is designed so that habitats where rare plants may occur are identified and then surveyed to locate any rare plant populations present. These data then would be used to facilitate project design, construction, and operations planning to help avoid and minimize impacts to the rare plant populations found.

The specific objectives of the rare plant study are to:

- Locate populations of the more rare vascular plant species that may occur in those portions of the Project area that would be disturbed by project construction and operations activities;
- Estimate population sizes for rare species and map their current distributions; and
- Quantify the potential direct, indirect, and cumulative impacts to rare plants from Project construction and operations activities.

The rare plant study is planned as a two-year study (2013–2014) and will be formally initiated in 2013. However, any rare species found during the field surveys in 2012 for the Vegetation and Wildlife Habitat Mapping, Riparian, and Wetland Mapping studies (see Sections 9.5, 9.6, and 9.7) will be documented, and those records of rare species will be used in planning the field surveys for rare species in 2013 and 2014. This study plan will be updated as necessary, including fine tuning of the field survey methods and areas, based on the results from the first year of work in 2013 and comments on the Initial Study Report by FERC, resource agencies, and other interested licensing participants.

9.8.2. Existing Information and Need for Additional Information

The AKNHP maintains a geospatial database, called BIOTICS, with collection locality and habitat information for rare and/or endemic vascular plants in Alaska (AKNHP 2012a). The species list from that database, known as the Rare Vascular Plant List, currently includes 306 taxa (AKNHP 2012b). In a review of rare plant collection locations from the BIOTICS database—selected from within a broad region surrounding the Project area (AEA 2011)—19 species with state rankings of S1 (critically imperiled) and S2 (imperiled) were identified (Table 9.8-1). These species were selected from the previous Rare Vascular Plant Tracking List

(AKNHP 2008), which was the most up to date list available during 2011. Species that are very rare in the state (5 or fewer occurrences or very few remaining individuals) or that are especially vulnerable to extirpation from the state are given a S1 ranking, whereas species with 6 to 20 collections in the state are and that are somewhat less vulnerable to extirpation are given a S2 ranking (Lipkin and Murray 1997). A larger number species in the search area are ranked as S3 (rare or uncommon; 21 to 100 collections in the state), but in this study, the focus will be on those species with the rarer state rankings (S1, S2, S1S2, and S2S3).

An aquatic species known as flatleaf pondweed or Robbins pondweed (*Potamogeton robbinsii*) was recorded in the APA Project area in the 1980s, in Watana Lake (McKendrick et al. 1982). That collection represents a second recorded observation for the species in the search area (the only other record was near the Summit airstrip in 1953). *P. robbinsii* is listed as S1S2 (critically imperiled or imperiled in Alaska) and as G5 (demonstrably secure globally), indicating that populations are more numerous outside Alaska. Characteristic of most rare species, many of the 19 listed rare plant taxa identified in the data review in AEA (2011) often occur in a narrow range of habitats (e.g., *Artemisia dracunculus* on exposed bluffs). Given the wide array of habitats present in the Project area (e.g., alpine, subalpine, forest, meadows, bogs, fens), it is possible that other rare plant taxa besides *P. robbinsii* may occur in the Project area.

Field surveys for rare plants will be needed for the proposed Project to document any populations of rare species occurring areas which would be disturbed by Project construction and operations activities. This information will be used to develop avoidance and mitigation options to minimize the impacts to rare plant species from development of the proposed Project.

9.8.3. Study Area

Because rare plant species typically occur in specific habitats, the study area for the survey of rare plants will be defined primarily by the locations of suitable habitats for the species that have been determined to have some potential to occur in the Project area (see Section 9.8.4). Field surveys will be conducted only in areas in and adjacent to those portions of the Project area in which habitat loss, alteration, and/or disturbance will occur (the reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites). These features all occur within the preliminary Project area boundary (Figure 9.8-1), and it is within this boundary that the surveys for rare plants will be conducted. Habitats for rare species will be identified from the preliminary mapping of vegetation, wildlife habitats, and wetlands (see Sections 9.5 and 9.7), and from photointerpretation of plant habitats on aerial photos or remote-sensed imagery. To prioritize the field survey efforts, areas to be searched will be categorized as having low, moderate, or high potential for supporting rare plants (see Section 9.8.4). Surveys for rare plants downstream of the proposed dam in riparian habitats currently are not being planned because disturbance-inducing construction and operations activities associated with the Project, which could affect rare plant populations, will not occur in downstream areas. This approach may be altered, however, if it is found that one or more rare species are possible in riparian habitats and that those species are also dependent on periodic (natural) disturbances and successional habitats, both of which could be affected indirectly in downstream riparian areas by Project development.

9.8.4. Study Methods

9.8.4.1. Field Surveys

The list of 19 rare species identified in AEA (2011), which have the rarer state rankings (S1, S2, S1S2, and S2S3; Table 9.8-1), will serve as the initial list of rare species to survey for. Species that are less rare in the state (S3 and S3S4 rankings) will be recorded if encountered in the field, but the focus of the survey work will be on the rarer species. The search area used for rare plants in AEA (2011) was a large rectangular area encompassing the entire drainage of the Susitna River from the headwaters in the Alaska Range to the mouth at Cook Inlet. Over the course of finalizing this study plan in 2012, AEA, with the help of resource management agencies and the AKNHP, will refine this search area so that it encompasses, as much as possible, areas with landscape features and habitats similar to those occurring in the Project area. Then a formal request will be made to the AKNHP for a listing of rare vascular plant species from the BIOTICS database that have been recorded in the updated search area. These species will be selected from the recently updated Rare Vascular Plant List (AKNHP 2012b). Using the collection-area information for the list of rare species from the BIOTICS database, the suitable habitats for each rare species will be identified. In cases in which the habitat information from the collected specimen(s) is sparse, additional information on the habitats for rare species will be obtained from the scientific literature. These habitat types will serve as the primary focus for the field survey efforts.

Prior to the field surveys in 2013 and 2014, the preliminary mapping of vegetation, wildlife habitats, and wetlands, which is to be conducted in 2012 and 2013 (see Sections 9.5 and 9.7), as well as current, high-resolution aerial photography and remote-sensed imagery will be reviewed to identify suitable habitats for the rare plant species within the Project area.

No standardized protocols have been developed for conducting rare plant surveys in Alaska, but the reconnaissance sampling methodology used by the AKNHP (Carlson et al. 2006; modified from Caitling and Reznicek 2003) provides a template for use in this study. To maximize the potential of encountering rare species, in the reconnaissance methodology researchers identify survey areas based on site-specific criteria, including regional or locally unique geological features, suitable habitats for the species of concern, logistical feasibility, and areas with high environmental gradients. For this study, the most emphasis will be placed identifying and surveying suitable habitats for each species that has some potential to occur in the Project area (see above), as well as unique geological and terrain features and areas with high environmental gradients (numerous transitions in habitats). By combining these landscape elements, regions will be categorized within the study area that have low, moderate, or high potential for supporting rare plants, and survey efforts will be prioritized in those areas with high and moderate potential.

Field surveys, will be conducted by botanists skilled in the identification of vascular plants, who have extensive field experience in Alaska (including previous experience surveying for rare plants), and who also are competent using local, statewide, and national-level taxonomic keys. Most identifications of rare plants will be made initially using the Flora of Alaska (Hultén 1968) and the Alaska Rare Plant Field Guide (Lipkin and Murray 1997). In some cases, the Flora of North America North of Mexico (FNAEC, 1993–2012) will be used, for those plant families that have been revised by the FNAEC. Final nomenclature for rare plant taxa will follow that used in

AKNHP (2012). In cases where the field crew determines that the collection of several plants will not significantly impact the population, voucher specimens will be collected for verification of identifications. The confirmation of plant identifications will be made by the University of Alaska Herbarium.

The habitat-specific surveys for rare plants will be conducted multiple times during the summers of 2013 and 2014, as needed, to coincide with the flowering times of the particular species being sought (the timing of these surveys will depend on which plant taxa are determined to have the potential of occurring in the Project area). When encountered, rare plant observations also will be recorded during the field surveys for Vegetation and Wildlife Habitat Mapping and Wetland Mapping studies in 2012, 2013, and 2014.

9.8.4.2. Impact Assessment

Direct impacts to rare plant species and their habitats from development of the Project could occur in the form of habitat loss from the placement of fill and from the conversion of terrestrial vegetation to lacustrine habitats in the proposed reservoir. Indirect impacts could occur from erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use.

The impact assessment for rare plant species will be conducted in GIS by overlaying the project footprint on the locations of rare plant populations to determine which populations would be affected directly by fill. The determination of which populations could be indirectly affected will be conducted similarly by overlaying disturbance buffers (surrounding the proposed Project infrastructure) to identify which areas are likely to be affected by ancillary impacts associated with Project construction, operations, and maintenance. The size and number of disturbance buffer(s) to be used will be determined based upon the final specifications for Project construction, operations, and maintenance activities, which will be provided in the Project description.

In the impact assessment, the potential impacts to rare plant species will be evaluated by quantifying the reductions in populations (0 to 100 percent) that could occur directly from fill associated with the development of each Project alternative. Potential for indirect impacts (percentage reductions in populations in the disturbance buffers noted above) will also be assessed.

Cumulative effects on rare plant species in the region of the proposed Project will be assessed by evaluating the extent of the direct and indirect impacts expected from the Project, while taking into account the locations of other existing rare plant populations in the region and the potential for other possible projects to be developed in the reasonably foreseeable future.

9.8.4.3. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of the rare plant locations found during the 2013 and 2014 field seasons, including representative photographs of the rare plant populations, will be prepared. If permission is granted from the AKNHP, the records of rare plants from the BIOTICS database, which occur near the Project area, will also be included in the database. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.

- **Rare plant maps in ArcGIS and PDF formats.** The preliminary and final maps of the locations of rare plant populations will be developed and delivered according to the schedule indicated below. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The rare plant study results will be presented in the Initial and Updated study reports, according the schedule indicated below. The reports will include descriptions of the rare plant populations found including detailed site characteristics, survey methodology, and the names and experience of the surveyors. The Initial Study Report will include recommendations for the 2014 field survey effort. Both reports also will include copies of site photographs.

9.8.5. Consistency with Generally Accepted Scientific Practice

The rare plant study will be conducted using the most up to date information on the previous locations of rare plants near the project area, from the BIOTICS database maintained by the AKNHP (2012a, b). The field protocols for the rare plant surveys will follow those outlined in the reconnaissance sampling methodology used by the AKNHP (Carlson et al. 2006; modified from Caitling and Reznicek 2003) for rare plant surveys in Alaska. These methods are the current standards for field surveys of rare plants in Alaska and were developed by the AKNHP, which is the state authority on rare plants and field surveys for rare plants.

9.8.6. Schedule

2013:

- Review of BIOTICS data and field survey site selection: April–May
- Field survey: June 26–July 2 and July 26–August 1 (two 2-person crews each survey); survey timing may need to be modified depending on which set of rare species are to be surveyed for, and it is possible that three surveys of shorter duration may be needed
- Data analysis: September–October
- Initial Study Report: December
- Delivery of preliminary field data and rare plant population maps: December

2014:

- Review of 2013 data and field survey site selection: April–May
- Field survey: June 26–July 2 and July 26–August 1 (two 2-person crews each survey); survey timing may need to be modified as noted above
- Data analysis: September–October
- Updated Study Report: December
- Delivery of final field data and rare plant population maps: December

9.8.7. Level of Effort and Cost

The rare plant study is planned to be conducted over two years (2013–2014). Field sampling will be conducted each year during the growing season by a crew of two observers. It is anticipated that the level of effort in 2013 and 2014 would be roughly the same (14 days each year). The rare plant study will be coordinated with the other botanical studies being performed for the Project to help facilitate the field surveys for rare plants and minimize costs. The field crews for the Vegetation and Wildlife Habitat Mapping, Riparian, and Wetland Mapping studies will document the locations of any rare plant species encountered during their field surveys in 2012 and 2013, and this information will be used to help prioritize the field surveys for the rare plant study. The total projected cost for this study for 2013 and 2014 combined is on the order of $220,000.

9.8.8. Literature Cited

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9.8.9. Tables

Table 9.8-1. Rare vascular plant taxa that have been collected in a broad region surrounding the Susitna River drainage (see AEA 2011).1

Scientific Name	Common Name	No. of Collections	State Rank[2]	Global Rank[3]
Arnica diversifolia	Sticky arnica	1	S1	G5
Arnica lessingii ssp. *norbergii*	Norberg arnica	1	S2	G5T2Q
Arnica mollis	Hairy arnica	1	S1	G5
Artemisia dracunculus	Dragon wormwood	2	S1S2	G5
Blysmopsis rufa	Red clubrush	1	S1	unranked
Botrychium ascendens	Upward-lobed moonwort	1	S2	G2G3
Carex athrostachya	Slender beak sedge	1	S1S2	G5
Carex parryana	Parry sedge	2	S1	G4
Ceratophyllum demersum	Common hornwort	1	S1	G5
Chamaerhodos erecta ssp. *nuttallii*	Nuttall's ground-rose	1	S1S2	G5T4T5
Cicuta bulbifera	Bulb-bearing water-hemlock	1	S2	G5
Eleocharis kamtschatica	Kamchatka spike-rush	1	S2S3	G4
Eriophorum viridicarinatum	Green-keeled cottongrass	1	S2	G5
Erysimum asperum var. *angustatum*	Wallflower	1	S1S2	unranked
Glyceria striata var. *stricta*	Fowl mannagrass	3	S2	G5T5
Maianthemum stellatum	Starry solomon-plume	4	S2	G5
Potamogeton obtusifolius	Blunt-leaf pondweed	2	S2S3	G5
Potamogeton robbinsii [4]	Flatleaf pondweed	1	S1S2	G5
Potentilla drummondii	Drummond cinquefoil	1	S2	G5

Notes:

1 Data from the Rare Vascular Plant Tracking List (AKNHP 2008), as represented in 2011 in the BIOTICS database of rare species (AKNHP 2012a).
2 State rarity rankings: S1 = critically imperiled, S2 = imperiled, and S3 = rare or uncommon.
3 Global rarity rankings: G2 = imperiled, G3 = rare or uncommon, G4 = apparently secure, G5 = demonstrably secure, T = rank of subspecies or variety, Q = indicates uncertainty about taxonomic status which may affect global rank.
4 A second record of this species was made by McKendrick et al. (1982) in the upper Susitna River basin (Watana Lake) (see AEA 2011).

9.8.10. Figures

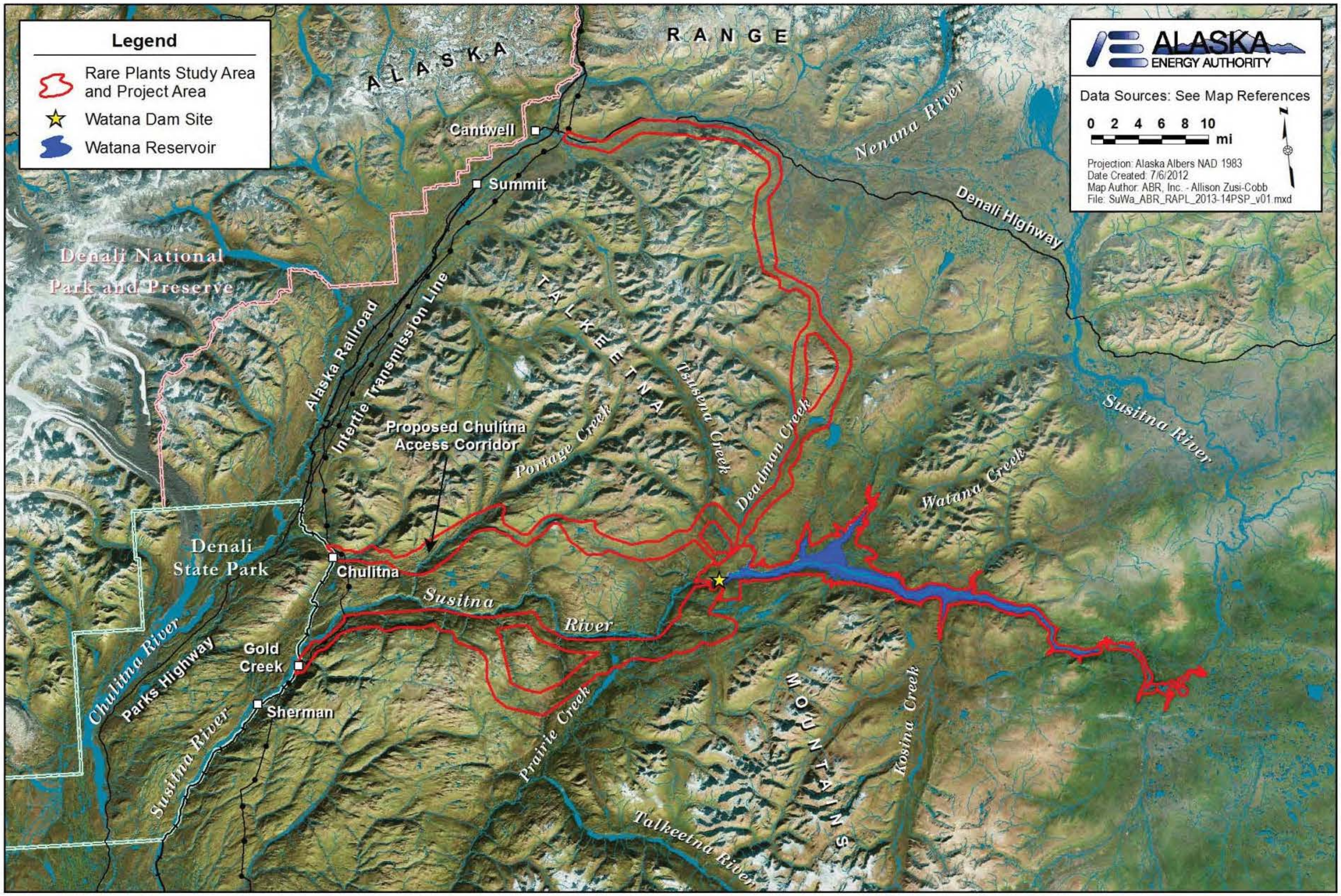

Figure 9.8-1. Study area for rare plant surveys in 2013 and 2014 in the Susitna-Watana Hydroelectric Project area.

9.9. Invasive Plant Study

9.9.1. General Description of the Proposed Study

The invasive plant study is a field-based investigation in which AEA will identify disturbed habitats in and near the Project area that could serve as sources of invasive vascular plant species. Field surveys will then be conducted in those disturbed areas to locate populations of invasive species that have some potential to spread into, or farther into, the Project area associated with development activities. An ecological risk assessment will be conducted for the invasive species located to evaluate the risk of the continued spread of those species because of Project development activities.

9.9.1.1. Study Goals and Objectives

The overall goals of the invasive plant study are to determine the current prevalence of invasive vascular plants in the Project area and nearby disturbed areas and to assess the risk of the continued spread of invasive species as a result of Project development.

The specific objectives of the invasive plant study are to:

- Identify the locations at which invasive plant species have already become established in the Project area and in nearby disturbed areas;
- Estimate population sizes for invasive species and map their current distributions; and Determine whether any of the species present could pose a substantial ecological threat.

The invasive plant study is planned as a two-year study (2013–2014) and will be formally initiated in 2013. However, any invasive species found during the field surveys in 2012 for the Vegetation and Wildlife Habitat Mapping, Riparian, and Wetland Mapping studies (see Sections 9.5, 9.6, and 9.7) will be documented, and those records of invasive species will be used in planning the field surveys for invasive species in 2013 and 2014. Results from the first year of work in 2013 will be used to update this study plan, as needed, and to fine-tune the field survey methods and survey areas for invasive species, in consultation with licensing participants.

9.9.2. Existing Information and Need for Additional Information

No surveys of invasive vascular plants were conducted as part of the APA Project in the 1980s, primarily because the risk of invasive species was not considered a major concern at the time (AEA 2011). Resource management agencies have since become increasingly concerned, however, about the potential for invasive plant species to become established in Alaska as a result of construction activities associated with new development projects. As a result, the U.S. Forest Service, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Department of Natural Resources Plant Material Center, and Alaska Natural Heritage Program work in cooperation to support the Alaska Committee for Noxious and Invasive Plants Management (CNIPM) and the Strategic Plan for Noxious and Invasive Plants Management in Alaska (Hebert 2001). An outcome of the strategic plan was the development of the Alaska Exotic Plant Information Clearinghouse (AKEPIC) database. This geospatial database is used to store invasive species occurrence and location information recorded in field surveys conducted throughout Alaska. The CNIPM provides updates regularly to the AKEPIC database as new surveys are conducted; the database is maintained by the AKNHP and can be accessed online (http://aknhp.uaa.alaska.edu/maps/akepic/).

Based on a search of collection localities in the AKEPIC database (AEA 2011), which included data from invasive plant surveys conducted along road systems in and near the Susitna basin and other regional plant surveys, it was found that 22 invasive plant species occur in areas relatively near the proposed Project (Table 9.9-1). These 22 species have some potential to establish in the project area (e.g., if seeds or reproductive shoots were brought in on construction equipment). Areas particularly vulnerable to the establishment of invasive plants include quarry sites, road edges, work pads, and gravel river bars (which are naturally disturbed by flooding and ice scouring). A species of particular concern is *Melilotus alba* (white sweetclover), which establishes readily and often forms monotypic stands along roadsides, trails, and river bars. The ability of this species to colonize linear features on the landscape is especially problematic because such features can act as corridors for dispersal and speed its establishment in new areas. *M. alba* already has been documented colonizing riparian areas along several of Alaska's glacially fed rivers, and low to moderate densities may promote the establishment of other exotic species, while high densities can negatively affect the establishment of both native and non-native species (Conn et al. 2011).

Field surveys for invasive vascular plants will be needed to document the specific locations of invasive species in and near the Project area in order to assess the likelihood that Project development will further aid the spread of invasive species.

9.9.3. Study Area

Since invasive vascular plant species are generally confined to disturbed areas and the Project area is mostly undeveloped, the field surveys for this study will be focused initially on those areas that can act as potential pathways for invasive species to enter and establish in the Project area. Sections of the Parks and Denali Highways that are relatively close to the alternative alignments for the access road and transmission lines, primitive roads or trails that currently provide access into the Project area, and other disturbed areas (see Section 9.9.4) would be surveyed. The specific locations and lengths of the highway segments to be surveyed will be defined during the finalization of this study plan in 2012, based on the locations of the final alternatives for the access road and transmission lines, and in consultation with licensing participants. The primitive roads and trails and other disturbed areas to be surveyed will be identified from high-resolution aerial photography and remote-sensed imagery for the Project area. Some of this imagery exists now and additional imagery for those areas that are currently not covered will be acquired during summer 2012. The area for which high-resolution imagery will be searched for primitive roads and trails and other disturbed areas occurs within a 5-mile buffer surrounding the proposed Project infrastructure areas that would be directly altered or disturbed by construction and operations activities (see Section 9.5, Figure 9.5-1). As engineering design for the Project proceeds and final alternatives are developed, potential gravel material sources will be identified and any existing gravel mine sites being considered for support of Project construction and operations also will be surveyed to assess the extent to which invasive plant species are present. Surveys for invasive plants downstream of the proposed dam in riparian habitats currently are not being planned because disturbance-inducing construction and operations activities associated with the Project will not occur in downstream areas; hence development of the Project will not result in an increase in potential disturbance vectors for the spread of invasives in downstream riparian areas.

9.9.4. Study Methods

9.9.4.1. Field Surveys

Prior to the field surveys in and near the Project area in 2013, recent aerial photography and remote-sensed imagery will be reviewed (see Section 9.9.3) to identify potential “hot spots” for invasive species. These include off-road vehicle trails, gravel roads, quarry sites, and other disturbances that may harbor invasives or are at risk for invasive plant colonization in association with the construction and operation of the proposed Project. The current records in the AKEPIC database will also be reviewed to determine what species have been recorded in the vicinity of the Project area. The areas where invasives have been recorded will be surveyed again to determine if the invasive species are still present and to assess whether the populations (in cases in which population estimates area available) are contracting, expanding, or are relatively unchanged since the previous surveys.

Surveys for invasive vascular plants will be conducted in 2013 and 2014 following guidelines in the AKEPIC User Manual (AKNHP 2008). Suspected invasive species will be collected and the locations of populations recorded with a hand-held GPS receiver. Non-native species that are not considered invasive also will be noted. If possible, population estimates will be made by visually enumerating or estimating the number of plants in the area. If population estimates are not possible, the degree of infestation at each location will be ranked qualitatively as low (1–10 percent cover of assessment area), medium (10–40 percent cover), or high (>40 percent cover). The distribution and size of areas where invasive species are present are likely be highly variable, therefore use of a standard assessment area size (e.g., a 10-meter [33-foot] radius plot) will not be appropriate for evaluating the degree of infestation. Thus, the geographic limits of an infested area will be used to define the assessment area boundaries (these areas may be as small as 0.01 acre or as large as 2 acres). Species will be identified using Hultén (1968) and Identification of Non-native Plants in Alaska (AKNHP 2010). Collected specimens of selected species will be submitted to the University of Alaska Herbarium for confirmation of identifications. All field data will be made available for entry into the AKEPIC database. As engineering design and construction plans for the Project are further developed, the invasive plant work conducted in 2014 likely will be focused more on sources of invasive species that could be accessed during construction activities, such as gravel material sites.

9.9.4.2. Ecological Risk Assessment

To assess the ecological risk of the invasive plant species found in and near the Project area to expand their distributions farther into the Project area, the U.S. Department of Agriculture (USDA) invasiveness rankings developed for selected species in Alaska (Carlson et al. 2008) will be used. The overall invasiveness scores for each species are based on sub-scores for ecological impact, biological characteristics (e.g., life history, potential for spread, allelopathy), distribution, and feasibility of control. The higher the overall score (ranging from 1–100), the greater the risk that a species will have negative ecological effects and the lower the likelihood it can be controlled effectively. The invasiveness scores for each invasive species found during the field surveys will be considered along with the number and size of the population(s) found, their proximity to proposed Project infrastructure and construction areas, and the species' dispersal mechanism(s) to rank the local ecological risk of spread and further infestation from development of the Project. The data gathered in this study (i.e., local ecological risk rankings for each species) will be used to develop PM&E measures, to be submitted in the license application, including introduction/prevention and management plans for minimizing the establishment and spread of invasive species in the Project area.

9.9.4.3. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of relevant records from the AKEPIC database and data collected during the 2013 and 2014 field seasons, including representative photographs of infested areas, will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Invasive species maps in ArcGIS and PDF formats.** The preliminary and final maps of the locations of invasive species populations will be developed and delivered according to the schedule indicated below. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The invasive plant study results will be presented in the Initial and Updated study reports according to the schedule indicated below. The reports will include descriptions of the invasive species populations found including estimated population sizes or degree of infestation, site characteristics, and the local ecological risk rankings for each species. The Initial Study Report will include any AEA recommendations for the 2014 field survey effort. Both reports also will include copies of field dataforms and field plot photographs.

9.9.5. Consistency with Generally Accepted Scientific Practice

The invasive plant study will be conducted following the protocols described for invasive plant surveys in Alaska in the AKEPIC User Manual (AKNHP 2008). These methods are the current standards for field surveys of invasive plants in Alaska. The AKEPIC database of invasive plant records, which is maintained by the AKNHP, will be used as the primary source of current records of invasive species in and near the Project area. The AKEPIC database was developed by the CNIPM, which is a working group of six state and federal agencies organized specifically to address the ecological threat of invasive plant species in Alaska.

9.9.6. Schedule

2013:

- Review of AKEPIC data and field survey site selection: April–May
- Field survey: June 25–July 4 (two-person crew); survey timing may need to be modified depending on plant phenological findings during the 2012 field surveys for other botanical studies in the Project area
- Data analysis: September–October

- Initial Study Report: December
- Delivery of preliminary field data and invasive species maps: December

2014:

- Review of 2013 data and field survey site selection: April–May
- Field survey: June 28–July 3 (two-person crew); survey timing may need to be modified as noted above
- Data analysis: September–October
- Updated Study Report: December
- Delivery of final field data and invasive species maps: December

9.9.7. Level of Effort and Cost

The invasive plant study is planned to be conducted over two years (2013–2014). Field sampling will be conducted each year during the growing season by a crew of two observers. The level of effort in 2013 is expected to be greater (10 days) than in 2014 (6 days). The goal in 2013 will be to survey the prominent disturbed habitats in and near the Project area, and work in 2014 likely will be focused on gravel material sites and other disturbed sites that may have been missed in the 2013 sampling. The invasive plant study will be coordinated with the other botanical studies being performed for the Project to help facilitate the field surveys for invasive plants and minimize costs. The field crews for the Vegetation and Wildlife Habitat Mapping, Riparian, and Wetland Mapping studies will document the locations of any invasive species encountered during their field surveys in 2012 and 2013, and this information will be used to help prioritize the field surveys for the invasive plant study. The projected cost for this study in 2013 is on the order of $100,000. For 2014, the approximate cost is $50,000.

9.9.8. Literature Cited

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9.9.9. Tables

Table 9.9-1. Invasive vascular plant species recorded on road-system surveys in and near the Susitna basin and in other plant surveys in the region of the proposed Project.

Scientific Name	Common Name	Invasiveness Rank[1]
Phalaris arundinacea	Reed canarygrass	83
Melilotus alba	White sweetclover	81
Cirsium arvense	Canada thistle	76
Prunus padus	European bird cherry	74
Sonchus arvensis	Perennial sowthistle	73
Vicia cracca	Bird vetch	73
Hordeum jubatum	Foxtail barley	63
Bromus inermis ssp. inermis	Smooth brome	62
Trifolium repens	White clover	59
Taraxacum officinale ssp. officinale	Common dandelion	58
Trifolium hybridum	Alsike clover	57
Crepis tectorum	Narrowleaf hawksbeard	54
Poa pratensis	Kentucky bluegrass	52
Poa annua	Annual bluegrass	46
Polygonum aviculare	Prostrate knotweed	45
Plantago major	Common plantain	44
Capsella bursa-pastoris	Shepherd's purse	40
Poa compressa	Flat-stem bluegrass	39
Chenopodium album	Lambsquarters	37
Cerastium glomeratum	Sticky chickweed	36
Matricaria discoidea	Pineapple weed	32
Brassica napus	Rapeseed mustard rutabaga	NR

Notes:

1 Assigned according to the Invasiveness Ranking System for Non-native Plants of Alaska (Carlson et al. 2008). Species are ranked on a scale of 0 to 100, with 100 being an extremely invasive species; NR = not ranked.

9.10. Attachments

ATTACHMENT 9-1. DOCUMENTATION OF CONSULTATION ON BOTANICAL RESOURCES STUDY PLANS

ATTACHMENT 9-1

DOCUMENTATION OF CONSULTATION ON BOTANICAL RESOURCES STUDY PLANS

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
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IN REPLY REFER TO:
AFWFO

February 10, 2012

Ms. Sara Fisher-Goad
Executive Director
Alaska Energy Authority
813 W Northern Lights Blvd
Anchorage, AK 99503

Re: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000

Dear Ms. Fisher-Goad:

The U.S. Fish and Wildlife Service (Service) is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. The Service provided some initial comments on the draft study plans during the work group meetings January 24-26, 2012, and had anticipated providing additional comments after receiving revised and more thorough descriptions of the proposed studies. Since that meeting, we have conducted an initial review of the Instream Flow, Aquatic Resource, Water Resource, and Eagle and Raptor Nest draft 2012 study plans provided at the January 24-26, 2012, meetings. Due to the short turnaround time requested for feedback (11 business days) on the study plans and their ongoing evolution, our comments should be consider cursory. The following represents our overall issues and concerns with the study plans and the enclosure provides a more detailed accounting of our comments and recommendations for each specific study plan.

Expanded Study Framework and Timeframe: The Service and other resource agencies have frequently expressed concerns about the limited temporal and spatial scale, and limited timeframe, for proposed studies in a dynamic basin such as the Susitna River. We have also raised concerns over the lack of proposed studies in the lower reaches (as defined by AEA) of the Susitna River for the proposed Susitna-Watana project. As part of the hierarchical framework, an ecologically meaningful space-timing scale should be identified related to project studies. As the spatial scale of studies increases, the time scale of important processes such as ice, sedimentation, and channel formation also increases, because they operate at slower rates,

time lags increase, and indirect effects become increasingly important. Studies related to these dynamic fish habitat forming processes need to be adequate (i.e., 5 years or more) to begin to understand mechanistic linkages (Wiens et al 1986; Wiens 2007). For this purpose, the Service recommends conducting fish habitat forming process studies on the minimum temporal scale of 5 years. This temporal scale equates to the typical life cycle of Chinook salmon, an Alaska Department of Fish and Game designated stock of concern.

To address these concerns, the Service expects that the 2012 studies and future project-related studies will be conducted on a hierarchical framework (Urban et al 1987; Frissell et al 1986) at a variety of scales including meso-habitat, reach, and basin wide. The Service also expects that the 2012 studies will not only help fill data gaps identified in the Preliminary Application Document (PAD), but will also be integrated between each other and with future project-related studies. This framework and integration is necessary to understand existing conditions and predicted changes to fish habitat in relation to changes in physical processes from proposed regulated flows. We recommend you establish a schedule for analysis of data obtained in 2012 and a framework for how to incorporate the 2012 data into 2013-2014 study plans. This is necessary for resource agencies to adequately assess potential project impacts to Alaska's fish and wildlife resources.

Winter Flow Regimes: At the January 24-26 work group meetings, and in the PAD, winter operations were described as load-following with flows ranging from 3,000 to 10,000 cfs in a 24-hour period. Regulated flows, including load-following operation, result in substantial changes to the natural hydrograph of a river. Dam construction and operation globally has resulted in adverse effects to anadromous and resident fish, macroinvertebrates, and their habitats. The Service is particularly concerned with the lack of study focus on Susitna River winter flows under natural and proposed flow operations. We recommend that winter base flows be assessed beginning in 2012 under the Instream Flow 2012 Study Planning, Water Resources Study Planning, and in the Aquatic Resources Study Planning. During colder winter months, glacial river base flows, such as those in the Susitna River, are derived entirely from groundwater inputs resulting in reduced habitat availability. We recommend assessing base flows as they relate to mainstem winter habitats (including adult spawning and juvenile fish overwintering locations, and the potential for stranding or increased mortality or condition related to changes in flow and water temperature), water quality conditions, ice-processes, and habitat and geomorphic processes in the Susitna River under current conditions and underthe proposed operation.

Temperature: In our December 30, 2011, letter we recommended thermal imagery (Torgerson et al. 1999) be conducted in 2012 throughout the Susitna River mainstem to identify important thermal habitats that may be utilized for spawning, refugia, or as overwintering areas. It is important to characterize the Susitna River water temperature profile as it relates to habitat because the proposed dam is expected to significantly alter the water temperatures downstream of the dam. Please review this letter as a reference for this study, as well as other Service recommendations.

Modeling Design: There is currently a lack of information in the draft study plans related to overall modeling approaches that will be used for the Susitna-Watana project. When identifying

instream flow model(s) the purpose and assumptions must be compared to Water Resources and Aquatic Resources study objectives. Model assumptions and model inputs need to be clearly stated and available for review. Spatial pattern should be one of the independent variables in the model analysis. At a minimum, we recommend using 2D hydrodynamic model(s) at a mesohabitat, reach, and basin wide scale (Crowder and Diplas 2000). We specifically recommend a 2D model be included to predict physical processes to spatially represent variation in input variables, and how those variables change temporally and spatially under differing flows. Selected model(s) should also include a sensitivity analysis (Turner et al. 2001). This information is critical to the general project understanding of existing ecological spatial patterns, and predicted spatial patterns under proposed regulated flows from the Susitna-Watana dam.

Mercury: Since the January meetings, it was brought to our attention that fish mercury concentrations frequently increase after impoundment of a reservoir, particularly boreal reservoirs. Soil flooding releases organic matter and nutrients, providing food to bacterial communities that methylate inorganic mercury. Methylation and bioaccumulation are the primary pathways for mercury accumulation in fish (Therriault, 1998). Although not identified in the 2012 draft studies, future studies should include pre- and post-impoundment mercury concentration studies.

Thank you for the opportunity to provide comments on the 2012 draft study plans for this proposed project. We look forward to continued coordination with AEA regarding resource appropriate studies. If you have any questions regarding these comments, please contact project biologist, Mike Buntjer at (907) 271-3053, or by email at michael_buntjer@fws.gov.

Sincerely,

Ann G. Rappoport
Field Supervisor

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Enclosure

The following comments and recommendations are based on our review of the 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project provided at the January 24-26, 2012, work group meetings.

Synthesis of Existing Fish Population Data (F-S1)

Recommend including information on seasonal distribution and abundance of anadromous and resident fish species among riverine habitat types and river reaches. As part of the spawning and incubation period for resident and anadromous species, studies need to include fry emergence periods and time (of day) information to determine potential impacts from fluctuating winter/spring flows. Potential issues include stranding of fish (by life stage and species) and downstream displacement relative to potential ramp rates. This study needs to integrate with instream flow and geomorphic studies to look at effects of daily flow fluctuations, particularly in winter, in the middle and lower river reaches.

For clarity, we recommend referring to river "reaches" as defined in the PAD rather than river "segments."

Fish persistence should be evaluated relative to spatial and temporal availability of fish habitat under existing and proposed flows. The Service recommends fish habitat studies be developed concurrent with the water resource studies to interface and characterize fish habitat as it relates to physical (hydrologic, sedimentation, and geomorphic) processes. Fish habitat metrics should be developed and integrated with modeling efforts related to physical processes and fish presence.

Chinook Salmon Presence above Devil's Canyon Study (F-S4)

Chinook salmon presence above Devil's Canyon study should include an upstream and downstream fish passage component. This 2012 study should include fish passage relative to all life stages of Chinook salmon. There is the potential to include Dolly Varden and Humpback whitefish pending results of an otolith/anadromy analysis by the Service for these species.

The Service supports the genetic component of the study (F-S4) which is necessary to determine whether the Chinook salmon meta-population in the vicinity of the proposed dam is a distinct population.

Wetland Mapping Study (B-S3)

The draft wetland study states that the methods used will be consistent with guidance in the Alaska Regional Supplement (USACE 2007), the U.S. Army Corps of Engineers (USACE) Manual (Environmental Laboratory 1987), and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Therefore, the Service recommends the use of the Cook Inlet Classification (CIC) developed by Mike Gracz. The CIC is an HGM-based wetland ecosystem classification scheme analogous to Cowardin. The Service supports the use of CIC for wetland mapping in the Cook Inlet Basin over Cowardin because CIC is regionally

specific and indicative of function (e.g., a spring fen always receives groundwater discharge; whether a palustrine emergent wetland does is unknown). CIC can be cross-walked with Cowardin if necessary. CIC methodologies and Mike Gracz' mapping protocols are described on www.cookinletwetlands.info.

In terms of compensatory mitigation related to a site that will be monitored over time using site-specific, precise functional attribution, the best functional assessment method available is the use of the HGM Regional Guidebooks. The citation for slope/flat wetlands is as follows:

- Hall, J.V., J. Powell, S. Carrick, T. Rockwell, G.G. Hollands, T. Walter and J. White. 2003. Wetland Functional Assessment Guidebook, Operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion, Alaska, using the HGM approach. State of Alaska, Department of Environmental Conservation, Juneau, Alaska.

Eagles and Raptor Nest Study (W-S3)

The Service's Migratory Bird branch is evaluating the potential for an eagle study that would compare productivity/behavior of golden eagles in disturbed areas (such as the Golden Valley Wind project, Usibelli Coal Mine, and the Susitna-Watana dam) versus undisturbed areas (Denali Park). We would like to explore the option of partnering with Watana projects to complete eagle nesting surveys. The Service could potentially provide experienced biologists to conduct the surveys. The benefits to this partnership include: 1) assistance to the project sponsors to conduct an eagle nesting survey; 2) provide cost savings to project sponsors by eliminating the need to hire a consultant to complete the survey; and 3) allow the Service to collect information valuable for our study. These surveys would not be considered compensatory mitigation, but would help meet eagle nest survey requirements. The Service generally recommends a pre-project survey with a follow-up survey just prior to construction.

Since 2009, compensatory mitigation is required for "take" or disturbance of active and inactive bald eagle nests. For golden eagles, there is a "no net loss" policy. Identifying ways to offset compensatory mitigation requirements early in the project development process can help the resource and the project sponsors. For example, a 2-year pre-construction eagle tracking study could help minimize required compensatory mitigation if the study demonstrated a "disturbance" rather than a "loss of territory."

Riparian (B-S2)

In addition to comments provided previously, we recommend riparian studies be integrated with other 2012 studies and with future project-related studies.

Beluga Prey Species Study (F-S6)

This study should identify components that specifically interface with the water resource and fish habitat studies. Anadromous prey species such as eulachon, Pacific and Arctic lamprey have been documented as present in the lower reach of the Susitna River and may be impacted by the proposed regulated flows. Relationships between natural flows and existing habitats should be

developed to best predict changes during proposed regulated flows that may impact beluga whale prey species.

Instream Flow Planning Study (F-S5)

1) Selection of a model or series of models of 1D or 2D nature will drive the type of data needs for the field studies. This discussion and selection must be made prior to finalizing habitat studies.
2) The habitat suitability curve development is a useful product. Conduct the studies in such a manner as to ensure the development uses actual suitability data and is not dominated by best professional consensus.
3) Need a better understanding of how the instream flow study relates to the routing model or uses its own calibrated flow model. Concern is that the overall routing model may have significant variation in water level between cross-sections depending on their placement in relation to the habitat cross-sections. Location in pools or riffles and within these features or braided section will vary the water level of a certain flow and may not correctly interpret the water level of a habitat cross-section.
4) Anticipate that the habitat study will have its own cross-sections and flow analysis separate from the routing model. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new spots as needed for 2013 and 2014.
5) Desire to have a large map with the routing and habitat cross-sections on it over recent aerial imagery.
6) In review of 1980s studies, were there any groundwater/surface water exchange studies?
7) Need to confirm whether the 1980s studies included mapping of groundwater upwelling areas along the river for gaining and losing reaches. We recommend at least a large-scale thermal temperature study along the river to note locations and relate it to the habitat study areas and cross-section surveys.

Reservoir and Flow Routing Model Transect Data Collection (WR-S1)

1) We recommend that the cross-section re-surveys in 2012 go beyond the forest limit but stay within the floodprone area, as there may be key floodplain elements not captured in the LIDAR data.
2) Need to evaluate appropriate model to consider ice effects as ice is a significant factor, not only for habitat but also for recreational use. We highly recommend utilizing one model that is fully dynamic and can deal with both floods and ice dynamics during winter low flows for routing. A model was recommended in the January work group discussion, created in Canada that may be appropriate. Model selection will drive data needs so this needs to be selected soon and with a full idea of the types of available models out there to select the best one.
3) Given the discussion of ice dynamics, cross-sections are likely needed in the lower reach to adequately assess ice dynamics as ice forms and slowly freezes upstream. We recommend that these cross-sections be identified and obtained in 2012 to maximize utilization of the model and potentially correlated to lower river habitat studies to reduce redundancy of effort.

4) Instream flow and habitat study cross-sections are assumed to be different than the routing cross-sections. We recommend creating a map for distribution that overlays the original routing and habitat cross-sections to begin to understand their spatial location and orientation and begin discussing 2012 study locations. Realize that some selected locations may not be adequate once fieldwork is performed so flexibility is needed to select new sampling locations as needed for 2013 and 2014.
5) Flows need to be measured to calibrate routing as much as possible. We recommend that water surface and flow be captured at key cross-sections while in the field to calibrate the routing model results and to verify Manning's n assumptions.

Determine Bedload and Suspended Sediment Load by Size Fraction at Tsusena Creek, Gold Creek, and Sunshine Gage Stations (G-S1)

1) For locations obtaining bedload data need to also do a bed pebble count to compare to transported load to calibrate for shear stress and other calculations.
2) Recommend that gravel bar sampling be part of the study to compare to transport load data obtained. This methodology must be well documented.
3) Evaluate the Chulitna and Talkeetna as well as other key tributary deltas for sediment distribution and load into the system.
4) Recommend attempting to get high flow values near bankfull stage at both Gold Creek and Watana sites to add to data.
5) Recommend sediment sampling at the Susitna-Watana dam site to demonstrate correlation to Gold Creek and/or model changes in sediment loading between the sites.
6) Evaluate 3-inch versus 6-inch bedload sampler use for 2012 field season to try to capture large fractions of bedload movement as able.

Geomorphic Assessment of Middle River Reach using Aerial Photography (G-S2)

1) Include a listing and evaluation of flood and ice conditions during and between aerial photography events, especially during breakup periods to help correlate differences to significant events in the watershed.
2) Does not address winter flows and habitat use under winter conditions; needs to come up with a plan to address this beginning winter 2012/13.
3) For geomorphic analysis and comparison to habitat studies, cross-section locations for substrate classification, large woody debris counts in floodprone width, and categorization of fluvial process (Montgomery and Buffington, Rosgen) should be determined and fieldwork performed. If location agrees with an old cross-section, it will help verify any changes over time and with flow to help determine stability and shear stress equations.

Geomorphic Assessment of Project Effects on Lower River Channel (G-S4)

1) There is a need to evaluate the hydrology and habitat use of the lower river to evaluate change over time from dam operations:
    a. Winter operations are a major concern given the need to evaluate daily flow fluctuations of 3,000-10,000 cfs in the winter. This effect must be modeled into

the lower reach to see if the magnitude of fluctuating flows in the winter extends further downstream than spring and summer flow periods. Additionally, ice and open water effects will be extended into the downstream area so modeling will need to address this by extending it downstream.

b. In the January work group meetings it was pointed out that ice is generated upstream and flows down the river to the lower reaches, beginning to form in the lower reach and slowly ice up the river upstream. This also needs modeling from a thermal standpoint, hence again, the need for cross-sections in the lower reaches.
c. Recommend that the gage at Su Station be turned on by the U.S. Geological Survey (USGS) and maintained by USGS to help calibrate lower reach modeling efforts over the next 5 years, especially for ice effects and dynamics modeling.
d. Cross-sections need to be made in the lower reach to add to an ice dynamics model as well as habitat studies – recommend selecting locations and getting these cross-sections in 2012 to facilitate modeling efforts.

2) Re-do all cross-sections at existing and past gage sites in the middle and lower reaches (including Su Station) to evaluate hydraulics, assess stability by comparing to old cross-section data and give an initial assessment of stability or changes in rating curve information. Also, it would be beneficial to do an initial evaluation of these gage sites at winter flows and with ice dynamics to begin to understand the impact winter flows will have. This will help with evaluating changes over the last 30 years in the lower reaches to determine whether additional work in 2013-2014 is needed.

Documentation of Sustina River Ice Breakup and Formation (G-S3)

1) Key elements to identify are: where ice generation occurs (production zones) and where ice lodges and begins the process of ice formation in the river.
2) Recommend that flights include an ice scientist, fishery biologist, riparian specialist and fluvial geomorphologist so that multiple observations can be made at the same time and can be stitched together to understand the processes taking place.
3) Recommend video be taken during all river flights for later reference.
4) Documentation of frazil ice generation is very important – current thought is that 80% is generated upstream of Devil's Canyon in the middle reach.
5) Daily flights might be needed during the height of breakup or freeze-up.
6) Is CRREL involved with the ice research?
7) Highly recommend utilizing our Canadian neighbors and their research and models for ice issues.

Review of Existing Water Temperature Data and Models (WQ-S1)

1) Identify appropriate temperature models to use based on new technology and understanding.
2) Evaluate MET station locations and strongly consider an additional station around the Deshka or Yentna which could help with ice studies.

3) Discuss MET station locations with NOAA Weather Forecast Center to access experts as well as potentially help with storing data.
4) Perform large-scale thermal study of the river for groundwater exchange areas over different flows.
5) At old, existing, and new gage sites, include continuous temperature monitoring; consider a water quality study at gage sites for 2012, 2013, and 2014 seasons with parameters agreed to by all parties and performed by USGS.
6) Evaluate past assumptions for temperature modeling (at least our understanding of it), i.e., summer analysis of surface water temperatures only, as this dominates habitat use, versus winter analysis of intergravel temperature only. Provide quantification of the hypothesis and assumptions made and determine if they are still relevant.
7) 2012 fieldwork in the work group meeting was discussed to primarily show how mainstem temperatures influence side channel habitat. This should be expanded to do a thermal analysis up and down the river (#4).
8) Discussed in the work group meetings that 2013-2014 work will deal with upwelling water temperatures. A thermal analysis in 2012 can help determine these sites.
9) Fieldwork needs to be performed that can help calibrate heat transfer coefficients and other assumptions in selected temperature models between mainstem and other waters.
10) Analysis of temperature effects on ice formation was not discussed and needs to be part of the scope in coordination with ice and habitat studies.
11) Ensure that solar radiation information will be collected at all MET sites as it is crucial to modeling efforts (ice, etc.) and evaluate other metrics that are needed for calibrating models.

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Wetlands Delineation and Mapping
2012/2013-2014 Study Plan Development
April 18, 2012 9:00 am
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
EPA	Matt LaCroix (on phone)
USACE	Mary Leykom (on phone)
USFWS	Mike Buntjer (on phone)
USFWS	Bob Henzley (on phone)
AEA	Betsy McGregor
ABR, Inc	Terry Schick
ABR, Inc.	Janet Kidd
ABR, Inc.	Wendy Davis
Solstice Alaska Consulting, Inc.	Robin Reich

Terry Schick (ABR) opened meeting and said that the primary goal of the meeting was to come to a consensus on a wetland classification system and wetland functional assessment methods for the Susitna-Watana Hydroelectric Project. Terry said that the interim goal was to determine what additional data to collect in the field in 2012 to support the wetland classification and functional assessment approaches selected. Terry said that the mapping effort would run through 2014. Terry said that the team needs to consider what the agencies' goals are for using the wetlands mapping and functional assessment information for this particular project. He said that if we know those goals, we can choose an appropriate set of methods to use.

Janet Kidd (ABR) presented *Susitna-Watana Hydroelectric Project—Wetland Classification and Functional Assessment Methodology*, a PowerPoint presentation attached to these notes.

Questions/Discussion

Janet said that the wetlands mapping work would focus on transmission corridors, potential reservoir, and access road locations. Janet said that they would use existing broad-scale NWI mapping to get an overview of the area. Janet said that there would be a 2-mile mapping buffer around project corridors and that LIDAR imagery would be used as the map base.

Mike Buntjer (USFWS) asked how the 2-mile buffer was selected. Janet said that for the immediate area of the project's footprint, the wetlands mapping would be conducted at a fine scale. Janet said that ABR wanted to establish a larger buffer in which wetlands would be mapped at a broader scale, so that the wetlands to be affected by the project could be compared to those in the surrounding area, this to provide a landscape context for the wetland ecosystems in the area. Janet said that it may be decided that we can reduce that mapping buffer size some if the agencies agree. Terry said that the study area boundary is a separate topic, isn't final, and would be defined during the FERC study plan development process.

Janet said that for the Susitna Basin there are not many wetland classification system methods to choose from. Janet said that the methods are the Cowardin classification (NWI) and the Cook Inlet Classification. Mike Gracz developed the Cook Inlet Classification, which is specific to the lowland areas in that region.

Bob Henzley (USFWS) asked whether Viereck's Alaska Vegetation Classification would be used. Janet said that Viereck is a vegetation classification system, not a wetland classification method, but that ABR would map vegetation using the Alaska Vegetation Classification as one of the steps in mapping wetlands.

Mike Buntjer said that Mike Gracz was asked about applicability of the Cook Inlet Classification in the project area. Mike Buntjer said that Mike Gracz said that if the method were to be used, it would have to be expanded because wetland types in the upper Sustina Basin have not been analyzed. Janet said that ABR would contact Mike Gracz. Robin Reich (Solstice) said that she thought that Mike Gracz was going to map wetlands north on the Parks Highway this summer in areas where you would expect to see future development. Janet said that the wetlands team would need to use a different approach, but could use some aspects of Gracz's work.

Janet said that the wetland team's goal is to characterize the wetlands in the project area as an integrated ecosystem, not as many separate polygons. Janet said that with the Cowardin system it is difficult to distinguish some wetland types.

Janet said that ABR's proposed approach includes using HGM methods (because they are used for many projects), Viereck level IV, and NWI because this would allow flexibility of defining wetland classes or wetland ecotypes. Janet said that in using this method, the team could assign wetland functional groups to the maps. She said that the team would get basic information from previous maps (e.g., NWI), and then add Viereck Level IV and HGM classes. She said that this method is more suitable to a variety of groups and useful for a wetlands functional assessment.

Matt LaCroix (EPA) asked whether Janet could describe in more detail the wetland functional groups that would be used. Janet Kidd said that the team could use life form (vegetation structure), scrub classes, hydrology, and HGM. Wendy Davis (ABR) said that instead of attributing each map polygon with several different wetland functions, groups of wetland classes that share the same wetland functions, based on the field data, could be grouped together in order to more quickly derive an interim functional assessment.

Matt said that he would like to point the team towards the Cook Inlet Classification, which does start with ecosystem types. Wendy Davis (ABR) said that they would be trying to emulate Mike Gracz's goal with his characterization. Wendy said that they were trying to pull this together with the riparian and habitat mapping studies. Janet confirmed that the ecosystem groups can be viewed as habitat types. Janet said that protocols that ABR developed for Ecological Land Classification are similar to the techniques proposed to be used for this project. Janet said that the wetland team's goals and desired outcomes are the same as the Cook Inlet Classification method..

Janet said that one of the issues with following the wetlands functional assessment methodology used in the Cook Inlet Classification for the Watana project is that the Cook Inlet Classification is designed for a different regional area (Cook Inlet lowlands) with different conditions. Janet said that ABR would need to come up with a new method by extracting from the Cook Inlet Classification methodology.

Mary Leykom (USACE) said that the USACE would be satisfied with the classification developed by Mike Gracz because the Corps has funded much of his work. Mary said that the team should examine areas for potential wetland impacts mitigation. Mary said that she didn't know the location of these areas. Mary said that the wetlands team needs to consider and examine areas where access to maintenance activities would occur.

Janet asked whether Mary was referring to areas (to consider for mitigation) that are disturbed or areas of importance for protection. Mary said that there might be areas not directly impacted by the project but vulnerable to development that the USACE could evaluate for mitigation. Matt said that Great Land Trust should be consulted because they may have looked at potential lands in the project area.

Mary asked for the deadline for comments on project documents. Betsy McGregor (AEA) said that the deadline was May 31, 2012 and that agencies should focus on the study plans and study requests instead of comments on the PAD. Betsy said that she would send Mary the wetlands mapping study presentation.

Bob said that he had looked at the MSB's Wetland Functional Analysis. Bob said that he was impressed by the ability to use GIS to give consistency for the evaluation, but that he didn't see the data basis. Robin said that that Gracz's Cook Inlet model was the basis for the analysis.

Matt said that the Watana project would need to use a new wetland classification for this new region (upper Susitna Basin). Matt said that the team would need to start out with landscape position in the office, gather field data that has functional characterizations, and from the data get an idea of wetland functions. Matt said that the GIS exercise is simply an attribution of the work done. Matt said that the project could have data that are collected outside of the wetlands work that could help with the functional assessment. He said that the functional attribution is a value-added product on top of the classification at a landscape level and is not as data intensive as it appears.

Janet said that the team needs to make sure that gathering field data doesn't take too long. Janet said that determining how to make inferences of sites that aren't visited could be tricky. Janet said that they usually visit representative wetland types, then use aerial photointerpretation to classify wetland types and determine wetland functions at sites that are not visited.

Matt said that Gracz collected field data at about 15 to 20 percent of the wetlands in the MSB's project area.

Matt said that coring the wetlands has been important procedure in the Cook Inlet model because the depth of the wetlands helps to determine many functional aspects of the wetlands including water storage. Matt said that coring is a key piece of info that is not typically collected during wetland delineation or functional assessment work in field. Matt said that the Cook lnlet Classification has been in place for many years.

Bob said that he didn't see any wetland functions concerning wildlife or wildlife habitat as well as abundance or rarity of a particular wetland type. Matt said that the Cook Inlet Classification method and the South Coastal Riverine Guidebook focus on vegetation structure (as a component of wildlife habitat). Matt said that there is an issue with the HGM Regional Guidebook because it is based on a gradient of disturbance, which doesn't make sense for many remote and undeveloped areas in Alaska. Matt said that in the Cook Inlet Classification, there is a focus on known habitat characteristics (e.g., for the three Cs: caribou, cranes, and coho [salmon]). Matt said that this methodology could be used for the Watana project, but it would need other attributions if we know the habitat requirements for various wildlife species. Matt said that right now, there isn't good enough information for wildlife to determine areas of importance. Janet said that ABR will be doing a wildlife habitat evaluation and information on wetland wildlife habitat characteristics could be obtained.

Matt said that the key to the habitat evaluation in the functional assessment is making linkages between wetland characteristics and habitat requirements of certain species. Matt said that ADF&G could provide limited data on the most important wetland characteristics. Matt said that ABR's work on Chuitna could be a model for this work. Terry said that there will be attributed habitat needs for wildlife in the project area and that it is possible to do similar a thing using wetland types. Matt said that this is the best model to figure out wildlife use of habitats.

Janet asked whether she could get information on projects that have received a permit using the Cook Inlet method because she was trying to understand how the method was used for determining compensatory mitigation for a project. Matt said that they have used the Cook Inlet wetland maps for defining wildlife habitat, but that he didn't know whether it had been used for permitting. Matt said to contact Dave Casey at the USACE Kenai Field Office. Matt said that the USACE was initiating a project to assign debits to relative ecological values 'and that there is data available that can be used to make decisions regarding compensatory mitigation.

Matt said that from what he has seen around the state, functional assessment methods are based on best professional judgment with limited field data. Matt said that he is requesting that the project decide on protocols in advance. Matt said that the standard now for determining wetland mitigation compensation is arm waving because there isn't site specific or landscape level data. Matt said that translating data to a compensatory ratio comes down to subjective decision. He wants to determine whether processes are important to certain wetlands based on as much data as possible.

Matt said that he did not think that a system like Anchorage's debit/credit methodology was needed. Matt discussed the Anchorage wetland debit/credit system. Matt said that the Mat-Su methodology determines wetland functions and values, but doesn't rank the function as high, moderate, or low. Matt said that the importance of each function is left to the person doing the analysis. Bob asked how the project would get from the compensatory mitigation ratio from the data. Janet said that the Anchorage methodology is useful in the Anchorage Bowl, but it would be difficult to use for the Susitna-Watana study area. Matt said that the key is to collect the information so that decisions can be made. Matt said that it could be basic information whether just a mapping layer or functional attributes. Matt said that agencies can come up with some list of functions and then assign a mitigation ratio based on data.

Janet said that they have considered functions based on certain development threats like the Anchorage debit/credit system; however, this might not make sense if the area isn't threatened with development impacts or if the functions would not be degraded by the impacts of the project.

Matt said that the team should look at the Cook Inlet mapping protocols because the field data collected is comparable to other methods. Matt said that the methodology requires coring and taking water YSI chemistry, but it doesn't require spending half of a day at each site. Matt said that the functional work wasn't the focus when the mapping protocols were developed and that opportunity or threat wasn't discussed. Matt said that the Anchorage method is focused on opportunities. . Matt said prefers a data driven protocol focusing on actual wetland functional values regardless of the potential specific threats to individual wetlands.

