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Susitna-Watana Hydroelectric Project Document
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Title: Pre-application document : Susitna-Watana Hydroelectric Project, FERC No. 14241	**SuWa 83**
Author(s) – Personal:	
Author(s) – Corporate: Alaska Energy Authority	
AEA-identified category, if specified: Volume I (notification of intent and pre-application document). Volume II (pre-application document appendices).	
AEA-identified series, if specified:	
Series (ARLIS-assigned report number): Susitna-Watana Hydroelectric Project document number 83	**Existing numbers on document:**
Published by: [Anchorage, Alaska : Alaska Energy Authority, 2011]	**Date published:** December 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:** 2 vols.
Related work(s):	**Pages added/changed by ARLIS:**
Notes: Includes: (1) cover letter with distribution list attachment, and (2) Notice of intent to file application for original license and request for designation as non-federal representative and for authorization to initiate consultation under Section 106 of the National Historic Preservation Act.	

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SUSITNA-WATANA HYDRO

Pre-Application Document

Susitna-Watana Hydroelectric Project

FERC Project No. 14241

Alaska Energy Authority

December 2011

VOLUME I OF II

EXECUTIVE SUMMARY

The Alaska Energy Authority (AEA) is filing this Notice of Intent (NOI) and Pre-Application Document (PAD) with the Federal Energy Regulatory Commission (FERC, or Commission) for an original license for the Susitna-Watana Hydroelectric Project, FERC No. 14241 ("Susitna-Watana Project", or "Project"). 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 miles (mi) upstream of Devils Canyon. Transmission lines connecting into the existing Railbelt transmission system and an access road would also be constructed. The FERC License Application is scheduled for filing on or about September 2015.

Organization of the PAD

This PAD contains the following information, as required under Title 18 of the Code of Federal Regulations (CFR 18), § 5.6, which provides FERC's licensing regulations governing major hydroelectric projects:

> **Section 1 – Introduction**, provides a brief overview of the proposed Project and the contents of this PAD;
>
> **Section 2 – Process Plan, Schedule, and Communications Protocol**, provides a description and schedule of the FERC licensing process and AEA's intended approach to communications with stakeholders and record keeping during that process;
>
> **Section 3 – Project Location, Facilities, and Operation**, describes in detail the proposed facilities and their operational characteristics in terms of reservoir levels, power output, plant discharges, etc, and a proposed timetable for Project development;
>
> **Section 4 – Description of Existing Environment and Resource Impacts**, provides information about the Project area, and a description of the affected environment in terms of the various resources to be studied, and impacts to be assessed as part of the FERC licensing effort; references to sources of information or relevant studies are provided at the end of each resources section;
>
> **Section 5 – Preliminary Issues and Studies List**, identifies issues that may be important to the assessment of Project impacts and provides an initial list of potential studies, along with an indication as to possible resource impact mechanisms and mitigation approaches;
>
> **Section 6 – Summary of Contacts**, provides information documenting resource agency and key stakeholder communications that have taken place during the formulation of this PAD;
>
> **Appendices**, contain selected environmental data, site photographs, and other information compiled either during the 1980's or more recently, and deemed relevant to

the understanding of the proposed Project and its potential impacts on a number of key resources.

Background

A larger scale "Susitna Hydroelectric Project" was proposed by the Alaska Power Authority (AEA's prior name) in the early 1980s (FERC Project No. 7114). That Project was to be composed of two major dams (the Watana Dam and Devils Canyon Dam) constructed in three stages over a period of two decades, to serve the growing electricity needs in the Railbelt (Southcentral) region. The state conducted extensive engineering and environmental studies and filed an application for license with FERC; FERC prepared a draft Environmental Impact Statement (EIS). Despite the extensive work that was conducted at the time, development efforts were halted in 1986 because of a significant reduction in oil prices leading to a drop in State revenue, coupled with discovery of large quantities of low cost, stranded gas in the Cook Inlet area. As explained below, the situation has changed since 1986 and the State and Railbelt utilities have determined there is a present need for the Project. The currently proposed Susitna-Watana Project will be constructed at the same location as the former Alaska Power Authority Susitna Project's Watana development, although smaller. It does not include a Devils Canyon development.

When the prior project ended, APA had just completed preparation of a draft amendment to its previous license application (dated 1985) and closed the project out by preparing an extensive index and bibliography of documents. This record provides a wealth of useful information relevant to the planning and licensing of the current AEA proposed Project.

Future Railbelt Energy Needs

Much of the generation and transmission infrastructure of the Railbelt region of Alaska is aging and is at or near its time for replacement. The Railbelt is generally defined as the service areas of six regulated public utilities: Anchorage Municipal Light & Power (ML&P), Chugach Electric Association (Chugach), Golden Valley Electric Association (GVEA), Homer Electric Association (HEA), Matanuska Electric Association (MEA), and the City of Seward Electric System (SES). This region covers a significant area of the State and contains the majority of the State's population and economic activity; it extends from Homer to Fairbanks and includes major metropolitan areas such as Anchorage, Fairbanks, and the Mat-Su Valley.

Even if very low future electricity demand increases are assumed for the Railbelt region, retirement of older generating units will require substantial new generation capacity to be constructed over the next two decades to meet demands and provide system reserves. Concern over both the future cost and supply of fuel for generation in Southcentral and Interior Alaska, and the projected high capital costs of new projects, caused the State Legislature in 2008 to task AEA with developing a Regional Integrated Resource Plan (RIRP) and reevaluating hydroelectric power from the Susitna River.

The 2010 RIRP is a long range conceptual generation and transmission plan for the Railbelt to minimize future power supply costs, and maintain or improve on current levels of power supply reliability. The intent of the RIRP was to include a diverse portfolio of power supply, and reliable, stable priced electrical energy for the 50 year planning horizon.

In 2010, the Alaska State Legislature passed legislation establishing a State energy policy and expressing intent that the State obtains 50 percent of its electrical generation from renewable and alternative energy sources by 2025. Hydropower currently provides approximately 19 percent of the electrical energy used in Alaska (11 percent in the Railbelt). While the situation continues to change on an annual basis, the RIRP studies concluded that the Railbelt could not achieve the 50 percent renewable goal without a new, large hydroelectric project.

The 2010 Legislature provided funding to AEA for the preliminary planning, conceptual design, and start of permitting and field work for hydroelectric projects along the Railbelt. In November, 2010, the AEA issued a Preliminary Decision Document (PDD) determining that the Susitna Hydroelectric Project – identified as the Watana site on the Upper Susitna River – was to be the primary large hydroelectric project for the State to pursue to help meet the State's renewable energy resources goals. The PDD recommended that engineering and environmental studies be conducted for the Susitna-Watana Project. The significant amount of winter reservoir storage provided by the Project would enable it to provide needed firm energy during the critical winter months when electricity demands are highest. It would reduce natural gas deliverability problems, increase generation diversity, and the new generation supplied would also help to replace older generation which will be retired prior to Project completion. In addition, it would make a substantial contribution to the State's goal of 50 percent renewable electrical generation.

The AEA is currently working with the Railbelt utilites to update the previous RIRP in order to reflect changes in planned unit additions and retirements for the utilities that were assumed in the initial modeling. The Susitna-Watana Project is a key resource that is factored into individual Railbelt utilities' expansion plans as a resource available to meet projected electrical loads in the 2023-2025 time frame. In conjunction with the RIRP update, additional transmission system stability and reliability modeling is planned for early 2012. Results from both of these activities will provide input to future Project sizing studies, finalization of design and operational parameters for the Susitna-Watana Project, and determination of how the Project will best integrate into the Railbelt electrical system.

Description of the Proposed Project

The AEA initiated studies of the Susitna-Watana Hydroelectric Project in January 2011. The proposed Project would be located on the Susitna River at RM 184, which is roughly 90 river miles northeast of the community of Talkeetna. As currently envisioned, the project would include a large dam with a 20,000-acre (ac), 39-mi long reservoir. The type and height of dam construction are still being evaluated as part of on-going 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 studies mentioned above, a nominal crest elevation up to El. 2,125 ft msl may be proposed in the license application, corresponding to a maximum dam height of up to 800 ft above the foundation. Preliminary studies have indicated the surface powerhouse should have three generating units and have a nominal installed capacity of 600 megawatts (MW). However, optimization studies are ongoing and the capacity of the Project eventually proposed for licensing could extend up to 800 MW. The sizing and number of units may change as a result of further transmission system studies. The unit size may be as low as 100 MW to ensure Railbelt electrical system reliability.

The Project has three possible alternatives for access roads and transmission lines. 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.

The current plan is 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 this, the reservoir would be drafted annually by an average of about 120 ft; the maximum annual drawdown would be approximately 150 ft, and this would occur about once in 50 years. 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. 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.

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. The Project would produce an average of about 250 MW of firm power capacity from November through April but the output could vary from about 100 MW to 500 MW for shorter durations. Approximately 44 percent of the Project's energy output, 1,100,000 MWh, would be delivered to meet electrical load demands during the months of November through April, when Railbelt electricity needs are at their highest levels.

1980s Studies and Current Gap Analyses

In the early 1980s extensive environmental, geological, engineering and economic studies were conducted, and APA completed a feasibility report for a three-stage hydroelectric development on the Susitna River. However as noted above, development efforts were halted in 1986, and no further work was performed until 2008 when the project was rekindled by the State of Alaska. An extensive body of studies was documented during the 1980s, including more than 3,500 individual study reports. This information is archived along with the APA index and bibliography, by the Alaska Resource Library Information System (ARLIS). The most relevant data and reports have been recovered and reviewed by AEA and its consultants in order to identify data gaps, and assess the validity of this earlier planning effort for use in current Project evaluations. Data gap analyses have been completed in the areas of aquatic resources, wildlife resources, cultural resources, subsistence and recreation and socioeconomics. These gap analyses are helping to inform AEA regarding the extent to which additional studies to support an updated environmental analysis and subsequent FERC license application are needed.

Overview of FERC's Integrated Licensing Process

AEA is embarking on its formal licensing process starting with the filing of its Notice of Intent and this Pre-Application Document. AEA has determined it would not seek any early waivers and would follow the Integrated Licensing Process (ILP) as the most appropriate licensing process for the Susitna-Watana Hydroelectric Project. The reasons for this include the ILP's defined structure and timeframes, formal study plan determination, and early NEPA scoping. AEA intends, moreover, to offer ample opportunities for public and agency input throughout the process, and has already followed this approach by initiating informal consultation with resource agencies and the public before filing of the Notice of Intent and Pre-Application Document.

There are a variety of engineering feasibility, geotechnical, and environmental studies currently underway. Many other studies and information gathering activities are now being planned. It is expected that licensing could take up to five to six years to complete, however AEA is looking for ways to expedite the timelines for planning, design, and construction of this Project in order to comply with Legislative energy goals and help stabilize long term energy supply for the Railbelt. The ILP culminating in a licensing decision by FERC, as well as the process of obtaining other regulatory approvals, would comprise the first six years of the development schedule. License implementation and construction would take an estimated five to six additional years as shown in the ensuing diagram.

Under the ILP, upon completion of NEPA scoping, the applicant must file a Proposed Study Plan (PSP) that includes detailed plans for each study it proposes to perform. For the Susitna-Watana Project this PSP is currently being drafted, and is slated for filing in June 2012. Prior to completion of the PSP, AEA will engage stakeholders in workgroups centered on aquatic resources, water resources, terrestrial resources, and social sciences disciplines including a cultural resources workgroup in order to inform development of the PSP.

Within 30 days from completion of the PSP, AEA will hold a formal study plan meeting, and subsequent workgroup meetings open to all interested participants who may file comments on the PSP. AEA will then file a Revised Study Plan; and absent any formal disputes, FERC will approve the Study Plan on or about November 29, 2012, directing AEA to perform the studies FERC determines necessary and appropriate.

At the conclusion of each field study season, AEA will file a Study Report with FERC that describes the progress in performing the studies, and identifies any variances and modifications, including the potential need for new studies. All interested parties have an opportunity to collaborate with AEA to discuss each report and file comments with FERC before FERC makes a determination regarding any proposed modifications. The final Pre-Application activity phase will commence when AEA files either a Draft License Application or a Preliminary Licensing Proposal (PLP), followed by a Final License Application (FLA). Interested parties will have 90 days to file comments on the PLP or Draft License Application.

Post-Filing activities for the Project will commence once AEA files its FLA and FERC tenders the application. During the Post-Filing activities FERC will: 1) determine if the application is complete and ready for processing, and request additional information from AEA if needed; 2) prepare an Environmental Impact Statement (EIS) consistent with NEPA; and 3) make a decision on issuance of the license, including license terms and conditions deemed appropriate under the Federal Power Act and other federal laws. In this process the public is notified and allowed to participate through commenting on FERC's NEPA document.

In summary, for the Susitna-Watana Project members of the public can expect to have multiple opportunities to participate in the licensing process through:

- Getting placed on mailing lists and accessing licensing information through each stage of the process.
- Providing written comments to FERC and all other parties at any time documenting concerns with, or support for the Project.
- Providing oral comments and asking questions of FERC staff and AEA at public scoping meetings, site visits, and in other technical meetings.
- Submitting study requests and participating in workgroups during study plan development.

AEA will utilize its licensing website *http://www.susitna-watanahydro.org* to keep stakeholders apprised of these opportunities throughout the licensing process. Interested parties should check the website regularly for updates or new information or events.

Key Resource Issues and Potential Impacts

Based on review of existing information, data gap analyses and preliminary discussions with agencies and other stakeholders ("licensing participants"), AEA has identified a number of potential issues for the Project licensing. The issues for each resource area, and the corresponding study needs, are described in Section 5 and are described briefly below. This listing identifies the high-level preliminary issue topics that will continue to be developed and refined through the ILP and preparation of the Study Plan for the Project. Some topics may drop out and other topics may be added.

The identified study needs indicate those studies that AEA currently anticipates including in its PSP, to be filed in June 2012 in accordance with requirements of FERC's ILP. The PSP will present detailed scope, objectives, and methodologies for each proposed study. AEA intends to hold a series of resource workgroup meetings through the formal study planning phase in 2012 to facilitate consultation with licensing participants on development of the study designs for inclusion in the PSP and subsequently the Revised Study Plan (RSP). The study designs will maximize the use of data from the earlier proposed APA Susitna Hydroelectric Project.

The Susitna-Watana Project would be located in a remote region of Alaska with abundant natural resources. As such, it can be expected that it will have certain impacts on these resources both during its construction and over the long-term operation. Some impacts may be beneficial and others may be adverse. Issues to be evaluated and potential Project-related impacts will likely include the following, among others:

- **Geology and Soils Issues**, covering direct short-term effects of construction activities on the landscape as well as long-term effects of project operation, including altered river flows and reservoir fluctuations. Potential impacts to be analyzed may include reservoir induced seismicity, reservoir bank instability, sediment transport blockage, surface soil erosion, and downstream river channel aggradation and other morphological changes affecting habitat quality.
- **Water Resources Issues**, covering flow timing and quantity changes, river ice formation, and changes in downstream flows and water levels. Potential impacts to the resources described below would result from changes in the natural river flow regime below the dam and the change from a free-flowing river to a reservoir for 39 miles.
- **Water Quality Issues**, including effects of Project construction and long-term operation on key water quality parameters such as turbidity, temperature, dissolved solids, nutrients, and dissolved gas. Potential impacts might involve changes in water temperature affecting aquatic species and overall water quality changes impacting aquatic and terrestrial habitats. It is possible a reduction in turbidity downstream of the dam could be a benefit to some fishery resources.
- **Geomorphology Issues**, covering sediment transport, changes in upstream and downstream river channel morphology and shoreline erosion. Potential impacts might involve changes in aquatic habitat in the middle and lower Susitna River, changes in spawning due to altered river morphology, and reduced sediment loading and woody debris as a result of dam construction blocking transport.
- **Fisheries Resource Issues**, including changes to aquatic habitats, evaluation of fish distribution, composition, and abundance, impacts related to fluctuating river flows, fish

migration considerations, instream flow requirements, and impacts to special status species. Potential changes might include enhanced quality of downstream habitat through moderation of natural high flows. There may also be changes to riverine habitat, varying access to spawning sloughs, and impediments to salmon migration.

- **Wildlife Resource Issues**, including alteration and/or loss of habitat, effects of the reservoir, roads and transmission lines on wildlife movement and migration patterns, potential increased mortality, and impacts to special status species. Potential impacts might include loss of habitats, habitat degradation, hazards/barriers to animal movements and migration, and effects of an expected gradual increase in human use of the area due to increased access. There could also be adverse effects on rare, threatened and endangered (RTE) animal species from habitat alterations.
- **Botanical Resource Issues**, including changes to vegetation, wetlands, and riparian assemblages, and potential impacts to special status species. Potential impacts might include loss of wetlands and riparian habitats from construction of the reservoir and other project features, and from changes in the natural, historic river flow patterns. Although there are no ESA-listed plant species, there is a potential for adverse effects on rare or sensitive species if they are found in the Project area.
- **Recreation, Land Use and Aesthetic Issues**, including direct short-term effects of construction activities as well as long-term effects of Project operation, including altered river flows and reservoir fluctuations. Potential impacts might include changes in river access and downstream navigation during certain periods, winter use of the river corridor, effects on fishing, hunting and trapping opportunities, changes in future land use and ownership due to increased access to the area, visibility of the dam, powerhouse, roads and transmission lines from important viewpoints, and visual effects of fluctuating reservoir elevations throughout the year.
- **Cultural Resource Issues**, covering construction and operation effects on cultural resource sites, including prehistoric, protohistoric or historic properties. Potential impacts might include inadvertent site damage or alteration during Project construction, vandalism, inundation of known sites by the reservoir, and adverse effects of increased human use on traditional spiritual areas. Aesthetic changes to a surrounding historic landscape may also affect the historic and cultural significance of a property.
- **Subsistence Resource Issues**, covering changes in subsistence fishing and hunting opportunities due to Project-related effects on fish and wildlife populations. Subsistence activities would be affected if there was a change in animal populations, or distribution of animals, if the Project changed access to subsistence resources, or if it disrupted traditional subsistence activities.
- **Socioeconomic and Transportation Resource Issues**, including those related to Project construction activities and long-term operation. Potential impacts might include demands on resources and local economic effects of a large construction workforce rapidly being mobilized and then demobilized when construction is completed, increased visitation to the area both during construction and as a result of the Project’s presence, and secondary land development impacts on the area’s economy. Potential beneficial effects include creation of jobs, increased economic activity, and long-term lower cost electricity.

Potential Resource Protection Measures (Environmental Commitments)

The AEA is committed to mitigating adverse impacts of the Project and providing enhancements to environmental resources when possible. As part of its FERC Licensing Proposal the AEA will work toward development of comprehensive resource management plans for protection and enhancement of environmental resources including:

- Sediment and Erosion Control Plan
- Revegetation Plan
- Historic Properties Management Plan
- Instream Flow Release Plan
- Recreation Development and Management Plan
- Road and Access Management Plan

In addition, resource protection and enhancement measures will be an important aspect of Project planning and design efforts. Measures already under consideration include:

- Using best management practices (BMPs) to minimize or prevent adverse impacts associated with Project construction activities.
- Avoiding impacts through designing Project features or scheduling construction activities to prevent loss of resources.
- Minimizing impacts on river habitat by controlling and managing power plant flow releases to maintain spawning habitats.
- Rectifying fisheries impacts by restoring disturbed areas to provide fish habitat and reestablishing fish in restored areas.
- Reducing or eliminating impacts over time through monitoring, maintenance, and proper training of Project personnel.
- Rehabilitating altered habitat where possible or managing resources on Project or nearby public lands to increase habitat value.
- Prohibiting public access to the Project area during construction, and prohibiting hunting, fishing, and trapping by employees and their families in the Project area during construction.
- Adjusting site access roads to avoid site-specific habitat loss or disturbance of wildlife.
- Implementing waste-control measures, educational measures, and strict enforcement of state regulations prohibiting intentional feeding to avoid creating attractive nuisances that result in the destruction of animals.
- Adjusting placement of the Watana construction camp and permanent housing sites to avoid habitat loss and disturbance of spring brown bear and fall moose concentration areas near Tsusena Butte.
- Minimizing wetland impacts from project construction by minimizing volume requirements for borrow extraction, which would reduce the overall project footprint.
- Using local borrow and quarry sites near the Watana dam construction area to minimize the length of haul roads and centralizing areas of disturbance.
- Designing, siting, and aligning all facilities to avoid wetlands to the maximum extent feasible.

- Marking private property and educating workers on avoiding private property without permission.
- Consolidating structures to minimize the amount of disturbance and need for rehabilitation and site facilities to minimize vegetative clearing.
- Developing and implementing soil erosion control and revegetation plans.
- Screening material borrow sites from significant view corridors where practical.
- Transmission line routing to minimize views of transmission line.
- Developing cultural resource protection, mitigation and enhancement measures in consultation with the appropriate agencies and entities to ensure effective resource management and recovery; include avoidance; preservation in place; data recovery; monitoring; and a public interpretation and education program.
- Developing protection measures for archaeological resources in accordance with the basic principles contained in the Advisory Council on Historic Preservation's "Recommended Approach for Consultation on Recovery of Significant Information from Archaeological Sites".
- Avoiding large and rapid population influxes into communities, especially small local communities.
- Avoiding large traffic increases on the Denali and Parks Highways. This will help prevent increases in traffic accidents and animal road kills.
- Providing housing and related facilities for Project workers located near the Project construction site, in order to avoid large population influxes into nearby communities.
- Developing and implementing an Impact Management Program to reduce adverse socioeconomic impacts caused by the Project.

Early Start 2012 Studies

Following is a list of studies proposed to start in early 2012. The AEA is proposing to start these studies early for a number of reasons. It will take almost a year from issuance of the PAD to FERC's Study Plan approval. This is a year of potential environmental data collection that will be lost if AEA waits for FERC's Study Plan Determination to start collecting data. This additional year of data collection is critical for some of the studies. In addition, obtaining the information in 2012 will help inform and focus the Study Plan . Starting early would also be useful if the weather, runoff, or other environmental factors result in abnormal conditions in subsequent years.

Fisheries:

- Synthesis of Existing Fish Data
- Susitna River Salmon Run Apportionment Study
- Middle River Habitat Utilization Study
- Study of Chinook Salmon Presence Above Devils Canyon
- Instream Flow Planning Study

Water Quantity and Quality:

- HEC ResSim Model Development
- Collection of Cross-Sectional Transect Data in Middle and Lower River Reaches
- Review of Existing Water Temperature Data and Models
- Documentation of Susitina River Ice Breakup and Formation

Sediment Transport and Geomorphology:

- Determination of Bedload and Suspended Sediment Loads at Selected River Gaging Stations
- Geomorphic Assessment of the Middle River Reach Using Aerial Photos

Wildlife Studies:

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

Botanical Studies:

- Vegetation and Wildlife Habitat Mapping Study
- Wetland Mapping Study

There will also be ongoing information gathering in the areas of Cultural Resources and Recreation during the 2012 study season.

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APPENDICES (SEE VOLUME II)

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND SCIENTIFIC LABELS

ABBREV.	DEFINITION
AAC	Alaska Administrative Code
AC	Alternating current
ACHP	Advisory Council on Historic Preservation
acre-feet	Ac-ft
ACS	American Community Survey
ACSR	Aluminum conductor steel reinforced
AD	*Anno Domini*
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
AEIDC	Arctic Environmental Information and Data Center
AFB	Air Force Base
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
AP	Acid potential
APA	Alaska Power Authority
APE	Area of potential effect
APLICs	Alaska Public Lands Information Centers
ARRC	Alaska Railroad Corporation
AS	Alaska Statutes
ASCP	Alaska Shorebird Conservation Plan
ASG	Alaska Shorebird Group
AST	Alaska State Trooper
ASTM	American Society for Testing and Materials
ATV	All-terrain vehicle

AVC	Alaska Vegetation Classification
BCC	Birds of conservation concern
BDPs	Best development practices
BIA	U.S. Department of the Interior, Bureau of Indian Affairs
BLM	U.S. Department of the Interior, Bureau of Land Management
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
BPLUD	Mat-Su Borough Planning and Land Use Department
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
CO	Carbon monoxide
COY	Cubs of the year
CSIS	ADF&G Community Subsistence Information System
DBSD	Denali Borough School District
DC	Direct current
DCCED	Alaska Department of Commerce, Community, and Economic Development
DEED	Alaska Department of Education and Early Development
DHHS	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
et al.	"*et alia*"; and the rest
FAA	Federal Aviation Administration
ft	Feet
ft MSL	Feet Mean sea level
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHA	USDOT Federal Highway Administration
FMP	Fishery Management Plan
fps	Feet per second
FR	Federal Register
FS	Featured species
FSA	Fire Service Area
FY	Fiscal Year
g	Gram
G2G	Government-to-government
GIS	Geographic Information System
GMP	General Management Plan
GMU	Game Management Unit
GPS	Global positioning system
GU	Globally unrankable
GVEA	Golden Valley Electric Association
HDR	HDR Alaska, Inc.; HDR, Inc.
HEA	Homer Electric Association
HRA	Historical Research Associates

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
KABATA	Knik Arm Bridge and Toll Authority
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 stakeholders
LRTP	Long Range Transportation Plan
LOEL	Lowest Observable Effect Level
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
M.S.	Master of Science

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
n.d.	No date
NCM	Newton Centimeter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLCD	National Land Cover Dataset
NLUR	Northern Land Use Research
NMFS	NOAA National Marine Fisheries Service
No.	Number
NO2; NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOEL	No Observed Effects Level
NOI	Notice of intent
NPCA	National Parks Conservation Authority
NPS	U.S. Department of the Interior, National Park Service
NRC	Natural Resources Consulting
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

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
PL	Public Law
PLC	Programmable logic controller
PLP	Preliminary license 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
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)
SHP	APA Susitna Hydroelectric Project
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
SWHP	Susitna-Watana Hydroelectric Project
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
UAAES	University of Alaska Agriculture Experiment Station
UAFAFES	University of Alaska Fairbanks Agricultural and Forestry Experiment Station
UCG	Underground coal gasification
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	USDOI, Fish and Wildlife Service
USGS	USDOI, 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
WDFW	Washington Department of Fish and Wildlife
WSR	Wild and Scenic River
yd	Yard(s)
^{14}C	Carbon 14
ºC	Degrees Celsius
ºF	Degrees Fahrenheit
µg	Microgram
µg/L	Micrograms per liter
$\mu g/m^3$	Microgram per cubic meter
µL	Microliter(s)

1. INTRODUCTION

The Alaska Energy Authority (AEA) is a public corporation of the State whose mission is to reduce the costs of energy to Alaska. AEA is filing this Notice of Intent (NOI) and Pre-Application Document (PAD) with the Federal Energy Regulatory Commission (FERC) for an original license for the Susitna-Watana Hydroelectric Project, FERC No. 14241 ("Susitna-Watana Project", or "Project"). The proposed Project would include construction of a dam, reservoir, and power plant on the Susitna River at river mile (RM) 184, approximately 30 mi upstream of Devils Canyon.

A Susitna Hydroelectric Project was formerly proposed by the Alaska Power Authority (now AEA) in the early 1980s (FERC No. 7114). That Project was to be composed of two major dams (the Watana Dam and Devils Canyon Dam) constructed in three stages, although it was never licensed or built. A draft Environmental Impact Statement was prepared by FERC but development efforts were halted in 1986 because of a significant reduction in oil prices leading to a drop in State revenue and discovery of large quantities of low cost stranded gas in the Cook Inlet area. The currently proposed Susitna-Watana Project dam is located at the same location as the former Susitna Project's Watana Dam site, although it is smaller and the project does not include a Devils Canyon development. The Project would provide energy to the Railbelt region of Alaska. The Railbelt region is generally defined as the service areas of six regulated public utilities, including: Anchorage Municipal Light & Power (ML&P), Chugach Electric Association (Chugach), Golden Valley Electric Association (GVEA), Homer Electric Association (HEA), Matanuska Electric Association (MEA), and the City of Seward Electrical System (SES). The Railbelt region contains the majority of the State population and economic activity.

1.1. Project Need

Much of the generation and transmission infrastructure of the Railbelt is aging and in need ofreplacement. Even at very low energy demand increases on the Railbelt the retiring of older generation will require substantial new generation capacity 10 to 20 years from now. Several Railbelt utilities have included the Project in their long-term generation plans.

Concern over both the future cost and supply of fuel for Southcentral and Interior Alaska generation as well as the projected capital costs of projects caused the Alaska State Legislature in 2008 to task AEA with developing a Regional Integrated Resource Plan (RIRP) and reevaluating hydroelectric power from the Susitna River.

The 2010 AEA RIRP is a long range conceptual generation and transmission plan for the Railbelt to minimize future power supply costs, and maintain or improve on current levels of power supply reliability. The intent of the RIRP was to include a diverse portfolio of power supply, and reliable, stable priced electrical energy for the 50-year planning horizon.

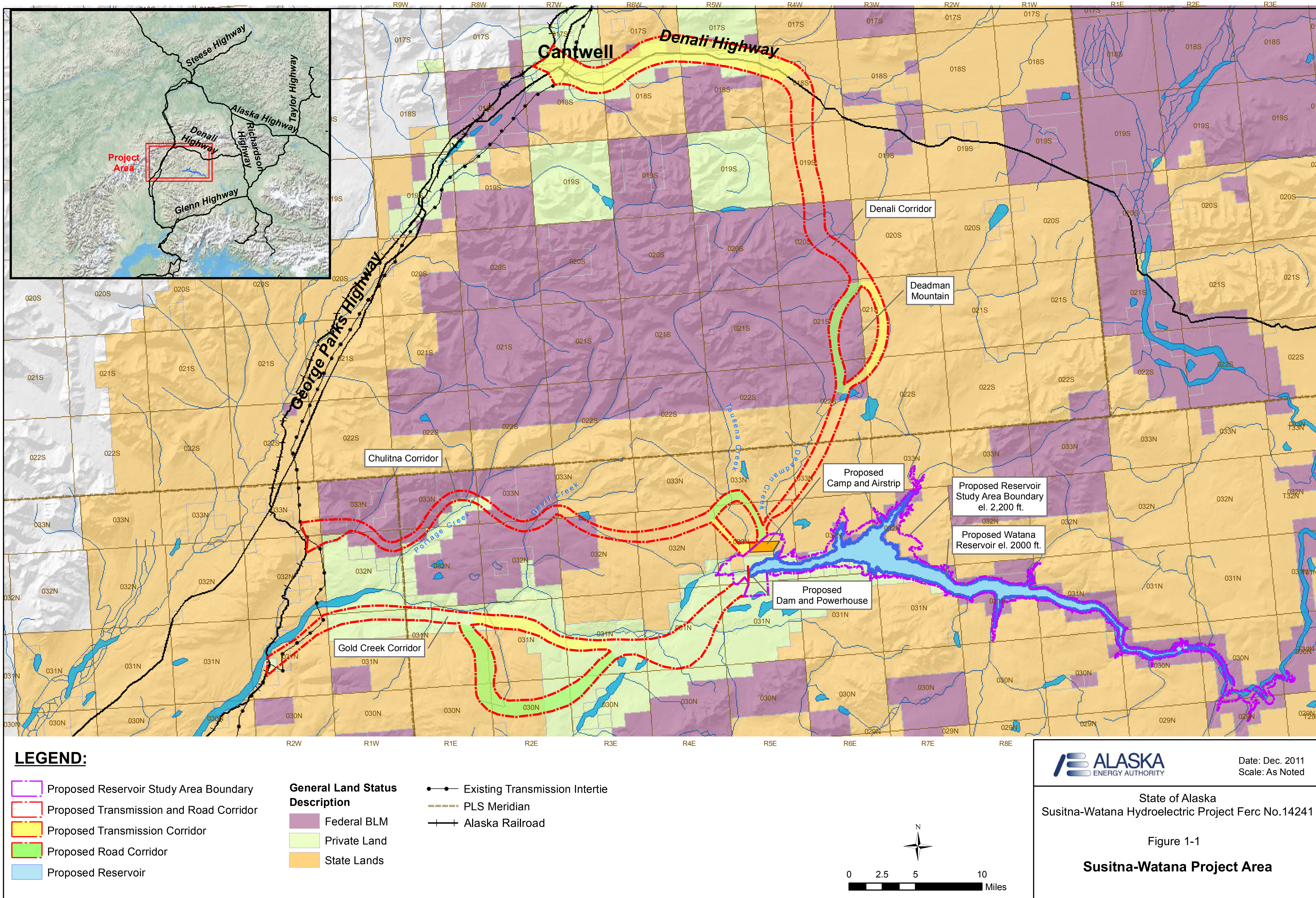
In 2010, the Alaska State Legislature passed legislation establishing a State energy policy and expressing intent that the State obtains 50 percent of its electrical generation from renewable and alternative energy sources by 2025. Hydropower currently provides approximately 19 percent of the electrical energy used in Alaska (11 percent in the Railbelt). While the situation continues to change on an annual basis, the RIRP studies concluded that the Railbelt could not achieve the 50 percent renewable goal without a new large hydroelectric project.

The 2010 Legislature provided funding to AEA for the preliminary planning, conceptual design, start of permitting and field work for hydroelectric projects within the Railbelt. In November, 2010, the AEA issued a Preliminary Decision Document (PDD) determining that the Susitna Hydroelectric Project – identified as the Watana site on the upper Susitna River was to be the primary large hydroelectric project to pursue to help meet the State's renewable energy resources goals. The PDD recommended that engineering and environmental studies be conducted on the Susitna-Watana Project.

The proposed project will provide stable priced firm winter energy, be part of a diverse generation portfolio, and enable the State of Alaska to meet its State energy policy. The significant amount of winter reservoir storage provided by the Project would enable it to provide needed firm energy during the critical winter months when electricity demands are highest. It would reduce natural gas deliverability problems, and the new generation supplied would also help to replace older generation which will be retired prior to Project completion. In addition it would make a substantial contribution to the State's goal of 50 percent renewable electrical generation.

In 2011 the Alaska State Legislature provided additional funds and passed SB 42 that gave Alaska Energy Authority the power to acquire or construct a Susitna River hydroelectric power project.

The AEA is currently working with the Railbelt utilities to update the previous RIRP in order to reflect changes in planned unit additions and retirements for the utilities that were assumed in the initial modeling. The Susitna-Watana Project is a key resource that is factored into individual utilities' expansion plans as a resource available to meet projected electrical loads in the 2023-2025 time frame. In conjunction with the RIRP update, additional transmission system stability and reliability modeling is planned for early 2012. Results from both of these activities will provide input to future Project sizing studies, finalization of design and operational parameters for the Susitna-Watana Project, anddetermination of how the Project will best integrate into the Railbelt electrical system.



State of Alaska
Susitna-Watana Hydroelectric Project Ferc No.14241

Figure 1-1

Susitna-Watana Project Area

Governor Sean Parnell on July 25, 2011, announced that the State will move forward on the Susitna-Watana Hydroelectric Project with an expected completion date in 2023.

1.2. Project Summary

The proposed Susitna-Watana Hydroelectric Project dam would be located at RM 184, which is roughly 90 river miles northeast of the community of Talkeetna. The Project as currently envisioned would include a large dam with a 20,000-acre, 39 mile-long reservoir (normal maximum pool elevation of 2,000 ft mean sea level [msl]). The powerhouse would have an installed capacity of 600 megawatts (MW). Optimization studies are ongoing and the size of the Project eventually proposed for licensing could extend up to 800 MW and a normal maximum reservoir level of approximately 2,100 ft msl. Optimal unit size is also being investigated. The type of dam construction is being evaluated as part of the on-going engineering studies and likely will be earth embankment, roller compacted concrete (RCC) or concrete faced rockfill.

Recent studies have placed the annual generation of the plant at 2,500,000 megawatt-hours (MWhrs). This amount is nearly 40 percent of the current Railbelt annual generation. The Project would produce from 200 MW to 500 MW of firm power depending on the time of year.

The Project has three possible alternatives for road and transmission lines (see Figure 1-1). One corridor, the Chulitna Corridor can accommodate 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 miles (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 proposed Project is on land owned partly by Alaska Native Claims Settlement Act (ANCSA) regional and village corporations, Bureau of Land Management (BLM) land, and State-selected lands.

Data gap analyses have been performed in the areas of aquatics, wildlife, hydrology, water quality, subsistence, socioeconomics, transportation, recreation, and cultural resources. Data from the original 1980s Susitna studies and more current data were reviewed to determine what data gaps exist that may require additional studies.

The existing, relevant, and reasonably available information provided in the PAD is intended to enable participants in the licensing proceeding to identify issues and related information needs; develop study requests and study plans; and ultimately, to prepare documents analyzing AEA’s Application for Original License (License Application) to be filed with FERC by September 2015. The PAD also is a precursor to the environmental analysis section of the License Application and to FERC's scoping documents and environmental impact statement under the National Environmental Policy Act of 1969 (NEPA). The requirement to file the PAD at the same time as the NOI is intended to enable those who plan to participate in the licensing proceeding to become familiar with the Project at the start of the proceeding and enhance the success of FERC's scoping process.

1.3. Document Organization

The PAD follows the content and form requirements of 18 C.F.R. § 5.6 (d) with minor changes in form for enhanced readability. The PAD is organized into two volumes. Volume I contains all of the information required by 18 C.F.R. § 5.6 (c) and (d) and Volume II contains the appendices. The PAD is being distributed to Federal and state resource agencies, local governments, Alaska Native entities, ANCSA Corporations, members of the public, and others likely to be interested in the licensing proceeding.

Because the Project will also require permits and approvals from other federal and state agencies, this PAD, the licensing studies and the license application are intended to be developed in a manner to allow all agencies to use one comprehensive set of environmental analysis documents to satisfy the requirements of NEPA for all federal permits and also to establish a record to support a water quality certification application, if needed under Section 401 of the Clean Water Act.

Volume I is organized as follows:

Executive Summary

Table of Contents; Appendices; List of Tables; List of Figures; List of Acronyms and Scientific Labels

Section 1 – Introduction; Project Need; Project Summary; Document Organization

Section 2 – Process Plan, Schedule and Communication Protocols; Process Plan and Schedule for all licensing activities through filing of the License Application; Communication Protocols

Section 3 – Description of the Proposed Project; Project Overview; Water Conveyance System; Hydro System; Lands of the United States; and Additional Information

Section 4 – River Basin Description; Project Area Overview; Major Land Uses; Major Water Uses; Project Area Dams; Drainage Basins and Tributary Streams; Climate; and Watershed Water Quality; Description of Existing Environment and Impacts by resource category

Section 5 – Issues, Studies and Plans by resource category

Section 6 – Summary of Contacts; Federal Agencies; Tribes; State Agencies; Regional Agencies; Local Governments; Non-Governmental Organizations; and Public

Maps, figures and tables are incorporated into each Section as applicable.

Volume II contains the following appendices:

Appendix 4.4-1	Existing Water Quality Data for the Susitna River and Tributaries
Appendix 4.6-1	Wildlife Habitat Scores
Appendix 4.9-1	Photographs
Appendix 4.9-2	Landscape Character Type Descriptions
Appendix 4.9-3	Notable Natural Features Photographs
Appendix 4.9-4	Aesthetic value and Visual Absorption Capability Ratings
Appendix 4.10-1	ANCSA 17(b) Easement Maps
Appendix 4.13-1	Corporation and Tribe Contact Information
Appendix 6-1	Pre-PAD Correspondence and Meeting Notes
Appendix 6-2	Susitna-Watana Project Contact List

2. PROCESS PLAN, SCHEDULE, AND COMMUNICATIONS PROTOCOL

The following sections contain information concerning licensing approach and early consultation; process plan and schedule; communications and document distribution; working groups; and development of a licensing study program.

2.1. Overview of Licensing Approach and Early Consultation

The Susitna-Watana Hydroelectric Project is being studied and evaluated by AEA under a proposed Preliminary Permit pursuant to Section 4(f) of the Federal Power Act (FPA). For the licensing of the Project, AEA is using the Integrated Licensing Process (ILP), the default process used by FERC, to guide the application development process in a collaborative, but structured manner. In accordance with the ILP requirements under 18 CFR Part 5, the NOI and PAD are being filed simultaneously and distributed to federal and state resource agencies, local governments, Alaska Native entities, ANCSA Corporations and members of the public and other interested parties. The ILP provides a consistent framework for the consultation process with agencies, Alaska Native entities, ANSCA Corporations, and other stakeholders during the period leading up to the filing of the license application.

The PAD follows the content and form requirements of 18 CFR 5.6. The purpose of the PAD is to provide substantial background information related to the engineering, operational, economic, and environmental aspects of the Susitna-Watana Hydroelectric Project, as well as to identify and define issues and potential study needs. AEA also intends to use the PAD as a first step in developing appropriate protection, mitigation, and enhancement (PM&E) measures, which in turn may lead to a formal agreement or agreements with stakeholders in support of a 50-year FERC license. The filing of the NOI and PAD with FERC officially starts the ILP process for this Project.

In preparing the PAD, AEA researched and reviewed reasonably available, relevant information concerning the existing conditions and environment in and around the Project site. This information was obtained through the search of various public information and reference sources, site visits, and stakeholder contacts and consultations.

Starting in early 2011, AEA implemented a stakeholder outreach program and initiated baseline environmental information gathering activities. AEA conducted meetings and has posted extensive licensing information on its website at http://www.sustina-watanahydro.org. Goals of the outreach process included providing stakeholders with relevant background information related to the Project and environmental resources. In addition, these meetings have helped AEA identify and scope issues and develop initial study plans to be incorporated into the PAD.

AEA has incorporated into this PAD the results of its early stakeholder outreach program, including a list of issue statements and study plan summaries (Section 5), brief summaries of draft 2012 informal study plans and a summary of discussions with stakeholders prior to filing this document (Appendix 6-1).

2.2. Process Plan and Schedule

The Process Plan and Schedule outlines the specific timeframes, deadlines, and responsibilities of FERC, AEA (the Applicant), and other stakeholders in the ILP from the filing of the NOI and PAD through the filing of the application for license. In accordance with FERC regulations [18 CFR 5.6 (d)(1)], AEA must adhere to the plan and schedule for pre-application activities including timelines for pre-filing consultation, information gathering, and resource studies. The plan and schedule also includes proposed locations and dates for the scoping meetingst. Table 2.2-1 presents AEA's Process Plan and Schedule for pre-application activities. In developing the proposed Process Plan and Schedule, AEA has included timeframes for Formal Dispute Resolution, highlighted in yellow [18 CFR 5.14] even though AEA anticipates resolving any study disputes through an informal process by working directly with all parties to reach consensus.