Matt said that the project has the potential for downstream effects. Matt said that the alteration of the hydrograph would affect downstream wetlands. Betsy said that riparian modeling will consider wetlands. Betsy said that the Corps has told AEA that downstream effects won't be within the Corps' permitting scope. Matt said that the EPA disagrees and that the 404 (b)(1) (of the Clean Water Act) guidelines need to be considered. Matt said that he understood that there would be riparian work, but that the same wetland mapping and functional assessment methodology should be used downstream. Janet said that they would be working with the riparian team on consistent methodology. Terry said that there would be an assessment and prediction of riparian vegetation change based on a change of flow and that downstream effects would be studied in detail. Betsy said that the modeling would be interactive and that changes to magnitude and duration of flow will be put back into the model. Betsy said that AEA is trying to reduce the potential impacts of the project through consideration of modeling.

Bob asked whether all riparian habitats would be considered wetlands. Terry said that wetlands would be a subset of the riverine system. Terry said that the combined ABR and R2 riparian team would use an integrated mapping system. Terry said that general wetland types (as classified using the ITU method proposed for the riparian study) and upland types of riparian vegetation would be mapped. Wendy said that the work would result in one product and that it would be part of one GIS system.

Bob asked how hard it would be to modify the method to meet the needs of the project area if the USACE strongly prefers the Cook Inlet method. Janet said that her main concern was that the landscape processes are very different and that many of them don't apply to the project area. Janet said that there are fundamental difference in geomorphology, climate, and precipitation between the Susitna basin and the Cook Inlet basin. Bob asked whether they would be able to develop a crosswalk between the two areas. Janet said that because they have not done fieldwork in the area, it is difficult to determine. Janet said that she could put together a matrix table showing where there are holes between the Cook Inlet method and the Watana project area wetlands.

Betsy said that it didn't make sense to try and apply a protocol that is specific to a different region. Wendy said that they could try and use Gracz's field methodology on the different wetland types. Janet said that the method would have to change a bit. Wendy asked whether there was a document that describes the Cook Inlet field methods. Bob said that he would check to see whether Betsy McCracken (USFWS) might know.

Terry asked whether Matt strongly supported using the Cook Inlet method for the Watana project because it would likely involve creating new wetland types nomenclature. Terry said that there might need to be some collaboration with Mike Gracz, which could change the scope of work significantly. Matt said that from the EPA's perspective, the Cook Inlet classification is good and he encourages its use. Matt said there could be development of different ecosystem types for the project area. Matt said that the field protocol is not documented and that the team should contact Mike Gracz to obtain the field protocols.

Matt said that the EPA wants regionally specific mapping that can have attributed functions.

Bob said that he was a little hesitant about using one method to come up with another region's method. Terry said that the Alaska Range is a transitional region. Bob said that there would be different kinds of wetlands because of higher elevation sites with landcover more typical of Interior Alaska.
Janet confirmed that there was no Interior Alaska classification system that could be used. Bob said that wetland functional assessment methods weren't that important until the Corps' Mitigation Rule came out.

Bob said that the EPA is concerned with the downstream indirect effects and asked whether the mapping existed already in the lower watershed. Terry said that there are no jurisdictionally mapped wetlands in the area. Terry said that there will be significant amount of study downstream. Betsy said that the riparian work would be done below three rivers and that AEA never intended for studies to end at middle river.

Terry said that the study area has not been defined. Terry said that they have proposed study areas for the study plans, but that the parties need to come to a consensus. Terry said that Willow is the proposed downstream study area limit for the riparian vegetation study, but this isn't set in stone. Bob said that the farther you move downstream, the harder it is to see project impacts. Betsy said the project is installing pressure transducers out to figure out flow and ice processes are being studied.

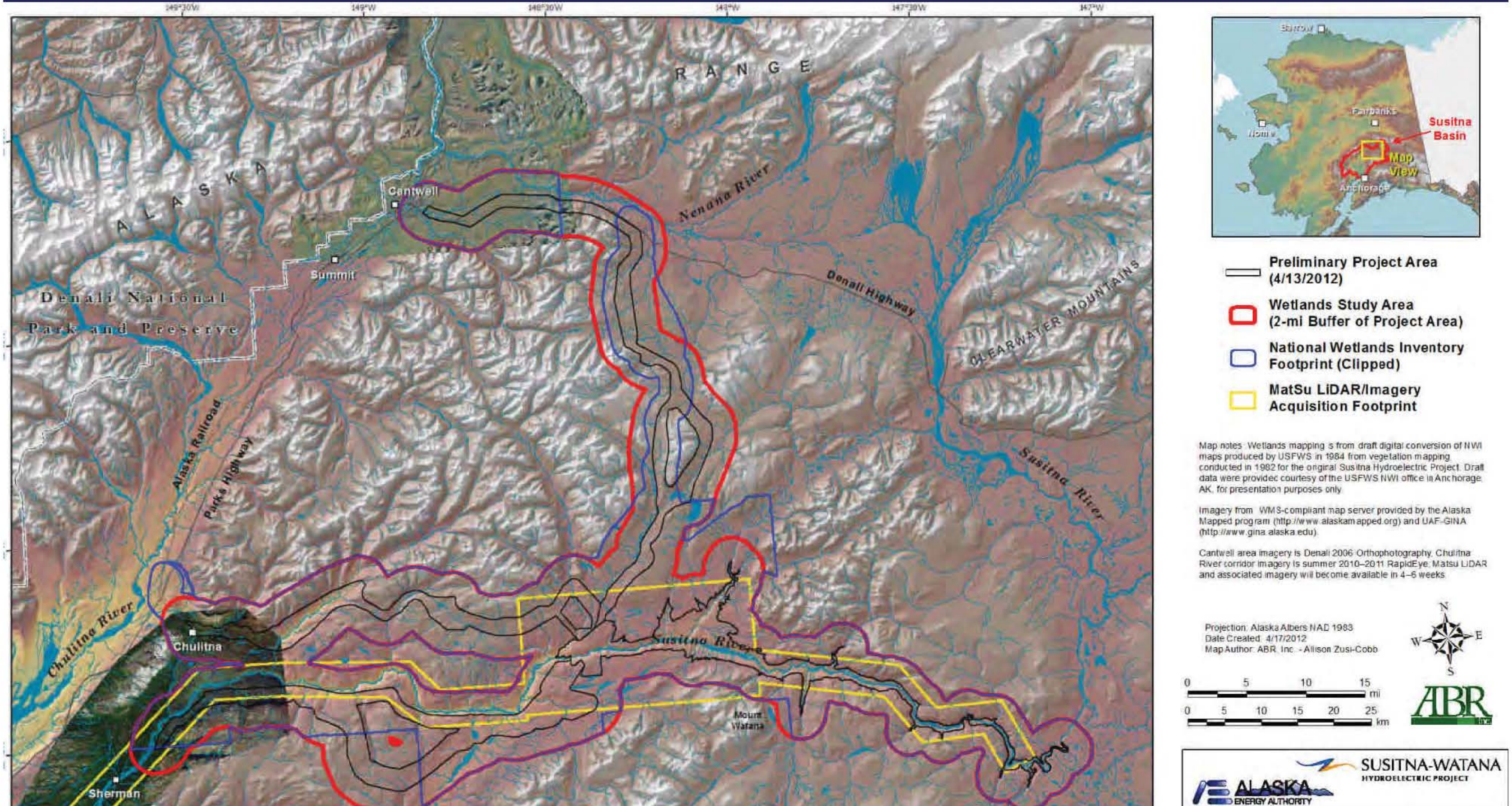
Susitna–Watana Hydroelectric Project—Wetland Classification and Functional Assessment Methodology

ABR inc. environmental research & services

SUSITNA-WATANA HYDROELECTRIC PROJECT

Wetlands Mapping Goals

- Classify and map wetland types to determine current baseline conditions in the project area
- Determine functional value of each mapped functional wetland type
- Quantify the potential direct and indirect impacts to wetlands and wetland function from Project construction
- Provide data that satisfies Section 404 wetland permitting requirements
- Facilitate the development of protection, mitigation, and enhancement (PME) measures to minimize project impacts to wetlands and wetland function



Wetlands Mapping Study Area and Available and Pending Imagery in the Susitna-Watana Project Area

Figure 1

Wetland Classification Protocol Comparisons

Cook Inlet Classification

Hierarchical, ecosystem-based system combining vegetation and hydrogeomorphic properties (geomorphic setting, water source, and hydrologic flow)

Intended as a regional wetland management tool for the Kenai and Mat-Su boroughs

Cowardin Classification (NWI notation)

Hierarchical system that includes landscape setting, vegetation structure, and limited hydrologic characteristics, with the option of providing modifiers to further distinguish wetland classes

Intended as a standardized nationwide wetland classification system for general comparisons

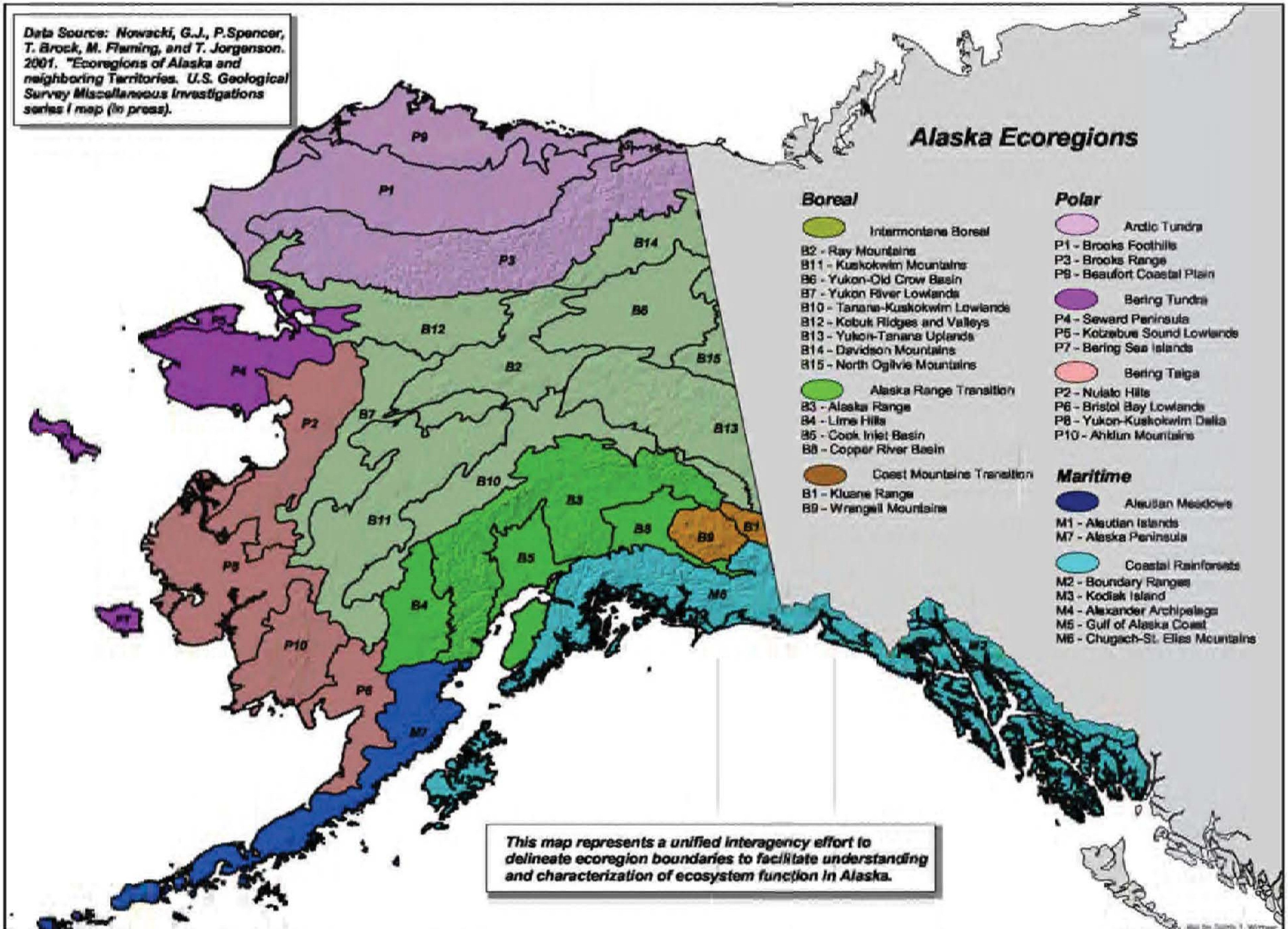
Cook Inlet Classification System

Advantages

- An ecosystem-based model for classifying wetlands that reflects wetland landscape position and water controls
- Allows for more site-specific analysis of wetland form and function than Cowardin system, and for developing plant species-habitat associations.

Disadvantage

- The Cook Inlet classification method is confined to wetlands occurring in the Cook Inlet Basin ecoregion. The Susitna-Watana project area falls within the Alaska Range and Tanana-Kuskokwim Lowlands ecoregions. Origins of the surficial deposits within these three ecoregions vary greatly.



Data Source: Nowacki, G.J., P.Spencer, T. Brock, M. Fleming, and T. Jorgenson. 2001. "Ecoregions of Alaska and neighboring Territories. U.S. Geological Survey Miscellaneous Investigations series I map (in press).
Alaska Ecoregions
Boreal
Intermontane Boreal
B2 - Ray Mountains
B11 - Kuskokwim Mountains
B6 - Yukon-Old Crow Basin
B7 - Yukon River Lowlands
B10 - Tanana-Kuskokwim Lowlands
B12 - Kobuk Ridges and Valleys
B13 - Yukon-Tanana Uplands
B14 - Davidson Mountains
B15 - North Ogilvie Mountains
Alaska Range Transition
B3 - Alaska Range
B4 - Lime Hills
B5 - Cook Inlet Basin
B8 - Copper River Basin
Coast Mountains Transition
B1 - Kluane Range
B9 - Wrangell Mountains
Polar
Arctic Tundra
P1 - Brooks Foothills
P3 - Brooks Range
P9 - Beaufort Coastal Plain
Bering Tundra
P4 - Seward Peninsula
P5 - Kotzebue Sound Lowlands
P7 - Bering Sea Islands
Bering Taiga
P2 - Nulato Hills
P6 - Bristol Bay Lowlands
P8 - Yukon-Kuskokwim Delta
P10 - Ahklun Mountains
Maritime
Aleutian Meadows
M1 - Aleutian Islands
M7 - Alaska Peninsula
Coastal Rainforests
M2 - Boundary Ranges
M3 - Kodiak Island
M4 - Alexander Archipelago
M5 - Gulf of Alaska Coast
M6 - Chugach-St. Elias Mountains
P9
P1
P3
B14
B12
B6
B15
B2
P4
P2
B7
B13
B10
B3
B11
B8
B9
B1
P8
B5
B4
P7
P10
P6
M7
This map represents a unified interagency effort to delineate ecoregion boundaries to facilitate understanding and characterization of ecosystem function in Alaska.

Cowardin Classification System

Advantages

- System that is commonly used and understood by resource agencies
- Provides quick synopsis of landscape setting, vegetation structure, and hydrology for wetland type
- Can limit the number of classes generated by combining wetland classes into Cowardin functional groups.

Disadvantages

- Classification is so general that one class can include several wetland habitats with contrasting plant community composition and soil characteristics
- Does not include regional influences on wetland function

Proposed Approach to Susitna – Watana Wetland Classification

NWI (Cowardin) →

HGM → Functional Wetland Class

Viereck Level IV →

Susitna-Watana Wetland Classification

- Incorporates regional wetland characteristics unique to the Susitna watershed
- Includes wetlands naming conventions that are familiar to resource agencies
- Provides link to habitat classification
- Allows for more meaningful wetland functional assessment

Wetland Functional Assessment as Part of the Section 404 Process

- Identify development alternatives that result in the lowest impacts to wetlands in terms of functional value
- Determine the magnitude of the effects of potential impacts
- Develop mitigation plans to compensate for losses in wetland function

Wetland Functional Assessment Methodology Requirements (from Smith et al. 1995)

- Standardized methods
- Applicable across study area
- Inclusive of all wetland types and functions
- Compatible with time and resources available
- Sensitive to potential impacts
- Addresses agency and other stakeholder concerns
- Capable of incorporating new data or changing project requirements

Functional Assessment Methodologies

- **Corps Regulatory Guidance Letter (2009)**—relatively rapid assessment method that allows for flexibility in classification method and relative rankings useful for determining the wetland category but is fairly subjective;
- **HGM methodology**—semi-quantitative with detailed field assessment protocols designed to increase repeatability, but
  - ❖ typically region specific or limited to a subset of HGM wetlands classes (e.g., slope and organic flats)
  - ❖ Impractical for a project of this size and would require developing impact analysis models to assess changes in function for reference wetlands (the Susitna-Watana study area comprises predominantly undisturbed, reference wetlands).

Functional Assessment Methodologies – Continued

Mat-Sue Wetland Functions and Values—GIS based methodology recently developed for the Mat-Su Borough

- designed to be repeatable and would be suitable for this project, where limited wetlands field data exists currently.
- Allows for better integration with other GIS layers (e.g., DEM, wetland and wildlife habitat classes, hydrography, project footprints)
- Main concern is need to consolidate function maps into layers that can be used to develop categories of wetland value for mitigation planning
- Need to develop limited set of functions that reflect Susitna-Watana landscape and stakeholder interests

Wetland Functions

2009 Alaska Regulatory Guidance

- Flood flow alteration
- Sediment removal
- Nutrient and toxicant removal
- Erosion control and shoreline stabilization
- Production of organic matter and its export
- General habitat suitability
- General fish habitat
- Native plant richness
- Educational or scientific value
- Uniqueness and heritage

HGM (Slope/Flat Wetlands)

Cook Inlet Basin

- Discharge of water to downgradient systems
- Surface and shallow subsurface water storage
- Particulate retention
- Organic carbon export
- Cycling of elements and compounds
- Maintenance of characteristic plant communities
- Maintenance of characteristic habitat structures
- Interspersion and connectivity

Interior Alaska

- Soil Profile Integrity
- Characteristic Soil Thermal Regime
- Surface and Near Surface Water Storage
- Cycling of elements and compounds
- Organic carbon export
- Plant Community
- Faunal Habitat Components
- Interspersion and connectivity

Mat-Su Wetlands Functions and Values

- Contribution to groundwater
- Transmission of groundwater
- Streamflow moderation
- Floodflow alteration
- Sediment/Toxicant/Pathogen retention
- Sediment shoreline stabilization
- Nutrient removal/Retention/Transformation
- Foodchain support
- Anadromous fish habitat
- Habitat and maintenance of biodiversity
- Habitat for species of interest
- Recreation
- Consumptive uses
- Education
- Visual quality/Aesthetics
- Cultural and historical significance
- Uniqueness

SUSITNA–WATANA HYDROELECTRIC PROJECT

COMMUNICATION RECORD

Meeting or Phone call (underline)

Date / Time: 4/19/2012, 2:00pm

Participants: Wendy Davis ABR, Inc. (907)344-6777 X 203
Mike Gracz, Kenai Watershed Forum (907) 235-2218

Subject(s): Use of the Cook Inlet Wetland Classification for mapping the Susitna-Watana study area.

Conclusions: We discussed the general applicability of the existing Cook Inlet protocol for the entire Susitna-Watana study area. Mike thought that much of the surficial geology of the study area was composed of quaternary deposits in lowland settings and had a high probability of containing peatlands and other lowland wetland types featured in the existing classification. However he expressed reservations about its applicability to areas of discontinuous permafrost in particular. I asked him if he thought that the classification could be expanded to include all areas in question but because of the general lack of data for the area he couldn't really confirm one way or another if his methods could be expanded to work in areas where the wetland genetic processes are different from the Cook Inlet. He reserved comment until he could see the area. I also asked if he had any documentation on his methodology beyond what is available on Cookinletwetland.info. As of yet there is no fully compiled methodology for the comprehensive field methods and classification scheme. We discussed the possibility of him participating in our next wetland meeting with agency participation. Mike was willing to participate in one meeting. I also clarified that we have no set mechanism in place to compensate him at this point and we would have to pursue that if further collaboration with Mike was requested.

Action Items: Contact Mike for participation at the next Susitna-Watana agency meeting, not currently scheduled but tentatively planned before the 1st week of May.

Prepared by: Wendy Davis

Wendy Davis <wdavis@abrinc.com>

USACE meeting next week

Michael Gracz <mike@kenaiwatershed.org> Fri, Apr 27, 2012 at 1:20 PM
To: Wendy Davis <wdavis@abrinc.com>

Hi Wendy,
OK I should be around on Wednesday, and near a reasonably fast connection to the internet

Let me know the urls of the broken links and I'll fix them, although there are now more "Ecosystems" than in the original key (i'm starting to refer to them as "Geomorphic Components"), and I haven't updated the key yet. When I get closer to finishing the mapping I plan on re-writing all of what is written on those pages. This project started as a Kenai Peninsula project, and I did not anticipate that it would carry further. The plant community classification was never a big priority, it just a way to organize the data from the start, during the pilot years of the project, before the wetland classification had been invented.

The respective keys are near the bottoms of these pages:
Geomorphic components: http://www.kenaiwetlands.net/EcosystemDescriptions/Intro.htm
Plant communities: http://www.kenaiwetlands.net/plant_community_classification_i.htm

The text is pretty outdated on these pages, so please read with generosity! But the keys should work, at least for what I mapped on the Kenai.

The mapping sheet: "Wetlands and Climate" on this page is a more recent effort: http://www.cookinletwetlands.info/Downloads/Downloads.htm

I think that the primary objective should be to have a wetland classification and mapping that could be relatively seamless with what is being/already mapped, because anything that you do may someday become contiguous with what I've been working on. I have been mapping the MatSu at 1:18,000.

I use the data sheets from the 2007 Alaska Regional Supplement to the delineation manual. I don't fill that data form out exactly, but lots of it. For example, I never calculate Plant Prevalence Index in the field, I do that in MSAccess. I use the soil profile section on that data sheet to describe the peat profile generally: the thicknesses of organic layers when they change among the basic classes that NRCS uses (Fibric/Hemic/Sapric), and then the presence and thickness of observable tephra layers, and the texture of the underlying mineral soil. Most sites are peat, but I'll describe the soil profile when it's mineral.

I do record some mapping info on a separate sheet, which changes year-to-year (most current version attached). For example, some years I have collected lots of water samples. Other years I have done a more rigorous mapping accuracy assessment. Other years have focused on rapid mapping. Lately I have settled on collecting at least a photo, plant cover, pH, specific conductance (the latter two with a YSI 63 meter calibrated each sample), along with the correct mapping unit name, and notes. Additionally, I almost always describe the peat profile and underlying mineral substrate (unless the latter is more than 5 meters below the surface). I record both the mapping unit of the polygon and the composition of the area around the plot (hole)- for example the entire polygon may be mapped as an LB24, but perhaps I'll be sampling in an LB4 area of that polygon. I'll also carry along aerial photos printed from ArcView at 1:12,000, which I use for field navigation and to edit my linework. Those photos have the provisional wetland linework, with all of the polygons numbered. The polygon numbers are the unique identifiers that tie the data together. Especially when collecting lots of water samples, data sheet management in the field sure becomes an issue!

Occasionally I'll titrate alkalinity in the field with a Hach "Digital Titrator", especially when collecting a water sample, or if I find an especially interesting or under-represented site. I also usually have a few bottles in a

Meeting Summary
Susitna-Watana Hydroelectric Project Licensing
Wetlands Delineation and Mapping
2012/2013-2014 Study Plan Development
May 2, 2012 9:00 am
AEA Project Offices, First Floor Conference Room
411 W 4th Avenue, Anchorage, AK

Attendees:

Organization	Name
EPA	Matt Lacroix
Kenai Watershed Forum	Mike Gracz (on phone)
USACE	Estrella Campellone (on phone)
USACE	Mike Holley (on phone)
USACE	Mary Leykom (on phone)
USFWS	Mike Buntjer (on phone)
USFWS	Bob Henzley (on phone)
AEA	Wayne Dyok
AEA	Betsy McGregor
ABR, Inc	Terry Schick
ABR, Inc.	Janet Kidd
ABR, Inc.	Wendy Davis
MWH	Kirby Gilbert
Solstice Alaska Consulting, Inc.	Robin Reich
VanNess Feldman	Matt Love

Janet Kidd (ABR) said that this is the second meeting to talk about the wetland classification methodology and functional assessment strategy for the Watana-Susitna Hydroelectric Project. She talked from a PowerPoint presentation attached to these notes.

Wetlands Classification System Questions/Discussion

Janet discussed the Susitna-Watana Hydroelectric Project wetland mapping goals and the proposed study area for the work. Janet said that the ABR Team reviewed a number of wetland mapping methods for the project, including the Cowardin Wetland Classification System and the Cook Inlet Wetland Classification System. She discussed the advantages and disadvantages of using the Cook Inlet Classification System on the project. Janet said that after talking with Mike Gracz and understanding the project area, ABR determined that some of the Project area wetlands are likely different from the wetlands described in the Cook Inlet Classification System. She said that other wetland classification methods don't fit the Project area perfectly either.

Mike Gracz (Kenai Watershed Forum) asked at what scale the on-screen mapping would be completed. Janet said that for the detailed wetland mapping, 1 to 3,000 would be used. For the broader wetland mapping effort, 1 to 10,000 or 15,000 would be used. Mike Gracz said that was a fine scale and said that for the Cook Inlet Wetland Classification effort in the Matanuska-Susitna area, he used 1:18,000.

Janet said that the ABR Team is proposing to use a system that combines the Cowardin classification (National Wetland Inventory [NWI]), Hydrogeomorphic (HGM) classifications, Cook Inlet Classification, and Viereck Alaska Vegetation Classification Level IV to come up with wetland functional classifications. Janet said that this system would incorporate wetland characteristics which are unique to the Susitna watershed. She said that it would include wetlands naming conventions that are familiar to agencies and would provide a link to habitat classification occurring on the project. Wendy Davis (ABR) said that ABR used this wetlands classification for a successful delineation in the Frog Lake area of the Mat-Su.

Matt LaCroix (EPA) said that as long as the Cook Inlet Classification code could be applied, the proposed wetlands classification methodology would be acceptable. Wendy said that there might be some wetlands where the Cook Inlet code would not apply. Mike Gracz said that he would be willing to prepare a cheat sheet comparing the two systems' codes based on aerial photography.

Janet said the field effort would include more vegetation delineation to Viereck Level IV to assist with the wildlife habitat map. She said for ecosystem level map production, the team would have to combine wetland types. Mike Gracz said that he had combined ecosystem levels to a dozen or so geomorphic types, which is the top level, but that the vegetation component of the classification are broad categories of species assemblages not focused on plant community structure.

Matt said that for habitat types, he would need more details. Matt said that the team might be able to cross attribute the wetlands boundaries together with the wildlife/vegetation habitats boundaries. Terry Schick (ABR) said that the team would map fine scale geomorphology, physiography, and vegetation types then aggregate the fine scale mapping components into wildlife habitats that could then be linked to species use data collected by the wildlife biologists.

Mike Gracz said that it would be good if the Cook Inlet Classification codes were included in the Project area shape files, so the Matanuska-Susitna Borough (MSB) could combine it with their existing mapping. Janet said that was the plan. She said that for wildlife habitat map production, the Cook Inlet classes might be aggregated.

Matt said that from his perspective, the exact classification in the wetland coding isn't as important as the meaning. He said that beyond the requirements Section 404 of the Clean Water Act, there is the National Environmental Policy Act (NEPA) and Federal Energy Regulatory (FERC) process. He said that we need to understand functions for each wetland ecotype. He said that the Cook Inlet Classification has data and rationale that can explain wetland functions.

Janet said that the study methodology needs to be able to document the delineation and classification process and make inferences about functions. Matt said that the wetland team will be collecting plenty of data. He said to make sure there are no sweeping characterizations of wetland functions without supporting data.

Mary Leykom (USACE) said that the U.S. Corps of Engineers (USACE) is fine with the wetland delineation methodology that AEA is proposing. Mary said that the USACE's focus is on wetland delineation and functions crosswalks to other classifications or wildlife habitat mapping.

Mike Gracz said that bogs are a very specific landform with specific characteristics. He said that there are likely few bogs in the Project area, and the team should make sure delineated bogs are in fact bogs.

Betsy McGregor (AEA) asked if determining wetland functions and values would be tied to the wetland classification system. Janet said that the goal would be to collect enough data to determine functions using the proposed classification system.

Wetland Functional Assessment Methods Discussion

Janet discussed wetland functional assessment methodologies that were considered for the Project including HGM (Slope/Flat Wetlands), Mat-Su Wetlands Functional Assessment, and the Magee-Hollands Wetland Functional Capacity. Janet said HGM method is not well-suited for the Project. She said that the Mat-Su method hasn't been field tested. She said that the Magee-Hollands method makes the most sense because it fits the Project area well.

Matt said that agencies looked into a number for functional assessment methodologies for the Mat-Su Wetlands Functional Assessment effort. He said that the issue is that Alaska doesn't have reference wetlands because most sites are considered pristine (or reference sites). He said that peatlands are common in Cook Inlet and the functional assessment assumptions don't work well for them. Matt said that he was concerned that functional models might not be well calibrated for types of wetlands in the Project area.

Mike Gracz said that the Magee-Hollands Wetlands Functional method is HGM based and was meant to work on a level of disturbance gradient. He said that without the disturbance gradient, we are left with developing a new model.

Matt said that the team needs to think about and be sure to identify wetlands with rare plants or wetlands that are extreme diverse or support high populations of breeding birds. Janet said that the ABR team is doing those types of studies.

Mike Gracz said that he was very involved in the Mat-Su Wetlands Functional Assessment and the Regional Guidebook for sloped/flat wetlands. He said that none of the functional assessment methods have been field tested. He said that the Mat-Su Functional Assessment was intended to be used on the landscape level for planning purposes.

Matt said the Mat-Su Functional Assessment findings have not been ground-truthed to determine how well the assessment methodology works; however, it helps agencies and developers make informed decisions. He said that when a project is planned, an onsite wetlands functional assessment would be required. Matt said that a certain percentage of the wetland sites would need to be visited for the Susitna-Watana Hydroelectric Project effort.

Matt said that he liked Magee-Hollands data form. Janet said that the Magee-Hollands method requires 2 to 3 hours at each site.

Matt said that one downfall of functional assessment methodologies is that there may be less variation between than within the functional classes. He said that the team needs to take care that the input wetland classifications for a functional assessment method be representative of distinct functioning wetland types..

Mike Gracz said that HGM classification was was not intended to measure natural variability. He said that the method is intended to measure human impacts on wetlands. Matt added that all undisturbed wetlands do not function at the same level.

Matt said that the key was to decide what variables to measure and what data to collect in the field. He said that the team should not collect a bunch of information and then not use it. He said that whatever assessment is developed should be used for the NEPA document and permitting. He said that the team should determine what information to collect, why it is important to collect, and what it says about the wetland functions at the site. He said that ABR's wildlife habitat assessment methodology is a good example of the appropriate use of data in a NEPA analysis..

Matt said that he agreed that the Mat-Su Functional Assessment Method considers too many functions. He said that the team should consider the potential project impacts and what is important to the area to determine which functions to measure. He suggested developing the functions list first and using that to develop the list of field variables to be measured.

Mike Holley (USACE) said that the Project could drop the HGM from further consideration. He said that the USACE would like to expand on the Mat-Su Functional Assessment methods that have been developed rather than develop a new method. He said that he was not familiar with the Magee-Hollands method. Mary said that she agreed with Mike Holley.

Mike Gracz said that it would be nice to have an area on the data forms were the Cook Inlet wetland type would be documented.

Betsy McGregor (AEA) asked whether there were other field measurements needed. Matt said that for the NEPA analysis, information regarding wetland functions is important to document direct, indirect, and cumulative impacts. He said that for the functional assessment, wetland functions are being scored to offset impacts to functions and guide mitigation decisions.

Janet said that the next steps are to come up with a list of function list and look at the Magee-Hollands method to see whether it could be used to determine those functions. Mary said that the strategy seemed reasonable to the USACE.

Matt said that it is tough to develop a functional assessment method there is not a good model or good data for the Project area. He said it is important that the functional assessment method is repeatable. He said that the key is collecting the correct information to determine wetland functions.

Wendy said that it would be good to put Cook Inlet Method's geomorphic components on the form.

Matt said that the Magee-Hollands data form is good to use as a base and Mike Gracz agreed. Mike Gracz said that a finer resolution might be needed. Mike Gracz said that as a starting place, it would be helpful to look at some of the variables that have been measured with the Cook Inlet Classification method and have been used to determine wetland functions. He said that pH, conductance, and temperature were measured in the field using a meter.

Janet said that the various other Project studies, including hydrology, will help to fill in gaps in some of the areas.

Matt said the modification of stream flow is an important wetland function. He said that there is a much greater storage capacity outside the floodplain within wetlands.

Mike Gracz said that water chemistry data may be important to collect. He said that isotope data will help to understand wetland geo/hydro functions. He said that this information can be collected from peat column layers. Matt said that the outputs within the peat profile have been very helpful in understanding peat hydrology. Janet asked how the data would help understand wetland functions. Matt said the information was collected to understand specific trends and more research is needed to understand the overall relevance to wetland function.

Matt suggested that if we see discontinuous permafrost, we should do coring to figure out whether there are an ice lenses (ice rich permafrost) or frozen soil. He said that the ice depth probably can't be determined using this method. He said understanding permafrost is important, especially if a road is planned in the area. Janet said that ABR had done this in the past. Betsy said that geomorphology information is being collected for this purpose. Wayne said that AEA was doing geotechnical work within the road corridor/road design to help with avoiding permafrost areas.

Wayne said that the Alaska Department of Transportation and Public Facilities (ADOT&PF) is drafting a report detailing the permafrost along the Project alignment. He said that ADOT&PF has identified kettle lakes within the Project alignment.

Wayne said that the USACE has stated that they are focused on the dam and upstream areas of disturbance. He asked whether AEA should be doing the same level of wetland mapping downstream.

Matt said that the USACE and FERC will have to figure out direct, indirect, and cumulative impacts to comply with NEPA. He said that the flow modeling and riparian assessments will help to understand the downstream indirect and cumulative impacts. He said that the locations of downstream wetlands need to be documented. Matt said that Mike Gracz has riparian wetland classifications that could be applicable in the lower Susitna. He said that the functions of many of the riparian wetlands have been determined using the Mat-Su Functional Assessment method.

Janet said that the riparian study will capture downstream wetlands information. Matt said that he would like to know what percent of the riparian area are wetlands.

Janet confirmed that Viereck Level IV information would be collected at all sites. Terry said that for vegetation mapping effort, successional vegetation types would be mapped at a more detailed level. He said that species percent cover would be collected for all plant community types, including wetlands.

Bob Henzley (USFWS) said that the riparian community has the potential to be impacted by the Project causing a different flow regime. Terry said that wildlife habitats and successional riverine habitat types would be determined in the riparian area. Janet said the goal of the riparian vegetation study was to revisit previously studied riparian sites if they can be located. Matt said that at a fine scale, changes in vegetation might look like major changes, but at a larger scale it might not mean much. Wayne said that the Team will look at the 1980s data and look at the larger scale using aerial photographs. He said that there is value in looking at the 1980s data.

Janet said that there is existing broad scale NWI mapping and there was some vegetation mapping that could be used from the past; however, most of the mapping was done in the upper basin, and there could be issues with matching up lines in GIS. Terry said that the Team must determine whether the information can be used within GIS. He said that the ADF&G has continued to collect moose habitat data in the upper basin which could be brought into GIS pretty easily.

Betsy asked whether the wetlands classification and functional assessment methodology designed for the upper basin would be required in the lower basin. Matt said that if there are wetlands in the lower basin, the same ecotypes that are used for the vegetation mapping could be used. He said that the same data sheet could be used in the lower basin.

Janet said that ABR was not planning on filling out the Corps' Wetlands Regional Supplement data forms in the lower basin. Matt said that whether areas are jurisdictional wetlands not at issue, and that it was not important to do the jurisdictional wetlands determinations. He said that the Team should just assume the all the wetlands areas are jurisdictional.

Betsy said that the USACE stated that they were only interested in classifying wetlands within the directly impacted area. Matt said that the USACE will need to identify downstream indirect effects to wetlands whether or not the wetlands are jurisdictional.

Betsy asked how far out of the riparian zone the wetlands would need to be mapped. Matt said that all of the floodplain zone should be mapped. Matt said that the river corridor area should be mapped with a buffer because the floodplain boundary is difficult to determine unless there is a distinct terrace.

Betsy said that AEA was proposing to map vegetation within the 100 year floodplain. Matt asked whether the floodplain area had been determined and said that it was always good to buffer areas of study. Terry said that the riparian vegetation study area had not been determined and would probably have a study area buffer. Matt said that the downstream vegetation mapping limit should be established from questions about project impacts. He said that, for example, there may be questions regarding whether the Project would impact the State Game Refuge, and if the answer can't determine with existing information, AEA would need to collect the data. Wayne said that the study area would need to be large enough to assist with modeling. He said that AEA did not want to have data gaps that would lead to additional studies.

Janet said that it sounded like there was flexibility in the wetlands functional assessment method as long as the wetland team correlated the information back to the Cook Inlet Classification System. She asked whether the proposed Magee-Hollands Data forms were acceptable. Matt said that the EPA did not have a data form that they used or preference. Betsy said that the form might be changed after the first year.

Bob asked whether there would be any overlap between wetlands classification systems. Janet said that the focuses of the classifications are different, but that it would not be hard to come up with a crosswalk between the methods. She said that the Cowardin Wetland Classification System is good at a higher scale or a national level and should be included in the methodology. Wendy said that the crosswalk between systems was tested, and it works because ABR would be collecting much of the needed information for the habitat mapping effort. Matt said that the two studies (wetlands and habitat mapping) would reinforce each other. Janet said that it would increase their field effort, but that they should be able to make inferences about sites that aren't visited.

Mike Gracz asked whether AEA would consider isotope measurements. He said that measuring isotopes would show how much evaporation might be dominating the system on the day you collect the data.

Other/General Discussion

Betsy asked about project impacts to salinity and how they could be determined. Wayne said that in the 1980s, we determined that initial filling of the Susitna Flats could have impacts to salinity. Betsy said that the water quality people would need to determine salinity impacts. Matt said that a common effect of similar projects is the loss of intertidal area. He said that sometimes you will see subsidence of river deltas because there is less sediment transport downstream; however, modeling would be needed to determine the impacts. Wayne said that the sediment transport study would be completed. Matt said that the Project could cause the blocking of (decreased) sediment from upstream and increased sediment loads from winter flow; therefore it is possible that there could be no net effect. Wayne cautioned that the additional winter flows added to the existing flows might not have an effect, but that modeling would help to determine the impacts.

Matt said that the EPA will not be submitting study requests. Betsy said that AEA's goal is to have the study requests close to final by May 4th for submission to FERC on May 15. She said that some agencies have said that they will references the AEA-produced study requests and other agencies are planning on submitting their own study requests. Mike Buntjer (USFWS) said that the USFWS was pulling together study requests. Terry said that the agencies' study requests did not need to be extremely detailed. Wayne said that he thought that most of AEA's study requests were close to agencies' expectations. He said that the only issue he saw was the number of years of data collection proposed by AEA.

Betsy said that questions remained about the study area and the size of buffer areas. Betsy said that FERC would like to see the study area in the study requests. Terry asked whether the study areas could be modified pending the results in the 2012/13 studies. Betsy said that the study areas could be modified later as long the decision making process was documented. Wayne said that the year-end study reports could end up justifying the study plan modifications.

Bob said that the USFWS agreed in general with the study requests, but there may be difference on proposed methods. Betsy said that the AEA study requests would be posted on behalf of AEA, but agencies can reference them. Betsy confirmed that studies proposed in AEA study requests would occur even if agencies did not request the studies.

Susitna-Watana Hydroelectric Project— Wetland Classification and Functional Assessment Methodology

Wetlands Mapping Goals

- Classify and map wetland types to determine current baseline conditions in the project area
- Determine functional value of each mapped functional wetland type
- Quantify the potential direct and indirect impacts to wetlands and wetland function from Project construction
- Provide data that satisfies Section 404 wetland permitting requirements
- Facilitate the development of protection, mitigation, and enhancement (PME) measures to minimize project impacts to wetlands and wetland function

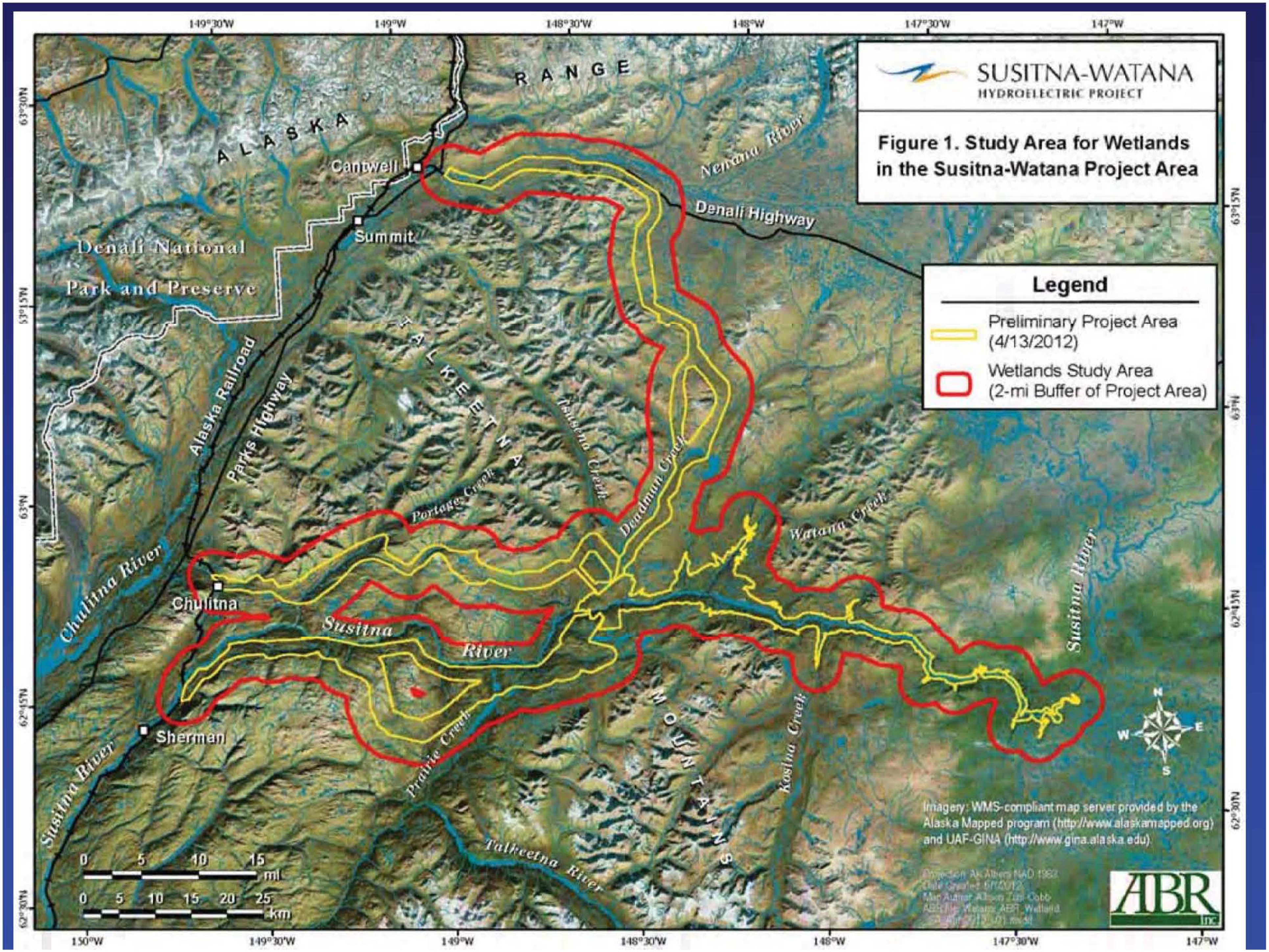
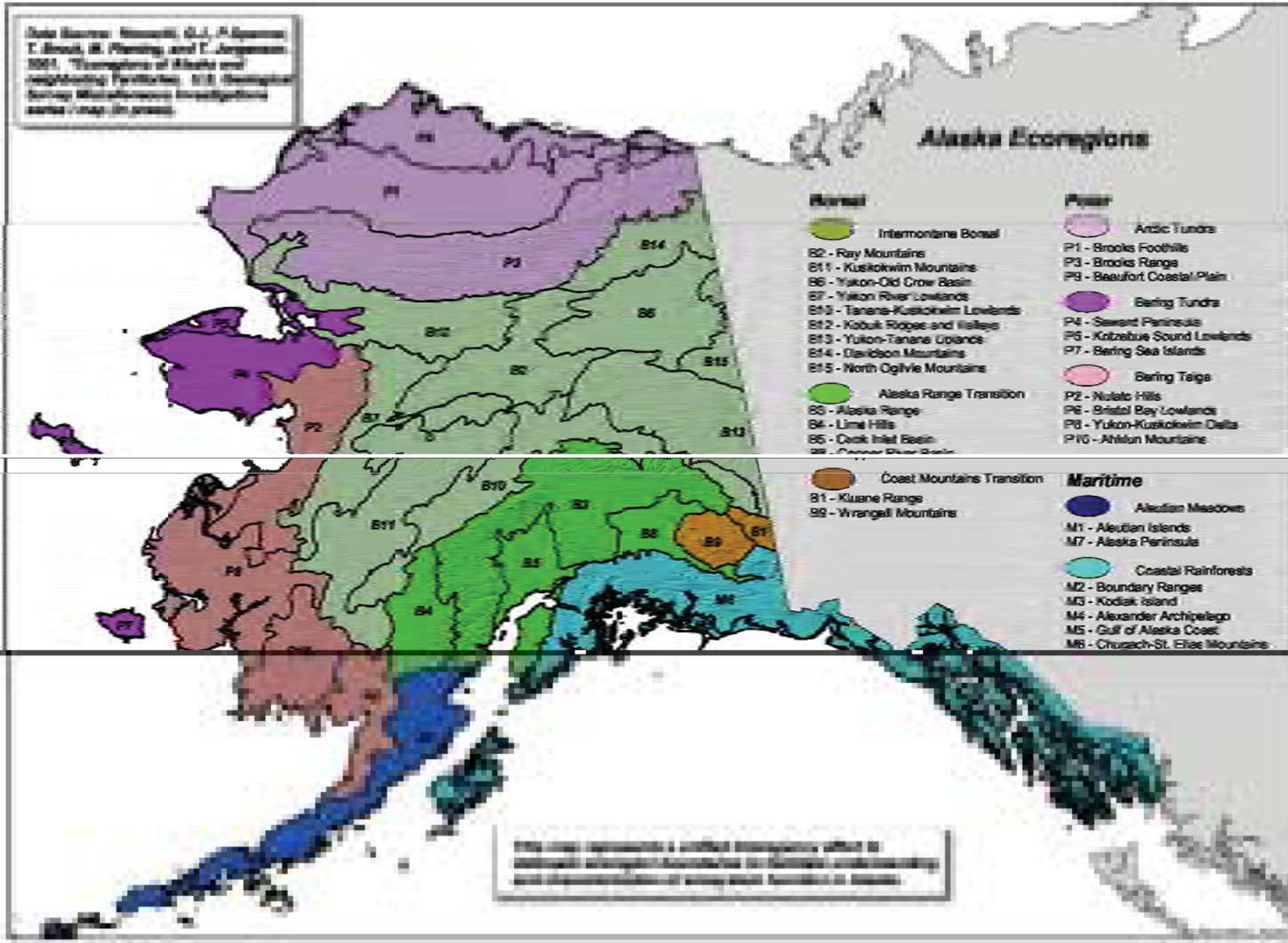


Figure 1. Study Area for Wetlands in the Susitna-Watana Project Area


Alaska Ecoregions
Intermontane Boreal
B2 - Ray Mountains
B11 - Kuskokwim Mountains
B6 - Yukon-Old Crow Basin
B7 - Yukon River Lowlands
B10 - Tanana-Kuskokwim Lowlands
B12 - Kobuk Ridges and Valleys
B13 - Yukon-Tanana Uplands
B14 - Davidson Mountains
B15 - North Ogilvie Mountains
Alaska Range Transition
B3 - Alaska Range
B4 - Lime Hills
B5 - Cook Inlet Basin
Coast Mountains Transition
B1 - Kluane Range
B9 - Wrangell Mountains
Arctic Tundra
P1 - Brooks Foothills
P3 - Brooks Range
P9 - Beaufort Coastal Plain
Bering Tundra
P4 - Seward Peninsula
P5 - Kotzebue Sound Lowlands
P7 - Bering Sea Islands
Bering Taiga
P2 - Nulato Hills
P6 - Bristol Bay Lowlands
P8 - Yukon-Kuskokwim Delta
P10 - Ahklun Mountains
Maritime
Aleutian Meadows
M1 - Aleutian Islands
M7 - Alaska Peninsula
Coastal Rainforests
M2 - Boundary Ranges
M3 - Kodiak Island
M4 - Alexander Archipelago
M5 - Gulf of Alaska Coast
M6 - Chugach-St. Elias Mountains

Proposed Approach to Susitna – Watana Wetland Classification

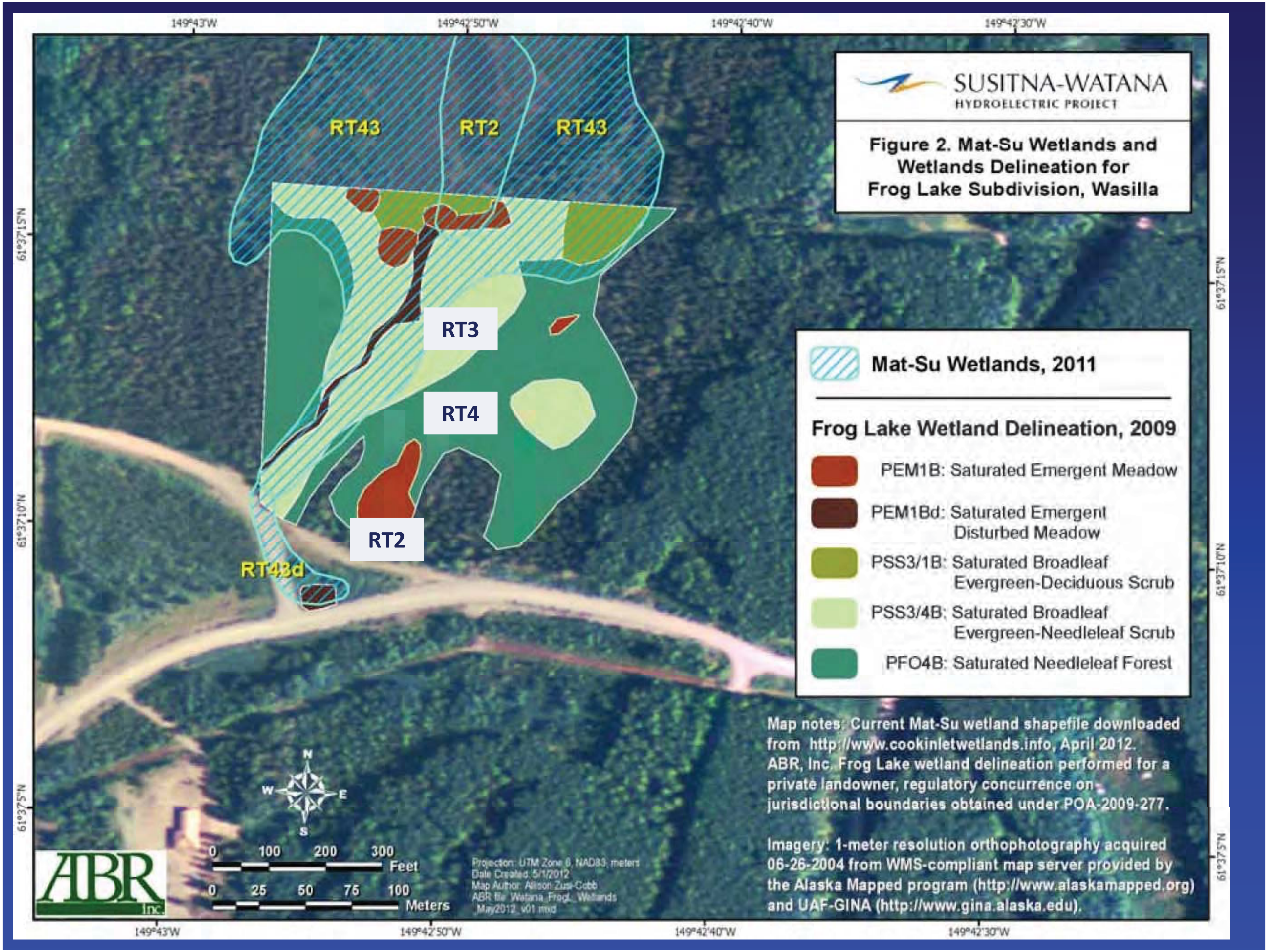
NWI (Cowardin)

Cook Inlet Classification

Viereck Level IV

ABR Wetland Ecotype

ABR Physiography	HGM (Tiner 2003)	Cook Inlet Geomorphic	Surface form	Cowardin Class	Viereck Level IV	Cook Inlet Classification	ABR Wetland Ecotype (Proposed)
Lowland	Terrene Slope/Flat groundwater-dominated throughflow headwater wetlands	VLD trough	Toeslope	PFO4B	Open Black Spruce Forest	RT4: Forested Ripple Trough	Lowland Saturated Forest
			Depression	PSS3/4B	Open Low Ericaceous Shrub Bog	RT3: Shrubby Ripple Trough	Lowland Saturated Shrub Bog
				PEM1B	Subartic Lowland Sedge Bog Meadow	RT2: Sedge Dominated Ripple Trough	Lowland Saturated Sedge Bog
				PEM1Bd	Disturbed Wet Meadow	RT43d: Highly Disturbed Ripple Trough with Shrubby Areas	Lowland Disturbed Wet Meadow
				PSS4B	Dwarf Open Black Spruce Forest	RT43: Forested Ripple Trough with Shrubby Areas	Lowland Saturated Forested Scrub


149°43'W
149°42'50"W
149°42'40"W
149°42'30"W
61°37'15"N
61°37'10"N
61°37'5"N
SUSITNA-WATANA
HYDROELECTRIC PROJECT
Figure 2. Mat-Su Wetlands and Wetlands Delineation for Frog Lake Subdivision, Wasilla
RT43
RT2
RT43
RT3
RT4
RT2
RT43d
Mat-Su Wetlands, 2011
Frog Lake Wetland Delineation, 2009
PEM1B: Saturated Emergent Meadow
PEM1Bd: Saturated Emergent Disturbed Meadow
PSS3/1B: Saturated Broadleaf Evergreen-Deciduous Scrub
PSS3/4B: Saturated Broadleaf Evergreen-Needleleaf Scrub
PFO4B: Saturated Needleleaf Forest
Map notes: Current Mat-Su wetland shapefile downloaded from http://www.cookinletwetlands.info, April 2012. ABR, Inc. Frog Lake wetland delineation performed for a private landowner, regulatory concurrence on jurisdictional boundaries obtained under POA-2009-277.
Imagery: 1-meter resolution orthophotography acquired 06-26-2004 from WMS-compliant map server provided by the Alaska Mapped program (http://www.alaskamapped.org) and UAF-GINA (http://www.gina.alaska.edu).
N
W
E
S
0 100 200 300 Feet
0 25 50 75 100 Meters
Projection: UTM Zone 6, NAD83, meters
Date Created: 5/1/2012
Map Author: Alison Zusi-Cobb
ABR file: Watana_FrogL_Wetlands_May2012_v01.mxd
ABR Inc.

Susitna-Watana Wetland Classification

- Incorporates regional wetland characteristics unique to the Susitna watershed
- Allows for smaller mapping scale (1:3,000 vs. 1:15,000) needed for wetland impact assessment for project footprint
- Provides link to habitat classification (includes vegetation structure)
- Will provide more seamless connection to the Cook Inlet Basin mapping

Wetland Functional Assessment as Part of the Section 404 Process

- Identify development alternatives that result in the lowest impacts to wetlands in terms of functional value
- Determine the magnitude of the effects of potential impacts
- Develop mitigation plans to compensate for losses in wetland function

Wetland Functional Assessment Methodology Requirements (from Smith et al. 1995)

- Standardized methods
- Applicable across study area
- Inclusive of all wetland types and functions
- Compatible with time and resources available
- Sensitive to potential impacts
- Addresses agency and other stakeholder concerns
- Capable of incorporating new data or changing project requirements

Wetland Functional Assessment Methods

HGM (Slope/Flat Wetlands)

Cook Inlet Basin

- Discharge of water to downgradient systems
- Surface and shallow subsurface water storage
- Particulate retention
- Organic carbon export
- Cycling of elements and compounds
- Maintenance of characteristic plant communities
- Maintenance of characteristic habitat structures
- Interspersion and connectivity

Interior Alaska

- Soil Profile Integrity
- Characteristic Soil Thermal Regime
- Surface and Near Surface Water Storage
- Cycling of elements and compounds
- Organic carbon export
- Plant Community
- Faunal Habitat Components
- Interspersion and connectivity

Mat-Su Wetlands Functions and Values

- Contribution to groundwater
- Transmission of groundwater
- Streamflow moderation
- Floodflow alteration
- Sediment/Toxicant/Pathogen retention
- Sediment shoreline stabilization
- Nutrient removal/Retention/Transformation
- Foodchain support
- Anadromous fish habitat
- Habitat and maintenance of biodiversity
- Habitat for species of interest
- Recreation
- Consumptive uses
- Education
- Visual quality/Aesthetics
- Cultural and historical significance
- Uniqueness

Magee-Hollands Wetland Functional Capacity

- Modification of groundwater discharge
- Modification of groundwater recharge
- Storm and flood-water storage
- Modification of stream flow
- Modification of water quality
- Export of detritis
- Contribution of abundance and diversity of wetland vegetation
- Contribution of abundance and diversity of wetland fauna

Possible additional functions:

- Consumptive uses
- Cultural significance
- Uniqueness

Magee–Hollands Wetland Functional Capacity

- Step-by-step procedure that is not region specific
- Field form can be tailored to include criteria unique to a project area
- Incorporates landscape, hydrologic, soil, and vegetation variables into the model
- Could add variables relating to recreation, subsistence, special aquatic sites

ECOLOGICAL LAND CLASSIFICATION (ELS) PROCEDURES

Definitions and Abbreviations
(Modified for wetland classification for Susitna-Watana Hydroelectric Project—2012)

The document provides the sampling protocols proposed for the Susitna-Watana wetland classification system. The field methodology is based on the standard USACE wetland determination form provided in the 2007 Alaska Regional supplement (USACE 2007) and ELS classification methodology used to define ecotypes. Additional data will be collected to accurately define the landscape position and water source of the wetland for subsequent classification and mapping.

<u>GENERAL DESCRIPTIONS</u>

SiteID: Unique alphanumeric identifier
Date:
Time:
Name of observer:
PhotoNo.: Site and soil profile photo number.

LOCATION

USGS Quad:
Nearest Geographic Landmark: Common name for nearby geographic location.
Latitude and longitude: For georeferencing purposes a field GPS position should be taken;
Elevation:
Aerial photo No.: If applicable

GEOLOGY

Geomorphic Unit: Refer to current ABR's GU classification scheme and use alpha code. Surface layer must be 30 cm or more thick to be identified as a geomorphic unit.
Slope (deg.) or Class (below):

- 0- N: nearly level (0-2%;<1°)
- 2- G: gently sloping (2-6%; 1-3 °)
- 5- S: strongly sloping (6-12%; 3-7 °)
- 10- M: moderately sloping (12-24%; 7-14 °)
- 20- T: steep (24- 45%; 14-24 °)
- 30- V: very steep (45-100%; 24-45 °)
- 50 –E: extremely steep (>100%; >45 °)

Slope Aspect (deg.): 8 cardinal points (e.g. 0, 45, 90, 135) or finer
Surface Form Class: (was slope position: see Surface Form (macrotopography) codes). classification appended.
Microtopography class: Refer to current microtopography classification scheme and use code. Classification appended
Microrelief: Give mode (typical) trough to crest height (cm).

HYDROLOGY

Hydrology at the site will be documented primarily using the 2007 Alaska Regional supplement data form parameters and augmented by the following criteria:

Origin of water: Precipitation (P), Groundwater (G), Stream (S), Lacustrine (L)

NWI Water Regime:

0 - Upland

1 - Tidal:		10	Nontidal
2 - Ts	Subtidal	11 - Np	Permanently flooded
3 - Te	Irregularly exposed	12 - Nei	Intermittently exposed
4 - Tr	Regularly flooded	13 - Nsm	Semipermanently flooded
5 - Ti	Irregularly flooded	14 - Nse	Seasonally flooded
		15 - Nsa	Saturated (S)
		16 - Nt	Temporarily flooded
		17 - Ni	Intermittently flooded
		18 - Na	Artificially flooded

Water pH (WatPH): ND if no water or no data

Water EC (WatEC) Electrical Conductivity: use units in µS/cm to avoid units confusion. Enter ND if no data or no water present.

Water Temperature (WatTemp): in deg. Celcius.

SOIL

Soil pit description follows procedures outlined in the 1987 USACE wetland delineation manual and the 2007 USACE Alaska Regional supplement, including depth of organic matter, mottling. . Depth of the active layer is described in the "Restrictive layer" section of supplement data form.

Test for soil reducing conditions: Alpha-alpha-Dipyridyl solution to confirm the presence of ferrous (Fe++) iron.

VEGETATION SAMPLING

Vegetation sampling is done following the procedures outlined in the 1987 USACE wetland delineation manual and the 2007 Alaska Regional supplement. Cover is based on visual estimate within each stratum.

Additional variables will be collected to provide a full species list beyond the dominants list required by the standard wetland delineation form:

Structure (Level IV): Viereck et al. (1992) level III

Floristic Class (V): Viereck et al. (1992) level IV

Cover %: Estimate cover visually for all additional species not recorded on the standard form, trace = 0.1.

ABR's MICROTOPOGRAPHY CLASSIFICATION SYSTEM

(Microsite features; <0.1 ha)

00	**N**	**NONPATTERNED**
01	**POLYGONS (ice aggradation)**	
02	Pr	Polygon rim
03	Pc	Polygon center
04	Pt	Polygon trough
06	Pd	Disjunct polygon rims
07	Pf	Flat-centered (usually Phl)
10	Pl	Low-centered
11	Plll	Low relief, low-density
12	Pllh	Low relief, high-density
13	Plhl	High relief, low density
14	Plhh	High relief, high density
15	Pm	Mixed high and low polygons
16	Ph	High-centered polygons
17	Phl	low-relief (and flat centered)
18	Phh	high-relief
20	**THERMOKARST**	
21	Tp	Pits (small features)
22	Tm	Mixed pits and polygons
24	Tc	Collapse scar (large, rounded features)
26	Tm	Moats (linear, water filled)
28	Tk	Kettle (glacial)
30	**FROST FEATURES**	
31	Fh	Hummocks (mineral cored)
32	Fr	Reticulate
33	Ff	Frost Scars and Boils
34	Fc	Circles (non-sorted, sorted)
36	Fs	Stripes (non-sorted, sorted)
38	Fn	Nets (non-sorted, sorted)
39	Fs	Steps (non-sorted, sorted)
40	**MOUNDS (ice and peat related)**	
41	Mi	Ice-cored mounds
44	Mpm	Peat mounds
45	Mt	Tussocks
47	Ms	String (strang)
48	Mg	Gelifluction lobes (saturated flow)
50	**MOUNDS (Misc.)**	
51	Mu	Undifferentiated mounds (distinct)
52	Mir	Ice-shoved ridge
53	Mid	Ice-rafted debris
55	Mrb	Rocks, Blockfields
56	Mrm	Rocky Mounds (soil covered rocks)
57	Mt	Tree mounds (downded logs and root balls)
58	Mw	Mounds caused by wildlife
59	Mh	Mounds caused by humans
60	**DRAINAGE or EROSION RELATED**	
61	Dt	Water tracks (non-incised drainages)
64	Df	Feather pattern (in fens)
66	Dr	Ripples
68	Dd	Flow dunes
70	**EOLIAN RELATED**	
71	Es	Small dune
74	Eb	Scour depression
99	**WATER (W)**	
100	**X**	**COMPLEXES**
101	Xb	Basin Complex

ABR's SURFACE FORM CLASSIFICATION SYSTEM

Macrotopographic Features (meso to macro site; 0.1-100 ha)

01 SUMMIT OR RIDGE

02 PLATEAU (high flats)

03 SHOULDER

04 PINGO

05 STEEP SLOPES
06 Sb Bluff (unconsolidated or with soil)
07 Sc Cliff (rocky)
08 St Streambanks

10 UPPER SLOPE (Su)(convex, creep dominated)
11 Sus South Facing (135-225^{o})
12 Sue East-West Facing (45-135:225-315^{o})
13 Sun North Facing (315-45^{o})
15 **Concave** (water gathering; gullies)
16 Sucs South Facing Concave Upr Slp (135-225^{o})
17 Suce East-West Facing (45-135:225-315^{o})
18 Sucn North Facing (315-45^{o})
19 Such Nivation hollows, Snowbanks,
20 **Convex** (water shedding)
21 Suvs South Facing (135-225^{o})
22 Suve East-West Facing (45-135:225-315^{o})
23 Suvn North Facing (315-45^{o})
25 Plane
26 Sups South Facing (135-225^{o})
27 Supe East-West Facing (45-135:225-315^{o})
28 Supn North Facing (315-45^{o})

30 LOWER SLOPE (Sl)(concave, wash dominated)
31 Sls South Facing (135-225^{o})
32 Sle East-West Facing (45-135:225-315^{o})
33 Sln North Facing (315-45^{o})
35 Slc **Concave** (water gathering; gullies)
36 Slcs South Facing (135-225^{o})
37 Slce East-West Facing (45-135:225-315^{o})
38 Slcn North Facing (315-45^{o})
39 Slch Nivation hollows, Snowbanks,
40 Slv **Convex** (water shedding)
41 Slvs South Facing (135-225^{o})
42 Slve East-West Facing (45-135:225-315^{o})
43 Slvn North Facing (315-45^{o})
45 Slp **Plane**
46 Slps South Facing (135-225^{o})
47 Slpe East-West Facing (45-135:225-315^{o})
48 Slpn North Facing (315-45^{o})
50 **TOE**

55 BASINS OR DEPRESSIONS
56 Bk Kettle
57 Bt Thermokarst
58 Bc Basin Complex
59 Bd Drained Basin

60 FLAT OR FLUVIAL RELATED
61 Fn Nonpatterned
62 Fpp Permafrost plateau (mineral soil,<5 m high)
63 Fpa Palsa
66 Fm Flats margins (transition, e.g. tidal flats)
69 Fw Water tracks or feather pattern
70 Fc Channel, swale or gut,
71 Fi Interfluv or flat bank
72 Fl Levee
73 Fb Bar (point, lateral, mid-channel)
74 Fbp Point Bar
75 Fbl Lateral Bar
76 Fbm Mid-channel Bar
77 Fs Crevasse splay
78 Ft Terrace
79 Ff Flood Basin (behind levee, “backswamp”)

80 LAKES AND OCEAN
81 Li Islands Present

85 LAKE MARGINS
86 Ls Smooth Flat Margin
87 Lp Polygonized Pond Margins (incl. islands)
88 Fwb Wave cut bench (lakeshore or ocean)
89 Fwt Wave cut terrace (lakeshore or ocean)

90 RIVER OR STREAM
91 Rp Deep Pools (>1.5 m)
92 Rs Shallow Runs (<1.5 m)
94 Ri Riffles,
95 Rr Rapids
97 Rc Cascades
98 Rf Falls

100 COMPLEX PATTERNS

110 CHANNEL COMPLEX ON FLATS (CC)
111 Braided channels and interfluvs
115 Meander scrolls

120 RIDGE AND SWALE COMPLEX (CR)

130 EOLIAN COMPLEX PATTERNS (E)
131 Ek Streak
133 Ed Dome-shaped
134 Ec Crescent (barchan, barchanoid ridge)
135 Ep Parabolic
136 El Linear
137 Er Reversing
138 Et Star
139 Eb Blowout

Wendy Davis <wdavis@abrinc.com>

Probable CIC mapping codes in Watana area

1 message

Mike Gracz <mike@kenaiwatershed.org> Wed, May 2, 2012 at 10:06 AM
To: Janet Kidd <jkidd@abrinc.com>, wdavis@abrinc.com

Share the attached, it should help with attributing most wetland polygons with a CIC code

Mike

From: Janet Kidd [mailto:jkidd@abrinc.com]
Sent: Tuesday, May 01, 2012 6:05 PM
To: Leykom, Mary F POA; Sandie T. Hayes; Betsy McGregor; Charles "Terry" Schick; Ross, Victor O POA; Matthew LaCroix (LaCroix.Matthew@epamail.epa.gov); William Ashton (william.ashton@alaska.gov); Bob Henszey (bob_henszey@fws.gov); Michael Buntjer (michael_buntjer@fws.gov); robin@solsticeak.com; Wendy Davis (wdavis@abrinc.com); mike@kenaiwatershed.org; Michiel.E.Holley2@usace.army.mil
Subject: Re: AEA SuWa Wetland Meeting May 2, 9:00 am

Hi folks. Attached is an e-mail version (so the resolution is a little rough) of my presentation for tomorrow morning's meeting. It is brief, mainly designed to hopefully generate a good discussion, especially given the time constraints of some of the participants. I also have attached a summary of the field parameters we would measure/collect to give you an idea of how we would try and capture the data needed to develop a classification scheme that is seamless with the Cook Inlet system.

I looked forward to meeting with you tomorrow and I appreciate everyone taking the time out to get together. Best regards, Janet.

--
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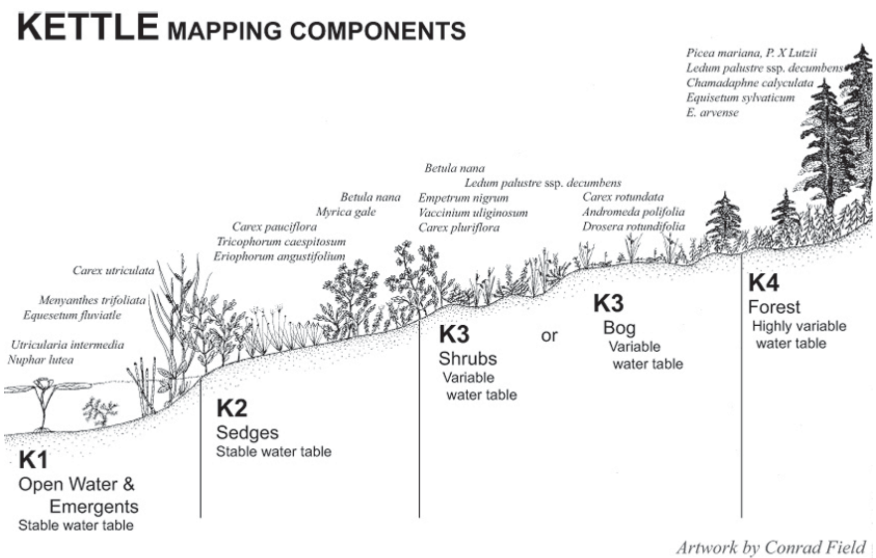
Probable CIC Codes in Watana Project Area.docx
334K

Probable CIC Codes in Watana Project Area

RIVERINE
Rib- River islands and bars
RB- Rosgen's B stream (Susitna River and larger tributaries)
E STREAMS: in underfit valleys on glacial deposits:
Rel- linear "e" stream (modified- Rosgen's E streams are sinuous)
Res- Sinuous "e" stream.

LAKE- >20 acres

D- Depressions- Peat (surrounded by uplands). Hydro code: 1-4, 1- open water…4= forest (figure below)
K- Kettles- Peat (surface or wetland cnx to navigable water). Same hydro codes as D's (figure below)
S- Discharge slopes- mineral soil at slope breaks. Plant dominants- up to two (A= Alnus, S= Salix, Z= High elevation diverse herbaceous meadow)



10. RECREATION AND AESTHETIC RESOURCES

10.1. Introduction

The Alaska Energy Authority (AEA) proposes a Recreation Resources Study, a Recreational River Flow Study, and an Aesthetic Resources Study in order to document baseline conditions and help assess potential impacts on recreation and aesthetic resources from construction and operation of the proposed Susitna-Watana Project (Project). The proposed Recreation Resources Study has been prepared in consultation with agencies and licensing participants.

The Recreation Resources Study (Section 10.5) will research, describe, and quantify recreation demand and capacity of facilities, and assess reasonably foreseeable recreation needs associated with development of the proposed Susitna–Watana Hydroelectric Project.

River-based activities, including boating and fishing, are largely dependent on river flow levels, river access points, and seasonal resource availability conditions. The Recreation River Flow Study (Section 10.6) will identify and document flow-dependent recreational opportunities in the proposed Project area, identify flow preference curves for relevant river-related recreational activities, and help establish the relationships between river flow levels and river uses.

The Aesthetic Resources Study (Section 10.7) will research, inventory, and describe visual and auditory resources in the Project area and identify potential impacts to these resources from construction and operation of the proposed Project.

10.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

The Susitna River valley is currently largely undeveloped. The Project, including a dam and associated facilities and access infrastructure, may affect current recreational opportunities and uses, and the aesthetic character of the Project area. For example, the Project may affect a number of forms of public recreation such as fishing, boating, hiking, camping, birdwatching, hunting, scenic touring, skiing, snowshoeing and other activities by affecting river flows, altering wildlife habitat, and changing recreation access conditions. Operation and construction of the Project also may affect visual and auditory experiences. More specifically, potential effects may include, among others:

- Temporary and/or permanent disruption or displacement of current recreational activities;
- Availability of new recreational facilities and opportunities;
- Changes in public access;
- Temporary and/or permanent changes in demand and levels of use; and
- Other changes to the recreational and aesthetic experience.

The Recreation Study will identify existing and foreseeable future recreation uses, levels of use, spatial use patterns, means of access, and facilities inventory and capacity that occur in the proposed Project area. The study will provide a basis for development of a Recreation Management Plan (RMP).

The Aesthetics Study will identify existing viewsheds and soundscapes, and describe changes that could occur as a result of Project construction and operation.

This documentation will provide an information base on which to establish recreation conditions for the license consistent with the Federal Energy Regulatory Commission's (FERC's) policies regarding development of public recreation at licensed projects.

10.3. Resource Management Goals and Objectives

In addition to providing information needed to characterize the potential Project effects, the Recreation and Aesthetic Resources Studies will provide information to help agencies and Alaska Native entities in the study area identify appropriate conditions for the Project license pursuant to their respective mandates. Project studies are designed to meet FERC licensing requirements, but also to be relevant to recent, ongoing, and/or planned resource management activities by other agencies. Part of the Project Area is within BLM lands administered through policies and management consideration of the Glennallen BLM Resource Area East Alaska Resource Management Plan (EARMP). The BLM management policies in the EARMP include those related to recreation and aesthetic resources. The Alaska Statewide Outdoor Recreation Plan, 2009-2014 also provides some resource management considerations through its assistance to recreation providers, advisory boards, user groups and the public in making outdoor recreation decisions.

10.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

AEA has consulted with federal and state agencies, Alaska Native entities, and other licensing participants at Project Technical Workgroup meetings held in February, April, and June 2012. The following Table 10.4-1 provides a summary of these meetings. Previous consultation regarding recreation and aesthetic studies are documented in the PAD.

Table 10.4-1. Summary of consultation on Recreation and Aesthetic Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Letter	01/12/2012	P. Bergmann	USDOI	Comments regarding outdoor recreation and aesthetics; sport fishing and sport hunting; recreational boating; land-based recreation; aesthetics; and visual resources. (Filed with FERC.)
Technical Workgroup Meeting Notes	02/27/2012	Variety of Stakeholders	Agencies, Alaska Native Entities, and Interested Individuals	Discussion of social science outlines (See Attachment 10-1).
Letter	03/07/2012	G. Yankus	USDOI NPS	Comments on draft study plans (See Attachment 10-1).
Technical Workgroup Meeting Notes	04/03/2012	Variety of Stakeholders	Agencies, Alaska Native Entities, and Interested Individuals	Discussion of planned study objectives and methods (See Attachment 10-1).
E-mail	04/05/2012	C. Thomas	USDOI NPS	Comments on draft study plans (See Attachment 10-1).
Technical Workgroup Meeting Notes	06/07/2012	Variety of Stakeholders	Agencies, Alaska Native Entities, and Interested Individuals	Discussion of licensing participant comments and study requests (See Attachment 10-1).

10.5. Recreation Resources Study

10.5.1. General Description of the Proposed Study

The Recreation Resources Study is designed to identify recreation resources and activities that may be affected by the construction and operation of the proposed Susitna-Watana Project (Project), and to help assess the potential impacts of Project construction and operation on those resources and activities. The specific goals of the study are to:

- Identify and document recreation resources and facilities that support both commercial and non-commercial recreation in the Project area;
- Identify the types and levels of current recreational uses and future reasonably foreseeable future uses based on surveys and interviews, consultation with licensing participants, regional and statewide plans, and other data;
- Evaluate the potential impacts of Project construction and operation on recreation resources, needs, and uses in the Project area; and
- Use the results of analyses to develop an RMP for the Project.

10.5.2. Existing Information and Need for Additional Information

Existing information was compiled in the Recreation Data Gap Analysis (AEA 2011a) and recreation resource descriptions and inventory presented in AEA's Pre-application Document (PAD) (AEA 2011b). A recreation study was initiated in 2012 to gather data to inform the 2013-2014 study plan, including the following elements:

— Interviews with key representatives of agencies and organizations, including Alaska Native entities knowledgeable about regional and state recreation management and issues

— A compilation of existing recreation inventory and capacity information

— An inventory of Project area access

— Incidental Observation Survey Data (completed by field crews)

— Coordination with other study disciplines and incorporation of data

— Geo-referenced mapping

— Field reconnaissance

— Identification of future trends and issues

— A description of the management framework

Available information from the 2012 data gathering efforts will be used to develop the Revised Study Plan.

10.5.3. Study Area

The Project area is shown in Figure 1.2-1. The study area includes the Susitna River watershed, focusing on recreation opportunities and use patterns in and around the immediate Project area.

10.5.4. Study Methods

Both water-based and land-based recreation uses and access will be analyzed. Seasonal uses that relate to ice and snow conditions will also be analyzed. Specialized study of river flow-dependent activities will also be conducted, as described in Section 10.7. The Recreation Resources Study is interdependent with analyses conducted in other disciplines, both biophysical (e.g., aquatics and hydrology) and social (e.g., transportation and socioeconomics), and systematic coordination of data with those study groups will be required.

Methods for the components of the proposed Recreation Resources Study Plan for 2013-14 are described below.

Regional Recreation Analysis

The regional recreation resources context will be defined in coordination with agencies, technical workgroups, and other participants, including Alaska Native entities. Regional and local data related to recreation use will be collected and analyzed, including examination of various land management regimes within the area. Existing resource management plans relevant to the recreational resources of the study area will be reviewed and compiled. The analysis will be conducted in accordance with existing and proposed community and regional plans, and private sector plans. Plans that will be incorporated include

- Alaska's Outdoor Legacy Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2009–2014 (Alaska Department of Natural Resources [ADNR] 2009)
- Alaska Recreational Trails Plan (ADNR 2000)
- Chase Comprehensive Plan (MSB 1993)
- Cultural Resource Management Plan for the Denali Highway Lands (VanderHoek 2005)
- Denali State Park Management Plan (Alaska Division of Parks and Outdoor Recreation [DPOR] 2006)
- DPOR Ten Year Strategic Plan 2007–2017 (DPOR 2007)
- East Alaska Resource Management Plan (Bureau of Land Management [BLM] 2006)
- MSB Comprehensive Development Plan (MSB 2005)
- MSB Trails Plan (MSB 2008)
- MSB Comprehensive Economic Development Strategy (TIP Strategies Inc. 2010)
- MSB Parks and Recreation Open Space Plan (MSB 2000)
- South Denali Implementation Plan and Environmental Impact Statement (National Park Service [NPS] 2006)
- Susitna Area Plan (ADNR 1985)
- Susitna Basin Recreation Rivers Management Plan (ADNR 1991)
- Susitna Matanuska Area Plan (ADNR 2011)
- Talkeetna Comprehensive Plan (MSB 1999)

Trails leading into and within the Project area will be identified using aerial imagery. These include multiple formal and informal trails and routes, several formally identified Revised Statute (RS) 2477 trails, and Alaska Native Claims Settlement Act (ANCSA) 17(b) trails. The trails will then be mapped, and "ground-truthed." This will identify trails that have historical use, and are legal under State "generally allowed uses," but have not been named or identified by ADNR. Management responsibilities for 17(b) easement trails will also be clarified wherever possible.

Recreation Activity Areas (per SCORP planning) and the Recreation Opportunity Spectrum (USFS 1979) "primitive" class will also be described as they relate to the study area. Scenic Byways, Wild and Scenic Rivers (WSR), and other special resource use designations will be identified and described. There are two river segments within the Project area that have been identified by BLM as eligible for inclusion into the WSR System: Brushkana Creek and the portion of the Susitna River from the headwaters to the confluence of Kosina Creek. BLM has stated that they will conduct a suitability determination for these eligible river segments (Social Sciences Technical Workgroup Meeting, April 3, 2012). The George Parks Highway between MP 132 and 248 is designated as an Alaska State Scenic Byway (ADOT&PF 2008; 2012).

Recreation Use and Demand

Currently, the recreation uses of the Project area are widely dispersed. Visitors to the area participate in a wide variety of activities; including sport hunting, sport fishing, recreational boating, skiing, snowshoeing, and snow-machining. The amount, extent, and potential impact of Project-related dispersed recreation use on the proposed Project area's land and water resources is currently unquantified.

A baseline of developed and dispersed recreation uses, including types, levels, and access will be determined and described. High use locations will be identified by activity, along with daytime and overnight visits, and seasonal patterns. User preferences and opinions about the quality of recreation resources will also be described. Data will be collected through a literature review and a comprehensive survey and interview program. Salient existing data will also be incorporated.

Future recreation demand will be estimated, based on socioeconomic indicators, foreseeable non-Project recreation developments, and identified issues and trends. Effects of the Project features (e.g., reservoir and access roads) on hunting and trapping opportunities and on non-consumptive uses (bird-watching, hiking, camping, boating, etc.) in the vicinity and downstream of the proposed Project reservoir will be assessed. Additionally, the recreation effects of any Project-induced changes in ice formation the Susitna River will be evaluated. There are also potential effects of induced recreation along the Denali Highway and downstream from the Susitna River bridge on the Denali Highway to the proposed Watana Reservoir. The effects of Project construction and operational activities (e.g. noise, dust, limitations on access, and recreation activities of construction workers) on recreation will also be analyzed. Recreation demand within the study will be estimated within the study area in the reasonably foreseeable future.

Survey results and an inventory of current and projected recreation opportunities, commercial services, and facilities will inform the Socioeconomic Resource Study in regard to the economic contribution of recreation in the study area.

Recreation Carrying Capacity

There are no existing developed recreation facilities on the Susitna River at the Watana Dam site. In the broader Project area, both public and private recreation facilities exist. These are primarily located along the road system.

The existing physical carrying capacity of recreation resources in the Project area will be estimated. Public facilities will be inventoried and described as to condition, capacity, adequacy and operational cost. Private facilities will also be inventoried to the extent practicable. Public access to recreation sites will also be described, including Americans with Disabilities Act (ADA) compliance, if appropriate.

The need for and capacity of additional reasonably foreseeable recreational facilities will be forecast. Carrying capacity guidelines and standards will be applied in order to develop recommendations for future recreation facilities and sites.

Data Collection

The collection of recreation user data will be accomplished through multiple survey processes. The study design will describe target respondents, geographic locations, target days and months, and questionnaire content; survey methods, in the context of consultation with agencies, workgroups, Alaska Natives, and others Survey instruments will be designed to collect information typical of and compatible with other FERC efforts. This includes the survey conducted for the 1985 studies (Harza-Ebasco 1985b) and other surveys such as the SCORP (DNR 2009) and the Alaska Visitor Statistic Program (AVSP) (McDowell 2012).

Identification and Analysis of Salient Data from Existing Survey Research

Recreation supply and demand data from other recreation planning sources applicable to the region will be synthesized. Existing data can inform estimates of levels (e.g., “recreation days”) and types of participation in recreation uses. The estimates will include a discussion and comparison of participation rates in activities regionally, statewide, and nationally. Recreation trends, as forecast in other studies, will also be described.

The AVSP Survey (McDowell 2012) is a statewide research program commissioned by the Alaska Department of Commerce, Community and Economic Development that included 6,747 visitors to Alaska in the summer of 2011 and 1,361 visitors in the Fall/Winter 2011/2012. The SCORP (ADNR 2009) survey database will also be used quantify recreation uses and demand. In addition, Alaska Travel Industry Association research (GMA 2011) about nonresident travel to Alaska will be reviewed and summarized as it pertains to recreation and aesthetic appeal of Alaska’s visitor market.

These data will be utilized to describe year-round nonresident (non-Alaskan) experiences by visitors in three major communities in the MSB (Palmer, Wasilla, and Talkeetna), passengers on the Alaska Railroad, and cruise passengers (visiting McKinley Princess Lodge).

The existing data include

- Lodging types
- Activities
- Length of stay
- Purpose of trip

- Previous travel to Alaska
- Modes of transportation used within the State
- Trip spending
- Communities visited (overall and overnight)
- Demographics (origin, age, income, party size)

This nonresident data will be evaluated along with existing data relating to recreation use by Alaska Resident, in the context of the overall study plan.

Incidental Observation Survey

The purpose of the incidental observation survey is to capture information from field researchers about dispersed recreational use. The survey will gather information on the date and time of day the activity was observed, the type of activity observed, number of people recreating, and the location of observed activity. This survey will not have statistical value, but will help identify types of recreational use in the study area. A protocol will accompany the survey to inform field crews how to complete and submit the survey. The survey will be used throughout the study.

Telephone Surveys of Railbelt Residents

The purpose of this survey is to interview a sample of residents about their recreation use in the area and to collect perspectives about recreational opportunities. The survey will be administered to a statistical sample of 600-900 randomly-selected Railbelt residents within a four-hour drive of the study area (Fairbanks, Denali Borough, Mat-Su Borough, and Anchorage). This survey will be central to the estimation of resident recreation demand. The SCORP survey instrument will be reviewed for any benchmark questions to be considered in the survey design. The overall sample size will be refined after considering desired subgroup samples.

The survey instrument design will capture

- Past and current recreation use within the study area
- Year-round seasonal, and day/night recreation use in the study area
- Nature of use or recreational interest, including, but not limited to, fishing, boating, camping, picnicking, hiking, off-roading, snowmachining, snowshoeing, skiing, horseback riding, biking, rock/ice climbing, dogsledding, photography, mushroom/berrypicking, scenic touring, wildlife viewing, and hunting
- Guided or unguided uses
- Recreation preferences (such as pristine, primitive, semi-primitive, or developed)
- Expected future recreation use within the study area, including how use may change with Project development and operational alternatives
- Means of access to the study area
- Quality of the recreational opportunity
- Importance of and satisfaction with current recreation facilities (such as boat launches and trails)
- Attractiveness of the study area for recreational activities
- Accessibility and conditions/availability
- Visual quality of the scenery in the study area
- Distance that users are willing to travel for weekend recreational opportunities
- Demographics of household and respondents.

Questions that elicit information central to related disciplines, such as the Regional Economic Evaluation Study, may also be included.

Intercept Surveys and Structured Observation Visitor Counts

The purpose of these surveys would be to capture specific recreation use data from users accessing the area by boat, rail, air, snowmachine, or other modes. The survey would be conducted in person based on a sampling plan that captures peak seasonal uses.

Access points may include, but are not limited to, boat launches (e.g., Susitna Landing, Willow Creek, Talkeetna, Deshka Landing), railroad whistle stops, trail heads (e.g., East-West snowmachine trail head on the Parks Highway, along the Denali Highway), air strips, and campgrounds (e.g., Brushkana Creek).

The survey instrument design would capture, but would not be limited to

- Number in party and demographics
- Community of residence
- Participation in type and location of recreation activity
- Rating of quality of recreation experience
- Level of satisfaction with facilities/recreation activities, including aesthetics
- Guided or unguided use
- Past use and intention for future use
- Trip expenses
- Means of access to the recreation area
- Accessibility, conditions, and availability
- Other opportunities within same distance that offers similar experiences
- Preferences
- Interest in potential new recreation facilities and opportunities.

On sample days, the survey crews will observe key characteristics of recreation use (e.g., the number of people present, the number of vehicles entering/exiting the access site, types of recreation activities evident) and record this information on pre-printed forms. Users to be surveyed in person will be selected by availability and willingness to participate.

Executive Interviews

The purpose of the executive interviews is to gather specific information about commercial (e.g., guides, tours, etc.) and private recreation use the study area. It is anticipated that between 50 and 70 private sector recreation businesses, associations, and other entities will be interviewed.

These interviews will be conducted by telephone. The executive interview process will be necessary to develop trust with businesses and organizations with recreation-related interests in the study area, in order to collect proprietary economic data for use in the Regional Economic Evaluation Study. The process of developing a list of potential respondents includes the identification of organizations, associations, government agencies, and businesses with recreation-related interests in study area. This list will be developed through existing and referred contacts, internet searches, and interviews. Contacts may include, but will not be limited to

- Mat-Su Borough Convention and Visitors Bureau
- Federal Agencies, such as BLM, NPS, etc.

- State Agencies, such as DNR, Alaska Department of Fish and Game (ADF&G), etc.
- Alaska Railroad
- Regional governments
- ANCSA corporations and tribal organizations
- Community councils
- Alaska Outdoor Council and other recreation organizations
- Alaska Outdoors Bulletin Board
- Citizen groups
- Environmental organizations

Business representatives to be interviewed may include those associated with

- Remote lodges/cabin rentals/accommodations/campgrounds
- Restaurants
- Airstrips and flying services/flightseeing
- Guide services
- Whitewater rafting/boat trips
- Tour operators (all modes)
- Recreational mining operations
- Transportation services, including buses and Alaska Railroad

The interview protocol (guide) may include, but is not limited to the following topics:

- Nature of business/service (e.g., guide, tour operator, accommodations, etc.)
- Employment
- Season of operation (e.g., year-round, summer, winter, hunting, etc.)
- Means of access to destination (e.g., fly-in, boat, road, etc.)
- Specific areas of operation within the study area
- Years of operation
- Estimated number of clients per year
- Client/membership information, including origin, party size, general perceptions of age, or other demographic features
- Fees charged
- Ways that use might change under the various operational alternatives identified and potential impacts on area image, fishing, hunting, and other recreation activities
- Past and current plans, programs, business operations, membership, activity, etc.
- Geographic areas of highest recreational interest (and reasons why)
- Recreation infrastructure used or needed
- Identification of any trends (anecdotal and data sources) in recreational use levels or patterns
- Information about other projects proposed in the study area that could directly or indirectly affect recreation, tourism, or access to the previously inaccessible areas
- Suggestions for prioritizing the highest potential recreation demand in the area
- Other data needed for socioeconomic baseline or other social science research

GIS Maps and Figures

Recreational sites, facilities, and access routes (RS 2477 rights-of-way, 17(b) easements, and other recreation use trails) will be identified and digitized in a GIS using existing agency and licensing participant datasets and aerial photography. These recreation features will be "ground-truthed" (via ground- and air-based observations) and geo-referenced where possible. Focus group interviews, discussions with licensing participants, coordination with other resource study disciplines, and user intercept surveys will augment recreation facilities and trails mapping. Significant recreation facilities and access points will be photographed for inclusion in the Recreation Resources Report.

10.5.5. Consistency with Generally Accepted Scientific Practice

The methods and work efforts outlined in this Study Plan are the same or consistent with analyses used by applicants and licensees and relied upon by the Commission in other hydroelectric licensing proceedings. The proposed methodology for analysis for demand and capacity estimates and survey sampling are commonly employed in the development of hydroelectric project license applications.

10.5.6. Schedule

Upon approval for implementation, it is estimated that the term of the study would be approximately two years.

Table 10.5-1. Recreation Resources Study Schedule.

Description	Start Date	Completion Date
Data Collection (including seasonal field visits and surveys)	January 2013	November 2014
Inventory	January 2013	October 2014
Analysis	November 2013	November 2014
Initial Study Report		December 2013
Updated Study Report		December 2014

10.5.7. Level of Effort and Cost

The estimate of the two-year recreation study is $570,000.

10.5.8. Literature Cited

Alaska Energy Authority (AEA). 2011a. Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality and Transportation Data Gap Analysis. Prepared by HDR, Inc., Anchorage.

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10.6. Aesthetics Resources Study

10.6.1. General Description of the Proposed Study

The goals and objectives for the Aesthetic Resources Study are to inventory and document baseline aesthetic (e.g., visual, auditory) conditions in the Project area and evaluate the potential effects on aesthetic resources, beneficial or adverse, that may result from construction and operation of the proposed Project.

10.6.2. Existing Information and Need for Additional Information

Existing information was compiled in the Recreation Data Gap Analysis (AEA 2011a) and recreation resource descriptions and inventory presented in AEA's Pre-application Document (PAD) (AEA 2011b). A recreation study was initiated in 2012 to gather data to inform the 2013-2014 study plan, including the following elements:

- Interviews with key representatives of agencies and organizations, including Alaska Native entities, knowledgeable about regional and state recreation management and issues
- A compilation of existing recreation inventory and capacity information
- An inventory of Project area access
- Incidental Observation Survey Data (completed by field crews)
- Coordination with other study disciplines and incorporation of data
- Geo-referenced mapping
- Field reconnaissance
- Identification of future trends and issues
- A description of the management framework
- Interviews with key representatives of agencies and organizations
- Assessment of management frameworks for pertinent agencies
- Identification of broad Project area viewsheds and preliminary KOPs using those identified in the 1985 license application
- Photography
- Field reconnaissance
- Description of Project area soundscape

Through the prior processes, the FERC scoping process and incorporation of work group and other licensing participant recommendations, study methods for 2013-2014 were developed. Issues, trends, original data collection strategies, and items for detailed analysis are incorporated into the 2013-2014 Study Plan.

10.6.3. Study Area

The overall Project area is shown in Figure 1.2-1. The specific study area for Aesthetic Resources will be developed as part of the analysis and in coordination with information from other disciplines, such as hydrology. It will be based on a viewshed model of proposed Project features, including the dam structure, transmission and road corridors, and the resulting Watana reservoir. The study area will also include portions of the Susitna River located downstream of the Watana Dam site down to Talkeetna.

10.6.4. Study Methods

The visual resource impact analysis will follow methods developed by the BLM (BLM 1986). Specific methodology will be augmented with relevant portions of the USFS Visual Management System (VMS) / Scenery Management System (SMS) (USFS 1995) methods, as consideration of this approach will be an important aspect of bridging data collected during the 1985 PAD (Harza-Ebasco 1985) and that collected during the current study effort. It is also expected that the Visual Sensitivity Analysis will be expanded beyond what is used by the BLM at the planning level to incorporate surveys, focus groups, and information collected through the scoping process. Data collection and analysis will be completed across all four seasons. The Aesthetic Resources Study is interdependent with analyses conducted in other disciplines, both biophysical (e.g., hydrology) and social (e.g., transportation), and coordination of data with other study groups will be significant.

<u>Define Study Area</u>

The preliminary study area identified as part of the 2012 work will be refined based on updated Project design and siting. The viewshed will be generated for all Project features, including roads and transmission lines, and refined in coordination with federal, state, and local agencies. The study area will be sufficient in size to address all established indicators of change, including potential indirect effects to recreation, cultural resources, subsistence, and socioeconomics. It is expected that this area will include the Susitna River drainage and upland areas where views of the basin are expected to change based on construction and/or operation of the proposed Project. Viewshed models will be developed for pre-and post-Project conditions to depict expected changes in viewshed areas (i.e., creation of new views, loss of others). The study area will also include common air transportation routes used for transportation and recreational air tours. Maps displaying the viewsheds and geographic boundary of the analysis area will be created. Important views and vistas identified through other resource reviews will be identified and placed on the viewshed map.

<u>Establish Key Observation Points</u>

A final list of KOPs will be developed using information from the 1985 license application (Harza-Ebasco 1985), field observations in 2012, ongoing interdisciplinary/interagency coordination, and Project scoping. It is expected that KOPs will differ by landscape analysis factors, such as their distance from the Project, predominant angle of observation, dominant use (i.e., recreation or travel), and average travel speed at which the Project could be viewed. KOPs may represent views experienced across all seasons or may be specific to a particular season.

<u>Baseline Data Collection</u>

Field data collection will include a combination of site visits by helicopter and travel of upstream segments of the Susitna River by boat. Additional information describing access, existing lighting, and movement will be recorded. Baseline photography will be collected at a resolution sufficient for use in computer-generated visual simulations.

Data on existing aesthetic resource values will be collected using the BLM's Visual Resource Inventory (VRI) methodology (BLM 1986). Data collection efforts will include an inventory of scenic quality, visual sensitivity, and distance zones within the Study Area. All areas will be evaluated within the context of viewer experiences. For example, views from roadways or from the perspective of a boater traveling downriver will be established as “linear” or “roving” KOPs. Data collection methods are described below.

Scenic Quality

Scenic quality of the Project area will be determined through the VRI process (BLM 1986). This process entails dividing the landscape into Scenic Quality Rating Units (SQRUs) based on conspicuous changes in physiography or land use and ranking scenic quality within each SQRU based on the assessment of seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. Each key factor is scored, and the value of each is added to derive an overall score for the unit. Based on these results, each SQRU is assigned a scenic quality rating of A, B, or C, with A representing the highest scenic quality and C representing the lowest scenic quality.

Visual Sensitivity

Viewer sensitivity will be classified using the BLM Visual Sensitivity Level Analysis (SLA) (BLM 1986). The SLA will be completed in two steps: (1) delineation of Sensitivity Level Rating Units (SLRUs), and (2) rating visual sensitivity within each SLRU. By definition, SLRUs represent a geographic area where public sensitivity to change of the visual resources is shared amongst constituents. The unit boundaries may be defined by a single factor driving the sensitivity consideration, or factors driving sensitivity may extend across numerous SLRUs. Units are thus derived, in part, by the consideration of factors analyzed in the SLA. Visual sensitivity within each SLRU is estimated as high, medium, or low, based on the types of users, amount of use, public interest, adjacent land use, and land use designations. Information required for this analysis will be obtained through land use plan review, data collected by other resource disciplines, and surveys and/or focus groups. The data collected through surveys and focus groups will be coordinated with the set conducted for the Recreation Resources Study. Respondents will be asked about their place-based visual preferences.

Visual Distance Zones

Distance zones represent the distance from which the landscape is most commonly viewed. These zones will be established by buffering common travel routes and viewer locations at distances of 3 miles, 5 miles, and 15 miles using GIS (BLM 1986).

<u>Photo Simulations</u>

To support the visual resource impact analysis and to disclose expected visibility of Project components from various vantage points, photo simulations will be prepared. Simulations will be produced by rendering Project components (turbines, substations, access roads, etc.) with 3-dimensional (3D) computer models and superimposing these images onto photographs taken from KOPs. Model parameters will account for environmental factors, such as seasons, viewing angle, and light conditions, resulting in an accurate virtual representation of the appearance of the proposed Project. Simulations will be produced to illustrate (1) the structure, (2) downriver landscape characteristics, (3) reservoir landscape characteristics, (4) access roads and transmission lines, (5) views of reservoir from upland areas, and (6) views of potential construction-related impacts. Additional simulations and/or videography will be produced as needed in key areas. Simulations will be completed by seasons and under daylight and nighttime conditions.

Visual Resources Analysis

BLM contrast rating procedures will be used (BLM 1986). The visual resource impact analysis focuses on established indicators of change. Indicators will include, but will not be limited to, the following:

- Impacts to visual resources, measured by the degree of visual contrast created by the Project
- Change in existing VRI values of scenic quality, visual sensitivity, and distance zones
- Introduction of new sources of light and glare
- Change in the viewshed area, including both the elimination and creation of views and vistas
- Change in the mechanism of view (e.g., transition from mobile view traveling downriver to a static view when situated on the reservoir)
- Change in visibility that may result from Project-related dust

Methodology used to address each indicator is described below.

Contrast Rating Analysis

The BLM Contrast Rating procedure will be used to determine visual contrast that may result from the construction and operation of the Project based on photo simulations depicting Project features. This method assumes that the extent to which the Project results in adverse effects to visual resources is a function of the visual contrast between the Project and the existing landscape character. Impact determinations will be based on the identified level of contrast and are not a measure of the overall attractiveness of the Project (BLM 1986).

At each KOP, Project features will be evaluated using photo simulations and described using the same basic elements of form, line, color, and texture used during the baseline evaluation. The level of perceived contrast between the proposed Project and the existing landscape will be classified using the following definitions:

- None: The element contrast is not visible or perceived.
- Weak: The element contrast can be seen but does not attract attention.
- Moderate: The element contrast begins to attract attention and begins to dominate the characteristic landscape.
- Strong: The element contrast demands attention, would not be overlooked, and is dominant in the landscape.

The level of contrast will be assessed for all Project components used during construction, operations and maintenance, and decommissioning of the proposed Project.

Visual Resource Inventory Analysis

The VRI analysis will be used to identify expected change to VRI classes based on changes to the visual resource values of scenic quality, visual sensitivity, and/or distance zones that may result from operation of the proposed Project. This analysis will be completed within the framework study area, with the goal of understanding how visual resource values and resulting VRI class may shift based on operation of the proposed Project (including the dam, access roads, and transmission lines). Impacts to VRI components will be evaluated by ranking each key factor used to classify scenic quality, visual sensitivity, and distance zones under operational conditions, and comparing those values to that determined through the established pre-Project VRI.

Light and Glare

The impact analysis for light and glare will focus on potential impacts that may result from nighttime artificial lighting and/or daytime glare. The analysis of artificial lighting will identify potential impacts to human activity at nearby off-site locations that may result from the proposed Project. Photo simulations will be produced to demonstrate views of the proposed Project at night from selected KOPs.

Change in Viewshed Area and Mechanism of View

Viewshed analysis performed for both pre- and post-Project conditions will be compared to identify the changes in viewshed and mechanism of view. These data will quantify the extent of changes in views, and the degree to which access to views changes with the development of roads and the elevation of the viewer within the inundated portions of the reservoir.

Change in Visibility

Data generated by the Air Quality Resource discipline will be used to determine the potential for changes in visibility that may result from construction and/or operation of the proposed Project and related recreation resource values. Results from the air quality dust analysis will be incorporated in this study.

Sound Analysis

A systematic sound study will be conducted to characterize the existing ambient sound environment in the vicinity of the proposed Project and estimate the potential impact associated with construction and operational activities.

The steps in the sound analysis are described below.

Review Documentation and Develop Data Needs

Relevant Project data will be reviewed, including the most current Project description, operating and construction equipment rosters, construction schedules. Ambient sound data recorded in the area or in a similar area will be obtained. Based upon this review, itemized data requirements will be developed that would be needed to perform predictive sound emission modeling. Based on this review a set of outdoor ambient sound level surveys in the vicinity of the Project area will be obtained. The data requirements will include anticipated categories of stationary and mobile construction equipment and their frequency of operation, locations of nearest representative noise-sensitive receivers (NSR), recreation sites (RS), and sound data or specifications associated with intended operating dam systems and processes. Laws, ordinances, regulations, and standards that may influence the sound impact assessment for this study will also be inventoried.

Seasonal Surveys of Ambient Sound Levels

Ambient sound level measurements will be collected in the Project vicinity. These will include unattended long-term ([LT]", a minimum of 24 continuous hours, up to a single week) sound level monitoring at up to a total of four representative NSR or RS locations and up to a total of

16 attended short-term ([ST], e.g., 15-20 minutes duration each) daytime and nighttime sound measurements to help characterize the affected environment. Observations of perceived and identifiable sources of sound contributing to the ambient sound environment and the conditions during which they occur will be documented as part of the field survey. This survey will be conducted up to four times, associated with up to four distinct seasons (e.g., summer, fall, winter, spring) but for a minimum of two seasons consistent with NPS Natural Sounds Program (NSP) published guidelines (NPS 2012). To the extent practicable, the survey locations will be the same for each surveyed season.

Modeling of Project Sound Levels.

Up to three scenarios or alternatives of future Project operational sound levels will be estimated with System for the Prediction of Acoustic Detectability (SPreAD). Computer Aided Noise Abatement (CADNA/A), an industry-accepted outdoor sound propagation modeling program, could also be used (Sound Advice Acoustics Ltd, 2012). Predicted sound level isopleths or “sound contours” will be superimposed on suitable aerial photographs or maps of the Project vicinity and will include specific sound level prediction at selected measurement and/or assessment locations from the ambient sound field surveys of Task 2. Predicted sound emissions associated with both Project construction and operation using different transportation route options will also be assessed.

<u>GIS Maps and Figures</u>

Viewsheds, KOPs, and soundscapes will be mapped as GIS layers according to Project standards. Mapping will also identify relevant management standards within the study area. Significant visual features will be photographed for inclusion in the Aesthetic Resources Report. Visual simulations depicting the appearance of the proposed Project will be produced for a subset of KOPs, and used to inform the impact analysis.

10.6.5. Consistency with Generally Accepted Scientific Practice

The methods and work efforts outlined in this Study Plan are the same or consistent with analyses used by applicants and licensees and relied upon by the Commission in other hydroelectric licensing proceedings. The Aesthetics studies are based on the BLM’s visual resources methodology. The sound analysis is consistent with National Park Service Guidelines.

10.6.6. Schedule

Upon implementation, it is estimated that the term of the studies will be approximately two years.

Table 10.6-1. Aesthetic Resources Study Schedule.

Description	Start Date	Completion Date	Duration (months)
Data Collection (including seasonal field visits and sound monitoring)	January 2013	November 2013	11
Inventory	January 2013	October 2013	10

Initial Study Report	October 2013	December 2013	3
Analysis	November 2013	March 2014	5
Updated Study Report	April 2014	December 2014	8

10.6.7. Level of Effort and Cost

The estimate of $500,000 includes the following components over two full years of study.

10.6.8. Literature Cited

AEA (Alaska Energy Authority). 2011a. Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality and Transportation Data Gap Analysis. Prepared by HDR, Inc., Anchorage.

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10.7. Recreational Boating / River Access Study

10.7.1. General Description of the Proposed Study

This study incorporates and contributes to data and analysis conducted as part of the Recreation Resources Study (Section 10.5). In the overall recreation study, recreational boating uses and river access points will be identified. Current and future use of the river by both motorized and non-motorized boat users will also be estimated therein. Because the Project will affect river flow regimes, including the inundation of about 39 miles of the river, and because changes in river flow regimes may directly impact boating and other flow-dependent recreation activities, a specific methodology of recreational flow analysis is also proposed.

<u>Study Goals and Objectives</u>

- The goal of the Recreational Boating / River Access Study is to contribute data to the Recreation Resource Study concerning recreational boating and access.

The goal and objective of the study is to contribute to the Recreation Resource Study concerning the relationship between river flows and recreation opportunities and uses, by:

- developing flow preference curves for each major river reach by type of use and equipment;
- describing the potential effects of altered river flows on existing and potential boating activity and other recreational uses of the Susitna River; and
- describing any new boating or other flow-dependent recreational opportunities that may be created by Project construction and operation.

10.7.2. Existing Information and Need for Additional Information

Existing information was compiled in the Recreation Data Gap Analysis (AEA 2011a) and recreation resource descriptions and inventory presented in AEA's Pre-application Document (PAD) (AEA 2011b). A recreation study was initiated in 2012 to gather data to inform the 2013-2014 study plan, including the following elements:

— Interviews with key representatives of agencies and organizations, including Alaska Native entities, knowledgeable about regional and state recreation management and issues

— A compilation of existing recreation inventory and capacity information

— An inventory of Project area access

— Incidental Observation Survey Data (completed by field crews)

— Coordination with other study disciplines and incorporation of data

— Geo-referenced mapping

— Field reconnaissance

— Identification of future trends and issues

— A description of the management framework

- — compilation of existing baseline boating recreation information and access;
- — hydrology data review;
- — field reconnaissance and photography;
- — identification of future trends and issues; and
- — description of the management framework and special river designations.

- — compilation of existing baseline boating recreation information and access;
- — hydrology data review;
- — field reconnaissance and photography;
- — identification of future trends and issues; and
- — description of the management framework and special river designations.

Available information from the 2012 data gathering efforts will be used to develop the Revised Study Plan.

Through the consultation events including the FERC scoping process and work group meetings, other licensing participant recommendations including input on study methods were used for development of the 2013-2014 study plans.

10.7.3. Study Area

The reaches of the Susitna River, shown in Figure 10.7-1, will be subdivided into smaller units as a result of physical studies in other disciplines and field observations conducted in the Recreational River Flow Study. Areas of concentration will include areas where the proposed reservoir would create the most flow changes.

The Recreation River Flow Study will focus on those reaches of the Susitna River directly affected by the Project. These include the section of river that would be inundated by the proposed reservoir, Devils Canyon, and the reach downstream of Devils Canyon to the confluence with the Talkeetna River.

10.7.4. Study Methods

The Recreation River Flow Study is interdependent with analyses conducted in other disciplines, especially physical (e.g., hydrology) and social (e.g., transportation), and input of data from those study groups will be significant.

This Study is designed to identify the minimum and optimum instream flow needed for motorized, non-motorized, and whitewater boating, as well as other flow-dependent recreational activities, on the Susitna River.

Using accepted practices for recreational flow study design, as described in Whittaker et al. (1993, 2005), a progressive sequence of levels of study will be undertaken. These include: Level 1, desktop analysis; Level 2, limited reconnaissance; and Level 3, intensive field studies. This process maximizes study efficiency by characterizing recreation activities for respective river segments in the desktop phase, confirming assessments in the reconnaissance phase, and then focusing intensive field studies to those activities and river segments warranting detailed study and analysis. This process also contributes to early identification of potential Project effects and user conflicts, and information needed to evaluate potential Project effects on river-based recreation.

Level 1: Desktop analyses integrate existing information about channel characteristics, hydrology, river recreational opportunities, access points, and flows in order to determine what recreational boating resources are present that could be affected by the potential Project.

Level 2: Reconnaissance efforts gather first-hand information on the river resource, types of recreation opportunities, and associated attributes as well as the recreational user groups accessing the river. The reconnaissance also provides valuable information on access sites, logistics, travel to and from the site, local resources and people, and, lastly, potential safety concerns. Motorized and non-motorized watercraft may be used during the reconnaissance to better understand recreation opportunities on the river.

Level 3: Intensive field studies will document the existing flow-dependent recreation opportunities (motorized and non-motorized watercraft) and the associated attributes for the respective opportunities, and will quantify the flow preferences (minimum acceptable and optimum) for each opportunity. This is done through a combination of field observations, interviews with licensing participant groups, focus group sessions, and an instream flow recreation survey targeting recreation opportunities for a given river segment. The survey work will be conducted in coordination with surveys associated with the overall Recreation Study.

Elements of recreational boating flow research include:

- *Data collection* - Water recreation attributes for discrete sections on the Susitna River will be described, including types of river recreation, reach length, gradient, character, whitewater difficulty classification, and recommended range of flows for respective recreation activities. Activities will be identified by type of motorized and non-motorized water craft, including whitewater kayaks and packrafts; commercial and non-commercial uses; and trip purposes, trip length, frequency of use, and seasonal considerations.
- *Reconnaissance* – River recreation opportunities and associated instream flow attributes will be observed and described. Existing and potential sites for recreational boating access along the river corridor and the area inundated by the proposed reservoir will also be described.
- *Consultations* - Boaters, land and resource managers, guides, user groups and others will be interviewed to determine the types and locations of boating activity occurring on the Susitna River. Interviews will be conducted with boaters and other experts with experience on the Susitna River to determine a range of conditions generally acceptable to various types of watercraft and skill levels.

Consultation methods include the following:

- Interviews will be conducted with river recreation users with previous experience on the Susitna, including motorized, non-motorized, and whitewater boaters.
- Focus group sessions will contribute additional information about flow preferences, recreation use patterns for respective reaches and groups, whitewater difficulty, safety, campsites, significant rapids, and recreational access. The focus group sessions will be coordinated with national, regional, or local water recreation clubs.

Outcomes of the process include the following:

- Motorized and non-motorized boating opportunities and associated attributes for the range of flows will be examined. This includes, where applicable, the level of whitewater difficulty, portage requirements, length of trip, and characterization of experiences. Includes tourism boating up to Devils Canyon.
- Flow preference curves for each reach will be developed for respective river recreation opportunities.
- The frequency for the range of preferred flows for respective opportunities will be quantified for existing conditions and likely proposed Project operations.
- Put-in and take-out sites and related needs (e.g., scouting and remote camping) that may be associated with respective recreation opportunities in a particular river segment will be identified.

10.7.5. Consistency with Generally Accepted Scientific Practice

The methods and work efforts outlined in this Study Plan are the same or consistent with analyses used by applicants and licensees and relied upon by the Commission in other hydroelectric licensing proceedings. The proposed methodology is often used in analysis for development of hydroelectric license applications to fulfill the FERC's Exhibit E requirements for documentation and development of mitigation measures for flow dependent recreation.

10.7.6. Schedule

Upon implementation, it is estimated that the term of the studies will be approximately two years.

Table 10.7-1. Recreational Boating / River Access Study Schedule.

Description	Start Date	Completion Date	Duration (months)
Data Collection (including seasonal field visits and consultations)	January 2013	November 2013	11
Inventory	January 2013	October 2013	10
Initial Study Report		December 2013,	
Analysis	November 2013	March 2014	5
Updated Study Report	April 2013	December 2014	8

10.7.7. Level of Effort and Cost

The estimated cost of the two-year study is $100,000.

10.7.8. Literature Cited

AEA (Alaska Energy Authority). 2011a. Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality and Transportation Data Gap Analysis. Prepared by HDR, Inc., Anchorage.

——. 2011b. Pre-application Document: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2011. Prepared for the Federal Energy Regulatory Commission, Washington, DC.

Harza-Ebasco Susitna Joint Venture (Harza-Ebasco). 1985. Susitna Hydroelectric Project Recreation Survey Report. Prepared for the Alaska Power Authority. Anchorage, Alaska.

Reed, S.E., J.L. Boggs and J.P. Mann. 2010. SPreAD-GIS: an ArcGIS toolbox for modeling the propagation of engine noise in a wildland setting. Version 2.0. The Wilderness Society, San Francisco, CA. U.S. Department of the Interior, National Park Service, Alaska Regional Office. March 7, 2012.

Whittaker, D., B. Shelby, W. Jackson. 1993. Instream flows for recreation: a handbook on concepts and research methods. U.S. Department of Interior, National Park Service Rivers and Trails Conservation Program, Oregon State University, and National Park Service. Water Resources Division.

Whittaker, D., B. Shelby, and J. Gangemi. 2005. Flows and recreation: a guide to studies for river professionals. Report for Hydropower Reform Coalition and National Park Service – Hydropower Recreation Assistance.

10.7.9. Figures

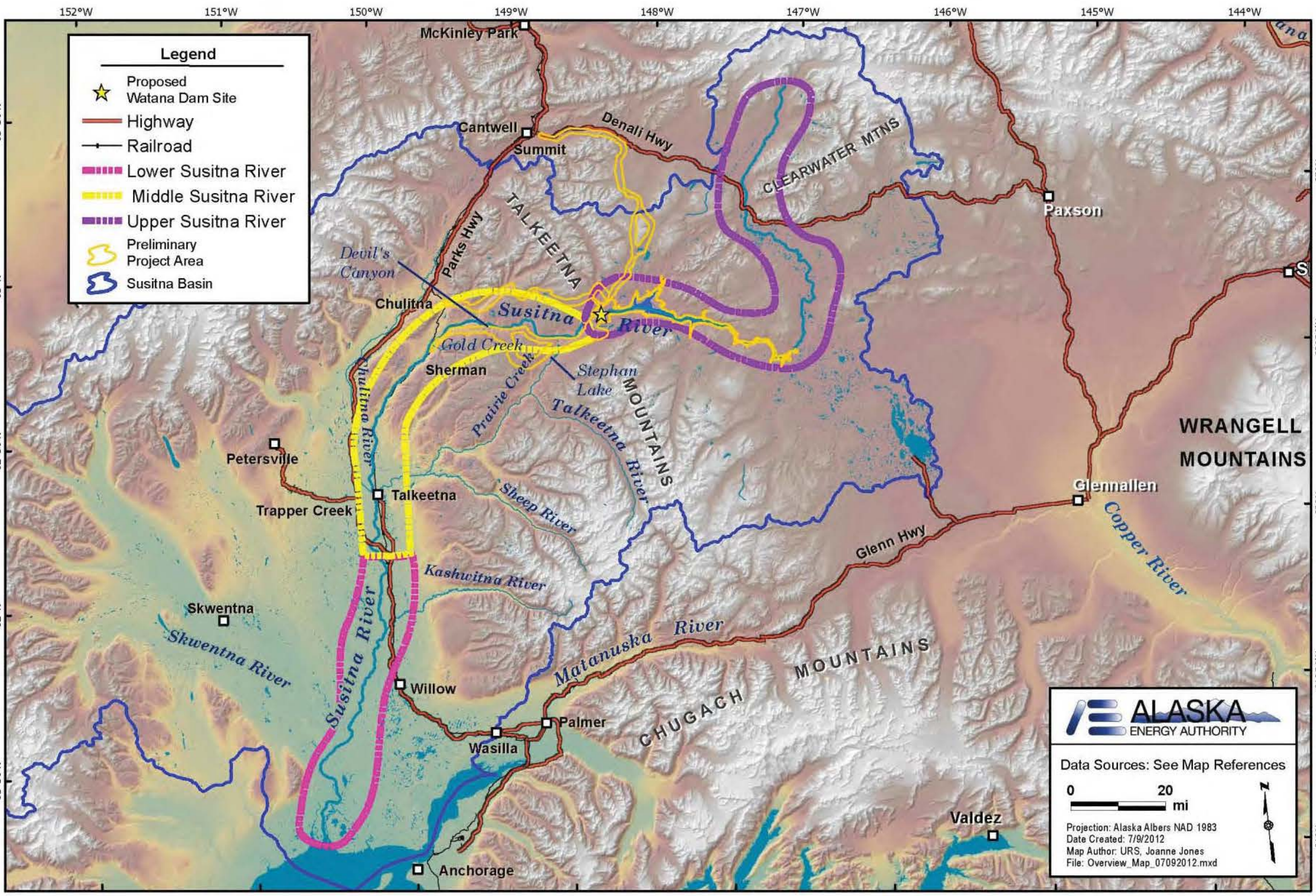

Figure 10.7-1. River Reaches and Key Locations – Recreation and Aesthetic Studies.