Table 2.2-1. Susitna-Watana Proposed Process Plan and Schedule

18 C.F.R. §	Lead	Action	Early Start	Late Finish
§ 5.5	AEA	**File Notification of Intent (NOI)**		**12/29/11**
§ 5.6	AEA	**File Pre-Application Document (PAD)**		**12/29/11**
§ 5.7	FERC	**Tribal Consultation**	**12/30/11**	**01/30/12**
		Initial Tribal Consultation Meeting (NLT 30 days after NOI)	12/30/11	01/30/12
§5.8	FERC	**FERC Notices NOI/PAD & Issues Scoping Document I**	**12/30/11**	**02/27/12**
(a)		FERC issues notice of commencement of proceeding and scoping document		
(b)(2)		FERC request to initiate informal Section 7 ESA consultation and designation of applicant as the Commission's non-federal representative		
(c)		FERC issues Scoping Document 1 (SD1)		
(b)(3)(viii)	FERC	**Public Scoping Meeting & Site Visit**	**02/27/12**	**03/28/12**
		(Within 30 days after Commencement Notice)		
(d)		Project Site Visit (Proposed Dates)	(08/29/11)	(07/11/12)
		Public Scoping Meetings (Proposed Dates)	03/22/12	03/28/12
§ 5.9	Participants	**Comments on PAD, SD1 and Study Requests**	**02/27/11**	**04/27/12**
(a)		Participants file comments on PAD & SD1 and study requests		
		(Within 60 days of Commencement Notices)		
§ 5.10	FERC	**Scoping Document 2 (If Necessary)**	**04/27/12**	**06/11/12**
		FERC issues Scoping Document 2 (SD2)		
		(Within 45 days of SD1 comments)		
§ 5.11	Applicant	**Applicant's Proposed Study Plan & Study Plan Meetings**	**04/27/12**	**07/11/12**
		Applicant files w/ FERC a proposed study plan (Tied to SD1)	04/27/12	06/11/12
		Conduct Study Plan Meetings	04/27/12	07/11/12
		Initial Study Plan Meeting	07/09/12	07/11/12
		(NLT 30 days after Applicant files study plan)		
§ 5.12	Participants	**Comments on proposed study plan**	**06/11/12**	**09/10/12**
		Participants file comments on Applicant's proposed study plan	06/11/12	09/10/12
		(Within 90 days of Applicant filed plans)		
§ 5.13		**Revised study plan and study plan determination**	**09/10/12**	**11/29/12**
(a)	Applicant	Applicant files revised study plan w/ FERC	09/10/12	10/10/12
(b)	Participants	Participants file comments on revised study plan w/ FERC	10/10/12	10/25/12
(c)	FERC	FERC issues Study Plan Determination	10/10/12	11/09/12
(d)		Study plans approved (If no study plan dispute)	11/09/12	11/29/12

§ 5.14		**Formal study dispute resolution process (Formal Study Plan Dispute)**	**11/09/12**	**02/07/13**
(a)	MCA/T	Mandatory condition agency/tribes (MCA/T) file Notice of Dispute (Within 20 days)	11/09/12	11/29/12
(d)	FERC	FERC convenes Dispute Resolution Panel (DRP) (Within 20 days)	11/09/12	12/19/12
(i)	Applicant	Applicant files comments re: dispute w/ FERC (NLT 25 days)	11/09/12	12/24/12
(k)	DRP	Dispute Resolution Panel (DRP) delivers to FERC finding of dispute (NLT 50 days)	12/19/12	01/18/13
(l)	FERC	FERC issues written determination re: dispute (NLT 70 days)	01/18/13	02/07/13
(d)		Study plans amended/approved (Formal Study Plan Dispute Process)	01/18/13	02/07/13
§ 5.15		**Conduct Studies**	**11/30/12**	**03/11/15**
(a)		Implement Study Plans (Tied to "No study plan dispute")	11/30/12	11/30/14
	Applicant	Implement Study Plans (1st Season)	11/30/12	10/12/13
(b)	Applicant	Applicant prepares & files periodic Study Plan progress reports	02/01/13	11/11/13
(c)(1)	Applicant	Applicant prepares & files Initial Study Report (NLT 1 year after FERC study plan approval)	08/15/13	11/29/13
		Initial Study Report Filing Deadline		11/29/13
(c)(2)	Applicant	Applicant holds study plan meeting (Within 15 days)	11/29/13	12/13/13
(c)(3)	Applicant	Applicant files study plan meeting summary & plan modifications (Within 15 days)	12/13/13	12/27/13
(c)(4)	Participants	Meeting summary & study plan disagreement filing by participants (Within 30 days)	11/29/13	01/24/14
(c)(5)	Applicant	Applicant files response to disagreement (Within 30 days)	01/24/14	02/24/14
(c)(6)	FERC	FERC resolves disagreement & amends study plan (NLT 30 days)	02/24/14	03/26/14
(c)(7)		Meeting Summary & Plan Modifications Approved (No Disagreement Filed by Participants)		01/27/14
		Meeting Summary & Plan Modifications Approved (Disagreement filed by Participants)		03/26/14
(f)	Applicant	Applicant prepares & files Updated Initial Study Report	08/11/14	11/28/14
	Applicant	Applicant holds study plan meeting (Within 15 days)		12/12/14
	Applicant	Applicant files study plan meeting summary & plan modifications		12/23/14
	Participants	Meeting summary & study plan disagreement filing by participants		01/26/15
	Applicant	Applicant files response to disagreement (Within 30 days)		02/24/15
	FERC	FERC resolves disagreement & amends study plan (NLT 30 days)		03/27/15
		Meeting Summary & Plan Modifications Approved (No Disagreement filed by Participants)		01/26/15
		Meeting Summary & Plan Modifications Approved (Disagreement filed by Participants)		03/11/15
§ 5.16		**Preliminary Licensing Proposal (Tied to "No study plan dispute")**	**11/11/13**	**04/14/15**
(a)(c)	Applicant	Applicant files Preliminary Licensing Proposal (or Draft License Application)		04/14/15
(e)	FERC	FERC issues comments on Preliminary Licensing Proposal (or Draft License Application)	04/14/15	07/13/15
§ 5.17		**Filing of Application**		**09/11/15**
(a)	Applicant	Applicant Files License Application		09/11/15

With this schedule, AEA assumes that formal field studies will be performed over two field seasons, during 2013 and 2014. The proposed schedule allows for additional information gathering activities and early studies in 2012. Figure 2-1 presents some of the key milestone dates and activities in a summary form for 2012 through 2015. It is AEA's intention to complete all studies and data collection to support the license application in these three field seasons, however, it is expected data may continue to be collected beyond 2014.

Under the ILP, the Commission conducts its National Environmental Policy Act (NEPA) scoping meeting and site visit within 90 days of filing of the applicant's Notice of Intent. The site visit is typically held in conjunction with the scoping meeting. However with the filing date of December 29, 2011, that scoping meeting would take place at the end of March 2012; that would not be a practical time to hold a site visit as there would be no chance to view the site free of ice and snow and access to the project site could be limited by winter weather. In anticipation of the NOI and PAD filing dates, a site visit was held on August 29, 2011 to allow FERC and interested parties a chance to view the site conditions in a snow free period. Under the ILP schedule, FERC will conduct scoping meetings on March 27, 28, 29 and 30, 2012 in Anchorage, Wasilla, at Su-Valley High School near Sunshine along the Parks Highway, Fairbanks, and Glennallen, respectively. Typically, FERC holds one meeting during the day and this meeting is planned for Anchorage and will focus on soliciting comments from resource agencies and Alaska Native groups. The other scoping meetings at each location will be scheduled in the evening, starting at 7:00 pm for the convenience of the public and non-governmental organizations. All interested parties are invited to attend and participate in either or all of the scoping meetings.

The March 27, 2012 daytime meeting will be in Anchorage, planned to be held in the morning at the Loussac Public Library, 3600 Denali Street. The March 27, 2012 evening meeting is planned to be held at the Menard Sports Center Meeting Rooms, 1001 S Mack Drive in Wasilla. The March 28, 2012 evening meeting is planned to be held at the Su-Valley High School at 42728 S Parks Highway, Sunshine, AK 99676 near the junction of Talkeetna Road and the Parks Highway. The March 28, 2012 evening meeting will be held at the Carlson Center, 2010 2nd Avenue in Fairbanks and the March 29, 2012 evening meeting will be held at the Caribou Café banquet room in Glennallen, AK 99588.

More detailed information regarding the scoping meetings will be announced by FERC and will also be posted on the Susitna-Watana Project licensing website at http://www.susitna-watanahydro.org. Additional information can also be obtained by contacting Mr. David Turner with FERC at (202) 502-6091.

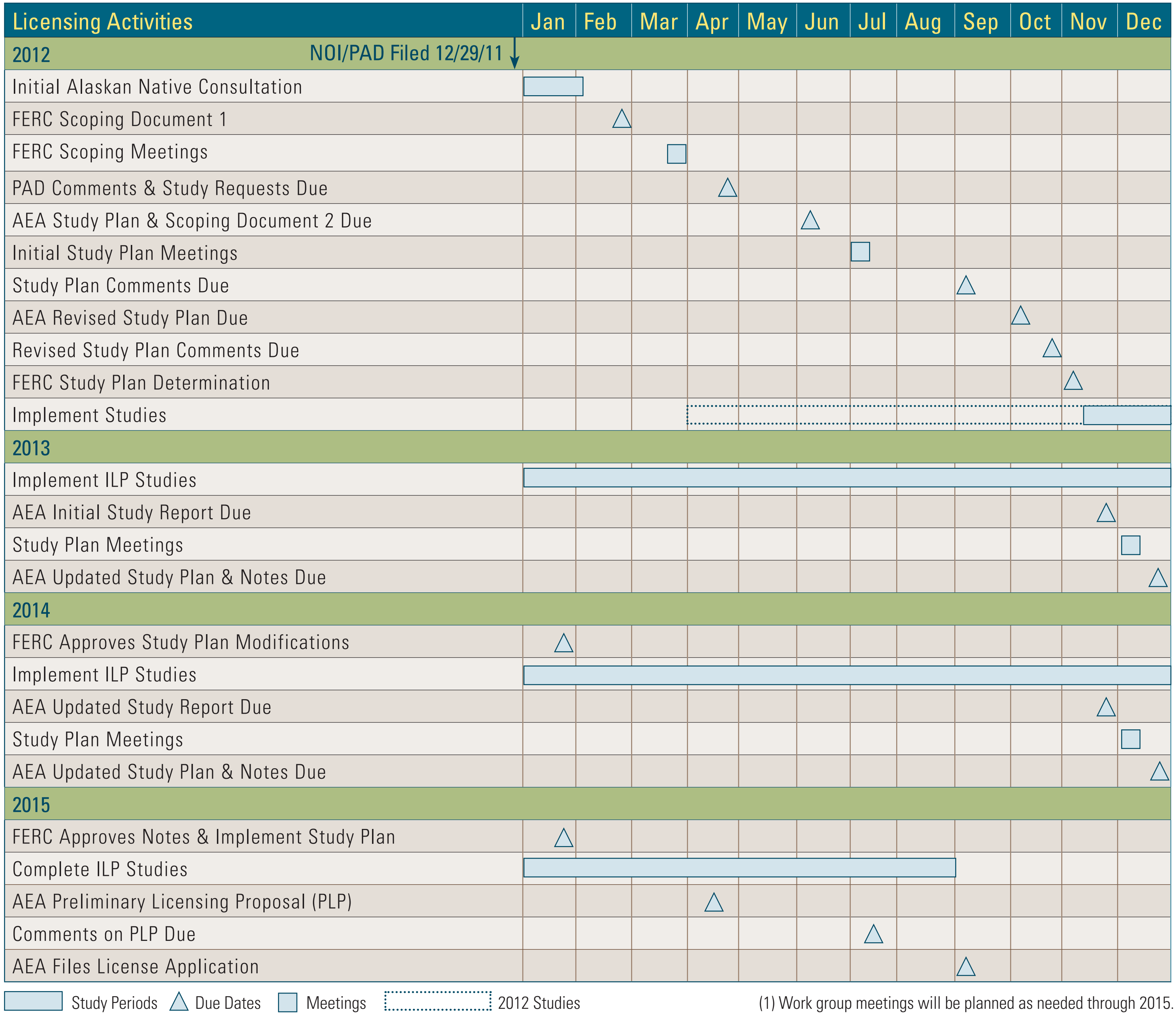
The scoping meetings will be recorded by a court reporter, and all statements, oral and written, will become part of FERC's official public record for this licensing. At the start of each meeting all individuals who attend will be asked to sign in. Anyone wishing to make a statement for the record will be asked to indicate this desire and to identify themselves and any organizations that they represent.

In addition to the opportunity to comment at the scoping meetings, all stakeholders may provide written comments to FERC by sending an original and eight copies of any written comments to:

The Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington D.C., 20426

Alternatively, stakeholders can e-file their comments to FERC's website, http://www.ferc.gov/docs-filing/docs-filing.asp where instructions are posted about how to file and view comments and documents in FERC's eLibrary. For any comment submissions, it is important to include the project name and project number, "Susitna-Watana Hydroelectric Project, FERC No. 14241" on the first page of any written comments. As noted in Table 2.2-1, the deadline for filing written comments on the PAD and FERC's Scoping Document 1 will be 60 days from the date of FERC's Notice of Issuance of the scoping document and consultation process.

Figure 2-1. Susitna-Watana Licensing Schedule Summary[1]



(1) Work group meetings will be planned as needed through 2015.

2.3. Communications and Document Distribution

This Communication Protocol (Protocol) is intended to facilitate communication and cooperation among AEA, federal and state agencies, ANSCA Corporations, Alaska Native groups, and other interested organizations and parties (collectively Participants) during the preparation of AEA's Application for Original License for the Susitna-Watana Hydroelectric Project (Project). This Protocol is structured to complement the requirements of the ILP for the pre-application consultation period for the Project licensing effort. AEA believes that the ILP, supplemented by the provisions outlined below, is the most effective process for completing the necessary pre-application work while providing for meaningful participation by agencies, other interested organizations and the public.

This Protocol is intended to provide a structured framework for communications among all Participants and provide AEA's plans regarding access to information regarding the consultation activities related to the licensing and planning of the Project. The Protocol also applies to communications to and from consultants on behalf of AEA, or any of the Participants. This Protocol is not intended to apply to communications solely between Participants, or to any Participant's internal communications. The Communication Protocol is intended to provide a flexible framework for dissemination of information and for document consultation among all participants involved in the Project licensing.

2.3.1. Maintenance of the Public Reference File

AEA will maintain copies of relevant written communications and other materials produced during the pre-filing consultation process. The consultation record will be updated regularly and available to the public on the website. Copies of the PAD will be distributed to the listing attached in Appendix 6-2 and the PAD and license application will also be provided to public libraries, or other convenient public offices located in the vicinity of the proposed Project.

This information will constitute the Formal Consultation Record covering the period prior to AEA filing the Final License Application with FERC and will be available for public viewing at two locations:

1. Public Reference File, Alaska Energy Authority, 411 W. 4th Avenue, Suite 1, Anchorage, AK 99501

2. Susitna-Watana Project Licensing Website: http://www.susitna-watanahydro.org

These materials will be available for public inspection during regular business hours in a form that is readily accessible, reviewable and reproducible. Copies of the materials will be available to a requester at AEA's Susitna-Watana Project Office, through the mail or electronically. AEA may charge the public the reasonable cost of reproduction, and if applicable postage, for any hard copies.

AEA will delete from any information made available in the public reference file, specific site or property locations the disclosure of which would create a risk of harm, theft, or destruction of archeological or Alaska Native cultural resources or of the site at which the sources are located, or would violate any Federal law, including the Archeological Resources Protection Act of 1979, 16 U.S.C. 479w-3, and the National Historic Preservation Act of 1966, 16 U.S.C. 470hh. Certain documents may also be restricted from publication on the licensing website in accordance with FERC's regulations protecting Critical Energy Infrastructure Information (CEII) (18 CFR§ 388.113) or in cases where the document contains privileged information (*e.g.*, sensitive species locations, cultural resource sites, etc.). AEA will address requests for access to this information on a case-by-case basis, in accordance with Alaska State and federal law as needed during the licensing consultation process.

Consistent with federal and state paper-reduction policies, and in accordance with the objectives of FERC Order No. 604, AEA will transmit and receive licensing related communications and other written materials in electronic format when possible. Preferred formats are: MS Word, Adobe, MS Excel, or ASCII text.

2.3.2. Licensing Website

AEA will maintain a website (www.susitna-watanahydro.org) as the primary mode of document distribution and access to key documents developed during the course of the licensing consultation, such as the PAD and NOI, meeting notices, meeting summaries, study plans and study reports, preliminary licensing proposal/draft license application and final license application.

AEA will maintain a current calendar of upcoming and past meetings, and will post meeting materials (including agendas, handouts, and summaries) on the website to increase the availability of these materials to all Participants.

AEA will use email notifications to Participants to announce important new postings, which will help maximize review and comment opportunities, where applicable. The following table summarizes the general guidelines that AEA will follow in determining the appropriate mode of distribution for licensing documents.

Table 2.3-1. Documents Distribution Guidelines.

Document Type	Distribution Mode(s)
Informal communications	Email or regular mail
Formal ILP Meeting notices and agendas	Website with email notice
Meeting summaries	Website with email notice
Large licensing related documents (e.g., PAD, SD1, PSP, study reports, progress reports, PLP, license application)	Website with email notice and/or CD-ROM through regular mail; paper format available upon request
PAD reference documents (to the extent practicable)	Website (scanned PDF files) or at ARLIS

2.3.3. ILP Meetings

AEA anticipates a variety of meetings being scheduled over the course of the pre-application process. These will include meetings required by the ILP as well as additional general information/project update meetings and technical work group meetings.

For meetings required by the ILP regulations, either FERC (e.g., scoping meeting) or AEA (e.g., study planning meetings) will comply with the applicable regulatory requirements and in addition AEA will post the meeting information on the Project website.

AEA will schedule the meetings for which it is responsible. AEA will solicit input from Participants on meeting dates, agendas and objectives and will seek to locate meetings to facilitate Participant attendance to most effectively accomplish those objectives.

AEA will strive to notify all Participants of meetings scheduled by AEA at least 30 days prior to the meeting date to the extent practicable. This notification may be made via email, posting on the Project website or by telephone conversation. If circumstances do not allow for the full 30 days notice, AEA may hold a meeting with less than 30 days notice.

AEA shall establish the draft meeting agenda and will strive to post a written meeting agenda on the Project website at least two weeks prior to a scheduled meeting. Participants may submit comments on the agenda to AEA up to one week before the scheduled meeting and AEA will distribute a final agenda at the meeting. In addition, the agenda may be modified at the beginning of the meeting.

AEA will strive to make available documents and other information necessary to prepare for a consultation meeting at least two weeks prior to the scheduled meeting.

2.3.4. ILP Documentation

All of the documentation requirements described below apply to substantive communications regarding the licensing of the Project; communications related to procedural matters (e.g., responding to inquiries regarding meeting scheduling) are not subject to the same documentation requirements.

2.3.4.1. Meeting Summaries

AEA will be primarily responsible for providing a written summary of the matters addressed at group meetings where agendas are posted involving AEA and Participants. To the extent practicable, a meeting summary will be posted to the Project Website within 15 days of the meeting. Comments should be submitted within 15 days of posting.

2.3.4.2. Technical Documents

A variety of technical documents will be produced during the course of licensing consultation, including the PAD, study plans, study reports, preliminary licensing proposal/draft license application and final license application. Whenever comments are solicited on documents, review periods will be established and communicated to Participants.

Review periods will typically be 30 days, unless longer periods are required by FERC regulations (e.g., 60 day comment period on the PAD and Scoping Document 1; 90 day comment period on the proposed study plan). AEA will consider adjusting comment periods to better utilize available time within the course of pre-application consultation, without jeopardizing the overall project schedule. Any such adjustments will be made in consultation with the Participants and subject to FERC's approval.

2.3.4.3. Written Correspondence

AEA requests that all licensing-related correspondence or other materials intended or required to be part of the Formal Consultation Record contain the following reference, "Alaska Energy Authority, Susitna-Watana Project, FERC Project No. 14241, Request for Inclusion in Formal Consultation Record" and be addressed to:

Wayne Dyok
Susitna-Watana Project Manager
Alaska Energy Authority
813 West Northern Lights Boulevard, Anchorage, AK 99503
wdyok@aidea.org

2.3.5. Distribution of Licensing Documentation

Distribution of the PAD and preliminary licensing proposal/draft and final license application is anticipated to be accomplished by mailing of CDs and posting the documents on the Project website and in FERC's e-Library. Hard copies of the PAD and license application documents will be made available to public libraries in Fairbanks, Talkeetna, Palmer, Anchorage and Juneau.

2.3.6. Communications with FERC staff

Communications with FERC staff that address the merits of the proceeding will be included in the public record. In order to have written communication with FERC staff made a part of the record for a project, it must be formally filed with FERC as follows:

The Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

All written communications to FERC not electronically filed must include an original and eight copies and have the following displayed on the first page:

"Alaska Energy Authority, Susitna-Watana Project, FERC Project No. 14241 – Application for License."

FERC is strongly encouraging stakeholders to file their comments electronically via the Internet instead of submitting comments by paper. Instructions for e-Filing are provided at www.ferc.gov under the eLibrary link. Additional information on this program can be found in the regulations at 18 CFR 385.2001(a)(1)(iii). Filing comments electronically with FERC also eliminates the need for filing an original and eight copies.

2.4. Work Group Structure for Pre-Filing Technical Efforts

AEA will be responsible for coordinating ILP-related licensing activities during the pre-filing period and has formed technical work groups of agencies, ANSCA Corporations, Alaska Native groups and other interested organizations as the focal point for technical interactions. AEA initiated discussions regarding development of such work groups in 2011, during the period leading up to issuance of this PAD.

With the issuance of this PAD, AEA plans to continue utilizing work groups organized around major technical resource areas to work with AEA to implement the pre-filing ILP activities. Currently, AEA envisions work groups for the following major resource areas:

- Water Resources & Geomorphology
- Fisheries Resources
- Terrestrial Resources (botanical, wildlife, wetlands)
- Social Resources (recreation, socioeconomics, transportation, subsistence, aesthetics, and land use and management)
- Cultural Resources (archaeological and historical)

AEA envisions work groups will consist of representatives of agencies, Alaska Native groups and other interested organizations who will engage with AEA in activities including:

- Development of study plan components
- Review of study work products
- Evaluation of Project effects
- Identification of potential protection, mitigation and enhancement (PM&E) measures

These work group efforts will occur within the ILP context to assist AEA as it develops the Proposed Study Plan (PSP), implements the approved Study Plan, and develops the Preliminary Licensing Proposal (PLP) and the License Application.

Membership in work groups will be voluntary, although AEA encourages agencies and other interested organizations to assign representatives to participate regularly in the work group activities of those resource areas in which they have interest. As noted above in section 2.3, AEA will communicate with licensing participants regarding work group activities primarily through the Project licensing website.

AEA has compiled an initial list of work group participants based on sign-in sheets from meetings and workshops held prior to the issuance of this PAD. Licensing participants' interest in one or more work groups may be communicated to AEA by utilizing sign-in sheets at upcoming scoping meetings and other licensing-related meetings. Licensing participants can also contact Betsy McGregor, Susitna-Watana Environmental Manager, at bmcgregor@aidea.org.

2.5. Development of a Licensing Study Program

This PAD includes summaries of existing, relevant information that AEA has compiled since initiating its efforts to identify and obtain reasonably available, relevant information in early 2011. This body of information forms the basis for AEA's current understanding of the resources in the vicinity of the Project potentially impacted by its development and operation. Through engagement of agencies and other interested organizations, AEA has developed a list of potential issues related to the licensing of the Project. Together, existing information and identified issues form the basis for the list of potential resource studies needed to support AEA's license application. Section 5 presents AEA's preliminary list of licensing issues and study needs. The following discussion describes the process for developing FERC-approved study plans as provided for in FERC's regulations.

Several sequential steps are involved in the ultimate development of a final approved study plan for the program of studies to support AEA's license application. These steps include the initial identification of issues and study needs in this PAD, consideration of information or study requests from licensing participants in response to the PAD and Scoping Document 1 (SD1), development of the Proposed Study Plan (PSP), development of the Revised Study Plan (RSP) in response to comments to the PSP, and FERC's final Study Plan Determination and approval. Details regarding the timing of these activities are included in Section 2.2.

Comments on the PAD and SD1, including information and study requests, must be received within 60 days following the Commission's notice of commencement of this licensing proceeding and issuance of SD1. As required by section 5.9 of the ILP regulations, any information or study request must:

1) Describe the goals and objectives of each study proposal and the information to be obtained;
2) If applicable, explain the relevant resource management goals of the agencies or Alaska Natives with jurisdiction over the resource to be studied;
3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
4) Describe the existing information concerning the subject of the study proposal, and the need for additional information;
5) Explain the nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;

6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant Alaska Natives and knowledge; and
7) Describe 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.

Within 45 days following the deadline for filing comments on the PAD and SD1, including information and study requests, AEA must file its PSP with the Commission. With respect to each proposed study, AEA's PSP must include:

1) A detailed description of the study and the methodology to be used;
2) A schedule for conducting the study;
3) Provisions for periodic progress reports, including the manner and extent to which information will be shared; and sufficient time for technical review of the analysis and results; and
4) If AEA does not adopt a requested study, an explanation of why the request was not adopted, with reference to the criteria set for in section 5.9(b) of the ILP regulations.

AEA's PSP must also:

1) Describe the goals and objectives of each study proposal and the information to be obtained;
2) Address any known resource management goals of the agencies or Alaska Native groups with jurisdiction over the resource to be studied;
3) Describe existing information concerning the subject of the study proposal, and the need for additional information;
4) Explain the nexus between project operations and effects (direct, indirect and/or cumulative) on the resource to be studied;
5) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers known Alaska Native interests; and
6) Describe considerations of level of effort and cost, as applicable.

Lastly, AEA's PSP must include provisions for initial and updated study reports and meetings.

AEA's PSP, when filed with the Commission, will be accompanied by a proposal to conduct a study plan meeting(s) within the first 30 days of the 90-day comment period on the PSP for the purpose of clarifying AEA's PSP and any initial information gathering or study requests, and to resolve any outstanding issues with respect to the PSP. Other meetings may also be scheduled within these timelines to resolve issues pertaining to the study plan.

Comments on AEA's PSP, including any revised information gathering or study requests, must be filed with the Commission by the end of the 90-day comment period. Any comments must include an explanation of any study plan concerns and any accommodations reached with AEA regarding those concerns.

Within 30 days of the deadline for filing comments on the PSP, AEA will file its Revised Study Plan (RSP) for FERC approval. The RSP must include comments on the PSP and a description of the efforts made to resolve differences over study requests. If AEA does not adopt a requested study, it must explain why the request was not adopted, with reference to the criteria in section 5.9(b) of the ILP regulations. Licensing participants may file comments on the RSP within 15 days following its filing. Within 30 days of the RSP filing, the Director of Energy Projects will issue a Study Plan Determination, including any modifications determined to be necessary in light of the record.

If no notice of study dispute is filed within 20 days of the Study Plan Determination, the study plans shall be deemed approved and AEA will proceed with their implementation. The steps associated with study plan dispute resolution (if needed) are outlined in section 5.14 of the ILP regulations.

As described in the approved study plan and schedule, AEA will prepare and file no later than one year after the study plan approval, an Initial Study Report (ISR) describing its overall progress in implementing the study program, and the data collected, including an explanation of any variance from the study plan and schedule. The report must also include any modifications to ongoing studies or new studies proposed by AEA. AEA may present interim results to Participants.

Within 15 days following the filing of the ISR, AEA will hold a meeting with licensing Participants and FERC staff to discuss the study results to date and AEA's or other Participants' proposals, if any, to modify the study plan in light of the progress of the study plan and data collected. Following the issuance of the meeting summary, there is an opportunity to file disagreements and proposals to modify ongoing studies or propose new studies. Following additional opportunity for responses, the Director of Energy Projects will resolve any outstanding disagreements and amend the approved study plan, as appropriate.

Criteria for modification of an approved study or for requiring a new study are found in section 5.15(d) and (e) of the ILP regulations.

AEA will also file an Updated Study Report (USR) no later than two years after the approval of the study plan. The USR will describe the overall progress in implementing the study program and the data collected, including an explanation of any variance from the study plan and schedule. The report must also include any modifications to ongoing studies or new studies proposed by AEA. The review, comment and disagreement resolution provisions that apply to the ISR also apply to the USR. AEA must promptly proceed to complete any remaining undisputed information gathering or studies under its proposed amendments to the study plan, if any, and must proceed to complete any information gathering or studies that are the subject of a disagreement upon the Director of Energy Project's resolution of the disagreement.

AEA intends for the work groups discussed in section 2.4 of this PAD to assist with the implementation of the study program, including development of information gathering and study requests, participation in study plan meeting(s), and review of comments on the PSP. In this regard it is AEA's intent to minimize the need for use of the formal study dispute resolution process available in the ILP regulations.

AEA also plans to utilize the work group structure during the review of the ISR and USR, including the required study report meetings.

3. PROJECT LOCATION, FACILITIES, AND OPERATION

This section of the PAD contains specific information regarding the proposed Project location, facilities and operations. This information will serve as a basis for evaluating project impacts during the licensing process.

3.1. Authorized Agents for the Applicant

The Applicant to the Federal Energy Regulatory Commission (FERC) for the Pre-Application Document (PAD) is the Alaska Energy Authority (AEA), a public corporation of the State of Alaska. The individual authorized to act as an agent for AEA during the process of applying for a license is:

Name: Wayne Dyok
Agency: Alaska Energy Authority
Position: Susitna-Watana Project Manager
Address: 813 West Northern Lights Boulevard
Anchorage, AK 99503
Phone: 907-771-3000
Email: wdyok@aidea.org

3.2. Project Location

The proposed Project is to be located along the east-west segment of the Susitna River at 184 river miles above the mouth, approximately half-way between Anchorage and Fairbanks. The Susitna River has its headwaters in the mountains of the Alaska Range about 90 mi south of Fairbanks. It flows generally southwards for about 318 mi before discharging into Cook Inlet just west of Anchorage. The nearest community is the unincorporated community of Cantwell in the Denali Borough which is located about 45 air mi from the proposed Project dam while Anchorage is approximately 180 air mi generally south of the Project area.

3.3. Proposed Project Facilities

The currently envisioned project would include a Watana Dam with a top level of elevation (El.) 2,025 ft above mean sea level (msl) with a maximum normal reservoir surface of El. 2,000 ft msl. During the course of studies leading to a license application, depending on operating and environmental studies and optimization of various reservoir levels, drawdown characteristics, and operational requirements – the final proposed project configurations may vary and may include a maximum reservoir elevation nearing 2,125 ft msl, thecorresponding maximum height of the dam. The Watana Dam will be a concrete gravity structure, most likely constructed by the roller compacted concrete (RCC) methodology. Optimization of the project during licensing studies may result in a proposal for a nominal curve in the dam resulting in an arch-gravity structure which would benefit the stability of the dam.

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.

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. Unit sizing studies are continuing and the final unit size may be as low as 100 MW. The firm energy of the project during the critical November - April time frame will be 1,094 gigawatt hours. The powerhouse will be designed and constructed with an extra empty generating unit bay for the potential installation of a fourth unit at some future time. Optimization studies are ongoing and the capacity of the Project eventually proposed for licensing could extend up to 800 MW.

There would be two outlet works facility structures and four power intake structures (one corresponding to the extra unused powerhouse bay). 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.

3.3.1. Project Structures

3.3.1.1. General Arrangement

The proposed Watana Dam will create a reservoir approximately 39 mi long, with a surface area of about 20,000 ac , and a gross storage capacity of 4,300,000 acre-feet (ac-ft) at the normal maximum operating level of El. 2,000 ft msl (See Figure 1-1).

If the proposed optimization studies were to lead to a normal maximum operating level of El. 2,100 ft msl, the accompanying reservoir would be longer and have a greater surface area.

The maximum water surface elevation of the project shown in the accompanying figures during probable maximum flood (PMF) conditions will be El. 2,017 ft msl. The minimum operating level of the reservoir will be El. 1,850 ft msl, providing 2,400,000 acre-ft of active storage during normal operation.

The dam will likely be a concrete gravity structure (or an arch gravity structure) constructed by the RCC methodology. The nominal crest elevation of the dam will be El. 2,025 ft msl, with a maximum dam height of approximately 700 ft above the foundation and a crest length of approximately 2,700 ft msl. Following completion of the studies mentioned above, a nominal crest elevation up to El. 2,125 ft msl may be proposed in the license application, corresponding to a maximum dam height of up to 800 ft above the foundation. The total volume of the concrete structure will be approximately 5,200,000 cubic yards. During construction, the Susitna River will be diverted through a concrete-lined diversion tunnel on the north side of the river, approximately 35 ft in diameter and approximately 1,800 ft long, together with a sluice through the base of the concrete dam of approximately 400-square foot (sf) cross section.

Each installed generating unit will be served by a single power intake located on the upstream face of the dam. Each power intake will be a concrete structure with multi-level gates capable of operating over the full reservoir operating range. From each intake structure, a steel penstock will penetrate the concrete dam and will be anchored to the downstream face of the dam leading to the powerhouse complex; after "day lighting", the steel penstock will be surrounded in a concrete encasement. The powerhouse will house three generating units with vertical shaft Francis-type hydraulic turbines driving direct connected synchronous generators. A fourth penstock will pass through the concrete dam, and the downstream end will be semi permanently capped–to be removed only if and when an additional generating unit is eventually installed in the future.

Access to the powerhouse floor level will be by means of a shotcrete-lined access tunnel, necessary because of the steep valley sides, and a road from the north bank of the downstream river valley. Turbine discharge will flow through three draft tubes (one per unit) and into the common tailrace. Unit generator step up transformers will be located on the powerhouse deck just downstream of the powerhouse building.

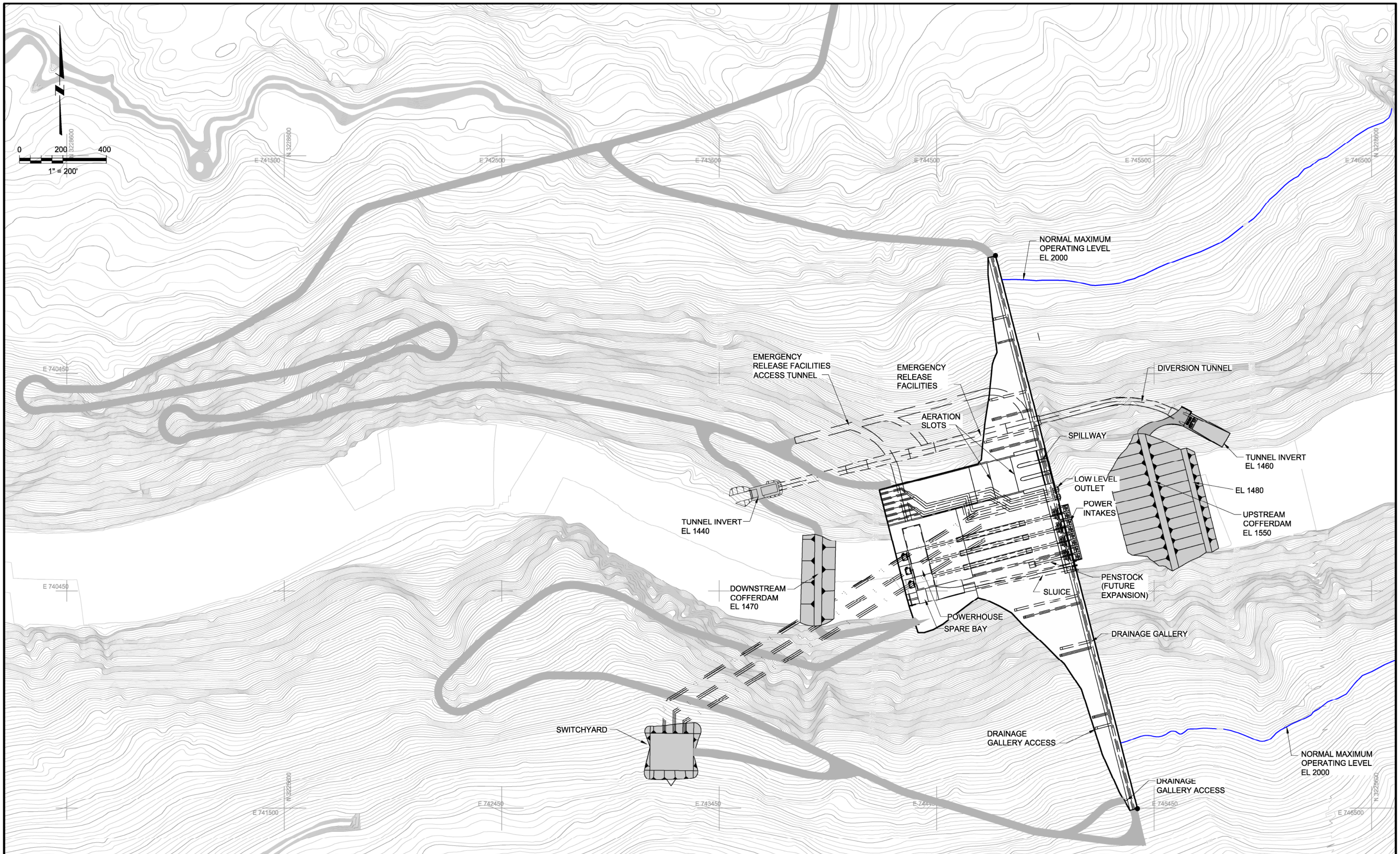
One three-phase generator step up transformer for each unit will be mounted on the deck, together with a spare transformer. From the transformer bushings there will be 230-kV high voltage lines that will connect to a switchyard on the left downstream abutment. The switchyard will provide switching to three transmission lines.

The intakes for the low-level outlet facilities will be located on the upstream face of the dam to the north side of the spillway, with a total combined capacity of approximately 24,000 cubic feet per second (cfs). In combination with the average powerhouse flow of 7,380 cfs, the arrangement provides for the storing and releasing of the 50-year flood without raising the pool level above El. 2,000 ft msl and without spillway operation.

The spillway located on the north side of the powerhouse will consist of an upstream ogee control structure with three radial gates and an inclined concrete chute and flip bucket designed to pass a maximum discharge of 278,300 cfs. This spillway, together with the outlet facilities, will be capable of discharging the estimated PMF of 326,000 cfs, while maintaining 8 ft of freeboard on the dam. Additionally, emergency release facilities will be located in the diversion tunnels after closure to allow controlled filling and for lowering of the reservoir over a period of time for emergency inspection or repair of impoundment structures.

3.3.1.2. Dam Structure

The Watana Dam structure will be located at Susitna River RM 184, in a broad U-shaped valley approximately 2.5 mi upstream of the Tsusena Creek confluence. The dam will be of concrete most likely placed by the RCC methodology. A plan overview is shown on Figure 3.3-1 and is described below.



REV	DESCRIPTION	BY	DATE

SCALE
1"=200'

WARNING
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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

Project No.	
Date	12/05/2011
Designed	A HUGHES
Drawn	A FRISK
Approved	B SADDEN

MWH

STATE OF ALASKA
ALASKA ENERGY AUTHORITY
ALASKA ENERGY AUTHORITY

SUSITNA-WATANA HYDROELECTRIC PROJECT

SITE PLAN

FIGURE
3.3-1

3.3.1.3. Construction Diversion

Diversion of the river flow during construction will be accomplished primarily with a single 35-foot diameter circular diversion tunnel. The approximately 1,800-foot concrete-lined tunnel will be located on the north bank of the Susitna River as shown on Figure 3.3-1. The dam structure will incorporate a low level sluice approximately 20 ft wide and 20 ft high to form a second diversion conduit. The tunnel, in conjunction with the sluice, is designed to pass a flood with a return frequency of 1:50 years, equivalent to a peak inflow of 89,500 cfs. Routing effects are small, and thus at peak flow the diversion will discharge 77,000 cfs. The estimated maximum water surface elevation upstream from the cofferdam for this discharge will be El. 1,532 ft msl. The design of the diversion facilities will take into account the special circumstances associated with “break up”.

3.3.1.4. Emergency Release Facilities

The diversion tunnel will be converted to a permanent low-level outlet, or emergency release facility. A local enlarging of the tunnel diameter to 45 ft will accommodate the low-level outlet gates and expansion chamber. These facilities will be used to pass the required minimum discharge during the reservoir filling period and will also be used for draining the reservoir in an emergency.

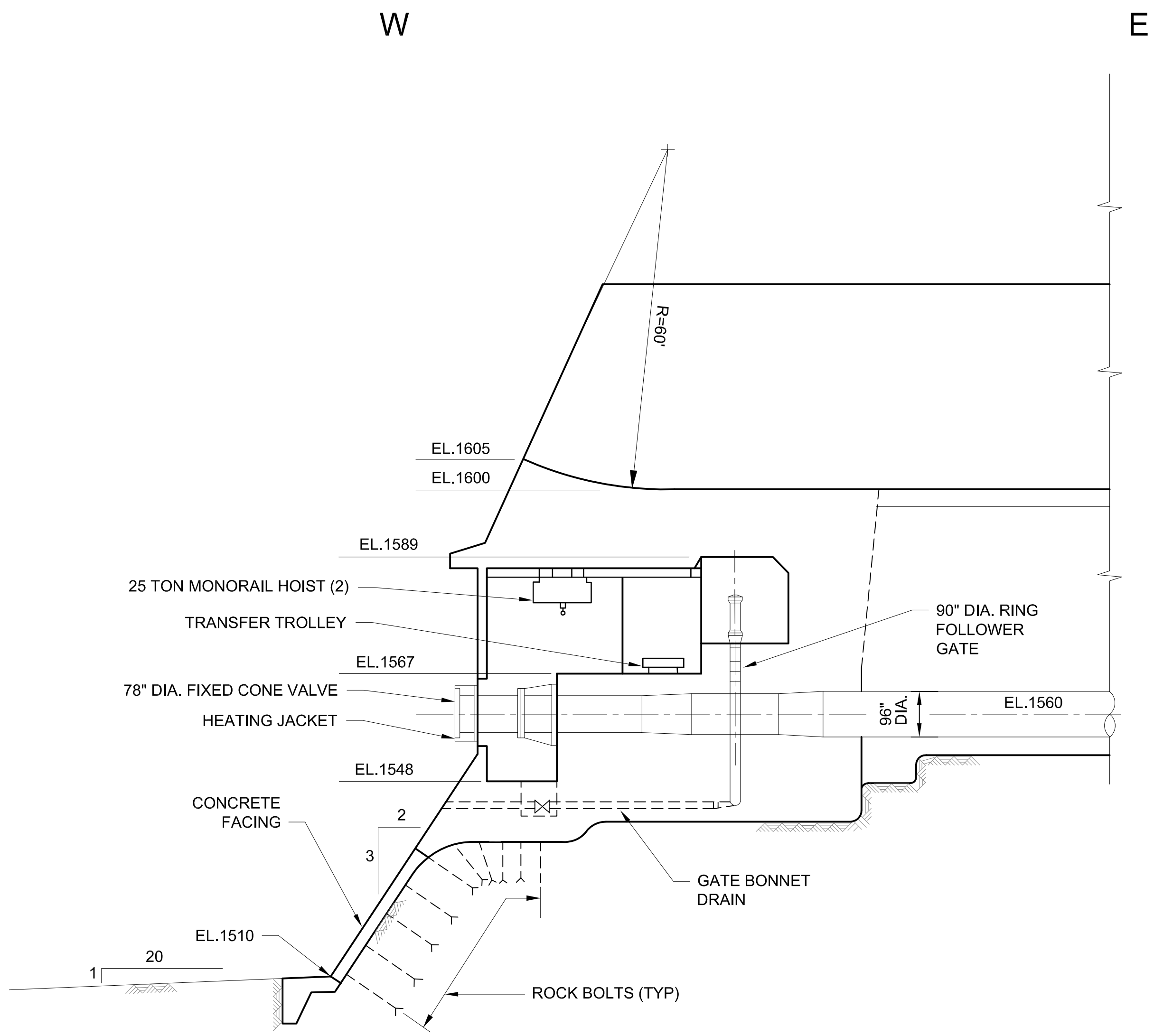
During operation, energy will be dissipated by means of two gated concrete plugs separated by a 340-foot length of tunnel. Each plug will contain three water passages.

Bonneted high pressure slide gates will be installed in each of the passages in the tunnel plugs. The gate arrangement will consist of one emergency gate and one operating gate in the upstream plug and one operating gate in the downstream plug. The 340-foot length of tunnel between plugs will act as an energy dissipating expansion chamber, and will be vented.