10.8. Attachments

ATTACHMENT 10-1. DOCUMENTATION OF CONSULTATION ON RECREATION AND AESTHETIC RESOURCES STUDY PLANS

ATTACHMENT 10-1

DOCUMENTATION OF CONSULTATION ON RECREATION AND AESTHETIC RESOURCES STUDY PLANS

VIA ELECTRONIC MAIL: NO HARD COPY TO FOLLOW (wdyok@aidea.org)

IN REPLY REFER TO:
L7425 (AKRO-EPC)

United States Department of the Interior
National Park Service
Alaska Regional Office
240 W. 5th Avenue
Anchorage, AK 99501

Wayne Dyok
Susitna-Watana Project Manager
Alaska Energy Authority
813 West Northern Lights Boulevard
Anchorage, AK 99503

March 7, 2012

Subject: 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241-0000.

Dear Mr. Dyok:

Representatives of the National Park Service (NPS) have attended a series of recent Technical Working Group meetings on the proposed Susitna-Watana Project (Project), including the 2/27/12 session addressing Social Resources where the proposed 2012 studies of Recreational and Aesthetics resources were presented and discussed. NPS is responding to the Alaska Energy Authority's (AEA) request for comments on 2012 pre-licensing draft study plans for the Susitna-Watana Hydroelectric Project. Our comments, below, are based on our review of the:

1) Pre-Application document (PAD)
2) Scoping Document 1 (SD1)
3) Limited "gap analyses" reports*
4) Request for Proposals (RFP) for Recreation and Aesthetics (released on February 13, 2012)
5) Draft 2012 Study Plans (released on February 16, 2012), including the 2012 Draft Recreation and Aesthetics Study Plan (Study Plan) addressing issues A-S1, A-S2, R-S1, R-S2 & R-S3

NPS has previously provided comments on Recreation, Aesthetics, and Wild and Scenic Rivers included in the Department of Interior's response to the Notice of Application for Preliminary Permit, dated January 12, 2012. These comments are focused on the <u>2012 draft study plans</u> for recreation and aesthetics, although we also intend to actively participate in the studies planned for future years during the FERC proceeding.

*With regard to item #3, above, NPS notes that the August 2011 Gap analysis for recreation and aesthetics, referred to by AEA as "*HDR Alaska, Inc. 2011. Socioeconomic, Recreation, Air Quality and Transportation Data Gap Analysis Draft Report prepared for the Alaska Energy Authority, August 25, 2011*", has still not been made available for our review. This information was referenced, but not included, in the PAD. NPS participated actively in a series of 2011 Gap analysis meetings that should have informed both this analysis and the PAD. We note that the Gap reports for other resources were distributed to stakeholders some time ago. We have requested a copy of the report by email twice during mid-February (to Emily Ford and Sandie Hayes at AEA), again in person during the 2/27/12 meeting, and again by phone (Cassie Thomas to Betsy McGregor on 3/7/12). At the 2/27 meeting AEA stated that it would soon be posted to the Project website. It is not yet there, and due to the importance of getting our input to AEA prior to the deadline set for your consultants to finalize the 2012 study plans, we are submitting these comments without having had the opportunity to review that document.

In general, we find the approach to conducting recreation resource studies for the current year to be unrealistic in terms of the timing and unlikely to achieve the stated objectives cited in the Draft 2012 Study Plan. We are primarily concerned with a lack of a comprehensive baseline of existing conditions within the project area. In order to proceed with future studies for recreation and aesthetic resources, we believe considerably more time and resources are needed to develop that baseline than what is currently envisioned. We are also concerned about reliance on the study efforts and dated methodology of the mid 1980's, the missing and hence unreviewed gap analysis, and the cursory survey of commercial outfitters conducted in 2010.

We have the following specific comments:

Time Schedule for 2012 Study Plan Development

Based on the very aggressive schedule reflected in the RFP, most notably for the 2012 studies, we have serious reservations about the selected consultants' ability to produce credible study plans within the stated deadlines. This is particularly relevant if the selectee is different from the consultants currently working on the project who, at least, have historic perspective on the proposed project. As an example, the RFP states that "The Program Lead shall use the following assumptions when planning for work efforts in calendar year 2012 (at a minimum)":

- "Participation in two (2) technical work group or other agency meetings in Anchorage (February and March) to finalize the 2012 study plans and present the approach to implementing the study plans."

  We note that the new Program Lead was not selected until Feb. 29, is unlikely to have participated in the first work group meeting (Feb. 27), and will have limited ability to interact and consult with resource agencies to inform preparation of the Final 2012 Study Plans, which are due to AEA on March 20. We find that completion date to be highly unrealistic.

- "Agency Workgroup Meetings on 2012 Final Study Plans - April 3-6, 2012".

We note that this date closely follows the March 23 public distribution date for the Final 2012 Study Plans and permits virtually no time for resource agency review and comment back to AEA. These multi-day workgroup meetings are scheduled shortly before the internal agency deadlines for submission of our final ILP study requests for 2013-14 (due to FERC by 4/27/12), overloading staff at this critical time in the project schedule. The workgroup meetings will follow a week of public scoping meetings, many of which the same agency staff will be attending. Agencies need more than six working days falling during the scoping meetings week to review the 2012 plans before being expected to participate in workgroup meetings. Between the week of scoping meetings and the workgroup meetings, there will be very little time left for agencies to integrate new or modified issues resulting from the 2012 study plans, scoping meetings, or early April workgroup meetings into their ILP requests, due to agency leadership around 4/13.

2012 Recreation Resources Study Plans: The 2012 Recreation studies should focus on establishing a baseline of information relative to existing recreation use (level and activities), supply, and demand. Much of this information was missing from the PAD. Specifically:

- For recreational resources, the study area should include the immediate vicinity of the dam, powerhouse, air strip, construction camp and staging area; the area that would be inundated by the reservoir; all new road and transmission corridors; and downstream areas that would be affected by changes in the Susitna River's flow regime due to project operations. NPS suggests that until shown otherwise, the entire downstream reach of the river be included in the study area, because the combination of the dam's effect on sediment transport, the proposed winter load-following flows, and substantial reduction in late spring breakup flows is likely to have a major impact on channel morphology, woody riparian vegetation, and snow and ice cover. This will affect not only the supply of huntable and fishable species, but also boating access and recreational experience, and winter access to and across the river. Until the results of, e.g., fluvial geomorphology studies and ice process studies are in hand, there is no way to narrow the geographical scope of many other studies, including those of recreational and aesthetic resources.

- The temporal scope of the 2012 study should include an entire year of recreational use.

- The Applicant will need to document the amount and types of sport fishing and hunting currently taking place in the project area.

- The Susitna River is known to offer dispersed recreational opportunities to skilled kayakers and packrafters seeking challenge and solitude. It is also used for sight-seeing by jetboat, for sport fishing access, and as a transportation corridor to access remote cabins and campsites. In order to better understand this use, the Applicant will need to inventory <u>all</u> existing water-borne recreation in the project area.

- In addition to recreational users identified above, current visitors to the project area include backpackers, snowmachiners, ATVers, and backcountry skiers, and may also include mushers, rock and ice climbers, and other categories of users. Many of these users enjoy engaging not only in their primary recreational activity, but in related activities that could be affected by the proposed project, such as berry picking, mushroom hunting, photography and wildlife viewing. As with the preceding categories of recreational use, the applicant will need to characterize the current use, during all seasons, within the area for these activities.

- Many recreational users to the area use informal trails and routes, travelling on foot, via ATV and snowmachine, and, potentially, on horseback, especially for hunting. While the PAD lists several RS 2477 routes, these routes are not identified on any base maps. Nor has the informal network of summer and winter trails and routes that exists in the project area been surveyed or digitized, to NPS's knowledge. To help inform future studies – e.g., to guide the choice of key observation points for aesthetics studies, and the choice of some transects for fluvial geomorphology studies – it is essential that the location of these recreational trails and routes be established as soon as possible.

The information from the mid 1980's, 2010 informal survey, and anecdotal based assumptions from the missing gap analysis do not represent an adequate foundation to characterize the recreation attributes specified above. We maintain that there is a real need for a rigorous reconnaissance effort in 2012 to reach out to current recreation providers and users in the project's region. We suggest that there are several ways to achieve this:

- Outreach to all potential recreation providers – contact by telephone, email, or directly (individually or in focus groups) all known outfitters and guides, air taxi operators, and equipment rental concerns. This inquiry should be guided by an effective survey instrument and appropriate survey protocol developed in consultation with the NPS and other resource agencies.

- A request for data from CIRI regarding permit requests it has received from non-shareholders interested in using Corporation lands for recreational purposes.

- Outreach to user groups – contact any known hiking, boating, fishing, hunting, and snowmachine user organizations to solicit level of use, and characteristics of various activities known to occur in the region. This effort should also be guided by an effective survey instrument and appropriate survey protocol developed in consultation with the NPS and other resource agencies. Again, effective focus group meetings may suffice.

- Direct all survey team members (regardless of discipline or task) working within the project area to document basic observations of recreation activity. They would record number of people seen, apparent activity, location, date and time. This does not involve actual contact of people, simply observation and documentation. We feel that, given the remoteness of this area and with limited access, there is no other way to quantify dispersed recreation use.

Aesthetic Resources:

In the comments of January 12, 2012, it was stated that the Susitna River's natural flow regime, morphology and riparian vegetation have intrinsic aesthetic value, as does the existing landscape upstream of the proposed dam that would be flooded by the proposed project. AEA will need to characterize current/baseline aesthetic conditions generally, and at key observation sites. Note that some of these key sites should be based on the results of the trail and route mapping work we describe above. The geographic and temporal scope of aesthetic resources should be the same as for recreation resources, except that it may be necessary to include more distant locations (e.g. KOPs on surrounding mountains) given that the project's geometric features and large reservoir may significantly alter views from these vantage points.

Observations need to include visual resources as well as auditory resources (natural sounds) in all seasons. We strongly suggest that georeferenced video and still photography be used to document these baseline conditions, and to provide the basis for future simulations of project effects. An effort should be made to video and photograph the Susitna River at a range of flow conditions. This will be particularly important for the section of the river that would be flooded by the reservoir, and the segment within Devil's Canyon, to illustrate the naturally high spring-early summer flows that would presumably be lost unless the Watana Dam is operated as a true run-of-river project.

We are pleased that AEA is adopting the Visual Resource Management (VRM) analysis in accordance with BLM procedures and protocol and suggest that this same methodology be used for all areas potentially affected by the project, not just those that are currently located on lands BLM manages. Given the assembly of this initial baseline data, potential visual and auditory impacts from proposed surface-disturbing activities or developments can be determined in the course of subsequent studies.

Based on review of the draft 2012 study plan for aesthetics, we believe that AEA's approach will adequately address the objectives for this study, provided that an auditory resource component is included and that sufficient information about trails and routes is developed in time to identify key observation points. We are very interested in working with AEA and its consultants to select appropriate KOPs.

Limited Opportunity for Consultation and Collaboration with Resource Agencies

We recognize that under the Integrated License Process, the level of consultation and collaboration is driven by FERC's rigid schedule and by the applicant. We feel that we have had little opportunity to discuss the <u>substance</u> of the 2012 study plans to date. With only the work group meeting on February 27 and another proposed set of meetings in early April before the consultant is expected to have actionable plans, we feel that the schedule is far too aggressive.

Need for Critical Path Analysis

We also note that the studies of highest interest to NPS are in many cases dependent on the results of other studies. We believe it will be essential for AEA and project stakeholders to utilize Critical Path Method (CPM) tools to ensure that studies are not inappropriately conducted simultaneously (in parallel) when the reality is that the results of some studies are needed before certain other study plans can be finalized.

Despite our misgivings about the insufficient time that has been allowed for preparation of the 2012 study plans, and the lack of the Gap analysis report for recreation and aesthetics, we stand ready to engage in the scheduled work group meetings and any other, less formal, opportunities to influence and enhance the 2012 study plans.

NPS appreciates the opportunity to comment on the 2012 Recreation and Aesthetics draft study plans. We intend to remain engaged in this project and look forward to making a valuable contribution to study plan development and future stages of the proceeding. Please contact Cassie Thomas at 907-677-9191 or Harry Williamson at 423-322-4151 with questions regarding these comments.

Sincerely,

/s/ Glen Yankus
SIGNED ORIGINAL ON FILE

For Joan Darnell
Team Manager
Environmental Planning and Compliance

Kirby Gilbert

From:	Cassie_Thomas@nps.gov
Sent:	Thursday, April 05, 2012 4:46 PM
To:	Betsy McGregor
Cc:	bridget.easley@urs.com; donna.logan@mcdowellgroup.net; hbwillia44@gmail.com; Paul_Hunter@nps.gov; j.gangemi@oasisenviro.com
Subject:	NPS Comments on Watana 2012 Study Plan for Recreation and Aesthetics
Attachments:	2012 Rec & Aesthetics Resources Study Draft Final, 4-5-12.docx

Dear Betsy,

NPS appreciates the opportunity to be involved in the development of the informal 2012 Recreation and Aesthetics Resources study plans for the proposed Susitna Watana project. We have reviewed the draft plan posted on the AEA website last week, and would like to offer you and your consultants our revisions to the plan (attached). We are very interested in engaging informally with your team as the project moves forward, and would welcome the opportunity to meet outside AEA's scheduled workgroup meetings.

In addition to our plan revisions, we offer the following comments:

We think there is a need to better describe the "economics" inquiry on page 10, and will continue to request that AEA consider conducting contingent valuation and ecosystem services studies to help quantify the value of the area's recreational and aesthetic resources beyond the direct cash value of tourism

We disagree that adventure film production is in itself a recreational (v. commercial) use of the project area

We agree that all types of user survey methods will be needed, including mail-in surveys, telephone follow-up, field interviews, focus groups, etc., and we are interested in helping design the survey instruments

We think there is a need to include collection of qualitative information (preference, experience, satisfaction, etc.) in the surveys and observations

We are confident that the approach John Gangemi described this Tuesday for evaluating flow-dependent recreation and aesthetics is sound

We are somewhat unclear about which MSB trails you intend to map and ground truth, because the discussion on p. 13 includes conflicting information about the relevance of these trails to the project. We assume all trails that could be affected by altered access, aesthetics, etc. associated with the project will be studied; this does not include all the trails in the borough's trails plan

We understand your intention to integrate auditory aesthetics baseline and study elements in the 2013-14 study plans instead of collecting this data in 2012; we do note, though, that without this baseline acoustic data it will presumably be impossible to evaluate noise detectability using the SPreAd approach

We are interested in helping select appropriate KOPs and KVAs for use in the aesthetic resources assessments (and encourage your use of this

consistent terminology)
Finally, we think it may be advantageous to split Recreation and Aesthetics into subgroups with separate work group meetings

(See attached file: 2012 Rec & Aesthetics Resources Study Draft Final, 4-5-12.docx)

Thanks again for all the work you do, and please feel free to share these comments with other members of your team.

Cassie Thomas

Program Analyst
WASO Park Planning & Special Studies Division AK Coordinator, NPS Hydropower Assistance Program

907 350-4139
11081 Glazanof Dr., Rm 108
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11. CULTURAL AND PALEONTOLOGICAL RESOURCES

11.1. Introduction

AEA is undertaking studies to obtain information to determine the effects of the proposed Project on environmental and cultural resources. Information from these studies will be used to assist in identifying appropriate protection, mitigation, and enhancement measures that will be proposed in the AEA license application.

This study plan outlines the purpose and framework for evaluating the potential effects of the Project on "historic properties." Section 106 of the National Historic Preservation Act (NHPA) requires the Federal Energy Regulatory Commission (FERC) to take into account the effects of licensing a hydropower project on any historic properties in the Project's Area of Potential Effect (APE) included in or eligible for inclusion in the National Register of Historic Places (National Register) and provide the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment. To help ensure compliance with Section 106, FERC requires license applications to include a report discussing any historical and archeological resources in the proposed Project's APE.

A cultural resource study plan normally investigates material resources from the past that may lie within the proposed study area. Material cultural resources such as stone tool artifacts are some of the tangible items used to identify and evaluate sites. Non-material cultural resources such as traditional place names and ethnogeography are also important criteria for identification and, especially, evaluation of site significance. Much of the non-material remains of human past are unattainable in vast regions of Alaska. This is not the case however in the proposed study area of the Susitna-Watana Hydroelectric Project. The proposed location of the project encompasses the western portion of the traditional territory of the Ahtna Athabascans including the entire upper Susitna River drainage upstream from Talkeetna and the upper Nenana River. The study area also encompasses the periphery of Dena'ina Athabascans (Talkeetna Mountains and middle Susitna River), (Kari and Fall 2003; de Laguna and McClellan 1981; Kari 2008). Linguistic data from this area have been systematically gathered for over 30 years and can be incorporated into the overall study of cultural resources within this study area.

This plan outlines and describes AEA's proposal for documenting, recording, identifying, and evaluating cultural resources within the proposed Area of Potential Effect (APE). The 2013-2014 Study Plan for cultural resource investigations begins with discussions of the nexus between cultural resources and FERC's licensing of the Project (Section 11.2), continues with statements of goals and objectives, identifies laws, regulations, and policies that may apply to the cultural resource investigations (Section 11.3), and states how the proposed work is embedded within accepted archaeological and anthropological perspectives and practices (Section 11.5.5). The record of consultation in the preparation of this study plan is summarized (Section 11.4) and also appended (Attachment 11-1). The plan for cultural resource investigations in 2013 and 2014 is discussed in detail in Section 11.5, and a paleontological study plan is summarized in Section 11.6.

11.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

NHPA Section 106 requires FERC to take into account the effect of licensing a hydropower project on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. These historic properties include archaeological sites and isolated finds (both precontact/prehistoric and post-contact/historic); historic properties of religious and cultural significance, including traditional cultural properties (TCPs); and built environment resources (material resources of an architectural nature). Because FERC's licensing of a hydroelectric project is an undertaking that may have an adverse effect on historic properties, FERC requires license applicants to develop a Historic Properties Management Plan (HPMP) to seek to avoid, reduce, or mitigate the any such effects. The Alaska Historic Preservation Act requires similar considerations for historic properties on state land.

The construction and operation of the Project is expected to involve both direct and indirect adverse effects to historic properties within the APE. Changes to the character or use of such resources may occur through ground disturbance associated with construction of the dam and associated linear facilities (e.g., roads and transmission lines); through inundation within the impoundment; and (over the license term) potentially through reservoir shoreline erosion and gradual development of recreational trails. In addition, downstream impacts to historic properties are possible due to Project-induced stream-flow variation. Changing patterns of subsistence and recreational land use brought about by the Project also have the potential to adversely affect historic properties.

Determining whether construction and operation of the proposed Project will adversely affect any historic properties requires systematic inventory of cultural resources within the APE for the Project; National Register eligibility determinations on cultural resources that may be adversely affected by the Project; and assessment of potential Project-related adverse effects on all National Register-eligible cultural resources within the APE. The 2013 and 2014 historic properties investigations will accomplish these objectives by advancing the site inventory effort beyond that of 1978-1985 to include the entire proposed Project's APE. All inventoried cultural resources that may be adversely affected by the proposed Project will be evaluated for National Register eligibility, and eligible historic properties will be analyzed for potential Project-related adverse effects. These investigations will be conducted in consultation with the Alaska State Historic Preservation Officer (SHPO), federal land management agencies, Alaska Native entities, local agencies, and landholders. A restricted service list may be necessary to protect sensitive locational information on cultural resources.

11.3. Resource Management Goals and Objectives

Federal, state, and borough agencies, as well as Alaska Native entities, have formal laws, regulations, and/or policies which may be relevant to analysis of Project impacts on cultural resources and inform the development of a HPMP.

Federal Laws include

- Historic Sites Act of 1935 (16 U.S.C. § 1982)
- National Historic Preservation Act of 1966 (as amended in 2006) (16 U.S.C. § 470)

- National Environmental Policy Act of 1969 (42 U.S.C. § 4321-4347)
- Archaeological Data Preservation Act of 1974 (16 U.S.C. § 469)
- American Indian Religious Freedom Act of 1978 (42 U.S.C. § 1996)
- Archaeological Resources Protection Act of 1979 (16 U.S.C. § 470aa-470ll)
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 et seq.)
- Paleontological Resources Preservation Act of 2009 (16 U.S.C § 470aaa)

Federal Regulations include

- 18 CFR 5: FERC Integrated License Application Process
- 18 CFR 380: Regulations Implementing the National Environmental Policy Act
- 36 CFR 60: National Register of Historic Places
- 36 CFR 79: Curation of Federally Owned and Administered Archaeological Collections
- 36 CFR 800: Protection of Historic Properties
- 43 CFR 7: Protection of Archaeological Resources
- 43 CFR 10: Native American Graves Protection and Repatriation Act

Federal Executive Orders (E.O.) include

- E.O. 11593: Protection and Enhancement of the Cultural Environment (1971)
- E.O. 13007: Indian Sacred Sites (1996)

State Laws include

AS 41.35: Alaska Historic Preservation Act

11.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

A summary of consultation with interested parties used in developing the cultural and paleontological resources study plan is provided in Table 11.4-1. Attachment 11-2 provides documentation of consultation.

Table 11.4-1. Summary of consultation on Cultural and Paleontological Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Letter	01/12/2012	P. Bergmann	USDOI	Comments regarding cultural and paleontological resources. (Filed with FERC.)
Technical Workgroup Meeting Notes	04/03/2012	Various	AEA, ADF&G, ADNR, BLM, FERC, Natural Heritage Institute, NPS, and other interested parties	Meeting with agencies and licensing participants to discuss the 2012 Study Plan and Study Request for 2013-2014 prepared by AEA team. (See Attachment 1-1.)
Meeting	05/02/2012	Ahtna, Inc.	Alaska Native Regional Corporation	Ahtna, Inc. officers and linguist Dr. James Kari discussed with NLUR methods and arrangements for a possible Native place name study and Traditional Cultural Property investigation.
Telephone call	05/21/2012	Dr. R. VanderHoek	Representing Alaska State Historic Preservation Officer, Alaska Office of History and Archaeology	VanderHoek and Charles M. Mobley discussed operational aspects of Unanticipated Discoveries protocols.
Telephone call	05/31/2012	Dr. R. King	BLM-Anchorage District Office	Charles M. Mobley called King to discuss Unanticipated Discoveries protocols, tribal review process, and the need to incorporate BLM Glennallen office as primary contact.
Conversation	06/01/2012	Dr. R. VanderHoek	Representing Alaska State Historic Preservation Officer, Alaska Office of History and Archaeology	VanderHoek and Charles M. Mobley discussed operational details of the Plan for Unanticipated Discoveries.
Technical Workgroup Meeting Notes	06/07/2012	Various	AEA, ADF&G/DOS, ADNR-OPMP, AHTNA, BLM, EPA, FERC, HDR Alaska, MSB, Natural Heritage Institute, NOAA Fisheries, NPS, , USFWS, Knik Inc., and other interested parties	Charles M. Mobley presented current status of cultural resources efforts: curation, unanticipated discovery protocols, and survey of 2012 geotechnical sites. Stakeholders raised concerns about definition of study areas for direct and indirect effects, inclusion of Alaska Native Claims Settlement Act 14(h)(1) sites, need for paleontological study, need for Traditional Cultural Property (TCP) study, levels of involvement by Native parties. (See Attachment 1-1.)
Telephone call	06/12/2012	John Jangala	BLM-Glennallen Office	Charles M. Mobley called Jangala; discussion topics included the following: the draft Unanticipated Discoveries protocol is workable; Native consultation is expected to be inclusionary at first, until parties sort out their interests; BLM's role with FERC may be as Intervener or as Cooperator; BLM wishes to coordinate timing of public meetings as much as possible; and the need for FERC documentation limits the degree of information confidentiality that can be assured.

Comment Format	Date	Stakeholder	Affiliation	Subject
Email	06/12/2012	Dr. Robert King	BLM	Verified reporting requirements for cultural resource survey of 2012 geotechnical sites.
Teleconferences	06/13/2012 11am 06/14/2012 - 1pm; 06/15/2012 - 1pm; 06/20/2012 - 10:15am;	Ahtna, Inc.; Dr. James Kari, Dr. William Simeone; URS CR Team	Alaska Native Regional Corporation, Anthropologists	Intensive work sessions to reach agreement on technical method and budget for the TCP - ethnographic study component of the CR PSP. Multiple drafts prepared by URS for review by participants.
Teleconferences	06/14/2012 - 1pm; 06/15/2012 - 1pm; 06/20/2012 - 10:15am;	Ahtna, Inc.; Dr. James Kari, Dr. William Simeone; URS CR Team	Alaska Native Regional Corporation, Anthropologists	Intensive work sessions to reach agreement on technical method and budget for the TCP - ethnographic study component of the CR PSP. Multiple drafts prepared by URS for review by participants.
Telephone call	06/19/2012 – 06/21/2012	Dr. Richard VanderHoek	Representing Alaska State Historic Preservation Officer, Alaska Office of History and Archaeology	Charles M. Mobley talked with VanderHoek in multiple calls to discuss logistics for field visit on June 28, 2012; and cultural resource discussion in draft Watana Transportation Access Study.
E-mail	06/14/2012 – 6:00pm	Dr. Robert King	BLM	Wrote NLUR that he had received ARPA permit application and cc'd John Jangala, BLM, Glennallen.
E-mail	06/12/2012 – 4:19pm	Dr. Richard VanderHoek	Representing Alaska State Historic Preservation Officer, Alaska Office of History and Archaeology	Responded to NLUR inquiry regarding geotechnical borehole documentation and reporting requirements. He agreed that an interim letter report was appropriate as long as the results are in the final draft summary of the 2012 report.
Field trip	06/28/2012	Dr. Richard VanderHoek	Representing Alaska State Historic Preservation Officer, Alaska Office of History and Archaeology	Charles M. Mobley and VanderHoek traveled to Talkeetna and inspected the project area via helicopter.

11.5. Cultural Resources Study

11.5.1. General Description of the Proposed Study

An initial APE study area proposed herein consists of the reservoir impoundment area and three access corridors (Figure 1.2-1). The impoundment area represents a 45,321-acre area below the 2,200 foot contour. The three proposed access routes differ in length and area. The *Chulitna Corridor* is 51.8 miles long and 36,107 acres in area; the *Denali Corridor* is 62 miles long and 45,097 acres in area; and the *Gold Creek Corridor* is 54.7 miles long and 59,750 acres in area.

The Study Area mentioned above includes areas of anticipated direct effects, at least those areas the will be subject to ground disturbance from Project construction. It is anticipated this APE will be refined during summer 2012 in consultation with interested parties to include other areas of potential direct and indirect effects to initiate the Project studies over an area that will encompass the potential direct and indirect Project effect areas. The APE, as updated for the Revised Study Plan, may need further adjustments during the course of conducting the AEA proposed studies and as the engineering feasibility continue refining the Project details. Within the currently defined APE (Figure 1.2-1), 86 known cultural resource sites (80 prehistoric, 4 Euroamerican historic, and 2 Native historic) lie within in the Susitna-Watana impoundment area. The proposed corridors have a combined total of 29 previously-documented sites (all precontact/prehistoric except for one historic). Additional sites could exist in unsurveyed areas within the APE. The known sites will be located in 2013 and 2014 and coordinates will be recorded with a survey-grade, handheld GPS unit. All site data will be recorded and the site conditions verified. Phase I (Inventory) surveys will be conducted in areas of the APE not previously surveyed or in areas within the APE that the 2012 locational model identifies as high potential for the occurrence of cultural resources. Phase II (Evaluation) studies will be conducted to assess eligibility and to analyze the adverse effects to eligible historic properties. "*Historic property* means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria." (36CFR800.16).

Cultural resources include existing traditional use areas, language, and local knowledge that require the same management considerations as archaeological materials. The ethnogeographic portion of the study is designed as a way to work with Ahtna Elders to integrate Ahtna perspectives on historical land use and cultural values into the cultural resources program. Through a partnership with Ahtna, Inc., the regional corporation for the Ahtna people, this ethnogeographic component of the 2013-2014 Cultural Resources Study Plan will work closely with Ahtna Elders to document Ahtna perspectives and ethnographic context for significance of the cultural resources sites potentially affected by the Project. This work will address the proposed Project area as an ethnographic landscape, documenting traditional Ahtna land use and settlement patterns, seasonal migration, religious and sacred sites, and traditional foot trail systems. There are high quality Ahtna language place name records on file (Kari 2008, 2012). Linguistic analysis of Ahtna place names, including archival taped sources and confirmation interviews with Ahtna Elders, will provide insight into the geographic information, notably hydrology, encoded in the Ahtna terms and narratives for important places.

11.5.1.1. Study Goals and Objectives

The goals of the 2013-2014 cultural resources study plan are to systematically inventory cultural resources within the APE (36CFR 800.4(b)), evaluate the National Register eligibility of inventoried cultural resources that may be adversely affected by the Project (36CFR 800.4(c)), and determine Project-related adverse effects on National Register-eligible historic properties within the APE (36 CFR 800(B).5).

Major objectives are to

- consult with the SHPO and Alaska Native entities throughout implementation of the 2013-14 cultural resources survey;
- inventory cultural resources within the APE;
- evaluate National Register eligibility of cultural resources within the APE that may be adversely affected by the Project;
- determine the potential Project-related adverse effects on National Register-eligible historic properties within the APE; and
- develop information needed to prepare a HPMP for the Project.

The TCP study will be informed through the ethnogeographic study, which has as its goals the identification, inventory, and evaluation of landscape features and resources that have been and continue to be important to the Ahtna people. The objective is to use ethnographic landscape and place name data, to help identify TCPs according to procedures set forth under 36 CFR 800, and determine their significance according to National Register criteria (36 CFR 60.4). Traditional land use patterns of the study area by the Ahtna were based on a migratory cycle that followed the fish, game, and plant harvest opportunities. A complex system of travel and trapping cabins, trails, fish camps, trade routes, portage areas, trap lines, hunting ranges, seasonal camps, and winter villages has been established since time immemorial. Some of these use patterns continue today, incorporating modern subsistence harvest technologies and transportation while maintaining traditional use areas by family and clan. In addition, subsistence activity and land use have also been affected over time by regulations on subsistence, aboriginal land title changes (ANCSA and Alaska National Interest Lands Conservation Act [ANILCA]), schooling, child protection, and medical care laws and regulations. Major activities may include one or more of the following

- document the Ahtna land use patterns in the study area, including the seasonal migration pattern of the late 19th and early 20th centuries, and how they relate to the system of trails, trap lines, hunting and fishing sites, winter villages, and religious sites;
- document types of wild resources exploited and Ahtna Traditional Ecological Knowledge about historic animal and fish populations in the area;
- document traditional stewardship (i.e., traditional management practices);
- document contemporary values associated with the landscape;

- transcribe and translate Ahtna language texts that pertain to the study area;
- document hydrological concepts embedded in place names, directional system, and landscape narratives; and

11.5.2. Existing Information and Need for Additional Information

Cultural resource investigations conducted within the study area between 1978 and 1985 for prior project designs documented almost 300 cultural properties believed to span the last 10,000 years. Site types in the inventory include historic and precontact archaeological sites, historic buildings and ruins, and other cultural features. About one-third of the sites are in or near the location of the proposed Watana Dam and impoundment. Approximately 90 percent have stone tools and other prehistoric artifacts, about 10 percent are historic sites consisting of building ruins and/or scatters of commercially manufactured items (metal cans, bottles, etc.), and less than 1 percent are fossils of animals or plants. The more recent Native sites are from the Athabascan Indians who inhabited the area historically and hold the majority of the area's Native place names in their linguistic dialect (Ahtna); the older sites fade into a more generalized adaptation shared by Alaska's ancient interior peoples. Historic sites in the Susitna-Watana area reflect mining, prospecting, hunting, trapping, fishing, and recreational pursuits, as well as simply remote Alaska living.

11.5.2.1. Archaeological Resources

Between 1978 and 1985, archaeologists conducted cultural resources surveys, testing, and site excavations for the proposed Susitna Hydroelectric project and ancillary facilities (construction camps, transmission lines, access roads). Although the project proposed in the 1980s had a different footprint than the currently proposed Project, much of the areas overlap. For the 1980s project, annual and summary reports described over 270 sites that required some form of analysis and curation of associated artifacts (e.g., Dixon 1985; Dixon et al. 1985; Greiser et al. 1985, 1986). Another 22 previously known sites were revisited and documented. Of the sites found, 111 were located through subsurface testing (resulting from approximately 28,000 shovel tests). Of those known sites, 87 percent have prehistoric/precontact remains, 2 percent have postcontact/protohistoric remains, 10 percent have historic and modern remains, and one site has paleontological remains. Advances in geoarchaeological techniques and current models of the region's stratigraphy, focused especially upon volcanic ash or tephra deposits, prompts re-examination of the conclusions reached in the 1980s regarding site locations and distributions in time and space, the project area's cultural chronology from a locational modeling perspective, and its place in the greater scheme of North American prehistory.

More than a quarter-century of modern archaeological research has been carried out in Alaska since the original Susitna work, aided by new methods and technology, including GPS and GIS, geoarchaeology, geochronology, stratigraphic analysis, lithic and faunal analysis, and ice patch research. Research in Southcentral and Interior Alaska river drainages has demonstrated that the prehistoric cultural chronology and dynamics are far more complex than was previously believed (Dixon 1985). Modern advances in radiometric dating techniques in particular require re-examination of the radiocarbon dates from the project area. Accurate dating is essential to determine site significance which can depend on cultural affiliation, archaeological tradition, and microstratigraphic layers that may represent multiple occupations and/or components spanning hundreds or thousands of years. Only a sample of sites will be prioritized for radiometric dating. Condtions that allow preservation of organic archaeological materials are relatively rare in the study area. Those sites that do contain well-preserved materials, such as animal bone or charcoal, and especially sites that have multiple occupations would be a higher priority than sites containing small flake scatters. Sites that have well-preserved organic features such as buried hearths or buried soils and tephra would also be given higher priority for dating analyses. Sites that represent a culture, archaeological tradition, and/or period in prehistory that is poorly understood would also be given a higher priority. Determining age can be essential for making stie recommendations for inclusion to the National Register.

The cultural resources data gap report (Bowers et al. 2012) reviews and summarizes the cultural resource literature for the Project area prepared during the 1978 to 1985 environmental studies. Data gaps identified include inadequacies in the location information of sites due largely to improvements in field and mapping methods since the 1980s (GIS, portable GPS units, better topographic maps) and advances in survey methodologies compared to those employed during the earlier research. The cultural chronology within the APE warrants re-examination due to more modern dating techniques (e.g., accelerated mass spectrometry [AMS] radiocarbon [^{14}C], optically stimulated luminescence [OSL]) and newer geoarchaeology (in this case tephra) studies. Research into prehistoric land use patterns in interior Alaska has advanced to more sophisticated locational models applicable to the Project's cultural resources field studies. Partial inventories of Alaska Native place names exist that were not available during the "legacy" studies of 1978-1985, and they, too, can now be incorporated into locational models and field survey strategies.

11.5.2.2. Ethnogeographic Resources

Previous studies in the Project area did not identify TCPs, a step that is now required for compliance with Section 106. There were very little data on Alaska Native place names collected during the 1980s Susitna Hydropower legacy studies (e.g., Dixon et al.1985; Greiser et al. 1985, 1986). Information that was collected does not meet current standards for studies such as the one being proposed here, nor are these data in modern geospatial format (see Bowers et al. 2012; Simeone et al. 2011). However, over the past 25 years extensive Ahtna place names research has been conducted by James Kari, William Simeone, and others (e.g., Kari 1983, 1999, 2008, 2010, 2011, and 2012).

Ethnographic data – as defined as interviews, archival documents, and linguistic data (place names) –can help us to determine the value or cultural significance of a site to the Ahtna people, which would better enable us to help identify TCPs. The data will also contribute to the locational model for identifying potential archaeological sites. For example, using ethnographic data to document annual or seasonal activity (including the type of resource used, where harvested, method of harvest, and the season of the year they were harvested) could make it easier to detect the location of archaeological sites. Ethnographic data will also enable us to develop a historical and cultural context for a site, which will help in determining its significance and possible eligibility for the National Register. Furthermore, ethnographic data will aide in the interpretation of a site or artifacts on a variety of levels, for example: (1) how was the site or artifact used, (2) how the site fits into Ahtna history and Alaska history, (3) if the site can be used to explain the cultural history of the area, and (4) if the site has a religious significance not apparent from its physical attributes.

The proposed ethnogeographic study builds on previous research by the two principal investigators, Dr. William Simeone and Dr. James Kari. Models for the research are taken from Simeone and Kari (2002) and Simeone and Valentine (2007)**.** Both studies combined ethnographic, historical, and linguistic research to document traditional Ahtna land use patterns, stewardship practices, and Ahtna Traditional Knowledge for use by the Federal Subsistence Management Program (administered by the U.S. Fish and Wildlife Service) in the management of subsistence fisheries. A third report was used by the State of Alaska to make customary use determinations on non-salmon fish species in the Copper Basin and upper Susitna River (Simeone and Kari 2004). A fourth report, sponsored by the Bureau of Land Management (BLM) as part of the East Alaska Resource Management Plan, analyzed some aspects of Ahtna Traditional Cultural Properties (Kari and Tuttle 2005).

11.5.3. Study Area

The proposed initial direct impacts APE currently encompasses the Watana Reservoir, Watana Construction site, and three potential road and transmission corridors (Chulitna, Denali, and Gold Creek corridors). The Study Area is the first iteration of the proposed APE and may undergo revisions to size and scope in the next several years. (AEA expects to work with the interested parties to refine the APE for the Revised Study Plan.) The APE consists of the geographic area or areas where the character or use of historic properties may be altered (directly or indirectly) by the construction and operation of the Project. The total acreage within the study area is 186,275. Of this area, 63,600 acres near the impoundment area and 19,760 acres near corridors were evaluated in the 1980s. A total of 86 cultural resource sites have been recorded in the project area (OHA 2011). Many were documented during the 1978-1985 surveys before GPS devices were available and therefore must be relocated and described with more accurate geographic coordinates using the correct datum.

11.5.4. Study Methods

The study methods to be implemented in 2013 and 2014 will be focused on cultural resource identification, inventory, and evaluation. The methods described here are the accepted professional practices commonly applied in contemporary archaeological and broader cultural resource investigations. Historic properties to be evaluated encompass precontact/prehistoric archaeological sites, including isolated finds (in Alaska); TCPs; and historic sites, buildings, structures, objects or districts of architectural nature that may be eligible for listing on the National Register.

The field investigations will be executed in two phases. Phase I inventory surveys in 2013 and 2014 to cover the APE, including the proposed Project footprint, corridors, and impoundment area (Figure 1.2.-1). Identification of prehistoric sites requires surface inspection and subsurface testing. TCPs require historic and ethnohistoric interviews, translation, and when possible, field trips. Identification of historic sites is often possible from aerial and ground survey. Surveys may also be needed in areas where access was denied to archaeological crews in 1979 through 1985; and subsurface testing may be required at high-potential areas that were identified but not tested during the previous fieldwork. GIS-modeled locational surfaces of the the APE, which incorporate numerous environmental and cultural variables, are categorized by cumulative numerical values. Higher values are areas of higher site potential, and lower values of lower site potential. The importance of defining and testing areas of *both* lower and higher site potential is fundamental for guiding survey efforts, i.e., confirming areas with higher values as holding most cultural resources, and confirming areas with lower values as having fewer cultural resources via empirical observation. Phase II evaluation surveys (2013 to 2014) will include returns to identified sites for data collection to evaluate each site's eligibility for inclusion in the National Register. Evaluation of known sites requires delineation, establishment, and mapping of site boundary; artifact analysis; and recommendations.

Protocols for the inadvertent discovery of human remains, graves, and/or burial items are described in full detail in the attached Unanticipated Discovery Document. This document outlines the methods; laws; and contact information of affected Alaska Native entities.

Results of the inventory survey will be presented in a Phase I report with recommendations for the Evaluation Phase II site testing and analysis. The Project team will immediately begin processing site evaluation data as they are gathered. Lab analysis and report writing will be conducted concurrent with execution of the field survey. The required Phase II evaluation report will be prepared in 2014 for submittal by AEA to SHPO, BLM, and FERC. The results of this survey will help inform preparation of the HPMP. As is common after the application has been obtained, subsequent seasons will be reserved to developing and implementing strategies for completing evaluations, as necessary, as well as developing management measures for historic properties within the APE, which will be described in the HPMP.

Details of the 2013 and 2014 methods and approaches to be used are listed in the following sections.

11.5.4.1. Mapping-Related Activities

- Map recently identified prehistoric resource locations. Sites will be relocated and mapped with a survey-grade Trimble GeoXT 6000 Series in North American Datum of 1983 (NAD83) with real-time accuracy of 50 centimeters (scheduled for completion in 2013-2014).
- Add to or adjust locational data on prehistoric settlement patterns and land use (scheduled for completion in 2013-2014).
- Add to or adjust locational data on historic settlement patterns and transportation routes (scheduled for completion in 2013-2014).
- Compile additional relevant environmental datasets from the 2012 field season for use in future locational model (scheduled throughout 2013-2014).
- Map TCPs, creating a geodatabase with TCP/sacred sites locations and place names. Locations will be depicted based on historical and cultural information. Depending on the nature of some of the resources, special restrictions may need to be placed on access to information to protect data pertaining to sacred or religious significance (scheduled throughout 2013-2014).
- Prepare maps using the latest GIS files with Ahtna place names (Kari 2012) and expanding and annotating the current Ahtna/Dena'ina place name corpus into the geodatabase currently being developed for cultural resources sites (scheduled throughout 2013-2014).

11.5.4.2. Ethnogeography-Related Activities

- Hold a regional Elders conference to provide a venue to inform the communities of the upcoming research work, including information on other AEA sponsored research, such as fisheries and wildlife studies, subsistence studies, etc. (scheduled throughout 2013-2014).
- Identify, inventory, and compile archival data sources of the Ahtna language, with particular focus on the Jake Tansy recordings on land use and travel, some of which appear in Kari (2010). Recorded stories pertinent to the upper Susitna River from other Ahtna narrators, including Jim Tyone, Jack Tyone, John Shaginoff, Henry Peters, and Fred John will be evaluated, along with the few known Shem Pete recordings and narrative segments that pertain to the Talkeetna Mountains and the upper Susitna River (scheduled throughout 2013-2014).
- Identify and inventory additional data from collections of tapes and transcripts recorded in the English language by the Bureau of Indian Affairs (BIA), the Institute for Social and Economic research (ISER), Ahtna Inc., and other researchers, including Frederica de Laguna and Constance West. Much of this material has never been analyzed with regard to the study area (scheduled throughout 2013-2014).
- Identify knowledgeable Ahtna individuals to interview for current ethnographic information on TCPs in the study area (scheduled throughout 2013-2014).
- Collect interview data on contemporary land use and the cultural landscape (scheduled throughout 2013-2014).
- Develop interview protocol with the assistance of knowledgeable Ahtna individuals in order to guide effective interviewing (scheduled throughout 2013-2014).
- Interview between 30 and 50 Ahtna persons of different ages (estimate 2 hours per interview (scheduled throughout 2013-2014).
- Document the results of interviews, and transcribe tapes. (Scheduled throughout 2013-2014).

11.5.4.3. Synthesis and Analysis Activities

- Develop historic contexts. This task that will be largely dependent on the outcome of 2012 planning studies, fieldwork, analysis, and agency consultation. This task will be implemented in 2014.
- Update cultural chronology: This task will be largely dependent on the outcome of 2012 planning studies and 2013-2014 fieldwork and analysis. For this reason, this work will be deferred until after field studies are complete. This will require collecting and analyzing samples at a number of sites for archaeometric analysis, radiocarbon dating, OSL dating, and tephrochronology (see Bowers et al. 2012).
- Summarize paleontological records and develop site location model. Thomas Bundtzen and Pacific Rim Geological Consulting (Fairbanks) will perform a geologic literature review of the APE, relying as much as possible on the legacy records from the 1980s.

From this, combined with knowledge of regional rock formations and geochronology, a classification system will be developed for the likely location of significant fossils. This effort will be targeted for the 2013 season (see Section 11.6).

- Develop archaeological locational model prior to fieldwork. Compiled digital data will be examined statistically to assess strength of associations between known dependent variables (site locations) and independent variables, such as elevation and other environmental variables (15 to 20 or more variables can be assessed). The derived model output is a map of the study area with negative to positive values depicted in 30 meter (98 feet) by 30 meter (98 feet) units that grade from dark to light; areas with negative or lower values are least likely to hold sites, and areas with higher, positive values are most likely to hold sites. The information generated is instructive for developing survey strategies across the APE prior to fieldwork, particularly for areas previously not surveyed, but also for areas surveyed in the past that appear to need further exploration.
- Transcribe and translate place name terms and narratives, with initial translation performed by Dr. Kari (scheduled throughout 2013-2014).
- Proof-read and correct initial and secondary translations by language specialists or Ahtna Elders (scheduled throughout 2013-2014).
- Develop a synthesis and final report. Combine the archaeological results; locational model; historic and contemporary land use patterns; Ahtna perspectives on the land and resources; Ahtna-language place names; and narratives about important locations. Identify additional studies and reports if needed (scheduled for 2014).

11.5.5. Consistency with Generally Accepted Scientific Practice

The research methods discussed in the proposed Cultural Resources Study (Section 11.5) are consistent with professional practices and FERC's study requirements under the Integrated Licensing Process (ILP). Inventory, evaluation, and determination of effect are well-established steps under NHPA Section 106 and the ACHP's implementing regulations at 36 CFR Part 800. Additionally, the quality of work and qualifications of workers will adhere to the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716).

The Cultural Resources Study for licensing of the proposed Project, as described in this study plan, will be undertaken in accordance with the implementing regulations of NHPA Section 106, FERC's ILP regulations, the Secretary of the Interior's (Secretary) Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716), the Secretary's Professional Qualification Standards (48 FR 22716), and the ACHP's general guidelines for identification and testing procedures as set forth in *Treatment of Archeological Properties, A Handbook*. Unless otherwise specified, field notes, samples, artifacts, and other collected data will be curated with the University of Alaska Museum in Fairbanks in accordance with the requirements set forth in 36 CFR Part 79. Site information, other than the site's Alaska Heritage Resources Survey (AHRS) number and National Register eligibility, will be maintained as confidential as provided for under NHPA Section 304, as amended (16 U.S.C. 470w-3).

11.5.6. Schedule

Fieldwork performed in 2013-2014 would include the following components:

- Site Surveys (Inventory Phase). Applying the GIS-based locational model developed early in the study, the 2013-2014 field efforts will begin within the Watana impoundment area. The survey will take place in the proposed Gold Creek, Chulitna, and Denali Corridors. To the extent possible, the study will make use of the 1978-1985 Phase I survey data (e.g., Bowers et al. 2012; Dixon et al. 1985; Greiser et al. 1985, 1986).
- Site Testing (Evaluation Phase). The 2013-14 field efforts will focus heavily on site systematic testing, with the goal of developing Recommendations of Eligibility to the National Register for each site within direct and indirect impact areas. This will include the Watana impoundment zone, the proposed Gold Creek, Chulitna, and Denali Corridors.

Study products to be delivered in 2013-14 would include

- Interim Reports. Interim reports will be prepared and presented to the Work Group to provide study progress. Reports will include up-to-date compilation and analysis of the data and ArcGIS spatial data products. Reporting schedules will be determined by the AEA and FERC.
- ArcGIS Spatial Products. Shapefiles of the 1980s and current cultural resources data will be compiled into a geodatabase for the study area. All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and NAD 83 horizontal datum consistent with ADNR standards. Naming conventions of files and data fields; spatial resolution; and metadata descriptions must meet the ADNR standards established for the Project.
- Final Reports. Final Reports will be completed for each field season at the end of 2013 and 2014. Reports will summarize the results of each field season and will be presented to resource agency personnel and other licensing participants along with spatial data products. This will include recommendations regarding additional study needs to be addressed in subsequent field seasons and will cover Identification and Evaluation Phases of the Project studies. Reports will follow FERC and SHPO protocols (36 CFR 800); will follow professionally-accepted standards; and will include site descriptions, site evaluations (Recommendations of Eligibility), and Determinations of Effect. The reports will be filed with FERC to fulfill the study report requirements of 18 CFR section 5.15(c) and (f) of the Commission regulations.

11.5.7. Level of Effort and Cost

The work described above will take place during the 2013 and 2014 field seasons, with evaluations of National Register eligibility completed by the end of 2014. Costs proposed here are in addition to the 2012 reconnaissance effort. For the combined 2013 and 2014 effort, the costs of the cultural resource investigations (including field studies, data collection and mapping, analysis, and reporting) are estimated to cost $7-$8 million.

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11.6. Paleontological Resources Study

11.6.1. General Description of the Proposed Study

Thomas Bundtzen and Pacific Rim Geological Consulting (Fairbanks) is currently performing a geologic literature review of the Project area, relying as much as possible on the legacy records from the 1980s. With this information the study team is developing a geo-database of the likely location of significant fossils. The results of this review are expected in October 2012 and may help with the final refinements to the study plan or inform some aspects of implementation of this study for 2013 and 2014.

11.6.1.1. Study Goals and Objectives

All work is intended to meet the requirements of the Paleontological Resources Protection Act of 2009 (16 U.S.C. 47Oaaa) and pertinent regulations (see: http://www.blm.gov/wo/st/en/prog/more/CRM/paleontology/paleontological_regulations.html
http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=200910&RIN=1004-AE13).

The existing regulatory framework applies to BLM managed lands; therefore the proposed field survey is currently planned to be limited to those areas.

Following a 2012 literature study, the area will have been classified into five classes, following BLM's classification system (http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins national_instruction/20080/im_2008-009.html).

Areas of BLM land classified as Class 3 (moderate or unknown potential), Class 4 (high potential) and Class 5 (very high potential) may require field survey and testing by a qualified professional paleontologist/geologist. Areas designated as having significant paleontological potential will be revisited and mapped with survey-grade GPS and incorporated into the paleontological geodatabase.

11.6.2. Existing Information and Need for Additional Information

The potential for Pleistocene faunal remains needs to be reviewed, given that Thorson et al. (1981) found approximately 29,000-year-old mammoth remains at the confluence of the Susitna and Tyone Rivers and that significant occurrences of dinosaur (Hadrosaur) fossils have been reported from the Talkeetna Mountains (Pasch and May 1997). During 1973, the State geological Survey (DGGS) discovered a new Tertiary sedimentary basin that contained abundant plant flora in Watana Creek, Talkeetna Mountains D-3 quadrangle (Smith, T.E., Lyle, W.M., and Bundtzen, T.K., in Hartman, 1974). Much of the Permian system at the stage level has been documented by fossil localities in the Clearwater Mountains south of the Denali Highway in the Talkeetna Mountains D-2 quadrangle (Kline, Bundtzen, and Smith (1990) and along the flanks of Mount Watana (Csejtey, 1973; Csejtey et al.,1978).

11.6.3. Study Area

The study area encompasses BLM-managed lands within the Watana Reservoir, Watana Dam Construction site, and three potential road and transmission corridors (Chulitna, Denali, and Gold Creek corridors)(Figure 1.2-1). The APE consists of the geographic area or areas where significant paleontological sites occur as surface outcrops and may be altered (directly or indirectly) by the construction and operation of the Project.

11.6.4. Study Methods

The approach will be to examine mapped rock units systematically and examine archived paleontological records, which exist in the U.S. Geological Survey (USGS) and other documents. Both hard rock paleontological sites and Pleistocene faunal remains may need to be considered on BLM lands in light of the Paleontological Resources Protection Act of 2009 (16 U.S.C. 47Oaaa).

The field investigations will be supported by helicopter and fixed wing support. A team of two geologists will visit existing sites and examine potential new sites using standard geological field methods. Geologists will be aided by all past federal and State geological mapping that exists in the study area.

Sample locations will be located using modern GPS technology, which will enable the geological team to provide very precise location information. To our knowledge nearly all past fossil localities were located before the widespread use of GPS technology. Hence, the existing fossil locales that are imprecisely known will have more accurate location data—at least those that will be visited during this investigation.

Samples will be bagged appropriately to prevent abrasion and damage. Depending on the type and quality of fossil material present, splits of samples will be sent to appropriate University or Private Sector paleontologists for identification and analysis.

11.6.5. Consistency with Generally Accepted Scientific Practice

Field investigations will be consistent with generally accepted scientific practices. During his career with the Department of Natural Resources, Bundtzen made numerous fossil collections during his geological mapping projects. He worked with both scientists from the U.S. Geological Survey as well as those in several universities and in the private sector to obtain fossil identifications, age estimates and their relevance. More than 100 of his fossil locales were eventually archived at the Museum of the North in Fairbanks.

11.6.6. Schedule

Work performed in 2013-2014 would include the following components:

- Applying the GIS-based classification scheme developed in 2012 within the Watana impoundment area and the proposed Gold Creek, Chulitna, and Denali Corridors.
- Systematic testing in areas of high potential indicated by the classification scheme in 2013-14.

Study products to be delivered in 2013-14 would include

- Initial Study Report (December 2013). An Initial Study Report will be prepared and presented to the interested parties to provide initial results and information on study progress. The Report will include up-to-date compilation and analysis of the data and ArcGIS spatial data products.

- ArcGIS Spatial Products. Shapefiles of the 1980s and current paleontological resources data will be compiled into a geodatabase for the study area. All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and NAD 83 horizontal datum consistent with ADNR standards. Naming conventions of files and data fields; spatial resolution; and metadata descriptions must meet the ADNR standards established for the Project.
- Updated Study Report (December 2014). An Updated Study Report will be completed at the end of 2014. The report will summarize the results of each field season and will be presented to resource agency personnel and other licensing participants along with spatial data products. Reports will follow FERC and BLM protocols and will follow professionally-accepted standards. The reports will be filed with FERC to fulfill the study report requirements of 18 CFR section 5.15(c) and (f) of the Commission regulations.

11.6.7. Level of Effort and Cost

The work described above will take place during 2013 and 2014. The estimated cost of the application of the classification system and field work is an unknown quantity until the results of the 2012 literature review and classification efforts are completed. However, it is estimated that 2013-14 fieldwork and pertinent reporting will cost in the range of $50,000.

11.6.8. Literature Cited

Csejtey, Bela, 1973, Paleozoic island arc in Talkeetna Mountains, in, United States geological Survey Program abstracts, U.S. Geological Survey Circular 683, page 45. (reports on upper Paleozoic fossils)

Csejtey, Bela, Nelson, W.H., Jones, D.L., Silberling, N.J., Dean, R.M., Morris, M.S., Lanphere, M.A., Smith, J.G., and Silberman, M.L., 1978, Reconnaissance geologic map of the Talkeetna Mountains Quadrangle, the northern part of the Anchorage Quadranglem and the southwest corner of the Healy quadrangle, Alaska: U.S. Geological Survey Open File report, 78-558A, scale 1:250,000 60 pages. (Reports on numerous new fossil localities)

Kline, J.T., Bundtzen, T.K., and Smith, T.E., 1990, Preliminary geologic map of the Talkeetna Mountains D-2 Quadrangle: Alaska Division of Geological and Geophysical Surveys Public Data File Report 90-24, scale 1:63,360. (reports new Permian and Triassic fossil localities)

Pasch, Anne D., and Kevin C. May. 1997. First Occurrence of a Hadrosaur (Dinosauria) from the Matanuska Formation (Turonian) in the Talkeetna Mountains of South-Central Alaska. Short Notes on Alaska Geology 1997, pp. 99-109, Alaska Division of Geological and Geophysical Surveys, Anchorage.

Smith, T.E., Lyle, W.M., and Bundtzen, T.K., Newly Discovered Tertiary Sedimentary Basin Near Denali, in, Hartman, D.C., 1974, 1973 Annual Report of the Department of Natural Resources, Division of geological and Geophysical Surveys, page 19.

Thorson, Robert M., E. James Dixon, George S. Smith, and Allan R. Batten. 1981.

Interstadial Proboscidean from South Central Alaska. Quaternary Research 16:

404-417.

Paleontological Legislation:

http://www.blm.gov/wo/st/en/prog/more/CRM/paleontology/paleontological_regulations.html

http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=200910&RIN=1004-AE13

Paleontological Classification systems:

http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/20080/im_2008-009.html

11.7. Attachments

ATTACHMENT 11-1. PLAN FOR UNANTICIPATED DISCOVERIES OF CULTURAL RESOURCES AND HUMAN REMAINS

ATTACHMENT 11-2. DOCUMENTATION OF CONSULTATION ON CULTURAL AND PALEONTOLOGICAL STUDY PLANS

ATTACHMENT 11-1

PLAN FOR UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN REMAINS

Plan for Unanticipated Discovery of Cultural Resources and Human Remains

Susitna-Watana Hydroelectric Project

FERC No. 14241

Alaska Energy Authority

ALASKA
ENERGY AUTHORITY

[Review Draft: 6/20/12]

PLAN FOR UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN REMAINS DURING THE 2012 SUSITNA-WATANA HYDROELECTRIC PROJECT FIELD INVESTIGATIONS

(Provisional – June 20, 2012)

The first part of this plan (pages 1-3) is addressed to non-cultural resource contractors and other personnel involved with the Susitna-Watana Hydroelectric Project and establishes procedures in the event that unreported or unanticipated cultural resources and/or human remains are found in the field. <u>The field reporting procedures differ depending on: a) whether cultural materials or human remains are encountered; and b) whether the discoverers are involved in a non-destructive effort or whether ground disturbance is involved.</u> Reports of finds will then be forwarded by the Cultural Resources Program or Study Lead as per the remainder of this plan according to <u>c) whether the finds are on federal, state, or private land</u>[1]. Prior to fieldwork, AEA and contracted personnel will receive environmental training including the following guidance for identifying and reporting cultural resources or human remains discovered in the field. This plan briefly describes cultural resources in the study area, how to distinguish them from insignificant items and trash, and what to do <u>if</u> you find them during your fieldwork (all "ifs" are underlined).

Cultural Resources in the Study Area

The general study area contains historic and prehistoric remains going back as much as 10,000 years, and over 250 sites are known from previous studies. Of those, about 90% had stone tools and other prehistoric artifacts, about 10% were historic sites consisting of building ruins or scatters of commercially manufactured items (metal cans, bottles, etc.), and only a couple were fossil discoveries (animal or plant remains). The more recent prehistoric sites are from the Athabascan Indians who inhabited the area historically and hold the majority of the area's Native place names in their linguistic dialect -- Ahtna, while the older sites fade into a more generalized adaptation shared by most of Alaska's ancient interior peoples. Historic sites in the Susitna-Watana area reflect remote land use like mining, prospecting, hunting, trapping, and recreational pursuits, in addition to simple homesteading.