3.3.1.5. Permanent Outlet Facilities

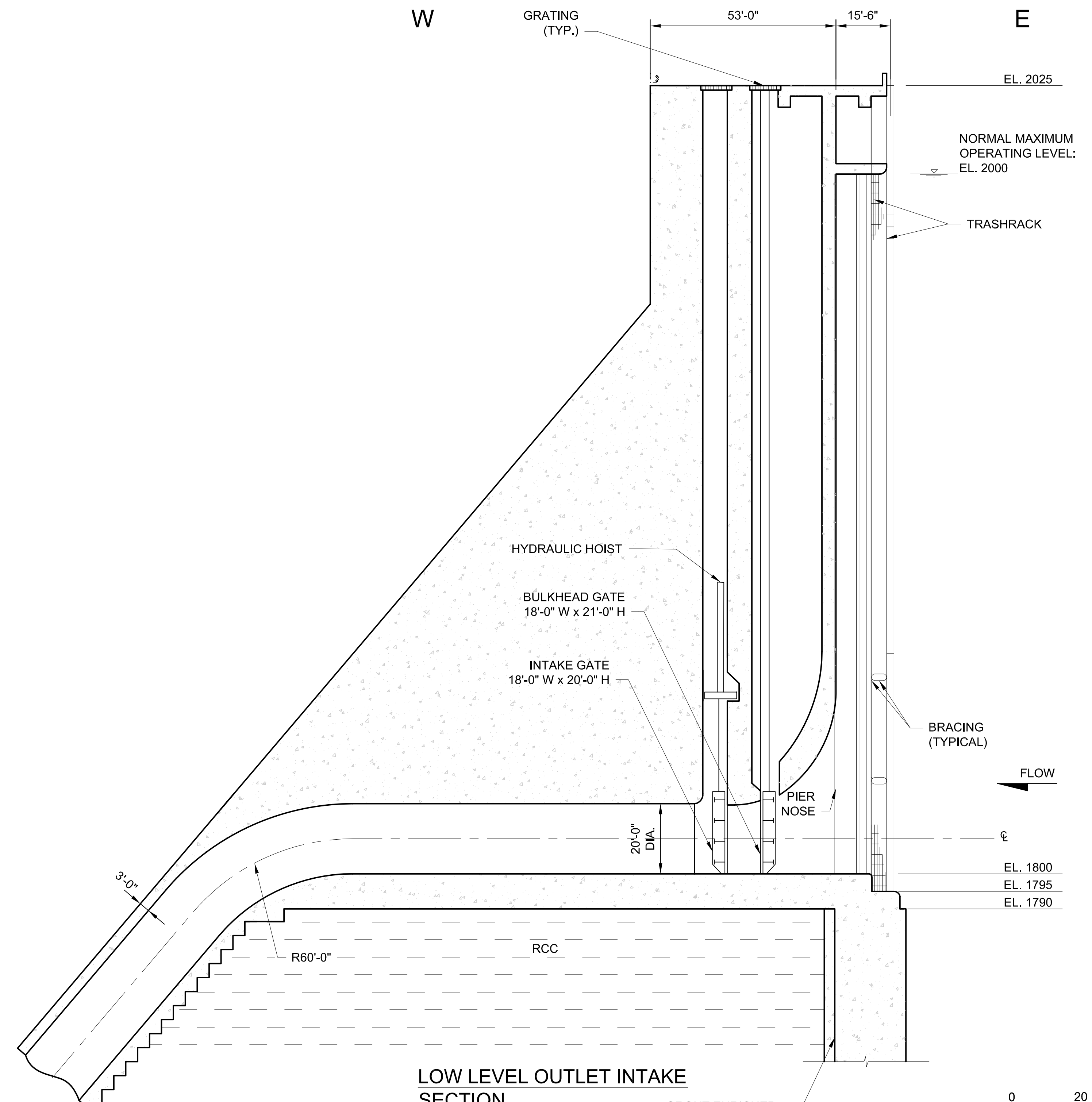
The primary function of the outlet facilities will be to provide continuing flows if the powerplant is inoperative. The arrangement of the outlet facilities is indicated on Figure 3.3-1 and Figure 3.3-2 presents further details. The use of fixed-cone discharge valves will ensure that downstream erosion will be minimal and will be configured so that any increase in the dissolved nitrogen content (as a result of the discharges) is minimized. The outlet facility will be able to release water from a lower level than the dam spillways and thus provide a method of discharging high flows without using the spillway. A secondary function will be to provide the capability to draw down the reservoir during an emergency situation.

The facilities will be located on the north end of the dam structure close to the spillway and will consist of two gated structures, and two steel conduits, each trifurcating into three steel pipes and an energy dissipation and control structure housing located beneath the spillway flip bucket. This structure will accommodate six fixed-cone valves which will discharge into the river below.



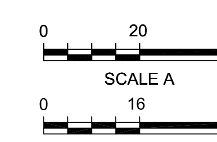
OUTLET SECTION

SCALE B



LOW LEVEL OUTLET INTAKE SECTION

SCALE A



REV	DESCRIPTION	BY	DATE

SCALE: AS NOTED

WARNING: 0 ½ 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

Project No.
Date 12/05/11
Designed A HUGHES
Drawn A FRISK
Approved B SADDEN

MWH

STATE OF ALASKA
ALASKA ENERGY AUTHORITY

SUSITNA-WATANA HYDROELECTRIC PROJECT

LOW LEVEL OUTLET

FIGURE 3.3-2

3.3.1.6. Spillway

The spillway will provide discharge capability for floods exceeding the capacity of the outlet facilities. The combined total capacity of the spillway and outlet facilities will be sufficient to safely pass the routed PMF.

The spillway, shown on Figures 3.3-1 and 3.3-3, will be located on the dam structure and the north bank of the Susitna River and will consist of a gated ogee control structure, a concrete-lined chute, and a flip bucket.

The spillway is designed to discharge flows corresponding to a maximum reservoir elevation of El. 2,014 ft msl.

3.3.1.7. Power Intake

Each of the three active penstocks will have its own power intake which will be a concrete structure mounted at the upstream face of the dam. Access to the structure will be from the dam crest road.

In order to draw from the reservoir surface over an expected drawdown range of 150 ft, two parallel vertical openings will be provided in the upstream concrete wall of the structure for each of the intakes. Sliding steel shutters operated in a common guide will be able to be adjusted to facilitate selective withdrawal. All openings will be protected by upstream trash racks. A heated boom will operate in guides upstream from the racks following the water surface, keeping the racks ice free.

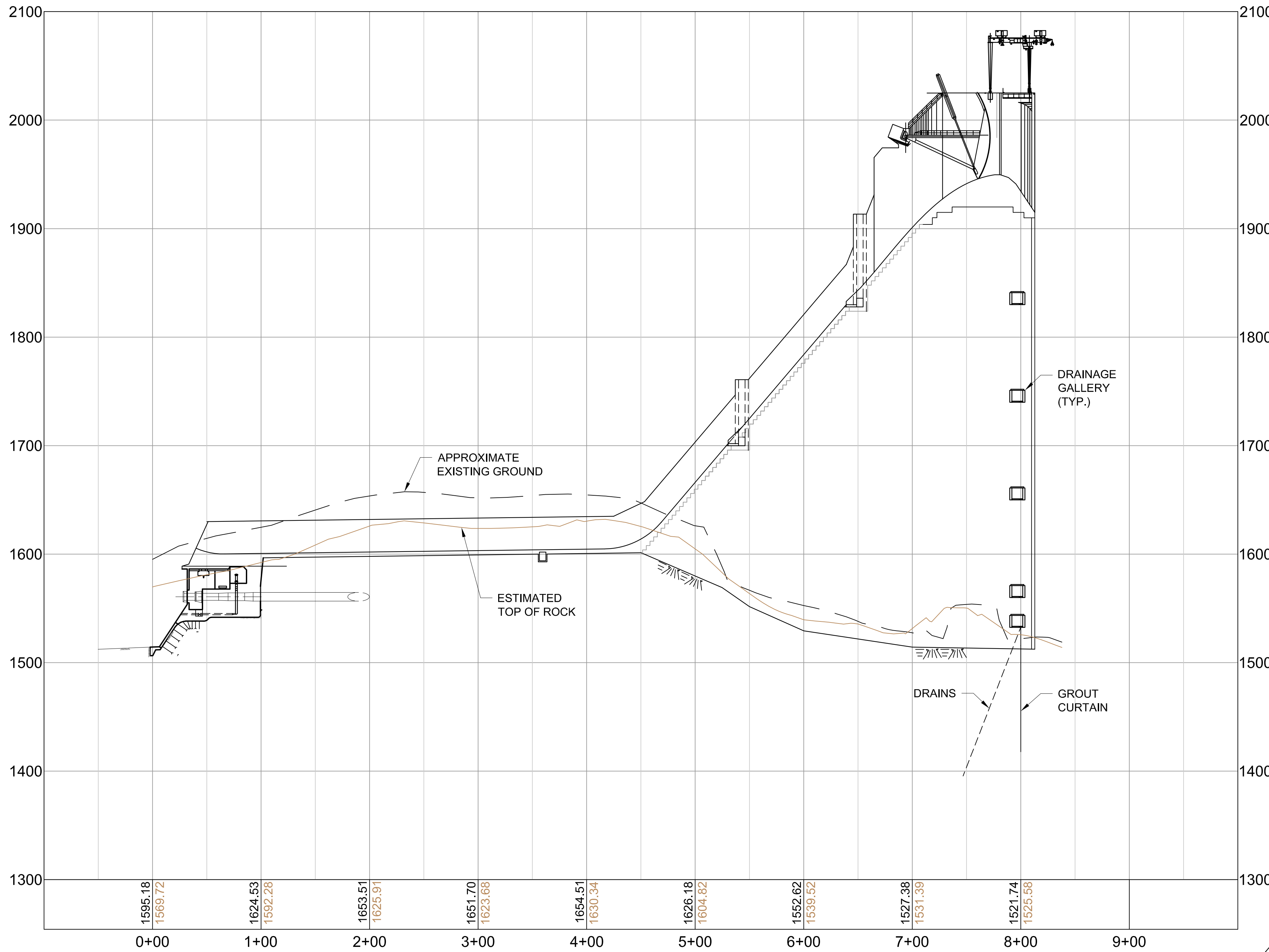
Lower control gates will be provided in each intake unit. A single set of upstream bulkhead gates will be provided for routine maintenance of the individual intake gates.

The overall width of each intake will be 65 ft.

The upper level of the concrete structure will be set at El. 2,025 ft msl, corresponding to the crest road. The level of the lowest intake is governed by the vortex criterion for flow into the penstock from the minimum reservoir level elevation of El. 1,850 ft msl.

The spare intake for the unused bay will be constructed at the time of dam construction, but will only be outfitted with stop logs to isolate the first part of the penstock.

The general arrangement of the power intake is shown on Figure 3.3-4.



SPILLWAY
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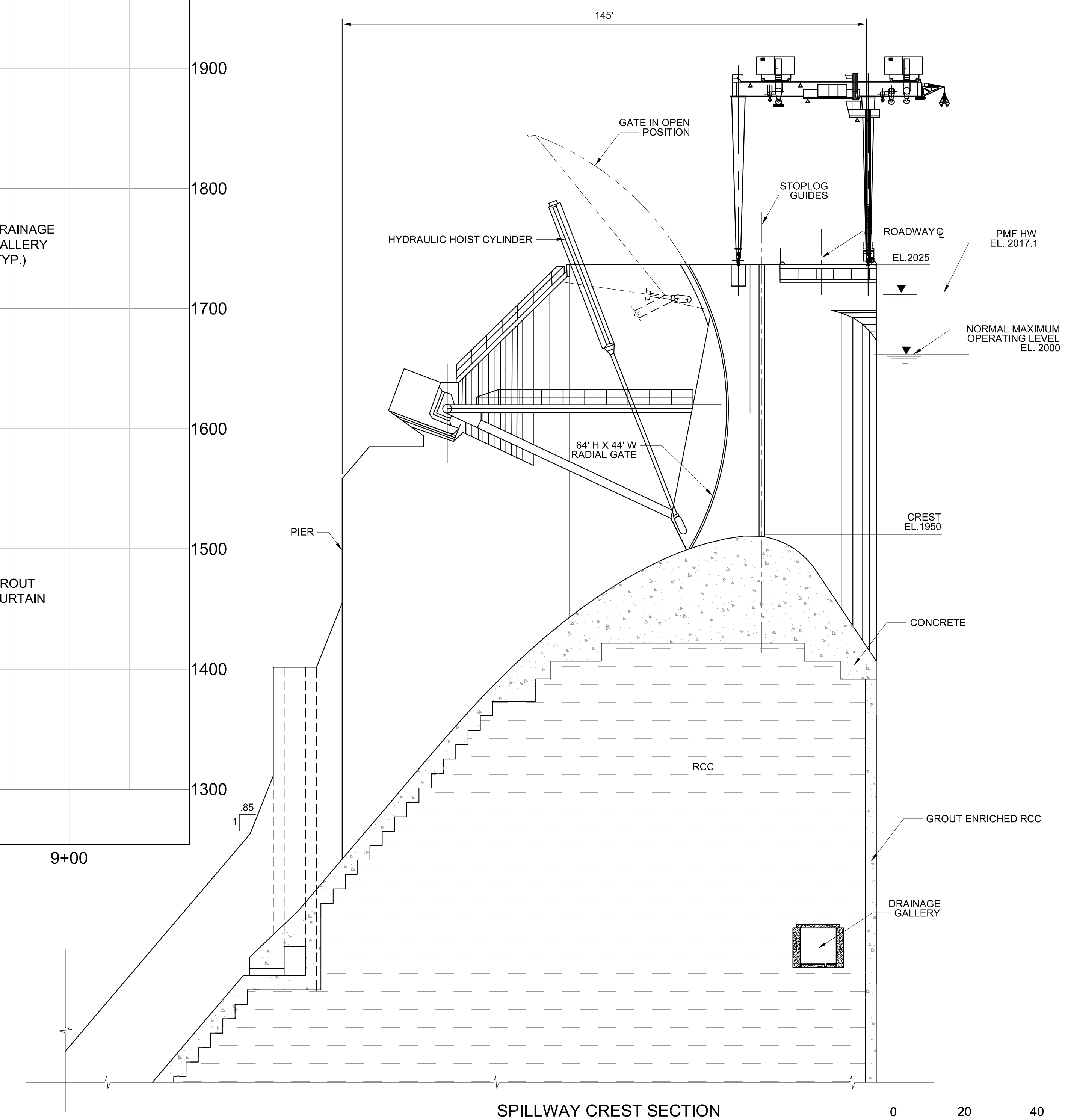

SPILLWAY CREST SECTION
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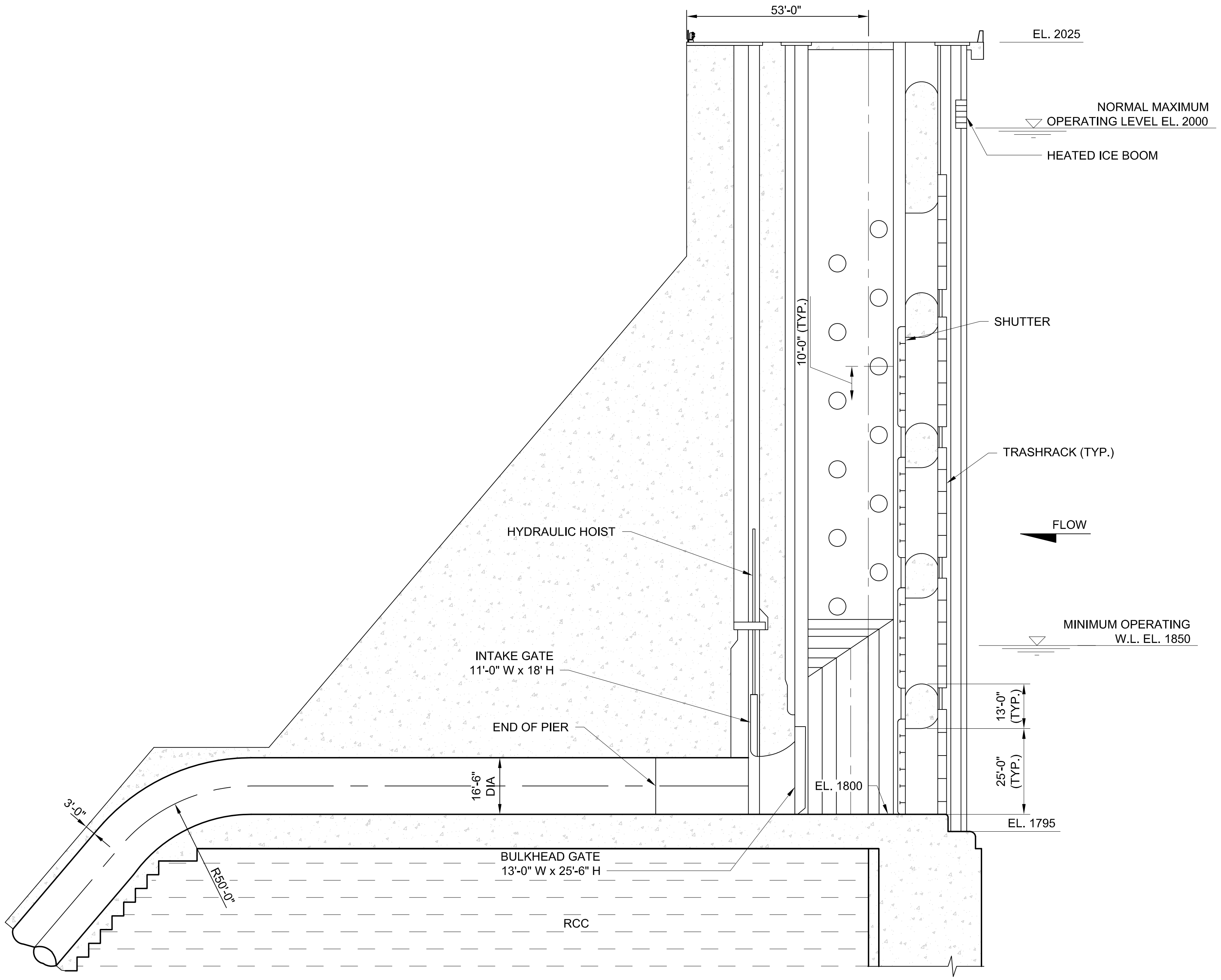
SUSITNA-WATANA HYDROELECTRIC PROJECT

OUTLET SPILLWAY

FIGURE 3.3-3



SECTION THROUGH POWER INTAKE
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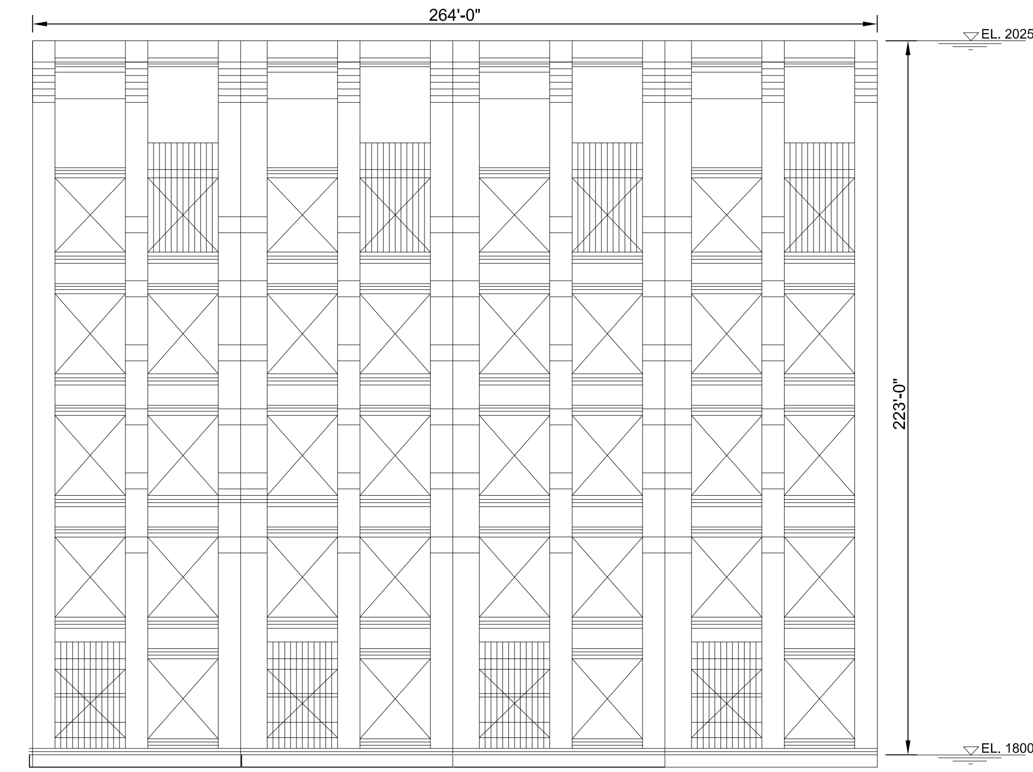

POWER INTAKE ELEVATION
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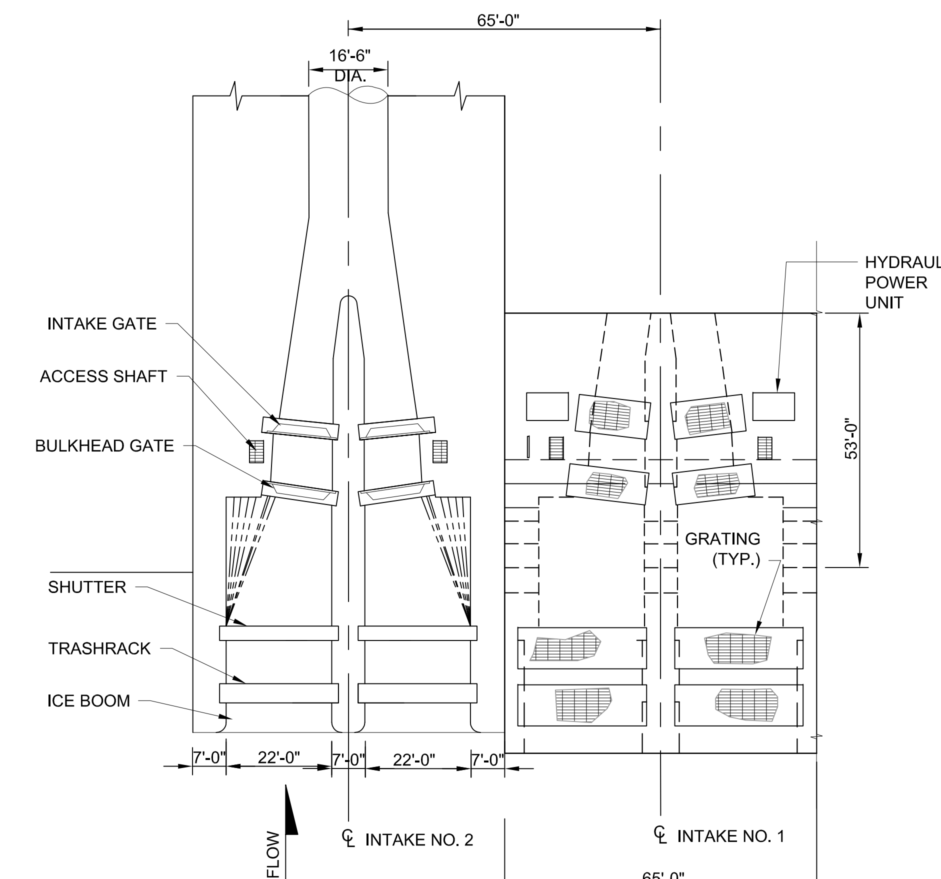

PLAN AT EL. 1812
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PLAN AT EL. 2025
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POWER INTAKE STRUCTURE

FIGURE
3.3-4

3.3.1.8. Penstocks

Each penstock is provided to convey water from the power intake to the powerhouse, one penstock for each generating unit. The penstock geometry consists of a short horizontal reach through the dam structure, a 50 degree bend, a penstock down the downstream face of the dam, another 50 degree bend and a short horizontal reach before the spiral case. The penstock will be approximately 16.5 ft in diameter, but their exact dimensions remain to be optimized. The penstock on the downstream face of the dam will be encased in concrete for protection.

The design static head on each penstock is 570 ft, at centerline distributor level (El. 1,430 ft msl). An allowance of up to 35 percent will be made for pressure rise in the penstock caused by hydraulic transients.

3.3.1.9. Powerhouse

The powerhouse will be a surface structure approximately 285 ft long by 78 ft wide constructed at the downstream toe of the dam, and will be founded on bedrock. Depending on the exact level of sound rock in the river bed, the powerhouse may be founded, effectively, on a concrete "infill" forming a downstream extension of the dam structure. This may be either RCC or conventional concrete. The exact method of placement will be determined during the project design.

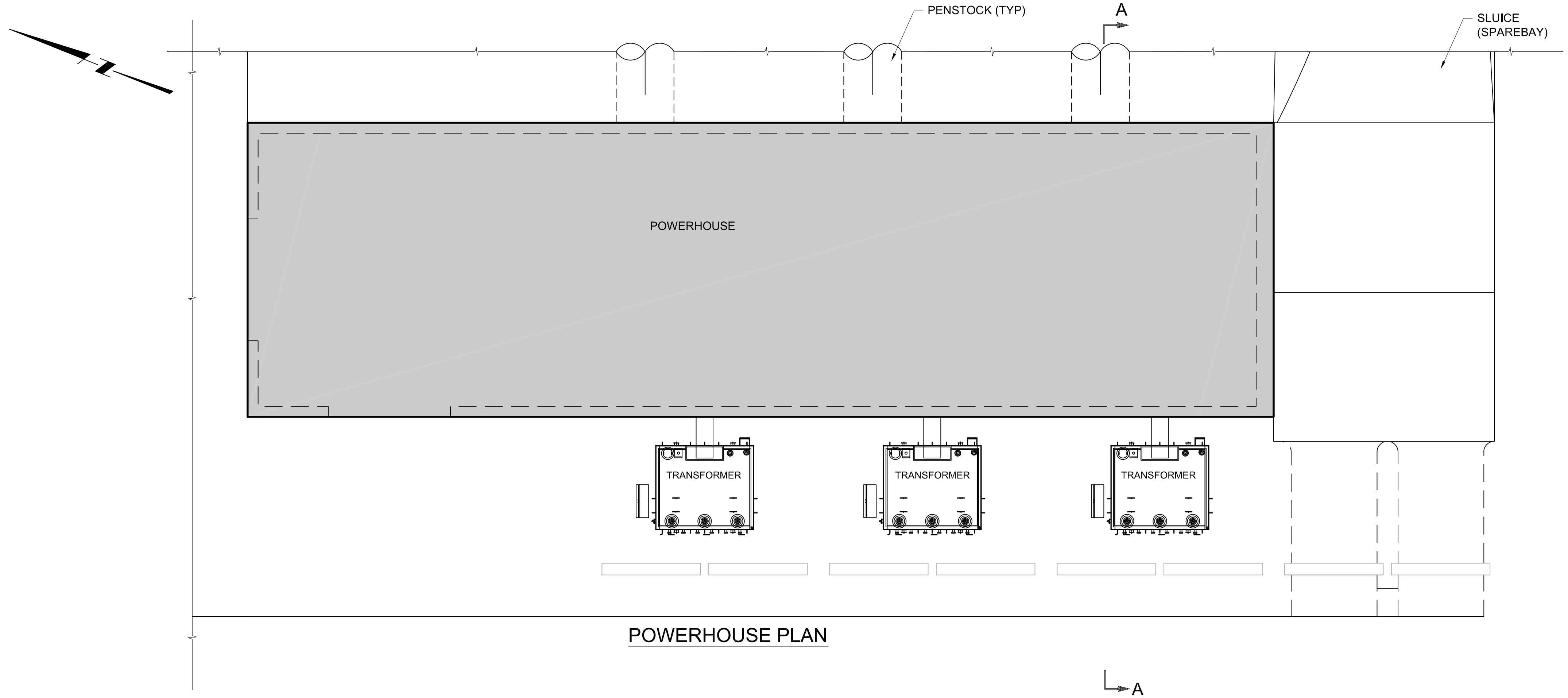
The powerhouse will be a surface structure parallel to the longitudinal access of the dam. Vehicular access will be from the north, through an access tunnel and under the spillway structure. The powerhouse will include an assembly bay, and three unit bays. Beyond the end wall of the powerhouse - to the south - a further bay will be constructed in case, in the future, AEA wishes to install a fourth unit.

On the draft tube deck will be mounted three unit transformers, together with a spare transformer. High voltage power lines will be anchored to the downstream face of the dam, spanning to the switchyard on the south bank of the river, downstream.

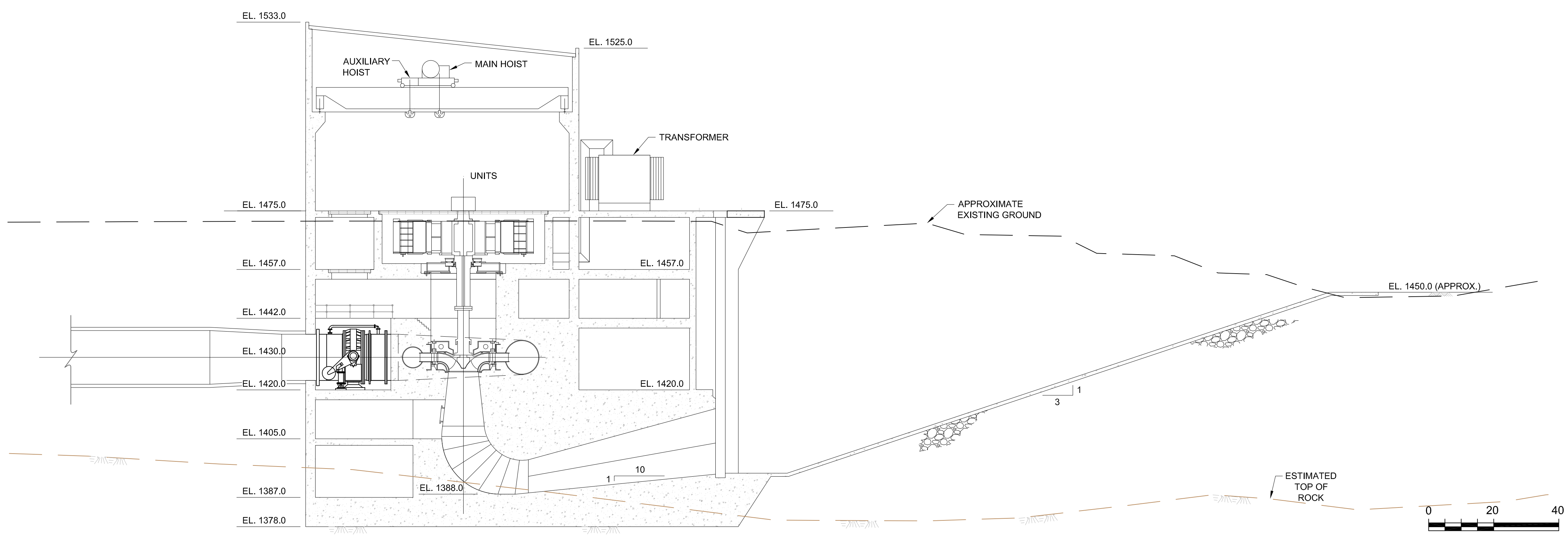
The general layout of the powerhouse complex is shown in plan and section on Figure 3.3-5.

The draft tube gate crane will be located on the draft tube deck, above the anticipated maximum tail water level.

Vehicular access to the powerhouse at Watana Dam will be provided by a single unlined rock tunnel from the north bank area at El. 1,560 ft msl, adjacent to the diversion tunnel portal. The access tunnel will descend to the deck level at El. 1,475 ft msl and will continue under the spillway structure to the powerhouse entrance. Access to the draft tube deck will either be from outside the powerhouse, or from the erection bay, and will be arranged so that a transformer can be offloaded and moved, or large equipment can access the areas around the powerhouse. The gradient will not exceed 9.5 percent in the permanent access tunnel.



POWERHOUSE PLAN



POWERHOUSE SECTION A-A

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A completely separate emergency egress will be provided at the southern end of the powerhouse. In emergencies, personnel can exit and withdraw from the powerhouse across the spare bay and up the separate access on the south abutment.

The main powerhouse will be designed to accommodate three vertical-shaft Francis turbines, in line, with direct coupling to synchronous generators. The length of the powerhouse will allow for a unit spacing of 65 ft, with a 90-foot long service bay at the north end for routine maintenance and for construction erection. Multiple stairway access points will be available from the main floor to each gallery level. Access to the transformer and draft tube deck from the powerhouse will be by a door in the west side of the erection bay. A service elevator will be provided for access to the various powerhouse floors.

Hatches will be provided through all main floors for installation and maintenance of heavy equipment using the powerhouse cranes.

3.3.1.10. Main Site Access Plan

3.3.1.10.1. Access Objectives

The primary objective of both temporary and permanent site access facilities is to provide a transportation system to support construction activities, and allow for the orderly development and maintenance of the Project. The current planning assumes restricted access during construction for safety considerations and permanent controlled public access. Another goal is to co-locate access roads and transmission facilities, as far as possible, in the same corridor to minimize impacts.

3.3.1.10.2. Access Plan Selection

The original license application in the 1980s reviewed 18 alternative access plans within three distinct corridors. The three corridors identified at that time were described as:

- A corridor running west to east from the George Parks Highway to the dam site on the north side of the Susitna River;
- A corridor running west to east from the George Parks Highway to the two dam sites on the south side of the Susitna River; and,
- A corridor running north to south from the Denali Highway to the Watana Dam site.

The final choice articulated in the 1985 draft amended license application after reflecting on the criteria, was an access road from the north (Denali Highway).

The final choice in the 1980s (identified as Access Plan 18, and as Denali Corridor in this document) continues to be a viable route now and would include a railhead facility at Cantwell. A new road would start at mile post (MP) 113.7 of the Denali Highway, although it is assumed that there would be improvements to approximately 20 mi of the Denali Highway at the Cantwell end to support the increased traffic during construction. At MP 113.7 a new road would be constructed south for approximately 44mi - as shown on Figure 1-1 to the Watana Camp site. The highest elevation of this route is 4,100 ft msl.

Other routes were studied by Alaska Department of Transportation and Public Facilities (ADOT&PF) in 2011. For this PAD there are three potential corridors including two western corridors paralleling the Susitna River described below.

The second route (termed Chulitna) runs east-west along the north side of the Susitna River, commencing at a new railroad facility at the Chulitna station. From this location, the road would cross Indian River before heading east into the Portage Creek valley, crossing Devil Creek and Tsusena Creek at higher elevations, before reaching the Watana camp. The new road construction is approximately 45 mi with a maximum elevation of approximately 3,250 ft msl.

The third route (termed Gold Creek and similar to Access Plan 16) commences at a new railroad facility to be constructed at the Gold Creek station. From Gold Creek, the route follows the Susitna River on the south bank and is approximately 50 mi long with a maximum elevation of 3,500 ft.

AEA proposes to study these three corridors. Creeks would be crossed using standard ADOT&PF bridge design, or using culverts as appropriate, and the construction is expected to be achieved using standard methods and local borrow pits/quarries within the corridor for fill and surfacing.

As noted the two east-west routes would not interconnect with a public road, terminating at the railhead at Chulitna or Gold Creek.

A study corridor width of up to approximately 5,000 ft has been shown on Figure 1-1, although at certain specific locations extra width may be required to skirt or surmount topographical features. The corridor width is slightly increased at both Watana Camp and the railheads.

3.3.1.10.3. Description of Access Plan

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 back up 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, etc.

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.

3.3.1.10.4. Right-of-Way

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. It is not anticipated that the Denali Highway would be a part of the Project.

Notwithstanding which road is chosen, the majority of the new road will follow terrain and soil types which 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. Typical road facilities are shown in Figure 3.3-6.

3.3.1.11. Site 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 during construction of the project. After construction, it is planned 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 contractors' 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.

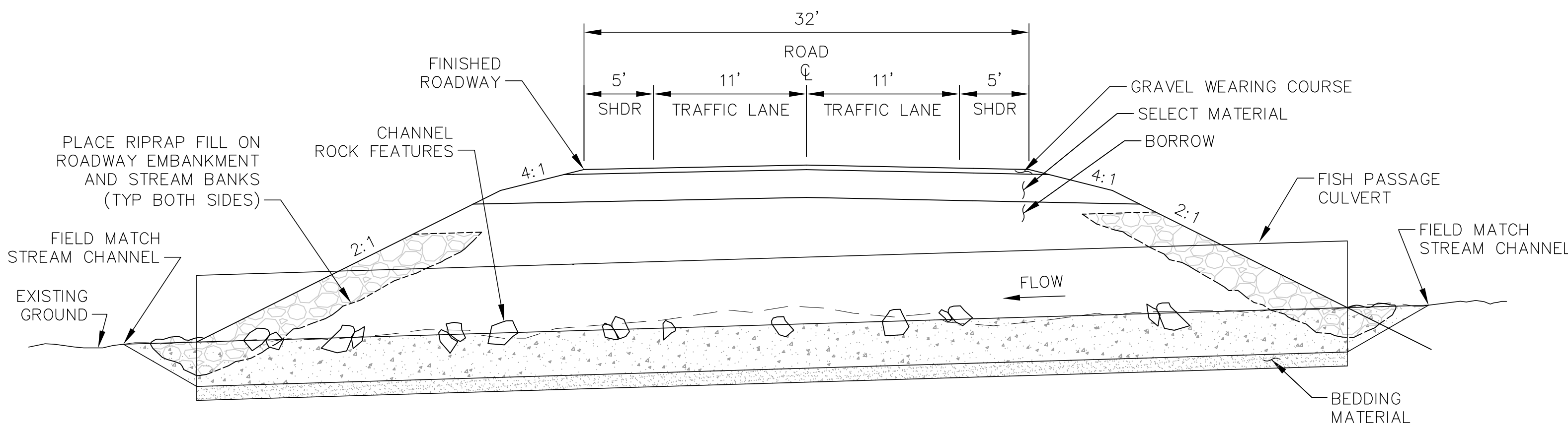
Permanent facilities will include community facilities for O&M staff members and any families. Other permanent facilities will include maintenance buildings for use during operation of the power plant.

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

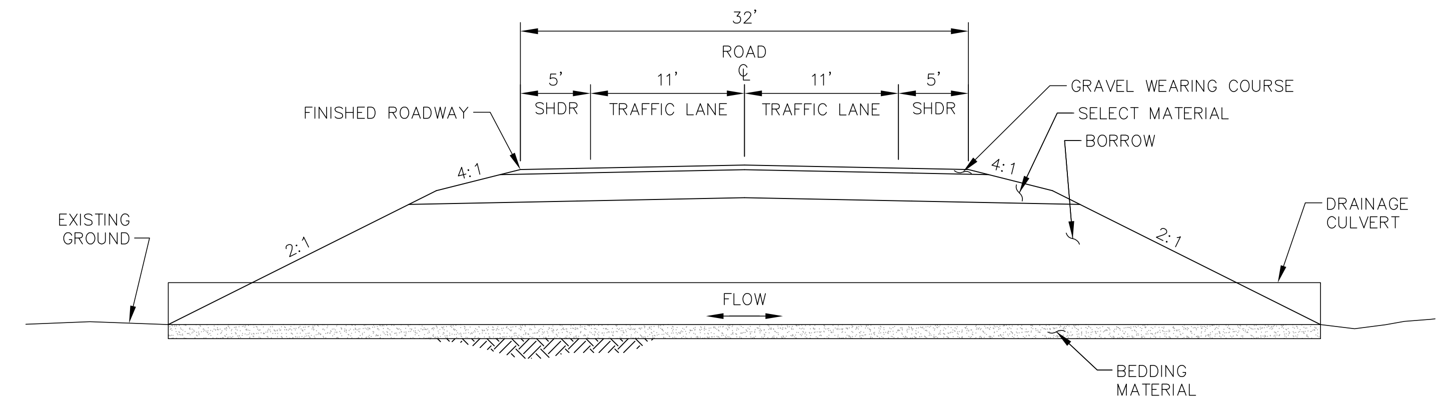
The location of the various facilities was essentially chosen during the infrastructure studies in the 1980s, with due regard to: size; accessibility; soils; wetlands; topography; water supply;

visual quality; living environment; recreational impacts; wildlife habitat; fishery impacts; cultural resources; and land ownership.

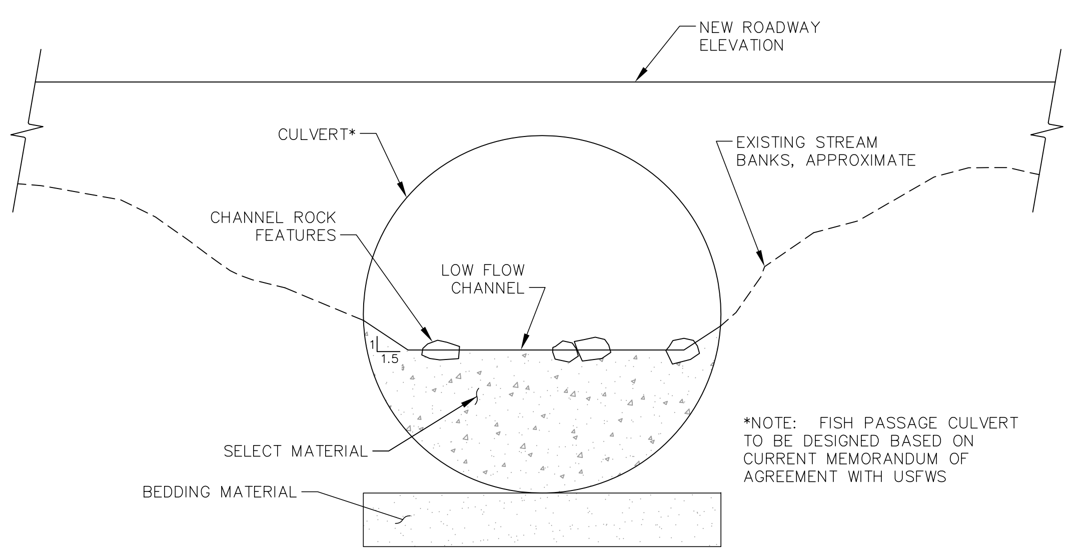
The construction camp will be surrounded by robust fencing to discourage local wildlife and will need to be properly maintained during the construction period and beyond.



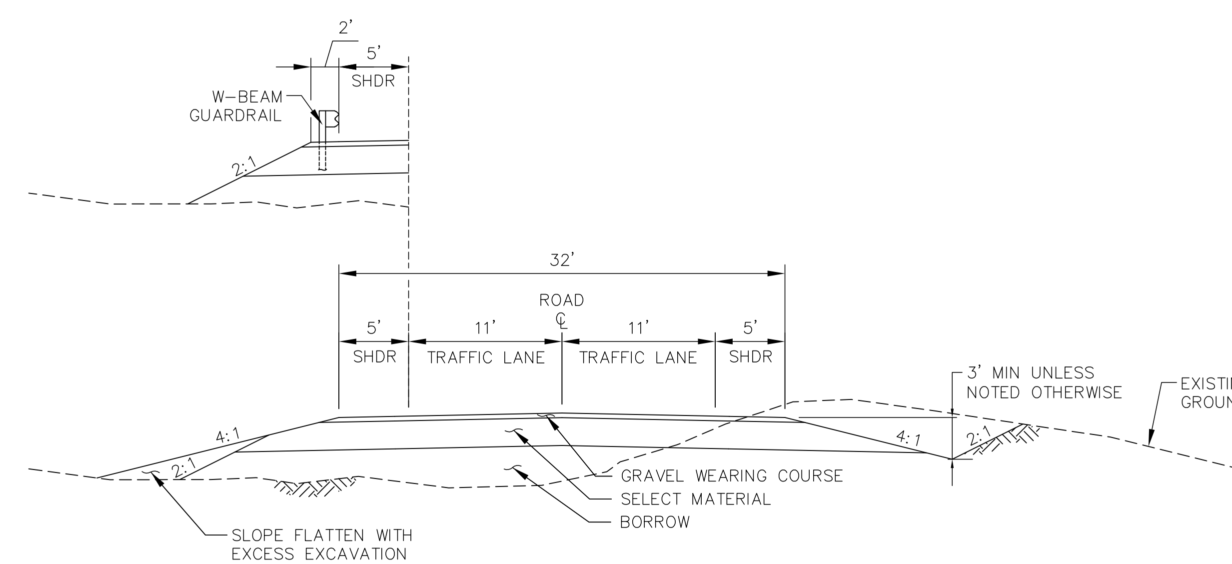
TYPICAL ROAD SECTION W/ FISH CULVERT



TYPICAL ROAD SECTION W/ DRAINAGE CULVERT



FISH PASSAGE CULVERT CROSS SECTION



TYPICAL ROAD CROSS SECTION

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TYPICAL ROAD DETAILS

FIGURE
3.3-6

3.3.1.11.1. Camp-Construction and Permanent Site Facilities

The proposed location of the temporary construction camp will be on the north bank of the Susitna River near Deadman Creek, approximately six mi northeast of the Watana Dam site. The north side of the Susitna River was chosen because most of the construction facilities and the diversion will be on the north, and south-facing slopes can be used for location of the structures. The proposed location is shown in Figure 4.1-1. During design development the temporary construction camp location may be changed within the proposed Project boundary.

Close to, but separated from the dormitory area of the construction camp, will be constructed separate accommodations for management staff from AEA; supervising engineers and construction managers; management staff from the contractors; and guest houses for visiting senior staff. Part of this separate area will remain as the permanent operator housing, but most of it will be demolished, along with the dormitories, at the end of construction. The area will be landscaped. The camp will be grouped around a service core containing recreation facilities, a small store and communal facilities. Facilities such as a fire station and medical facilities will also be part of the camp.

Construction power will be brought in by overhead line from the intertie, along the selected access road route (or the permanent transmission line route) at a voltage of 12.47 kV. Two transformers will be installed at a Watana substation to reduce the line voltage to the desired voltage levels for distribution. Backup generators will be incorporated into the system, located at the construction facilities. Power for the permanent accommodation will be supplied from the station service system after the power plant is in operation, but a standby generator will be incorporated.

The water supply system will provide for potable water and fire protection for the camp and selected contractors' work areas. The principal source of water will be Deadman Creek, with a backup system of wells drawing on ground water. The water will be treated in accordance with the U.S. Environmental Protection Agency's (EPA) primary and secondary requirements, and Drinking Water Standards of the State of Alaska, Department of Environmental Conservation (ADEC).