How to Distinguish Cultural Resources

Prehistoric sites most commonly contain stone tools, which are the main indicator for field personnel. Rocks free of flaws that fracture easily and predictably (like flint or obsidian) were typically struck and pressured into form, resulting in tools and discarded flakes with distinctively faceted surfaces – shallow concave scars on tools as well as the corresponding positive bulbs on removed flakes (imagine the rippled conical chunk of glass your son, daughter, – or you – once popped out of a plate glass window with a BB gun). This is the major diagnostic you need to have in mind for prehistoric sites. Discriminating between an artifact and a naturally shattered rock relies a lot on context. A few suspicious stone shards among a rocky talus slope of identical mineralogy are probably not cause for concern. An interesting multi-flaked sharp stone plus a few others nearby (perhaps with detachment bulbs) on a flat overlook would more likely be a cultural

[1] As set forth by the National Historic Preservation Act (NHPA), as amended (16 USC 470) and implementing regulations (36 CFR 800), Archaeological Resources Protection Act (ARPA), Native American Graves Protection and Repatriation Act (NAGPRA) and Alaska Statutes 11.46.482 (a)(3), 12.65.5, 18.50.250, and 41.35.200.

occurrence. Many of these locales have already been found and recorded as formal archaeological sites; likely more remain to be discovered.

Historic sites can have more variability than prehistoric sites in terms of surface and subsurface features and their degree of preservation. Building ruins ranging from roofed examples to those fast entering the archaeological record are part of the cultural resource inventory. Scatters of metal cans and glass bottles legally can be cultural resources, too, if they are 50 or more years old (using that criterion, hypothetically, archaeologist Ivar Skarland's field camp from his 1953 investigations of the then-proposed Devils Canyon dam impoundment could be historically significant). Unvegetated deposits of loose rock at the base of mineralized outcrops – often reddish or yellowish, may indicate historic prospecting, as might the remains of water diversion systems. As with the prehistoric inventory, many of these sites have already been discovered, and likely more remain to be found.

What to Do if You Find Cultural Features or Artifacts

Regardless of whether you are involved in a non-destructive field program or one involving ground disturbance, stop work immediately in the vicinity and don't disturb the features or artifacts further. If you are involved in a ground-disturbing activity then contact immediately either Cultural Resource Program Lead Charles M. Mobley or Study Lead Justin Hays (below). Information you will be requested to provide is primarily description of the finds and location including GPS coordinates. If you are involved in a non-destructive field program, then you are requested to report the description and location of the suspected cultural resource including GPS coordinates to Mobley or Hays within five days. Digital photographs accompanying the report are especially recommended but no photographs or site-specific location information should be released to the press or other individuals other than the Cultural Resource Program or Study Leads. Contact either:

Charles M. Mobley
Cultural Resources Program Lead
(907) 653-1937 office
(907) 632-1933 cell
mobley@alaska.net
Charles M. Mobley & Associates
200 W. 34th Avenue #534
Anchorage, Alaska 99503

OR

Justin Hays
Cultural Resources Study Lead
(907) 474-9684 office
(907) 750-9857 cell
jmh@northernlanduse.com
Northern Land Use Research, Inc.
234 Front Street
Fairbanks, Alaska 99709

How to Distinguish Human Remains

Animal bones are statistically more common than human remains by far, so probabilities favor your find not being human. Ask the biologist or hunter on your crew for an opinion. If the bones are cut or sawn then let's assume they're not human. Human skulls and our all-one-piece jaws are relatively unique and easily identified. For the other bones, try to imagine each one in your body where you think it should fit – does it? If not, it's less likely human.

Context is important. If the bones are scattered around a not-too-old fire ring, for example, then they're likely animal. If they're tumbling out of a rock cairn, they're more likely human.

What to Do if You Find Human Remains

Regardless of whether you are involved in a non-destructive field program or one involving ground disturbance, stop work immediately in the vicinity and don't disturb the bones further. Contact immediately either Cultural Resource Program Lead Charles M. Mobley or Study Lead Justin Hays, by telephone or email (below). Information you will be requested to provide is primarily description of the bones and location including GPS coordinates. Digital photographs accompanying the report are especially recommended but no photographs or site-specific location information should be released to the press or other individuals other than the Cultural Resource Program or Study Leads. Contact either:

Charles M. Mobley Cultural Resources Program Lead (907) 653-1937 office (907) 632-1933 cell mobley@alaska.net Charles M. Mobley & Associates 200 W. 34th Avenue #534 Anchorage, Alaska 99503	**OR**	Justin Hays Cultural Resources Study Lead (907) 474-9684 office (907) 750-9857 cell jmh@northernlanduse.com Northern Land Use Research, Inc. 234 Front Street Fairbanks, Alaska 99709

Forwarding Reports of Discoveries from the Field

After the field report has been made to Mobley or Hays the field finders' responsibilities are over other than to be available for further consultation if necessary. The following steps will then be set in motion:

1. The Cultural Resources Program or Study Lead will compare the find's GPS coordinates and description with the known site inventory to determine if it actually reflects a new discovery or an already-recorded site.

2. If the discovery involves human remains or is determined to be an unrecorded cultural property, the Cultural Resources Program or Study Lead will immediately notify AEA's Environmental Manager of the find and its potential significance.

Betsy McGregor, AEA Environmental Manager
(907) 771-3957 office
(503) 312-2217 cell
BMcGregor@aidea.org
411 W. 4th Avenue, Ste. 1
Anchorage, Alaska 99501

3. AEA's Environmental Manager will coordinate with a cultural resources consultant who will travel to the location and evaluate the find as warranted to determine if indeed human bones have been discovered, or if a new cultural site has been found.

4. If the materials found are human remains, then the protocols outlined in the subsequent two sections entitled **Protection of Human Remains** (distinguished according to land ownership) will be followed. If a cultural site is at imminent risk from a proposed ground-disturbing activity, the procedures specified in the following two sections entitled **Protection of Cultural Remains** (again distinguished according to land ownership) below will be followed. If the materials are already recorded cultural sites and not in jeopardy, no further action will be taken.

Protection of At-Risk Cultural Materials on Private and State-Managed Land

a) AEA's Environmental Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Manager will direct the cultural resources consultant to begin a more detailed assessment of the find's significance and the potential effect of construction.

c) AEA's Environmental Manager will promptly notify the Alaska State Historic Preservation Officer (SHPO) or State Archaeologist of the find. Contact either:

Judith Bittner, SHPO (907) 269-8721 judy.bittner@alaska.gov Alaska Dept. of Natural Resources Office of History and Archaeology 550 West 7th Avenue Ste. 1310 Anchorage, Alaska 99501-3565	OR	David McMahan, State Archaeologist (907) 269-8723 dave.mcmahan@alaska.gov Alaska Dept. of Natural Resources Office of History and Archaeology 550 West 7th Avenue Ste. 1310 Anchorage, Alaska 99501-3565

d) The landowner will be promptly notified.

e) The cultural resources consultant will document the site circumstances, potential significance, and risk of harm. If the cultural resources consultant assesses the find as not significant or lacking integrity, then the consultant will notify the AEA Environmental Manager who will then inform the SHPO. Upon SHPO agreement of a finding of no effect, AEA will request approval to resume construction. A brief report of the find will be provided to the SHPO within one week of its recording. If the archaeological consultant recommends that the find may be significant, then the following steps will be implemented.

f) AEA's Environmental Manager will notify other parties, such as appropriate Alaska Native organizations, as directed by the SHPO.

Alaska Native Regional Corporations:

- Ahtna, Incorporated (Ahtna)
  Michelle Anderson, President
  PO BOX 649, Glennallen, Alaska 99588

Glennallen Office: (907) 822-3476
Fax: (907) 822-3495
Anchorage Office: (907) 868-8250
Fax: (907) 868-8285
Email: manderson@ahtna.net

- Cook Inlet Region Incorporated (CIRI)
  2525 C Street Suite 500, Anchorage, Alaska 99503
  P.O. Box 93330, Anchorage, Alaska 99509-3330
  (907) 274-8638
  Fax: (907) 279-8836

- Doyon, Ltd. (Doyon)
  1 Doyon Place, Suite 300
  Fairbanks, Alaska 99701-2941
  (907) 459-2000
  (888) 478-4755 (toll-free)
  (907) 459-2060 (fax)

- Doyon, **Limited - Anchorage Office**
  11500 C Street, Suite 250
  Anchorage, Alaska 99515-2692
  (907) 563-5530 or (907) 375-4220
  (907) 375-4205 (fax)

A more complete contact list is attached as Appendix A.

g) If the find is significant and continuing work may damage more of the site, then AEA's Environmental Manager will request recommendations from the SHPO and other parties regarding appropriate measures for site treatment. These measures may include: formal archaeological evaluation of the site; visits to the site by the SHPO and other parties; preparation of a mitigation plan by AEA for approval by the SHPO; implementation of the mitigation plan; and/or approval to resume construction following completion of the fieldwork component of the mitigation plan.

h) If further analysis indicates that the find lacks significance, then AEA's Environmental Manager will consult with the SHPO and other appropriate parties to request approval for resumption of construction.

i) AEA's Environmental Manager will notify the on-site Field Coordinator who will grant clearance to the Contractor to start construction.

Protection of At-Risk Cultural Materials on Federal Lands

a) AEA's Environmental Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Manager will direct the cultural resources consultant to begin a more detailed assessment of the find's significance and the potential effect of construction.

c) AEA's Environmental Manager will promptly notify the appropriate federal land managing agency and Alaska State Historic Preservation Officer (SHPO) of the find. Contact both:

John Jangala, Archaeologist
(907) 822-7303
jjangala@blm.gov
Glennallen Field Office
Bureau of Land Management
P.O. Box 147
Glennallen, Alaska 99588-0147

Judith Bittner, SHPO
(907) 269-8721
judy.bittner@alaska.gov
Alaska Dept. of Natural Resources
Office of History and Archaeology
550 West 7th Avenue Ste. 1310
Anchorage, Alaska 99501-3565

d) The cultural resources consultant will document the site circumstances, potential significance, and risk of harm, and then notify the AEA Environmental Manager who will in turn then inform the Bureau of Land Management (BLM) archaeologist and the SHPO. <u>If</u> the cultural resources consultant assesses the find as not significant or lacking integrity, and the BLM and SHPO agree on a finding of *no effect*, then AEA will request approval to resume construction. A brief report of the find and an AHRS site form will be provided to the BLM and SHPO within two weeks of its recording. <u>If</u> the archaeological consultant recommends that the find may be significant, then the following steps will be implemented.

e) AEA's Environmental Manager will notify other parties, such as appropriate Alaska Native organizations, as directed by the SHPO.

Alaska Native Regional Corporations:

- Ahtna, Incorporated (Ahtna)
  Michelle Anderson, President
  PO BOX 649, Glennallen, Alaska 99588
  Glennallen Office: (907) 822-3476
  Fax: (907) 822-3495
  Anchorage Office: (907) 868-8250
  Fax: (907) 868-8285
  Email: manderson@ahtna.net

- Cook Inlet Region Incorporated (CIRI)
  2525 C Street Suite 500, Anchorage, Alaska 99503
  P.O. Box 93330, Anchorage, Alaska 99509-3330
  (907) 274-8638

- Doyon, Ltd. (Doyon)
  1 Doyon Place, Suite 300
  Fairbanks, Alaska 99701-2941
  (907) 459-2000
  (888) 478-4755 (toll-free)
  (907) 459-2060 (fax)

- Doyon, **Limited - Anchorage Office**
  11500 C Street, Suite 250
  Anchorage, Alaska 99515-2692
  (907) 563-5530 or (907) 375-4220
  (907) 375-4205 (fax)

A more complete contact list is attached as Appendix A.

f) If the find is assessed as significant and continuing work may damage more of the site, then AEA's Environmental Manager will request recommendations from the appropriate federal land managing agency, SHPO, and other parties regarding appropriate measures for site treatment. These measures may include: formal archaeological evaluation of the site; visits to the site by the SHPO and other parties; preparation of a mitigation plan by AEA for approval by the appropriate federal land managing agency and SHPO; implementation of the mitigation plan; and/or approval to resume construction following completion of the fieldwork component of the mitigation plan.

g) If further analysis indicates that the find lacks significance, then AEA's Environmental Manager will consult with the federal land managing agency, SHPO and other appropriate parties to request approval for resumption of construction.

h) AEA's Environmental Manager will notify the on-site Field Coordinator who will grant clearance to the contractor to start construction.

Protection of Human Remains on Private and State-Managed Land

a) AEA's Environmental Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Manager will notify a peace officer of the state (police, Village Public Safety Officer, or Alaska State Trooper [AST]) and the Alaska State Medical Examiner (SME) immediately of the discovery, as stipulated in Alaska Statute 12.65.5. In addition to a local peace officer (if in a local jurisdiction), notification should include the AST Criminal Investigation Bureau. If the human remains appear recent (less than 50 years old) in the judgment of the archaeologists, the AST and SME will determine whether the remains are of a forensic nature and/or subject to criminal investigation. The AST and SME contacts are:

Sgt. Kid Chan
(800) 478-9333
(907) 269-5058
choong.chan@alaska.gov
(cc: Stephanie Johnson at steph.johnson@alaska.gov)
Alaska State Troopers
Missing Persons Bureau
5700 East Tudor Road
Anchorage, AK 99507

Talkeetna Post - Alaska State Troopers
(907) 733-2256
HC89 Box 8576
Talkeetna, AK 99676

Dr. Gary Zientek, Deputy Medical Examiner
(907) 334-2200
gary.zientek@alaska.gov
Alaska State Medical Examiner
5455 Dr. Martin Luther King Jr. Ave
Anchorage, Alaska 99507

c) The landowner will be promptly notified.

d) The Alaska SHPO will also be notified of any discovery unless circumstances indicate that the death or burial is less than 50 years old and that there is need for a criminal investigation or legal inquiry by the coroner.

Judith Bittner, State Historic Preservation Officer
(907) 269-8721
judy.bittner@alaska.gov
Alaska Dept. of Natural Resources
Office of History and Archaeology
550 West 7th Avenue Ste. 1310
Anchorage, AK 99501-3565

e) Written authorization in the form of a Burial Transit Permit from the Alaska State Bureau of Vital Statistics (BVS) shall be obtained prior to any excavation or re-interment of any human remains. In addition, clearance from the appropriate Alaska Native organization must be obtained prior to excavation or re-interment of Alaska Native remains. The BVS contact is:

Phillip Mitchell, Section Chief
(907) 465-3391
BVSResearch@alaska.gov
Phillip.mitchell@alaska.gov
Alaska Bureau of Vital Statistics
5441 Commercial Boulevard
P.O. Box 110675
Juneau, AK 99801

f) If the human remains are found to be historic in nature, a qualified professional physical anthropologist with experience in the analysis of human remains will examine them in situ to determine racial identity. The physical anthropologist shall document, analyze, and photograph the remains so that an independent assessment of racial identity can be made. The physical anthropologist shall be afforded no more than 30 days time to conduct his or her analysis.

g) If the unanticipated discovery consists of Alaska Native human remains, AEA will consult with the Alaska SHPO, FERC, and appropriate Alaska Native organizations regarding the appropriate measures to respectfully handle such a discovery. If it can be determined adequately that the identified human remains have affinity to any federally recognized tribe(s), a reasonable effort will be made by AEA to identify, locate, and notify these tribes. The appropriate Alaska Native Regional Corporations also will be contacted by AEA. A comprehensive contact list is attached as Appendix A.

h) AEA's Environmental Manager will notify other parties, as directed by the SHPO.

i) If the human remains are not Native American, and a determination has been made by the AST and Alaska SME that a death investigation is not warranted, then AEA, in consultation with the Alaska SME, will identify, locate and inform descendants of the deceased.

j) After permission to resume construction has been issued by the SHPO, AEA's Environmental Manager will notify the on-site Field Coordinator who will grant clearance to the contractor to restart construction.

Protection of Human Remains on Federal Land

a) AEA's Environmental Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Manager will notify a peace officer of the state (police, Village Public Safety Officer, or Alaska State Trooper [AST]) and the Alaska State Medical Examiner (SME) immediately of the discovery, as stipulated in Alaska Statute 12.65.5. In addition to a local peace officer (if in a local jurisdiction), notification should include the AST Criminal Investigation Bureau. If the human remains appear recent (less than 50 years old) in the judgment of the archaeologists, the AST and SME will determine whether the remains are of a forensic nature and/or subject to criminal investigation. The appropriate federal land managing agency will also be contacted in case the human remains are related to a crime scene. The contact of the AST and SME are:

Sgt. Kid Chan
(800) 478-9333
(907) 269-5058
choong.chan@alaska.gov
(cc: Stephanie Johnson at steph.johnson@alaska.gov)
Alaska State Troopers
Missing Persons Bureau
5700 East Tudor Road
Anchorage, AK 99507

Talkeetna Post - Alaska State Troopers
(907) 733-2256
HC89 Box 8576
Talkeetna, AK 99676

Dr. Gary Zientek, Deputy Medical Examiner
(907) 334-2200
gary.zientek@alaska.gov
Alaska State Medical Examiner
5455 Dr. Martin Luther King Jr. Ave
Anchorage, Alaska 99507

John Jangala, Archaeologist
(907) 822-7303
jjangala@blm.gov
Glennallen Field Office
Bureau of Land Management
P.O. Box 147
Glennallen, Alaska 99588-0147

c) The Alaska SHPO will also be notified of any discovery unless circumstances indicate that the death or burial is less than 50 years old and that there is need for a criminal investigation or legal inquiry by the coroner. The SHPO contact is:

Judith Bittner, State Historic Preservation Officer
(907) 269-8721
judy.bittner@alaska.gov
Alaska Dept. of Natural Resources
Office of History and Archaeology
550 West 7th Avenue Ste. 1310
Anchorage, AK 99501-3565

d) Written authorization in the form of a Burial Transit Permit from the Alaska State Bureau of Vital Statistics shall be obtained prior to any excavation or re-interment of any human remains. In addition, clearance from the appropriate Alaska Native organization must be obtained prior to excavation or re-interment of Alaska Native remains. The BVS contact is:

Phillip Mitchell, Section Chief
(907) 465-3391
BVSResearch@alaska.gov
phillip.mitchell@alaska.gov
Alaska Bureau of Vital Statistics
5441 Commercial Boulevard
P.O. Box 110675
Juneau, AK 99801

e) If the human remains are found to be historic in nature, AEA, as directed by the appropriate federal land managing agency, will determine the origin of the human remains. A qualified professional physical anthropologist with experience in the analysis of human remains will examine them in situ to determine racial identity. The physical anthropologist shall document, analyze, and photograph the remains so that an independent assessment of racial identity can be made. The physical anthropologist shall be afforded no more than 30 days to conduct his or her analysis. The appropriate federal land managing agency will follow NAGPRA and the implementing regulations set forth in 43 CFR 10, for Alaska Native remains.

f) For Alaska Native remains, the appropriate federal land managing agency will retain the responsibility for determining and contacting the appropriate Alaska Native groups. In this case, NAGPRA dictates that work in the immediate vicinity of the remains cannot proceed until 30 days after the reply from the federal agency in charge or appropriate Alaska Native group that the documents regarding the finding were received, unless a written and binding agreement is issued from the federal agency in charge and the affiliated Native American group(s) (NAGPRA 25 USC 3002 Sec 3(d)). The remains will then be assessed and treated based on the guidance of the federal agency in charge and the appropriate Alaska Native group as defined by NAGPRA.

g) If the human remains are not Native American, and a determination has been made by the AST and Alaska SME that a death investigation is not warranted, then AEA, as directed by the appropriate federal land managing agency in consultation with the Alaska SME, will identify, locate, and inform descendants of the deceased.

h) AEA's Environmental Manager will notify other parties, as directed by the appropriate federal land managing agency.

i) After permission to resume construction has been issued by the appropriate federal land managing agency, AEA's Environmental Manager will notify the on-site Field Coordinator who will grant clearance to the Contractor to restart construction.

Contacts for AEA's Cultural Resource Program

Charles M. Mobley
Cultural Resources Program Lead
(907) 653-1937 office
(907) 632-1933 cell
mobley@alaska.net
Charles M. Mobley & Associates
200 W. 34th Avenue #534
Anchorage, Alaska 99503

<u>OR</u>

Justin Hays
Cultural Resources Study Lead
(907) 474-9684 office
(907) 750-9857 cell
jmh@northernlanduse.com
Northern Land Use Research, Inc.
234 Front Street
Fairbanks, Alaska 99709

APPENDIX A: CONTACTS FOR ALASKA NATIVE ENTITIES

Though communities potentially affected by the Project have different histories and cultures, they are characterized by strong past and present ties to the land and its resources. The successful completion of the Consultation and Coordination phase of the National Historic Preservation Act (NHPA) Section 106 process requires an efficient and effective consultation process that addresses the laws and regulations within the context of local custom and practice. Several Alaska tribal entities recognized by the U.S. Department of Interior and established through the Alaska Native Claims Settlement Act (ANCSA) of 1971, are broadly located near the study area. In Alaska, consultation typically occurs with the 229 federally-recognized tribes, the 13 Alaska Native Regional Corporations, and some 200 Alaska Native Village Corporations created by the ANCSA (the Regional and Village Corporations are recognized as "Indians tribes" for NHPA purposes).

There are four Regional Native Alaskan corporations that have interests within or near the Project area (see Table 1). In addition, twenty-two tribes recognized by the Bureau of Indian Affairs under 25 CFR 83.6(b) are located within or near the Project area, including those indicated in Table 2. Table 3 includes a list of recognized and non-recognized ANCSA village; group and urban corporations; and village organizations that also have interests.

Table 1. List of Regional Native Corporations with interests within the vicinity of the Susitna-Watana Hydroelectric Project.

Ahtna, Incorporated (Ahtna) Michelle Anderson, President PO BOX 649, Glennallen, Alaska 99588 Glennallen Office: (907) 822-3476 Fax: (907) 822-3495 Anchorage Office: (907) 868-8250 Fax: (907) 868-8285 Email: manderson@ahtna.net	Doyon, Ltd. (Doyon) 1 Doyon Place, Suite 300 Fairbanks, Alaska 99701-2941 (907) 459-2000 (888) 478-4755 (toll-free) (907) 459-2060 (fax)
Cook Inlet Region Incorporated (CIRI) 2525 C Street Suite 500, Anchorage, Alaska 99503 P.O. Box 93330, Anchorage, Alaska 99509-3330 (907) 274-8638	Doyon, Limited - Anchorage Office 11500 C Street, Suite 250 Anchorage, Alaska 99515-2692 (907) 563-5530 or (907) 375-4220 (907) 375-4205 (fax)

Table 2. List of Tribes recognized by the Bureau of Indian Affairs under 25 CFR 83.6(b) within the vicinity of the Susitna-Watana Hydroelectric Project.

Cheesh-Na Tribal Council/Mount Sanford bal Consortium P.O. Box 357 Gakona, Alaska 99586 907-822-5399 Fax 907-822-5810	Knik Tribe P.O. Box 871565 Wasilla, AK 99687 907-373-7991 Fax 907-373-2161 kniktribe@mtaonline.net
Chickaloon Native Village P.O. Box 1105 Chickaloon, AK 99674-1105 907-745-0707 Fax 907-745-7154 cvadmin@chickaloon.org http://www.chickaloon.org	Mentasta Traditional Council P.O. Box 6019 Mentasta Lake, AK 99780-6019 907-291-2319 Fax 907-291-2305 kmartin@tribalnet.com
Native Village of Chitina P.O. Box 31 Chitina, AK 99566-0031 907-823-2215 Fax 907-823-2233 aceak2000@yahoo.com	Native Village of Cantwell P.O. Box 94 Cantwell, AK 99729 907-768-2591 Fax 907-768-1111 hallvc@yahoo.com
Gulkana Village P.O. Box 254 Gakona, AK 99586 907-822-3746 Fax 907-822-3976 lclaw@gulkanacouncil.org http://gulkanacouncil.org/	Eklutna Native Village 26339 Eklutna Village Road Chugiak, AK 99567-6339 907-688-6020 Fax 907-688-6021 nve@eklutna-nsn.gov http://www.eklutna-nsn.gov
Healy Lake Village P.O. Box 74090 Fairbanks, AK 99706-0300 907-876-0638 Fax 907-876-0639 jpolstonhitc@live.com	Native Village of Gakona P.O. Box 102 Gakona, AK 99586 907-822-5777 Fax 907-822-5997 gakonavc@cvinternet.net www.nvgakona.com
Kenaitze Indian Tribe P.O. Box 988 Kenai, AK 99611-0988 907-283-3633 Fax 907-283-3052 kenaitze@alaska.net http://www.kenaitze.org/	Native Village of Kluti-Kaah P.O. Box 68 Copper Center, AK 99573-0068 907-822-5541 Fax 907-822-5130 nvkktops@cvinternet.net

Table 2. List of Tribes recognized by the Bureau of Indian Affairs under 25 CFR 83.6(b) within the vicinity of the Susitna-Watana Hydroelectric Project (continued).

Native Village of Tazlina P.O. Box 87 Glennallen, AK 99588-0087 907-822-4375 Fax 907-822-5865 tazlinajulie@cvinternet.net ▪	Northway Village P.O. Box 516 Northway, AK 99764 907-778-2287 Fax 907-778-2220 dnnvc@yahoo.com
Native Village of Tetlin P.O. Box 797 Tetlin, AK 99779 907-883-2021 tetlin@earthlink.net ▪	Seldovia Village Tribe P.O. Drawer L Seldovia, AK 99663 907-234-7898 Fax 907-234-7865 svt@svt.org http://www.svt.org/
Native Village of Tyonek P.O. Box 82009 Tyonek, AK 99682-0009 Phone 907-583-2271 Fax 907-583-2442 E-mail tyonek@aitc.org ▪	Native Village of Tanacross P.O. Box 76009 Tanacross, AK 99776 907-883-5024 Fax 907-883-4497 jerry_isaac@hotmail.com
Nenana Native Association P.O. Box 369 Nenana, AK 99760 907-832-5461 Fax 907-832-1077 nibor652004@yahoo.com ▪	Village of Dot Lake P.O. Box 2279 Dot Lake, AK 99737-2279 907-882-2695 or 907-322-2694 Fax 907-882-5558 dotlake@aitc.org ▪
Ninilchik Village P.O. Box 39070 Ninilchik, AK 99639 907-567-3313 Fax 907-567-3308 ntc@ninilchiktribe-nsn.gov/ http://www.ninilchiktribe-nsn.gov/ ▪	Village of Salamatoff P.O. Box 2682 Kenai, AK 99611 907-283-7864 Fax 907-283-6470 ▪

Table 3. List of recognized and non-recognized ANCSA village; group and urban corporations; and village organizations that have interests within the vicinity of the Susitna-Watana Hydroelectric Project.

Alexander Creek, Incorporated 8128 Cranberry Anchorage, AK 99502 (907) 243-5428	Knikatnu, Incorporated P.O. Box 872130 Wasilla, AK 99687-2130 907-376-2845 Fax 907-376-2847 knikcorp@gci.net
Caswell Native Association HC 89, Box 83 Willow, AK 99688 (907) 495-1263	Little Lake Louise Corporation (907) 250-2098
Chitina Native Corporation P.O. Box 3 Chitina, AK 99566-0031 907-823-2223 Fax 907-823-2202 chitina_native@cvinternet.net http://www.chitinanative.com	Lower Tonsina Corporation Unavailable
Chickaloon-Moose Creek Native Association, corporated P.O. Box 875046 Wasilla, AK 99687 907-373-1145 Fax 907-373-1142 cmena@alaska.net http://www.chickaloon.org	Kenai Natives Association, Inc. 215 Fidalgo Ave. #101 Kenai, AK 99611-7776 907-283-4851 Fax 907-283-4854
Dot Lake Native Corporation 3500 Wolf Run Fairbanks, AK 99709 907-882-2755 Fax 907-882-2775	Nabesna Native Group, Inc. Unavailable
Eklutna, Incorporated 16515 Centerfield Dr. #201 Eagle River, AK 99577 907-696-2828 Fax 907-696-2845 receptionist@eklutnainc.com http://www.eklutnainc.com	Mendas Cha-ag Native Corporation Gary Lee, President 457 Cindy Dr. Fairbanks, AK 99701

Table 3. List of recognized and non-recognized ANCSA village; group and urban corporations; and village organizations that have interests within the vicinity of the Susitna-Watana Hydroelectric Project (continued).

Gold Creek-Susitna NCI P.O. Box 847 Talkeetna, AK 99676-0847 (907) 733-2329	Seldovia Native Association, Incorporated P.O. Drawer L Seldovia, AK 99663-0250 907-234-7625 Fax 907-234-7637 info@snai.com http://www.snai.com
Montana Creek Native Association P.O. Box 100379 Anchorage, AK 99510	Tanacross, Incorporated P.O. Box 76029 Tanacross, AK 99776 907-883-4130 Fax 907-883-4129 http://www.tanacrossinc.com
Ninilchik Natives Association, Incorporated P.O. Box 39130 Ninilchik, AK 99639 907-567-3866 Fax 907-567-3867 nnai@nnai.net http://www.nnai.net	Tetlin Native Corporation Gary David Sr., President P.O. Box 657 Tok, AK (907) 883-6652 (907) 505-0253
Northway Natives, Incorporated P.O. Box 401 Northway, AK 99764 907-778-2298 Fax 907-778-2266	Toghotthele Corporation P.O. Box 249 Nenana, AK 99760 907-832-5832 Fax 907-832-5834 Toghotthele@hotmail.com
Point Possession, Incorporated Feodoria Pennington, President 1321 Oxford Dr. Anchorage, AK 99503 (907) 563-1848	Twin Lake Native Group, Incorporated Unavailable
Salamatkof Native Association, Incorporated 100 N. Willow Street Kenai, AK 99611 907-283-3745 Fax 907-283-6470 info@salamatof.com http://www.salamatof.com/	Tyonek Native Corporation 1689 C Street, Suite 219 Anchorage, AK 99501 907-272-0707 Fax 907-274-7125 http://www.tyonek.com/
Slana Native Corporation - Unavailable	

ATTACHMENT 11-2

DOCUMENTATION OF CONSULTATION ON CULTURAL AND PALEONTOLOGICAL STUDY PLANS

NLUR Project #:	12-027

NLUR Record of Consultation

Date:	May 2, 2012	**Time:**	5:00-5:45
Contact:		**Project:**	Susitna-Watana
Company:	AEA	**Place:**	NLUR-FAI

Attendees and Affiliation:

NLUR: Pete Bowers, Justin Hays, Carol Gelvin-Reymiller

UAF – Alaska Native Language Center: Jim Kari, Emeritus Professor

AHTNA: Michele Anderson, President

Nick Jackson, Chairman

Karen Linnell, Vice Chair

Joe Bovee, Lands and Resources Manager

Bruce Cain, VP, Admin. and Finance

Purpose:

General discussion of Ahtna Place Names study needs

Summary of Discussion:

Dr. Kari and NLUR have had on-going technical and methodological discussions regarding Native place names and Traditional Cultural Properties in the Susitna Project area (on this subject Dr. Kari is the pre-eminent scholar in the world and has on-going research contracted by Ahtna). Part of the 2012 Study Plan involves developing studies for place names and TCPs to meet the needs of a variety of resource areas, including at minimum: cultural resources, subsistence, trails, transportation, and recreation. The place names study will collect, compile, annotate, and digitize place names relevant to the Susitna Study area. This study directly involves Ahtna since the Native place names are mostly theirs, and it provides data pertinent to a number of land use concerns raised by Native groups at several public meetings. The study would build upon narratives in books and articles published by Dr. Kari and his colleagues.

The meeting occurred on short notice and was expected by NLUR to be attended by NLUR, Dr. Kari, and "a representative or two of Ahtna" who were in Fairbanks for other business. NLUR did not anticipate the participation of Ahtna officers. The informal meeting and discussions were very informative and productive.

Meeting Notes:

- Dr. Kari discussed his interest and availability should a collaborative Place Names Study develop later this year. He indicated that he could possibly spare 25% time on such a project with perhaps one other co-P.I. Dr. William Simeone (who was a primary author of NLUR's subsistence data gap report) was suggested by Kari as another possible co-P.I., and Carol Gelvin-Reymiller was identified as another key participant.
- Dr. Kari mentioned developing the ethnohistory of the Tyonek and/or Lake Louise areas, as part of the Susitna ethnogeography. Very little study has been conducted in these areas relating to Ahtna. Dr. Kari also mentioned that there are existing interview tapes that still need to be transcribed from the Talkeetna Mtns. and other areas. This could be a possible project of local interest and direct relevance to the Susitna planners.
- Names of possible students, mentors, transcribers, etc. were offered around the table regarding local involvement. Cantwell, Fairbanks, Gulkana, Copper Center, and Glennallen were specific communities mentioned that may have individuals interested in some type of collaborative project.
- Ms. Linnell stressed the need that the product of the collaboration should be something the Ahtna can use themselves as opposed to the usual "grey literature" report that sits on a shelf and is not widely distributed. All agreed.

- Other ideas for possible projects and products were offered by several members of the meeting. Products were suggested such as an interactive Place Names Atlas, CD-ROM maps, large display map of the Ahtna region with Place Names, scholarships for Ahtna students, school curricula, and books similar to those already published by Dr. Kari and other scholars at the Alaska Native Language Center.
- Mr. Bovee indicated that Ahtna Inc. could develop a Study Request for AEA (with input from Peter Bowers and Dr. Kari) in the next several weeks. He asked if AEA was interested in developing a collaborative project; Bowers responded that AEA had expressed several times in meetings their interest in closer involvement with native groups in projects such as this.

Signature/Name:

Peter M. Bowers

Notes on a May 21, 2012 telephone conversation between Charles M. Mobley, Cultural Resource Program Lead, and Richard VanderHoek, SHPO's representative, concerning provisions of the Plan for Unanticipated Discoveries, as part of the Susitna-Watana Dam cultural resource program. Submitted to Betsy McGregor, AEA, May 21, 2012, with cc.

I called VanderHoek to discuss details of the Plan for Unanticipated Discoveries and help me edit the current draft into a more user-friendly protocol. One of the main elements discussed was my interest in doing away with immediate notification, shut-down, site flagging, etc. for cultural sites if a field crew is not engaged in a ground-disturbing action. Thus only discovery of human remains or a cultural site in immediate jeopardy from a ground-disturbing action would engage the protocol for immediate notification. Cultural sites not in immediate jeopardy are to be reported within five days, at which point the GPS coordinates will be compared to those of the existing inventory to determine whether it is a known or as-yet-undiscovered site. And onward from there closer to the current draft plan. My goal is to avoid the requirement for immediate notification and action every time a non-disturbing crew sees a building ruin or surface archaeological scatter in the APE, since the more conspicuous sites could very well already be recorded. Richard was favorable to this level of streamlining.

Upon completion of that discussion, Richard mentioned that the Alaska Office of History and Archaeology staff had circulated our Cultural Resource 2013/14 Study Request inhouse for review and would be submitting comments to AEA.

Charles M. Mobley

Notes on a May 31, 2012 telephone conversation between Charles M. Mobley, Cultural Resource Program Lead, and Bob King, BLM State Archaeologist, concerning: a) content and process in the current Plan for Unanticipated Discovery of Cultural Resources and Human Remains; b) tribal review; c) Glennallen field office involvement. Submitted to Betsy McGregor, AEA, June 1, 2012, with cc.

I sent BLM archaeologist Bob King a copy of the current Plan for Unanticipated Discoveries document on Thursday, May 31, and he emailed me right back with the following self-admittedly rushed comments:

1) In terms of discovering NAGPRA materials (e.g., human bones) on BLM land, are there any scenarios where BLM doesn't get informed immediately? I note discussion of an up to 5-day delay, is it? which seems to apply to human bone discoveries if the finds are not in jeopardy of eminent destruction? On whose land does that apply?
2) If there is a delay in notification after encountering human bones on federal land, how does that square with NAGPRA regulation requirements?
3) Have tribes been informed of this policy yet? If so, by whom? And have they been (or will they be?) consulted with in a federal gov-to-gov consultation relationship to agree with this policy?
4) How will this policy come into effect? (part of a PA with the ACHP?)
5) Did this get sent to our Glennallen BLM Field Office for comment?

I called him immediately and we discussed the Plan in particular and BLM expectations in general. My impression that the human remains discovery protocol in the first and subsequent drafts of the Plan had been standardized through previous application was not shared by Bob. I told him that he'd misread it somewhat, that there was not a 5-day lag in human remain reporting – the clock starts ticking as soon as the find is confirmed by a specialist as human.

His comment about the need for tribal review of the document means through other than already-established project review processes. He is thinking this through to an ultimate conclusion of a Programmatic Agreement with multiple agency and tribal and landowner signatories. I told him field crews are going out almost immediately and the time to get to a P.A. would be lengthy. He agreed. He asked about anticipated tribal govt/govt relationships. All I know so far is that Chickaloon Village Traditional Council requested a govt/govt relationship with FERC in their filed letter. Which leads into…

Bob King said he isn't actually to be in the loop on this at all except peripherally, deferring to archaeologist John Jangala at BLM Glennallen Field Office and their jurisdiction (I will change the Plan to read Glennallen contact). I expect Jangala will be attending Thursday's meeting, and he and I have a call scheduled for Tuesday morning. Jangala's email of today indicated BLM has had discussion with FERC about tribal relationships and I expect to learn more soon. Both Bob King and I also expect Jangala to have a better idea of the actual level of tribal review and involvement called for in regard to the Plan for Unanticipated Discoveries and other cultural resource matters.

Charles M. Mobley

Notes on a June 1, 2012 hallway conversation between Charles M. Mobley, Cultural Resource Program Lead, and Richard VanderHoek, SHPO's representative, concerning: a) his official comments on the draft 2013-2014 PSP; b) non-attendance at this Thursday's Susitna-Watana meetings. Submitted to Betsy McGregor, AEA, June 1, 2012, with cc.

I was at AOHA on other business and Richard hailed me from his cubicle to say that he couldn't attend this Thursday's meetings because he was out of town on other business.

He also said that he'd neglected to mention it in his official comments on the draft 2013-14 PSP, but he did have another thought about its content and implementation. That is, whatever inventory or other sorts of work suggested to be done after project construction – like monitoring varying reservoir shoreline elevations to look for archaeological sites eroding out, etc. – will be a responsibility/liability of the State most likely. So be thoughtful about creating long-term responsibilities and consider who will be managing any residual efforts required.

Charles M. Mobley

Notes from AEA's June 7, 2012, Social Science Study Plan Development Meeting (C. Mobley)

Purpose of the meeting was to discuss stakeholders' comments on the draft 2013-14 PSP. About 150 written comments have been filed so far. Some federal agencies' comments are a couple hundred pages long.

About 20 people attended in person, probably more than that by telephone. VanderHoek couldn't be there to represent SHPO. John Jangala attended representing BLM (he mentioned his other appointment option was the Canadian snow-field conference where VanderHoek was). Steve Braun was there to discuss the Traditional Knowledge and other survey work being done under Tracie Krauthoefer's HDR auspices. Fran Seager-Boss for Matsu Borough was there. Social Science subjects: Socioeconomics; Transportation; Recreation & Aesthetics; Subsistence, and Cultural Resources.

I first discussed 2012 matters – the beginning the borehole survey today, curation agreement, and unanticipated discovery protocol. The latter got a question regarding whether state and federal tracks were different, and a little more conversation. I mentioned the WhoYaGonna'Call? Card.

Then into the 2013-14 PSP comments – divided into a) more detail about methods; b) missing study elements; c) APE. Regarding missing or deficient study elements, the first one I mentioned is paleontology, the second is cultural landscapes. Kirby recommends we use specific subheadings by those names in the next PSP draft.

TCP matters drew some comment – mostly the need for integration with other data sets derived from other studies. Bill Simeone contributed and mentioned he/Kari/Ahtna intention to get a Study Request in with a few weeks. Later after the meeting I caught up with him and discussed the immediacy of the need, and the routing from Ahtna to URS, neither of which he was aware of.

The focus of the PSP on inventory and evaluation within the direct APE to the exclusion of indirect APE got much attention in agency comments. When I brought it up it was mostly as a query to AEA, because my impression all along is that AEA has wanted the cultural resource effort to focus on the impoundment area, construction site, any staging areas, and the linear features. That got some response. Kirby made a vague comment about maybe reserving 2014 for investigation of indirect impacts. Wayne Dyak commented that the work to be done in the indirect impact areas wouldn't need to be as comprehensive as that for the direct impact area. Fran shifted in her chair on that one, so I responded to Wayne that I wouldn't necessarily agree that the investigative methods or intensities would automatically be less in the indirect impact zone. It was at that point (after three hours of meeting?) that the speakerphone interrupted and we all learned that Frank Winchell for FERC in D.C. was on the line. He didn't directly clarify matters for us but the end result is that AEA is much more sensitized to the need for the cultural resource program to address indirect impacts thoroughly. Another result is that I reread the Study Area description and it is not clear. The PSP is for the 2013-14 work but its Study Area description only refers to the 2012 areal limitation specified by AEA – impoundment/staging/linearfeatures. So this subsection needs a significant rewrite. Kirby says be specific about the criteria used to define the indirect APE; Bruce Tiedemann said define terms explicitly because Natives in particular may confuse legal/colloquial meanings, etc.

Bruce Tiedemann made a general statement without attribution that Natives want their cultural sites protected. End of Cultural stuff.

Site visits have been moved back, tentatively to around July 25-26.

Important Question: Is there to be any work in 2012 on BLM land? Such that BLM should be expecting an ARPA permit application?

Action Needed: Steve Braun made a plea for each of the Study Programs to submit to him 3-5 specific questions that we want to be included in the Traditional Knowledge survey that they will be conducting. I would think NLUR might want to generate those questions in consultation with Jim Kari, or maybe there are particular places that deserve a question. He didn't give a target for getting these questions to them. Pretty nice opportunity for us.

If I think of another highlight I'll send it around. This is the most of it. Cheers, Chuck

Notes on a June 12, 2012 telephone conversation between Charles M. Mobley, Cultural Resource Program Lead, and John Jangala, BLM – Glennallen Field Office Archaeologist.

Submitted to Betsy McGregor, AEA, June 14, 2012, with cc.

I first called BLM state archaeologist Bob King for a brief confirmation that he would be available this week and next to sign the ARPA permit, if needed (we have confirmed it is needed).

Then I called John Jangala at Glennallen, who will issue the BLM field office's paperwork – a Local Field Authorization – corresponding to the ARPA permit. Bob and John coordinate that between themselves.

Highlights of the conversation:

1) the provisional Unanticipated Discovery document is workable from BLM's perspective.

2) though interested Native groups may differ according to whether they have primarily a cultural interest (ties through occupancy – Ahtna etc.) or a property interest (Tyonek etc.), at this point in time it would be better not to exclude any Native groups when circulating review materials (like the Unanticipated Discovery document). He used the term "winnowing" to describe the subsequent process of determining which Native parties wish to participate in which ways to what degrees.

3) BLM will be sending FERC a letter soon notifying them of their desire to be a supplemental consulter with FERC. BLM has not decided whether they wish to be a Cooperator and sign-on to FERC's EIS, or an Intervener and develop a secondary EIS.

4) **BLM wishes to coordinate their public meeting times with AEA as much as possible, including the interviews and other public meetings that various Study Groups may desire for their respective investigations.** John's concern is simply courtesy to local individuals, who have 8-5 jobs and kids and fish to clean, etc., so that consolidation of their attention into one block of time is good for everybody.

5) Native parties sometimes wish to participate and still keep certain information confidential, which is difficult under the circumstances in which it has to go to FERC and be shared with other agencies or it doesn't get considered in the process.

Charles M. Mobley

NLUR Project #:	12-027

NLUR Record of Consultation

Date:	6/12/12	**Time:**	4:19pm
Contact:	Dr. Richard VanderHoek	**Project:**	Susitna-Watana
Company:	AEA	**Place:**	NLUR-FAI

Attendees and Affiliation:

Richard VanderHoek, Archaeologist, OHA

Justin Hays, Study Lead, NLUR

Purpose:

Verify reporting requirements for cultural resources investigations of proposed geotechnical borehole sites.

Summary of Discussion:

I emailed Dr. VanderHoek to inquire if a standard NLUR letter report/interim report was sufficient for reporting requirements to OHA. He responded it was acceptable as long as the results also appear in the end of the year final report draft submitted to OHA. I thanked him for his timely response and assured him both an interim/letter report and the final report would contain the results of all geotechnical survey in addition to the scheduled cultural resources investigations in 2012.

Signature/Name:

Justin M. Hays

NLUR Project #:	12-027

NLUR Record of Consultation

Date:	6/14/12	**Time:**	10:56am; 5:40pm; 6:00pm
Contact:	Dr. Robert King Mr. John Jangala	**Project:**	Susitna-Watana
Company:	AEA	**Place:**	NLUR-FAI

Attendees and Affiliation:

Dr. Robert King, Archaeologist, Anchorage BLM

Mr. John Jangala, Archaeologist, Glennallen BLM

Justin Hays, Study Lead, NLUR

Purpose:

Submit a permit application for archaeological investigations on Bureau of Land Management lands within the proposed study area.

Summary of Discussion:

Initially, I called Mr. Jangala in Glennallen to inquire about whom I should submit my permit application to. He directed me to Dr. King, State Archaeologist at the Anchorage BLM. Mr. Jangala indicated he was the Field Office Manager of this area and he would oversee the permit in the field and to cc him on emails to the BLM.

That day, I emailed my permit application to Dr. King and cc'd Mr. Jangala. Dr. King quickly responded to my email and thanked me for getting the application in early. On June 27, Dr. King sent a copy of the signed permit (# AKAA-093320) back to me. The document still needs to be signed by the Principal Investigator, Peter Bowers and mailed back to Dr. King at BLM. NLUR is in the process of delivering a signed copy.

Signature/Name:  Justin M. Hays

Brelsford, Taylor

Subject: Discussion of AEA Cultural Resources Place Names proposal; follow up on other CR items

Location: teleconference

Start: Wed 6/13/2012 11:00 AM
End: Wed 6/13/2012 12:30 PM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Brelsford, Taylor
Required Attendees: Chuck Mobley (mobley@alaska.net); Pete Bowers; Bill Simeone; Justin Hays

In response to e-mail traffic today, let's try for a meeting at

11:am on Wed. Agenda for all:

1. Place names study proposal
    a. Current status of the proposal initiated by Jim Kari and Ahtna
    b. Role of cultural landscapes issue
    c. Role for CIRI
    d. Next steps

Additional Items on Cultural Resources contractors work program -

2. Implementation of the unanticipated discovery protocols
3. Rewrite schedule & parameters for the 2013/14 PSP

Teleconference Info:

Dial in: 1-888-369-1427

Passcode: 2616705

Brelsford, Taylor

Subject:	AEA Cultural Resources - Work session on study proposal for place names, TCP, and ethnographic landscape
Location:	URS office, 700 G St., Suite 500; and teleconference
Start:	Thu 6/14/2012 1:00 PM
End:	Thu 6/14/2012 2:30 PM
Recurrence:	(none)
Meeting Status:	Meeting organizer
Organizer:	Brelsford, Taylor
Required Attendees:	Chuck Mobley (mobley@alaska.net); Pete Bowers; Justin Hays; Bill Simeone; James Kari; Bruce Cain (bcain@ahtna.net)

Friends,

Following a very constructive meeting today, we made homework assignments and agreed to meet for a work session tomorrow. Bruce was kind to distribute a summary of the meeting discussion and assignments.

Teleconference Number: 1-888-369-1427
Passcode: 2616705

Contact Information for the AEA Susitna-Watana Cultural Resources Contractor Team

Program Manager
Charles (Chuck) Mobley, Ph.D., Charles M Mobley & Associates
Office: 907-653-1937
e-mail: Mobley@alaska.net

Deputy Project Manager Taylor Brelsford (URS) Office:
907-261-6705
Cell: 907-244-2992
e-mail: Taylor.Brelsford@urs.com

Field Study Leads
Peter (Pete) Bower (NLUR)
907-474-9684
e-mail: Peter Bowers pmb@northernlanduse.com

Justin Hayes (NLUR)

907-474-9684
e-mail: Justin Hays <jmh@northernlanduse.com>

William (Bill) Simeone, Ph.D., Independent Researcher
Home/Office: 907-277-1525
ll: 907-230-5785
e-mail: Bill Simeone <wesimeone2@gmail.com>

James (Jim) Kari, Ph.D., Professor of Linguistics,
Emeritus e-mail: James Kari <jmkari@alaska.edu>

Bruce Cain, Vice President of Administration and Finance, Ahtna,
Incorporated Direct 907-822-8126, Glennallen Receptionist 907-822-3476,
Cell - 907-952-2798 e-mail: Bruce Cain <bcain@ahtna.net>

Brelsford, Taylor

Subject:	AEA CR- Ethnographic Landscape, Place Names study plan work session
Location:	Teleconf
Start:	Fri 6/15/2012 1:00 PM
End:	Fri 6/15/2012 2:00 PM
Recurrence:	(none)
Meeting Status:	Meeting organizer
Organizer:	Brelsford, Taylor
Required Attendees:	Chuck Mobley (mobley@alaska.net); Pete Bowers; Justin Hays; Bill Simeone; Joe Bovee; Bruce Cain (bcain@ahtna.net); kmartin@ahtna.net; kmaratin@ahtna-inc.com

Purpose:

Update on AEA process for 2013-2014 study plan development
Additional review of draft study plan circulated this morning

Teleconference Info:

Number: 1-888-369-1427
Passcode: 2616705

Brelsford, Taylor

Subject: Review of 6/16 budget and study plan
Location: teleconf

Start: Wed 6/20/2012 10:15 AM
End: Wed 6/20/2012 11:15 AM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Brelsford, Taylor
Required Attendees: Bill Simeone; Bruce Cain (bcain@ahtna.net); Justin Hays; Chuck Mobley (mobley@alaska.net); Pete Bowers

Dial in at: 1-888-369-1427

Passcode: 2616705

(Bruce, if there is trouble getting on-line, please dial Angel as before at 907-562-3366) (Bruce, please forward to Jim Kari, if you like.)

Notes on June 19-21, 2012 telephone and email dialogue between Charles M. Mobley, Cultural Resource Program Lead, and Richard VanderHoek, SHPO's representative, concerning: a) logistics for field visit on June 28, 2012; b) cultural resource discussion in Transportation PSP submitted by B. Carey. Submitted to Betsy McGregor, AEA, June 21, 2012, with cc.

Rich VanderHoek and I exchanged three emails on June 19 and another on the 20th working out the details for the two of us to take a field trip into the project area on Thursday, June 28.

He and I also talked on the telephone twice on June 21 and had two email exchanges regarding the cultural resource discussion in the Transportation PSP that B. Carey sent to him this morning (subsequently forwarded to me) requesting review and comment. VanderHoek and State Archaeologist Dave McMahan conferred and provided comments back to me. (I've circulated them back to B. Carey and the cultural resource team). On the telephone Rich commented that they preferred to handle such consultation through one point of contact and were expecting that would be me. I agreed.

Specific SHPO comments on the Transportation PSP language are not included in this meeting notes document since it is to be included in the PSP, and the comments referred to specific site locational information that they wished deleted.

Charles M. Mobley

Notes on a June 28, 2012 meeting/field trip between Charles M. Mobley, Cultural Resource Program Lead, and Richard VanderHoek, SHPO's representative, concerning provisions of the Plan for Unanticipated Discoveries, as part of the Susitna-Watana Dam cultural resource program. Submitted to Betsy McGregor, AEA, June 29, 2012, with cc.

Rich VanderHoek and I independently drove to Talkeetna, met up with Quicksilver helicopter, and flew the length of the impoundment, part of the Denali corridor up to Deadman Lake, and the Gold Creek corridor. Weather was barely fair and delayed departure from Talkeetna. The work required three tanks of fuel, involving two stops at the tank slung in behind Stephens Lake Lodge.

One archaeological site was inspected on the ground – TLM-143, which has yielded C14 dates of 4500 years ago and overlooks a salt lick that had a flock of sheep ranging over it when we were there.

Of note for implementation of the archaeological fieldwork is the lack of LZs throughout much of the project area inspected. Our pilot said that no trees or bushes were allowed to be cut for helicopter landings, which further limits access. Consequently the field investigations will entail considerable pedestrian access in addition to just the effort for the actual pedestrian archaeological survey.

Additional archaeological observations will be shared with the specialists on the team. Of note, though, is a complex of eskers just (within 1-2 miles) north of the upper reach of the impoundment that would seem to have the same potential as the Tangle Lakes Archaeological District

Charles M. Mobley

Attachment 11.7.2. Plan for Unanticipated Discovery of Cultural Resources and Human Remains During The 2013-2014 Susitna-Watana Dam Field Investigations

(PROVISIONAL – JULY 8, 2012)

The first part of this plan (pages 1-3) is addressed to non-cultural resource contractors and other personnel involved with the Susitna-Watana Hydroelectric Project (Project) and establishes procedures in the event that unreported or unanticipated cultural resources and/or human remains are found in the field. <u>The field reporting procedures differ depending on whether cultural materials or human remains are encountered, whether the discoverers are involved in a non-destructive effort, or whether ground disturbance is involved.</u> Reports of any finds will be forwarded by the Cultural Resources Program or Study Lead as per the remainder of this plan according to whether the finds are on federal, state, or private land[1]. Prior to fieldwork, AEA and contracted personnel will receive environmental training including the following guidance for identifying and reporting cultural resources or human remains discovered in the field. This plan briefly describes cultural resources in the study area, how to distinguish them from insignificant junk and trash, and procedures to follow <u>if</u>[2] cultural resources or human remains are encountered during fieldwork).

Cultural Resources in the Study Area

The general study area contains historic and prehistoric remains dating back as far as 10,000 years, and over 250 sites are known from previous studies. Of those, about 90 percent had stone tools and other prehistoric artifacts, about 10 percent were historic sites consisting of building ruins or scatters of commercially manufactured items (metal cans, bottles, etc.), and only a couple were fossil discoveries (animal or plant remains). The more recent prehistoric sites are from the Athabascan Indians who inhabited the area historically and hold the majority of the area's Native place names in their linguistic dialect (Ahtna); older sites fade into a more generalized adaptation shared by most of Alaska's ancient interior peoples. Historic sites in the Susitna-Watana area reflect remote land use like mining, prospecting, hunting, trapping, and recreational pursuits, in addition to simple homesteading.

How to Distinguish Cultural Resources

Prehistoric sites in the sample most commonly contain stone tools, which are the main indicator for field personnel. Rocks free of flaws that fracture easily and predictably (like flint or obsidian) were typically struck and pressured into form, resulting in tools and discarded flakes with distinctively faceted surfaces,

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[1] As set forth by the National Historic Preservation Act (NHPA), as amended (16 USC 470) and implementing regulations (36 CFR 800), Archaeological Resources Protection Act (ARPA), Native American Graves Protection and Repatriation Act (NAGPRA) and Alaska Statutes 11.46.482 (a)(3), 12.65.5, 18.50.250, and 41.35.200.

[2] "ifs" are underlined in this document.

i.e., shallow concave scars on tools as well as the corresponding positive bulbs on removed flakes (imagine the rippled conical chunk of glass your son, daughter, or you once popped out of a plate glass window with a BB gun). This is the major diagnostic feature to keep in mind for prehistoric sites. The process of discriminating between an artifact and a naturally shattered rock depends a lot on context. A few suspicious stone shards among a rocky talus slope of identical mineralogy are probably not cause for concern; an interesting, multi-flaked, sharp stone plus a few others nearby (perhaps with detachment bulbs) on a flat overlook would more likely be a cultural occurrence. Many of these locales have already been found and recorded as formal archaeological sites, but it is likely that more remain to be discovered.

Historic sites can have more variability than prehistoric sites in terms of surface and subsurface features and their degree of preservation. Building ruins ranging from roofed examples to those fast entering the archaeological record are part of the cultural resource inventory. Scatters of metal cans and glass bottles legally can be cultural resources too, <u>if</u> they are 50 or more years old (using that criterion, archaeologist Ivar Skarland's field camp from his 1953 investigations of the then-proposed Devil's Canyon dam impoundment could hypothetically be historically significant). Unvegetated deposits of loose rock at the base of mineralized outcrops, often reddish or yellowish in color, may indicate historic prospecting, as might the remains of water diversion systems. As with the prehistoric inventory, many of these sites have already been discovered, but it is likely that more remain to be found.

What to Do <u>if</u> Cultural Features or Artifacts are Encountered

Regardless of whether the field program is non-destructive or involves ground disturbance, work must be stopped immediately in the vicinity, with no further disturbance of the features or artifacts. <u>If</u> work involves a ground-disturbing activity, either Cultural Resource Program Lead Charles M. Mobley or Study Lead Justin Hays should be contacted immediately (contact information is listed below) and provided information describing of the finds and their location, including GPS coordinates. <u>If</u> work is part of a non-destructive field program, the description and location of the suspected cultural resource, including GPS coordinates, must be reported to Mobley or Hays within five days. Digital photographs accompanying the report are especially recommended, but no photographs or site-specific location information should be released to the press or individuals other than the Cultural Resource Program or Study Leads.

Charles M. Mobley		Justin Hays
Cultural Resources Program Lead		Cultural Resources Study Lead
(907) 653-1937 office	**<u>OR</u>**	(907) 474-9684 office
(907) 632-1933 cell		(907) 750-9857 cell
mobley@alaska.net		jmh@northernlanduse.com
Charles M. Mobley & Associates		Northern Land Use Research, Inc.
200 W. 34th Avenue #534		234 Front Street
Anchorage, Alaska 99503		Fairbanks, Alaska 99709

How to Distinguish Human Remains

Animal bones are statistically much more common than human remains, so probabilities favor the find not being human. A biologist or hunter on the crew should be consulted for a determination. If the bones are cut or sawn, they can be assumed to be non- human. Human skulls and all-one-piece jaws are relatively unique and easily identified. For other bones, imagining where they may fit in a human body is recommended. If they do not appear to fit, they are less likely to be human.

Context is important. If the bones are scattered around a fairly recently used fire ring, for example, then they are likely to be animal bones. If they are tumbling out of a rock cairn, they are more likely to be human.

What to Do if Human Remains are Found

Regardless of whether work is part of a non-destructive field program or one involving ground disturbance, work must be stopped immediately in the vicinity, with no further disturbance of the bones. Either Cultural Resource Program Lead Charles M. Mobley or Study Lead Justin Hays must be contacted immediately by telephone or email (see contact information above) and provided with a description of the bones and their location, including GPS coordinates. Digital photographs accompanying the report are especially recommended but no photographs or site-specific location information should be released to the press or individuals other than the Cultural Resource Program or Study Leads.

Forwarding Reports of Discoveries from the Field

After the field report has been made to Mobley or Hays the field finders' responsibilities are over other than to be available for further consultation if necessary. The following steps will then be set in motion:

1. The Cultural Resources Program or Study Lead will compare the find's GPS coordinates and description with the known site inventory to determine if it actually reflects a new discovery or an already-recorded site.

2. If the discovery involves human remains or is determined to be an unrecorded cultural property, the Cultural Resources Program or Study Lead will immediately notify AEA's Environmental Project Manager of the find and its potential significance.

Betsy McGregor, AEA Environmental Project Manager
(907) 771-3957 office
BMcGregor@aidea.org
411 W. 4th Avenue, Ste. 1
Anchorage, Alaska 99501

3. AEA's Environmental Project Manager will coordinate with a cultural resources consultant who will travel to the location and evaluate the find as warranted to determine if indeed human bones have been discovered or if a new cultural site has been found.

4. If the materials found are human remains, the protocols outlined in the subsequent two sections entitled **Protection of Human Remains** (distinguished according to land ownership) will be followed. If a cultural site is at imminent risk from a proposed ground-disturbing activity, the procedures specified in the following two sections entitled **Protection of Cultural Remains** (again distinguished according to land ownership) below will be followed. If the materials are already recorded cultural sites and not in jeopardy, no further action will be taken.

Protection of At-Risk Cultural Materials on Private and State-Managed Land

a) AEA's Environmental Project Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter (66-foot) buffer as appropriate. This buffer may be larger if there is the possibility of more resources occurring in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Project Manager will direct the cultural resources consultant to begin a more detailed assessment of the find's significance and the potential effect of construction.

c) AEA's Environmental Project Manager will promptly notify the Alaska State Historic Preservation Officer (SHPO) or State Archaeologist of the find.

Judith Bittner, SHPO (907) 269-8721 judy.bittner@alaska.gov Alaska Dept. of Natural Resources Office of History and Archaeology 550 West 7th Avenue Ste. 1310 Anchorage, Alaska 99501-3565	OR	David McMahan, State Archaeologist (907) 269-8723 dave.mcmahan@alaska.gov Alaska Dept. of Natural Resources Office of History and Archaeology 550 West 7th Avenue Ste. 1310 Anchorage, Alaska 99501-3565

d) The landowner will be promptly notified.

e) The cultural resources consultant will document the site circumstances, potential significance, and risk of harm. If the cultural resources consultant assesses the find as not significant or lacking integrity, the consultant will notify the AEA Environmental Project Manager who will then inform the SHPO. Upon SHPO agreement of a finding of no effect, AEA will request approval to resume construction. A brief report of the find will be provided to the SHPO within one week of its recording. If the archaeological consultant determines that the find may be significant, then the following steps will be implemented.

f) AEA's Environmental Project Manager will notify other parties, such as appropriate Alaska Native organizations, as directed by the SHPO.

Alaska Native Regional Corporations:

- Ahtna, Incorporated (Ahtna)
  Michelle Anderson, President
  PO BOX 649, Glennallen, Alaska 99588
  Glennallen Office: (907) 822-3476
  Fax: (907) 822-3495
  Anchorage Office: (907) 868-8250
  Fax: (907) 868-8285
  Email: manderson@ahtna.net

- Cook Inlet Region, Incorporated (CIRI)
  2525 C Street Suite 500, Anchorage, Alaska 99503
  P.O. Box 93330, Anchorage, Alaska 99509-3330
  (907) 274-8638
  Fax: (907) 279-8836

- Doyon, Limited (Doyon)
  1 Doyon Place, Suite 300
  Fairbanks, Alaska 99701-2941
  (907) 459-2000
  (888) 478-4755 (toll-free)
  (907) 459-2060 (fax)

- Doyon **- Anchorage Office**

11500 C Street, Suite 250
Anchorage, Alaska 99515-2692
(907) 563-5530 or (907) 375-4220
(907) 375-4205 (fax)

A more complete contact list is attached as Appendix A.

g) If the find is significant and continuing work may damage more of the site, AEA's Environmental Project Manager will request recommendations from the SHPO and other parties regarding appropriate measures for site treatment. These measures may include formal archaeological evaluation of the site; visits to the site by the SHPO and other parties; preparation of a mitigation plan by AEA for approval by the SHPO; implementation of the mitigation plan; and/or approval to resume construction following completion of the fieldwork component of the mitigation plan.

h) If further analysis indicates that the find lacks significance, AEA's Environmental Project Manager will consult with the SHPO and other appropriate parties to request approval for resumption of construction.

i) AEA's Environmental Project Manager will notify the Cultural Resource Program Lead or Study Lead who will grant clearance to the Contractor to start construction.

Protection of At-Risk Cultural Materials on Federal Lands

a) AEA's Environmental Project Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter (66-foot) buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Project Manager will direct the cultural resources consultant to begin a more detailed assessment of the find's significance and the potential effect of construction.

c) AEA's Environmental Project Manager will promptly notify the appropriate federal land managing agency and Alaska SHPO of the find.

John Jangala, Archaeologist
(907) 822-7303
jjangala@blm.gov
Glennallen Field Office

Judith Bittner, SHPO
(907) 269-8721
judy.bittner@alaska.gov
Alaska Dept. of Natural Resources

Bureau of Land Management
P.O. Box 147
Glennallen, Alaska 99588-0147

Office of History and Archaeology
550 West 7th Avenue Ste. 1310
Anchorage, Alaska 99501-3565

d) The cultural resources consultant will document the site circumstances, potential significance, and risk of harm, and then notify the AEA Environmental Project Manager who will in turn inform the Bureau of Land Management (BLM) archaeologist and the SHPO. If the cultural resources consultant determined the find is not significant or lacking integrity, and the BLM and SHPO agree on a finding of *no effect*, then AEA will request approval to resume construction. A brief report of the find and an Alaska Heritage Resources Survey (AHRS) site form will be provided to the BLM and SHPO within two weeks of its recording. If the archaeological consultant recommends that the find may be significant, then the following steps will be implemented.

e) AEA's Environmental Project Manager will notify other parties, such as appropriate Alaska Native organizations, as directed by the SHPO.

f) If the find is assessed as significant and continuing work may damage more of the site, then AEA's Environmental Project Manager will request recommendations from the appropriate federal land managing agency, SHPO, and other parties regarding appropriate measures for site treatment. These measures may include formal archaeological evaluation of the site; visits to the site by the SHPO and other parties; preparation of a mitigation plan by AEA for approval by the appropriate federal land managing agency and SHPO; implementation of the mitigation plan; and/or approval to resume construction following completion of the fieldwork component of the mitigation plan.

g) If further analysis indicates that the find lacks significance, then AEA's Environmental Project Manager will consult with the federal land managing agency, SHPO, and other appropriate parties to request approval for resumption of construction.

h) AEA's Environmental Project Manager will notify the Cultural Resource Program Lead or Study Lead who will grant clearance to the contractor to start construction.

Protection of Human Remains on Private and State-Managed Land

a) AEA's Environmental Project Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Project Manager will notify a peace officer of the state (police, Village Public Safety Officer, or Alaska State Trooper [AST]) and the Alaska State Medical Examiner (SME) immediately of the discovery, as stipulated in Alaska Statute 12.65.5. In addition to a local peace officer (if in a local jurisdiction), notification should include the AST Criminal Investigation Bureau. If the human remains appear recent (less than 50 years old) in the judgment of the archaeologists, the AST and Alaksa SME will determine whether the remains are of a forensic nature and/or subject to criminal investigation. The AST and Alaska SME contacts are

Sgt. Kid Chan
(800) 478-9333
(907) 269-5058
choong.chan@alaska.gov
(cc: Stephanie Johnson at steph.johnson@alaska.gov)
Alaska State Troopers
Missing Persons Bureau
5700 East Tudor Road
Anchorage, AK 99507

Talkeetna Post - Alaska State Troopers
(907) 733-2256
HC89 Box 8576
Talkeetna, AK 99676

Dr. Gary Zientek, Deputy Medical Examiner
(907) 334-2200
gary.zientek@alaska.gov
Alaska State Medical Examiner
5455 Dr. Martin Luther King Jr. Ave
Anchorage, Alaska 99507

c) The landowner will be promptly notified.

d) The Alaska SHPO will also be notified of any discovery unless circumstances indicate that the death or burial is less than 50 years old and that there is need for a criminal investigation or legal inquiry by the coroner.

e) Written authorization in the form of a Burial Transit Permit from the Alaska State Bureau of Vital Statistics (BVS) shall be obtained prior to any excavation or re-interment of any human remains. In addition, clearance from the appropriate Alaska Native organization must be obtained prior to excavation or re-interment of Alaska Native remains. The BVS contact is:

Phillip Mitchell, Section Chief

(907) 465-3391
BVSResearch@alaska.gov
Phillip.mitchell@alaska.gov
Alaska Bureau of Vital Statistics
5441 Commercial Boulevard
P.O. Box 110675
Juneau, AK 99801

f) If the human remains are found to be historic in nature, a qualified professional physical anthropologist with experience in the analysis of human remains will examine them in situ to determine racial identity. The physical anthropologist shall document, analyze, and photograph the remains so that an independent assessment of racial identity can be made. The physical anthropologist shall be afforded no more than 30 days time to conduct his or her analysis.

g) If the unanticipated discovery consists of Alaska Native human remains, AEA will consult with the Alaska SHPO, FERC, and appropriate Alaska Native organizations regarding the appropriate measures to respectfully handle such a discovery. If it can be determined adequately that the identified human remains have affinity to any federally recognized tribe(s), a reasonable effort will be made by AEA to identify, locate, and notify these tribes. The appropriate Alaska Native Regional Corporations also will be contacted by AEA. A comprehensive contact list is attached as Appendix A.

h) AEA's Environmental Project Manager will notify other parties, as directed by the SHPO.

i) If the human remains are not Native American, and a determination has been made by the AST and Alaska SME that a death investigation is not warranted, then AEA, in consultation with the Alaska SME, will identify, locate and inform descendants of the deceased.

j) After permission to resume construction has been issued by the SHPO, AEA's Environmental Project Manager will notify the Cultural Resource Program Lead or Study Lead who will grant clearance to the contractor to restart construction.

Protection of Human Remains on Federal Land

a) AEA's Environmental Project Manager will promptly notify the Environmental Inspector to flag the at-risk site with a 20-meter (66-foot) buffer as appropriate. This buffer may be larger if there is the possibility of more resources in the area or in the case of slopes or cut-banks where ongoing construction may impact the site.

b) AEA's Environmental Project Manager will notify a peace officer of the state (police, Village Public Safety Officer, or AST) and the SME immediately of the discovery, as stipulated in Alaska Statute

12.65.5. In addition to a local peace officer (if in a local jurisdiction), notification should include the AST Criminal Investigation Bureau. If the human remains appear recent (less than 50 years old) in the judgment of the archaeologists, the AST and Alaska SME will determine whether the remains are of a forensic nature and/or subject to criminal investigation. The appropriate federal land managing agency will also be contacted in case the human remains are related to a crime scene. The contact of the AST and Alaska SME are:

Sgt. Kid Chan
(800) 478-9333
(907) 269-5058
choong.chan@alaska.gov
(cc: Stephanie Johnson at steph.johnson@alaska.gov)
Alaska State Troopers
Missing Persons Bureau
5700 East Tudor Road
Anchorage, AK 99507

Talkeetna Post - Alaska State Troopers
(907) 733-2256
HC89 Box 8576
Talkeetna, AK 99676

Dr. Gary Zientek, Deputy Medical Examiner
(907) 334-2200
gary.zientek@alaska.gov
Alaska State Medical Examiner
5455 Dr. Martin Luther King Jr. Ave
Anchorage, Alaska 99507

John Jangala, Archaeologist
(907) 822-7303
jjangala@blm.gov
Glennallen Field Office
Bureau of Land Management
P.O. Box 147
Glennallen, Alaska 99588-0147

c) The Alaska SHPO will also be notified of any discovery unless circumstances indicate that the death or burial is less than 50 years old and that there is need for a criminal investigation or legal inquiry by the coroner

d) Written authorization in the form of a Burial Transit Permit from the Alaska State Bureau of Vital Statistics (see above for contact information) shall be obtained prior to any excavation or re-interment of any human remains. In addition, clearance from the appropriate Alaska Native organization must be obtained prior to excavation or re-interment of Alaska Native remains.

e) If the human remains are found to be historic in nature, AEA, as directed by the appropriate federal land managing agency, will determine the origin of the human remains. A qualified professional physical anthropologist with experience in the analysis of human remains will examine them in situ to determine racial identity. The physical anthropologist shall document, analyze, and photograph the remains so that an independent assessment of racial identity can be made. The physical anthropologist shall be afforded no more than 30 days to conduct his or her analysis. The appropriate federal land managing agency will follow Native American Graves Protection and Repatriation Act (NAGPRA) and the implementing regulations set forth in 43 CFR 10, for Alaska Native remains.

f) For Alaska Native remains, the appropriate federal land managing agency will retain the responsibility for determining and contacting the appropriate Alaska Native groups. In this case, NAGPRA dictates that work in the immediate vicinity of the remains cannot proceed until 30 days after the reply from the federal agency in charge or appropriate Alaska Native group that the documents regarding the finding were received, unless a written and binding agreement is issued from the federal agency in charge and the affiliated Native American group(s) (NAGPRA 25 USC 3002 Sec 3(d)). The remains will then be assessed and treated based on the guidance of the federal agency in charge and the appropriate Alaska Native group as defined by NAGPRA.

g) If the human remains are not Native American, and a determination has been made by the AST and Alaska SME that a death investigation is not warranted, then AEA, as directed by the appropriate federal land managing agency in consultation with the Alaska SME, will identify, locate, and inform descendants of the deceased.

h) AEA's Environmental Project Manager will notify other parties, as directed by the appropriate federal land managing agency.

i) After permission to resume construction has been issued by the appropriate federal land managing agency, AEA's Environmental Project Manager will notify the Cultural Resource Program Lead or Study Lead who will grant clearance to the Contractor to restart construction.

Appendix A: Contacts for Alaska Native Parties

Though communities potentially affected by the project have different histories and cultures, they are characterized by strong past and present ties to the land and its resources. The successful completion of the Consultation and Coordination phase of the Section 106 process requires an efficient and effective consultation process that addresses the laws and regulations within the context of local custom and practice. Several Alaska tribal entities recognized by the U.S. Department of Interior and established through the Alaska Native Claims Settlement Act (ANCSA) of 1971, are broadly located near the study area. In Alaska, consultation typically occurs with the 229 federally-recognized tribes, the 13 Alaska Native Regional Corporations, and some 200 Alaska Native Village Corporations created by the ANCSA (the Regional and Village Corporations are recognized as "Indians tribes" for National Historic Preservation Act [NHPA] purposes).

Regional Native Alaskan corporations that have interests within or near the Project area include:

- Ahtna, Incorporated (Ahtna)
  Michelle Anderson, President
  PO BOX 649, Glennallen, Alaska 99588
  Glennallen Office: (907) 822-3476
  Fax: (907) 822-3495
  Anchorage Office: (907) 868-8250
  Fax: (907) 868-8285
  Email: manderson@ahtna.net

- Cook Inlet Region Incorporated (CIRI)
  2525 C Street Suite 500, Anchorage, Alaska 99503
  P.O. Box 93330, Anchorage, Alaska 99509-3330
  (907) 274-8638

- Doyon, Ltd. (Doyon)
  1 Doyon Place, Suite 300
  Fairbanks, Alaska 99701-2941
  (907) 459-2000
  (888) 478-4755 (toll-free)
  (907) 459-2060 (fax)

- Doyon, Limited - Anchorage Office
  11500 C Street, Suite 250
  Anchorage, Alaska 99515-2692

(907) 563-5530 or (907) 375-4220
(907) 375-4205 (fax)

Twenty-two tribes recognized by the Bureau of Indian Affairs under 25 CFR 83.6(b) are located within or near the Project area including:

- Cheesh-Na Tribal Council/Mount Sanford Tribal Consortium
  P.O. Box 357
  Gakona, Alaska 99586
  907-822-5399
  Fax 907-822-5810

- Chickaloon Native Village
  P.O. Box 1105
  Chickaloon, AK 99674-1105
  907-745-0707
  Fax 907-745-7154
  cvadmin@chickaloon.org
  http://www.chickaloon.org

- Native Village of Chitina
  P.O. Box 31
  Chitina, AK 99566-0031
  907-823-2215
  Fax 907-823-2233
  aceak2000@yahoo.com

- Gulkana Village
  P.O. Box 254
  Gakona, AK 99586
  907-822-3746
  Fax 907-822-3976
  lclaw@gulkanacouncil.org
  http://gulkanacouncil.org/

- Healy Lake Village
  P.O. Box 74090
  Fairbanks, AK 99706-0300
  907-876-0638
  Fax 907-876-0639
  jpolstonhitc@live.com

- Kenaitze Indian Tribe
  P.O. Box 988
  Kenai, AK 99611-0988
  907-283-3633
  Fax 907-283-3052
  kenaitze@alaska.net
  http://www.kenaitze.org/

- Knik Tribe
  P.O. Box 871565
  Wasilla, AK 99687
  907-373-7991
  Fax 907-373-2161
  kniktribe@mtaonline.net

- Mentasta Traditional Council
  P.O. Box 6019
  Mentasta Lake, AK 99780-6019
  907-291-2319
  Fax 907-291-2305
  kmartin@tribalnet.com

- Native Village of Cantwell
  P.O. Box 94
  Cantwell, AK 99729
  907-768-2591
  Fax 907-768-1111
  hallvc@yahoo.com

- Eklutna Native Village
  26339 Eklutna Village Road
  Chugiak, AK 99567-6339
  907-688-6020
  Fax 907-688-6021
  nve@eklutna-nsn.gov
  http://www.eklutna-nsn.gov

- Native Village of Gakona
  P.O. Box 102
  Gakona, AK 99586
  907-822-5777
  Fax 907-822-5997
  gakonavc@cvinternet.net
  www.nvgakona.com

- Native Village of Kluti-Kaah
  P.O. Box 68
  Copper Center, AK 99573-0068
  907-822-5541
  Fax 907-822-5130
  nvkktops@cvinternet.net

- Native Village of Tazlina
  P.O. Box 87
  Glennallen, AK 99588-0087
  907-822-4375
  Fax 907-822-5865
  tazlinajulie@cvinternet.net

- Native Village of Tetlin
  P.O. Box 797
  Tetlin, AK 99779
  907-883-2021
  tetlin@earthlink.net

- Native Village of Tyonek
  P.O. Box 82009
  Tyonek, AK 99682-0009
  Phone 907-583-2271
  Fax 907-583-2442
  E-mail tyonek@aitc.org

- Nenana Native Association
  P.O. Box 369
  Nenana, AK 99760
  907-832-5461
  Fax 907-832-1077
  nibor652004@yahoo.com

- Ninilchik Village
  P.O. Box 39070
  Ninilchik, AK 99639
  907-567-3313
  Fax 907-567-3308
  ntc@ninilchiktribe-nsn.gov/
  http://www.ninilchiktribe-nsn.gov/

- Northway Village
  P.O. Box 516
  Northway, AK 99764
  907-778-2287
  Fax 907-778-2220
  dnnvc@yahoo.com

- Seldovia Village Tribe
  P.O. Drawer L
  Seldovia, AK 99663
  907-234-7898
  Fax 907-234-7865
  svt@svt.org
  http://www.svt.org/

- Native Village of Tanacross
  P.O. Box 76009
  Tanacross, AK 99776
  907-883-5024
  Fax 907-883-4497
  jerry_isaac@hotmail.com

- Village of Dot Lake
  P.O. Box 2279
  Dot Lake, AK 99737-2279
  907-882-2695 or 907-322-2694
  Fax 907-882-5558
  dotlake@aitc.org

- Village of Salamatoff
  P.O. Box 2682
  Kenai, AK 99611
  907-283-7864
  Fax 907-283-6470

ANCSA recognized and non-recognized villages; group and urban corporations; and village organizations may have interests near the Project area. These entities include:

- Alexander Creek, Incorporated
  8128 Cranberry
  Anchorage, AK 99502
  (907) 243-5428

- Caswell Native Association
  HC 89, Box 83
  Willow, AK 99688
  (907) 495-1263

- Chitina Native Corporation
  P.O. Box 3
  Chitina, AK 99566-0031
  907-823-2223
  Fax 907-823-2202
  chitina_native@cvinternet.net
  http://www.chitinanative.com

- Chickaloon-Moose Creek Native Association, Incorporated
  P.O. Box 875046
  Wasilla, AK 99687
  907-373-1145
  Fax 907-373-1142
  cmena@alaska.net
  http://www.chickaloon.org

- Dot Lake Native Corporation
  3500 Wolf Run
  Fairbanks, AK 99709
  907-882-2755
  Fax 907-882-2775

- Eklutna, Incorporated
  16515 Centerfield Dr. #201
  Eagle River, AK 99577
  907-696-2828
  Fax 907-696-2845
  receptionist@eklutnainc.com
  http://www.eklutnainc.com

- Gold Creek-Susitna NCI
  P.O. Box 847
  Talkeetna, AK 99676-0847
  (907) 733-2329

- Knikatnu, Incorporated

P.O. Box 872130
Wasilla, AK 99687-2130
907-376-2845
Fax 907-376-2847
knikcorp@gci.net

- Little Lake Louise Corporation
  (907) 250-2098

- Lower Tonsina Corporation
  Unavailable

- Kenai Natives Association, Inc.
  215 Fidalgo Ave. #101
  Kenai, AK 99611-7776
  907-283-4851
  Fax 907-283-4854

- Nabesna Native Group, Inc.
  Unavailable

- Mendas Cha-ag Native Corporation
  Gary Lee, President
  457 Cindy Dr.
  Fairbanks, AK 99701

- Montana Creek Native Association
  P.O. Box 100379
  Anchorage, AK 99510

- Ninilchik Natives Association, Incorporated
  P.O. Box 39130
  Ninilchik, AK 99639
  907-567-3866
  Fax 907-567-3867
  nnai@nnai.net
  http://www.nnai.net

- Northway Natives, Incorporated

P.O. Box 401
Northway, AK 99764
907-778-2298
Fax 907-778-2266

- Point Possession, Incorporated
  Feodoria Pennington, President
  1321 Oxford Dr.
  Anchorage, AK 99503
  (907) 563-1848

- Salamatkof Native Association, Incorporated
  100 N. Willow Street
  Kenai, AK 99611
  907-283-3745
  Fax 907-283-6470
  info@salamatof.com
  http://www.salamatof.com/

- Slana Native Corporation
  Unavailable

- Seldovia Native Association, Incorporated
  P.O. Drawer L
  Seldovia, AK 99663-0250
  907-234-7625
  Fax 907-234-7637
  info@snai.com
  http://www.snai.com

- Tanacross, Incorporated
  P.O. Box 76029
  Tanacross, AK 99776
  907-883-4130
  Fax 907-883-4129
  http://www.tanacrossinc.com

- Tetlin Native Corporation
  Gary David Sr., President

P.O. Box 657

Tok, AK

(907) 883-6652

(907) 505-0253

- Toghotthele Corporation
  P.O. Box 249

  Nenana, AK 99760

  907-832-5832

  Fax 907-832-5834

  Toghotthele@hotmail.com

- Twin Lake Native Group, Incorporated
  Unavailable

- Tyonek Native Corporation
  1689 C Street, Suite 219
  Anchorage, AK 99501
  907-272-0707
  Fax 907-274-7125
  http://www.tyonek.com/

12. SUBSISTENCE RESOURCES

12.1. Introduction

The purpose of the subsistence resources study is to document traditional and contemporary subsistence harvest and use and to collect baseline data to facilitate the assessment of potential impacts of the Project construction and operation on subsistence harvest and use in the Project area. This study will provide information that will serve as the basis for compliance with FERC's NEPA obligations, along with other required approvals and analyses including those of the Bureau of Land Management (BLM) under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA), and also address State of Alaska needs regarding subsistence resources management.

For purposes of this study plan, traditional use will be defined as the values and practices related to subsistence that are passed down through generations of subsistence users and that inform and guide contemporary subsistence practices. Contemporary use will be defined as recent harvest and use patterns that characterize the resources and areas that are being utilized by communities.

12.2. Nexus Between Project Construction/Existence/Operations and Effects on Resources to be Studied

Construction and operation of the Project may result in changes to access to subsistence resources or changes in resource abundance or availability that could have potential direct or indirect effects on subsistence harvest and use. Increased human activity in the upper Susitna River basin also may affect subsistence uses, for instance by impacting wildlife behaviors or creating additional competition for subsistence resources. If a portion of a community's subsistence use areas are within the Project area, then a direct effect on subsistence use could occur.

Successful subsistence harvests depend on both continued availability of subsistence resources in adequate numbers and health and on continued access to those resources. Subsistence resource availability is affected by such factors as resource mortality or health changes, displacement from traditional harvest locations, and contamination (including actual and/or perceived contamination of resources and habitat or habituation of resources to development activities). Access to subsistence resources may be affected by such factors as construction of new roads and other infrastructure and establishment of a new reservoir. Changes in access can result in increased access to subsistence resources by harvesters. Increased access to an area may also result in more competition for resources from outsiders and/or from community or nearby community residents who did not previously use the area or who use the area differently as a result of changes induced by Project development. A decrease in access may decrease competition in the potentially affected area and introduce additional competition in new areas because harvesters can no longer access previously used hunting, fishing, or gathering areas (displaced users). A decrease in resource availability may potentially result in increased competition among harvesters as they try to meet their harvest needs from a depleted or displaced resource stock. It is important that these activities and resources are understood along with potential Project impact sources, to adequately assess potential impacts to subsistence uses and, if needed, identify potential protection, mitigation, and enhancement measures.

12.3. Resource Management Goals and Objectives

The results of this subsistence resources study and other related studies will inform FERC's NEPA analysis for the FERC licensing process and other agency approvals, as well as BLM's obligations under Title VIII of ANILCA and State of Alaska needs regarding subsistence resources management.

Alaska and the federal government regulate subsistence hunting and fishing in the state under a dual management system. The federal government recognizes subsistence priorities for rural residents on federal public lands, while Alaska considers all residents to have an equal right to participate in subsistence hunting and fishing when resource abundance and harvestable surpluses are sufficient to meet the demand for all subsistence and other uses. Much of the land occupied by the proposed Project is owned and managed by the ADNR, BLM, and private land owners, including Alaska Native Corporations established under the Alaska Native Claims Settlement Act (ANSCA).

ANILCA recognizes that "the situation in Alaska is unique" regarding food supplies and subsistence practices. Title VIII of ANILCA establishes subsistence protections on federal lands, including land selected by, but not yet conveyed to, the State or Alaska and Native Corporations, for Alaska's rural Alaska Native and other residents. Under section 803 of ANILCA, the term "subsistence uses" is defined as "the customary and traditional uses by rural Alaska residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade" (16 USC 3113). Where a "customary or traditional use" is identified for a given resource, the Secretary of the Interior must ensure that "rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public lands" (16 USC 3113).

Section 810 of ANILCA specifies that before making any decision to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands, a federal land management agency must first evaluate the effects of such a decision on subsistence use and needs (16 USC 3120). If, upon completion of such review, the agency finds that the proposed action may "significantly restrict" subsistence, additional requirements with respect to the proposed withdrawal, reservation, lease, permit or other use of public lands are triggered (16 USC 3120).

In 1990, the U.S. Department of the Interior and the U.S. Department of Agriculture established a Federal Subsistence Board to administer the Federal Subsistence Management Program (55 FR 27114). The Federal Subsistence Board, under Title VIII of ANILCA and regulations at 36 CFR 242.1 and 50 CFR 100.1, recognizes and regulates subsistence practices for rural residents on federal lands. Federal regulations recognize subsistence activities based on a person's residence in Alaska, defined as either rural or nonrural. Only individuals who permanently reside outside federally designated nonrural areas are considered rural residents and qualify for subsistence harvesting on federal lands under federal subsistence regulations. Nonrural residents may harvest fish and game on most federal lands (unless these are closed to non-federally qualified subsistence uses), but these harvests occur under State regulations. Federal subsistence regulations do not apply to certain federal lands, regardless of residents' rural designations. These include lands withdrawn for military use that are closed to general public access (50 CFR Part 100.3). Nonrural areas in Alaska include the areas around Prudhoe Bay, Fairbanks North Star Borough, Wasilla/Palmer, Anchorage, Kenai, Homer, Valdez, Seward, Juneau, and Ketchikan. Nonrural areas in relation to the proposed Project are shown on Figure 12.5-1.

The Alaska Board of Fisheries and the Alaska Board of Game have adopted regulations enforced by the State for subsistence fishing and hunting on all State of Alaska lands (except nonsubsistence areas) and waters, and lands conveyed to ANCSA entities. State subsistence uses are regulated under Alaska Statutes (AS) 16 and Title 5 of the Alaska Administrative Code (AAC)(05 AAC 01, 02, 85, 92, and 99). Under Alaska law, when there is sufficient harvestable surplus to provide for all subsistence and other uses, all Alaskan residents qualify as eligible subsistence users.

Under Alaska State law, subsistence refers to the practice of taking wild fish or game for subsistence uses (AS 16.05.258). Defined under state law as the "noncommercial customary and traditional uses" of fish and wildlife, subsistence uses under State law include:

> "consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumptions, and for the customary trade, barter, or sharing for personal or family consumption." (AS 16.05.940 33).

The State distinguishes subsistence harvests from personal use, general hunting, sport, or commercial harvests based on where the harvest occurs and the resource being harvested, not where the harvester resides (as is the case under federal law). More specifically, State law provides for subsistence hunting and fishing regulations in areas outside the boundaries of "nonsubsistence areas," as defined in state regulations (5 AAC 99.015). According to these regulations, a nonsubsistence area is "an area or community where dependence upon subsistence is not a principal characteristic of the economy, culture, and way of life of the area of community" (5 AAC 99.016).

Activities permitted in these nonsubsistence areas include general hunting and personal use, sport, guided sport, and commercial fishing. There is no subsistence priority in these areas; therefore, no subsistence hunting or fishing regulations manage the harvest of resources. Nonsubsistence areas in Alaska include the areas around Anchorage, Matanuska-Susitna (Mat-Su) Valley, Kenai, Fairbanks, Juneau, Ketchikan, and Valdez (Wolfe 2000). The Anchorage–Mat-Su–Kenai nonsubsistence area is located closest to the Project area (Figure 12.5-2).

12.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Consultation efforts to date include discussions with agency representatives, Alaska Native entities, and other licensing participants at the Project Technical Workgroup Meetings and other meetings with ADF&G held in between December and June 2012 (Table 12.4-1).

Table 12.4-1. Summary of consultation on Subsistence Resources study plans.

Comment Format	Date	Stakeholder	Affiliation	Subject
Technical Workgroup Meeting	12/08/2011	Various	Various	Attendees discussed how to define the study area and the communities needing study, particularly how to deal with communities like Talkeetna that lie in non-subsistence areas but whose residents exhibit a subsistence lifestyle
Letter	01/12/2012	P. Bergmann	USDOI	Comments regarding subsistence resources. (Filed with FERC.)
Technical Workgroup Meeting Notes	02/282012	Various	Various	Attendees questioned why Lake Louise was not included in ADF&G plan; why Chase was and how to get at other, similarly situated and dispersed households along the Railbelt; noted that ADF&G plan was baseline but that it needed to keep impact analysis and next steps in mind; noted that access would play a role in impact analysis; questioned if 1 year of data collection would be sufficient and how that might be augmented by other resource studies
Meeting	03/08/2012	Davin Holen	ADF&G Division of Subsistence	Kickoff meeting with ADF&G to discuss subsistence study planning, particularly HDR technical assistance with ADF&G use of tablets for mapping
Meeting	06/05/2012	Davin Holen, Jamie Van Lanen	ADF&G Division of Subsistence	Meeting to prep for Technical Workgroup meeting and discuss updates to study plan
Technical Workgroup Meeting Notes	06/07/2012	Various	Various	Attendees questioned whether studies would consider and delineate harvest based on regulatory system; AEA noted the need for coordination with harvest survey; BLM noted that the studies need to contain enough information for his agency to be able to complete an ANILCA 810 evaluation, which ultimately would be completed prior to the draft EIS (2014-2015 timeframe)

12.5. Subsistence Baseline Documentation Study

12.5.1. General Description of the Proposed Study

Through a combination of household harvest surveys, mapping interviews, and traditional and local knowledge interviews, the subsistence resources study will collect baseline data and document traditional and contemporary subsistence harvest and use to facilitate the assessment of potential impacts of the Project construction and operation on subsistence harvest and use in the Project area.

12.5.1.1. Study Goals and Objectives

The overall goal of this study is to demonstrate whether and, if so, the extent to which, communities harvest and use subsistence resources within or near the Project area, use Project area lands to access other lands for subsistence harvest and use, or harvest and use resources that migrate through the Project area and are later harvested in other areas

The objectives of the subsistence resources study are as follows:

1. Document whether and, if so, the extent to which communities within the Susitna River watershed, as well as communities outside the Susitna River watershed that have subsistence use areas in the watershed, use areas that are within or near the Project area for subsistence harvests;
2. Document whether and, if so, the extent to which communities within the Susitna River watershed, as well as communities outside the Susitna River watershed that have subsistence use areas in the watershed, use Project area lands to access other lands or waters for subsistence harvest;
3. Document whether and, if so, the extent to which communities within the Susitna River watershed, as well as communities outside the Susitna River watershed that have subsistence use areas in the watershed, use resources that migrate through the Project area and are harvested in other areas;
4. Collect and document traditional and local knowledge of communities within the Susitna River watershed, or who have subsistence use areas within the watershed, to assist in assessing the potential impacts of construction and operation of the proposed Project on subsistence harvest and use. This information will be directly shared with the program leads for other resources, as appropriate;
5. Evaluate Project development plans to identify likely sources of potential impacts on identified subsistence uses; and
6. Provide the necessary information needed to support preparation of an ANILCA 810 valuation.

The data developed through this study will be evaluated along with data from biological and wildlife and cultural resources studies to supplement the subsistence information and put it into context with other related resource conditions.

12.5.2. Existing Information and Need for Additional Information

The intent of subsistence baseline studies is to facilitate the assessment of potential impacts to subsistence uses by providing current and representative data that will characterize the existing environment of subsistence uses in and around the proposed Project area. Critical to this assessment is the establishment of baseline indicators of subsistence use that can be used to assess potential effects of the Project. Existing baseline indicator information that characterizes the subsistence environment is available in the form of harvest data, mapping of subsistence use areas, and traditional knowledge studies. Existing information from harvest data can be used to demonstrate which subsistence resources are harvested by communities either in or outside the Project area or resources that migrate through the Project area and are harvested in other areas. In addition, harvest data provide information about harvest amounts, harvest participation, and other baseline harvest indicators in potentially affected communities. Existing information from subsistence use area mapping studies can be used to identify which communities utilize areas within Project area or use Project area lands to access other lands for subsistence harvests. Traditional knowledge studies will help provide the cultural basis for why and how community residents engage in subsistence activities and how cultural values and practices are incorporated into and inform present-day subsistence activities. Traditional knowledge studies also provide information about resources and the environment, all of which is relevant to identifying potential impacts and, possibly, mitigation measures for a development project. Obtaining pertinent Alaska Natives' statements of subsistence use policy and goals would require identification of each Alaska Native entity potentially involved and documentation and identification of each entity's specific policies or mission statements related to subsistence. This task could be performed during the literature review.

Updated information regarding harvests must be collected for communities lacking current data. Harvest amounts and species that are harvested change over time and are subject to annual variation. Timely data are needed in order to establish baseline conditions and assess what resources are being used by a community in order to assess effects.

ADF&G harvest surveys contain a one-year mapping component and are useful for comparing multiple data sets; however, as a stand-alone study, the one-year mapping component does not take into account annual variation in use areas. Without multiple one-year use area data sets, it is useful to conduct subsistence mapping that covers a more extensive time period (e.g., a mapping interview that documents residents' last 10-year use area) so that some annual variation is accounted for and the assessment of effects to use areas and user access can consider the variability in use over time and varying resource conditions.

Traditional knowledge is relevant regardless of the time period it was collected, as it is information that is intended to be passed down through generations of subsistence users. Traditional knowledge interviews can potentially identify cultural resources and potentially inform the Project design and/or the assessment of impacts and development of mitigation measures.

The information collected in this study will help to support the assessment of environmental impacts under NEPA as well as an ANILCA 810 subsistence evaluation. Section 810 of ANILCA requires certain federal agencies, when determining whether to permit the use, occupancy, or disposition of public lands, to evaluate:

- the effect of use, occupancy, or disposition to be authorized on subsistence uses and needs;
- the availability of other lands for the purposes sought to be achieved; and

- other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes (16 USC 3120).

The existing information and additional information collected in the form of harvest surveys, subsistence mapping interviews, and traditional and local knowledge interviews will provide the baseline data that describes the use, occupancy, and disposition of subsistence uses and needs in order to assess effects, and potential effects and alternatives.

Existing information has been summarized in the Subsistence Resources Data Gap Analysis (Simeone, Russell, and Stern 2011). The study team reviewed the communities selected in the data gap and ADF&G scope of work for this Project and documented whether the communities had existing subsistence baseline use area data and recent (within last three years) harvest data. See Attachment 12-1 for the results of the study team's review of the data gap and ADF&G selected communities. After the subsistence study plan and associated study communities have been finalized, the study team will systematically compile existing subsistence data for the selected study communities as part of the baseline description of subsistence uses (see Section 12.5.4.1, Task 1: Compilation of Existing Data).

12.5.3. Study Area

To inform the selection of study communities and create a study area for this Project, the study team reviewed the previous Subsistence Resources Data Gap Analysis (Simeone, Russell, and Stern 2011) and communities reviewed in ADF&G's scope of work for this Project. See Attachment 12-1 for the results of the study team's review of the data gap and ADF&G selected-study communities.

For purposes of this study plan, the study area is based on the Susitna River watershed, because the proposed Project could affect natural resources and access conditions upstream and downstream of the Susitna River as well as its associated tributaries. The study area also includes the proposed reservoir, road and transmission corridors, and other Project facility sites. The study team developed the following criteria for inclusion as a study community:

1. the community is located within the Susitna River watershed;
2. the community is located outside of the Susitna River watershed but has previously documented subsistence use areas that extend into the watershed; and
3. the community is included in ADF&G's 11 communities (Chase, Cantwell, Susitna, Skwentna, Glenallen, Gulkana, Nelchina, Paxson, Tazlina/Copperville, Tolsona and Tonsina) needing updated baseline information

Based on the above criteria, the study team has identified 32 study communities whose subsistence uses could potentially be affected by the proposed Project (Table 12.5-1; Figure 12.5-1).

12.5.4. Study Methods

To meet the study objectives and demonstrate whether and, if so, the extent to which, communities harvest and use subsistence resources within or near the Project area, use Project area lands to access other lands for subsistence harvest and use, or harvest and use resources that migrate through the Project area and are later harvested in other areas, this subsistence study plan proposes to complete the following tasks:

1. Compilation of Existing Subsistence Data
2. ADF&G Household Surveys
3. Household Surveys in State-Designated Nonsubsistence Areas
4. Subsistence Mapping Interviews
5. Traditional and Local Knowledge Interviews
6. Impact Analysis
7. Annual Study Reports

The methods used to implement the above tasks are described in the following sections.

12.5.4.1. Task 1: Compilation of Existing Data

The study team will compile existing data describing the subsistence uses of communities that may be affected by the proposed Project. Communities will include the 32 study communities listed in Table 12.5-1. In addition, to the extent that the ADF&G Winfonet database (i.e., land mammal harvest database for the state) is available, the study team will assess this information to determine whether residents of additional communities use the area for subsistence purposes. Analysis of the Winfonet database will be conducted in coordination with the wildlife resource study. Methods for the compilation of existing data are as follows:

- Use ADF&G's Community Subsistence Information System (CSIS), and identify and compile existing harvest data for the 32 communities listed in Table 12.5-1.
- Compile available subsistence use area data for 32 communities listed in Table 12.5-1.
- Compile available baseline indicator data (e.g., timing of harvest activities) from available sources.
- Request access to ADF&G's Winfonet database. These data can provide the following information:
    - identification of subsistence users and communities in Alaska who travel to the proposed Project area to participate in land mammal harvest activities and
    - Additional information about study communities' (including those located in nonsubsistence areas) subsistence activities in the Project area.
- Create tables and maps describing the information compiled from the CSIS, Winfonet database, and additional sources.
- Incorporate results of the data review and compilation within the context of the proposed Project into Task 7.

12.5.4.2. Task 2: ADF&G Household Surveys

ADF&G's Division of Subsistence will document one year of subsistence harvest and use by households in and around selected census designation place (CDP) communities located in the study area and outside the State-designated nonsubsistence areas (Figure 12.5-2). In its scope of work for this project, ADF&G identified the following 11 communities as needing updated harvest data: Chase, Cantwell, Susitna, Skwentna, Glenallen, Gulkana, Nelchina, Paxson, Tazlina/Copperville, Tolsona, and Tonsina.

The study team conducted a review to determine whether additional study communities located in the Susitna River watershed needed updated harvest data, i.e., if harvest data is not available for those communities from within the past three years. Table 12.5-2 depicts all Susitna River watershed study communities that are located outside State-designated nonsubsistence areas.

Talkeetna and Trapper Creek are located within a nonsubsistence area but are close to the nonsubsistence area boundary. Because of residents' close proximity to the boundary, members of these communities likely travel outside the nonsubsistence area regularly for subsistence purposes; therefore, they are also included in Table 12.5-2. None of the eight communities listed in Table 12.5-2 have harvest data from the last three years. ADF&G listed three of the communities in Table 12.5-2 (Chase, Skwentna, and Susitna) in their scope of work for updated harvest surveys. Two of the communities listed in Table 12.5-2 are not CDPs and were therefore not selected for harvest surveys. Of the three remaining communities, only one (Lake Louise) is outside State designated nonsubsistence areas. Therefore, the study team recommends that ADF&G add Lake Louise to its scope of work for updated harvest surveys. Based on ADF&G's scope of work and the results shown in Table 12.5-2, ADF&G would conduct household harvest surveys in the following 12 communities:

1. Chase
2. Cantwell
3. Glenallen
4. Gulkana
5. Lake Louise
6. Nelchina
7. Paxson
8. Susitna
9. Skwentna
10. Tazlina/Copperville
11. Tolsona
12. Tonsina

The ADF&G Division of Subsistence has prepared a scope of work for this objective. Specific study methods identified in this scope of work include the following:

- Development of a survey instrument to produce updated comprehensive baseline information about subsistence hunting, fishing, and gathering and other topics that address subsistence needs and are compatible with information collected in past household interviews;
- Community consultation to identify community liaisons and seek study support;
- Household surveys to record the following information: demographic information; involvement in use, harvest, and sharing of fish, wildlife, and wild plants in their study year (i.e., 2012 or 2013); estimate of amount of resources harvested in their study year; information about employment and cash income; assessments of changes in subsistence harvest and use patterns based on data available from past study years; and location of fishing, hunting, and gathering activities in their study year;
- Household surveys conducted in each community by community liaisons contracted and trained by ADF&G, with the goal of interviewing a representative of each year-round household in all the study communities. Participation in the surveys will be voluntary and all individual and household level responses will be confidential. ADF&G staff will conduct the harvest mapping component of the survey with each household. Surveys will be timed to avoid seasonal activities to allow for best participation;
- Collaborative review and interpretation of study findings through data analysis, the production of standard tables and figures, and community review meetings;

- Communication of findings to communities through community review meetings and four-page study finding summaries mailed to all households in each community; and
- Addition of final data to the CSIS and production of a final report summarizing the results of the systematic household surveys and mapping for each study year, including long-term trends for communities with harvest data available in the CSIS.

12.5.4.3. Task 3: Household Surveys in State-Designated Nonsubsistence Areas

As discussed above, ADF&G will conduct household harvest surveys in 12 CDP communities that are located outside State-designated nonsubsistence areas; are located in the Susitna River watershed or use the Susitna River watershed for subsistence; and have not had updated subsistence harvest studies within the previous three years (since 2009). In addition, the study team has identified Talkeetna and Trapper Creek for updated household harvest surveys (see Table 12.5-2). These two additional communities are located within a State-designated nonsubsistence area (Figure 12.5-2) and are therefore generally not included in ADF&G Division of Subsistence harvest studies. Because of their proximity to the subsistence/nonsubsistence boundary and to the Project area, agency and public concern raised during technical Workgroup meetings and the lack of recent (last three year) harvest data for these communities, the study team selected Talkeetna and Trapper Creek for household harvest surveys.

ADF&G and the study team will document one year of harvest and use by households in Talkeetna and Trapper Creek. Methods for the nonsubsistence area household surveys will be consistent with ADF&G's methodology for surveys in communities identified under Task 2 and include

- Development and use of a survey instrument and household harvest survey methodology comparable to that used in Task 2 so that data collection, entry, and analysis are compatible with existing ADF&G methodology (see ADF&G survey methods described in Section 12.5.4.2).
- Coordination with communities to seek study support and communicate findings.
- Collaborative review and interpretation of study findings through data analysis, reporting, and community review meetings.
- Incorporation of results of analysis, discussion and reporting of community-level survey, and mapping results within the context of the proposed Project into Task 7.

12.5.4.4. Task 4: Subsistence Mapping

The study team will conduct subsistence mapping interviews in selected study communities to document last 10-year subsistence use areas as well as related baseline indicators. Because a primary application of subsistence use area data in impact analyses is to determine whether a direct impact (i.e., occurring at the same time and place as the Project) may occur, the study plan is focused on selecting communities whose residents conduct activities in or near the Project area (Figure 1.2-1). The study team assumes that the closer a community is to the Project area, the more likely that community is to experience the direct subsistence use area impacts of project construction and operation. Therefore, the study communities closest to the Project area, including the reservoir, reservoir study area, or any of the three potential road options, were selected for inclusion in the subsistence mapping studies.

Eight communities (Cantwell, Chase, Healy, Talkeetna, Lake Louise, McKinley Park, Trapper Creek, and Petersville) were identified for possible inclusion in the subsistence mapping studies due to their proximity to the Project. Four of these communities (Cantwell, Healy, Lake Louise, and McKinley Park) have documented subsistence use area data showing use of the Project area. Available use area data for these four communities are all at least 10 years old. For the remaining four communities (Chase, Talkeetna, Trapper Creek, and Petersville), subsistence use area data are not available. The study team will refine the list of identified subsistence mapping communities based on additional information (e.g., consultation with communities and agencies, adequacy of existing data, need for updated data, or suitability of community for subsistence mapping efforts).

The subsistence mapping studies will use the following methods to document subsistence use areas and related baseline indicators for the selected study communities:

- Coordinate with tribal governments and Alaska Native entities as appropriate to seek community support for the interviews;
- Identify active and knowledgeable harvesters in each study community through consultation with coordinating organizations and by asking study participants to nominate other active and knowledgeable harvesters;
- Work with coordinating organizations or local liaisons to contact respondents and schedule interviews;
- With two staff members present, conduct subsistence mapping interviews with active and knowledgeable harvesters to document resource-specific 10-year subsistence use areas within the last 10 years, along with related indicators (e.g., harvest timing, transportation method) on a U.S. Geological Survey (USGS) 1:250,000 map;
- Conduct post-field data processing, including editing of notes, data entry, digitizing of mapped data, and quality control checks of all data entry and digitizing;
- Conduct analysis and prepare community and resource-specific maps of subsistence use areas and related indicators;
- Conduct analysis and prepare tables and figures describing baseline indicators;
- Review findings with study communities; and
- Incorporate results of analysis from the subsistence mapping interviews, supplemented by respondent observations, within the context of the proposed Project, into Task 7.

12.5.4.5. Task 5: Traditional and Local Knowledge Interviews

The study team will conduct workshops with knowledgeable residents in selected study communities to document traditional and local knowledge about the physical, biological, and social environment as it relates to the proposed Project. To select study communities for the traditional and local knowledge research, the study team considered the following criteria:

- the study community is located within the Susitna River watershed, OR
- the study community's use area is located within the Susitna River watershed, AND
- at least 50 percent of the community is Alaska Native, OR
- a federally recognized tribe is affiliated with the community.

The study team's criteria were based on consideration of the likelihood that the community has knowledge about the Project area (proximity of community or use area to the Susitna River watershed), as well as consideration of the presence of long-term knowledge held by at least a portion of the community (Alaska Native population or affiliation of a federally recognized tribe). As depicted in Table 12.5-3, the following eight communities meet the criteria for inclusion in the traditional and local knowledge studies:

- Cantwell
- Chickaloon
- Chitina
- Copper Center
- Eklutna
- Gakona
- Gulkana
- Tyonek

The traditional and local knowledge studies will use the following methods to document knowledge of the physical, biological, and social environment with the selected study communities:

- Coordinate with tribal governments and Alaska Native entities as appropriate to seek community support for conducting the interviews.
- Consult with program leads for other resources (e.g., cultural resources, wildlife, fish, vegetation, water quality, air quality, socioeconomics) to identify key topics and questions for the traditional and local knowledge workshops.
- Develop a workshop protocol, incorporating input from program leads for other resources, that covers the following basic topics:
    - Physical Environment;
    - Biological Environment;
    - Social Environment; and
    - Issues and Concerns.
- Work with coordinating organizations in each community to schedule and arrange workshops and to identify knowledgeable residents to participate in the workshops.
- With two staff members present, conduct multiple traditional and local knowledge workshops in each selected community to document knowledge about the physical, biological, and social environment.
- Conduct post-field data processing by editing notes and compiling and organizing quotes by topic and subtopic.
- Review findings with study communities.
- Incorporate results of the traditional and local knowledge workshops in each selected community, supplemented by respondent observations, within the context of the proposed Project into Task 7.

12.5.4.6. Task 6: Impact Analysis

Based on the data collected and compiled throughout the subsistence program study tasks (Sections 12.5.4.1 through 12.5.4.5), the study team will conduct an analysis of the potential impacts of the proposed Project on subsistence uses. The analysis will include assessment of potential impacts to subsistence use areas, user access, resource availability, resource competition, costs and time associated with subsistence activities, and culture. The study team will review other resource impact analyses as appropriate (e.g., wildlife, fish, and vegetation) to inform the analysis of potential changes to the environment that might yield insight into the types and levels of potential impacts on subsistence uses. In addition, information provided by community residents during the traditional and local knowledge workshops will inform the impact analysis.

12.5.4.7. Task 7: Study Report Preparation

The study team will prepare study reports at the end of each calendar year that document yearly progress to date and describe the methodology and field results of Tasks 1-5. The final report will contain the methodology, analysis, and synthesis of all data collected for Tasks 1-5, as well as an analysis of potential impacts and mitigation measures associated with the proposed Project that will be useful for preparation of the Project license application.

12.5.5. Consistency with Generally Accepted Scientific Practice

The ADF&G) Division of Subsistence will conduct harvest and use studies using standard Division of Subsistence methodology involving systematic household surveys conducted by community-based survey technicians in cooperation with Division of Subsistence resource specialists. Methods for subsistence mapping and undertaking traditional and local knowledge interviews will be similar to those employed on other recent projects involving federal approvals. These include traditional knowledge interviews to support the EPA's National Pollutant Discharge Elimination System (NPDES) permit (SRB&A 2011); subsistence mapping and traditional knowledge interviews to support the NEPA EIS for the Red Dog Mine Extension, Aqqaluk Project (EPA 2009); and subsistence mapping for Bureau of Ocean Energy Management (BOEM) oil and gas leases on the Outer Continental Shelf (SRB&A 2009). Related to projects under FERC's purview, traditional knowledge interviews were recently conducted in 2012 for the Alaska Pipeline Project and it is proposed that the subsistence interview process for the Susitna-Watana Hydroelectric Project would employ similar methods as those accepted for use for the Alaska Pipeline Project.

AEA will be guided by the research principles adopted by the Interagency Arctic Research Policy Committee (1990). These principles include informing community organizations of planned research in their communities, gaining community consent, informing all project participants of all positive and negative implications of participating in the study, and protecting the anonymity of study participants. The study team will coordinate with each community to conduct research and provide each study participant with an informed consent form to read and sign. The informed consent will note the risks and benefits of the study, agree to protect the anonymity of participants, and agree to show data only in an aggregated form.

12.5.6. Schedule

Tables 12.5-4 through 12.5-6 present the anticipated schedule for the subsistence study plan by primary tasks. Key dates (e.g., meetings, deadlines) are also presented for each calendar year. Also, Initial and Updated Study Reports will document actions taken and data collected to date will be issued in December 2013 and 2014, respectively.

12.5.7. Level of Effort and Cost

For information related to level of effort, see Tables 12.5-4 through 12.5-6 for a description of tasks that will occur by month. Section 12.5.4, "Study Methods," provides additional information regarding the level of effort for each task. The estimated effort to implement this study plan, including field studies, data collection, analysis, and reporting over the two year study period for Tasks 1-7 is approximately $1.5 million..

12.5.8. Literature Cited

Braund, Stephen R. & Associates (SRB&A). 2011. Chukchi and Beaufort Seas National Pollutant Discharge Elimination System Exploration General Permits Reissuance: Report of Traditional Knowledge Workshops – Point Lay, Barrow, Nuiqsut, and Kaktovik. Prepared for Tetra Tech and U.S. Environmental Protection Agency. Anchorage, Alaska.

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U.S. Environmental Protection Agency (EPA). 2009. Red Dog Mine Extension: Aqqaluk Project. Final Supplemental Environmental Impact Statement. Seattle, WA.

Wolfe, R. 2000. Subsistence in Alaska: A Year 2000 Update. Alaska Department of Fish and Game Division of Subsistence. Juneau, Alaska.

12.5.9. Tables

Table 12.5-1. Study Communities.

Number	Study Community	Community in Watershed	Use Area in Watershed	ADF&G Study Community
1	Beluga		X	
2	Cantwell		X	X
3	Chase	X	No Data	X
4	Chickaloon		X	
5	Chitina		X	
6	Copper Center		X	
7	Copperville		No Data	X
8	Denali Hwy Households	X	No Data	
9	Eklutna		X	
10	Gakona		X	
11	Glennallen		X	X
12	Gulkana		X	X
13	Healy		X	
14	Kenny Lake		X	
15	Lake Louise	X	X	
16	McCarthy		X	
17	McKinley Park		X	
18	Nelchina		No Data	X
19	Parks Hwy Households (Chulitna, Gold Creek, Hurricane/Broad Pass)		No Data	
20	Paxson		X	X
21	Petersville	X	No Data	
22	Skwentna	X	X	X
23	Susitna	X	No Data	X
24	Talkeetna	X	No Data	
25	Tazlina		No Data	X
26	Tolsona		No Data	X
27	Tonsina		X	X
28	Trapper Creek	X	No Data	
29	Tyonek		X	
30	Wasilla[1]	X	No Data	
31	Western Susitna Basin		X	
32	Willow	X	No Data	

[1]Wasilla includes the outlying CDPs of Big Lake, Buffalo-Soapstone, Fishhook, Houston, Knik-Fairview, Meadow Lakes, Point MacKenzie, and Tanaina.

Stephen R. Braund & Associates, 2012.

Table 12.5-2. Household Harvest Survey Study Communities.

Study Community[1]	Census Designated Place	Existing ADF&G Study Community	Additionally Selected for ADF&G Household Surveys	Selected for Nonsubsistence Area Household Surveys
Chase	X	X		
Denali Hwy Households				
Lake Louise	X		X	
Parks Hwy Households (Chulitna, Gold Creek, Hurricane/Broad Pass)				
Skwentna	X	X		
Susitna	X	X		
Talkeetna[2]	X			X
Trapper Creek[2]	X			X

[1]Table includes only communities located within the Susitna River watershed outside of a State designated nonsubsistence area, with the exception of Talkeetna and Trapper Creek.
[2]Talkeetna and Trapper Creek, while located in a State Designated nonsubsistence area, are included in this table because of their proximity to the nonsubsistence area boundary. Residents from these communities are presumed to travel outside the nonsubsistence area regularly to participate in subsistence activities.

Stephen R. Braund & Associates, 2012.

Table 12.5-3. Traditional Knowledge Criteria and Selected Study Communities.

Study Community	Community in Watershed	Documented Use Area in Watershed	50 Percent or more Alaska Native Population	Federally Recognized Tribe	Selected Traditional Knowledge Study Community
Beluga		X			
Cantwell		X		X	X
Chase	X	No Data			
Chickaloon		X		X	X
Chitina		X		X	X
Copper Center		X	X	X	X
Denali Hwy Households	X	No Data	No Data		
Eklutna		X	No Data	X	X
Gakona		X		X	X
Glennallen		X			
Gulkana		X	X	X	X
Healy		X			
Kenny Lake		X			
Lake Louise	X	X			
McCarthy		X			
McKinley Park		X			

Study Community	Community in Watershed	Documented Use Area in Watershed	50 Percent or more Alaska Native Population	Federally Recognized Tribe	Selected Traditional Knowledge Study Community
Parks Hwy Households (Chulitna, Gold Creek, Hurricane/Broad Pass)	X	No Data	No Data		
Paxson		X			
Petersville	X	No Data			
Skwentna	X	X			
Susitna	X	No Data			
Talkeetna	X	No Data			
Tonsina		X			
Trapper Creek	X	No Data			
Tyonek		X	X	X	X
Wasilla[1]	X	No Data			
Western Susitna Basin		X	No Data		
Willow	X	No Data			

[1]Wasilla includes the outlying CDPs of Big Lake, Buffalo-Soapstone, Fishhook, Houston, Knik-Fairview, Meadow Lakes, Point MacKenzie, and Tanaina.

Stephen R. Braund & Associates, 2012.

Table 12.5-4. Schedule of Subsistence Study Plan Tasks in 2012.

	2012											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Subsistence Study Plan												
Task 2: ADF&G Household Surveys Pre-field Planning - Year 1												
Key Dates												
July 16, 2012 - AEA Files Proposed Study Plan with FERC												
August 9, 2012 – Formal Social Sciences Study Plan Meeting												
November 14, 2012 - AEA Files Revised Study Plan with FERC												
December 14, 2012 - FERC Issues Study Plan Determination												

Table 12.5-5. Schedule of Subsistence Study Plan Tasks in 2013.

	2013											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Task 1: Compilation of Existing Data												
Task 2: ADF&G Household Survey - Year 1												
Task 2: ADF&G Reporting and Community Review - Year 1												
Task 2: ADF&G Household Surveys Pre-field Planning - Year 2												
Task 3: Household Surveys in Nonsubsistence Areas												
Task 4: Subsistence Mapping Interviews												
Task 1, 3-4: Prepare 2013 Study Report and Community Reviews												
Revise Study Plans (as needed)												▶
Consultation												▶
Key Dates												
▶ **Task continues into next calendar year**												

Table 12.5-6. Schedule of Subsistence Study Plan Tasks in 2014.