Telephone and internet communications will be provided during construction via fiber optic cables hung on the same poles as the construction power supply.

A wastewater collection and treatment system will serve the construction camp. One treatment plant will serve all facilities. Gravity flow lines, with lift stations, will be used to collect the wastewater from all of the facilities.

3.3.1.11.2. Contractors Facilities

The on-site contractors facilities will include offices; workshops; tire shops; stores for construction equipment spare parts; stores for permanent materials to be included in the works (both outdoor and climate controlled); fuel and grease storage; and general steel, woodwork, electrical and other workshops.

Space required by the contractors and their suppliers will be located between the main construction camp and the dam. At the railhead, there will also be temporary storage, to allow for scheduling of trucks from the railhead to the site.

3.3.1.11.3. Site Roads

Temporary construction roads will be needed to facilitate construction in and around the dam site. Construction roads will form the basis of the permanent road system, or will be restored with topsoil stored during construction.

3.3.1.11.4. Airstrip

Construction at the site is envisaged to proceed on the basis of 3 weeks on/1 week off (or similar), which will require considerable movement of personnel at the beginning and end of each working week, as well as the daily flow of visitors, food, spare parts, etc., and occasional evacuation of individuals. Previous studies concluded that an airstripcapable of accommodating Boeing 737 and C130 aircraft, as well as helicopters, is required.

At the time of the 1980s studies, an airstrip of a length 6,500 ft was selected because of the required take off length for a 737-200. Subsequent 737 models require a somewhat longer runway of 8,000 ft, and requirements for an increased runway length will be addressed during Project design.

Nine areas were studied for the airstrip and the selected site, based on the criteria mentioned above, as well as FAA criteria for glide paths and the requirements to accommodate the prevailing wind, have resulted in the location shown on Figure 4.1-1. This location selection will be revisited during licensing studies, but the final location will be within the proposed FERC Project Boundary.

3.3.2. Reservoir Data

The Watana Reservoir, at normal operating level of El. 2,000 ftmsl, 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. The reservoir will have a total capacity of 4.3 million ac-ft, of which 2.4 million ac-ft will be active storage.

3.3.3. Turbines and Generators

3.3.3.1. Unit Capacity

The Watana powerhouse will have three generating units, each with a maximum generator output of 282 MVA at a 0.9 power factor corresponding to the maximum normal reservoir level of El.

2,000 ft msl and a corresponding net head of 533 ft. The hydraulic capacity of each turbine will be 4,900 cfs when the reservoir is at El. 2,000 ft msl.

The net head on the plant will vary from 384 ft to approximately 533 ft.

The generator rating has been selected to match with the maximum turbine output of 250 MW under a net head of 533 ft. The generator output is assumed to be 98 percent of the turbine output at full load.

3.3.3.2. Turbines

The turbines will be of the vertical-shaft Francis type with steel spiral casing and a steel lined concrete elbow-type draft tube. The draft tube for each unit will comprise a single water passage with a center pier.

At the design head of 458 ft, the output of the turbine will be 206 MW. For study purposes, the best efficiency (best-gate) output of the turbines has been assumed as 85 percent of the full gate turbine output. Additional studies will be conducted, including electrical system studies, to determine turbine size. The unit size may be as low as 100 MW to ensure Railbelt electrical system reliability.

Each turbine will be provided with a straight-flow type butterfly valve. These guard valves will be located within the powerhouse, just upstream of the turbines.

3.3.3.3. Generators

Each of the three generators in the Watana powerhouse will be of the vertical-shaft type directly connected to a vertical Francis turbine. There will be one three-phase step up transformer per generator. The generators will be connected to the transformers by isolated phase bus through generator circuit breakers.

Each generator will be provided with a high initial response static excitation system. The units will be controlled from the regional energy control center in Anchorage or Fairbanks, with local control facility also provided at a control room on site and from facilities on the powerhouse floor. The units will be designed for black start operation.

The generators will be air-cooled, with a closed circuit air-to-water heat exchanger stator/rotor cooling system.

The generators will be provided with a high initial response type static excitation system supplied with rectified excitation power from transformers connected directly to the generator terminals. The excitation system will be capable of supplying 200 percent of rated excitation field (ceiling voltage) with a generator terminal voltage of 70 percent. The power rectifiers will have a one-third spare capacity to maintain generation even during failure of a complete rectifier module.

3.3.3.4. Governor System

The governor system which controls the generating unit will include a governor actuator and a governor pumping unit. A single separate governing system will be provided for each unit. The governor actuator will be the programmable logic controller (PLC) based digital electronic electric hydraulic type.

3.3.4. Appurtenant Mechanical and Electrical Equipment

Miscellaneous powerhouse mechanical equipment will include:

- Powerhouse Cranes
- Draft Tube Gates
- Draft Tube Bulkhead Crane
- Miscellaneous Cranes and Hoists
- Elevators
- Power Plant Mechanical Service Systems
    - Station Water Systems
    - Fire Protection System
    - Compressed Air Systems
    - Oil Storage and Handling
    - Drainage and Dewatering Systems
    - Heating, Ventilation, and Cooling
    - Service Facilities Mechanical Systems

The mechanical services at the control center will include:

- A heating, ventilation, and air conditioning system for the control room offices and other rooms workers may occupy;
- Domestic water and washroom facilities;
- A fire protection system for the control room; and
- A standby generator that will be located in a separate building or in a gallery adjacent to the access tunnel.

3.3.4.1. Accessory Electrical Equipment

Accessory electrical equipment will include the following:

- Main generator step-up 13.8/230-kV transformers;
- Isolated phase bus connecting the generators and transformers;
- Generator circuit breakers;
- 230-kV lines from the transformer terminals to the switchyard;
- Control systems of the entire hydro plant complex;
- Station service auxiliary AC and DC systems; and
- Other equipment and systems including grounding, lighting system, and communications.

3.3.4.1.1. Transformers and High Voltage Connections

The 3-phase transformers and one spare transformer will be located on the transformer (draft tube) deck, separated by blast walls. The high voltage bushings of the transformers will be connected to overhead transmission lines to the switchyard on the downstream left abutment. The lines will be anchored to the downstream face of the dam.

The isolated phase bus main connections will be located between the generator, generator circuit breaker, and the transformer. Tap-off connections will be made to the surge protection and potential transformer cubicle, excitation transformers, and station service transformers.

The generator circuit breakers will be enclosed SF6 circuit breakers suitable for mounting in line with the generator isolated phase bus ducts.

3.3.4.1.2. Control Systems

A PLC and PC-based Watana Control Room will be located at the power plant and will be linked through the supervisory system to the Dispatch Control Center.

The supervisory control of the entire Alaska Railbelt electrical power system is at the Dispatch Control Center. Independent operator controlled local-manual and local-auto operations will, however, be possible at the Watana power plant for testing/commissioning or during emergencies.

The Control Room at the project will be capable of control completely independent of the Dispatch Control Center in case of system emergencies.

The Watana plant will be capable of "black start" operation in the event of a complete blackout or collapse of the power system. The control systems of the plant will be supplied by a non-interruptible power supply from the station battery (DC) system.

The unit control system will permit the operator to initiate an entire sequence of actions by pushing one button at the control console, provided all preliminary plant conditions have been first checked by the operator, and system security and unit commitment have been cleared through the central dispatch control supervisor.

3.3.4.1.3. Station Service Auxiliary AC and DC Systems

A station service system will be designed to achieve a reliable and economic distribution system for the power plant.

A double ended unit substation switchgear arrangement will be used for providing the 480-V AC power distribution, the turbine-generator, and common station equipment. The switchgear will be provided with an automatic tie system that will automatically switch the 480-V AC service in the event that one of the unit substation main feeders fails. The system will also be automatically backed up with a diesel standby generator system.

A 120/208-V AC distribution system fed from the 480-V AC switchgear will be provided to serve the lighting and small powerhouse loads.

A 125-V DC battery system will be provided to serve the turbine-generator control and automation equipment along with other critical loads. Two station batteries will be provided. Two redundant battery chargers will be provided for each of the batteries. The batteries will be located in a ventilated battery room.

3.3.4.2. Switchyard

A surface switchyard will be sited on the south bank of the Susitna River (Figure 3.3-1). The switchyard station will provide switching for the generator transformer banks and three transmission lines. A breaker-and-a-half bus switching scheme will be provided as shown in the single line electrical diagram in Figure 3.3-7. This arrangement provides the desired switching flexibility and reliability of service required by the adopted system reliability criteria. Disconnecting and grounding switches as well as voltage transformers will be provided for each of the circuits.

3.3.5. Transmission Facilities

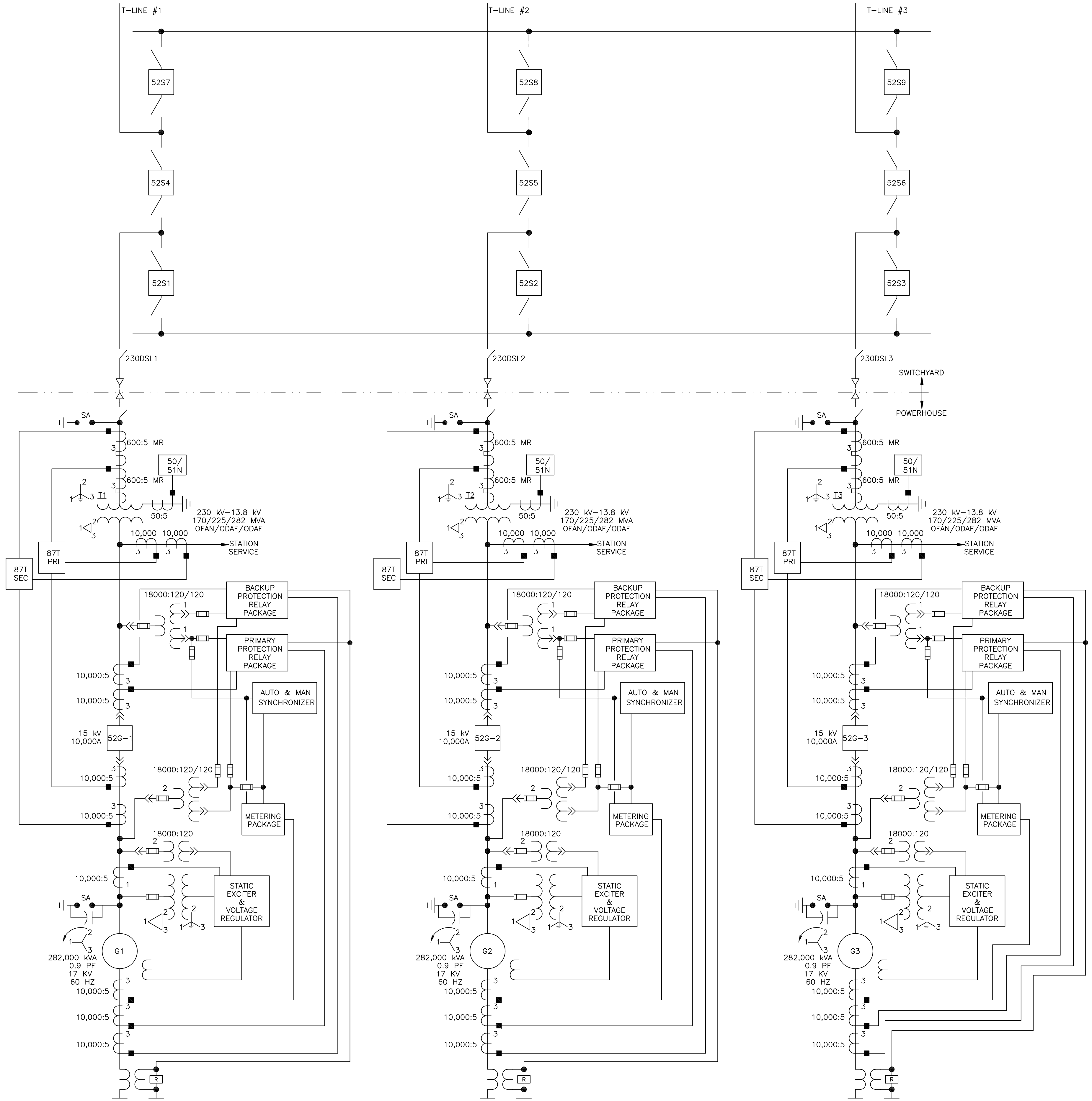
3.3.5.1. Transmission Facilities

The transmission facilities will consist of three overhead transmission lines, switchyards, substations, and a communications system. The interconnection of the primary project transmission line with the existing Alaska Intertie will either be near Chulitna, Gold Creek, or Cantwell, depending on system considerations that will be studied during the License Application preparation. The current plan is either two circuits running west and one north or all three circuits running westward.

3.3.6. Description of Transmission and Interconnection Facilities

3.3.6.1.1. Transmission Corridor

At this time, three corridors are being considered. Two would run generally westward from the dam, one on the north of the Susitna River and one south to connect with the Alaska Intertie near Chulitna and Gold Creek, respectively. The third corridor would run north where it would intersect with the Denali Highway and then follow the highway corridor to a point of interconnection near Cantwell. The transmission facilities are intended to be co-located with the road facilities to the extent possible as described in Section 3.3.6.1.2. The most likely configuration of transmission is described below. The locations of the corridors under study are shown on Figure 3.3-8.



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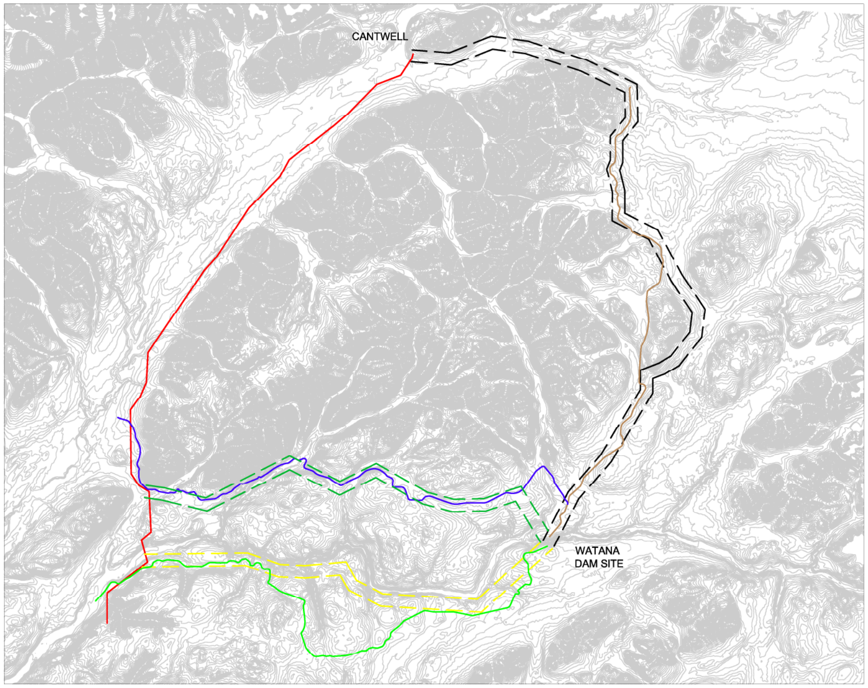
ONE LINE DIAGRAM

FIGURE
3.3-7

WATANA OVERVIEW MAP



PROPOSED TRANSMISSION LINE CORRIDORS

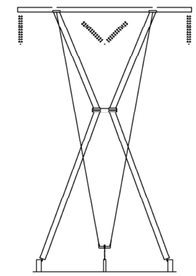
- CHULITNA
- DENALI
- GOLD CREEK

ANCHORAGE- FAIRBANKS INTERTIE

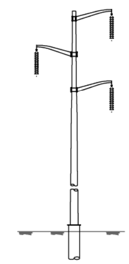
ROAD ALTERNATIVES

- CHULITNA
- DENALI
- GOLD CREEK

CONTOURS-100 FT



X- STRUCTURE TOWER
900 FT SPANS



SINGLE POLE
400 FT SPANS

REV	DESCRIPTION	BY	DATE	SCALE	WARNING		
				AS NOTED	0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE	Project No.	
						Date	
						Designed	D LARUE
						Drawn	A FRISK
						Approved	B SADDEN

MWH®

STATE OF ALASKA
ALASKA ENERGY AUTHORITY
ALASKA ENERGY AUTHORITY

SUSITNA-WATANA HYDROELECTRIC PROJECT

TRANSMISSION LINE ROUTE
AND TYPICAL DETAILS

FIGURE
3.3-8

3.3.6.1.2. Components

At the Watana site, a 230-kV substation/switchyard will be provided. The generator transformers will be located on the powerhouse draft tube deck. Overhead lines will connect the generator transformers to the 230-kV switchyard. The switching arrangement at the switchyard will be a breaker-and-a-half arrangement which will provide the necessary switching feasibility and reliability.

From Watana, two single-circuit 230-kV lines will be built westward and one northward to the Alaska Intertie and a switching station in 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 twin 230-kV circuit 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 double circuit 230-kV lines would not follow the planned road corridor, rather the transmission line 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.

3) 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 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.

3.3.6.1.3. Right-of-Way

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 ft 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.

3.3.6.1.4. Transmission Lines

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.

The conductor capacity for the lines will be in the range of 1,950 kcmil; this can be provided in several ways. Typical transmission facilities are shown in Figure 3.3-8. Typical of these is a phase bundle consisting of two 954 kcmil "Rail" (45/7) Aluminum Conductor Steel Reinforced (ACSR) or a single 2,156 NCM "Bluebird" (84/17) ACSR conductor, both of which provide comparable levels of corona and radio noise within normally accepted limits. The single “Bluebird" conductor attracts less load under wind or ice loadings and avoids the need to provide the space damper devices required for a bundled phase. The single conductor is stiffer and heavier to handle during stringing operations, although this will tend to be balanced out due to the extra work involved in handling the twin bundle. Selection of the optimum conductor arrangement will be made in final design. The conductor will be specified to have a dull finish treatment to reduce its visibility at a distance.

Two overhead ground wires will be provided the full length of the line. These will consist of 3/8-inch diameter galvanized steel strands. The arrangement will be based on a shielding angle of 15 degrees over the outer phases; this will provide protection against lightning strikes to the line. More refined studies of the lightning performance of the line will be made during final design to confirm the arrangement outlined above.

The transmission structures and foundations that serve to support the conductors and ground wires will be designed for a region where foundation movement due to permafrost and annual freeze-thaw cycling is common. Of the structural solutions that have proved successful in similar conditions, all utilize an arrangement of guy cables to support the structure and depend upon the basic flexibility inherent in guyed structures to resist effects of foundation movement. The guyed “X” design has been selected for use on the Alaska Intertie and is therefore a prime candidate for consideration on the Watana lines.

Structures for larger angle and dead-end applications will be in the form of individual guyed masts, one for each phase. Individual guyed masts will also be used for lengths of line that are judged to be in unusually hazardous locations due to exposure in extremely rugged terrain. All structures will utilize a “weathering” steel which ages over time to create a dark brown appearance which generally has a more pleasing appearance than galvanized steel or aluminum.

Foundations for structures will utilize driven steel piles in unstable soil conditions. In better soils steel grillage foundations will be used and set sufficiently deep to avoid the effects of the freeze-thaw cycle. Rock footings will employ grouted rock anchors with a minimum use of concrete to facilitate winter construction. Foundations for cantilever pole type structures will be large diameter cast-in-place concrete augered piles. Several types of guy anchor will be available for use; they include the screw-in helix type, the grouted bar earth anchor, driven piles and grouted rock anchors. Selection of the most economical solution in any given situation will depend on the site specific constraints including soil type, access problems and expected guy load. Foundation sites will be graded after installation to contour the disturbed surface to suit the existing grades. Tower grounding provisions will depend upon the results of soil electrical resistivity measurements both prior to and during construction. Continuous counterpoise may be required in sections where rock is at or close to the surface; it also may be required in other areas of high soil resistance. The counterpoise will take the form of two galvanized steel wires remaining at a shallow bury parallel to and under the lines. These will be connected to each tower and cross connected between lines in the right-of-way.

3.3.6.1.5. Substations at Interconnection with Alaska Intertie

Construction access to all sites will be over the route of the permanent access provided for each location. Any grading of the sites will be carried out on a balanced cut-and-fill basis wherever possible. Equipment will be supported on reinforced concrete pad-and-column type footings with sufficient depth-of-bury to avoid the active freeze-thaw layer. Backfill immediately around the footings will be granular to avoid frost heave effects.

Light equipment may be placed on spread footings if movements are not a significant factor in operational performance.

The station equipment requirements are determined by the breaker-and-a-half arrangement adopted, for reasons of reliability and security of operation. One and one-half breakers will be needed for each line or transformer circuit termination. The transformer capacities are determined by the load requirements at each substation. Control and metering provisions will cater to the plan for remote operation of all the facilities in normal circumstances. Protective relaying schemes for the 230-kV system will be in accordance with conventional practices, using the general philosophy of dual relaying and the local backup principle.

The station layouts are based on conventional outdoor design with a two-level bus which will result in a relatively low profile. This will assist in limiting the visual impact of the stations and make the most of any available neutral buffers. Although they will be remotely controlled, all stations will be provided with a control building; in larger stations an additional relay building will be provided. A storage building will also be provided for maintenance purposes. Each station will have auxiliary power at 480 V; the normal 480-V AC power will be supplied from the tertiary on the autotransformers or the local utility.

3.4. Proposed Construction and Development Schedule

The Project schedule presented in Figure 3.4-1, 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:

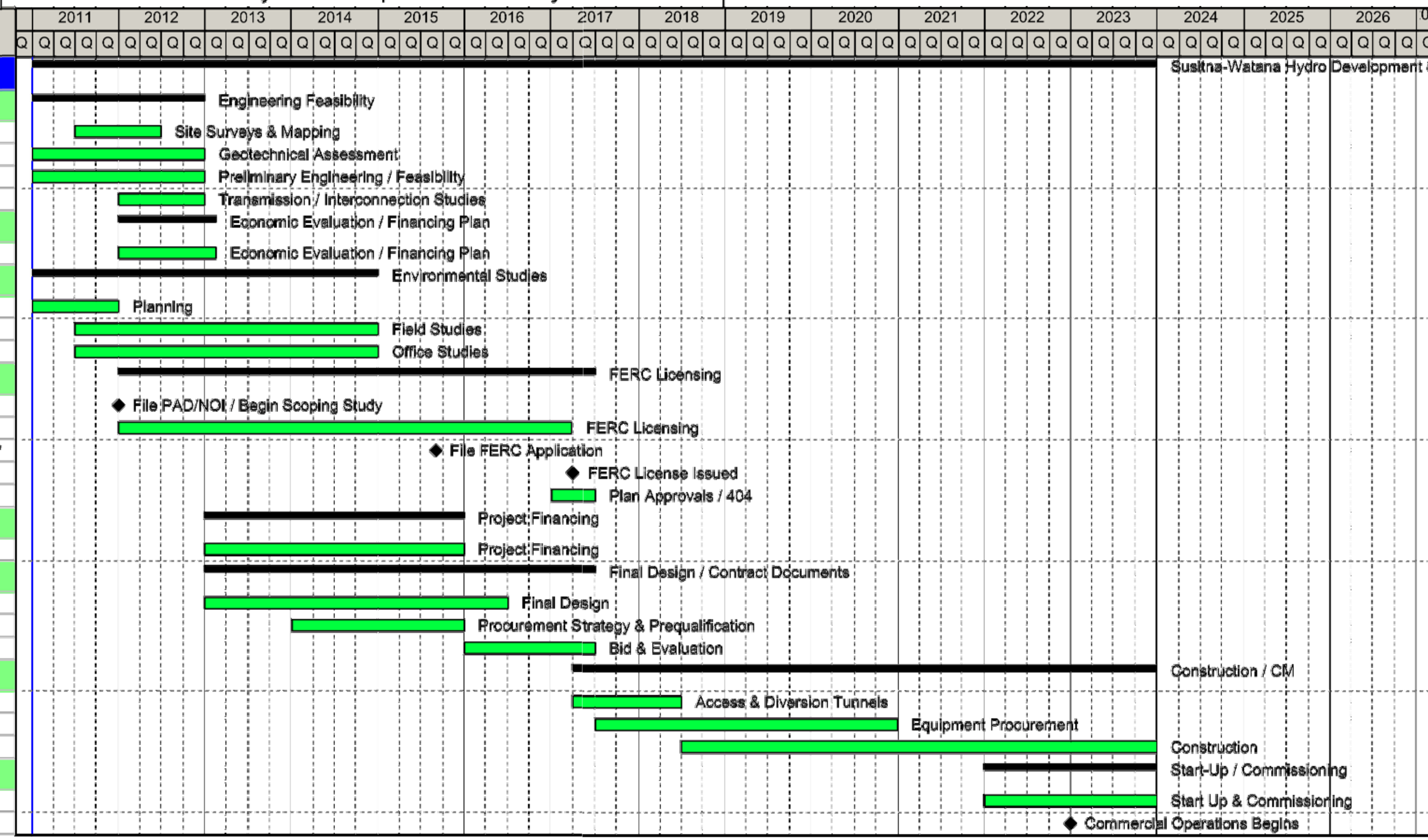
- Total schedule – 12 years, 2012-2023
- Pre-Application studies and related activities 3.5 years
- FERC and Cooperating agencies post-filing activities – approximately 1.5 years.
- Project Construction – 6.5 years
- Reservoir filling – one to two years
- Site Restoration – throughout construction.

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.

Susitna-Watana Hydro Development Preliminary Schedule

01-Dec-11 16:51

Activity ID	Activity Name	Start	Finish
	Susitna-Watana Hydro Development Schedule	03-Jan-11	29-Dec-23
	Engineering Feasibility	03-Jan-11	31-Dec-12
A1000	Site Surveys & Mapping	01-Jul-11*	29-Jun-12
A1080	Geotechnical Assessment	03-Jan-11*	31-Dec-12
A1090	Preliminary Engineering / Feasibility	03-Jan-11*	31-Dec-12
A1100	Transmission / Interconnection Studies	02-Jan-12*	31-Dec-12
	Economic Evaluation / Financing Plan	02-Jan-12	14-Feb-13
A1010	Economic Evaluation / Financing Plan	02-Jan-12*	14-Feb-13
	Environmental Studies	03-Jan-11	31-Dec-14
A1020	Planning	03-Jan-11*	30-Dec-11
A1110	Field Studies	01-Jul-11*	31-Dec-14
A1120	Office Studies	01-Jul-11*	31-Dec-14
	FERC Licensing	02-Jan-12	30-Jun-17
A1029	File PAD/NOI / Begin Scoping Study		02-Jan-12*
A1030	FERC Licensing	02-Jan-12*	31-Mar-17
A1031	File FERC Application		01-Sep-15*
A1150	FERC License Issued		03-Apr-17*
A1160	Plan Approvals / 404	03-Jan-17*	30-Jun-17
	Project Financing	01-Jan-13	31-Dec-15
A1040	Project Financing	01-Jan-13*	31-Dec-15
	Final Design / Contract Documents	01-Jan-13	30-Jun-17
A1140	Final Design	01-Jan-13*	01-Jul-16
A1141	Procurement Strategy & Prequalification	02-Jan-14*	31-Dec-15
A1145	Bid & Evaluation	01-Jan-16*	30-Jun-17
	Construction / CM	03-Apr-17	29-Dec-23
A1128	Access & Diversion Tunnels	03-Apr-17*	29-Jun-18
A1129	Equipment Procurement	03-Jul-17*	31-Dec-20
A1130	Construction	02-Jul-18*	29-Dec-23
	Start-Up / Commissioning	03-Jan-22	29-Dec-23
A1070	Start Up & Commissioning	03-Jan-22*	29-Dec-23
A1170	Commercial Operations Begins		02-Jan-23*



REV	DESCRIPTION	BY	DATE	SCALE	WARNING	Project No. / Date / Designed / Drawn / Approved					Sheet No.
				NO SCALE	0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE		SUBMITTAL PHASE/DATE NOT FOR CONSTRUCTION STAMP, SIGNATURE BLOCK STAMP, CONFORMED STAMP OR RECORD DRAWING STAMP (SEE MWHCOMMON.CEL)	MWH	STATE OF ALASKA ALASKA ENERGY AUTHORITY	SUSITNA-WATANA HYDROELECTRIC PROJECT PROJECT DEVELOPMENT SCHEDULE	3.4-1 SHEET OF X

3.5. Project Operations

As noted previously, a final decision on the exact configuration and size of the generating facilities will be made during the licensing studies. The preliminary Project design includes 600 MW installed capacity in 3 units. The current study program and collaboration with utilities will continue to be carried out during the 2012-2013 timeframe to determine the optimum size of the Project and units to meet projected future Railbelt power requirements over the operating life of the Project. Based on those future projections a final project operating plan will be developed for inclusion in the application to FERC for a license.

3.5.1. Proposed Project Operations

During the preparation of this document computer modeling of several potential reservoir operation scenarios has been performed using the preliminary (Base Case) Project configuration as described above in Section 3.3. It is planned that the Project would be operated in a load-following mode such that firm power is maximized during the critical winter months of November through April each year to meet Railbelt utility load requirements. To accomplish this, the reservoir would be drafted annually by an average of about 120 ft; the maximum annual drawdown would be approximately 150 ft, with a probability of occurring about once or twice in 50 years. Flow discharges through the powerhouse under this operating plan would range from a low of zero cfs when the power plant is off line on rare occasions during emergency outages, to a high of about 14,500 cfs during times of maximum power generation. When the power plant is not discharging, instream flow releases would be made through a 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, powerhouse discharges would vary over a 24-hour period in the winter months, typically ranging from a low of 3,000 cfs to a high of 10,000 cfs. For the Base Case operating plan, initial operation model runs have been made using the Case E-VI minimum instream flow criteria developed during the 1980s APA Susitna Hydroelectric Project studies. Those criteria specified a minimum wintertime flow release of 2,000 cfs and a minimum summertime flow release of about 9,000 cfs. Environmental studies will guide the daily range of flow variation permitted.

3.5.1.1. Reservoir Operation and Drawdown

The following description of a potential reservoir operation scenario has been developed using results of initial Base Case operations model runs, and serves as a starting point for further refinements. All information is subject to change as conceptual planning takes place for the Project and the License Application is prepared.

The primary operating objective for the modeling of the Base Case scenario was to maximize firm power generation during the winter months of November through April. Therefore, the model assumes that the reservoir would be drafted to meet those objectives. The maximum annual drawdown to achieve the target is projected to be about 150 ft, although different draw downs will be considered during future conceptual planning studies. Figure 3.5-1 presents the modeled daily reservoir elevations for four selected years (from the available flow records) of operation, including the maximum year (1990), the minimum year (1970), the second minimum year (1974), and the most nearly average year (1986). As indicated, the reservoir can be filled in almost every year, even after reaching the minimum power pool level at El. 1,850 ft msl during the minimum inflow year. Generation requirements were reduced during the minimum year (1970) when the reservoir level was far short of filling in late summer and it would be known that full generation requirements could not be met.

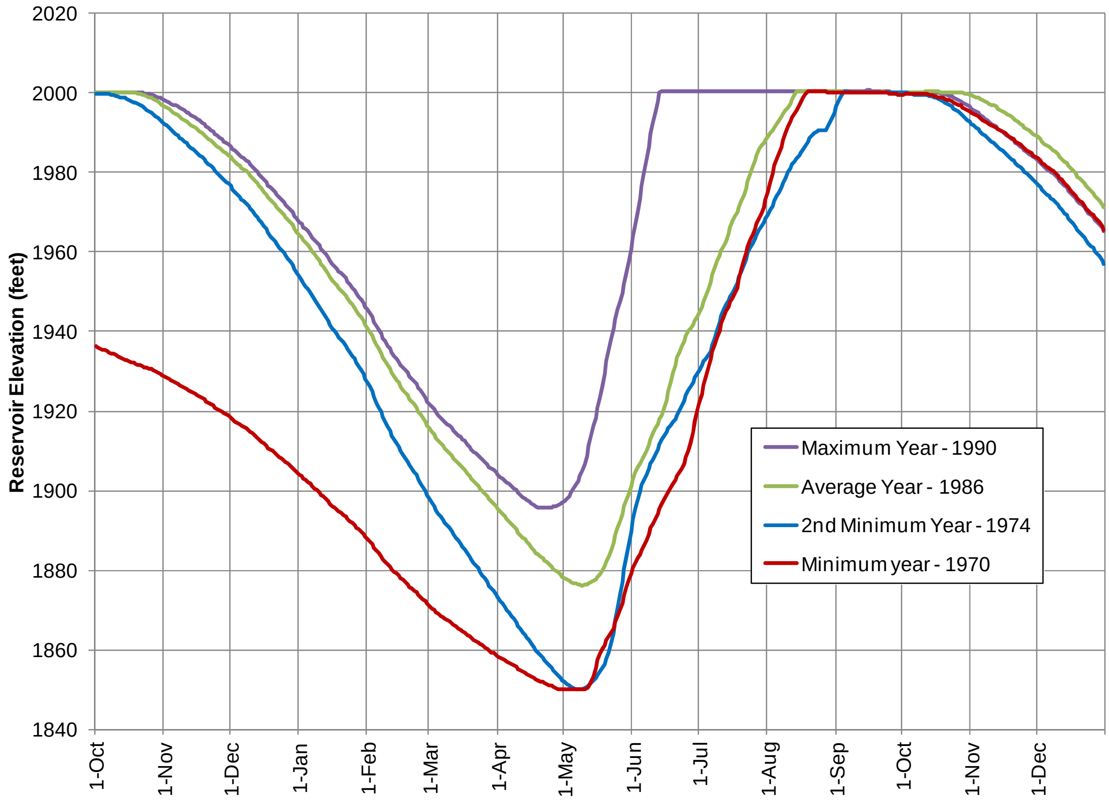


Figure 3.5-1. Daily Reservoir Elevation (ft) for Selected Years

The modeled reservoir fluctuation during the driest period of record is presented on Figure 3.5-2 for illustration purposes

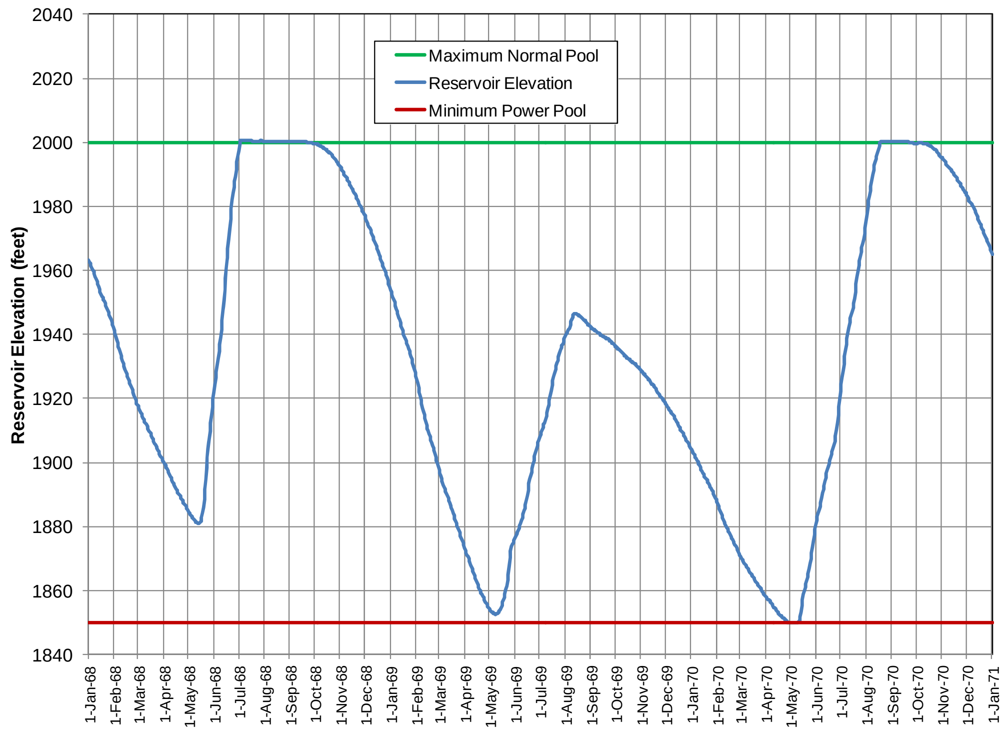


Figure 3.5-2. Reservoir Elevation (ft) for the Driest Period

3.5.1.2. Minimum Flow Releases

Minimum flow requirements in the Susitna River downstream of the Watana Dam have not yet been established. An acceptable flow regime will be determined through the planned licensing studies and through agencies' and other Participants' collaboration.

Similar to the current, natural river flow conditions, after the Project is constructed downstream flows at the project site are expected to vary significantly on a seasonal, weekly, and daily basis. In addition to the flows discharged through the powerhouse for generation purposes, flow augmentation, when required, will also be made by making releases through the low-level outlets if the powerhouse is not operational. A preferred environmental flow regime (designated as Case E-VI) was developed for the previous FERC License Application in 1985 for the larger (1,790 MW) APA Susitna Hydroelectric Project proposal and is presented in Figure 3.5-3 below.

Although no final decision on these recommended flows was made during the 1980s license considerations by FERC, this flow release schedule was considered by the applicant (Alaska Power Authority) as the optimum to meet a variety of downstream requirements, and therefore it has been used for the current operation study runs as the Base Case flow scenario. As shown on Figure 3.5-3 on an average monthly basis, with the Project in place, regulated peak summer flows downstream of Watana Dam at Gold Creek would be reduced and winter flows would be increased in comparison to the natural flow regime. The previously recommended environmental flow regime will be subject to further analysis during the licensing study period.

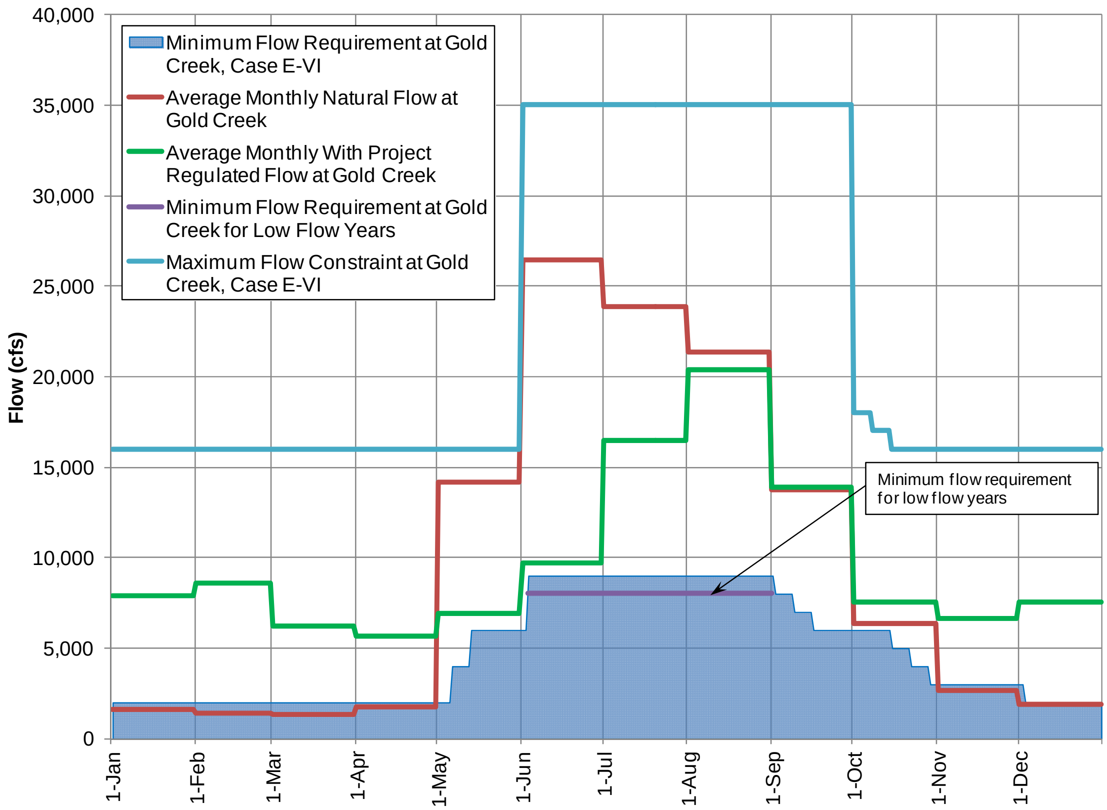


Figure 3.5-3. Average Monthly Natural and Regulated Flows, modeled flows, and 1985 Environmental Flow Schedules at Gold Creek (Case E-VI)

3.5.2. Proposed Project Generation

3.5.2.1. Operational Objectives

The 1985 FERC License Application envisioned the APA Susitna Hydroelectric Project as a load-following project. Under that operating mode there would be variation in powerhouse discharge to meet hourly and daily Railbelt electrical loads, satisfy downstream environmental flow requirements, and prevent spill, therefore optimizing power generation within the constraints of the system. As noted, this mode of operation was used as a premise for the initial Base Case model runs.

For the Base Case model runs, the primary operating objectives of the Project included the following:

- Maximize firm power generation during the months of November through April.
- Generate power as necessary to meet Case E-VI minimum flow requirements at Gold Creek as stated in the 1985 FERC License Application.
- Maximize power generation during the months of May through October without reducing the firm power generation during the November through April period.

- Shape generation according to Railbelt area power requirements, to the extent possible with the other given objectives.

Future operations model runs will examine variations from this Base Case scenario.

3.5.2.2. Future Railbelt Utility Electrical Loads

The Railbelt utilities are comprised of six regulated public utilities: Anchorage Municipal Light & Power (ML&P), Chugach Electric Association (Chugach), Golden Valley Electric Association (GVEA), Homer Electric Association (HEA), Matanuska Electric Association (MEA), and the City of Seward Electric System (SES). The military bases are also currently considering privatizing their utility operations which could add to the load demand. The Railbelt region covers a significant area of the State of Alaska and contains large population centers; it extends from Homer to Fairbanks and includes the major metropolitan areas such as Anchorage and the Mat-Su Valley.

The Railbelt region currently generates about 11 percent of its electric energy needs from renewable sources. This renewable energy principally derives from the Bradley Lake, Cooper Lake and Eklutna hydroelectric projects. The Railbelt Integrated Resources Plan (RIRP), prepared for AEA, assumed future deployment of a combination of large hydroelectric, wind and geothermal resources to achieve the State's 50 percent renewable energy target. For development of the RIRP, load forecasts were provided by the utilities, and because the RIRP Study has a 50-year planning horizon, load forecast data was extrapolated through 2060.

The tables below present the future projected coincident winter and summer peak demands for the combined system. The coincident peak demand forecasts were developed by combining all of the utilities' hourly load profiles for 2008 and calculating the 2008 coincident peak demands. The results were compared to the 2008 non-coincident peak demands to develop coincident factors. These factors were applied seasonally to the non-coincident peak demand for both winter and summer months of the study period to develop the resulting coincident peak demand forecasts for the system.

Winter Peak Demand Forecast:

Year	Load (MW)
2011	869.3
2025	927.5
2030	959.0
2040	1,024.1
2050	1,092.0
2060	1,163.0

Source RIRP table 6-1

Summer Peak Demand Forecast:

Year	Load (MW)
2011	668.0
2025	712.7
2030	736.9
2040	786.9
2050	839.1
2060	893.6

Source RIRP table 6-2

Currently, the Railbelt utilities maintain a 30 percent reserve margin above these peak load values. Figure 3.5-4 below is a graph that shows the Railbelt load requirements on a typical winter day.

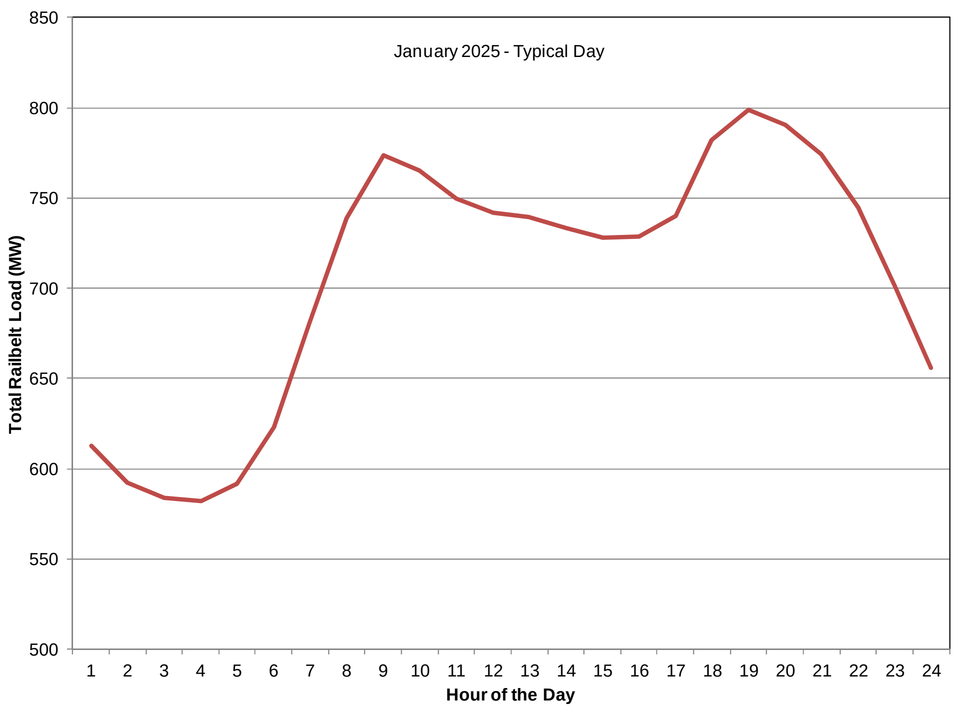
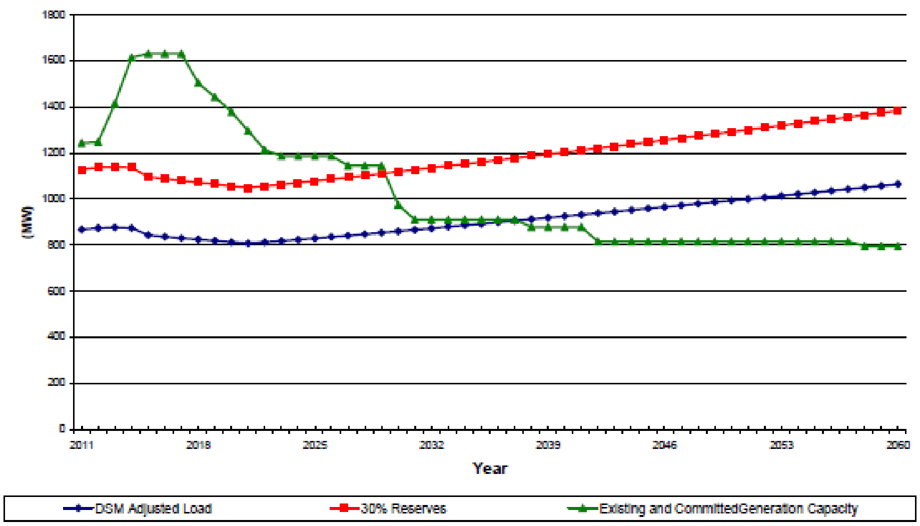


Figure 3.5-4. Railbelt Utilities Typical January Day Load Shape

The following load projection in Figure 3.5-5 (Figure 9-6 from the RIRP) illustrates the scenario used to model the various future supply options and compare total system power costs under a wide variety of underlying assumptions. As indicated, even with Demand Side Management/EE (DSM/EE) reductions, existing resources are only sufficient to meet overall demands, including reserve requirements, until about the year 2029. Without these demand reductions new generating resources will be needed much sooner. As indicated, with DSM/EE reductions, total capacity requirements, including a 30 percent reserve margin allowance, are estimated to be approximately 1,400 MW by the year 2060. This assumes that DSM measures are implemented to reduce demand over that time frame. Without this level of DSM/EE load reductions, total capacity requirements would be about 130 MW higher, totaling about 1,530 MW.

Scenario 1A: Capacity Requirements Including Committed Units with DSM/EE



Source RIRP Figure 9-6

Figure 3.5-5. Projected Railbelt Electrical Demands

3.5.2.3. Power Plant Operation to Meet Future Load Requirements

As noted previously the primary operating objective for modeling the Base Case scenario was to maximize firm power generation during the winter months of November through April. Therefore, the reservoir would be drafted on a daily and seasonal basis to meet those objectives. Using that as an operating objective, Figure 3.5-6 below shows the resulting average power plant generation in megawatt-hours (MWh) for each year of the Base Case simulation model run. The average annual total generation is estimated to be 2,500,000 MWh, which corresponds to an average of 285 MW of continuous power.

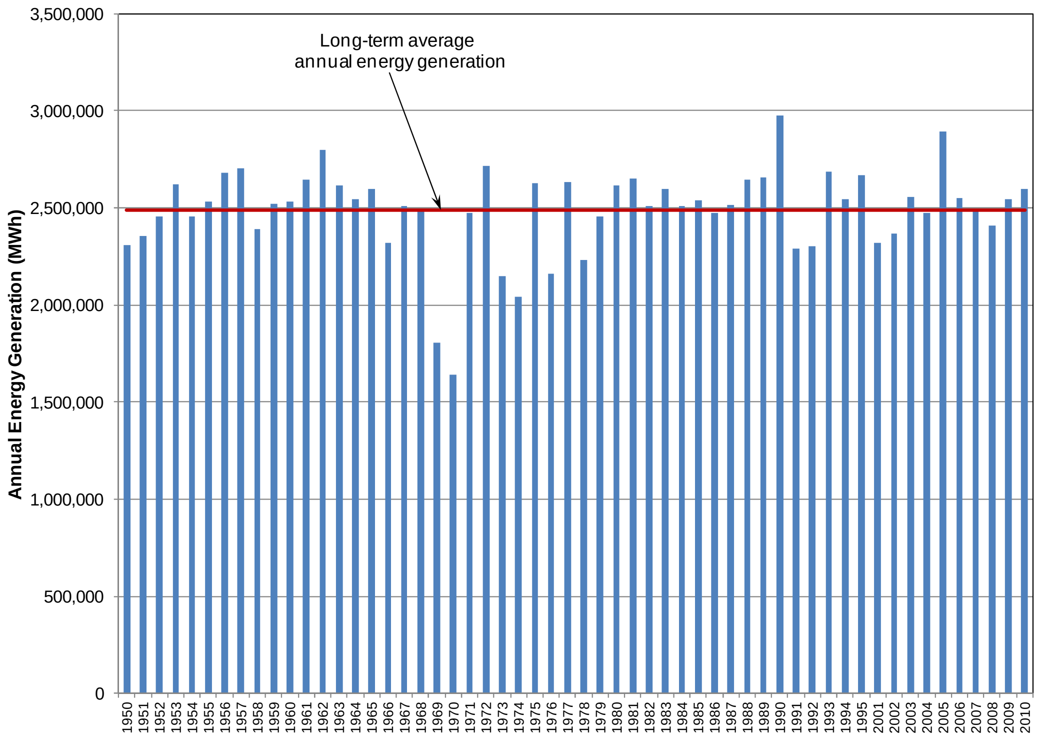


Figure 3.5-6. Annual Average Energy Generation (MWh)

Figure 3.5-7 shows the modeled average monthly distribution of power output based on this mode of operation. Firm power (98 percent reliable) output averages 250 MW during the months of November through April and 223 MW for the entire year, with monthly variations following the Railbelt average power demand shown on Figure 3.5-8. Figure 3.5-8 also shows that the pattern of Railbelt energy demand is completely out of phase with the pattern of reservoir inflows. To reshape the reservoir inflows into a release pattern that is more similar to the power demands, active storage is used for an annual cycle of water storage and withdrawal. With greater active storage, more complete regulation of inflows could be accomplished.

Non-firm power generation would occur mostly during the months of July through September when the powerhouse would generate up to full capacity (600 MW installed in this case) to reduce releasing water through the low-level outlet without generation. Non-firm generation would average about 62 MW annually, or about 22 percent of the total generation. For the entire year, the 223 MW of average firm power plus 62 MW of non-firm power would total 285 MW of average power output, which is equivalent to the 2,500,000 MWh of average annual energy. The Susitna-Watana generation values presented herein assume that all potential generation is usable.

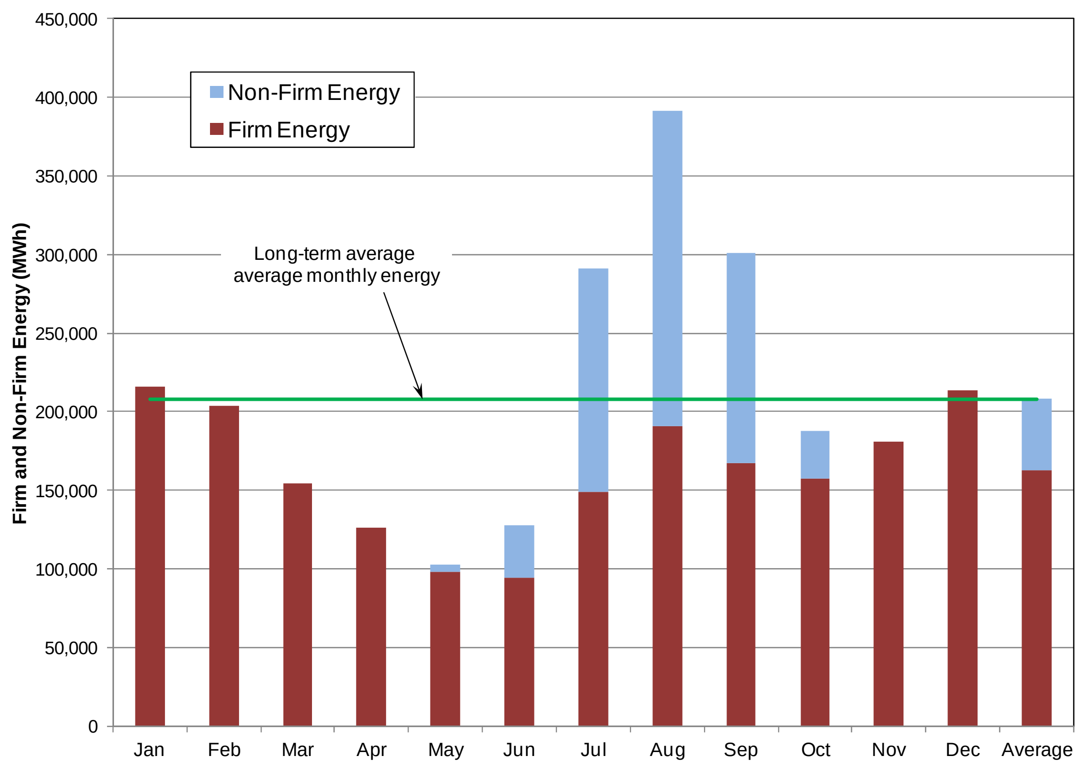


Figure 3.5-7. Monthly Average Energy Generation (MWh)

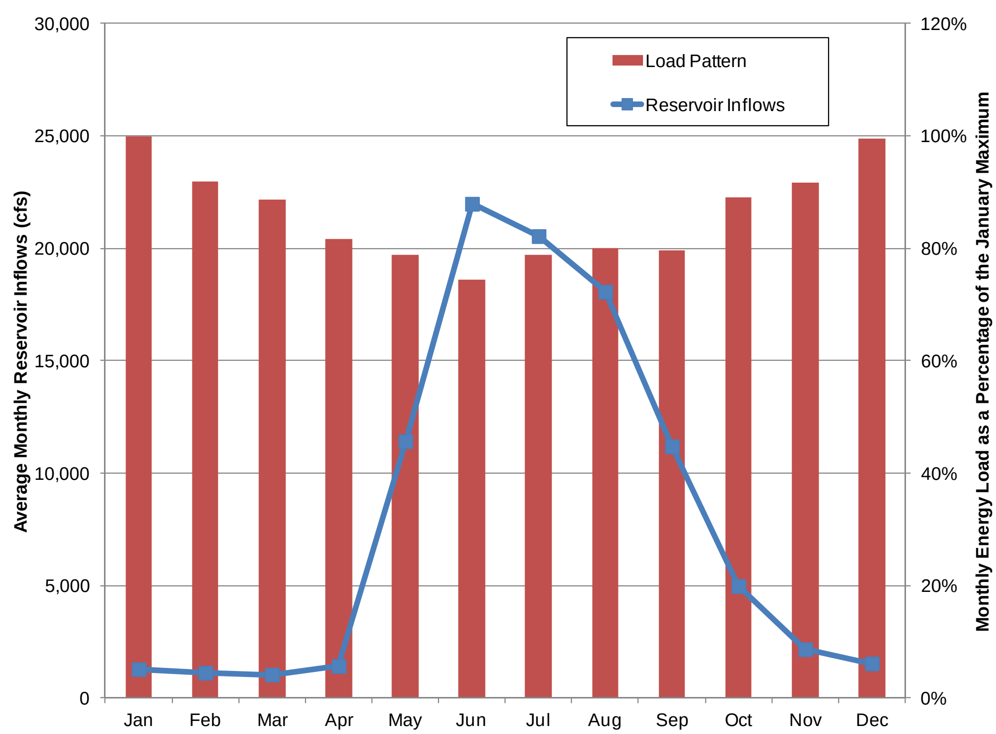


Figure 3.5-8. Railbelt Monthly Energy Demand Pattern Compared with Reservoir Inflow Pattern

Figure 3.5-9 presents the modeled daily power output for selected years - the maximum year (1990), the minimum year (1970) and most nearly average year (1986). These years were selected for illustration based on the annual power generation values. The 98 percent reliability goal essentially means that the firm power objective of 250 MW during the November through April period will not be met during one year in the 56-year period of simulation modeling. Because significantly reducing the firm power objective causes system operating characteristics to be substantially different in 1970 from other years, the second minimum generation year of 1974 is also included in the daily plots for illustration purposes.

On Figure 3.5-9, the minimum year (red line) for 1970 clearly shows the large firm power deficit during most of the November through April period. Note that only one or two lines are visible in places on the plots because the lines at times plot on top of each other. Power peaks at 600 MW (the full plant capacity under this scenario) when the reservoir fills at times during June through October.

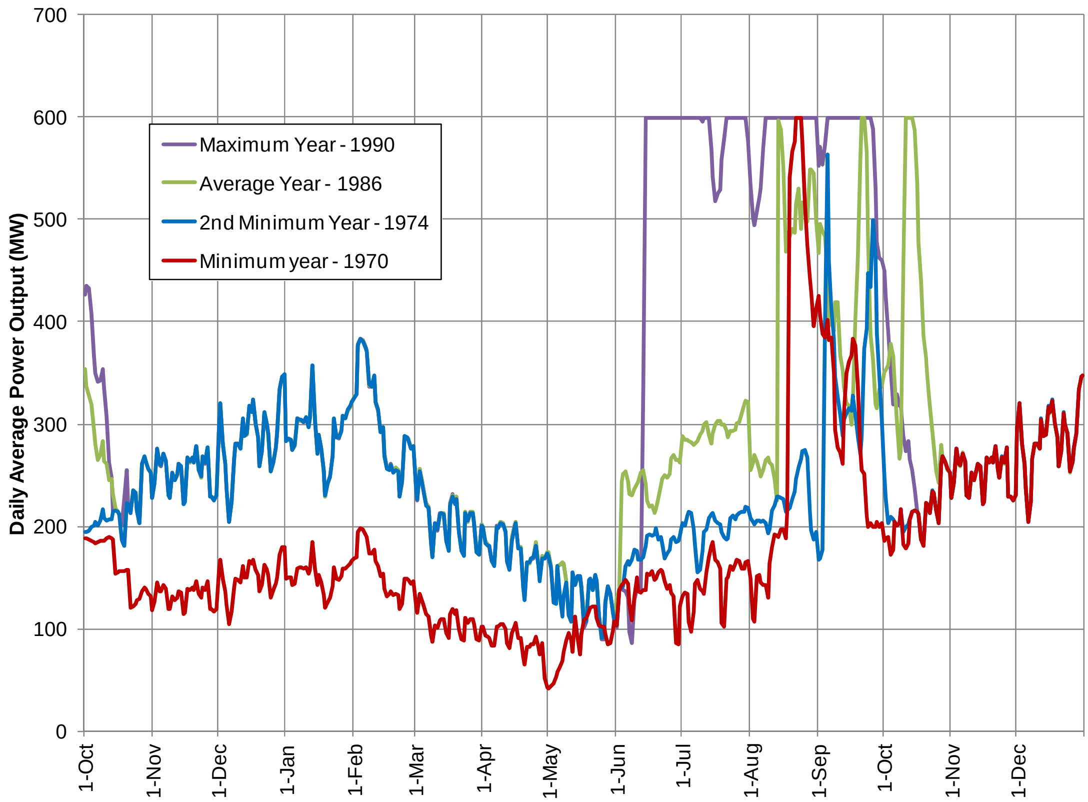


Figure 3.5-9. Daily Power Output (MW) for Selected Years

3.5.2.4. Powerhouse Discharges

Daily powerhouse discharges into the Susitna River for the Base Case model run for selected years are presented on Figure 3.5-10. As modeled, average monthly flows would be increased from the existing natural flows from January through April in response to power demands. The day-to-day flow variation is caused by both seasonal power demand variations and weekday/weekend variations. Although the power demand remains the same in all years, some powerhouse flow variations are caused by variations in local inflow between Watana and Gold Creek while the powerhouse operates to meet the Base Case minimum instream flow schedule in the Susitna River at Gold Creek. The large increases in powerhouse discharges during the June through October period are in response to periods when the powerhouse would be operated at maximum capacity to generate from flow that would otherwise be released through the low-level outlet (i.e. to minimize spill volume and maximize generation). Refinements to this operating scenario will be made as Project development plans progress during future licensing studies.

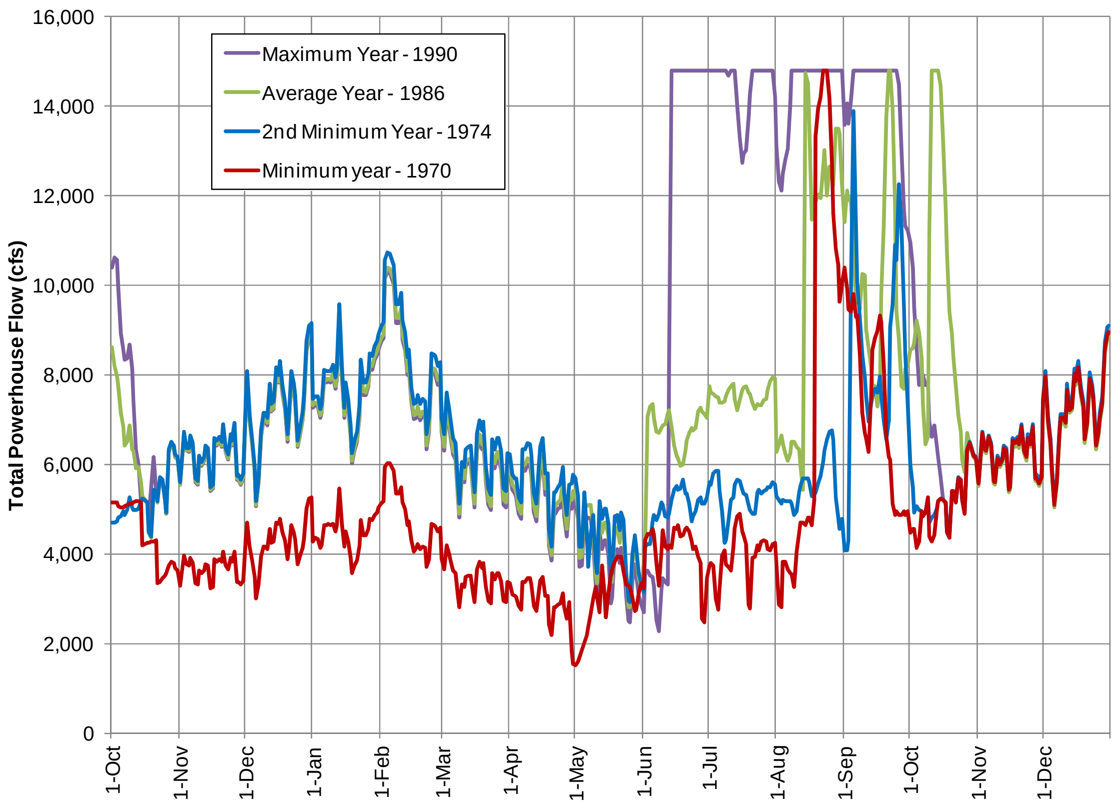


Figure 3.5-10. Daily Powerhouse Discharge for Selected Years

3.5.2.5. Low-Level Outlet Releases

Figure 3.5-11 presents the daily low-level outlet discharges during the four selected years as modeled. Low-level outlet releases occur when the active reservoir storage is full and reservoir inflows exceed the powerhouse operating capacity. During most years, the low-level outlet releases would be zero or of short duration. During the wettest year of 1990, substantial releases would occur from mid-June through September. The average annual flow release would be 738 cfs, which is about 9 percent of the total reservoir inflow. Some low-level outlet releases would occur during about 90 percent of the years, primarily during the months of July through September. It is anticipated that low-level outlet release can be substantially reduced with future refinements in the operating scheme.

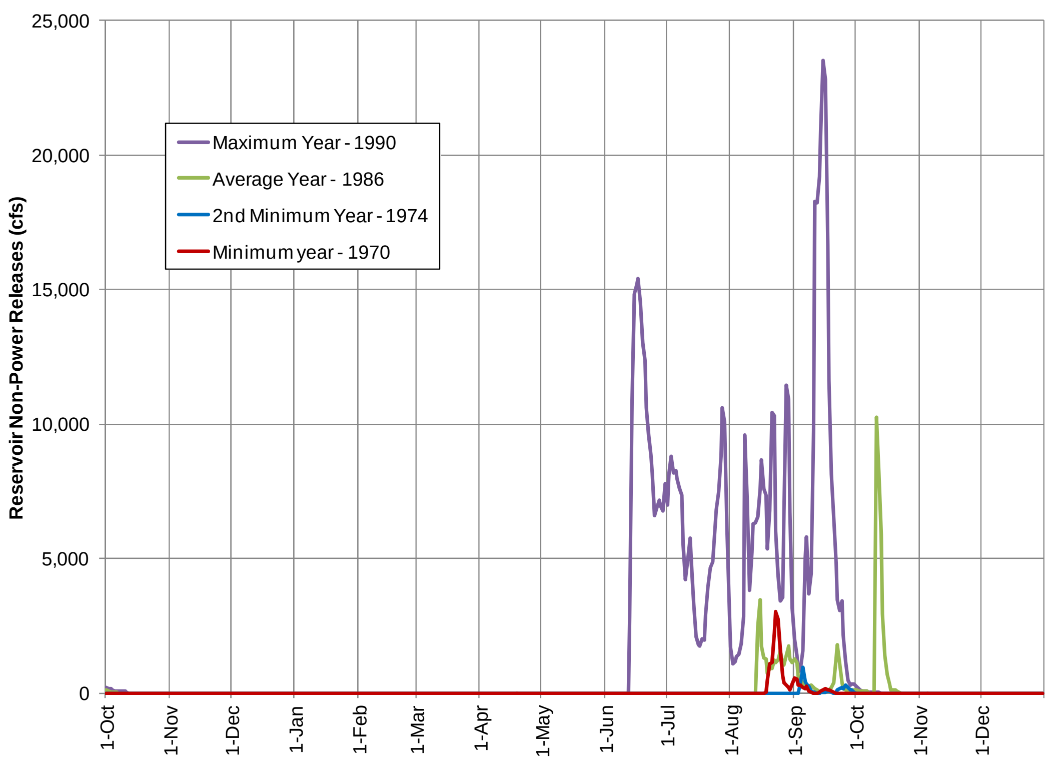


Figure 3.5-11. Daily Outlet Releases at Watana Dam for Selected Years (cfs)

3.5.2.6. Flushing Flows

The need for downstream flushing flows has not yet been determined. If required to protect or enhance downstream resources, these flows would be provided either by making releases through the powerhouse as part of planned power operations, or by releases through the low-level outlet in combination with the powerhouse if powerhouse capacity is insufficient by itself. A proposed plan will be included in the FERC License Application.

3.5.2.7. Flow Ramping Rates

Flow ramping rates have not yet been determined. If restrictions on flow ramping are needed to protect or enhance downstream resources, then hourly powerhouse and/or low-level outlet schedules will be developed and included in the FERC License Application.

3.5.2.8. Downstream Susitna River Flow Changes

Project operations would alter the natural flows of the Susitna River downstream from Watana Dam, with the effects becoming progressively less at greater distances downstream due to tributary inflow, including several major rivers. For about five years during the early 1980s, the USGS operated several streamflow gaging stations concurrently, which provides the opportunity to use recorded streamflow data as the basis to display daily flows at several locations on the Susitna River for both the recorded natural flows and the adjusted “With-Project” flows.

On the following four figures, the natural flows are shown in green and the “With-Project” adjusted flows are shown in red for the Watana Dam site and at the three downstream USGS gaging stations noted above. At the current stage of Project planning, the “With-Project” flows are preliminary and subject to change, but it is useful to get an early approximate look at how flows could be altered on the lower and middle sections of the Susitna River. Further, more detailed modeling and downstream flow analyses will be performed as part of ongoing licensing engineering studies prior to submittal of the FERC License Application.

There are two predominant effects of Project operation on downstream flows in the Susitna River in comparison to the natural pre-Project flows. The first is an increase in the average November through April flows, which corresponds to the period of greatest need for power generation. The second major effect is a reduction in the average flow at the beginning to at least the middle of the snowmelt runoff season from May through July, which is the period when the reservoir would normally be refilled. In the latter part of the high flow season (late August through October), the reservoir would usually be filled and average monthly reservoir releases would be nearly equal to the natural flows. As shown on Figures 3.5-12 and 3.5-13, the difference in the flow regime between Watana and Gold Creek is not great because the difference in drainage areas at the two locations is not great. Moving downstream to Sunshine (Figure 3.5-14), below the confluence with the Chulitna and Talkeetna rivers, the effects of Project operations are much less pronounced. At Susitna Station (Figure 3.5-15), below the confluence with the Yentna and other rivers, the effects of Project operations are further minimized by substantial tributary river inflows.

<u>Watana Dam Site (Figure 3.5-12)</u> – the site is located at RM 184. The drainage area at Watana Dam is 5,180 square mi and the annual average flow is about 8,100 cfs. Although there are no USGS recorded flows at Watana, they can be reliably estimated from recorded flows downstream at Gold Creek (RM 136.5) and upstream at Susitna River near Cantwell gage (RM 223.7).

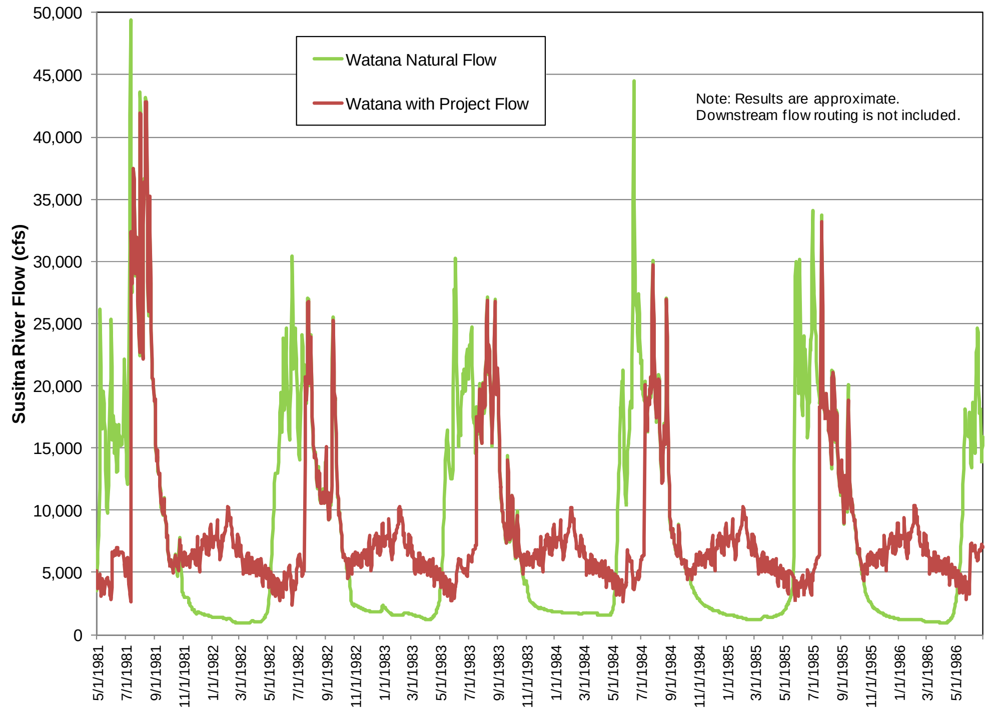


Figure 3.5-12. Natural and With-Project Flows at Watana

Susitna River at Gold Creek (Figure 3.5-13) – this USGS gaging station is located at RM 136.5, which is 47.5 mi downstream from Watana Dam. The drainage area at Gold Creek is 6,160 square mi and the annual average flow is about 9,800 cfs.

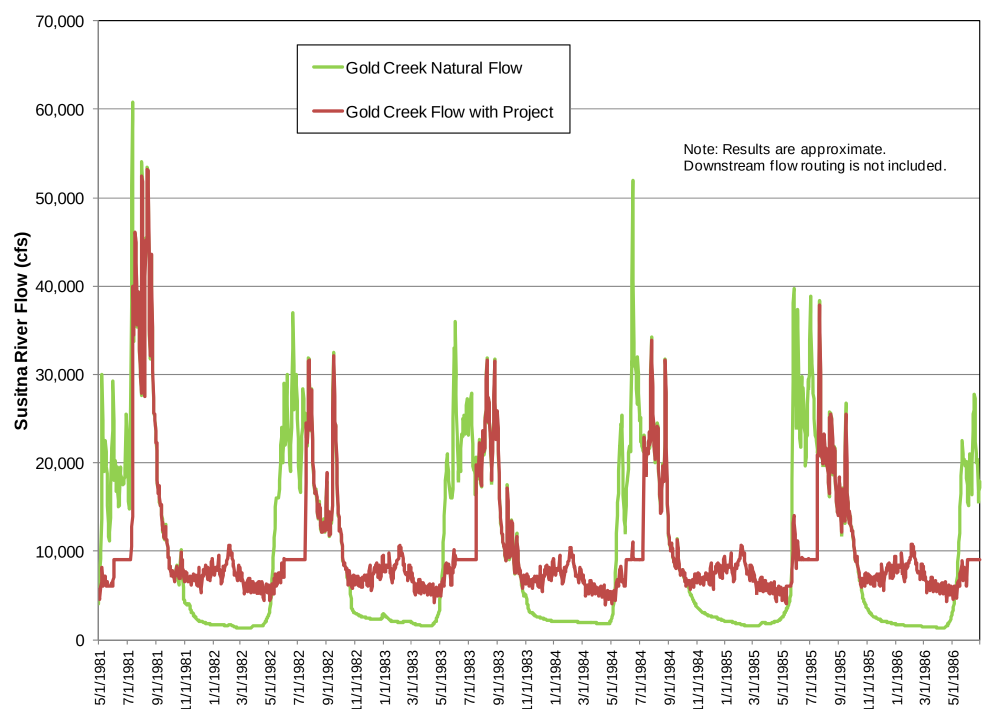


Figure 3.5-13. Natural and With-Project Flows at the Gold Creek USGS Gage

Susitna River at Sunshine (Figure 3.5-14) – this USGS gaging station is located at approximately RM 83.8, more than 10 miles downstream from the confluence of the Susitna River with the Chulitna River (2,570-square mi drainage area) and the Talkeetna River (1,996-square mi drainage area). The drainage area at Sunshine is 11,100 square mi and the annual average flow, based on a short period of record, is about 23,900 cfs.

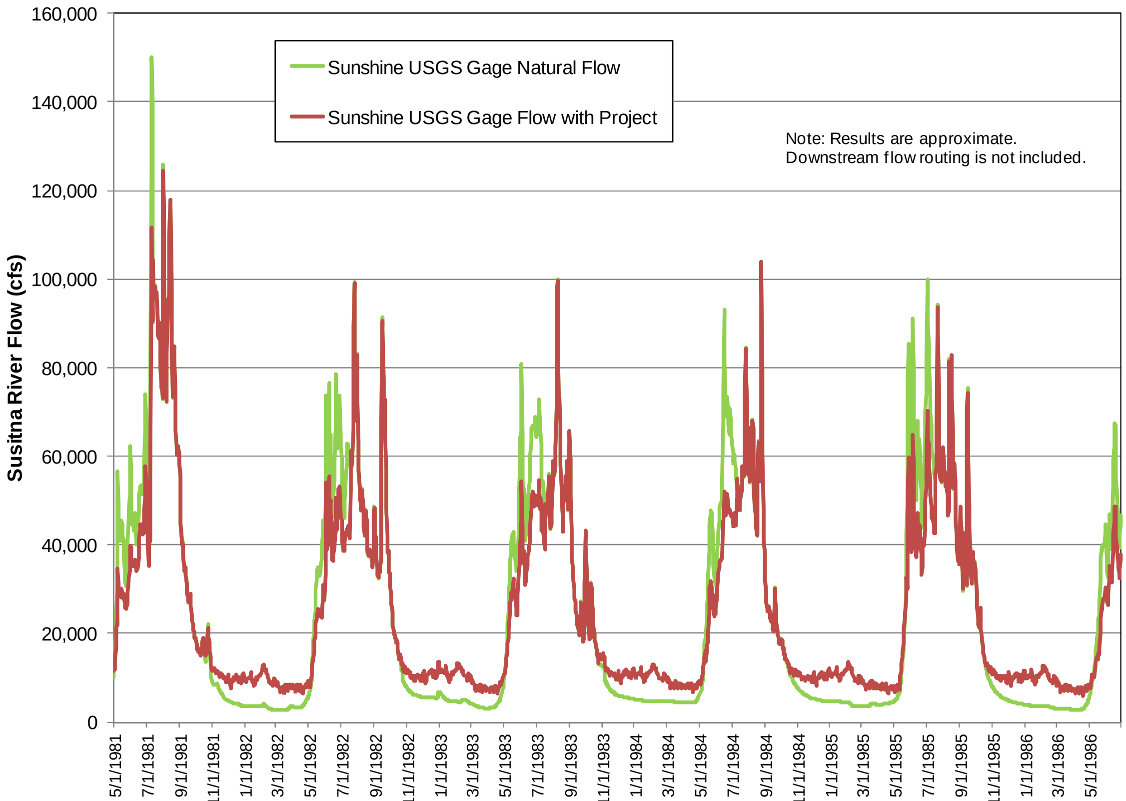


Figure 3.5-14. Natural and With-Project Flows at the Sunshine USGS Gage

Susitna River at Susitna Station (Figure 3.5-15) – this USGS gaging station officially at RM 25.8, is located about 18 mi upstream from Cook Inlet at El. 40 ft msl where it measures the flow of virtually the entire Susitna watershed. Between Sunshine and Susitna Station, the Yentna River, with a drainage area of 6,180 square mi, joins the Susitna River. The total drainage area at Susitna Station is 19,400 square mi and the annual average flow is about 50,400 cfs.

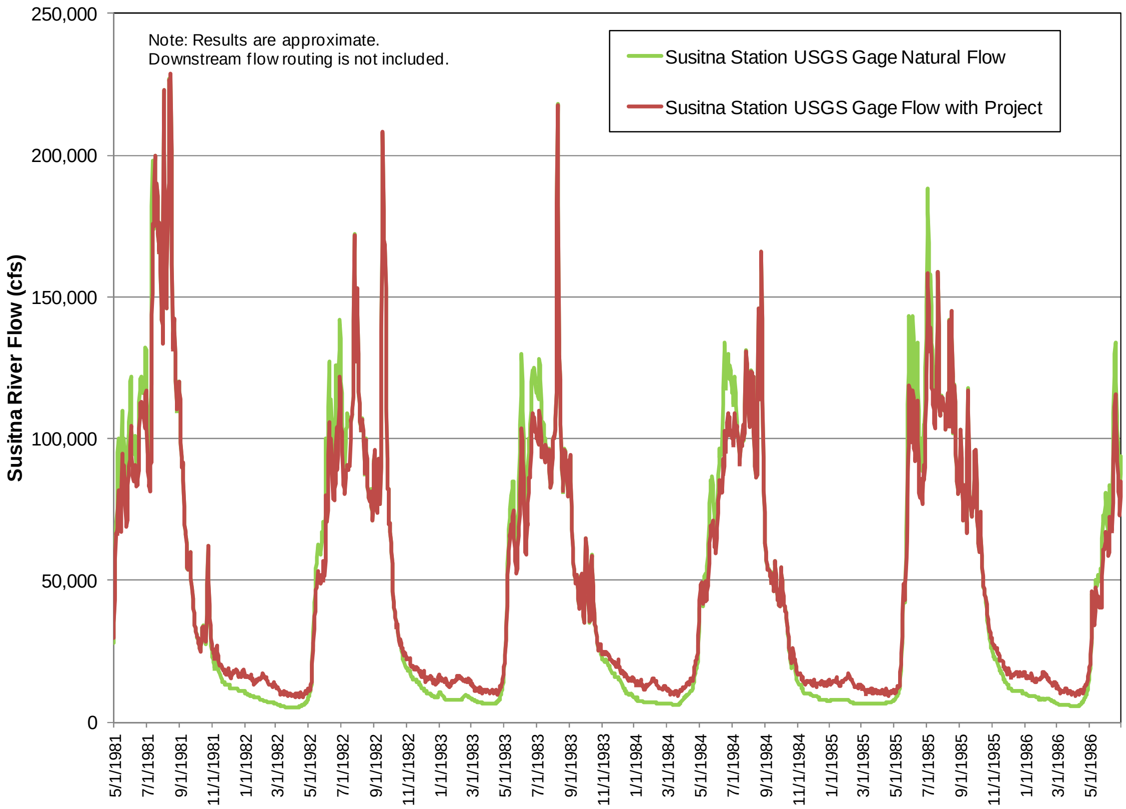


Figure 3.5-15. Natural and With-Project Flows at Susitna Station USGS Gage

3.5.3. Effects of Hydrologic Change

Climate change can significantly modify the expected firm energy from hydroelectric projects like Susitna-Watana due to altered seasonal and annual reservoir inflow regimes. In comparison with projected future temperature changes, future changes in runoff patterns are considered to be much less certain. As part of ongoing licensing studies, available literature will be reviewed with respect to similar rivers with snowmelt dominated runoff under potential climate change scenarios, and site-specific studies will be performed to assess how future climate changes in Alaska might affect long-term Project generation estimates.

Stochastic hydrology techniques can be utilized to evaluate alternative runoff futures for the Watana reservoir under both the historic river flow patterns and under changing climatic conditions in the future. Stochastic hydrology analyses would generate 1,000 traces of equally probable 50-year streamflow data sets for selected alternative future scenarios. This stochastic hydrology will be used by project planners to further quantify firm energy reliability from the Project.

Preliminary hydrology studies conducted to date indicate that there is a trend toward earlier snow and glacier melt runoff in the Susitna River basin probably due to climate warming. As shown on Figure 3.5-16, April is the month that shows the most dramatic trend toward increasing flows. The months of June (Figure 3.5-17), July, and August, have historic trends toward decreasing average flows. The net effect is that historic annual flows have shown essentially no trend toward either increasing or decreasing flows, as shown on Figure 3.5-18.

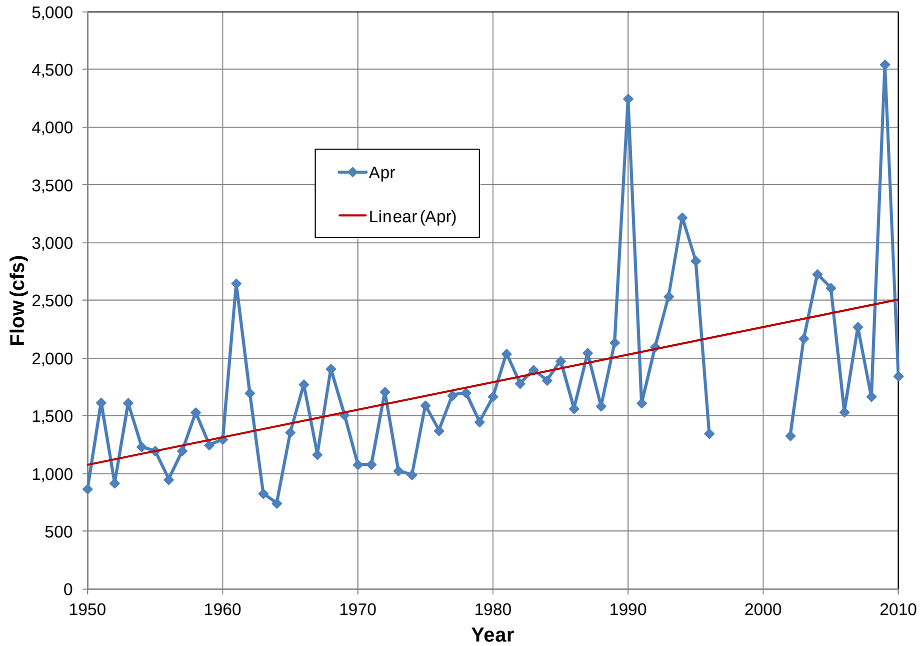


Figure 3.5-16: April Recorded Flows (cfs) – Susitna River at Gold Creek

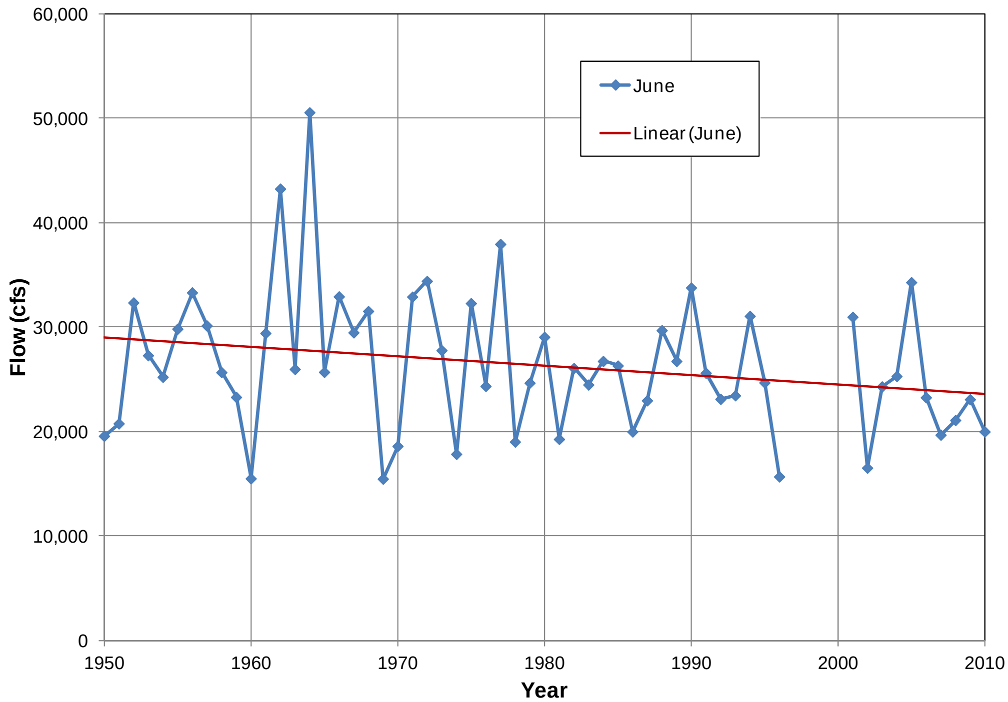


Figure 3.5-17: June Recorded Flows (cfs) – Susitna River at Gold Creek

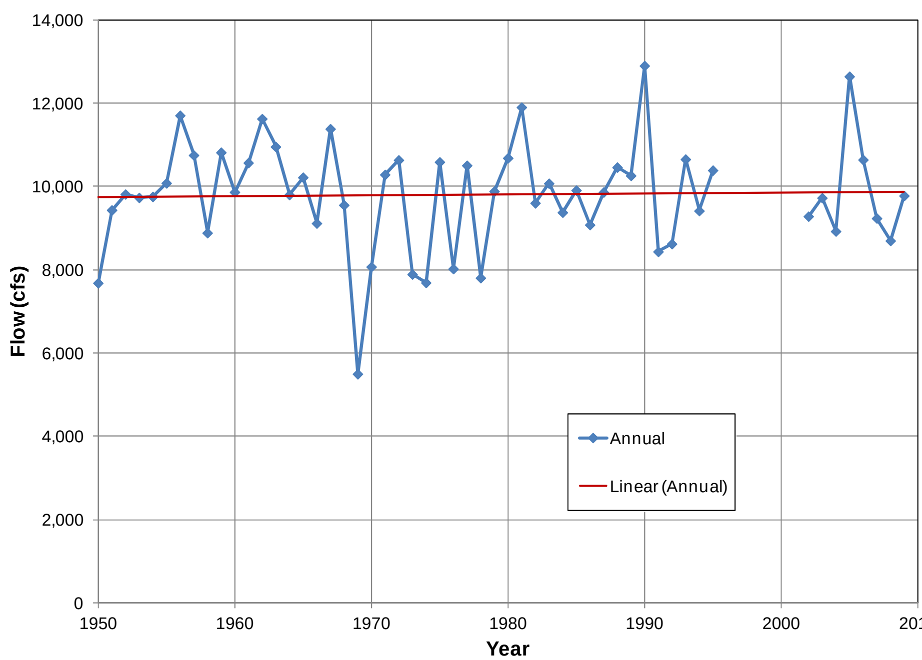


Figure 3.5-18: Annual Recorded Flows (cfs) – Susitna River at Gold Creek

Figure 3.5-19 shows the historic average monthly flows at the USGS gage at Gold Creek (1949 – 2011) along with a projection of the trends in monthly flows to the year 2050. The 2050 projected flows also show no net change on an annual basis compared to the historic annual flows.