	2014											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Task 2: ADF&G Household Survey - Year 2												
Task 2: ADF&G Reporting and Community Review - Year 2												
Revise 2013/2014 Study Plans (as needed)												
Task 5: Traditional and Local Knowledge Interviews												
Task 3-4: Additional 2014 Subsistence Data Collection as needed												
Task 3-5: Prepare 2014 final updated Study Report and Community Reviews												
Consultation (as needed)												

12.5.10. Figures

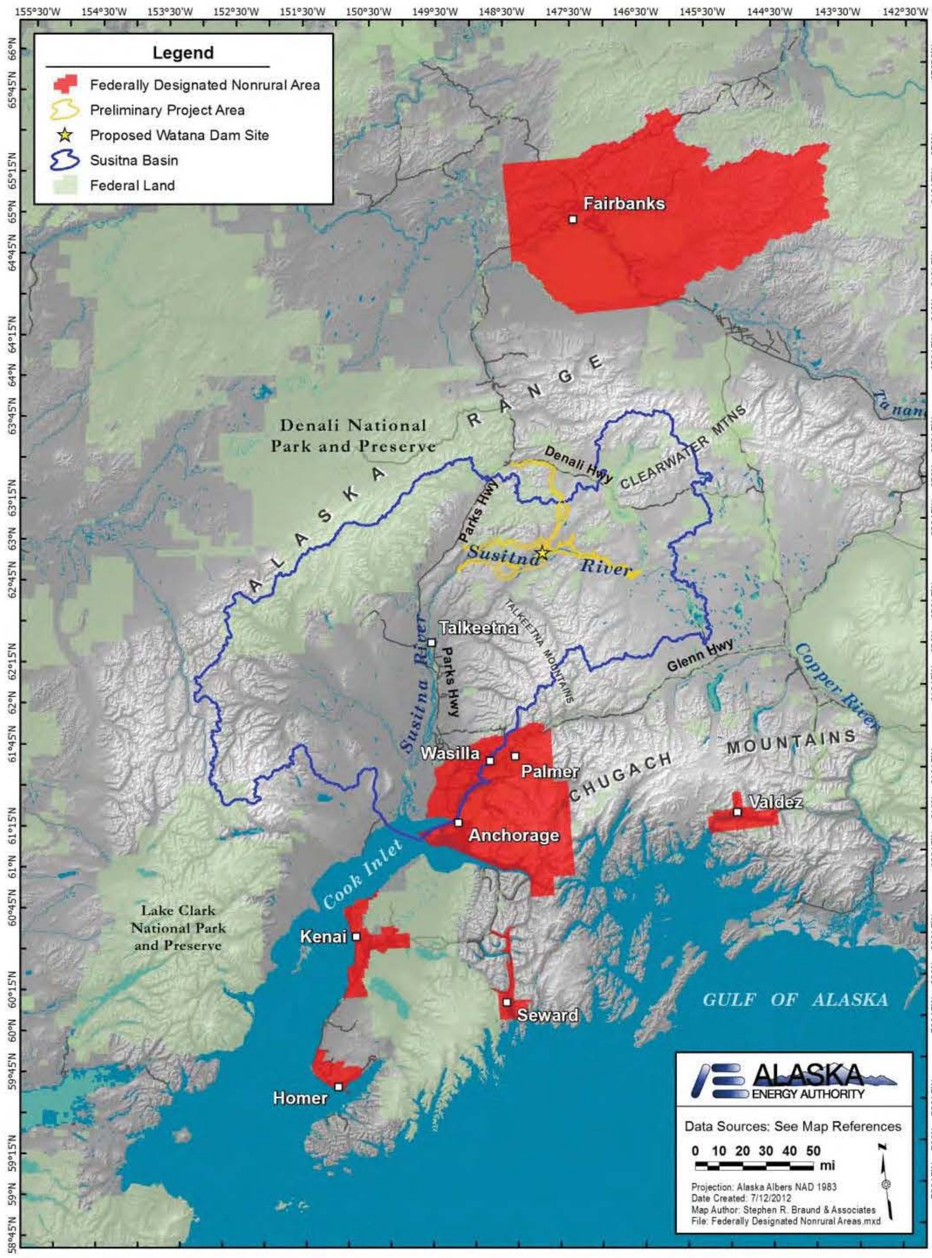


Figure 12.5-1. Federally Designated Nonrural Areas

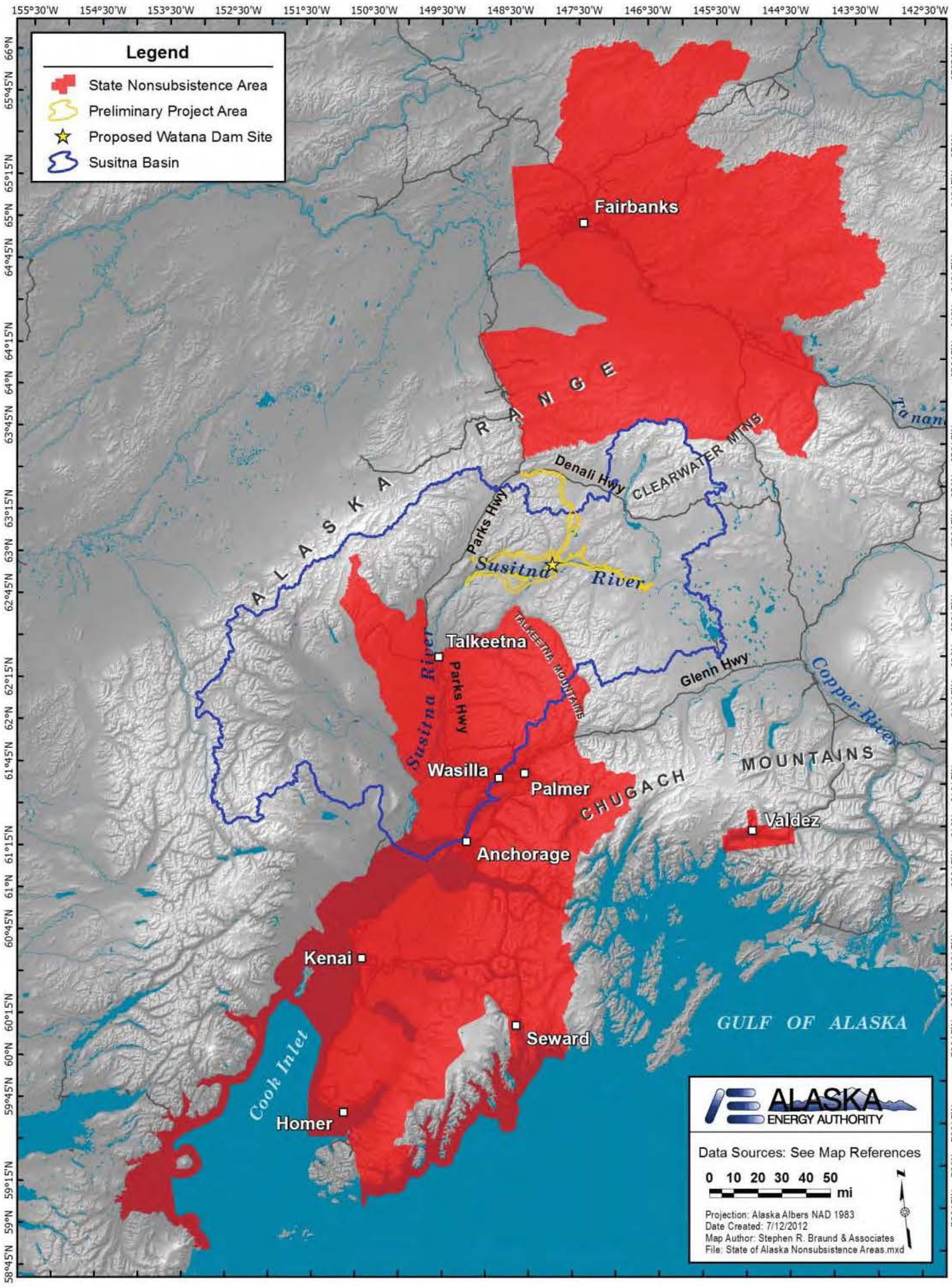


Figure 12.5-2. State of Alaska Designated Nonsubsistence Areas

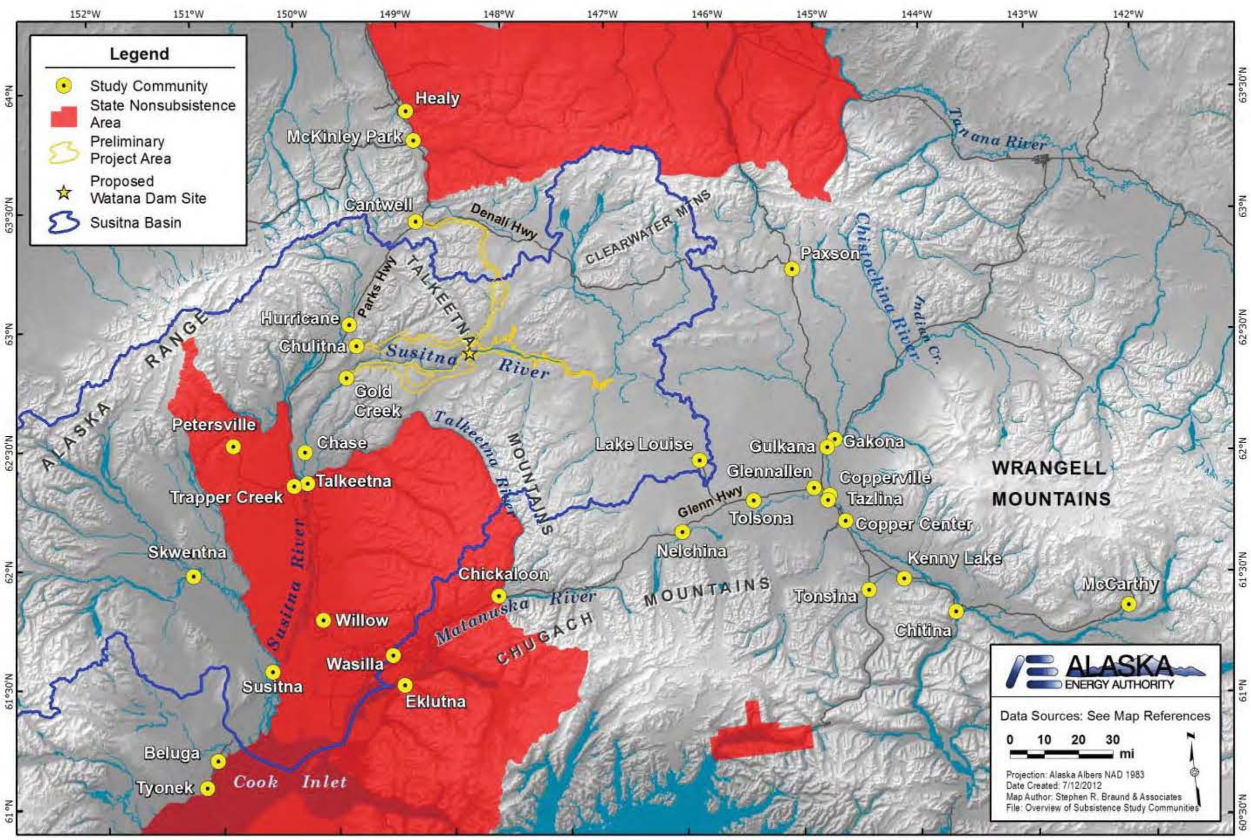


Figure 12.5-3. Overview of Subsistence Study Communities

12.6. Attachments

ATTACHMENT 12-1. REVIEW OF COMMUNITIES AND SUBSISTENCE USE AREAS IN THE SUSITNA RIVER WATERSHED

ATTACHMENT 12-1. REVIEW OF COMMUNITIES AND SUBSISTENCE USE AREAS IN THE SUSITNA RIVER WATERSHED

The study team reviewed the communities included in the Alaska Department of Fish and Game (ADF&G) scope of work and in the subsistence data gap analysis prepared by Northern Land Use Research, Inc. (NLUR). In addition, the study team identified four other communities that are located, or whose use areas are located, in the Susitna River watershed. These include Chickaloon, Eklutna, Healy, and Lake Louise. Because subsistence use area study is available for the Western Susitna Basin (communities not specified), this region was included in the review. The study team reviewed a total of 42 communities (including a regional use area for the Western Susitna Basin and dispersed households along the Parks Highway and Denali Highway). These communities are listed in Table 1 and depicted on Map 1. The study team reviewed each community for its proximity to the Susitna River watershed, and for the proximity of the community's subsistence use areas (if available) to the Susitna River watershed. In addition, the study team identified whether recent (last three year) harvest data are available for each community. As noted in Table 1, harvest data as collected by ADF&G do not provide all subsistence baseline indicators that are important for characterizing baseline subsistence uses or assessing potential impacts on subsistence uses. Additional baseline indicators not generally available through ADF&G harvest data include multi-year subsistence use areas, comprehensive seasonal round, transportation methods, trip duration, trip frequency, and traditional knowledge including harvester observations of resource change.

As shown in Table 1, the study team identified 14 communities located within the Susitna River watershed, and 18 communities whose use areas are located within the Susitna River watershed. Subsistence use area data are not available for 19 communities. A total of 30 communities are either located within the Susitna River watershed or have use areas that are located within the Susitna River watershed. Map 1 counts do not include the Western Susitna Basin use areas, Denali Highway dispersed households, and Parks Highway dispersed households.

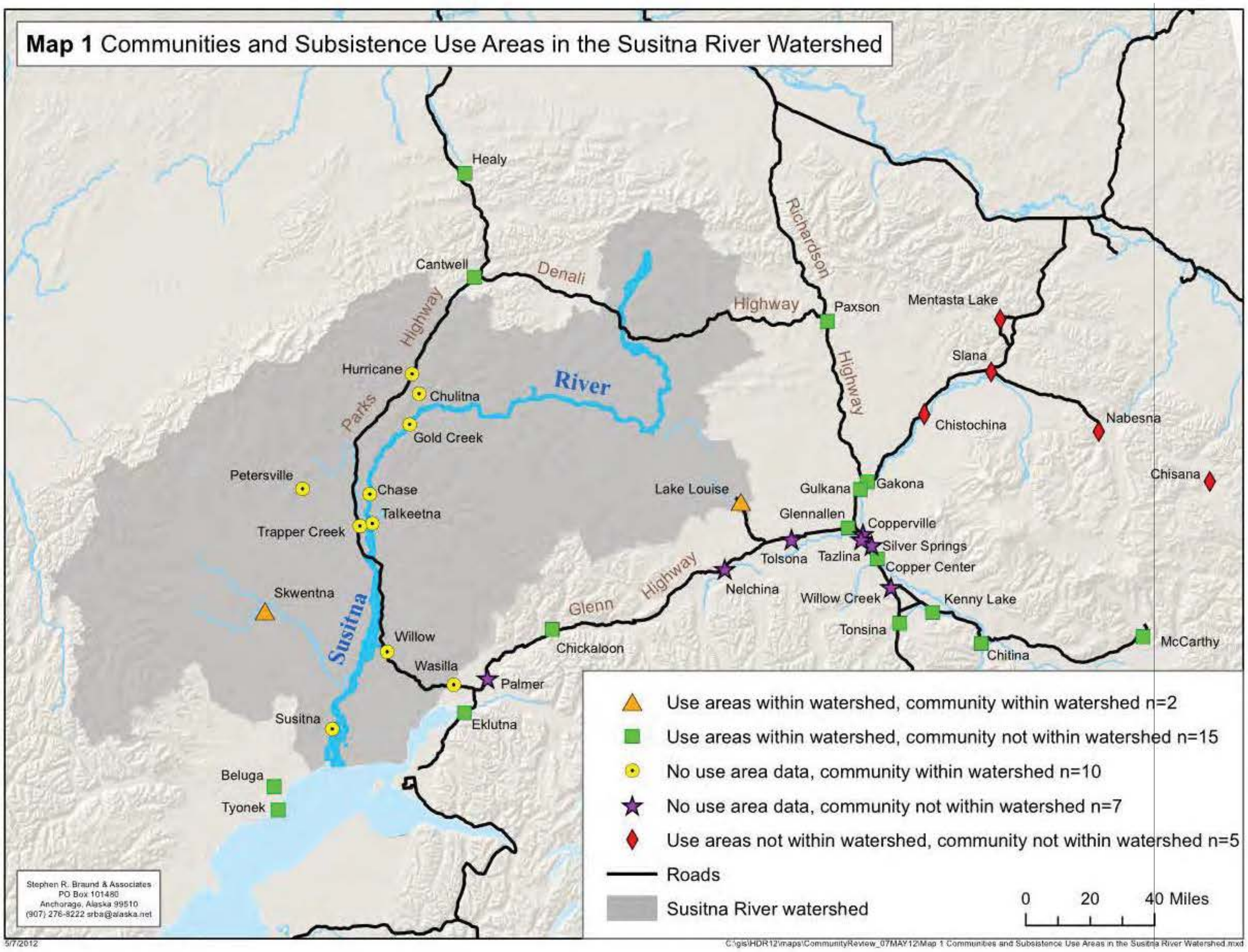
Recent (last three year) harvest data are currently available for only 11 of the 42 communities in Table 1. In their scope of work, ADF&G included communities that are not located in the Susitna River watershed and whose use areas are not included in the Susitna River watershed. These include Chistochina, Mentasta, Nabesna, and Slana. In addition, ADF&G included communities that are not located in the Susitna River watershed for which no use area data are available. These include Copperville, Nelchina, Silver Springs, Tazlina, Tolsona, and Willow Creek.

In their subsistence data gap analysis, NLUR included communities that are not located in the Susitna River watershed and whose use areas are not included in the Susitna River watershed. These include Chisana, Chistochina, Mentasta, and Slana. In addition, NLUR included communities that are not located in the Susitna River watershed for which no use area data are available. These include Copperville, Palmer, Silver Springs, and Tazlina.

Table 1. Communities and Subsistence Use Areas in the Susitna River Watershed

		Reason for Study Community Consideration			Proximity to Susitna River Watershed						
	Community	ADF&G SOW	NLUR Data Gap	Added Based on Community or Use Area in Watershed	Community in Watershed	Approximate Distance (in Miles) of Community from Watershed	Use Area in Watershed	Approximate Distance (in Miles) of Use Area from Watershed	Community and/or Use Area in Watershed	Harvest Data Last 3 Years (2009 or Later)[1]	Notes
1	Beluga	x				11	x	0	x		
2	Cantwell	x	x			5	x	0	x		
3	Chase	x	x		x	0	No Data	No Data	x		
4	Chickaloon			x		14	x	0	x		
5	Chisana		x			143		95			
6	Chistochina	x	x			53		25		x	
7	Chitina	x				85	x	0	x	x	
8	Chulitna		x		x	0	No Data	No Data	x		
9	Copper Center	x	x			45	x	0	x	x	
10	Copperville	x	x			35	No Data	No Data	No Data		
11	Denali Hwy Households & Lodges		x		x	n/a	No Data	No Data	x		Portion of Denali Highway is in watershed.
12	Eklutna			x		9	x	0	x		
13	Gakona	x	x			35	x	0	x	x	
14	Glennallen	x	x			30	x	0	x		
15	Gold Creek		x		x	0	No Data	No Data	x		
16	Gulkana	x	x			35	x	0	x		
17	Healy			x		32	x	0	x		
18	Hurricane/Broad Pass		x		x	0	No Data	No Data	x		
19	Kenny Lake	x				62	x	0	x	x	
20	Lake Louise			x	x	0	x	0	x		
21	McCarthy	x	x			127	x	0	x	x	
22	Mentasta	x	x			71		52		x	
23	Nabesna	x				107		52		x	
24	Nelchina	x				10	No Data	No Data	No Data		
25	Palmer		x			8	No Data	No Data	No Data		
26	Parks Hwy Dispersed Households		x		x	n/a	No Data	No Data	x		Parks Highway transects watershed
27	Paxson	x	x			23	x	0	x		
28	Petersville		x		x	0	No Data	No Data	x		
29	Silver Springs	x	x			37	No Data	No Data	No Data	x	
30	Skwentna	x			x	0	x	0	x		Use Areas for Upper Yentna
31	Slana	x	x			70		42		x	
32	Susitna	x			x	0	No Data	No Data	x		
33	Talkeetna		x		x	0	No Data	No Data	x		
34	Tazlina	x	x			37	No Data	No Data	No Data		
35	Tolsona	x				14	No Data	No Data	No Data		
36	Tonsina	x				56	x	0	x		
37	Trapper Creek		x		x	0	No Data	No Data	x		
38	Tyonek	x				17	x	0	x		
39	Wasilla		x		x	0	No Data	No Data	x		
40	Western Susitna Basin			x	n/a	n/a	x	0	x		Use area data are not provided at a community-specific level
41	Willow		x		x	0	No Data	No Data	x		
42	Willow Creek	x				48	No Data	No Data	No Data	x	

[1]Includes harvest data collected during ADF&G household harvest surveys. Harvest data generally include subsistence baseline indicators related to harvest amounts, harvest effort, harvest success, harvest participation, harvest sharing, and harvest diversity. Additional subsistence baseline indicators not generally available through ADF&G harvest data include subsistence use areas, seasonal round, transportation methods, trip duration, trip frequency, and traditional knowledge including harvester observations of resource change. This document does not review the availability of additional subsistence baseline indicators for the potential study communities.



Map 1 Communities and Subsistence Use Areas in the Susitna River Watershed

13. SOCIOECONOMIC AND TRANSPORTATION RESOURCES

13.1. Introduction

This section outlines the study plans for socioeconomic issues, transportation, health impacts, and air quality. The socioeconomic sections will address evaluation of regional economic effects as well as effects on social conditions and public goods and services.

13.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

The construction and operation of the Project has the potential to affect social resources, including the local and regional economies; provision of public services by local, state and federal governments; air emissions and local and regional air quality; community health and safety; and traffic levels and capacity of transportation resources including roads, airports, rail, and local river transportation. The type, intensity, and extent of effects on these social resources need to be understood during the licensing process so that appropriate measures to address or mitigate the effects can be considered for incorporation into the Project license.

Some of the potential socioeconomic effects of the Project during the construction phase are related to the large number of construction workers that would build the Project and their potential impact on communities, public services, infrastructure and temporary housing. The construction workforce is likely to be drawn from a broad region of Southcentral and Interior Alaska. The number of certain skilled occupations required for the Project may exceed the number of workers available within the state, which could lead to some in-migration of out-of-state workers and their families for some occupations, or such workers might commute from their current residences in other states.

Additional socioeconomic effects that could occur during the construction phase include increased job opportunities and income associated with local employment and through local expenditures by AEA, contractors, other utilities, and non-local construction workers. Also during construction, local government taxes (e.g., sales tax, hotel/motel occupancy tax) would be generated on items and services purchased in communities in the vicinity of the Project.

Project construction will also require the transportation of people, equipment, and materials to and from the construction worksite, which could result in increased rail, air, and road traffic volumes, disruption of normal traffic patterns and associated noise and congestion effects. Such conditions may disrupt the transportation patterns of tourists and local travelers, especially in summer, and may require additional police and emergency response calls for traffic accidents and other incidents.

Project construction and operation would also result in new air emission sources in the vicinity of the Project and could have effects on local community health.

The development of a major new energy source would affect the economy of the Railbelt area. The economic literature suggests that benefits accrue to regional economies from electric utility system improvements. The Project will generate electricity for a significant portion of the state's residents. While the final capital cost, financing, and other information needed to estimate the cost of this electricity is still uncertain, it is known that the cost will be relatively stable for the life of the Project. In contrast, the cost of electricity generated from fossil fuels may rise over time. Therefore, at some point in time, savings may accrue to residential and industrial consumers of the electricity generated by the Project. These savings in energy costs could expand the regional economy by stimulating business activity and creating more disposable income for consumers to spend on purchases of other goods and services.

Project construction and operation may change the level of production of commercial farming, grazing, logging, mining, and fishing operations in the study area. In addition, Project operation, together with Project features (i.e., reservoir and access roads), could change fishing, hunting, and other recreation and subsistence opportunities, including availability of recreational and subsistence resources, access, and quality of experience. In turn, these changes have an impact on tourism and other sectors of the local and regional economies. Project features that stimulate residential location, tourism and other types of economic development may affect surrounding property uses and values.

New residents may be attracted to the study area by the Project features (i.e., reservoir and access roads). This immigration could affect the demand for both housing and municipal and state services, such as police, fire protection, medical facilities and schools. Local government could see additional expenditures for these services and additional revenues based on increased property taxes from new land development.

Project construction activities and operations are likely to result in increased transportation demands that could affect local roadways, the Alaska Railroad Corporation (ARRC), and airports. Air emissions during both construction and operations could change air quality locally, or in the event that the Project affects operations levels at other regional power plants, regionally. Project-related changes in water levels and ice formation could affect local use of the river for winter transportation. Project-related changes in water temperatures and levels, along with development of the dam and reservoir complex and transmission and road system, could alter some of the bio-physical attributes of the Susitna River system that many residents of the Matanuska-Susitna valley have adapted lifestyles around.

13.3. Resource Management Goals and Objectives

The proposed Project would occupy federal lands currently administered by the U.S. Bureau of Land Management (BLM) but selected by the State of Alaska under the Alaska Statehood Act, state lands administered by the Alaska Department of Natural Resources (ADNR), and private lands owned by Alaska Native Corporations and others. The Project site is within the Matanuska-Susitna Borough (MSB), which has adopted an Economic Development Strategic Plan that contains policies designed to support economic growth in the area. The MSB plan will be reviewed and BLM, ADNR and Alaska Native entities will be contacted to determine their socioeconomic goals and objectives for the lands in the vicinity of the Project. These goals and objectives will be incorporated into the socioeconomic studies.

Local government provision of public services is regulated under Title 29 of Alaska Statutes as well as a variety of city and borough codes and management plans. The goals and objectives for management and use of state and federal lands are documented in area management plans. These plans are designed to allow use of public lands for public use that is compatible with the intent identified for the lands in the management plans.

Surface and aviation transportation resources in Project area are managed under the MSB Long-Range Transportation Plan, as well as under Alaska Department of Transportation & Public Facilities (ADOT&PF) Statewide Transportation Policy Plan. Rail facilities are managed under Federal Railroad Administration regulations and the state code. All of these agencies work together to ensure that appropriate types and levels of transportation facilities are available to provide for the safe and efficient movement of people and goods to support the state's economy and quality of life.

Air quality is regulated by the Alaska Department of Environmental Conservation (ADEC) and the Environmental Protection Agency (EPA). These regulations are designed to maintain air quality to support public health.

13.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Consultation efforts to date have been limited to discussions with agency representatives, Alaska Native entities, and other licensing participants at the Project Technical Workgroup Meetings held in February, April, and June 2012 (Table 13.4-1). Documentation of these meetings are found in Attachment 1-1 of this PSP.

Table 13.4-1. Summary of consultation on Socioeconomic and Transportation Resources study plans.

Comment Format	Date	Licensing participant	Affiliation	Subject
Work Group Meeting	2/27/2012	Variety of Licensing participants	Variety of Agencies, Tribal Entities, and Interested Individuals	Brief discussion of social science outlines.
Work Group Meeting	04/03/2012	Variety of Licensing participants	Variety of Agencies, Tribal Entities, and Interested Individuals	Discussion of planned study objectives and methods.
Work Group Meeting	06/06/2012	Variety of Licensing participants	Variety of Agencies, Tribal Entities, and Interested Individuals	Discussion of licensing participant comments and study requests.

13.5. Regional Economic Evaluation Study

13.5.1. General Description of the Proposed Study

13.5.1.1. Study Goals and Objectives

The goal of the regional economics study plan is to assess potential changes in regional economic conditions in the study area resulting from the operation of the proposed Project and the power generated by the Project. Changes in regional economic conditions resulting from the non-power effects of the Project are included in the social conditions and public goods and services study plan.

The objectives of the study are listed below.

- Describe the effects of the Project on the regional economy resulting from improvements in the reliability of the electrical power grid.
- Describe the effects of the Project on the stability of electric prices over time.
- Determine the economic effects of the Project's power over time.

13.5.2. Existing Information and Need for Additional Information

A data gap analysis report of socioeconomics, recreation, air quality and transportation was prepared in August 2011 (HDR 2011). That report along with the Alaska Energy Authority's (AEA's) 2011 Pre-Application Document (PAD) provides substantial information about the Project and socioeconomic resources in the Project vicinity. Information collected for the socioeconomic conditions and public goods and services component of the socioeconomic analysis will provide a portion of the data needed for the regional economic model to conduct the regional economic analysis. However, information regarding electric utility rates, power outages, and other data required for this regional economic analysis is not addressed in the other socioeconomic study, and is lacking in the data gap analysis and the PAD. Additional information needed for the regional economic modeling effort includes the following.

- Historical data on electric utility rates for Railbelt utilities
- System Average Interruption Duration Index reliability minutes for Railbelt utilities
- Information on the cost of power disturbances in the commercial and residential sectors within the study area
- Information on how the cost and reliability of power may affect creation of new businesses or expansion of existing businesses

A review of relevant published documents and information from public scoping meetings will be useful to further inform the study inputs and information collection. In addition, it is anticipated that interviews will be conducted with businesses in the Railbelt to ascertain the potential for changes in business opportunities as a result of the new energy source provided by the Project.

13.5.3. Study Area

The regional economic impacts of the new energy source provided by Project operations will be concentrated in the area collectively referred to as the Railbelt, which includes the Fairbanks

North Star Borough (FNSB), Denali Borough, MSB, Municipality of Anchorage (MOA), and Kenai Peninsula Borough (KPB).

13.5.4. Study Methods

The study methods discussed below are consistent with methods used for economic analysis completed during the licensing proceedings for other hydroelectric projects.

13.5.4.1. Data Collection and Analysis

The proposed Project would not start operations until 2023 under the current schedule. In addition, the Project is anticipated to continue operations for more than 50 years. Given the long timeframe for construction of the Project and its operations, the effects of the power produced by the Project on the regional economy will be estimated by comparing future socioeconomic conditions with and without the Project.

The forecast of socioeconomic conditions with and without the Project will be based in part on estimates derived from a data and software program called REMI (Regional Economic Models, Inc.). The REMI model incorporates aspects of four major modeling approaches: input-output, general equilibrium, econometric and economic geography. Changes in supply, demand and prices are entered into the REMI model in order to identify the iterative economic and demographic effects of these changes. While the REMI model provides a wide range of output variables, the variables of interest in the socioeconomic impact analysis for the proposed Project are population, employment, labor income, output (sales), and housing. The REMI model extends economic and demographic forecasts through 2060, which is consistent with the time frame of the temporal scope of the socioeconomic impact analysis. The REMI model can provide projections for all of the boroughs and census areas within the Railbelt, including the MOA, FNSB, KPB, MSB and Denali Borough. The current REMI model also includes the Yukon-Koyukuk Census Area and Valdez-Cordova Census Area.

The forecast analysis performed by the REMI model will be guided by assumptions about reasonably foreseeable future actions that would have an important and measurable effect on Alaska's economy. These actions will be identified through interviews conducted with individuals knowledgeable about the state's economy. In addition, it is anticipated that interviews will be conducted with business representatives in the Railbelt area to ascertain the potential for changes in business opportunities as a result of the new energy source provided by the Project.

Forecasts for the With-Project condition will be compared to the Without-Project condition. Under the Without-Project case, the mix of electrical generation sources will be based on production cost modeling with Railbelt utilities and an appropriate alternative that does not include a large hydroelectric project. The With-Project condition will be based on the large hydroelectric alternative in the RIRP, adjusted as necessary to fit with the current Project description.

13.5.4.2. Documentation of Regional Economic Analysis

The results of the regional economic analysis will be documented in the initial and updated study report. The report will include study objectives, study area, methods, and tabulated results.

13.5.5. Consistency with Generally Accepted Scientific Practice

Much of the socioeconomic background information will come from published sources, including local governments, boroughs, state agencies, and the federal government. The REMI model being used to forecast future economic conditions has been calibrated for Alaska and has recently been used in work completed for the Alaska Pipeline Project. The REMI model is used by federal, state, and local governments as well as universities and consulting firms.

13.5.6. Schedule

It is anticipated that completion of the work described above would require about six or seven months of effort in 2013 to provide the Initial Study Report. The process described above should provide sufficient information for the licensing and environmental review of the Project. There could be some additional analyses or model runs in 2014 to update input parameters that perhaps have changed as a result of changes to the Project plans or other changes as determined by AEA in collaboration with licensing participants. Any additional work in 2014 will be reported in the Updated Study Report.

13.5.7. Level of Effort and Cost

Conducting this analysis and preparing the report sections is estimated to require about 1,200 to 1,500 person-hours in 2013. This effort would occur over a six to seven month period required to prepare the Initial Study Report. The estimated cost could range from about $250,000 to $400,000.

13.5.8. Literature Cited

Alaska Energy Authority (AEA) 2011. Pre-Application Document, Susitna-Watana Hydroelectric Project, FERC No. 14241.

HDR, Inc. (HDR) 2011. Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality, and Transportation Data Gap Analysis. Unpublished, by the Alaska Energy Authority.

13.6. Social Conditions and Public Goods and Services Study

13.6.1. General Description of the Proposed Study

13.6.1.1. Study Goals and Objectives

The study goal for the social conditions and public goods and services section of the socioeconomics study plan is to assess potential changes in population, housing, public goods and services, and other quality of life factors resulting from the construction and operation of the proposed Project and potential changes in regional economic conditions resulting from the non-power effects of the Project. Coordination with the other social resource analyses (e.g., recreation, transportation, and subsistence) from the outset is an essential component of the socioeconomic study plan.

The objectives of the study are listed below.

- Describe, using text and appropriate tables and graphics, existing socioeconomic conditions within the study area.
- Evaluate the effects of on-site manpower requirements, including the number of construction personnel who currently reside within the study area, who would commute to the site from outside the study area, or who would relocate temporarily within the study area.
- Estimate total worker payroll and material purchases during construction and operation.
- Evaluate the impact of any substantial immigration of people on governmental facilities and services, and describe plans to reduce the impact on local infrastructure.
- Determine whether existing housing within the study area is sufficient to meet the needs of the additional population.
- Describe the number and types of residences and businesses that might be displaced by the Project access road and transmission corridors.
- Describe the non-power effects on the local or regional economy, including commercial opportunities related to fishing, logging, mining, and recreational activities.
- Describe based on other studies what bio-physical attributes of the Susitna River system may change as a result of the Project and what those changes might mean to recreation and subsistence use values, quality of life, community use patterns, and social conditions of the area.

13.6.2. Existing Information and Need for Additional Information

A data gap analysis report of socioeconomics, recreation, air quality, and transportation was prepared in August 2011 (HDR 2011). That report along with AEA's 2011 PAD provides substantial information about the Project and socioeconomic resources in the Project vicinity.

Information provided for communities within the study area by the U.S. Census Bureau, the Alaska Department of Labor and Workforce Development (ADLWD), the Alaska Department of

Commerce, Community and Economic Development (DCCED), MSB, Denali Borough, and other secondary sources includes the following:

- Current population and population density statistics
- Per capita income
- Number and composition of workforce (e.g., manufacturing; transportation and public utilities; wholesale trade; retail trade; finance, insurance, and real estate; and services)
- Current unemployment rate (latest year of record)
- Number of units and vacancy rates for temporary housing (e.g., apartment rentals, hotels/motels, and campgrounds)
- Location and availability of local government public services (e.g., police, fire protection, medical services, utilities, and schools)
- Local tax revenues and sources of funding (e.g., personal property, sales, hotel/motel occupancy, etc.)

Information that will be needed to complete the analysis includes the following:

- Final location of the Project components
- Length of construction phase
- Cost of materials and supplies during construction
- Approximate cost of materials and supplies during construction that will be spent locally, versus non-locally
- Number of total workforce, including how many workers will be hired locally versus non-locally (data from the ADLWD on employment by occupation will be used to estimate the percent of out-of-state workers)
- Total number of construction workforce by month, or peak number of workers and when that peak would occur
- Summary of construction workforce by craft or discipline
- Total construction wages or average construction pay, including benefits
- Total number of workers required for operation and maintenance of the Project, and total wages including benefits
- Approximate cost of materials, supplies, and services during operation that will be spent locally versus non-locally
- For trucks that would be used, estimated number and size, number of trips per day and week to and from the Project site, travel route, and capacity of the roads on which the trucks will be traveling
- The number of residences or businesses that could be removed by construction of the Project
- Number of acres of agricultural/pasture land or timberland that will be removed from production

Information on recreation use values will be obtained from a travel cost survey that will be conducted in the study area. The survey will collect information on participation in recreational fishing, hunting, boating, wildlife viewing, hiking, and camping in the study area, related expenditures, travel distance, site quality, and substitute recreational opportunities.

Information on subsistence use values will be obtained from a subsistence survey that will be conducted in the study area. The survey will collect information on participation in subsistence fishing, hunting, and gathering in the study area.

There is little published information on non-economic, socio-cultural values and needs of study area residents; therefore, the intent is to use informal interviews with community residents, MSB officials, and other knowledgeable people to help provide additional information that could be useful in evaluating social impacts in the study area.

13.6.3. Study Area

Based on the current Project description, the principal study area for the analysis of impacts on social conditions and public goods and services includes communities in the Denali Borough and MSB that are located in relatively close proximity to the proposed Project, including the hydroelectric facility, access road and transmission lines. Most of the effects specific to these communities during the construction phase are related to the transportation and supply of construction materials, the number of construction workers that would work on the Project and their potential impact on population, public services and infrastructure, and temporary housing during construction. Within the Denali Borough, the principal community under consideration is Cantwell, as this is the closest community to the proposed Project. In the MSB, the closest communities are Trapper Creek, Chase, and Talkeetna.

A wide range of occupations are needed to construct and operate a large hydroelectric facility, and it is likely that workers in many regions of Alaska would benefit from the additional employment opportunities created by the Project. However, the largest concentration of workers with the required occupational skills is in highly populated Southcentral Alaska. The concentration of major engineering, construction, and manufacturing firms in the MOA makes it probable that this city would be most affected by construction period expenditures.

Transportation effects during the construction phase of the Project would occur in ports of entry for freight and along the subsequent transportation routes for supplies, equipment and labor. Boroughs and census areas through which potential overland transportation routes pass include the MOA, FNSB, Valdez-Cordova Census Area, KPB, Yukon-Koyukuk Census Area, MSB, and Denali Borough.

During Project construction there may be additional requirements for law enforcement and health and human services. The Alaska Department of Public Safety (ADPS) provides law enforcement in the unorganized areas of the state (census areas) and in areas of municipalities without police powers. State and Alaska Native programs provide most health and human services in Alaska.

Effects of Project operations and features (i.e., reservoir and access roads) on the local or regional economy, including changes in commercial opportunities related to fishing, hunting, boating, wildlife viewing, mountaineering, and other recreation, are likely to be concentrated in those communities in the Denali Borough and MSB that are located in relatively close proximity to the Project.

13.6.4. Study Methods

The study methods discussed below are consistent with the socioeconomic analysis completed during the licensing proceedings for other hydroelectric projects.

13.6.4.1. Data Collection and Analysis

The proposed Project would not start operations until 2023 under the current schedule. The Project is anticipated to operate for more than 50 years, similar to other large hydroelectric developments around the world. Given the long time frame for construction and operation of the Project, the Project's socioeconomic effects will be estimated by comparing future socioeconomic conditions with and without the Project.

The forecast of socioeconomic conditions with and without the Project will be based in part on estimates derived from the REMI model described for the Regional Economic Evaluation study. While the REMI model provides a wide range of output variables, the variables of interest in the socioeconomic impact analysis for the proposed Project are population, employment, labor income, output (sales), and housing. The REMI model extends economic and demographic forecasts through 2060, which is consistent with the temporal scope of the socioeconomic impact analysis. The REMI model can provide projections for all of the boroughs and census areas within the Railbelt, including the MOA, FNSB, KPB, MSB, and Denali Borough. The current REMI model also includes the Yukon-Koyukuk Census Area and Valdez-Cordova Census Area.

The forecast analysis performed by the REMI model will be guided by assumptions about reasonably foreseeable future actions that would have an important and measurable effect on Alaska's economy. These assumptions will be developed based on information received from the Department of Commerce, Community and Economic Development.

As the Project design becomes more developed, specific requirements for the types of construction specialties (e.g., firms with roller-compacted concrete experience) will be identified and compared with current expertise of regional construction companies to see which opportunities can be filled by Alaska firms. This evaluation would improve the model estimates of future economic activity and provide recommendations to increase the percentage of these opportunities captured by Alaska businesses.

The effect of potential immigration during Project construction and operations on municipal and state services, such as police, fire protection, medical facilities, and schools, will be assessed. For schools, the effect of the influx of additional school-age children on teacher-pupil ratios will be determined. In an attempt to identify changes to quality of life and overall natural resource uses trends and potential changes resulting from the Project, some survey questions will be added to the public survey proposed in the Recreation and Aesthetics Study Plan. The survey questions will be oriented toward identifying how the Susitna River corridor and upper basin is used and valued by local residents and to identify the importance of the various bio-physical aspects important to area residents. Once the types of Project-induced changes in riverine and basin resources is known, a further analysis will be undertaken to identify how such changes might alter the resources used and valued by the area residents. The results of the Project effects on subsistence, recreation, and transportation can be used to further evaluate the overall effects on the residents of the region.

A fiscal impact analysis will be conducted to evaluate incremental local government expenditures in relation to incremental local government revenues that would result from construction and operation of the Project. Incremental expenditures include, but are not limited to, school operating costs, road maintenance and repair, public safety, and public utility costs.

Incremental revenues include, but are not limited to, property taxes and hotel/motel occupancy taxes.

Transportation of construction equipment and materials through communities on the transportation routes to and from the Project could result in increased traffic volumes, with associated noise and congestion effects. Such conditions might require additional police and emergency response calls for traffic accidents and other incidents. These impacts will be assessed based on the results of the Transportation Resources study. For example, estimates of changes in vehicle miles traveled can be converted into estimates of traffic accidents and injuries, which could place additional demands on police, emergency response, and medical care services.

The economic impact of the Project on local tourism establishments (e.g., river sport fishing, whitewater boating) and the regional economy will be estimated using the results of the Recreation and Aesthetics study. Calculations will be based on information obtained from the recreation survey, including the estimated recreation-related expenditures per recreational day or trip and changes in the number of days or trips per year. The regional economic impact of changes in subsistence-related expenditures due to the proposed Project will be estimated using the results of the Subsistence study. Approximate cash expenses to generate each pound of subsistence harvest will be based on published information (Goldsmith 1998).

The Project, including access roads, could affect surrounding property uses and values. These effects will be described by identifying the properties that are on or in close proximity to the Project area, including the access road(s) that will be built; determining the degree to which the use of the properties would change as a result of the Project; and estimating to the extent practicable, the extent that properties' values will change as a result of the change in use.

If Project features (i.e., reservoir and access roads) stimulate residential development, spending by new residents in the local economy will generate new economic activity, including additional jobs and labor income. Interviews will be conducted with regional businesses to identify potential opportunities for residential development and estimate the economic impacts should this development occur.

To the extent that Project construction and operations will change the level of production of commercial farming, grazing, logging, mining, and fishing operations, these effects will be approximated by the change in production multiplied by the current price of the resource in question. Information on the quantity and value of market-based natural resources is available through state and federal resource management agencies.

Changes that result in increases or decreases in economic activity such as production of commercial resource extraction (e.g., commercial fishing), or changes in spending for recreational goods and services will become inputs to the REMI model to calculate the regional economic impacts. The annual incremental change (i.e., from the No Action Alternative) in dollars for each activity with the Project will be estimated and then added or subtracted from the No Action Alternative to arrive at the With-Project condition.

The travel cost method or random utility model will be used to estimate changes in recreational use values associated with sport fishing, sport hunting, boating, wildlife viewing, hiking, and camping in the study area. The travel cost method estimates the number of recreational trips an average person takes to a specific site as a function of the cost of travelling to that site, the comparative costs of travelling to substitute sites, and the quality of the recreational experience at the sites (Black et al. 1998). The basis of the method is the assumption that the recreational experience is enhanced by high quality sites (e.g., clean water, abundant recreational fisheries), hence the net willingness to pay for, and hence the value of, recreational trips depends on site quality. Different model specifications can be used to value specific qualities of the resource and attributes of the recreational experience. To value these types of amenities, economists typically rely on a variant of the basic travel cost model referred to as a discrete choice or random utility model. Whereas basic travel cost models are most appropriate in analyzing the number of trips people make to a site, random utility models can be used to assess how people choose between multiple sites based on the qualities of the sites. Travel cost approaches require data on site visitation, place of residence, substitute sites, and user characteristics (such as income) (Black et al. 1998). These data will be obtained from the recreation survey conducted for the Recreation and Aesthetics Study.

In addition, the benefits transfer approach will be used to supplement or compare unit values (e.g., value per-day of sport fishing) for recreational goods and services obtained from primary valuation methods. Benefits transfer involves the application of unit value estimates, functions, data, and/or models from one or more previously conducted valuation studies to estimate benefits associated with the resource under consideration (Black et al. 1998). For example, an extensive number of previously conducted studies estimated the value of sport fishing in various regions of Alaska. Similarly, several existing reports estimated the value of Alaska wildlife. It also may be possible to obtain information from a study currently being conducted by ECONorthwest, in consultation with DHM Research, ADF&G, and others. The study is assessing the economic importance of wildlife to Alaska and will include the value of non-market goods of services, e.g., ecosystem services and wildlife's contributions to Alaskans' quality of life.

The value of changes in subsistence activities in the study area will be estimated by applying a wage compensating differential model that examines tradeoffs between time spent on subsistence and cash employment (Duffield 1997). The advantage of this method is that it captures the cultural and social value of participating in subsistence activities as well as the product value. It requires community-specific per capita income levels and subsistence harvest per capita data, both of which will be obtained from the subsistence survey conducted for the Subsistence study.

Following the methodology of Braund and Lonner (1982), information on the values, attitudes, and lifestyle preferences of residents in the Talkeetna, Trapper Creek, and Cantwell areas will be collected through informal interviews with community residents, MSB officials, and other knowledgeable people. Interview questions will be oriented toward identifying how the Susitna River corridor and upper basin is used and valued by local residents to identify the importance of the various bio-physical aspects important to area residents. Once the types of Project-induced changes in riverine and basin resources are known, a further analysis will be undertaken to identify how such changes might alter the resources used and valued by area residents. The results of the Project effects on subsistence, recreation, and transportation can be used to further evaluate the overall effects on the residents of the region.

13.6.4.2. Work Products

The results of the social conditions and public goods and services study will be documented in initial and updated study reports. The report will include study objectives, study area, methods, and tabulated results.

13.6.5. Consistency with Generally Accepted Scientific Practice

Much of the socioeconomic background information will come from published sources, including local governments, boroughs, state agencies, and the federal government. The REMI model being used to forecast future economic conditions has been calibrated for Alaska and has recently been used in work completed for the Alaska Pipeline Project. The REMI model is used by federal, state, and local governments as well as universities and consulting firms.

13.6.6. Schedule

It is anticipated that completion of the work described above would require about six or seven months of effort in in 2013 and would be summarized in an Initial Study Report in December 2013. There may be additional analyses or model runs in 2014 to incorporate information from the 2013 studies. These will be addressed in the Updated Study Report in December 2014. The process described above should provide sufficient information for the licensing and environmental review of the Project.

13.6.7. Level of Effort and Cost

Conducting this analysis and preparing the report sections for the seven boroughs and census areas, and the associated communities, is estimated to require about 2,400 to 2,800 person-hours in 2013 and 2014. Limited secondary data for many of the communities in the study area will require telephone calls and personal interviews to develop sufficient information to evaluate the effects of the Project on each community. This effort would occur over an eight to nine month period required to prepare the final deliverables. The estimated cost could range from about $400,000 to $500,000.

13.6.8. Literature Cited

AEA 2011. Pre-Application Document, Susitna-Watana Hydroelectric Project, FERC No. 14241.

Black, R., B. McKenney and R. Unsworth. 1998. Economic Analysis for Hydropower Project Relicensing: Guidance and Alternative Methods. Prepared for U.S. Fish and Wildlife Service. Washington, D.C.

Braund, S.R. and T.D. Lonner. 1982. Alaska Power Authority Susitna Hydroelectric Project Sociocultural Studies. Submitted to Acres American Inc. Duffield, J. 1997. Nonmarket Valuation and the Courts: The Case of the Exxon Valdez. *Contemporary Economic Policy* 15 (4):98-110

Goldsmith, S. et al. 1998. Economic Assessment of Bristol Bay Area National Wildlife Refuges: Alaska Peninsula/Becharof, Izembek, Togiak. Institute of Social and Economic Research, University of Alaska Anchorage. Anchorage, AK.

HDR 2011. Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality, and Transportation Data Gap Analysis. Unpublished, by the Alaska Energy Authority.

13.7. Transportation Resources Study

13.7.1. General Description of the Proposed Study

13.7.1.1. Study Goals and Objectives

The Transportation Resources Study will assess the current conditions of the Project area and evaluate the Project's impact against capacity and safety requirements for road, railroad, aviation, port, and river traffic. The analysis will evaluate short-term (construction) and long-term (operational) impacts from the Project, as well as the cumulative impacts of the Project and other significant infrastructure projects. The transportation effects of the Project (With-Project) will be compared to a Without-Project scenario.

The public will benefit from the Transportation Resources Study by having transportation infrastructure capacity near the Project evaluated. Identifying traffic demands during Project construction and operation will allow the Project team and regulatory agencies to identify needed local and regional transportation operational requirements and infrastructure improvements to accommodate Project-related traffic transportation demands and mitigate potential negative impacts on transportation capacity and public safety. Potential effects of the Project on local river use for winter transportation will also be evaluated.

Jurisdiction over public transportation infrastructure and operations is shared by ADOT&PF, ARRC, local governments, and federal transportation agencies. These entities all have similar management goals: for roads, railroads, ports, and aviation facilities to have sufficient capacity to safely and efficiently meet transportation demands during Project construction and operations; and to provide transportation facilities and services that support economic development and general public safety.

The Project team will use information from this study to identify and coordinate needed transportation infrastructure improvements with ADOT&PF, ARRC, MSB, the Denali Borough, and others. This report will also provide valuable information for the multidisciplinary analysis of the Project required under the National Environmental Policy Act (NEPA).

13.7.2. Existing Information and Need for Additional Information

The existing transportation resources in the Project area are well documented and studied. Included in this documentation are studies conducted by AEA and ADOT&PF specifically for the Project; reports developed for the Alaska Power Authority (APA) Project in the 1980s; and other documents publicly available from the MSB, the Denali Borough, ADOT&PF, ARRC, and the Federal Aviation Administration (FAA).

Tables 13.7-1 through 13.7-5 identifies some key reports that will help provide a foundation for the Transportation Resources Study.

Table 13.7-1. General Resources for Transportation Resources Study.

Report Title	Year Published	Publishing Agency[1]	Area Covered
Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality and Transportation Data Gap Analysis (Draft)	2011	AEA	MSB
Pre-Application Document: Susitna-Watana Hydroelectric Project FERC Project No. 14241	2011	AEA	MSB
Mat-Su Long Range Transportation Plan	2009	MSB	MSB
Mat-Su Long Range Plan	2013; in progress	MSB	MSB
Talkeetna Comprehensive Plan	1999	MSB	MSB
Big Game Guides and Transporters	2011	DCCED	Statewide
Susitna-Matanuska Area Plan	2010	ADNR	MSB
Railbelt Large Hydro Evaluation Preliminary Decision Document	2010	AEA	MOA, MSB, Denali Borough
Matanuska-Susitna Borough Comprehensive Development Plan	2005	MSB	MSB
Railbelt Electrical Grid Authority Study	2008	AEA	MOA, MSB, Denali Borough
Susitna Basin Recreation Rivers Management Plan	1991	ADNR, ADF&G	Susitna Basin Recreation Rivers Management Plan

Notes:

1 ADNR: Alaska Department of Natural Resources; ADF&G: Alaska Department of Fish and Game; DCCED: Department of Commerce, Community and Economic Development; MOA: Municipality of Anchorage.

Table 13.7-2. Road Resources for Transportation Resources Study.

Report Title	Year Published	Publishing Agency[1]	Area Covered
Access Corridor Evaluation	2012; in progress	ADOT&PF	MSB
Annual Traffic Volume Report, Northern Region, 2008-2010	2011	ADOT&PF	MSB, Denali Borough
Annual Traffic Volume Report, Central Region, 2007-2009	2010	ADOT&PF	MOA, MSB
State of Alaska Annual Vehicle Miles of Travel	2010	ADOT&PF	Statewide
Parks Highway Visioning Document	2008	ADOT&PF	MSB, Denali Borough
The George Parks Highway Scenic Management Byway Corridor Partnership Plan	2008	ADOT&PF	MSB, Denali Borough
Alaska's Scenic Byways: Parks Highway	2006	ADOT&PF	MOA, MSB, Denali Borough
Alaska Denali Highway Points of Interest	2008	BLM	Denali Borough
Memorandum on the Economic and Demographic Impacts of a Knik Arm Bridge	2005	KABATA	MOA, MSB

Notes:

1 BLM: Bureau of Land Management; KABATA: Knik Arm Bridge and Toll Authority.

Table 13.7-3. Rail Resources for Transportation Resources Study.

Report Title	Year Published	Publishing Agency	Area Covered
Alaska Statewide Rail Plan	2013; in progress	ADOT&PF	MOA, MSB, Denali Borough
Alaska Railroad 2011 Program of Projects	2011	ARRC	MOA, MSB, Denali Borough

Table 13.7-4. Aviation Resources for Transportation Resources Study.

Report Title	Year Published	Publishing Agency[1]	Area Covered
Alaska Aviation System Plan	2011	ADOT&PF	Statewide
Mat-Su Regional Aviation System Plan	2009	MSB	MSB
Ted Stevens Anchorage International Airport 2008 Master Plan Study Report (Draft)	2009	TSAIA	MOA
Wasilla Airport Master Plan Update 2010	2010	City of Wasilla	MSB
Palmer Municipal Airport Master Plan Update	2009	City of Palmer	MSB

Notes:

1 TSAIA: Ted Stevens Anchorage International Airport.

Table 13.7-5. Port Resources for Transportation Resources Study.

Report Title	Year Published	Publishing Agency	Area Covered
Port MacKenzie Master Plan	2012	MSB	MSB (Port MacKenzie)
Port of Anchorage Master Plan	1999	MOA	MOA (Port of Anchorage)

Additional information needed to complete the Transportation Resources Study is discussed below.

- Project Information

    Proposed access corridor alternatives
    Approximate volumes of construction materials, construction equipment, and personnel that need to access the Project area during construction and operation
    Expected modes of transportation for various materials, supplies, and personnel
    Information on any other proposed Project transportation infrastructure, such as airstrips

- Existing Operations Information

    Existing operations data for all modes of transportation
    Information on existing operating and maintenance costs for all modes of transportation
    Existing capacity and any capacity issues

- Future Operations Information

    Forecasts of operations for all modes of transportation
    Information on planned or proposed non-Project transportation infrastructure improvements

13.7.3. Study Area

The proposed study area for the Transportation Resources Study extends north from Anchorage to Fairbanks and east to the Susitna River to cover all relevant traffic sources, traffic nodes (points where travelers or shippers may select different routes), and destinations for each mode of transportation. The primary sources and destinations of road and railroad traffic will be the Project site, the Port of Anchorage, Port MacKenzie, and local material sources. The majority of the aviation traffic will originate in populated areas at primary and smaller general aviation airports. As preliminary design progresses and local material sites are identified the transportation study area may change.

The proposed study area includes the roadways listed below.

- New access roads to the Project site
- The Denali Highway, Mile Post (MP) 78-133, from the Susitna River crossing to the Parks Highway
- The Parks Highway, MP 35 to 356, from the Glenn Highway to Fairbanks (the junction with the Denali Highway is at MP 210)
- The Glenn Highway, MP 0 to 35, from downtown Anchorage to the Parks Highway
- MSB roads to access Port MacKenzie: Point MacKenzie Road, Knik Goose Bay Road, Burma Road (after completion of realignment and upgrade currently being designed), Big Lake Road, and Vine Road
- MOA streets that access the Port of Anchorage: A Street, C Street, 3rd Avenue, 4th Avenue, 5th Avenue, and 6th Avenue
- Other state highways and local roads near the Project site

The study area also includes the ARRC main line from MP 113 (Anchorage) to MP 478 (Fairbanks), giving consideration to the following areas:

- MP 113, Anchorage Yard (Ship Creek Intermodal Transportation Center)
- MP 173, Port MacKenzie branch line (under construction – roughly 40 miles long)
- MP 248, Curry Quarry
- Access corridor alternatives identified by the Project design team

    MP 263, Gold Creek
    MP 274, Chulitna
    MP 319, Cantwell

- MP 478, Fairbanks Yard

For aviation facilities, the study area contains two primary airports (Ted Stevens Anchorage International Airport and Fairbanks International Airport), plus several smaller general aviation airports (Lake Hood and Merrill Field in Anchorage, plus public airports in the MSB).

For river transportation the study will evaluate non-recreation or subsistence transportation uses in the Susitna River corridor from the Denali Highway to the river mouth.

13.7.4. Study Methods

The proposed methodology consists of the five steps described below.

13.7.4.1. Collect and Review Data

The first step is developing a bibliography of existing documents including recent transportation reports from AEA and the items mentioned in Section 13.8.2. The bibliography will evaluate the relevance of each document to the overall study. The study team will also compile information regarding transportation planning projects, design projects, and any scheduled construction projects near the Project site; these projects may already address potential impacts from the Project, but this will need to be verified.

13.7.4.2. Inventory Assets and Conduct Any Field Studies

The study team will develop a transportation asset inventory for the Project area focused on roads, railroads, bridges, ports, air infrastructure, traffic levels, capacities, and crash and accident statistics. Some traffic data are available; depending upon the type and the age of the data, traffic counters may need to gather current data. Information on use of the river for winter transportation will be obtained by interviewing knowledgeable sources.

13.7.4.3. Document Existing Conditions

Existing transportation infrastructure and traffic levels will be documented to establish baseline conditions for the various transportation resources. Much of this information is available from existing sources, but the information will be supplemented and updated with field collection or interviews if needed.

In particular, surveys of and interviews with knowledgeable individuals and property owners in the area will be used to collect data on the types, levels, areas, and seasons of river transportation uses in the study area. The timing, location, questionnaire content, and survey methods will be developed in consultation with agencies and other interested parties, including the work groups. These surveys will likely include a combination of in-person surveys and mail-out surveys and will be supplemented with information from field crews that encounter people in the study area. These surveys may be conducted coincidentally with the recreation use surveys proposed. Results of the surveys will be used to document river transportation uses, relationships to flow levels and ice conditions, and any feasible access alternatives to use of the river.

13.7.4.4. Forecast Future Conditions

Future traffic forecasts, including Project-related construction and operations traffic, will be developed. These forecasts will address the following issues:

- Proposed transportation/transmission corridors
- Railroad loading and unloading facilities
- Proposed airport facilities
- Other facilities to support fueling, maintenance, and operations
- Possible staging areas
- Temporary improvements for construction
- Any scheduled improvements, such as improvements proposed for the Denali Highway

The study will use *Trip Generation, 8th Edition* (ITE 2008) to forecast future roadway traffic levels. *SimTraffic 8, Synchro 8,* and *HCS 2010* may be used to simulate and evaluate the current and future capacity of the road system. Existing aviation forecasts for existing public airports will be modified if needed, and forecasts for proposed new airports would be developed in accordance with FAA Advisory Circular 150/5070-6B and Forecasting Aviation Activity by Airport (July 2001). These methods of evaluating and predicting traffic levels are consistent with the standard practices of the transportation engineering community. For railroad and port traffic, the study team will work with ARRC operations staff and MSB and MOA port staff to project future activity levels and evaluate future capacity.