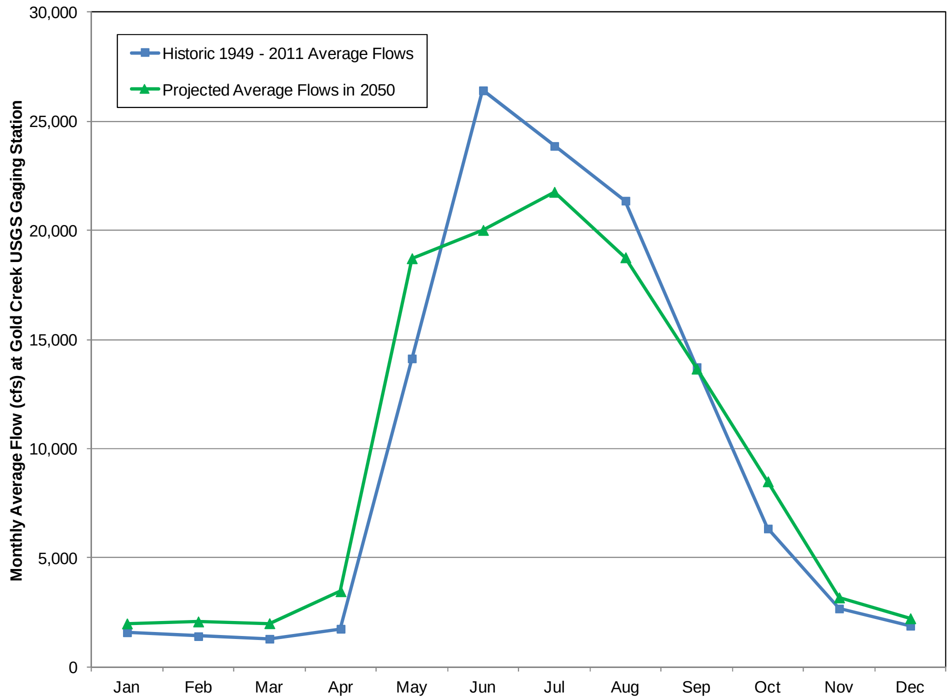


Figure 3.5-19: April Recorded Flows (cfs) – Susitna River at Gold Creek

The Intergovernmental Panel on Climate Change (IPCC) has published an authoritative global study of the effects of climate change. Starting with an ensemble of 23 Atmosphere-Ocean General Circulation Models (AOGCMs) and multiple alternative emission scenarios, the IPCC developed worldwide simulation model projections of changes in temperature, precipitation, evaporation, runoff, and other parameters. Projections of temperature changes all indicated temperature increases worldwide, but runoff projections showed both areas of increasing runoff and decreasing runoff. As shown on Figure 3.5-20, simulation model projections indicate increased Susitna River basin runoff in the coming decades (IPCC 2007). These projections are based on the SRES A1B emission scenario and show the change in average annual runoff for the 2080-2099 period relative to 1980-1999. The regions are stippled on Figure 3.5-20 where at least 80 percent of the models agree on the sign of the mean change. This means that the Susitna watershed is in a region that is projected to have among the highest average annual increases in runoff worldwide, with a high degree of agreement among the models that the change in runoff will be an increase. Reading Figure 3.5-20 for the Susitna watershed and converting the units, it translates to about a 10 percent increase in average annual runoff by 2050.

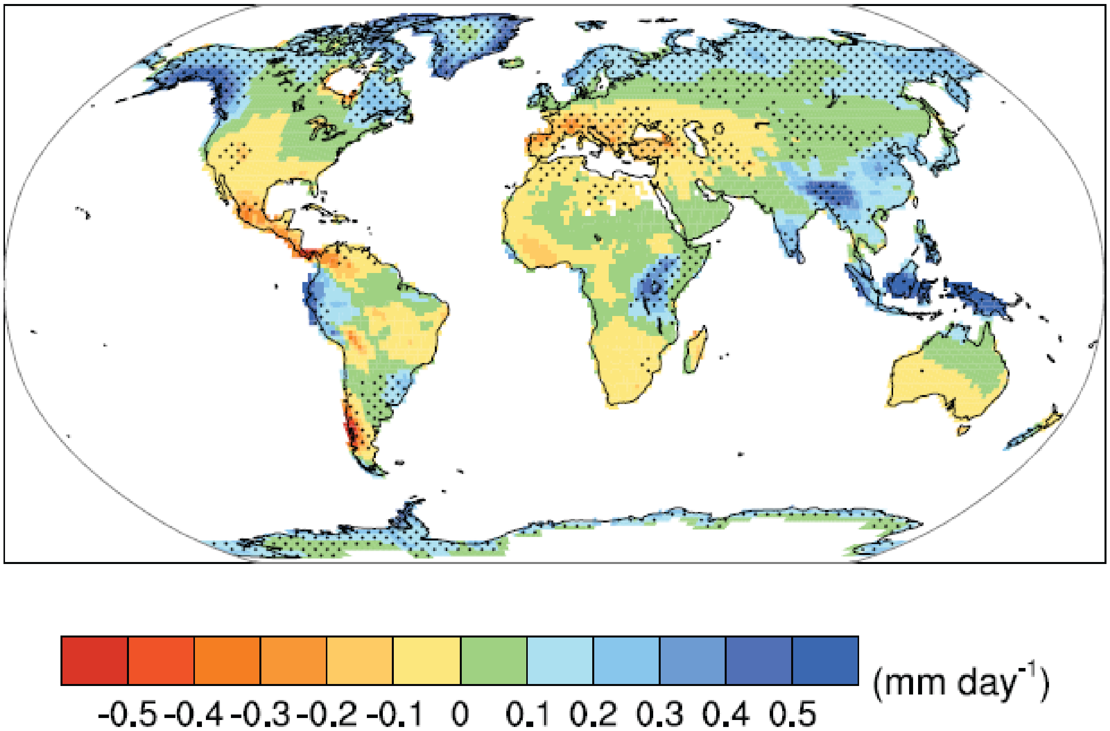


Figure 3.5-20: Change in Annual Mean Runoff (mm/day) for the Period 2080 – 2099 Relative to 1980 – 1999 (Source: IPCC 2007)

Section 4.4.1.2.4 presents further information regarding considerations of climate change. If increased average runoff does occur, it would be expected that there will be a net positive effect (increase) in Susitna-Watana Project annual and firm power generation over time.

4. DESCRIPTION OF EXISTING ENVIRONMENT AND RESOURCE IMPACTS

4.1. Summary

The Susitna-Watana Hydroelectric Project would be located in a remote region with abundant natural resources (see Figure 1-1). The description of the existing Project environment and Project-related impacts presented in this section of the PAD are addressed for the following resource areas:

- Geology and soils
- Water resources
- Fish and aquatic resources
- Wildlife and botanical resources
- Wetland, riparian, and littoral resources
- Rare, threatened, and endangered species
- Visual resources
- Recreation and land use
- Cultural resources
- Socioeconomic resources
- Tribal resources
- Transportation

The general geographic setting of the drainage basin is described in a brief overview section preceding the discussion of individual resource areas. The descriptions of existing conditions and potential Project-related impacts associated with each resource area are based on a review of available existing information, which is cited in the text. For each resource area, the description of the Project environment and potential impacts is generally organized as follows:

- Description of the existing resources in the Project vicinity.
- Description of potential adverse and positive impacts of the Project on these resources.
- Description of potential PM&E measures to be evaluated for possible inclusion in the new license.

The area directly affected by the construction of the Project (a.k.a. the Project "footprint") is delineated in Figure 1-1. This area includes the area of direct disturbance from construction of the Project,however not all the area will be directly impacted by construction of Project facilities. Portions of this area within this footprint would be proposed for inclusion within the FERC Project boundary once facilities are sited. The lands and waters within a FERC project boundary are those deemed necessary for operation and maintenance of the project and for other project purposes including recreation facilities, shoreline and waterway protection, and protection of environmental resources.

As described in Section 3, the Project involves construction of a major dam at RM 184 on the Susitna River, a powerhouse structure situated at the downstream toe of the dam, three 230-kV primary transmission lines, access road, and construction and operations facilities including an airstrip. Figure 4.1-1 shows the main Project facilities at the dam site and Figure 4.1-2 shows the Susitna River system and the locations of the upper, middle and lower river reaches as discussed in this document.

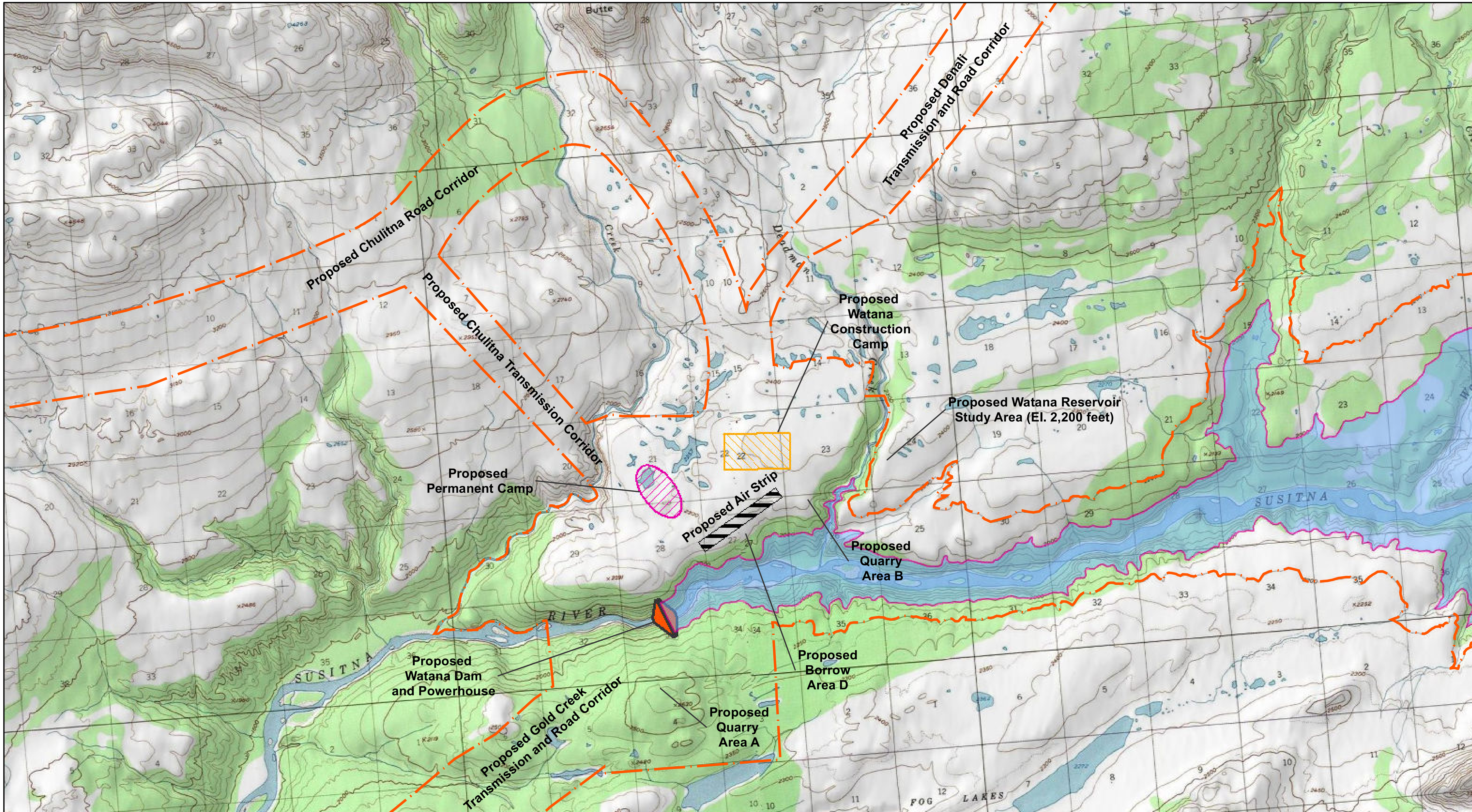
The currently envisioned project would include a Watana Dam with a top level of elevation 2,025 ft above mean sea level (msl) with a maximum normal reservoir surface of El. 2,000 ft msl. During the course of studies leading to a license application, depending on operating and environmental studies and optimization of various reservoir levels, drawdown characteristics, and operational requirements – the final proposed project configurations may vary and may include a maximum reservoir elevation of up to about 2,100 ft and corresponding height of the dam (i.e., about 2,125 ft). The Watana Dam will be a concrete gravity structure, most likely constructed by the roller compacted concrete (RCC) methodology. Optimization of the project during licensing studies may result in a proposal for a nominal curve in the dam resulting in an arch-gravity structure which would benefit the stability of the dam. The proposed dam would create a reservoir approximately 39 mi long, with a surface area of about 20,000 ac, and a gross storage capacity of approximately 4.3 million acre-ft at the normal maximum operating level of elevation 2,000 ft.

The powerhouse would be located immediately downstream of the dam, and would 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. Unit sizing studies are continuing and the final unit size may be as low as 100 MW. The firm energy of the of the project during the critical November - April time frame would be 1,094 gigawatt hours The powerhouse would be designed and constructed with an extra empty generating unit bay for the potential installation of a fourth unit at some future time. Optimization studies are ongoing and the capacity of the Project eventually proposed for licensing could extend up to 800 MW.

There would be a spillway, one low-level outlet works facility structure and four power intake structures (one corresponding to the extra unused powerhouse bay). 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. The Project would be operated in load following mode. Under that operating mode there would be variation in powerhouse discharge to meet hourly and daily Railbelt electrical loads, satisfy downstream environmental flow requirements, and prevent spill. Reservoir levels would fluctuate daily with a maximum annual drawdown of up to 150 ft.

Project construction would occur from 2017-2023, assuming access has been gained to the site by road in early 2017.

The information presented in this section provides the foundation for the identification of licensing issues and scoping of studies to be conducted to support the licensing process, including FERC's analysis to satisfy NEPA requirements. Section 5 of this PAD identifies licensing issues and associated study needs for all resource areas described in Section 4.



Legend

- Proposed Study Area
- Proposed Watana Dam and Powerhouse
- Proposed Permanent Camp
- Proposed Watana Construction Camp
- Proposed Air Strip
- Proposed Watana Reservoir (El. 2000 feet)

N

0 0.5 1 2 Miles

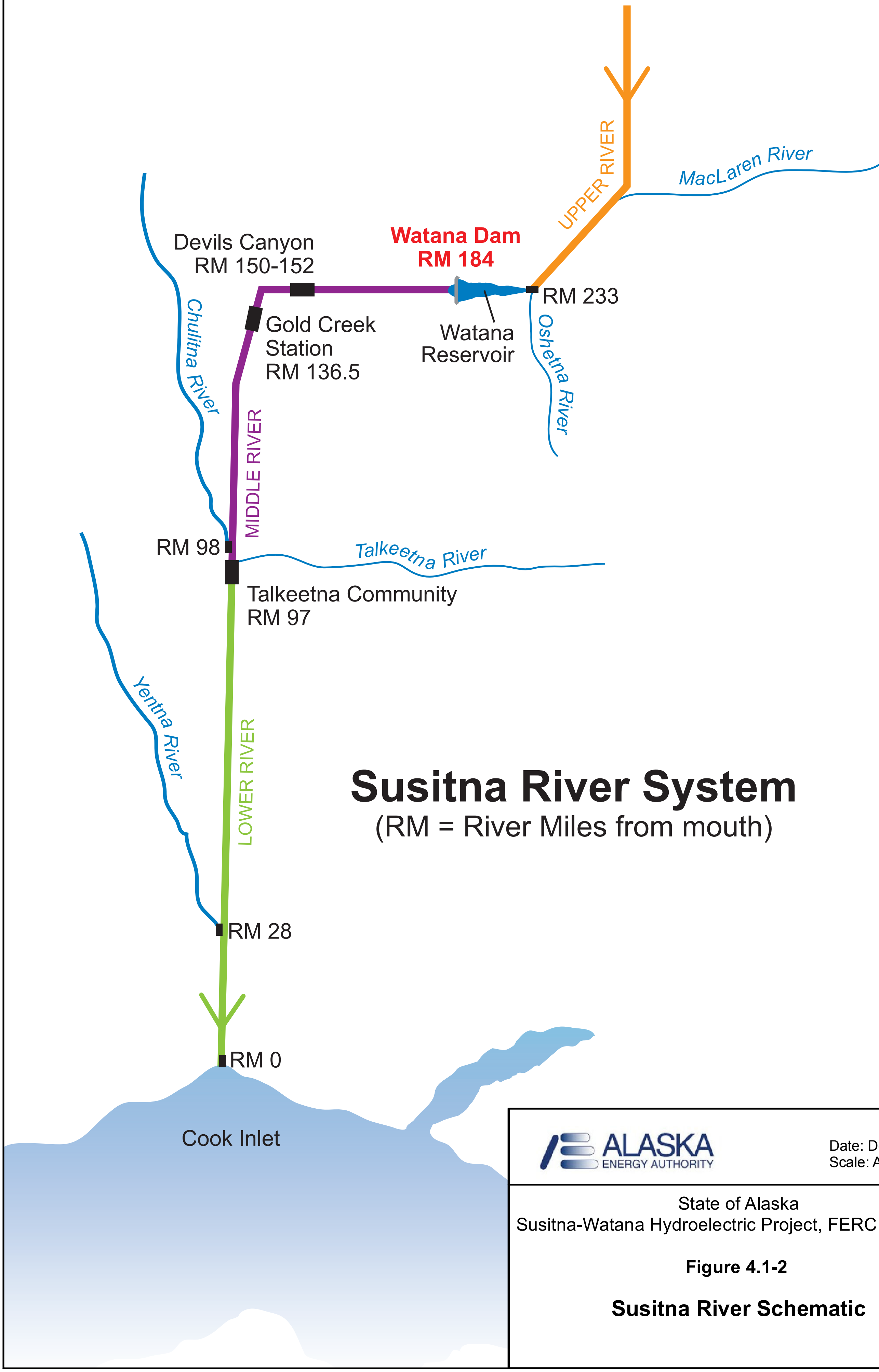
ALASKA ENERGY AUTHORITY

Date: Dec 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.1-1

Project Study Area at Dam Site



ALASKA ENERGY AUTHORITY

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Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.1-2

Susitna River Schematic

4.2. Basin Overview

The proposed Project is located in the Southcentral region of Alaska, approximately 120 mi north-northeast of Anchorage and 110 mi south-southwest of Fairbanks. The Southcentral region of the state is geographically bounded by the Alaska Range to the north and west, the Wrangell Mountains to the east, and the Talkeetna Mountains to the south. This region encompasses 86,000 square mi of the total 586,000 square mi of the state.

The Southcentral region has wide geographic variety: broad, u-shaped valleys and plateaus, rugged mountain ranges, with glaciers, forests, and coastal waters. Mount McKinley, the highest mountain in North America at 20,320 ft, is located on the region's northwest border. Denali National Park and Preserve and Denali State Park showcase the diversity of landscapes and offer recreational opportunities.

4.2.1. Major Land Uses and Demography

Land ownership in Alaska is complex and in transition. Under terms of the 1959 Alaska Statehood Act, the State of Alaska is authorized to receive over 103 million acres of land from the federal government. To date, the state has received about 89.5 million acres of this land (ADNR 2009).

Signed into law in 1971, the Alaska Native Claims Settlement Act (ANCSA) settles the claim of Alaska's native Indian, Aleut and Eskimo populations to aboriginal title to the land on which they have lived for generations. The act provided for formation of 13 regional corporations, and over 200 Native Villages, and allows transfer of up to 44 million acres of land from federal to ANCSA corporations ownership. State and ANCSA conveyances have not been completed. The federal government (Bureau of Land Management) is to convey ANCSA corporations about 9 million acres and is to convey the state about 16 million ac. Many of these remaining claims are in conflict and will require many years to resolve. Various selections cannot be completed until actual land surveys are done, which will also take many years. Upon completion of the conveyance process, the state’s largest landowner will remain the federal government, with about 220 million acres or 60 percent of Alaska. The state will own 28 percent, ANCSA corporations 11 percent, private (non-ANCSA Corporation) 1 percent, and municipalities less than 1 percent (ADNR 2009).

The Southcentral region extends from the hydrographic divide of the Alaska Range on the north to the western Matanuska-Susitna Borough (MSB) boundary on the west, Kodiak Island on the south, and the Alaska/Canada border on the east. It abounds with ocean shorelines, freshwater lakes, free-flowing rivers, massive mountains, wildlife, and glaciers. The diversity of landscapes and natural resources offer a wide variety of outdoor recreational opportunities. The Southcentral region contains a more developed transportation system than other portions of the state. Paved highways and gravel secondary roads provide access to many of the cities and villages in the region. Use of planes to reach areas not accessible by road is also prevalent. The Alaska Railroad and ferry systems also serve portions of the Southcentral region.

The Southcentral region includes the George Parks Highway, the Denali Highway, and the Alaska Railroad. The George Parks Highway (numbered Interstate A-4 and Alaska Route 3) extends 323 mi from the Glenn Highway 35 mi north of Anchorage to Fairbanks in the Alaska Interior. The highway was completed in 1971. The highway, which mostly parallels the Alaska Railroad, is one of the most important roads in Alaska. It is the main route between Anchorage and Fairbanks (Alaska's two largest metropolitan areas), the principal access to Denali National Park and Preserve and Denali State Park, and the main highway in the Matanuska-Susitna Valley.

Most residential, commercial, agricultural, transportation and utility land use development occurs in and around Parks Highway communities and along rural sections of the Parks Highway west of the proposed Project area. That is, small towns such as Willow, Talkeetna, Cantwell, and Healy have a mix of residential and commercial land and transportation lands for the highway, other roads, railroad, and airstrips. Other scattered residential lands occur in agricultural, homestead or other settlements along the highway, near the railroad or area rivers (APA 1985).

The Denali Highway is about 135 mi long and connects the Cantwell junction (located just north of Broad Pass) on the Parks Highway with Paxson Lodge on the Richardson Highway while a loop trip originating and returning to Fairbanks is about 436 mi. A loop trip from Anchorage is close to 600 mi. The Denali Highway is generally open from mid-May to October 1.

The Alaska Railroad extends from Seward and Whittier, in the south, to Fairbanks (passing through Anchorage), and beyond to Eielson Air Force Base and Fort Wainwright in the interior of the state. The Alaska Railroad carries both freight and passengers throughout its system. The railroad has a mainline over 470 mi long, and is well over 500 mi long when branch lines and sidings are included. It is currently owned by the State of Alaska.

The Chugach National Forest, located south and east of Anchorage, surrounds Prince William Sound. This 5.4 million-acre forest includes the Kenai Peninsula, the Russian River, and the delta of the Copper River.

Denali State Park is approximately 324,240 acres in size. The State Recreation Areas include an additional 1,470 acres. Although much smaller than Denali National Park and Preserve to the north (6,028,203 acres), Denali State Park and its associated State Recreation Areas include diverse landscapes. They afford tremendous views of Denali; contain three major rivers, the Susitna, Chulitna, and Tokositna; and have three glaciers adjacent to or within their boundaries, the Ruth, Eldridge and Tokositna. Vegetation ranges from lowland spruce and hardwood forests to alpine tundra. The George Parks Highway transects the park and opens its scenery, wildlife and other natural resources to the public. Primary uses of Denali State Park are camping, hiking, fishing, viewing Mt. McKinley, canoeing, rafting, river boating, hunting and trapping.

The Consolidated General Management Plan (GMP) for Denali National Park and Preserve (NPS 2007) consists of an original GMP (1986) and three major amendments addressing the park entrance area and road corridor (1997), south side development (1997), and backcountry management (2006). Zoning broadly delineates the appropriate management strategies for various lands, based on their resource characteristics and how they can best be used to achieve the park's purpose and objectives. Areas of Denali are placed in four management zones: natural, historic, park development, and special use.

The proposed Susitna-Watana Hydroelectric Project is within the northwest corner of the Bureau of Land Management's (BLM) Glennallen Field Office Planning Area. The planning area includes approximately 7.1 million acres in east Alaska, including approximately 5.5 million acres of lands that have been selected by the State of Alaska or Alaska Natives. The BLM is responsible for management of selected lands until conveyance occurs or until the selections are relinquished back to the BLM because of over selection. The planning area also includes private land (including ANSCA corporations land) and state lands.

The Project is located within the MSB and adjacent to the Denali Borough. The nearest community is Cantwell, which is located approximately 41 mi north-northwest of the proposed Susitna-Watana dam site. Cantwell is an unincorporated community with an estimated population of 219 in 2010 U.S. Census Bureau (USCB 2010). The nearest sizeable town is Wasilla, with a 2010 population of 7,831 (USCB 2010). Wasilla is located approximately 91 mi southwest of Watana and approximately 130 mi south of Cantwell (distances are "as the crow flies").

In the Denali Borough, the population is centered around the Parks Highway. The population of this borough has remained relatively unchanged since it was formed. However, in the past 30 years the population of Cantwell has increased by almost 150 percent (from 89 to 219).

In the MSB, while a substantial amount of development is focused along the Parks and Glenn highway corridors, development is more dispersed. The MSB has grown dramatically (by almost 400 percent) in the past 30 years. Much of this growth has been in the MSB's core area, which includes Wasilla and Palmer. The northern portion of the Borough near the proposed Project, has also experienced growth but at a lower rate. These areas are less densely populated than the core area.

According to the 2010 Census, the racial composition of the MSB and the Denali Borough is predominantly Caucasian. The highest proportion of minority residents is found in the Cantwell area, where approximately 23 percent of the residents are considered a minority (primarily American Indian/Alaska Native). Overall, the Denali Borough and the MSB are less racially diverse than the Southcentral region population. The gender distribution in the Denali Borough and the MSB is similar to that of the Southcentral region, with slightly more than half the population being male. The percentage of males is highest in Chase and Cantwell (64.7 and 58.4 percent, respectively). The median age in the Denali Borough and in Cantwell, Trapper Creek, Chase and Talkeetna is higher than that of the MSB and the Southcentral region. This is not due to significantly higher numbers of people aged 65 and over in these areas. Rather, it is due to a relatively high percentage (26 to 53 percent) of the residents in these areas who were between the ages of 45 and 59, according to the 2010 Census. Per capita and median household incomes are lower in Trapper Creek and Cantwell than in the Denali Borough, MSB or the Southcentral region as a whole. This is expected as these areas tend to have more people who live a subsistence lifestyle rather than holding a year-round wage and salary job. According to the 2005-2009 American Community Survey (ACS), approximately one-third of the workforce in the MSB and the Denali Borough work in management, professional and related fields; a percent that is similar to the Southcentral region as a whole. In Trapper Creek the occupation with the highest number of people is production, transportation and material moving, while the occupation with the largest number of people in Talkeetna and Cantwell is construction, extraction, maintenance and repair.

Most employment in the Denali Borough is driven by Clear Air Force Base, Denali National Park and Preserve, Usibelli Coal Mine, and Golden Valley Electric Association. Employment dramatically increases during the summer months (from 1,000 in the winter to approximately 4,000) due to employment in tourism-related fields. A large number of these workers come from outside the borough. Residents tend to work in less seasonal industries such as government (including schools and national park personnel) and power generation (Fried 2009).

The economy of the MSB is more diverse than the Denali Borough economy. In general, employment has been growing faster than the population and the MSB now offers more employment opportunities than in the past. Two areas that have seen large increases in employment are health care and retail. Increases in these sectors mean residents can meet more of their needs without having to go into Anchorage or Fairbanks. While employment in the MSB is increasing, many MSB residents commute outside the borough for employment. A substantial number of these commuters travel to Anchorage, but many commute to places even further such as the North Slope (Fried 2010).

4.2.2. Major Water Uses

Instream flow uses of the Susitna River include fish, wildlife, riparian vegetation, navigation and transportation, recreation, waste assimilative capacity, freshwater recruitment to Cook Inlet estuary, downstream water rights, hydroelectric power generation, and water required to maintain the desirable aesthetic characteristics of the river itself. Irrigation, water supply, and industrial uses are limited.

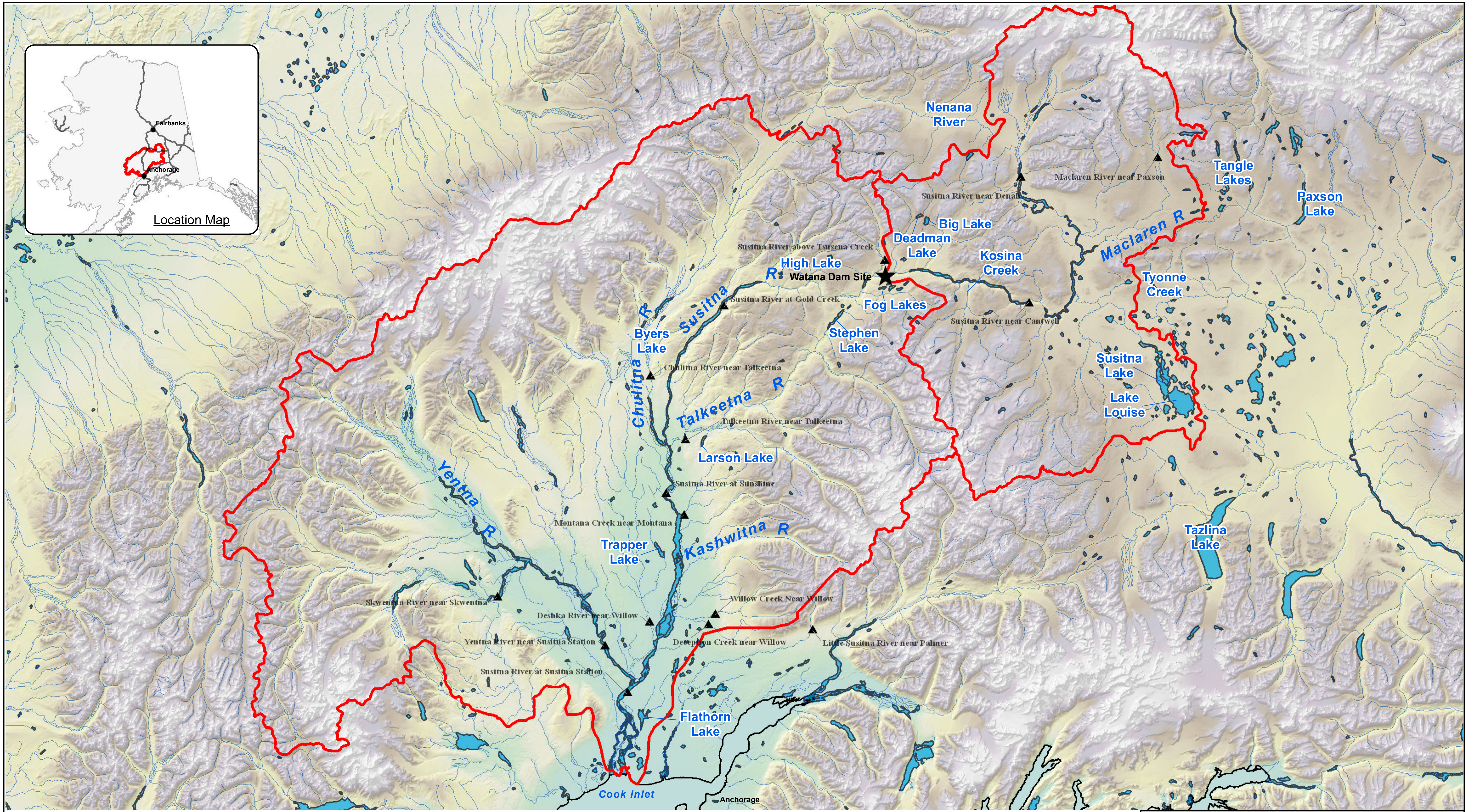
Water rights in Alaska are issued by the Alaska Department of Natural Resources (ADNR) and are discussed in section 4.4.2.1.

4.2.3. Lakes and Dams

As shown in Figure 4.2-1 numerous named and unnamed lakes are located in the vicinity of the proposed Project. Named lakes located closest to the proposed Project include:

- Stephan Lake
- Tsusena Butte Lake
- Fog lakes
- Big Lake
- Deadman Lake
- High Lake

No dams are located on the mainstem of the Susitna River.



LEGEND:

★ Watana Dam Site

▲ Gaging Station

Basin Boundary

NOTES:
1. Spatial Reference: NAD83 Alaska Albers, meters
2. Topography: USGS National Elevation Dataset (NED), 2-Arc Second
3. Basin boundary based on modified USGS HUCs 19020501-5

N

0 10 20 40 Miles

ALASKA ENERGY AUTHORITY

Date: Dec. 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project Ferc No.14241

Figure 4.2-1

Susitna River Hydrologic Features

4.2.4. Tributaries and Streams

The Susitna River drainage area is about 19,400 square mi. Upstream of the proposed location of the Watana Dam (RM 184) the drainage area is about 5,180 square mi. The upper Susitna River (i.e., area upstream of the proposed dam site) is fed by three glaciers in the Alaskan Range. The glaciers cover an area of 290 square mi (Acres 1983a). The three glacially fed forks, including the MaClaren River, flow southward for about 18 mi before joining to form the mainstem of the Susitna River. The river flows an additional 55 mi southward through a broad valley, where much of the coarse sediment from the glaciers settles out. The river then flows west about 56 mi to the proposed Watana Dam site. Other tributaries that flow into the proposed reservoir include Deadman, Watana (RM 194), Kosina (RM 206.8), Goose (RM 231.3), and Jay creeks, along with the Oshetna River (RM 233.4).

Downstream of the proposed dam site, the Susitna River continues west for about 40 mi through the Devils Canyon areas; the river valley in this reach is narrow with violent rapids. Within the 96-mile westward section of the Susitna River, there are numerous small, steep gradient, clear water tributaries that flow into the Susitna River. Several of these tributaries traverse waterfalls as they enter the gorge. Tributaries located between the proposed dam site and Devils Canyon include Devil, Fog (RM 179.2), and Tsusena (RM 181.3) creeks. Portage Creek enters the Susitna River below Devils Canyon. As the Susitna River curves south past Gold Creek (RM 136.8), about 12 mi downstream from Devils Canyon, its gradient gradually decreases. The Susitna river is joined by two major rivers, the Chulitna (RM 98) and Talkeetna (RM 97), about 40 mi downstream of Gold Creek in the vicinity of the town of Talkeetna. A third major tributary, the Yentna River (RM 28), joins the Susitna River about 70 mi farther downstream. From the confluences with the Chulitna and Talkeetna rivers, the Susitna River flows south through braided channels for about 97 mi until it empties into Cook Inlet near Anchorage, approximately 318 mi from its source.

4.2.5. Climate

Alaska climate varies from brief, cool summers and long, frigid, dark winters in the Arctic regions to southern, coastal areas where temperatures rarely fall below zero. Four general climactic zones comprise Alaska, based on annual and monthly averages of temperature and precipitation: Arctic Zone, Continental Zone, Maritime Zone, and Transitional Zone. The Susitna-Watana Hydroelectric Project area lies near the border of the Continental and Transitional zones.

Continental Zone temperatures in the summer average around 60°F (15°C). Mean lows in the winter are near -10°F (-23°C), with -45°F (-43°C) to -55°F (-48°C) on occasion. Annual precipitation is generally about 10 inches with the majority falling within the summer months. Where terrain lifting is a factor in precipitation augmentation, annual precipitation totals may exceed 20 inches. In general, this zone is located south of the Brooks Range and inland. The sun does not set for more than a month in the summer. Surface winds are lighter than those in the Arctic.

The Transitional Zone includes the region around the Cook Inlet, the Chugach Mountains, and areas as far east as the southern Copper River basin. The transitional zone follows approximately 1,492 mi of the Alaskan Coast. Unlike the other regions, this zone is difficult to define due to the large variation in topography. The Transitional Zone has coolest month temperature averages below 64°F (18°C) and above 20°F (-3°C) with the warmest month above 50°F (10°C). In addition, it is considered to only have one to three months with a temperature above 50°F (10°C). Moderate moisture is present in all seasons. Winds are moderate, skies are usually cloudy, and the relative humidity is moderate to high. In addition, heavy fog is very frequent as a result of maritime influences. Both continental and maritime climate systems affect the transitional zone.

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4.3. Geology and Soils

4.3.1. Regional Geology

4.3.1.1 Stratigraphy

The oldest bedrock that outcrops in the region are a metamorphosed upper Paleozoic rock sequence which trends northeastward along the eastern portion of the Susitna River basin (Acres 1982b). These rocks consist chiefly of coarse to fine-grained clastic flows and tuffs of basaltic to andesitic composition, locally containing marble interbeds. This system of rocks is uncomformably overlain by Triassic and Jurassic metavolcanic and sedimentary rocks consisting of a shallow marine sequence of metabasalt flows, interbedded with chert, argillite, marble, and volcaniclastic rocks. These units are exposed in the Project area around Watana and Portage creeks. The Paleozoic and lower Mesozoic rocks are intruded by Jurassic plutonic rocks composed chiefly of granodiorite and quartz diorite. The Jurassic age intrusive rocks form the batholithic complex of the Talkeetna Mountains.

Thick turbidite sequences of argillite and graywackes were deposited during the Cretaceous period. These rocks were subsequently deformed and intruded by a series of Tertiary age plutonic rocks which range in composition from granite to diorite and include related felsic and mafic volcanic extrusive rocks. The Watana Dam site is underlain by one of these large plutonic bodies. These plutons were subsequently intruded and overlain by felsic and mafic volcanics. The mafic volcanics at the Watana site consist primarily of andesite porphyry (Acres 1982b).

4.3.1.2 Tectonic History

At least three major episodes of deformation are recognized for the project areas: a period of intense metamorphism, plutonism, and uplift in the Jurassic, a similar orogeny during the middle to late Cretaceous, and a period of extensive uplift and denudation from the middle Tertiary to Quaternary periods.

Most of the structural features in the region are the result of the Cretaceous orogeny associated with the accretion of northwest drifting continental blocks into the North American plate. This plate convergence resulted in complex thrust faulting and folding which produced the pronounced northeast/southwest structural grain across the region. The majority of the structural features, of which the Talkeetna Thrust fault is the most prominent in the Talkeetna Mountains, are a consequence of this orogeny. The Talkeetna Thrust represents an old suture zone, involving the thrusting of Paleozoic, Triassic and Jurassic rocks over the Cretaceous sedimentary rocks. Other compressional structures related to this orogeny are evident in the intense shear zones roughly parallel to and southeast of the Talkeetna Thrust.

Tertiary deformations are evidenced by a complex system of normal, oblique slip, and high-angle reverse faults. The prominent tectonic features of this period bracket the basin area. The Denali fault, a right-lateral, strike-slip fault located 40 to 43 mi north of the Project dam site, exhibits evidence of fault displacement during the Holocene epoch (<10,000 years from present). The Castle Mountain fault system, which borders the Talkeetna Mountains approximately 70 mi southeast of the Project dam site, is a normal fault which also has had fault displacement during-the Holocene.

4.3.1.3 Quaternary Geology

The Quaternary period, approximately the last 2 million years, is commonly subdivided into the Pleistocene and the Holocene epochs. Generally, the Pleistocene epoch is equated to the glacial age and the Holocene epoch with post-glacial time, though such distinctions are less defined in southern Alaska, where the mountains still contain extensive glaciers. A period of cyclic climatic cooling during the Quaternary resulted in repeated glaciations of southern Alaska (Acres 1982b). Little information is available regarding the glacial history in the upper Susitna River basin. Unlike the north side of the Alaskan Range which is characterized by alpine type of glaciations, the Susitna Basin experienced coalescing piedmont glaciers that originated from both the Alaska Range and the Talkeetna Mountains and merged to fill the upper basin area.

At least three periods of glaciation have been delineated for the region based on the glacial stratigraphy. During the most recent period (Late Wisconsinan), glaciers filled the adjoining lowland basins and spread on to the continental shelf. Waning of the ice masses from the Alaska Range and Talkeetna Mountains formed ice barriers which blocked the drainage of glacial meltwater and formed large proglacial lakes. As a consequence of the repeated glaciation, the Susitna and Copper River basins are covered by varying thicknesses of till, lacustrine, and outwash deposits (Acres 1982b).

Within the Project site region, the late Quaternary surfaces include those of Holocene and Pleistocene age (including the Wisconsinan and Illinoian stages). These surfaces range from a few years to approximately 120,000 years before present.

Repeated glaciations modified the landscape, resulting in the development of many of the distinct landforms found within the project area. At this time, the upper Susitna watershed, in particular along the Alaska Range, is glaciated; however, the Project dam site is not impacted by current glacial activity.

4.3.2. Seismic Geology

4.3.2.1 Regional Seismology

Alaska is the most seismically active State in the United States, and southern Alaska is a particularly active region. The active faulting, seismicity, and volcanism of southern Alaska are products of the regional tectonic setting. The primary cause of the faulting and seismic activity is the stress imposed on the region by the relative motion of the Pacific lithospheric plate relative to the North American plate along their common boundary. The Pacific plate is moving northward relative to the North American plate at a rate of about 2.4 inches/year (WCC 1981). The relative motion between the plates is expressed as three styles of deformation: high-angle strike-slip faults, as seen along the Alaska Panhandle and eastern margins of the Gulf of Alaska; underthrusting of the Pacific plate beneath the North American plate, as seen along the northern margins of the Gulf of Alaska, including the Cook Inlet area and the central and western portions of the Aleutian Islands; and oblique thrust faulting, noted at the eastern end of the Aleutian Islands

The Project site is located within a relatively stable tectonic unit bounded by the Denali-Totschunda fault to the north and east, the Castle Mountain fault to the south, a broad zone of deformation with volcanoes to the west, and the Benioff zone at depth. All of the boundaries are (or contain) faults with recent displacement except for the western boundary which is primarily a zone of uplift marked by Cenozoic age volcanoes. Strain accumulation and resultant release appears to be occurring primarily along the margins of this tectonic unit, as indicated by evidence for recent displacement along the Denali-Totschunda and Castle Mountain faults and the Benioff zone; the absence of major historical earthquakes within the unit; and the absence of faults within the unit that clearly have evidence of recent displacement. Some compression related crustal adjustment within the unit is probably occurring as a result of the proposed plate movement and the stresses related to the subduction zone. Study of selected faults for project planning in the 1980s did not indicate that there would be potential seismic sources that could cause seismic ground motions or surface rupture through the Project dam site (WCC 1982). The magnitude 7.9 Denali earthquake originating on the Susitna Glacier fault in November 2002 was within the range of potential earthquakes identified in the 1980s study. A review of the 1980s evaluation indicates that the seismic hazard determined previously is still applicable, however, there is a much better understanding of regional seismicity that should be incorporated in to the design of structures (R&M 2009).

4.3.2.2 Reservoir-Triggered Seismology

Reservoir-triggered seismicity (RTS) is defined as the phenomenon of earth movement and resultant seismicity that has a spatial and temporal relationship to a reservoir and is triggered by nontectonic stress. Studies of the occurrence of RTS have shown that it is influenced by the depth and volume of the reservoir, the filling rate of the reservoir, the state of tectonic stress in the shallow crust beneath the reservoir, and the existing pore pressures and permeability of the rock mass under the reservoir. Although direct measurements are difficult to obtain for some of these factors, indirect geologic and seismologic data, together with observations about the occurrence of RTS at other reservoirs, can be used to assess the potential for RTS at the Watana Dam site.

Analysis of RTS by Harza-Ebasco (1985) included: (a) a comparison of the depth, volume, regional stress, geologic setting, and faulting in the Project area with the same parameters at comparable reservoirs worldwide; (b) an assessment of the likelihood of RTS at the Project area based on the above comparison; (c) a review of the relationship between reservoir filling and the length of time to the onset of induced events and the length of time to the maximum earthquake; (d) an evaluation of significance of these time periods for the Project area; (e) the development of a model to assess the impact of RTS on groundmotion parameters; (f) a review of the relationship between RTS and rate of reservoir filling; and (g) an assessment of the potential for slope instability around the reservoir rim resulting from RTS.

The Watana Reservoir will be about 600 ft deep, and will have a total volume of 4.3 million acre-feet. For comparison, deep reservoirs have been characterized as having a maximum water depth of 300 ft or deeper, and a very deep reservoir is 492 ft deep or deeper; a large reservoir has a maximum water volume greater than one million acre-feet, and a very large reservoir has a volume greater than eight million acre-feet. At the time of the 1980s review, 21 percent of all deep, very deep, or very large reservoirs had been subject to RTS. Geologic and tectonic conditions that are expected to influence the likelihood of RTS at the Watana Reservoir include basin geology and proximity to faults with recent displacement. Review of worldwide case histories of RTS indicates that there is a negative correlation between significant RTS and recent loading and unloading as a result of glaciation (Harza-Ebasco 1985). In addition, RTS appears to be more probable where reservoirs are underlain by sedimentary rock sequences as compared to metamorphic and igneous rock (AEA 2011). In terms of pre-existing active tectonics, moderate to large RTS events are expected to occur only along faults with recent displacement, and previous investigation concluded that no such faults exist within the hydrologic influence of the Watana Reservoir (WCC 1980). With the exception of currently unidentified local faults, the earthquake sources do not lie within the zone potentially influenced by reservoir filling. The final major reservoir specific parameter defining RTS hazard is the filling history and the rate of filling. Review of incidence of RTS at other locations indicates that sudden changes in water level and sudden deviations in the rate of water level change can trigger seismicity. The initial filling and seasonal fluctuation of the Watana Reservoir are not expected to occur at a rate that would result in increased risk of RTS (Harza-Ebasco 1985).

It should be noted that RTS primarily represents the release of pre-existing tectonic strain, with the reservoir being only a perturbing influence (AEA 2011). That is, reservoirs are believed to provide an incremental increase in stress that may be large enough to trigger strain release in the form of an earthquake. Thus, reservoirs are considered capable of triggering an earlier occurrence of an earthquake (i.e., of decreasing the recurrence interval of the event) than would have occurred if the reservoir had not been filled. The Susitna-Watana Reservoir is not expected to trigger an earthquake larger than that which would occurr "naturally."

4.3.3. Watana Dam Site Geologic Conditions

4.3.3.1 Bedrock Lithology and Structures

Bedrock at the Watana Dam site is primarily an intrusive dioritic body which varies in composition from granodiorite to quartz diorite to diorite (Harza-Ebasco 1985). The texture is massive and the rock is hard, competent, and fresh except within locally developed sheared and altered zones. The diortite has been intruded by mafic and felsic dikes which are generally only a few feet wide. The contacts are healed and competent. The rock immediately downstream and south of the Project dam site is an andesite porphyry. This rock is medium to dark gray to green and contains quartz diorite inclusions. Where mapped or drilled, the contact zone is generally weathered and fractured up to 10 to 15 ft.

Several shears, fracture zones, and alteration zones are present at the Project dam site. Shears, which are generally discontinuous and less than one foot wide, occur in two forms. The first form occurs only in the diorite and is characterized by brecciated zones of sheared rock that have been rehealed into fresh and hard rock. The second form occurs in all rock types and consists of unhealed breccia and/or gouge. These shears are soft and friable. Fracture zones range from 6 in to 30 ft wide, but are generally less than 10 ft wide; where exposed at the ground surface, these zones trend to form topographic lows. Alteration zones, where hydrothermal solutions have caused the chemical breakdown of the feldspars and mafic minerals, are highly variable across the site. These zones, which were encountered in boreholes, are rarely seen in outcrop as they are easily eroded into topographic lows and gullies. Alteration zones range up to 20 ft thick but are usually less than five ft thick, and the transition between fresh and altered rock is typically gradational.

There are two major and two minor joint sets at the Project dam site. Set I, which is the most prominent set, strikes 320° and dips to 80° northeast to vertical. This set is found throughout the Project dam site and parallels the general structural trend in the regions. Set I has a subset, which strikes 290° to 300° with a dip of 75° northeast. This subset is localized in the downstream area near potential diversion tunnel portals. This subset also parallels the shear zones in the downstream area of the Project dam site. Set II trends northeast to east and dips vertically. This set is best developed in the upstream portion of the Project dam site, but is locally prominent in the downstream areas. Sets III and IV are minor sets but can be locally well developed. Set III trends north-south with variable dips ranging from 40° east to 65° west, while Set IV trends 90° with subhorizontal dips. Set III forms numerous open joints on the cliff faces the "Fingerbuster," described below, and several fracture zones and occasional shears parallel this orientation. Set IV appears to have developed from stress relief from glacial unloading and/or valley erosion.

Shears, fracture zones, and alteration zones at the Watana Dam site have resulted in formation of several significant geologic features. The two most prominent alteration/shear zones are located upstream and downstream of the proposed dam site. The upstream geologic feature (about 800 ft upstream of the dam centerline), is exposed on the north bank of the riverand is characterized predominantly by sound, jointed bedrock and a series of northwest trending zones of fractured and/or sheared rock that has been altered. The rock mass in this zone contains near vertical rock ridges 5-50 feet wide and steeply inclined northwesterly trending zones of closely fractured rock up to 15-20 feet wide, 5-10 foot-wide zones of weak, friable altered rock, and shears which measure one inch to approximately one foot in thickness. These zones have contributed to the erosion of steep gullies, which are separated by intact rock ridges. There is no evidence indicating persistence of the zones; however, the zones are difficult to trace due to the steepness of the terrain, talus cover, and the thick overburden deposits above approximately el 2,000 ft msl. The upstream end of this geologic feature coincides with a steep, narrow gulley, the contact between the diorite and quartz diorite pluton and a large andesite porphyry dike outcrops. Above the rock ridges comprising this northwest-trending geologic feature, a zone of highly weathered to decomposed diorite exists locally at the bedrock surface that is overlain by a thick cover (70-80 ft) of unconsolidated glacial sediments. The high-groundwater levels indicate a low permeability of te rock mass associated with this geologic feature.

Downstream of the Project dam site (about 800 ft downstream of the proposed dam centerline) a prominent geologic feature is exposed in a 40-foot-wide, deep, talus-filled gully on the north bank, just upstream of the andesite porphyry/diorite contact. The rock is moderately close to closely fractured rock with local shears and alteration zones which trend parallel to Set I (330°) and Set III (0°). Slickenslides indicate vertical displacement. The degree of rock fracturing varies widely in this area, and is influenced by structural control, near surface stress relief fracturing, and under cutting of the south-facing slope. Because of the lack of exposure, and the variability of the features, no major structural features were identified.

The two prominent geologic features or zones are geologic structures which could impact the construction of the Susitna-Watana Dam. Accordingly, the dam and power facilities have been located to avoid these geologic features. Main project features have been located between the two geologic features to avoid the need to tunnel through these fracture/shear zones.

4.3.3.2 Relict Channel

A relict channel or buried valley is present north and south of the Susitna River at the Watana Dam site. The Fog Lakes relict channel is located in the area between the Watana Dam site and the mountain range approximately five mi to the southeast (Acres 1982b). At this location, the bedrock surface dips to 350 ft below ground surface with the lowest point in the bedrock surface approximating the normal mean operating pool elevation of 2,000 ft. The channel is overlain by glacial deposits. The Watana relict channel, located north of the Watana Dam site, is much deeper and is shorter in length than the Fog Lakes Relict Channel. The bedrock surface in the "channel" is at about elevation 1775 ft msl, or about 225 ft below the proposed maximum reservoir pool elevation.

The potential for seepage from the reservoir through the buried valleys or channels may occur, thus bypassing the dam. During early evaluations of the Project site, the Watana relict channel north of the Watana Dam site was presumed to pose the greatest potential for seepage, due to the presence of permeable outwash and alluvial layers within the layered sequence of glacial and interglacial deposits and the relatively short travel path, from the reservoir to Tsusena Creek (Harza-Ebasco 1985). These evaluations also indicated that seepage through the buried channel area could result in piping and erosion of materials at the exit point on Tsusena Creek. The Fog Lakes relict channel southeast of the Project dam site is not expected to pose seepage problems because of the low gradient and long travel distance (approximately 4-5 mi) from the reservoir to Fog Creek.

The potential for seismically-induced failure in the relict channel areas following saturation of soils following impoundment of the reservoir is considered low. The stratigraphy of the Watana relict channel was defined during the 1970s and 1980s explorations (Harza-Ebasco 1985). These explorations indicated that deposits are either well graded, dense to very dense or cohesive and there are no apparent widespread or continuous units within the relict channel that are susceptible to liquefaction. In addition, multiple periods of glaciation resulted in overconsolidating the overburden deposits within the relict channel, thereby minimizing the potential for liquefaction.

4.3.3.3 Groundwater

The groundwater regime in the bedrock is a function of permeability, confined to movement along fractures and joints of the rock mass. At the dam site, the water table is a subdued replica of the surface topography. The groundwater table on the north abutment is generally from 5 to 30 ft below the surface except in areas with steep terrain, where it can reach depths of 60-90 ft (Harza-Ebasco 1985). Icing can be found on both abutments in the winter, particularly on the steep slopes of the south abutment, where the groundwater table is at the surface. Rock mass permeability of the bedrock does not vary significantly within the site area, generally ranging between 3.28×10^{-6} fps to 3.3×10^{-8} fps. Rock mass permeability is controlled by a degree of fractures within the rock, with the higher seepage rates occurring in the more sheared and fractured zones and decreasing with depth.

As the result of dam construction and reservoir impoundment, there will be the tendency for seepage through the foundation rock. The potential for seepage in the foundation of the Watana

Dam is not problematic and the bedrock foundations can be treated by grouting and controlled with drainage curtains.

4.3.3.4 Permafrost

Permafrost was sporadic to continuous below approximately 2,500 ft elevation during the 1980s, especially on north-facing slopes, as evidenced by ground ice, patterned ground stone nets, and slumping of the glacial till overlying permafrost. Measurements in the 1980s indicated that permafrost existed to depths of approximately 120 ft on the south abutment and up to 60 ft on the north abutment. Temperature measurements showed the permafrost to be "warm" (within l°F of freezing), and aerial photograph reconnaissance in the 1980s indicated that permafrost was thawing in some locations. Current permafrost conditions at the Project dam site, along the reservoir perimeter, and below project facilities, including the camp and airstrip, represent a data gap.

Where permafrost currently exists in the Project area, future thawing will primarily affect reservoir slope stability, liquefaction potential, and settlement of surface facilities constructed in areas of deep overburden north of the Watana Dam site. The airstrip, and camps, and site roads will likely encounter areas of permafrost, and although the soils in this area are not ice rich, some settlements may occur because of thawing.

During site evaluations described in Harza-Ebasco (1985), fractures in the rock on the north and south abutment at the Watana Dam site were ice-filled to approximately 60 and 120 ft respectively. Thawing of this permafrost, which will be caused or accelerated by the thermal effect of the reservoir remaining several degrees above freezing throughout the year, may influence seepage as it will likely occur prior to grouting of the cutoff below the core.

4.3.4. Overburden and Project Area Soils

Overburden thickness on the dam abutments may reach up to 70 ft or more. Above El 1,900 ft msl, overburden depth averages 20 ft with local zones to 50 ft on the south abutment. On the north abutment, overburden thickness reaches 50 to 60 ft. In upper areas of the abutments, near the top of the slopes, overburden consists of till, alluvium, and talus. Below El 1,900 ft msl, overburden consists primarily of talus with an average thickness of 10 ft. Subsurface investigations show the contact between the overburden and bedrock to be relatively unweathered.

The river alluvium beneath the proposed dam is up to 140 ft deep, averaging about 80 ft. The alluvium is thickest within the two large topographic lows, depressions in the bedrock surface just upstream of the main dam. The alluvial material in the river channel is comprised primarily of well graded coarse-grained gravels, sandy gravels, and gravelly sands with cobbles and boulders.

Generally, the lower section of the Watana Reservoir and adjacent slopes are covered by a veneer of glacial till and lacustrine deposits. Two main types of glacial till have been identified in this area: ablation and basal tills. The basal till is predominately over-consolidated, with a fine grain matrix (more silt and clay) and low permeability. The ablation till has fewer fines, is a silty sand and a somewhat higher permeability. Lacustrine deposits consist primarily of poorly graded fine sands and silts with lesser amounts of gravel and clay, and exhibit a crude stratification.

On the south side of the Susitna River, the Fog Lakes area is characteristic of a fluted ground moraine surface. Upstream in the Watana Creek area, glaciolacustrine material forms a broad, flat plain which mantles the underlying glacial till and the partially lithified Tertiary sediments.

Due to the highly variable geology and topography in the area, soil properties vary greatly over short distances. Some of the soils are relatively thin overlying bedrock, whereas in other areas the soil cover is quite thick over bedrock. Low-lying areas often have wet soils with a high water table, whereas soils along the rivers are often composed of well drained coarse material. Soil survey data at the level of detail required for project feature placement and site planning are not currently available. Geologic characterization of the soils will be conducted during terrain unit and geologic mapping of the reservoir, as well as site-specific geotechnical investigations at proposed sites for facilities such as the camp, airstrip, and features such as quarry and borrow sites, and along the access road and transmission line alignments. Project site soil information including thickness and texturewill be considered in the implementation of soil management during construction.

4.3.5. Reservoir Shoreline and Downstream River Banks

Most of the slopes within the Watana Reservoir are composed of unconsolidated materials. Permafrost within basal till and lacustrine deposits was found to be sporadic to discontinuous. Current data on permafrost distribution is not available, and the effect of permafrost thawing on slope stability represents a source of uncertainty. Existing slope instability within the reservoir indicates that the types of mass movement are primarily solifluction, skin flows, bimodal flows, and small rotational slides. These types of failure occur predominantly in the basal till or areas where the basal till is overlain by lacustrine deposits. In some cases, solifluction, which originated in the basal till, has proceeded downslope over some of the floodplain terraces.

The 2,000 foot-elevation normal maximum operating pool level lies largely within the general confines of the river valley. As a result, the drawdown zone will generally be in contact with bedrock-controlled slopes with thin to no overburden. This does not preclude the potential for slope instability along the shoreline of the reservoir, but it is anticipated that there could be less potential for large rotational or block slides. Major factors which will contribute significantly to slope instability in the Watana Reservoir are large seasonal fluctuations of the reservoir level, changes in the groundwater regime, ice floes, freezing and thawing, and wind driven waves. Because of the relatively slow rate of impounding, the potential for slope instability occurring during flooding of the reservoir will be minimal and confined to shallow surface flows and possibly some sliding.

Overburden data for the reservoir perimeter are not sufficient for predicting the gradation and contribution of sediment from hillslopes to the reservoir. In addition, the amount of sediment from glacial headwater streams that reaches the reservoir is not known. Coarse sediment will likely settle out in the broad valleys above the dam, and finer materials are expected to form deltas where the river and tributaries meet the reservoir. Sedimentation within the reservoir will reduce reservoir storage over time.

Sedimentation in the river channel downstream of the reservoir will be altered by regulated flows and a sediment deficit due to sediment trapping in the reservoir. Immediately downstream of the reservoir, lack of sediment from upstream will likely result in coarsening of bed material, and reduced flows will result in increased channel stability. However, regulated flows may reduce sediment transport at the confluences with the Chulitna and Talkeetna Rivers, which could lead to local aggradation and aggradation-induced flooding and lateral channel erosion at these confluences (URS, TT, and AHC 2011).

4.3.5.1 Reservoir Slope Stability

Shoreline erosion will occur as a result of two geologic processes: beaching and mass movement. Beach erosion can give rise to general instability through the sloughing or failure of an oversteepened slope, thereby enlarging the beach area. Aside from the formation of beaches resulting from erosion, instability along the reservoir slopes can result from two principal causes: a change in the groundwater regime and the thawing of the discontinuous permafrost. The types of mass movement expected to occur within the reservoir are: bimodal flow, block slide, flows, multiple regressive flow, multiple retrogressive flow/slide, rotational slides, skin flows, slides, and solifluction flow.

Changes in groundwater regime resulting from reservoir creation and operation alter the saturation and therefore stability of slopes. As a reservoir fills, the groundwater table in the adjacent bank also rises, potentially causing a previously stable slope above the groundwater table to become unstable due to increased pore pressures and seepage. Similarly, a rapid drawdown of the reservoir and concurrent lowering of the water table may result in loading the slopes and increased instability of susceptible slopes. Thawing of discontinuous permafrost can result in solifluction slopes, skin flows, and the lobes of bimodal flows on low-angle slopes. Slope mobility due to permafrost thaw is often substantial and rapid, as the movements are generally distributed throughout the mass.

Slope failure as a result of liquefaction during an earthquake is possible but not likely due to the limited extent of fine-grained sands, coarse silts, and other susceptible materials in the reservoir area. No evidence of liquefaction has been noted in the Project area, however, permafrost thaw, groundwater elevation changes, and saturation of susceptible materials in submerged slopes could result in small slides, including slides below the reservoir level, during earthquake shaking.

4.3.5.2 Slope Stability Models

Based on historical data from previous slope stability models presented in Harza-Ebasco (1985), the following conclusions can be drawn about the slope conditions of the Susitna-Watana Reservoir after impounding:

- The principal factors influencing slope instability are the large seasonal drawdown of the reservoir and the thawing of frozen soils (discontinuous permafrost). Other factors are the change in the groundwater regime, the steepness of the slopes, coarseness of the overburden material, thermal toe erosion, and the fetch length (maximum line of site across the reservoir) available to wave action;

- The potential for beaching is much greater on the north abutment of the reservoir;
- A large portion of the reservoir slopes are susceptible to shallow slides, mainly skin and bimodal flows, and shallow rotational slides;
- The potential for a large block slide that might generate a wave that could overtop the dam is remote.

4.3.6. Geologic Conditions and Project Excavations

4.3.6.1. Borrow Material and Quarry Site Development

Extensive investigations were conducted during previous site studies to identify quantities of suitable materials for Project construction. Detailed discussion of material properties, geology, and quantities are addressed in the Corps of Engineers (1975, 1979), Acres (1981, 1982) and Harza-Ebasco (1983) reports. Exact material requirements will be determined following finalization of Project design, and quarry and borrow site selection can be reassessed at that time.

Development of borrow material sites and quarry material will result in disturbance of the natural terrain and impact on aesthetics, noise levels, and air quality. These sites will be sufficiently removed from the camp facilities to minimize the noise and air quality impacts, however, exact locations and amounts of required borrow material has yet to be determined for the Project.

4.3.6.2. Project Facilities

The primary geologic hazard for project facilities, including the construction camp, airstrip, transmission lines, and roads is settlement due to the presence of soft organic soils and the delicate thermal balance associated with areas of melting permafrost where overburden has some thickness. The potential access routes and transmission line locations have the potential for liquefaction, and for landslides which could occur during earthquakes.

4.3.7. Potential Adverse Impacts

Potential impact issues associated with development and operation of the Susitna-Watana Project, which were described in above sections, are addressed in this secton.

Table 4.3-1 Potential geology and soils impact issues.

Impact Issue Category	Impact Issue
Reservoir Creation	Filling and seasonal fluctuation associated with operation of the Watana Reservoir may increase the occurrence probability of natural seismic events within the area of hydrologic influence.
	Impoundment of water behind the reservoir may lead to seepage through the Watana relict channel on the north abutment, upstream of the dam. Piping and erosion of soils within the relict channel may occur at seepage exit on Tsusena Creek. Impoundment will also increase the tendency for seepage through the foundation rock at the abutments.
	Increased ground temperature due to groundwater table alteration and the presence of a large body of water which will remain above freezing throughout the year may lead to an increased rate of thaw where permafrost exists within and around the reservoir rim.
	Submerged slopes in granular materials, particularly loose, uniform fine sands, may be susceptible to liquefaction during earthquakes.
	Retention of sediment behind the reservoir will result in a sediment deficit downstream.
	Seasonal fluctuations in reservoir elevation are likely to result in slope instability.
Groundwater and Permafrost	Creation and seasonal fluctuations of the reservoir will alter the groundwater regime. Locally slope instability may occur as a result of a corresponding increase in pore pressures and seepage activity.
	Whether natural or enhanced by the creation of the reservoir, permafrost thaw will impact slope stability, liquefaction potential, settlement of site infrastructure, and seepage within bedrock along the north and south abutments.
	Solifluction slopes, skin flows, and the lobes of bimodal flows are caused by instability on low-angle slopes resulting from thawing of permafrost.
River Flow Alteration	Reduced flow in the river may result in increased stability directly downstream of the dam, and aggradation and aggradation-related channel migration at the confluences with the Chulitna and Talkeetna rivers.
Quarry and Borrow Development	Removal of vegetation and soil for quarry and borrow development will increase erosion potential.
	Transport of quarry and borrow materials to the project site may result in erosion along the transport route.
	Airborne dust will be present in the quarry and borrow areas and along transportation corridors.
Transmission Lines, Roads, Airstrip, and Camp	Construction and operation of transmission lines, roads, airstrip, and construction camp will result in increase erosion potential at these facilities and settlement may occur due to thawing of frozen soils.

4.3.8. Potential Protection, Mitigation, and Enhancement

Specific PM&E measures for geologic and soil resources have not been developed for the Project. However, potential measures that may be applied to the Project are summarized in Table 4.3-2.

Table 4.3-2 Potential protection, mitigation, and enhancement measures.

Impact Issue Category	Potential Protection, Mitigation, and Enhancement Measures
Reservoir-Triggered Seismicity	Historic estimates of reservoir-triggered seismicity (RTS) hazard will be re-evaluated for the current Project based on contemporary models and understanding of seismic geology within the area of hydrologic influence of the dam. However, based on past investigations significant RTS hazard is not anticipated. Furthermore, the magnitude of an earthquake generated by RTS is unlikely to exceed the magnitude of any earthquake which would normally occur in the area. Therefore, the design level earthquake developed for the Project will provide the design criteria for any reservoir-triggered earthquake.
	The planned controlled, smooth filling curve, with no sudden changes in filling rate, will reduce the RTS hazard.
	A microseismic network installed to monitor seismic eventsprior to, during, and after impoundment will help distinguish naturally occurring events (background seismicity) from those that could be attributed to the filling and operation of the reservoir.
Reservoir Seepage	Grout curtain installation will be utilized to reduce or prevent normally occurring seepage within the foundation rock below the dam.
	An effective pattern of drain holes will be incorporated into the dam design in order to control downstream pressures in the bedrock foundation.
	Instrumentation of the dam abutments will be placed during construction for long-term, post-construction monitoring of seepage. Provisions will be made by virtue of the grouting and drainage galleries beneath the dam foundation to allow for remedial grouting and additional drain hole installations for post-construction grouting after abutment thawing and should excessive seepage develop during impoundment.
Reservoir Slope Failures	While some degree of localized slope failures will be generated during reservoir filling, slope failure is expected to be small and localized with much of the slide activity occurring underwater. Long-term progressive activities such as beaching, skin flows, minor slides, will promote long-term stability of reservoir shores.
	Evaluation and monitoring of key slopes will be initiated prior to impoundment.
Permafrost and General Soil Issues	Adequate structural designs will be implemented to mitigate for settlement in areas of frozen soils . In addition, large pads of granular material may be placed in active areas in order to distribute the load and insulate soil to retard permafrost thaw.
	Regrading to offset the effects of differential settlement will be part of the maintenance program for the airstrip in areas of permafrost.
	Root systems remaining after tree clearing will help stabilize reservoir slopes in areas of thawing permafrost until excessive pore pressures dissipate.
Soil Management	Areas where erosion may occur near streams or rivers will be protected during the construction period and reseeded when construction is complete.
	Construction site best management practices, including maintenance of native vegetation, temporary reseeding, use of interception ditches, and installation of silt fences and other barriers, as described in ADOT&PF (2011) and ADEC (2009) will be implanted at the site.
Project Facilities Abandonment	All temporary access roads will be graded, re-contoured, and seeded following abandonment.
	Borrow sites will be excavated only as necessary and will either be regraded and seeded with appropriate species, or, if excavation is deep enough, converted to ponds.

4.3.9. References

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4.4. Water Resources

This section describes water resources in the Susitna River and its tributaries (See Figure 4.4-1). Topics addressed include (1) drainage basin hydrology, including groundwater conditions, (2) streamflow data, (3) hydrologic change, (4) existing and proposed water uses, (4) water quality (chemical and physical parameters), (5) ice dynamics, and (6) bedload and sediment transport. The primary focus of the water quality discussion is on parameters determined most important for the maintenance of habitat for fish populations and other aquatic organisms, including temperature, dissolved oxygen (DO), total dissolved gas (TDG), pH, nutrients, chlorophyll-*a*, turbidity, metals, among others.

Conditions are evaluated in the following reaches within the Susitna River basin: (1) in and upstream of the proposed Watana Dam site at RM 184, (2) the middle Susitna River, from RM 184 downstream to the confluence with the Chulitna River at RM 98, and (3) the lower Susitna River, from RM 98 downstream to Cook Inlet (Table 4.4-1). These reaches, identified during the 1980s FERC licensing process, were designated based on differences in channel morphology. In addition to the mainstem, water resource conditions are assessed for important tributaries, sloughs adjacent to the Susitna River mainstem, and at locations of potential access road and transmission line stream crossings.

Water quality information presented in this section is derived primarily from studies conducted in the 1980s and is supplemented with more recent, reasonably available information assembled for the AEA Susitna Water Quality and Sediment Transport Data Gap Analysis Report (URS 2011). Recently collected water quality data pertain mainly to the Susitna River's tributaries downstream from the town of Talkeetna.

The Data Gap Analysis Report (URS, TT and AHC 2011) concluded that existing water quality information is insufficient for assessing baseline conditions in the Susitna River basin and for evaluating potential Project effects. The gap report concluded that the nearly 30-year-old water quality data do not represent present conditions, and more current information is needed to assess potential impacts to fish and other aquatic biota in the mainstem Susitna River and at the mouths of tributaries downstream of the proposed Project. The gap report (URS, TT and AHC 2011) also concluded that existing sediment transport data allow for only limited analysis because of the age of the data and a lack of points for calibration with current investigations. Predictions for changes to sediment transport in the Susitna River require that a current and comprehensive baseline of information be developed.

To gain a better perspective of potential water quality issues and potential future studies, baseline water quality data are analyzed on a seasonal basis and then compared to Alaska's water quality standards (Section 4.4.4.1). Construction and operation of the Susitna-Watana Project will change some water quality conditions. These potential changes are addressed under Potential Adverse Impacts (Section 4.4.9). Potential protection, mitigation and enhancement measures are discussed in Section 4.4.10.

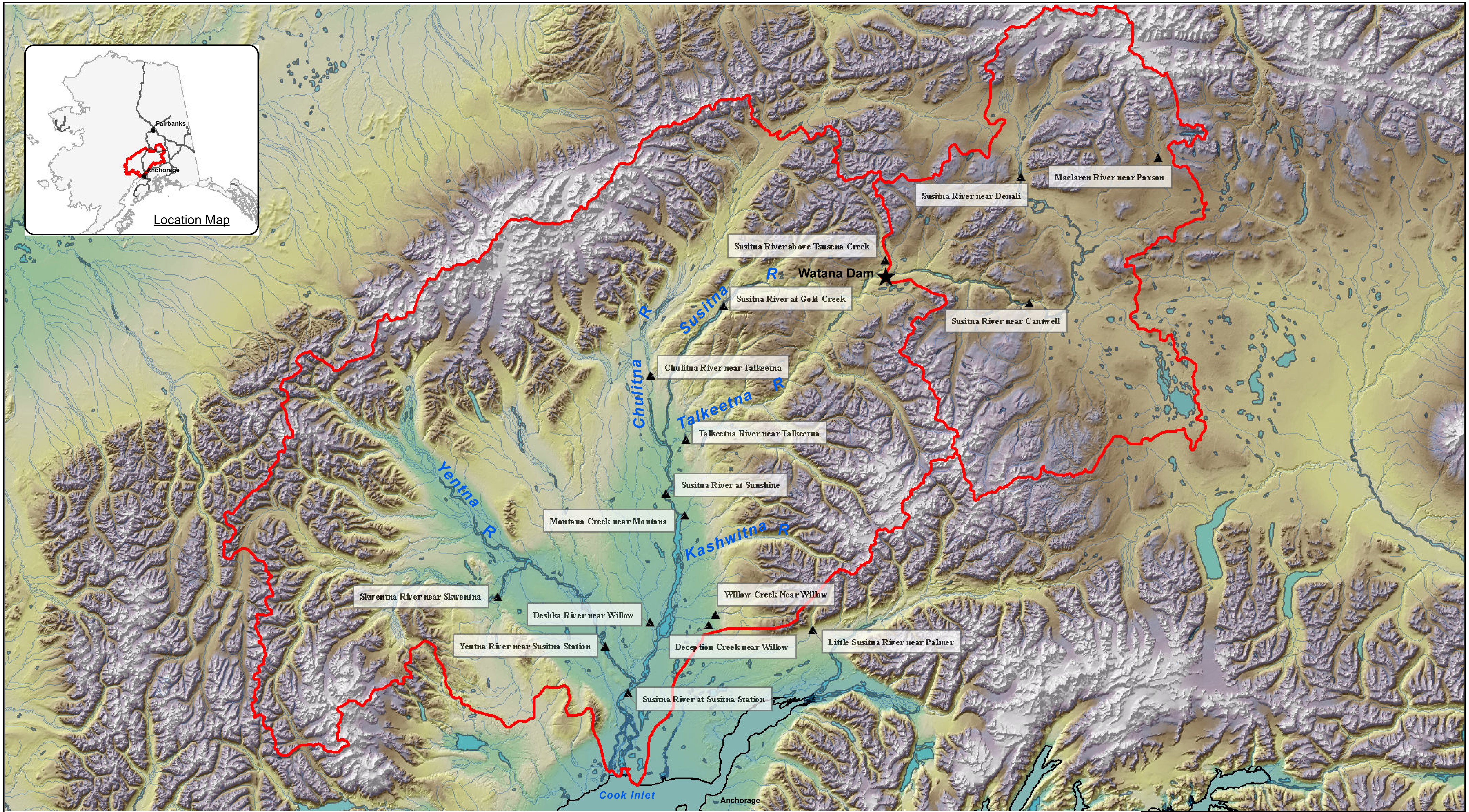
4.4.1. Drainage Basin Hydrology

4.4.1.1. Basin Description

The Susitna River drainage area is about 19,400 square mi. Upstream of the proposed location of the Watana Dam (RM 184) the drainage area is about 5,180 square mi. The upper Susitna River (i.e., area upstream of the proposed dam site) is fed by three glaciers in the Alaskan Range. The glaciers cover an area of 290 square mi (Acres 1983a). The three glacially fed forks, including the MacLaren River, flow southward for about 18 mi before joining to form the mainstem of the Susitna River. The river flows an additional 55 mi southward through a broad valley, where much of the coarse sediment from the glaciers settles out. The river then flows west about 56 mi to the proposed Watana Dam site. Other tributaries that flow into the proposed reservoir include Deadman, Watana (RM 194), Kosina (RM 206.8), Goose (RM 231.3), and Jay creeks, along with the Oshetna River (RM 233.4).

Table 4.4-1. Reach segmentation for the Susitna River basin water quality analysis.

Bounds of Reach (Susitna River Mi)	Reach Number	General Description
313 – 184	1	Upper Susitna River, including headwaters and tributaries above the proposed Watana Dam site
184 – 150	2a	Middle Susitna River and tributaries from below proposed Watana Dam Site through Devils Canyon
150 – 98	2b	Middle Susitna River and tributaries from the mouth of Devils Canyon to the Susitna – Chulitna – Talkeetna confluence
98 – 0	3	Lower Susitna River from Susitna – Chulitna – Talkeetna confluence to mouth at Cook Inlet



LEGEND:

★ Watana Dam Site

▲ Gaging Station

Basin Boundary

NOTES:
1. Spatial Reference: NAD83 Alaska Albers, meters
2. Topography: USGS National Elevation Dataset (NED), 2-Arc Second
3. Basin boundary based on modified USGS HUCs 19020501-5

N

0 10 20 40 Miles

ALASKA ENERGY AUTHORITY

Date: Dec. 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project Ferc No.14241

Figure 4.4-1

Susitna River Drainage Basin Boundary and Streamflow Gage Locations

Downstream of the proposed dam site, the Susitna River continues west for about 40 mi through the Devils Canyon areas; the river valley in this reach is narrow with violent rapids. Within the 96-mile westward section of the Susitna River, there are numerous small, steep gradient, clear water tributaries that flow into the Susitna River. Several of these tributaries traverse waterfalls as they enter the gorge. Tributaries located between the proposed dam site and Devils Canyon include Devil, Fog (RM 179.2), and Tsusena (RM 181.3) creeks. Portage Creek enters the Susitna River below Devils Canyon. As the Susitna River curves south past Gold Creek (RM 136.8), about 12 mi downstream from Devils Canyon, its gradient gradually decreases. The river is joined by two major rivers, the Chulitna (RM 98) and Talkeetna (RM 97), about 40 mi downstream of Gold Creek in the vicinity of the town of Talkeetna. A third major tributary, the Yentna River (RM 28), joins the Susitna River about 70 mi farther downstream. From the confluences with the Chulitna and Talkeetna rivers, the Susitna River flows south through braided channels for about 97 mi until it empties into Cook Inlet near Anchorage, approximately 318 mi from its source.

4.4.1.2. Project Streamflow Data

4.4.1.2.1. USGS Recorded Streamflow Data

A summary of recorded flow data in the Susitna River watershed is useful to many groups associated with the Susitna-Watana Hydroelectric Project. Recorded flow data is also needed to develop a long-term estimate of flow and flood frequency at the Watana Dam site for use in Project design, reservoir operation and power generation studies. Fifteen gaging stations have been intermittently operated by the USGS within the Susitna River watershed between 1949 and 2011 (Table 4.4-2). An additional station on the Little Susitna River, which is not a tributary of the Susitna River, was included in Table 4.4-2 due to its proximity to the Susitna River and the exceptionally long period of record for this gage.

Table 4.4-2: USGS streamflow gages in the Susitna watershed.

USGS Gage Number	Gage Name	Drainage Area (sq.mi.)	Latitude	Longitude	Gage Datum (feet)	Available Period of Record
15290000	Little Susitna River near Palmer	62	61°42'37"	149°13'47"	917	63 years: 1948 - 2011
15291000	Susitna River near Denali	950	63°06'14"	147°30'57"	2,440	27 years: 1957 - 1976; 1978 - 1986
15291200	Maclaren River near Paxson	280	63°07'10"	146°31'45"	2,866	28 years: 1958 - 1986
15291500	Susitna River near Cantwell	4,140	62°41'55"	147°32'42"	1,900	17 years: 1961 - 1972; 1980 - 1986
15291700	Susitna River above Tsusena Creek	N/A	62°49'24"	148°36'17"	1,500	Established October 2011
15292000	Susitna River at Gold Creek	6,160	62°46'04"	149°41'28"	677	57 years: 1949 - 1996; 2001 - 2011
15292400	Chulitna River near Talkeetna	2,570	62°33'31"	150°14'02"	520	19 years: 1958 - 1972; 1980 - 1986
15292700	Talkeetna River near Talkeetna	1,996	62°20'49"	150°01'01"	400	39 years: 1964 - 1972; 1980 - 2011
15292780	Susitna River at Sunshine	11,100	62°10'42"	150°10'30"	270	5 years: 1981 - 1986
15292800	Montana Creek near Montana	164	62°06'19"	150°03'27"	250	4 years: 2005 - 2006; 2008 - 2011
15294005	Willow Creek Near Willow	166	61°46'51"	149°53'04"	350	25 years: 1978 - 1993; 2001 - 2011
15294010	Deception Creek near Willow	48	61°44'52"	149°56'14"	250	7 years: 1978 - 1985
15294100	Deshka River near Willow	591	61°46'05"	150°20'13"	80	21 years: 1978 - 1986; 1988 - 2001
15294300	Skwentna River near Skwentna	2,250	61°52'23"	151°22'01"	200	23 years: 1959 - 1982
15294345	Yentna River near Susitna Station	6,180	61°41'55"	150°39'02	80	6 years: 1980 - 1986
15294350	Susitna River at Susitna Station	19,400	61°32'41"	150°30'45	40	19 years: 1974 - 1993

The locations of the gaging stations listed in Table 4.4-2, along with the watershed boundaries for the entire Susitna River and the portion of the tributaries, are shown on Figure 4.4-1. Figure 4.4-2 shows the chronological availability of USGS flow data in the Susitna watershed.

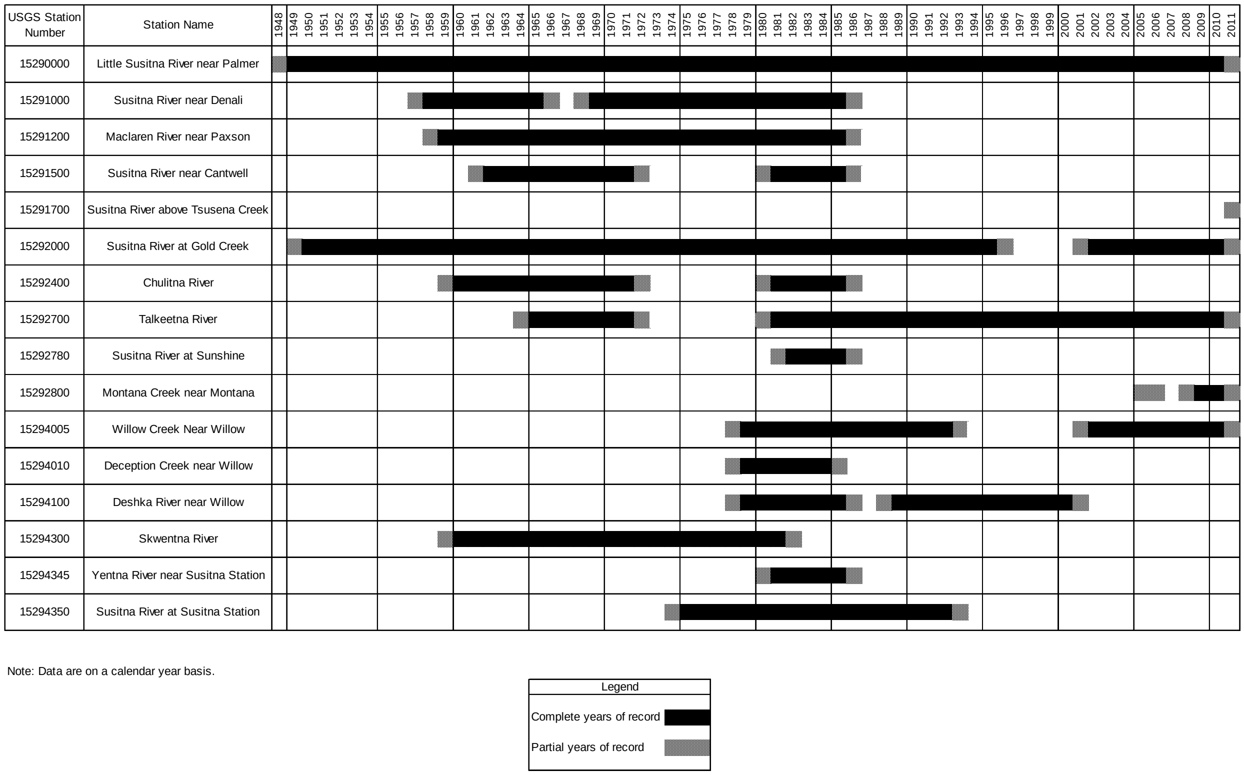


Figure 4.4-2: Susitna watershed USGS flow data – chronological availability.

Average monthly flows over the period of record for the gage sites listed in Table 4.4-2 are presented in Table 4.4-3.

Table 4.4-3: Average monthly flows (cfs) at USGS gages in the Susitna watershed.

	Little Susitna River near Palmer ($61.9mi^2$)	Susitna River near Denali ($950mi^2$)	Maclaren River near Paxson ($280mi^2$)	Susitna River near Cantwell ($4,140mi^2$)	Susitna River at Gold Creek ($6,160mi^2$)	Chulitna River near Talkeetna ($2,570mi^2$)	Talkeetna River near Talkeetna ($1,996mi^2$)	Susitna River at Sunshine ($11,100mi^2$)	Montana Creek near Montana ($164.1mi^2$)	Willow Creek near Willow ($166mi^2$)	Deception Creek near Willow ($48mi^2$)	Deshka River near Willow ($591mi^2$)	Skwentna River near Skwentna ($2,250mi^2$)	Yentna River near Susitna Station ($6,180mi^2$)	Susitna River at Susitna Station ($19,400mi^2$)
January	31	262	105	961	1,590	1,367	666	4,375	39	84	18	277	1,120	3,265	8,487
February	25	220	90	828	1,414	1,132	562	3,939	33	73	15	239	953	2,985	7,739
March	21	199	82	779	1,297	1,001	508	3,496	31	61	15	240	837	2,576	7,136
April	27	233	89	915	1,753	1,171	703	3,948	54	95	39	590	1,095	3,863	10,021
May	240	2,135	850	7,908	14,138	8,169	5,050	27,970	888	653	169	2,800	8,599	26,433	64,825
June	661	7,279	2,894	18,230	26,417	21,474	10,631	56,472	547	981	95	902	19,001	47,997	118,479
July	485	9,831	3,240	17,542	23,871	26,363	10,151	66,238	346	637	89	831	17,644	53,394	130,317
August	409	8,159	2,548	14,918	21,365	22,516	9,102	60,972	576	619	84	1,140	13,401	49,070	113,051
September	306	3,296	1,136	7,936	13,741	11,834	5,860	35,202	541	633	91	1,231	8,466	27,608	74,446
October	148	1,181	421	3,365	6,345	5,188	2,946	16,600	246	427	72	1,161	4,522	14,003	39,578
November	64	525	192	1,575	2,679	2,169	1,201	6,787	70	158	47	673	1,945	5,823	15,966
December	41	339	130	1,117	1,892	1,576	820	4,877	47	105	25	338	1,327	3,893	9,983
Annual	206	2,793	981	6,340	9,805	8,792	4,039	23,864	242	388	65	903	6,640	20,208	50,417

Table 4.4-4 presents the average monthly flows for the period of record at the nearest USGS gaging station downstream from the Watana Dam site (Gold Creek), and Table 4.4-5 presents similar information for the nearest USGS gaging station upstream from the dam site (Cantwell).