13.7.4.5. Evaluate Impacts

The study team will identify the direct, indirect, and cumulative transportation capacity and safety concerns based on projected future road, railroad, port, aviation, and river traffic levels. All modes of transportation will be evaluated before, during, and after Project construction. After identifying and evaluating the effectiveness of scheduled improvements on projected future traffic levels, the team will evaluate solutions to avoid, minimize, and mitigate any remaining capacity and safety problems. Some mitigation measures may consist of general best management practices, such as widening shoulders and adding guardrails on roadways to improve safety. Other mitigation measures may apply to a particular mode of transportation at a specific site and location. Examples include adding additional lanes or passing lanes along the Parks Highway; adding apron space, improving navigation aids, or improving runway surfaces at existing airports; and improving or adding siding tracks along the existing ARRC mainline.

River transportation effects will be assessed based on expected changes in flow levels and ice formation using data from the hydrology and ice processes studies proposed. Measures to mitigate potential effects on river transportation will be identified.

13.7.5. Consistency with Generally Accepted Scientific Practice

Transportation forecasts will be developed using standard forecasting tools for highway and aviation operations. Forecasts of roadway traffic levels will be based on the Institute of Transportation Engineers (ITE) *Trip Generation, 8th Edition* (ITE 2008). Other generally accepted models, including *SimTraffic 8*, *Synchro 8*, and *Highway Capacity Software* (HCS) can be used if needed to evaluate road capacity. Forecasts for aviation traffic will be in accordance with FAA *Advisory Circular 150/5070-6B Airport Master Plans* and *Forecasting Aviation Activity by Airport* (July 2001).

13.7.6. Schedule

The initial transportation study would be carried out over 12 months, with an initial study report issued in December 2012. An Updated Study Report would be issued in December 2014 to incorporate any new or changed information that becomes available based on other studies conducted in 2013 or changes in the proposed Project.

Table 13.7-6. Transportation Resources Study Schedule

Description	Start Date	Completion Data	Duration	Cost
Data Collection and Review	January 2013	March 2013	2 months	$12,000
Asset Inventory and Field Studies	April 2013	June 2013	3 months	$35,000
Document Existing Conditions	July 2013	August 2013	2 months	$10,000
Forecast Future Conditions	September 2013	November 2013	3 months	$40,000
Evaluate Impacts	December 2013	December 2013	1 month	$15,000
Initial Study Report	October 2013	December 2013	3 months	$15,000
Updated Study Report (if updates needed)	October 2014	December 2014	3 months	$10,000

13.7.7. Level of Effort and Cost

The research into local and regional transportation will require professional engineers and planners with experience relevant to each mode of transportation to conduct the field investigations and data analyses identified in Section 13.8.4 (Study Methods). Total study costs are estimated to be approximately $137,000.

13.7.8. Literature Cited

Center for Microcomputers in Transportation (McTrans). Highway Capacity Software (HCS) 2010, Release 6.3 [computer software]. University of Florida, Gainesville, Florida.

Federal Aviation Administration (FAA). 2001. Forecasting Aviation Activity by Airport.

FAA. 2007. Advisory Circular 150/5070-6B, Airport Master Plans.

Institute of Transportation Engineers (ITE). 2008. Trip Generation, 8th edition: An ITE Informational Report. Washington, DC.

Trafficware. 2011. SimTraffic 8 [computer software]. Sugarland, Texas.

Trafficware. 2011. Synchro 8 [computer software]. Sugarland, Texas

13.8. Health Impact Assessment Study

13.8.1. General Description of the Proposed Study

13.8.1.1. Study Goals and Objectives

Health Impact Assessment (HIA) is a structured planning and decision-making process for analyzing the potential positive and negative impacts of programs, projects, and policies on health of residents in communities impacted by the Project. In particular, three aspects of the Project may impact community health:

- The physical size of this prospect will likely require a protracted and large influx of non-resident construction personnel which could impact the residents in nearby communities.
- The development of the Project could lead to increased rail traffic and additional traffic on the Parks and Denali Highways, potentially impacting communities and individuals using these transportation resources.
- If construction and operation of the Project is shown to cause the release of naturally occurring mercury, which then could be ingested by humans of harvestable resources, then evaluate the potential health implications to local communities.

Potential health impacts on construction and operational staff will be discussed in the Occupational Medicine and Safety sections of the Project Description.

The HIA will use the methods and guidelines in the Alaska Department of Health and Human Service's (DHSS's) "Technical Guidance for HIA in Alaska," July 2011 (www.epi.hss.state.ak.us/hia/AlaskaHIAToolkit.pdf).

The goals and objectives of the HIA include the following:

- Identify public issues and concerns about how community health might be affected during construction and operation of the Project.
- Collect baseline health data at the state, borough or census area, and potentially affected community, as possible.
- Identify data gaps and determine the most efficient method to fill those gaps, including coordinating with other field studies, including subsistence studies and social and demographic surveys.
- Evaluate the baseline data against the Project description to determine potential impacts, both positive and negative.
- Prepare an HIA document which is scientifically rigorous and understandable to the public.

13.8.2. Existing Information and Need for Additional Information

A variety of existing information sources will be useful to the HIA analysis. These information sources include reports from various Alaska state agencies including:

- Alaska Department of Health and Social Services

Bureau of Vital Statistics
Alaska Behavioral Risk Factor Surveillance Survey (BRFSS)
Youth Risk Behavior Study (YRBS)
Section of Epidemiology bulletins
Alaska Trauma Registry (ATR)
Cancer Registry

- State of Alaska Department of Labor and Work Force Development

  Employment reports

- Alaska Department of Transportation and Public Facilities

  Highway traffic statistics, particularly on large loads vehicles
  Alaska State Trooper annual reports

- Alaska Department of Fish & Game

  Harvest studies
  Community Information System

The Alaska Native Tribal Health Consortium (ANTHC) prepares health status reports on a statewide and regional basis. The HIA team will use these reports as baseline data:

- Alaska Native Health Status Report, August 2009
- Regional Health Profile for Interior Alaska, July 2011
- Regional Health Profile for Anchorage and Matanuska-Susitna, December 2011

In addition, pertinent reports from the U.S. Centers for Disease Control and Prevention and annual reports, such as County Health Rankings, prepared by the University of Wisconsin are important resources that will be reviewed.

Review of the above data sources allows identification of data gaps which require additional information. Study Area

13.8.3. Study Area

The proposed HIA study area includes those communities potentially directly affected, such as Cantwell and Talkeetna, as well as those communities further away but potentially affected by the movement of workers, materials, and supplies by using the criteria available in the Technical Guidance for HIA in Alaska (DHSS 2011). The study will develop a set of clear criteria which will allow the HIA team to identify PACs in a systematic way and facilitate the development of zones of impact for the Project. Some sample criteria are communities with

- Close geographic proximity to the Project
- Potential changes to water sources and quantities
- High likelihood for worker influx
- Intense work force recruitment potential
- High likelihood for change in key subsistence resources
- High likelihood for change in transportation infrastructure
- Potential for economic change including regional staging centers

- Existing large burden of diseases or health problems
- Existing high level of exposure to an environmental hazard

13.8.4. Study Methods

The HIA would be divided into the following phases to accommodate the possible need for field studies to address data gaps identified during the overview process.

13.8.4.1. Project Overview and Issues Summary

The Project overview process is designed to

- develop Project-specific criteria for establishing potentially affected communities (potentially affected communities for health may not be the same as for other social sciences and must be established);
- coordinate through other social study areas and AEA licensing participant engagement programs to ensure there will be enough information to meet health impact assessment needs; and,
- identify potential key health concerns and issues related to the Project.

The result of this effort will be a "Project Overview and Issues Summary" that will set the geographical, time scale, and population boundaries of the assessment. The report will follow the overall strategies and methodologies presented in the "Technical Guidance for HIA in Alaska." For example, the State of Alaska HIA Program has identified the following eight health effect categories (HECs) that should be used to categorize the issues and concerns:

- Social Determinants of Health (SDH)
- Accidents and Injuries
- Exposure to Potentially Hazardous Materials
- Food, Nutrition, and Subsistence Activity
- Infectious Disease
- Water and Sanitation
- Non-communicable and Chronic Diseases
- Health Services Infrastructure and Capacity

These HECs are fully described in the "Technical Guidance for HIA in Alaska." An HIA cannot address every conceivable health effect or effects that are primarily nuisance impacts and rarely observed. Instead, the initial Project review process highlights health effects that produce intense impacts with persistent duration and broad geographical scope that are highly likely to occur. There must also be a clearly defined causal link between the Project and the anticipated health effect.

13.8.4.2. Phase 2: Baseline Data Collection

After the "Project Overview and Issues Summary" report is complete, it will be necessary to perform an analysis of available federal/state/regional/tribal/community/household level health data. Data collected by other Project study teams' studies would also be included where such studies will produce baseline data that may be useful to the HIA. For example, the HIA team will use information from the air quality study concerning existing and future air quality levels, and from the socioeconomic studies for population projections and household characteristics, which have been shown to be key determinants of health. Coordination between study teams will avoid unnecessary duplication of effort and community 'survey fatigue.'

Subsistence issues and existing available community / household consumption and nutritional data are often critical for local communities. The HIA team will coordinate with the subsistence study team to address how subsistence issues interact with the proposed Project location, size, linear features, and number and variety of communities in reasonably close proximity to the Project. Subsistence baseline data will be used to identify those subsistence foods that are vital to residents of the area, and data from the subsistence studies will be used to identify potential impacts to the quality, quantity, and access to subsistence resources. Direct, indirect, and cumulative impacts to subsistence must be considered during HIA baseline data evaluation.

After the key baseline data have been assembled and reviewed, the HIA team should assess whether there are significant data gaps remaining. This is a crucial exercise required to create a coherent and cost-effective plan for closing data gaps.

Field studies will be designed to fill data gaps. If needed, the HIA team will visit relevant communities during the field studies phase of the baseline data collection to document community food sources and make observations on critical community services, such as water, sanitation, and health care facilities. Field studies would be coordinated with other Project study efforts in the area to provide the information in an efficient manner.

The output of the baseline data review, data gaps analysis, and field studies will be a "Baseline Community Health Data Assessment" chapter in the HIA.

13.8.4.3. Phase 3: Impact Assessment

The specific health impacts for the Project will be identified when all components of the Project have been fully defined and evaluated against the baseline data. The HIA team will rate and rank the health impacts using a semi-quantitative model described in detail in the HIA Toolkit. The point of rating and ranking impacts is to enable interested parties to construct a health impact management framework.

The HIA should include impacts that have beneficial or detrimental consequences to communities or individuals. Each health impact has several different dimensions, listed below.

- Significance
- Nature
- Timing and duration
- Extent
- Magnitude (intensity)
- Frequency

The HIA process may include the following components.

- An in-depth review of available state, regional, and local health data
- Comparison of study area data to state and regional health data
- Analysis of special at-risk subpopulations (such as children under the age of five years, pregnant women, elderly, or other previously defined vulnerable groups)

- Consideration of key Project-specific toxicology issues, e.g., mercury loading associated with reservoir development and impacts on subsistence resources
- Field survey visit by an HIA study team. Consultation with local health representatives, particularly from tribal organizations, if present
- Seasonality considerations, i.e., summer versus winter differences in subsistence practices, water use, and associated disease-transmission dynamics
- Variability of existing health care infrastructure across different affected areas
- Coordination and alignment with existing State disease-control programs and strategies (e.g., TB, HIV/AIDS, hypertension, diabetes, substance abuse, etc.)

The information developed in this study may be used to prepare a Health Management Plan (HMP) which may include:

- Types of health protection processes that may be needed
- Strategies available to lessen impacts and the timescales relating to health impacts
- Temporary measures which can be put in place
- Local capacity to put the proposed strategies into practice

13.8.4.4. Phase 4: HIA Document Preparation

An HIA document, with technical appendices as needed, written in accordance with the DHHS HIA guidelines will be issued as an Initial Study Report in December 2013. The HIA will be updated to include relevant results from 2013 field studies and reissued as an Updated Study Report in December 2014

13.8.5. Consistency with Generally Accepted Scientific Practice

The HIA uses rigorous scientific methods to determine potential impacts and appropriate mitigation, and the assessment will follow the ADHHS technical guidance for HIAs (ADHSS 2011).

13.8.6. Schedule

The HIA could be completed by the end of the 2014.

Table 13.8-1. HIA Study Schedule

Description	Start Date	Completion Data	Duration	Cost
Project Overview and Issues Summary	January 2013	March 2013	2 months	$20,000
Baseline Data Collection	February 2013	August 2013	5 months	$85,000
Impact Assessment	June 2013	August 2013	3 months	$15,000
Initial Study Report	October 2013	December 2013	3 months	$10,000
Updated Study Report	October 2014	December 2014	3 months	$10,000

13.8.7. Level of Effort and Cost

Based on past HIA experiences in Alaska, the HIA is expected to cost approximately $140,000.

13.8.8. Literature Cited

AEA 2011. Railbelt Large Hydroelectric, Presentation to the Alaska Senate Resources Committee and the House Energy Committee, by the Alaska Energy Authority, January 25, 2011.

DHSS 2011. Technical Guidance for Health Impact Assessment in Alaska, Alaska Department of Health and Human Services, Section of Epidemiology, Health Impact Assessment Program, July 2011

13.9. Air Quality Study

13.9.1. General Description of the Proposed Study

The air quality study will assess the current conditions of the area against applicable state and national air quality standards and evaluate the Project's air quality impact against these standards. The analysis will evaluate both short-term (construction) and long-term (operational) impacts from the Project and how Project emissions compare to the Without-Project alternative. The analysis will also include an assessment of the indirect impact of the Project on existing fossil-fuel electricity generators in the area, which could result in improvements to regional air quality to the extent that Project generation replaces fossil fuel generation.

The primary benefit to the public of this analysis will be the assurance of clean air and public safety. The identification of potential emission sources and levels can be used to identify recommendations to reduce emissions during construction and operations.

This report would also provide valuable information for the multidisciplinary analysis need for the NEPA analysis.

13.9.1.1. Study Goals and Objectives

The primary goal and objective of the air quality analysis is to ensure the proposed action does not violate state air quality standards in Alaska Administrative Code (AAC) 18 AAC 50. The national and state air quality regulations are designed to maintain and/or improve air quality by controlling or reducing emissions of air pollutants. The air quality impact analysis is subject to the state and national ambient air quality standards and state and national attainment designations (i.e. attainment, non-attainment, maintenance).

The following are the primary objectives of the air quality study:

- Assess the current conditions of the area against applicable state and national air quality standards.
- Review and summarize existing air monitoring data in the area.
- Determine attainment status of the study area (i.e. attainment, non-attainment, maintenance, and unclassifiable).
- Quantify short-term (construction) and long-term (operational) emissions.
- If applicable, analyze ground level impacts using air dispersion models.
- If applicable, evaluate indirect mobile source emissions from additional traffic generated.
- Compare Project emissions to the Without-Project alternative.
- Evaluate potential emission reductions from nearby Railbelt fossil-fuel utility plants if the Project is implemented.
- Evaluate and recommend mitigation measures to reduce emissions during construction.
- Ensure the Project does not violate any state air quality standards (18 AAC 50).

13.9.2. Existing Information and Need for Additional Information

There is little existing ambient monitoring data available in the vicinity of the Project site. The nearest state monitoring sites are located in the MSB urban core. The primary air quality concern in the area is particulate matter (PM_{10} and $PM_{2.5}$) from fugitive dust, volcanic ash, and wildfire smoke. There have been supplemental monitoring projects conducted by ADEC within the MSB over the past several years which will also be reviewed. These supplemental studies mainly pertain to particulate matter. There are some limited data available from a site in Denali National Park. The team will investigate whether the state has any other project-specific data that may be available and will summarize any available data to support the existing conditions section.

Existing data will be compared to applicable standards for criteria pollutants in a table. The study assumes ambient air monitoring will not be required. If site specific monitoring data is required, it is anticipated that at least one year's worth of data will be collected consistent with methods outlined in 18 AAC 50.035. The area is likely considered unclassifiable under 18 AAC 50.015, as there may be insufficient data to determine whether it is in attainment with respect to all criteria pollutants. EPA maintains a list of non-attainment areas for all six criteria pollutants on their Green Book website: (http://www.epa.gov/oar/oaqps/greenbk/index.html).

An emissions inventory of other Railbelt fossil-fuel utility plants will be generated and categorized by type (i.e. coal, oil, gas, etc.) to evaluate the potential emissions reductions from such facilities if the Project is implemented. This inventory will be based on existing information in the RIRP or updated information, if available.

Detailed information on Project construction and operations will be needed to estimate and evaluate the Project emissions for criteria pollutants for comparison to national and state standards. This would include levels of traffic by various modes and timeframes, construction equipment and activities, and operations equipment and schedules. A table comparing the Project emission with Without-Project alternative emissions will be generated.

13.9.3. Study Area

The Project study area for the air quality analysis will mainly comprise the immediate vicinity of the Project Study Area (Figure 1.2-1) and the greater Railbelt region

While preparing the air quality analysis, particular attention will be made to the following:

- Environmentally sensitive areas
- Nearby dense population areas
- Issues raised by ADEC and other agencies such as the National Park Service (NPS) or other licensing participants

13.9.4. Study Methods

EPA and ADEC have air quality standards that must be met for new sources of emissions of criteria pollutants. The study team will estimate emissions generated by the Project, including construction and operation emissions. The emissions, along with the type and size of equipment, will be compared to appropriate ADEC thresholds as outlined in 18 AAC 50 to determine the type of license and air dispersion modeling required, if any. Denali National Park is designated as a Class I area through the federal Prevention of Deterioration (PSD) program. The study assumes emission estimates from the Project are expected to be below major source thresholds, therefore a PSD and Title V permit are not anticipated for the Project.

The air quality study will assess the existing conditions of the area against applicable state and national air quality standards and evaluate the Project's air quality impacts against these standards. The analysis will include evaluation of both short-term and long-term impacts from the Project and a comparison of Project emissions to the no-action alternative. An emissions inventory of other Railbelt fossil fuel utility plants will be generated and categorized by type (i.e. coal, gas, oil, etc.) to evaluate the potential emissions reduction from these facilities if the Project is implemented.

13.9.4.1. Document Existing Conditions

Air monitoring reports prepared by ADEC will be reviewed to assess the existing conditions of the area for comparison to applicable standards. There is little existing ambient monitoring data available in the vicinity of the Project site. The team will investigate whether the state has other project-specific monitoring data that may be available to help characterize the air quality within the Project area. ADEC data and any other available data will be summarized to support the existing conditions section. The monitoring data will be compiled and compared to applicable standards for criteria pollutants in a table. Criteria pollutants as defined by EPA are nitrogen dioxide (NO_2), sulfur dioxides (SO_2), carbon monoxide (CO), PM_{10}/$PM_{2.5}$, lead (Pb) and ozone (O_3).

The attainment status of the area will be determined based on the latest EPA designations. If the air quality in a geographic area meets or exceeds the national standard, it is designated an attainment area. Areas that do not meet the national standard are designated non-attainment areas. If there is insufficient information to classify an area as attainment or non-attainment for a particular air pollutant, the area is designated unclassifiable for that pollutant. Once a non-attainment area meets the standards, the EPA will re-designate the area as a "maintenance area".

The area is likely considered attainment or unclassifiable under 18 AAC 50.015 and EPA Green Book, as there may be insufficient data available to ADEC and EPA to determine whether it is in attainment with respect to all criteria pollutants.

13.9.4.2. Estimate Project Emissions

Emissions from construction equipment and related activities will be estimated for comparison to appropriate state licensing criteria. Construction equipment emission factors will be obtained from the EPA's NONROAD model or similar model. Fugitive particle matter emissions from the handling and storage of raw materials and wind erosion during construction will be quantified according to methodologies specified in EPA's Compilation of Air Pollutant Emission Factors (AP-42) or similar source of emission factors. Typical construction activities could include, but are not limited to, construction equipment, earth moving activities, construction worker commutes, material deliveries, earth hauling, and operation and maintenance activities. Detailed information on Project construction and operations will be needed to estimate and evaluate the Project emissions. This will include levels of traffic by various modes and timeframes, construction equipment and activities, and operations equipment and schedules. The temporary air quality impacts from construction activities associated with the proposed Project are not expected to be significant. If a state license is required, air quality dispersion modeling may also be required and will be performed consistent with 18 AAC 50 dispersion modeling guidelines.

The Project is likely not located in an EPA designated non-attainment area; therefore, General Conformity and Transportation Conformity is not anticipated. If the Project generates average daily traffic volumes that exceed a state mobile source threshold for CO, PM_{10}/$PM_{2.5}$, or mobile source air toxics (MSATs) analyses, then a mobile source evaluation may be required. This will be determined after consultation with appropriate state personnel and a review of the transportation study.

13.9.4.3. Summarize Baseline Fossil Fuel Generation Emissions

The study will also include a summary of the baseline fossil fuel generation emissions in the area. The team will use the source data and references identified by HDR in the Section 7.3.1.2 of the Data Gap Analysis along with other applicable source data for generating the emissions inventory. It is assumed that no additional monitoring or data collection will be required at existing power generation sites.

13.9.4.4. Analyze and Compare With-Project Emissions to Without-Project Emissions

The study will include a comparison of future With-Project emissions to emissions estimated for future Without-Project emissions. The Without-Project case emissions will be estimated as the potential emissions from other Railbelt fossil fueled facilities to provide the equivalent annual generation power as the Project if the Project is not implemented, or the installation of new generation facilities for the future using a similar fuel mix to the current Railbelt facilities.

13.9.4.5. Identify Best Management Practices

Best management practices to reduce air emissions related to construction and operation of the Project will be identified, including evaluating dust mitigation measures based on studies conducted by ADEC and the Alaska University Transportation Center.

13.9.5. Consistency with Generally Accepted Scientific Practice

Air quality study estimates and forecasts will be developed using EPA's NONROAD model or EPA's Compilation of Air Pollutant Emission Factors (AP-42) for construction equipment and other non-automotive sources. If needed, EPA-approved methods would be used to estimate mobile source emissions.

13.9.6. Schedule

The anticipated schedule for the air quality analysis would be six to seven months as shown in the table below.

Table 13.9-1. Air Quality Study Schedule

Description	Start Date	Completion Date	Duration
Review Existing Information, Identify Needs	January 2013	February 2013	One month
Document Existing Conditions	February 2013	March 2013	One month
Estimate Project Emissions	March 2013	April 2013	One month
Summarize Baseline Fossil Fuel Emissions and No-Action Alternative Emissions	April 2013	May 2013	One month
Initial Air Quality Study Report	June 2013	August 2013	Three months
Updated Air Quality Study Report	October2014	December 2014	Three months

13.9.7. Level of Effort and Cost

Given the lack of nearby existing monitoring data, existing monitoring data may not be representative of the area. If this is determined to be the case, a program of air quality monitoring would need to be implemented to gather baseline data. Details regarding equipment to be used for construction and operations and operational information should be sufficient to perform an analysis of Project emissions. Information on emissions from other Railbelt power sources that may be offset by this Project would be needed to allow for a full analysis of potential costs and benefits.

Completion of the work described above would require seven to ten months of effort, assuming that no air monitoring is required at an estimated cost of $100,000.

13.9.8. Literature Cited

18 AAC 50, Alaska Administrative Code, Air Quality Control.

EPA 40 CFR Part 50, National Ambient Air Quality Standards.

EPA Green Book Non-Attainment Areas for Criteria Pollutants.

HDR 2011. Susitna-Watana Hydroelectric Project, Socioeconomic, Recreation, Air Quality, and Transportation Data Gap Analysis. Unpublished, by the Alaska Energy Authority.

42 U.S.C. 7401, The Clean Air Act.

14. PROJECT SAFETY

14.1. Introduction

The Project, as currently envisioned, is likely to include a dam constructed using roller compacted concrete (RCC) construction methods. The Project works will also include a large reservoir, a spillway, cofferdams, diversion tunnels, integrated penstocks and powerhouse, railhead improvements, temporary construction housing and maintenance facilities, borrow and quarry areas, transmission lines, access roads, staging and stockpile areas, etc. The public safety studies will provide information and analysis to demonstrate that proposed structures are safe and adequate to fulfill their stated functions.

14.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

Among the basic studies required to verify the design criteria for and the design of a large dam are the seismic hazard evaluation and the Probable Maximum Flood (PMF) studies.

Project construction, operation, and maintenance activities have the potential to be affected by, and to affect, seismic activity in the Project area, and extreme floods can also affect Project operations. Thus, the ability to safely pass extreme floods and safely survive a regional or local seismic event is of paramount importance in dam development. These studies will verify the design criteria to be used for the PMF inflow and the routing of the PMF and also verify the condition or nature of the seismic hazard such that appropriate design criteria are formulated.

14.3. Resource Management Goals and Objectives

The capability of Watana Dam to safely pass the most extreme floods is a FERC requirement, and the ability of the dam to survive a seismic event are basic elements of a comprehensive dam safety program under FERC's 18 CFR Part 12 regulations. Dam safety is a fundamental design criterion for the Watana Dam.

Additionally, The DNR's Alaska Division of Geological and Geophysical Surveys (DGGS) evaluates potential geologic hazards to buildings, roads, bridges, and other installations and structures as part of its mission statement.

14.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants

Many residents of the upper Susitna Valley expressed concerns about the stability of the proposed dam during and after a seismic event. They have also expressed concern about the dam's ability to withstand extreme flood events.

AEA has informally consulted with the Alaska Division of Geological and Geophysical Surveys.

14.5. Probable Maximum Flood (PMP) Study

14.5.1. General Description of the Proposed Study

14.5.1.1. Study Goals and Objectives

The general goals and objectives of the PMF study are as follows:

- develop a site-specific Probable Maximum Precipitation (PMP) to be used for the derivation of the PMF including both a temporal and spatial distribution of rainfall;
- model the runoff through the project drainage basin to produce the PMF inflow, including snowmelt considerations for the Project reservoir;
- route the PMF inflow through the Project to obtain the PMF outflow and maximum flood elevation at the dam; and
- use the Board of Consultants (BOC) for technical review during development and performance of the site-specific studies.

The FERC PMF study request (FERC 2012) contains references to assessing the stability of Project facilities during flood loading conditions. which will be addressed in detailed design documents, and requirements for several geologic and geotechnical assessments that relate to dam safety, which will be addressed in the Geology and Soils study plan. Geology and soils considerations would only be included in the PMF study to the extent that they affect flood runoff. Structural aspects of Project facilities will not be included in the PMF study.

14.5.1.2. Selection of the Inflow Design Flood

The Inflow Design Flood (IDF) is used in the design of the spillways and other structures that are affected by maximum flood levels. The adequacy of a spillway is evaluated by considering the hazard potential that would result from failure of the Project works during passage of flood flows. For dams of different sizes and hazard potentials, the IDF may range anywhere from the 100-year flood up to the PMF. Because of its size and downstream hazard potential, the selected IDF for Watana Dam will be the PMF.

The PMF is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the drainage basin under study. The PMF is generated by the PMP, which is defined as theoretically the greatest amount of precipitation for a given duration that is physically possible for a given size storm area at a particular geographic location at a certain time of year.

14.5.2. Existing Information and Need for Additional Information

A PMF study was developed about 30 years ago for the Watana Dam site (Acres 1982) at the time that feasibility reports were being prepared for the then proposed APA Susitna Hydroelectric Project. Although the PMF study report from the previous study is available, no calculations, model input, or model output are included. This means that preparation of an updated PMF study is required. In addition to the availability of more years of meteorological and streamflow data since the time of the previous PMF study, new PMF guidelines have been developed (FERC 2001) and additional data and more advanced methods are available for development of site-specific PMP.

Development of the PMP and PMF are based on a variety of historical data, including streamflow data, meteorological data, watershed data, and far-field information such as sea surface temperatures and storm patterns. Data availability is anticipated to be adequate for development of the PMP and PMF for Watana Dam.

14.5.3. Study Area

The study area will be the entire watershed tributary to the Watana Dam site, plus the additional drainage area between Watana Dam and the USGS gaging station at Gold Creek. The watershed drainage area is 5,180 square miles at the Watana Dam site and 6,160 square miles at the Gold Creek USGS gage. Extension of the study area to the Gold Creek USGS gage is necessary because this is where a long-term streamflow record is available for calibration and verification of hydrographs for the entire watershed tributary to the Watana Dam site.

14.5.4. Study Methods

The following sections describe the study methods and major tasks necessary to develop the PMP and PMF for Watana Dam.

14.5.4.1. Board of Consultants Review

A BOC will be established for technical review of many aspects of the dam design. The BOC review of the subject studies will be primarily focused on the development of the site-specific PMP but may include other aspects of the PMF study. The BOC will meet and review design progress at appropriate intervals and, if appropriate, will co-opt specialists for particular topic review. The study methods and tasks described herein may be subject to suggested alteration by the BOC.

14.5.4.2. Data Acquisition

A variety of historical recorded meteorological and hydrologic data are necessary to develop the PMP and PMF. Data acquisition should begin at the earliest possible time as some data (e.g., streamflow data on a time increment less than daily) could take months to retrieve. Additionally, the availability and area extent of next-generation radar (NEXRAD) data must be determined for use in a site-specific PMP. The types of data to be collected for storm periods at stations in the vicinity of the study area include, but are not limited to streamflow, precipitation, dry-bulb and wet-bulb temperature, snowpack and snow water equivalent, wind speed, and humidity. Relevant watershed data will also be collected including the drainage area of sub-basins, the area within elevation bands for snowpack and snowmelt estimation, channel slopes, vegetation cover, lake area, and soil types. For the site-specific PMP, information far from the study area may be collected including sea-surface temperatures and synoptic storm information.

14.5.4.3. Historical Data Analysis

Historical data analysis will contribute to the PMP and PMF analysis in several ways, including being used to perform the following tasks:

- determine the major historic storms by analysis of total storm precipitation, intensity, duration, and areal extent;

- summarize historic peak flows for selection of major flood events for model calibration and verification;
- estimate flood frequency up to at least the 100-year flood from historical peak flow data;
- determine the 100-year snowpack and snow water equivalent for various elevation bands;
- develop a basis for antecedent watershed conditions prior to the PMP;
- summarize maximum seasonal temperature conditions; and
- summarize coincident data availability for major storm events.

14.5.4.4. Review of Previous PMF Study Report

In support of the previous design and licensing effort for the APA Susitna Hydroelectric Project, a PMF study was performed (Acres 1982). The 1982 PMF study included developing a site-specific PMP and used generally accepted methods at the time. It is notable that although many new data have become available in the 30-year interim since the previous PMF study, all of the five largest floods of record at the Gold Creek USGS gaging station were available for calibration and verification studies in 1982. Although no calculations or model input and output are available, the 1982 study does contain useful information regarding final results and conclusions of the analysis, including numerous tables and figures. The 1982 PMF study report will be thoroughly reviewed to gain applicable insights to be used in the current PMF study.

14.5.4.5. Field Visit

A field visit is a recommended part of the PMF study (FERC 2001). Observations made during the field visit would include

- Manning's "n" and general hydrologic and hydraulic characteristics of river channels;
- special features within the drainage basin such as marshes, lakes, and closed basins that may delay or reduce runoff;
- constrictions such as bridge abutments that may influence flood routing characteristics;
- large natural constrictions that could act as hydraulic control structures; and
- areas that could result in locally different infiltration rates, including rock exposures, dense forest, or high altitude meadows.

14.5.4.6. Flood Hydrology Model Selection

At least three flood hydrology models are available, and a key task will be to select which to use to develop the PMF. These models include:

- Streamflow Synthesis and Reservoir Routing (SSARR). This model was developed by the U.S. Army Corps of Engineers (USACE), North Pacific Division. The SSARR model was used for the 1982 Susitna PMF study. In addition to its use by the USACE, the SSARR model was used occasionally by consultants for flood simulation on major watersheds, particularly in the Pacific Northwest. The SSARR model is no longer in general use. The latest version of SSARR was modified in 1991 to run on IBM-compatible personal computers. The USACE has noted that there will be no further program updates or modifications to the SSARR files by the USACE, and no user support is available.

- Flood Hydrograph Package (HEC-1). This model was developed by the Hydrologic Engineering Center (HEC) of the USACE and was (possibly still is) the most widely used model in PMF studies. HEC-1 is one of the two rainfall-runoff models recommended for PMF studies (FERC 2001). Compared to other models, HEC-1 has the advantage of including the recommended energy budget snowmelt method as well as fully documented equations for calculating snowmelt in the model.
- Hydrologic Modeling System (HEC-HMS). This model was also developed by the HEC and is the Windows-based successor to HEC-1. HEC-HMS contains many of the same methods as HEC-1 and is the other model recommended for PMF studies (FERC 2001). Snowmelt in the HEC-HMS model is based on a method that uses temperature data only.

Flood hydrology model selection will be reviewed with the BOC. Following input from that review, AEA will propose to use one of the three models.

14.5.4.7. Flood Hydrology Model Initial Setup

The flood hydrology computer model initial setup will include sub-basin delineation, areas in elevation bands for use in snowmelt calculations, lake areas, areas in various soil groups, coincident baseflow, and initial estimates of infiltration rates. Sub-basin delineation will be aligned with USGS stream-gaging station locations whenever possible to facilitate model calibration and verification. River channel geometry will be checked for areas that may warrant special consideration for storage-outflow routing. Topographic mapping will be developed using ArcGIS software.

14.5.4.8. Flood Hydrology Model Calibration and Verification

This task would include calibration and verification of the sub-basin unit hydrographs to the extent that available recorded streamflow and meteorological data allow. Calibration provides the important adjustments to hydrograph parameters that are initially estimated from standard equations or based on experience in similar watersheds. Two of the largest floods on record will be selected for calibration, with a third large historical flood used for verification. The calibration points at the outlets of the sub-basins will coincide with USGS stream-gaging stations to the extent possible. Activities under this task will also include estimating ungaged local runoff as necessary, baseflow separation, and a final estimate of infiltration loss rates.

14.5.4.9. Development of the Site-Specific PMP

The applicable available U.S. Weather Bureau PMP guidance document is *Probable Maximum Precipitation and Rainfall-Frequency Data for Alaska,* Technical Paper No. 47 (Miller 1963). Technical Paper No. 47 is applicable to areas up to 400 square miles and durations up to 24 hours. Because the drainage area at the Watana Dam site is 5,180 square miles and current standards call for the PMP to have a duration of at least 72 hours, development of a site-specific PMP is necessary. The existing PMP studies can be used to make comparisons to the 1982 Susitna site-specific PMP and the Technical Paper No. 47 PMP at the highest-intensity central 400-square-mile area of the new site-specific PMP. Development of the site-specific PMP for the watershed tributary to the proposed Watana Dam site will require a substantially greater effort than is necessary for most other dams in the USA.

The site-specific PMP study will follow many of the methods used to develop the current National Weather Service PMP hydrometeorological reports (HMR). The basic techniques for storm maximization and transposition are well-established. An additional 30 years of data and more advanced models and recent adjustments to methods are now available for development of site-specific PMP. Results will include both a temporal and spatial distribution of the PMP for durations up to 72 hours and guidance for alternative centering of the PMP. NEXRAD data will be used, if available. The site-specific PMP task will also include development of the 100-year precipitation temporal and spatial distribution during a season coincident with the probable maximum snowpack. It is anticipated that a consultant with recent experience in developing site-specific PMP will be retained to perform this task.

14.5.4.10. Coincident Conditions for the PMF

Developing coincident conditions would include the 100-year snowpack, the probable maximum snowpack, necessary temperature sequences, and data for energy budget method as necessary. The 100-year seasonal precipitation will also be developed, because one of the potential combinations of coincident conditions that can result in the PMF is the probable maximum snowpack combined with the seasonally appropriate 100-year precipitation. A determination of the maximum reservoir level during the 50-year flood is also required, as this will become the starting reservoir elevation for spillway operation.

14.5.4.11. Development of the PMF Inflow Hydrograph

The PMF will be developed at the proposed Watana Dam site by combining sub-area runoff and performing channel and reservoir routings for various cases and months. Routing of the PMF through the reservoir will account for use of the fixed-cone outlet valves for discharges up to the 50-year flood and use of the spillway only after the expected maximum level of the 50-year flood has been exceeded. This task also includes a sensitivity analysis to test the effects of variation in parameters with relatively high uncertainty that could potentially have more significant effects on the results. The PMF channel routing would be performed using the selected flood hydrology model.

14.5.4.12. Reservoir Routing of the PMF

Spillway capacity should be determined as part of the economical combination of spillway capacity and surcharge storage. Surcharge storage is defined as the storage between the maximum normal pool level (still water) and the maximum design flood water storage level. Determining the economical combination of surcharge storage/spillway capacity requires evaluation of the cost of increasing spillway capacity versus the cost of raising the dam height to provide the required freeboard (routed maximum flood level plus any required allowance for wind setup and wave run-up). Reservoir flood routing is used to determine the temporal and water level variation of the hydrograph as the flood passes through the reservoir. Increasing the spillway capacity will reduce the necessary surcharge storage (determined by flood routing), thereby lowering the required height of the dam. Alternatives analysis will be performed to optimize spillway capacity and flood surcharge. The PMF reservoir routing would be performed the using the selected flood hydrology model.

14.5.4.13. Freeboard Analysis

Freeboard provides a margin of safety against the potential for overtopping of dams. Freeboard and flood control storage are required to provide the capacity to store and/or route the design storm through the reservoir considering inflows, precipitation on the reservoir basin, and wind generated waves without hazardous overtopping of the dam. Although freeboard selection involves more than simply the PMF water level, the freeboard selection will be made as part of the subject study, based on wind setup, wave action, uncertainties in analytical procedures, and uncertainties in Project function in combination with the most critical pool elevation (USACE 1991). The freeboard determination will be based on site-specific conditions that can be reasonably expected to occur simultaneously. Design criteria will be developed for logical combinations of reservoir levels/precipitation and wind conditions for freeboard determination. Wind setup and wave run-up would be determined with standard methods (USACE 1984 and USACE 2003).

Normal freeboard is defined as the difference in elevation between the top of the dam and the normal maximum pool elevation. Minimum freeboard is defined as the difference in pool elevation between the top of the dam and the maximum reservoir water surface that would result from routing the PMF through the reservoir. It is generally not necessary to prevent splashing or occasional overtopping of a dam by waves under extreme conditions particularly for a concrete dam. If studies demonstrate that the RCC dam can withstand wave overtopping without erosion of foundation or abutment material, then minimum (or no) freeboard will be selected for the PMF condition. In that case, only normal freeboard would be required. The study of freeboard will take into account unusual circumstances.

14.5.4.14. Reporting

Two reports will be prepared, one covering the development of the site-specific PMP, the other an overall PMF report for all aspects of the PMF study, including a summary of the site-specific PMP. The sections of the PMF report would generally follow the outline suggested by FERC for PMF studies (FERC 2001). AEA proposes to submit all reports and supporting information for this study only to the Commission and the Alaska Department of Geological and Geophysical Surveys pursuant to FERC’s Critical Energy Infrastructure Information (CEII) regulations, which are designed to ensure that critical energy infrastructure is protected from security threats. Licensing participants who wish to review this information can request it from FERC pursuant to FERC’s CEII regulations.

14.5.5. Consistency with Generally Accepted Scientific Practice

Accepted standard practices for PMF studies are available in the FERC *Engineering Guidelines*, Chapter 7, “Determination of the Probable Maximum Flood” (FERC 2001). Exceptions taken from these guidelines, if any, will be noted and justified. Hydrologists performing the studies will have prior experience using the FERC guidelines in preparation of other recent previous PMF studies.

Hydrometeorological reports are available and applicable for determining the PMP for most PMF studies in the USA. Because of this, the FERC *Engineering Guidelines*, Chapter 7 do not provide methods for preparation of the site-specific PMP that is necessary for the Watana Dam PMF. A consultant that is experienced in preparation of site-specific PMP under FERC jurisdiction will perform the necessary study. Methods used in preparation of the site-specific PMP are very similar to those used in preparation of the most recent NOAA PMP hydrometeorological reports. The BOC will review the PMF Study with an emphasis on the site-specific PMP.

14.5.6. Schedule

A PMF study is typically a part of the Feasibility Report for a new dam. It is anticipated that the site-specific PMP and PMF study would begin on January 2013 and be completed in December 2013.

14.5.7. Level of Effort and Cost

The estimated level of effort for the study is as follows:

Activity	Effort
Site-Specific Probable Maximum Precipitation	3 full-time person months
Probable Maximum Flood	7 full-time person months
Total	10 full-time person months

This study is estimated to cost up to $700,000.

14.5.8. Literature Cited

Acres, 1982. *Susitna Hydroelectric Project, Feasibility Report*, Volume 4, Appendix A, Hydrological Studies, Final Draft, prepared for the Alaska Power Authority.

Federal Energy Regulatory Commission (FERC), October 1993. *Engineering Guidelines*, Chapter II, Selecting and Accommodating Inflow Design Floods for Dams.

Federal Energy Regulatory Commission (FERC), September 2001. *Engineering Guidelines*, Chapter VIII, Determination of the Probable Maximum Flood.

Federal Energy Regulatory Commission (FERC), May 31, 2012. Letter from Jennifer Hill, Chief, Northwest Branch, Division of Hydropower Licensing, FERC, to Wayne Dyok, Susitna-Watana Project Manager, Alaska Energy Authority.

Miller, John F., 1963. *Probable Maximum Precipitation and Rainfall-Frequency Data for Alaska, Technical Paper No. 47*, U.S. Weather Bureau, Department of Commerce, Washington D.C.

U.S. Army Corps of Engineers (USACE), March 1, 1991. *Inflow Design Floods for Dams and Reservoirs*, ER 1110-8-2(FR).

U.S. Army Corps of Engineers (USACE), 1984. *Shore Protection Manual*, Coastal Engineering Research Center, Waterways Experiment Station, Second Printing.

U.S. Army Corps of Engineers (USACE), July 31, 2003. Coastal Engineering Manual, EM-1110-2-1100, Part II Coastal Hydrodynamics.

14.6. Site Specific Seismic Hazard Evaluation Study

14.6.1. General Description of the Proposed Study

14.6.1.1. Study Goals and Objectives

The goals of this study are to conduct deterministic and probabilistic seismic hazard evaluations to estimate earthquake ground motion parameters at the Project site, assess the risk at the site and the loads that the Project facilities would be subject to during and following seismic events, and propose design criteria for Project facilities and structures considering the risk level. The intent of the study is to fulfill the following specific objectives including, but not limited to the following:

- identify the seismic sources along which future earthquakes are likely to occur, including the potential for reservoir-triggered seismicity;
- characterization of the degree of activity, style of faulting, maximum magnitudes, and recurrence information of each fault;
- develop maps and tables depicting the spatial and geometric relations of the faults and seismic source zones together with specific distance parameters to evaluate ground motion parameters from each source;
- assemble available historical and instrumental seismicity data for the region, including maximum and minimum depth of events;
- determine the distance and orientation of each fault with respect to the site;
- estimate the earthquake ground motions at the proposed dam site, updating previous studies to include changes in practice and methodology since the 1980s;
- propose the seismic design criteria for the site;
- prepare a supporting design report that include the seismic criteria and results of dam stability analysis under seismic loading (this will be addressed as part of the dam analysis, not as part of the initial seismic characterization); and
- use a BOC for independent technical review and guidance during development of site-specific studies.

The FERC study request (FERC 2012) refers to assessing the stability of Project facilities during seismic events and performing a dynamic analysis that identifies any damage caused by the earthquake and shows that the dam can continue to resist applied static loading in the damaged condition with any possible resulting loading changes. This aspect of dam engineering will be carried out during the ongoing analytical phase and design process; it is not proposed that that such dam analyses form part of the initial seismic hazard analysis studies. While the seismic studies are in progress, dam engineering analyses and design will also be in progress and the requirements and initial dam analysis results will be incorporated into the seismic study to the extent necessary before final designs are completed using the results of the seismic studies.

14.6.2. Existing Information and Need for Additional Information

Several geology and seismic characterization studies were conducted for the APA Project in the 1980s. The most important studies relating to the seismic characterization were

- site-specific seismic hazard evaluations, including fault trenching, geologic mapping and age-dating, microseismic network operations, and ground motion evaluations (Woodward Clyde Consultants 1980; and Woodward Clyde Consultants 1982); and
- evaluation of reservoir induced seismicity (RIS) (Harza-Ebasco 1985).

Other associated geological studies of the region and site have included

- regional mapping of surficial deposits (rock and soil) using aerial photography and geologic reconnaissance (Acres 1982a);
- studies of reservoir slope stability (Acres 1982a);
- subsurface explorations through geophysics, borings, test pits, and trenches (USACE 1975; USACE 1979; Acres 1982a; Acres 1982b; Harza-Ebasco 1983, Harza-Ebasco 1984;); and
- laboratory testing of physical and strength properties of rock and soil (USACE 1979; Acres 1981; Acres 1982, Harza-Ebasco 1983; Harza-Ebasco 1984).

These previous studies and site investigations represent a dataset of substantial magnitude that will be beneficial to the proposed studies.

Despite the large amount of data, it is acknowledged that there are data gaps, and thus the proposed studies essentially are an update and expansion of the studies carried out in the 1980s by Woodward Clyde Consultants.

The following examples indicate topics or aspects of the region that will be addressed in the proposed studies:

- Since the 1980s there has been a magnitude 7.9 earthquake on the Denali fault.
- Regional probabilistic seismic hazard maps by the USGS (e.g., Wesson 2007) and the 2008 probabilistic seismic hazard analysis were prepared for the Port of Anchorage.
- The USGS has opined that the Denali fault is fairly well studied, but the Broad Pass fault, a major active thrust fault in the project area, has not been studied. The USGS recommends that information be gathered to verify its existence and characterize its history.

14.6.3. Study Area

The study area for the seismic hazard evaluation is necessarily large in order to include potentially significant seismic sources throughout the region. The study area encompasses subduction-related sources (plate interfaces between the North American and Pacific Plates, which were the source of the 1964 earthquake, and intraslab sources within the down-going Pacific Plate) and all applicable Quaternary crustal seismic sources within about 125 miles (200 kilometers) of the site (Figure 14.6-1). Crustal seismic sources beyond these distances are not expected to provide significant ground motion contributions at the dam site relative to nearby sources. A more focused study area will include the dam site and reservoir areas, and a minimum area defined by an approximately 62-mile (100-kilometer) radius around the proposed dam location. The focused study area will therefore include much of the Talkeetna block and surrounding fault zones such as the Denali; Castle Mountain; Northern Foothills fold and thrust fault zone; Chugach-St Elias Thrust fault; Bruin Bay Fault; and Broad Pass Fault.

14.6.4. Study Methods

14.6.4.1. General

The study methods shall generally be in accordance with Chapter 13 of the FERC Engineering Guidelines for the Evaluation of Hydropower Projects. The site-specific seismic hazard evaluation for assessing the seismic risks and developing the seismic design criteria in support of licensing and detailed design will include of the following tasks:

- update the understanding of geologic conditions and seismo-tectonic setting for the dam site area;
- identify and characterize the seismic source, including detailed geologic studies and lineament analyses;
- perform a deterministic and probabilistic seismic hazard assessment in order to define earthquake ground motions for structural analyses;
- evaluate the potential for Reservoir Triggered Seismicity (RTS) or RIS;
- assess risks to Project structures and operation associated with seismic loading conditions; and
- select appropriate seismic design criteria.

These tasks and the associated study methods will generally be as presented below.

14.6.4.2. Board of Consultants Review

As requested by FERC (FERC 2012), a BOC will be established for technical review of the dam analyses and design. The BOC review will be primarily focused on appropriate aspects of the Seismic Hazard Evaluation, the determination of response spectra, and the crafting of design criteria. The BOC will meet and review study progress at appropriate intervals. The study methods and tasks described herein may be subject to suggested modification by the BOC.

14.6.4.3. Review of Project Documentation

A review will be conducted of the existing documentation, including all available previous applicable Project reports, to characterize the geologic, geotechnical, and seismic conditions in support of feasibility and licensing studies and detailed design so as to take maximum advantage of the large body of knowledge that already exists for the site. Documentation will include work from the studies performed in the 1970s and 1980s. A geologic and geotechnical database will be developed in order to build upon the earlier studies as they pertain to the current Project development.

14.6.4.4. Seismic Hazard Analysis

A deterministic and probabilistic seismic hazard evaluation will be undertaken to update the seismic hazard studies from the 1980s in order characterize the seismic sources, to define the earthquake ground motion parameters, and to develop seismic design criteria for the Project structures. The methods follow general guidance defined according to Chapter 13 of the Federal Energy Regulatory Commission's Engineering Guidelines. Subtasks will include the following:

- Update evaluations of geologic, seismologic, and seismotectonic literature for the Project study area to identify data gaps and uncertainties that may require further evaluations.

- Update seismicity catalogue for evaluation of seismicity rates, depths, magnitudes, and focal mechanisms. This will include evaluation of recent and ongoing data collected by the Alaska Seismographic Network and augmented by the additional seismic stations installed in the Project area as part of the long term earthquake monitoring program.
- Develop a seismotectonic model that identifies and characterizes seismic sources of significance to the Project.
- Conduct geologic studies using newly acquired Light Detection and Ranging (LiDAR) and Interferometric Synthetic Aperture Radar (IFSAR) datasets to aid in the identification and evaluation of potential seismic sources and geohazards.
- Perform Surface Faulting and Geohazard Analysis to evaluate the potential significance of surface faulting and geologic hazards in the area of the Project.
- Conduct Ground Motion Analyses and Assessment to estimate the expected ground motions at the Project facilities using a probabilistic seismic hazard analysis (PSHA) and deterministic seismic hazard analyses (DSHA) based on the seismic source characterization, and FERC guidelines.
- Develop seismic design criteria to develop appropriate seismic design parameters for use in dam analyses and considerations for construction.
- Perform Dynamic Analysis of the dam (in other studies).

Ground motion estimates from the PSHA and DSHA will be developed for a number of critical seismic sources using weighted ground motion prediction equations (GMPE's) appropriate for each source in the analyses. Results from the PSHA analyses will consist of hazard curves for a range of spectral response frequencies, uniform hazard spectra (UHS) for a range of return periods, and deaggregation of seismic source contributions for design-specific return periods and spectral frequencies. The purpose of the deaggregation is to provide parameters for the development of Conditional Mean Spectra (CMS). CMS will be generated using the methodology of Baker (2011). As recommended in FERC guidelines, the CMS will be extended so that the envelope of the CMS for a given return period equals the UHS. Following procedures in FERC guidelines, DSHA results will be compared to the total uniform hazard spectra for use in developing the final design earthquake motions and criteria.

Results of the site-specific seismic hazard assessment studies will documented with Project reports.

14.6.4.5. Long-Term Earthquake Monitoring System

A long-term earthquake monitoring system will be installed for the purpose of continuously monitoring earthquakes that occur in the Project area, both pre- and post-construction, and to record strong shaking of the ground at the Project site during moderate to strong earthquakes. The long-term monitoring system will consist of one 6-component strong motion and broadband seismograph station at the Watana Dam site area and two or three 3-component broadband seismograph stations in the vicinity of the proposed dam site and reservoir area. The seismograph stations will be operated as part of the Alaska Seismographic Network by the University of Alaska. These stations will provide additional resolution on the seismicity rates and characteristics of earthquakes in the Project area.

14.6.4.6. Reservoir Triggered Seismicity

The potential for RTS to occur during and after, filling of the reservoir will be evaluated. This examination of the potential for RTS will include information from the seismic hazard analysis including the potential possibility of “unknown” faults capable of generating strong or major earthquakes close to the site. The attributes that will be considered in evaluating the probability of RTS include reservoir depth; reservoir volume; the tectonic stress state; and the rock type and structure underlying the reservoir. The probabilities that are considered are conditional and represent the total chance for RTS to occur as a result of reservoir filling and operation. Conditional probabilities will be developed for each attribute, as well as for all attributes combined. For the multi-attribute analysis, each attribute will be considered independently and also in a discrete-dependent model focusing on depth and volume.

Additionally, a literature review, case study, and statistical analysis will be performed of RTS based on other projects with large, deep reservoirs in order to develop an understanding of the potential of RTS at the Susitna-Watana site.

The long-term earthquake monitoring system will provide a baseline of the rates and seismological characteristics of local seismic events prior to the impoundment of the reservoir. Seismicity data collected before and after installation of the long-term monitoring system will be used to perform seismological analyses to help define local seismotectonic characteristics. Such analyses would include activities such as development of local velocity models, focal mechanism and regional stress analysis, analysis of spatial patterns, and relationship of seismicity to reservoir operation. The ultimate purpose of this study is to assure that possible RTS earthquakes are accounted for by the dam seismic design parameters.

14.6.4.7. Reservoir Slope Stability Study

An assessment will be made of the reservoir rim stability based on the geologic conditions in the reservoir area, particularly in the reservoir drawdown zone. Geologic information from the previous study on reservoir slope stability (1982), as well as mapping, geotechnical investigations, and instrumentation monitoring will be used to assess the stability concerns of the reservoir rim not only under drawdown but also from seismic loads. Key factors in this study are the planned reservoir level and anticipated range of drawdown, soil conditions, presence of permafrost, topography and slope conditions.

14.6.4.8. Engineering Analysis

A dynamic analysis will be performed (separately under the engineering studies and design) to identify the performance of the major hydraulic structures under earthquake loading conditions. The analyses will optimize the design of the structures, assessing the potential damage that may occur during an earthquake event, and verify that the dam can continue safe operation in a damaged state until any necessary repairs are performed.

14.6.4.9 Reporting

Several technical reports will be prepared for each stage for the study for the BOC. A summary report will be prepared for the Initial Study Report and Updated Study Report. . AEA proposes to submit technical reports and all supporting information for this study only to the BOC, Commission and the Alaska Department of Geological and Geophysical Surveys pursuant to

FERC's Critical Energy Infrastructure Information (CEII) regulations, which are designed to ensure that critical energy infrastructure is protected from security threats. Licensing participants who wish to review this information can request it from FERC pursuant to FERC's CEII regulations.

14.6.5. Consistency with Generally Accepted Scientific Practice

The seismic hazard analyses and development of seismic design criteria will be performed in accordance with general industry accepted scientific and engineering practices, following the guidance and procedures outlined in FERC Chapter 13. Each task will be performed by technical experts in their field of study. To further check that each task complies with accepted scientific practice, each task will be peer reviewed by senior technical experts, reviewed by external reviewers (e.g., BOC) and approved by an appropriate AEA representative.

Independent senior technical staff and industry consultants will review the appropriateness of the field investigations and testing, seismic source characterization, deterministic and probabilistic seismic hazard assessment, selection of appropriate ground motions at the site and determination of critical seismic design criteria and decisions. Several working sessions and site visits will be scheduled to review the results of the field investigations and testing, characterize the seismic source, assess seismic hazards, select earthquake ground motions, perform a dynamic analysis, and determine design criteria and assumptions.

14.6.6. Schedule

The proposed study plan includes a limited field investigation program in 2012 for aerial photographic interpretation, reconnaissance geologic mapping, lineament analysis, installation of a long-term earthquake monitoring system, assessment of slope stability for the reservoir rim, and reservoir triggered seismicity study. For 2013-14, a field program is envisioned for investigating significant seismic sources or features and continuing collection of microseismic and strong motion data with the long-term earthquake monitoring system.

Deterministic and probabilistic seismic hazard assessment and engineering analysis will be performed through the 2012-2014 time period. A summary of the studies and results will be provided in the Initial Study Report in December 2013 and Updated Study Report in December 2014.

14.6.7. Level of Effort and Cost

The level of effort for the studies outlined in this document, using a phased multiple year approach is estimated to be in excess of 50 person-months or approximately $1.5 million.

14.6.8. Literature Cited

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14.6.9. Figures

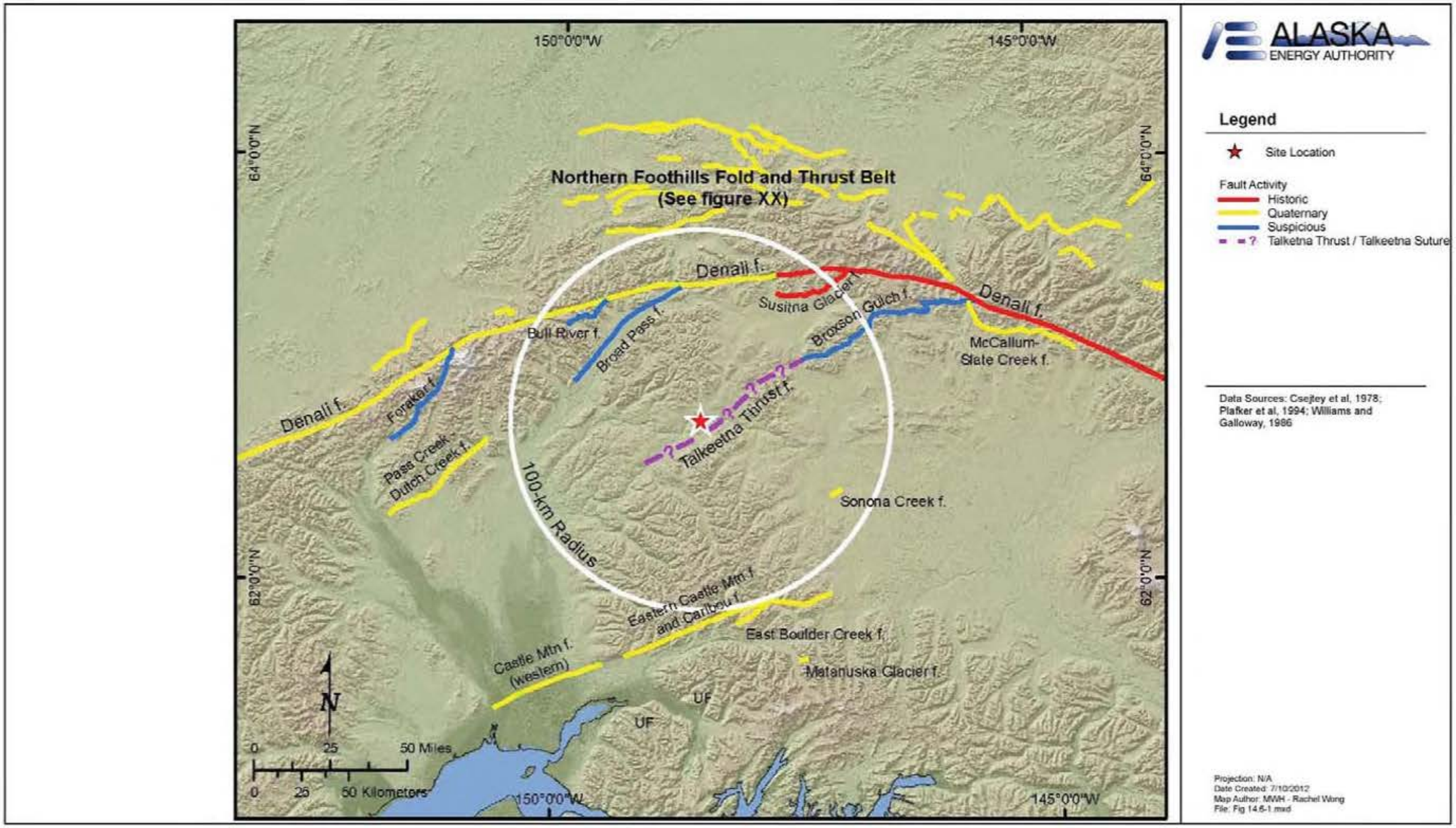

Figure 14.6-1. Regional Faults (Csejtey et al, 1978; Plafker et al, 1994; Williams and Galloway, 1986).