Table 4.4-4: Average flows (cfs) at USGS Gage 15292000 – Susitna River at Gold Creek (RM 136.5).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1949	---	---	---	---	---	---	---	24,250	15,650	6,335	2,583	1,439	---
1950	1,027	788	726	870	11,510	19,600	22,600	19,880	8,301	3,848	1,300	1,100	7,687
1951	960	820	740	1,617	14,090	20,790	22,570	19,670	21,240	5,571	2,744	1,900	9,439
1952	1,600	1,000	880	920	5,419	32,370	26,390	20,920	14,480	8,202	3,497	1,700	9,820
1953	1,100	820	820	1,615	19,270	27,320	20,200	20,610	15,270	5,604	2,100	1,500	9,738
1954	1,300	1,000	780	1,235	17,280	25,250	20,360	26,100	12,920	5,370	2,760	2,045	9,762
1955	1,794	1,400	1,100	1,200	9,319	29,860	27,560	25,750	14,290	4,951	1,900	1,300	10,087
1956	980	970	940	950	17,660	33,340	31,090	24,530	18,330	5,806	3,050	2,142	11,712
1957	1,700	1,500	1,200	1,200	13,750	30,160	23,310	20,540	19,800	8,212	3,954	3,264	10,758
1958	1,965	1,307	1,148	1,533	12,900	25,700	22,880	22,540	7,550	4,811	2,150	1,513	8,891
1959	1,448	1,307	980	1,250	15,990	23,320	25,000	31,180	16,920	6,558	2,850	2,200	10,824
1960	1,845	1,452	1,197	1,300	15,780	15,530	22,980	23,590	20,510	7,794	3,000	2,694	9,872
1961	2,452	1,754	1,810	2,650	17,360	29,450	24,570	22,100	13,370	5,916	2,700	2,100	10,575
1962	1,900	1,500	1,400	1,700	12,590	43,270	25,850	23,550	15,890	6,723	2,800	2,000	11,633
1963	1,600	1,500	1,000	830	19,030	26,000	34,400	23,670	12,320	6,449	2,250	1,494	10,961
1964	1,048	966	713	745	4,307	50,580	22,950	16,440	9,571	6,291	2,799	1,211	9,807
1965	960	860	900	1,360	12,990	25,720	27,840	21,120	19,350	7,205	2,098	1,631	10,225
1966	1,400	1,300	1,300	1,775	9,645	32,950	19,860	21,830	11,750	4,163	1,600	1,500	9,121
1967	1,500	1,400	1,200	1,167	15,480	29,510	26,800	32,620	16,870	4,900	2,353	2,055	11,390
1968	1,981	1,900	1,900	1,910	16,180	31,550	26,420	17,170	8,816	3,822	1,630	882	9,560
1969	724	723	816	1,510	11,050	15,500	16,100	8,879	5,093	3,124	1,215	866	5,502
1970	824	768	776	1,080	11,380	18,630	22,660	19,980	9,121	5,288	3,407	2,290	8,076
1971	1,442	1,036	950	1,082	3,745	32,930	23,950	31,910	14,440	5,847	3,093	2,510	10,291
1972	2,239	2,028	1,823	1,710	21,890	34,430	22,770	19,290	12,400	4,826	2,253	1,465	10,641
1973	1,200	1,200	1,000	1,027	8,235	27,800	18,250	20,290	9,074	3,733	1,523	1,034	7,897
1974	874	777	724	992	16,180	17,870	18,800	16,220	12,250	3,739	1,700	1,603	7,694
1975	1,516	1,471	1,400	1,593	15,350	32,310	27,720	18,090	16,310	7,739	1,993	1,081	10,595
1976	974	950	900	1,373	12,620	24,380	18,940	19,800	6,881	3,874	2,650	2,403	8,027
1977	1,829	1,618	1,500	1,680	12,680	37,970	22,870	19,240	12,640	7,571	3,525	2,589	10,511
1978	2,029	1,668	1,605	1,702	11,950	19,050	21,020	16,390	8,607	4,907	2,535	1,681	7,810
1979	1,397	1,286	1,200	1,450	13,870	24,690	28,880	20,460	10,770	7,311	4,192	2,416	9,892
1980	1,748	1,466	1,400	1,670	12,060	29,080	32,660	20,960	13,280	7,725	3,569	1,915	10,689
1981	2,013	1,975	1,585	2,040	16,550	19,300	33,940	37,870	13,790	7,463	3,260	1,877	11,910
1982	1,681	1,486	1,347	1,783	13,380	26,100	24,120	15,270	17,780	6,892	2,633	2,358	9,608
1983	2,265	1,996	1,690	1,900	14,950	24,510	21,150	24,500	13,590	8,301	3,153	2,258	10,079
1984	2,048	1,969	1,900	1,810	12,960	26,770	23,540	20,400	9,429	5,670	3,093	2,394	9,382
1985	1,939	1,643	1,726	1,977	11,170	26,330	26,510	19,920	15,640	6,944	2,673	1,929	9,915
1986	1,658	1,561	1,394	1,565	12,080	20,010	21,870	17,250	12,860	12,680	3,450	1,955	9,084
1987	1,615	1,518	1,500	2,048	12,990	23,000	29,890	21,750	13,340	5,924	2,483	1,600	9,868
1988	1,561	1,500	1,500	1,587	17,370	29,720	25,690	19,540	13,780	7,674	3,013	2,000	10,467
1989	2,000	1,800	1,800	2,137	13,740	26,770	23,650	22,390	15,430	8,025	2,997	1,848	10,267
1990	1,765	1,700	1,852	4,250	25,630	33,800	23,510	23,730	26,510	6,895	2,447	2,200	12,906
1991	1,897	1,800	1,619	1,613	6,048	25,630	21,220	18,280	12,350	5,817	2,440	2,200	8,441
1992	1,965	1,800	1,868	2,100	6,104	23,140	25,540	21,150	10,170	4,379	2,733	2,039	8,628
1993	1,865	1,754	1,639	2,537	20,880	23,480	19,350	18,750	21,290	9,915	3,327	2,529	10,660
1994	2,058	1,786	1,526	3,221	14,610	31,090	20,960	18,580	9,357	4,530	2,780	2,097	9,421
1995	1,855	1,718	1,700	2,846	17,710	24,710	25,500	18,380	19,140	6,482	2,657	1,442	10,394
2002	1,548	1,421	1,303	1,330	11,510	16,550	18,150	23,780	16,250	10,950	5,394	2,590	9,288
2003	1,655	2,243	1,509	2,173	8,019	24,330	29,200	21,120	13,510	8,109	2,500	1,810	9,732
2004	1,471	1,276	1,081	2,730	23,570	25,330	20,160	17,720	6,452	3,300	1,733	1,610	8,930
2005	1,439	1,239	1,045	2,611	26,940	34,320	26,760	21,970	22,860	8,238	2,143	1,497	12,650
2006	1,400	1,389	1,361	1,535	15,730	23,290	23,140	30,810	12,300	10,390	3,140	2,319	10,648
2007	2,024	1,905	1,744	2,273	17,190	19,710	21,580	19,260	13,500	5,017	3,222	2,813	9,241
2008	1,842	1,343	1,360	1,670	11,860	21,120	22,030	19,730	14,520	5,529	1,548	1,300	8,703
2009	1,385	1,300	1,340	4,547	22,930	23,110	19,370	18,470	12,480	7,122	2,807	1,842	9,783
2010	1,468	1,350	1,305	1,847	19,610	20,020	27,520	20,080	15,820	---	---	---	---
Average	1,596	1,418	1,300	1,760	14,274	26,528	24,047	21,433	13,861	6,372	2,680	1,891	9,805
Maximum	2,452	2,243	1,900	4,547	26,940	50,580	34,400	37,870	26,510	12,680	5,394	3,264	12,906
Minimum	724	723	713	745	3,745	15,500	16,100	8,879	5,093	3,124	1,215	866	5,502

Table 4.4-5: Average Flows (cfs) at USGS Gage 1529150 – Susitna River near Cantwell (RM 223.7).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1961	---	---	---	---	9,688	15,710	14,820	16,700	6,725	3,281	1,800	1,400	---
1962	1,300	1,000	940	1,200	10,000	28,320	20,890	16,000	9,410	4,326	2,200	1,400	8,116
1963	1,000	850	760	720	11,340	15,000	22,790	18,190	9,187	3,848	1,300	877	7,214
1964	644	586	429	465	2,806	34,630	17,040	11,510	5,352	3,134	1,911	921	6,625
1965	760	680	709	1,097	8,818	16,430	18,350	13,440	12,910	3,116	1,000	750	6,538
1966	700	650	650	875	4,387	18,500	12,220	12,680	6,523	2,322	780	720	5,103
1967	680	640	560	513	9,452	19,620	16,880	19,190	10,280	3,084	1,490	1,332	7,018
1968	1,232	1,200	1,200	1,223	9,268	19,500	17,480	10,940	5,410	2,406	1,063	618	5,992
1969	508	485	548	998	7,471	12,330	13,510	6,597	3,376	1,638	815	543	4,094
1970	437	426	463	887	7,580	9,909	13,900	12,320	5,211	2,155	1,530	1,048	4,693
1971	731	503	470	529	1,915	21,970	18,130	22,710	9,800	4,058	2,050	1,371	7,056
1972	1,068	922	881	876	9,694	20,000	16,690	15,620	9,423	---	---	---	---
1980	---	---	---	---	---	17,370	20,460	14,870	8,570	5,472	2,487	1,658	---
1981	1,694	1,186	919	1,218	12,150	14,020	20,870	22,760	9,417	3,829	1,627	1,297	7,646
1982	1,061	698	573	573	8,219	16,500	16,540	11,010	9,942	3,309	1,600	1,400	5,982
1983	1,300	1,200	1,148	1,210	8,196	16,460	16,250	17,000	8,656	5,377	2,130	1,600	6,751
1984	1,500	1,500	1,481	1,403	8,571	18,810	17,700	14,260	5,137	2,758	1,632	1,167	6,362
1985	990	880	844	1,028	5,541	15,810	19,880	12,730	7,522	3,087	1,367	891	5,916
1986	729.4	674.3	660	734.7	7,245	15,490	18,890	---	---	---	---	---	---
Average	961	828	779	915	7,908	18,230	17,542	14,918	7,936	3,365	1,575	1,117	6,340
Maximum	1,694	1,500	1,481	1,403	12,150	34,630	22,790	22,760	12,910	5,472	2,487	1,658	8,116
Minimum	437	426	429	465	1,915	9,909	12,220	6,597	3,376	1,638	780	543	4,094

As shown on Figure 4.4-3 for the Gold Creek gage and Figure 4.4-4 for the Cantwell gage, flow in the Susitna River and its tributaries is highly seasonal, with peak flows in July corresponding with summer snow melt conditions, and low winter flows occurring when much of the precipitation is stored in the watershed as snow.

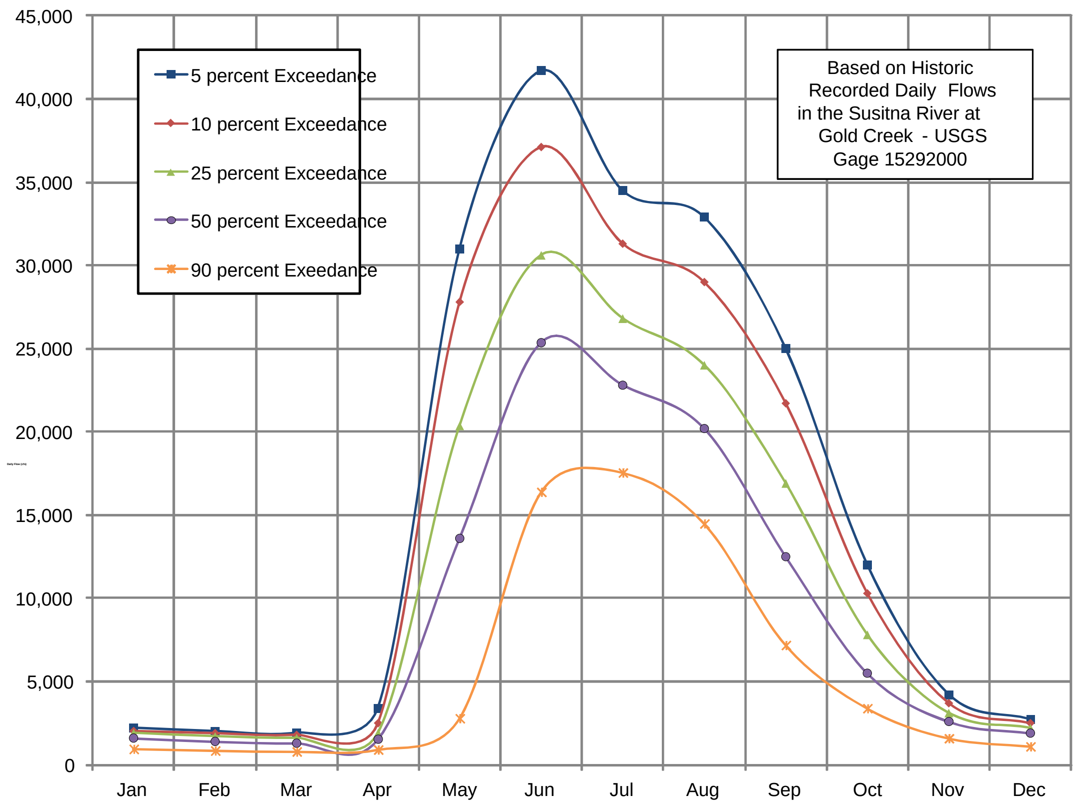


Figure 4.4-3: Susitna River Flow Frequency at Gold Creek RM 136.5, Period 1949-2010.

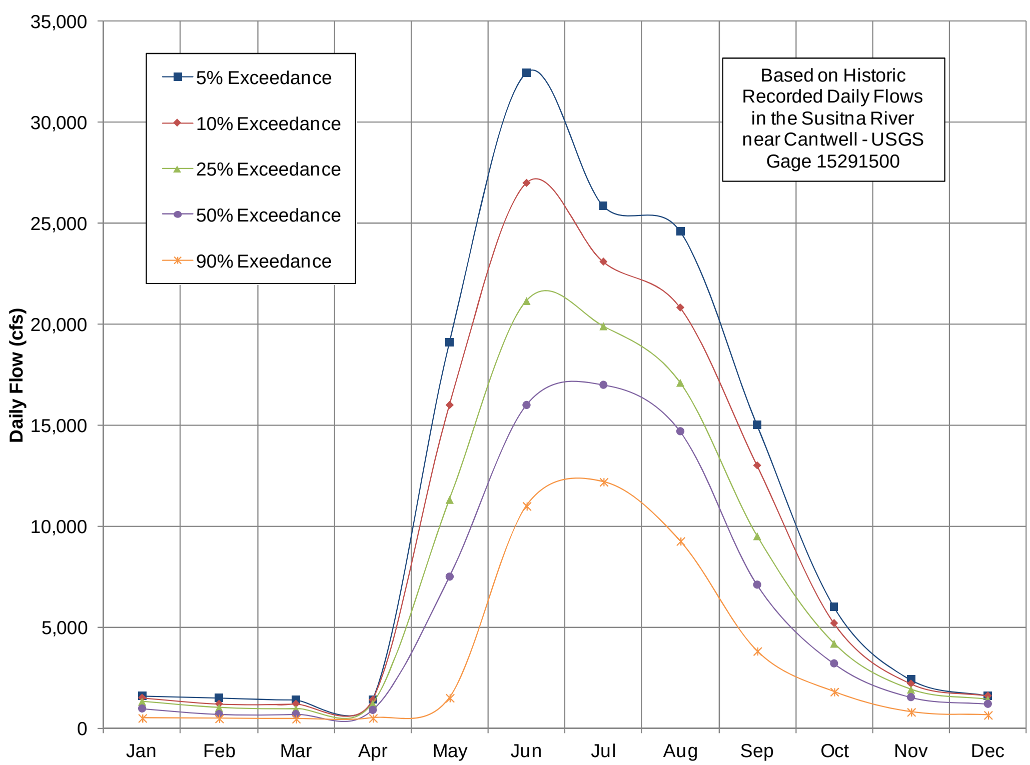


Figure 4.4-4: Susitna River Flow Frequency at Cantwell RM 223.7, Period 1961-1986.

Similar tabular and graphical information for other USGS stations is presented in MWH Americas, June 2011, Technical Memorandum on Watana Hydroelectric Project Hydrology TM-03-0003-050411.

4.4.1.2.2. Watana Dam Site

No USGS recorded streamflow data is available in the immediate vicinity of the Watana Dam site, except for the very short period of provisional record available at the new gage 15291700 that was established above the Tsusena Creek confluence in October 2011. A modeled daily flow data set for the Watana Dam site was developed from the daily data at the downstream gage at Gold Creek (RM 136.5) and the upstream gage near Cantwell (RM 223.7). The drainage area at the Watana Dam site, 5,180 square mi, is approximately half-way between the drainage area at Cantwell (4,140 square mi) and Gold Creek (6,160 square mi). The drainage areas for these sites were confirmed with GIS measurements. The 17 years of concurrent data at the Cantwell and Gold Creek gaging stations were used to calculate monthly scaling factors for use in estimating flows at the Watana Dam site, with the resulting monthly flows summarized in Table 4.4-6 (MWH Americas, June 2011, Technical Memorandum on Watana Hydroelectric Project Hydrology TM-03-0003-050411).

The Susitna River is typical of unregulated northern, glacial rivers with high, turbid summer flows and low, clear winter flows. Runoff from snowmelt and rainfall in the spring causes a rapid increase in flow in late April and May relative to the low discharges experienced throughout the winter. Peak annual floods usually occur during this period. The maximum, mean, and minimum monthly estimated flows at the proposed Watana Dam site are 42,842 cfs (June 1964), 8,114 cfs, and 575 cfs (March 1964), respectively (Table 4.4-6). The peak annual flow, which occurred on June 7, 1964, was estimated to be 90,700 cfs at Gold Creek. Rainfall-related floods often occur in August and early September, but generally these floods are not as severe as the spring snowmelt floods. Approximately 80 percent of the annual flow occurs between May and September. Note that the critical streamflow for dependable capacity occurred in water years 1969 and 1970.

At the proposed Watana Dam site, average flow approaches 5,000 cfs in October (the beginning of the water year) and then decreases in November and December as the river freezes, with a low flow of about 1,000 cfs occurring in March and/or April. Breakup of the river ice has historically occurred in early to mid-May. Average monthly flows at the Watana Dam site are over 11,000 cfs in May and peak at about 22,000 cfs in June. Average monthly flows gradually decrease to 20,500 cfs in July, 18,000 cfs in August, and 11,000 cfs in September. Annual and monthly flow duration curves for the proposed Watana Dam site, for low flow and high flow, are shown in Figures 4.4-5 and 4.4-6. Flows are based on historic recorded daily flows at the Gold Creek gage, adjusted for the drainage area between the Cantwell and Gold Creek gaging stations.

From October 1982 through October 1984, streamflow data were collected near the Watana Dam site by a consultant to the Alaska Power Authority (R&M Consultants 1985b). A comparison of the recorded streamflow data near the Watana Dam site to the estimated flows based on the Gold Creek and Cantwell data is shown on Figure 4.4-7. Periods of no recorded data are highlighted with the red line. Results show an acceptable comparison of recorded and estimated daily flows.

The only consistent difference between the recorded and estimated flows is for the period of highest flows when the greatest error would be expected in recorded data.

Table 4.4-6: Estimated Monthly Average Flow (cfs) at the Watana Dam Site.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1949	---	---	---	---	---	---	---	20,518	12,726	4,970	2,086	1,170	---
1950	829	625	583	706	9,297	16,203	19,360	16,821	6,750	3,019	1,050	894	6,394
1951	775	651	594	1,312	11,381	17,187	19,334	16,643	17,272	4,370	2,216	1,544	7,813
1952	1,291	794	707	746	4,377	26,760	22,607	17,701	11,775	6,434	2,825	1,382	8,150
1953	888	651	658	1,310	15,565	22,585	17,304	17,439	12,417	4,396	1,696	1,219	8,055
1954	1,049	794	626	1,002	13,958	20,874	17,441	22,084	10,506	4,213	2,229	1,662	8,089
1955	1,448	1,112	883	973	7,527	24,685	23,609	21,788	11,620	3,884	1,535	1,057	8,388
1956	791	770	755	771	14,265	27,562	26,633	20,755	14,905	4,555	2,464	1,741	9,718
1957	1,372	1,191	963	973	11,107	24,933	19,968	17,379	16,101	6,442	3,194	2,653	8,893
1958	1,586	1,038	922	1,243	10,420	21,246	19,600	19,072	6,139	3,774	1,737	1,230	7,383
1959	1,168	1,038	787	1,014	12,916	19,279	21,416	26,382	13,759	5,145	2,302	1,788	8,979
1960	1,489	1,153	961	1,054	12,746	12,839	19,686	19,960	16,678	6,114	2,423	2,190	8,163
1961	1,979	1,393	1,453	2,149	13,638	22,784	19,840	19,480	10,146	4,638	2,263	1,760	8,509
1962	1,609	1,257	1,177	1,457	11,333	36,017	23,444	19,887	12,746	5,560	2,509	1,709	9,927
1963	1,309	1,185	884	777	15,299	20,663	28,767	21,011	10,800	5,187	1,789	1,195	9,143
1964	852	782	575	609	3,579	42,842	20,083	14,048	7,524	4,759	2,368	1,070	8,263
1965	863	773	808	1,232	10,966	21,213	23,236	17,394	16,226	5,221	1,565	1,204	8,436
1966	1,060	985	985	1,338	7,094	25,940	16,153	17,391	9,214	3,270	1,202	1,122	7,172
1967	1,102	1,031	890	850	12,556	24,712	21,987	26,104	13,673	4,019	1,934	1,704	9,269
1968	1,618	1,560	1,560	1,577	12,827	25,704	22,083	14,148	7,164	3,135	1,355	754	7,829
1969	619	608	686	1,262	9,314	13,962	14,843	7,772	4,260	2,403	1,021	709	4,819
1970	636	602	624	986	9,536	14,399	18,410	16,264	7,224	3,768	2,496	1,687	6,435
1971	1,097	778	717	814	2,857	27,613	21,126	27,447	12,189	4,979	2,587	1,957	8,722
1972	1,671	1,491	1,366	1,305	15,973	27,429	19,820	17,510	10,956	3,786	1,820	1,191	8,734
1973	968	953	803	833	6,652	22,982	15,634	17,168	7,379	2,928	1,230	840	6,559
1974	705	617	581	804	13,069	14,773	16,105	13,724	9,961	2,933	1,373	1,303	6,372
1975	1,223	1,168	1,124	1,292	12,399	26,711	23,746	15,306	13,263	6,071	1,610	879	8,773
1976	786	754	723	1,114	10,194	20,155	16,225	16,753	5,595	3,039	2,141	1,953	6,661
1977	1,476	1,285	1,204	1,363	10,242	31,390	19,591	16,279	10,278	5,939	2,847	2,104	8,697
1978	1,637	1,325	1,289	1,380	9,653	15,749	18,007	13,868	6,999	3,849	2,048	1,366	6,471
1979	1,127	1,021	963	1,176	11,203	20,411	24,740	17,312	8,758	5,735	3,386	1,964	8,205
1980	1,411	1,164	1,124	1,355	9,741	23,399	26,741	18,005	10,995	6,632	3,044	1,790	8,836
1981	1,858	1,592	1,262	1,641	14,415	16,738	27,599	30,539	11,668	5,700	2,468	1,596	9,841
1982	1,380	1,103	971	1,196	10,876	21,443	20,443	13,203	13,977	5,154	2,132	1,893	7,849
1983	1,797	1,610	1,427	1,565	11,673	20,605	18,773	20,861	11,196	6,882	2,657	1,939	8,465
1984	1,782	1,741	1,697	1,613	10,831	22,908	20,707	17,421	7,347	4,257	2,384	1,799	7,917
1985	1,479	1,273	1,298	1,517	8,439	21,226	23,293	16,432	11,702	5,073	2,039	1,426	7,975
1986	1,207	1,131	1,038	1,162	9,734	17,817	20,424	14,596	10,457	9,947	2,787	1,589	7,707
1987	1,303	1,205	1,204	1,661	10,493	19,014	25,605	18,403	10,848	4,647	2,006	1,301	8,195
1988	1,260	1,191	1,204	1,287	14,031	24,569	22,007	16,533	11,206	6,020	2,434	1,626	8,661
1989	1,614	1,429	1,445	1,733	11,098	22,131	20,260	18,945	12,547	6,296	2,421	1,502	8,496
1990	1,424	1,350	1,487	3,447	20,703	27,942	20,140	20,078	21,557	5,409	1,977	1,788	10,650
1991	1,531	1,429	1,300	1,308	4,885	21,188	18,178	15,467	10,043	4,563	1,971	1,788	6,998
1992	1,586	1,429	1,500	1,703	4,930	19,130	21,879	17,895	8,270	3,435	2,208	1,657	7,175
1993	1,505	1,393	1,316	2,058	16,866	19,411	16,576	15,865	17,312	7,778	2,687	2,056	8,778
1994	1,661	1,418	1,225	2,612	11,801	25,702	17,955	15,721	7,609	3,554	2,246	1,705	7,800
1995	1,497	1,364	1,365	2,308	14,305	20,428	21,844	15,552	15,564	5,085	2,146	1,172	8,595
1996	1,007	942	883	1,095	5,342	12,987	13,715	14,494	8,465	---	---	---	---
2001	---	---	---	---	---	25,628	18,889	18,437	8,424	3,797	2,122	1,542	---
2002	1,249	1,128	1,046	1,079	9,297	13,682	15,548	20,121	13,214	8,590	4,357	2,105	7,666
2003	1,336	1,781	1,212	1,762	6,477	20,114	25,014	17,870	10,986	6,361	2,019	1,471	8,077
2004	1,187	1,013	868	2,214	19,039	20,940	17,270	14,993	5,247	2,589	1,400	1,309	7,390
2005	1,161	984	839	2,118	21,761	28,372	22,924	18,589	18,589	6,463	1,731	1,217	10,448
2006	1,130	1,103	1,093	1,245	12,706	19,254	19,823	26,069	10,002	8,151	2,536	1,885	8,818
2007	1,633	1,513	1,400	1,844	13,885	16,294	18,486	16,296	10,978	3,936	2,603	2,287	7,643
2008	1,486	1,066	1,092	1,355	9,580	17,460	18,872	16,694	11,807	4,337	1,250	1,057	7,213
2009	1,118	1,032	1,076	3,688	18,522	19,105	16,593	15,628	10,148	5,587	2,267	1,497	8,071
2010	1,185	1,072	1,048	1,498	15,840	16,550	23,575	16,990	12,864	---	---	---	---
Average	1,282	1,122	1,041	1,419	11,415	21,818	20,420	18,054	11,173	4,978	2,164	1,536	8,116
Maximum	1,979	1,781	1,697	3,688	21,761	42,842	28,767	30,539	21,557	9,947	4,357	2,653	10,650
Minimum	619	602	575	609	2,857	12,839	13,715	7,772	4,260	2,403	1,021	709	4,819

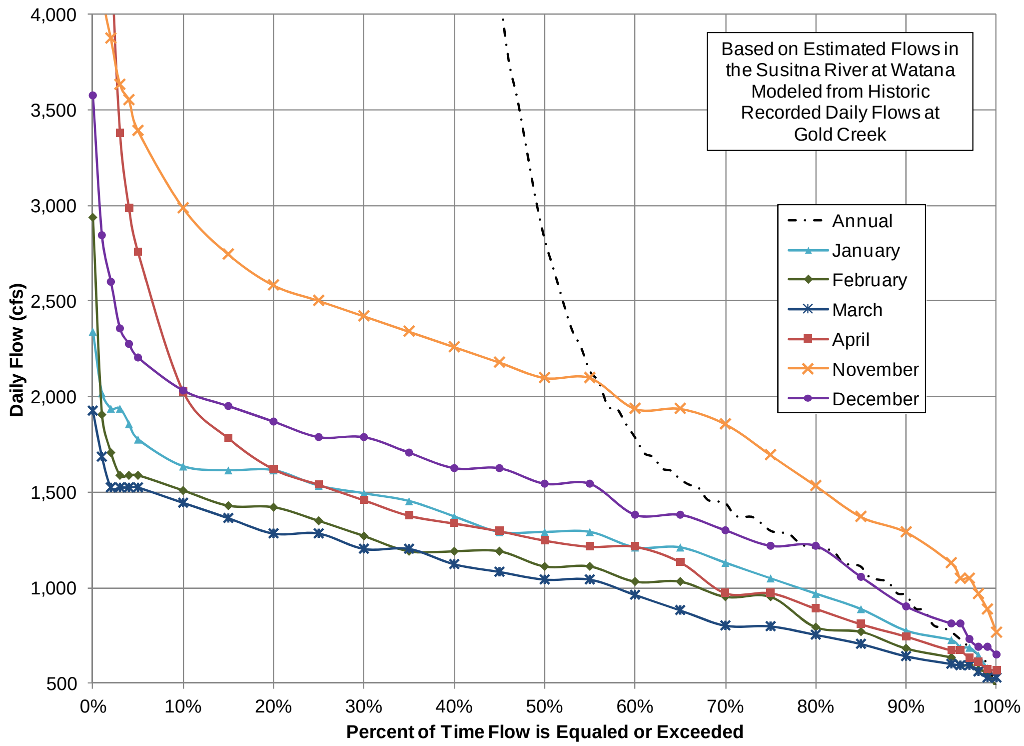


Figure 4.4-5: Estimated Susitna River Flow Duration at Watana Dam Site for Low Flow Months based on Gold Creek Gage Measurements, 1949-2010.

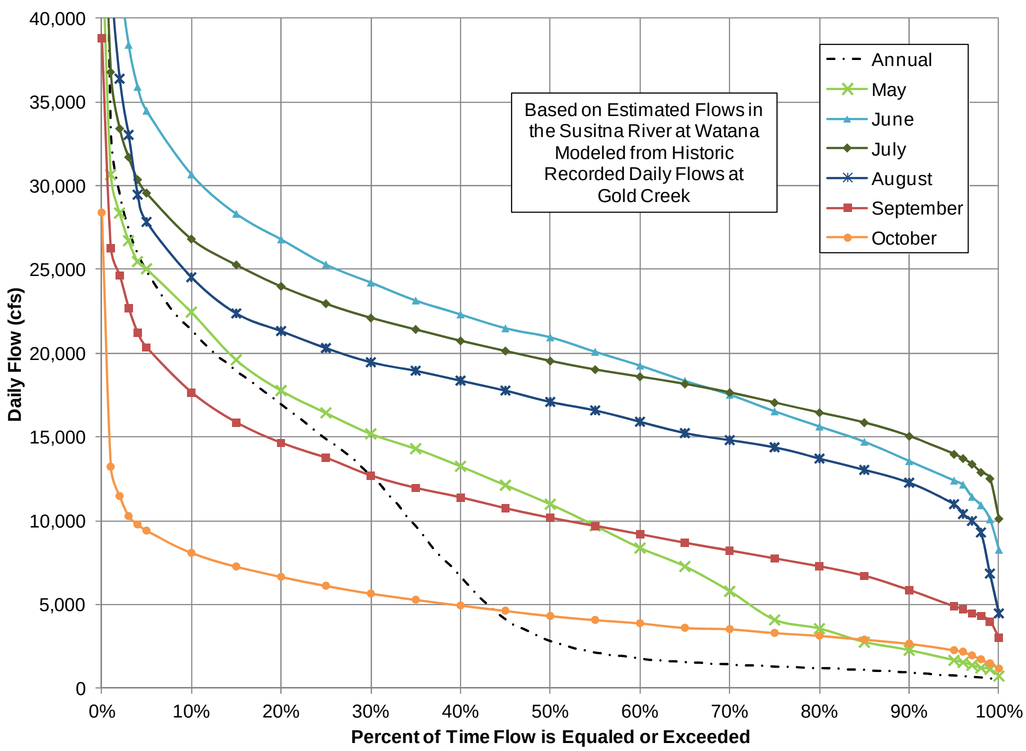


Figure 4.4-6: Estimated Susitna River Flow Duration at Watana Dam Site for High Flow Months based on Gold Creek Gage Measurements, 1949-2010.

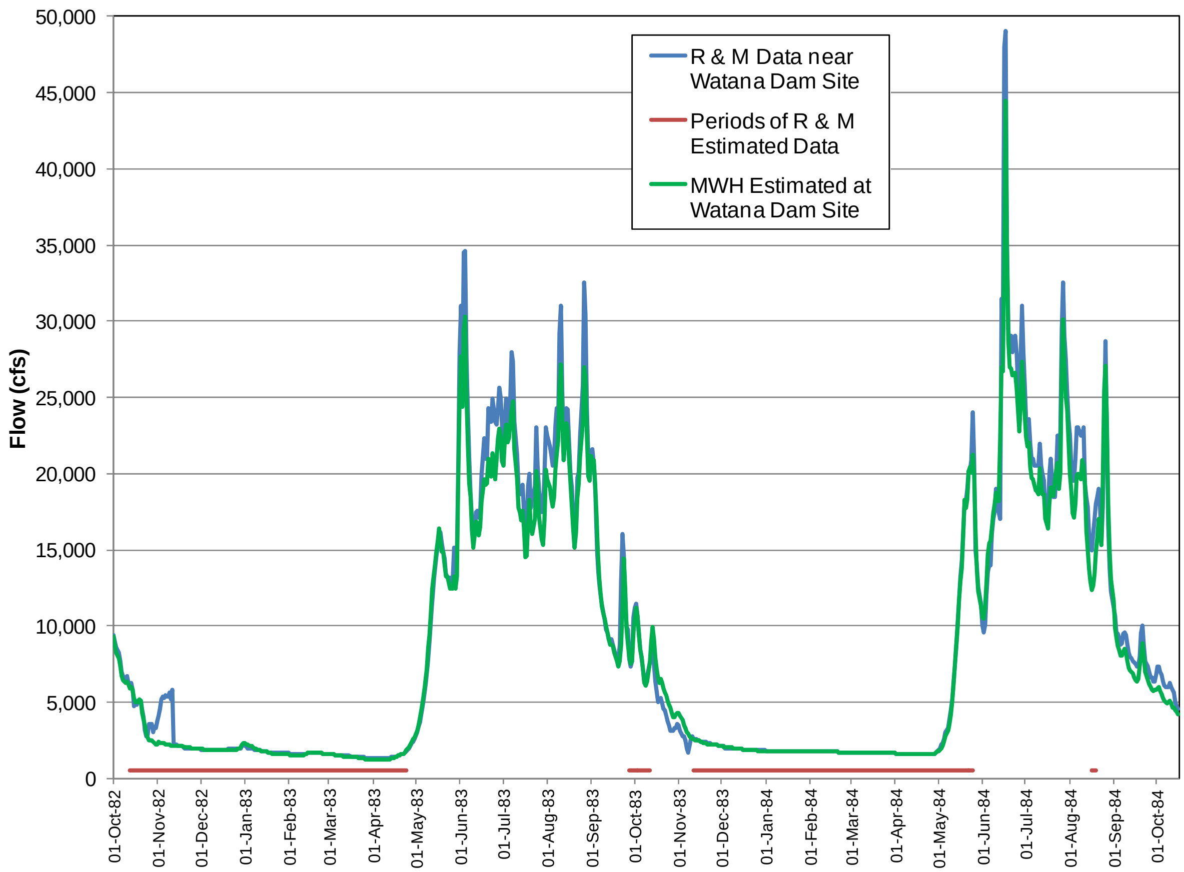


Figure 4.4-7: Susitna River Flow Duration at Watana for Low Flow Months

4.4.1.2.3. Susitna River Flows Downstream of Watana Dam Site

Flows in the Susitna River increase gradually with distance downstream as small tributaries enter the watershed. Flows then increase significantly as the result of input from the Chulitna and Talkeetna rivers. The reach that would contain the proposed Project represents about one third of the total Susitna River flow immediately downstream of Talkeetna. Hence, the Susitna-Watana Project would have the greatest flow effect in the reach immediately below Watana Dam downstream to the Chulitna-Talkeetna confluences. Farther downstream, the Yentna River provides about 41 percent of the total Susitna River flow that discharges into Cook Inlet. Overall, the Susitna River at the proposed Watana Dam site accounts for about 17 percent of the total Susitna flow into Cook Inlet. A summary of average monthly flows at the proposed Watana Dam and downstream USGS gaging stations is presented in Table 4.4-7. The values are expressed as a percent of the flow at Susitna Station, the most downstream gaging station that essentially represents the entire flow of the Susitna River. The corresponding average annual values are plotted on Figure 4.4-8.

Table 4.4-7: Percent flow contribution of Susitna River locations to flow at the Susitna Station USGS gage (RM 25.8).

	Drainage Area (sq.mi.)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Susitna River at Watana	5,180	**20**	**19**	**21**	**18**	**20**	**20**	**18**	**16**	**15**	**14**	**15**	**18**	**17**
local inflow [a]	980	5	5	5	4	5	4	3	3	4	4	3	4	4
Susitna River at Gold Creek	6,160	**24**	**24**	**26**	**22**	**25**	**24**	**21**	**19**	**19**	**18**	**18**	**22**	**21**
Chulitna River near Talkeetna	2,570	20	16	17	14	13	17	21	20	17	16	16	19	18
Talkeetna River near Talkeetna	1,996	9	8	8	7	8	10	9	9	9	8	7	9	9
local inflow [a]	374	2	7	7	6	6	5	3	4	3	1	1	0	4
Susitna River at Sunshine	11,100	**55**	**56**	**57**	**50**	**51**	**56**	**53**	**52**	**48**	**43**	**42**	**50**	**52**
Yentna River near Susitna Station	6,180	38	38	40	45	42	44	44	44	37	34	32	35	41
local inflow [a]	2,120	6	6	3	6	6	1	3	4	15	23	26	15	7
Susitna River at Susitna Station	19,400	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

[a] Percent of flow attributed to local inflow is equal to the increase in flow between gaged locations on the Susitna River.

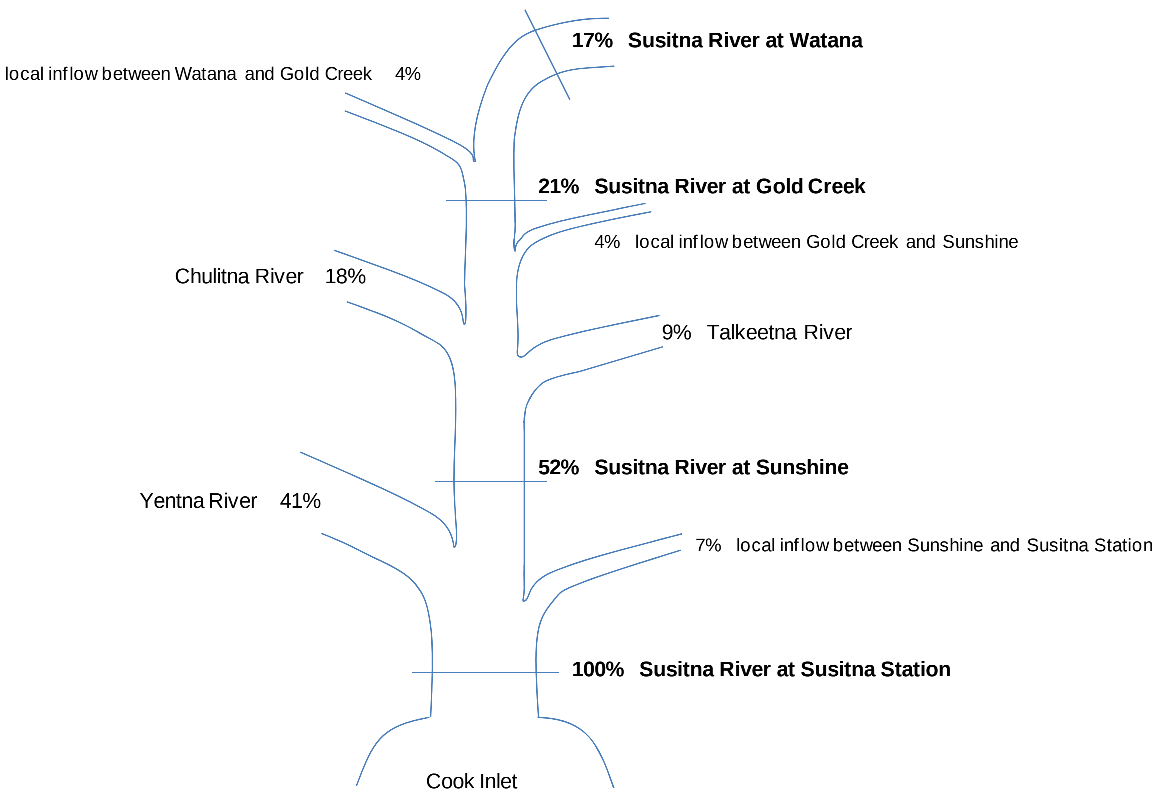


Figure 4.4-8: Percent flow contribution of Susitna River locations to flow at the Susitna Station USGS gage (RM 25.8).

4.4.1.2.4. Hydrologic Change

Climate change models project that the greatest increases in temperature will occur at high latitudes. Over the past 50 years, Alaska has warmed at more than twice the average rate for the rest of the United States. Average annual temperature has increased 3.4 ˚F (2.1 ˚C), while winters have warmed by 6.3 ˚F (3.5 ˚C) (Karl, et al. 2009). As a result, climate change impacts could be expected to be more pronounced in Alaska than in other regions of the United States. Among other effects, higher temperatures should contribute to earlier spring snowmelt, a higher percentage of precipitation falling as rain instead of snow, and glacier retreat.

The effect of increasing average annual temperatures on annual average streamflow is not easily predicted. Major factors to be considered include climate change effects on precipitation, evaporation, transpiration, snow ablation (direct change in phase from solid to vapor), and the net rate of glacier loss. Increased flows from glacial melt can be more than balanced by reduced runoff due to increased evaporation and transpiration. Conversely, if continued glacier wasting resulted in reduced runoff from glaciers at some time in the distant future, it could potentially be counterbalanced by increased precipitation and snowmelt runoff (IPCC 2007). Projections of future average precipitation at a location are generally considered to be less certain than projections of future average temperatures.

The long-term USGS streamflow record measured at the Gold Creek gage is useful for assessing the effects of climate change on long-term reservoir inflows for the proposed Susitna-Watana Project. MWH evaluated the average annual flows at Gold Creek for the complete calendar year period of record and determined that average annual flows were essentially unchanged over the period of record as shown on Figure 4.4-9.

However, analysis of monthly flow data at Gold Creek presents an entirely different picture from the annual data. As shown in Figure 4.4-10 for February data and Figure 4.4-11 for April data, the linear trend lines show a pronounced increase in average monthly flows over time. Statistical tests of significance indicate with very high reliability that the observed trends in streamflow are not random. The April trends are most significant and undoubtedly result from an earlier initiation of the spring snowmelt as well as more precipitation falling as rain instead of snow. If annual average flows remain constant while winter and early spring flows are increasing, flows in other months must be decreasing. A statistically significant decrease in flows has been observed in June, as shown in Figure 4.4-12. Although the percentage decrease in flows is less than the percentage increase in flows in other months, June is the month with the highest average flow, so that a smaller percentage change is indicative of a larger empirical change in flow.

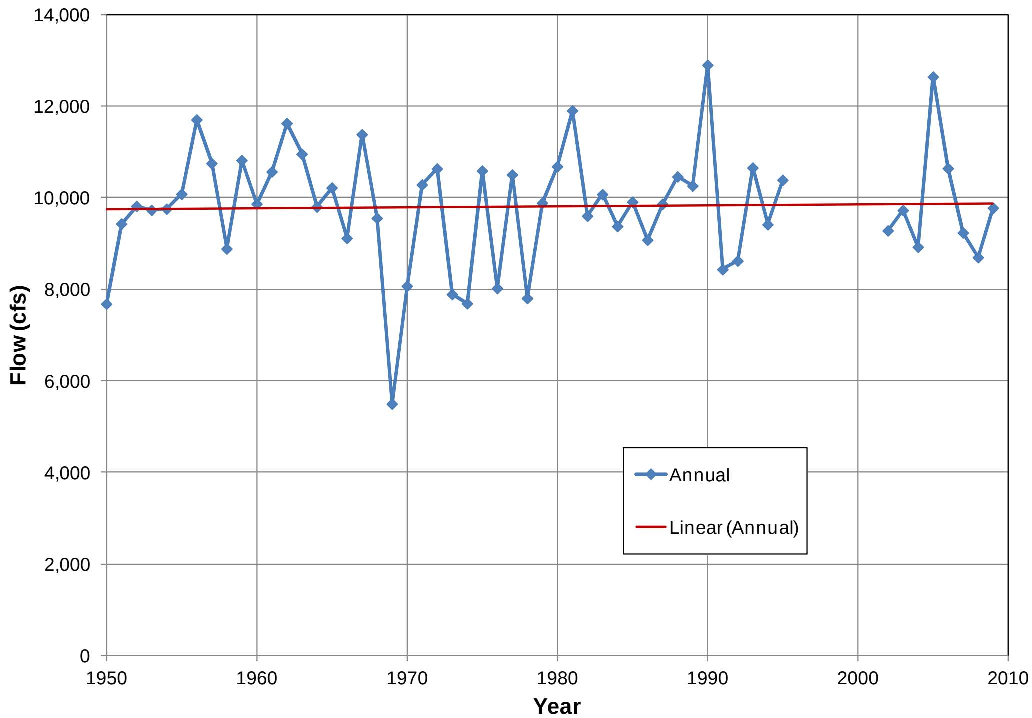


Figure 4.4-9: Average annual recorded flows (cfs) – Susitna River at Gold Creek (RM 136.5).

By projecting the monthly average streamflow trends to the year 2050, a comparison of the historic and projected average monthly flows at Gold Creek can be made as shown on Figure 4.4-13. Monthly average flows are projected to increase in the 8 months from October through May, decrease in the 3 months from June through August, and remain about the same in September. The average annual flows, resulting from the sum of the projected monthly flows in 2050, would remain the same as the historic average annual flow. The net effect of this seasonal change in flows would be to increase the generation of the Susitna-Watana Project by a few percent. The increased generation is produced by more flow in the colder months when power demand is the highest and less flow in the warmest months when inflows fill the reservoir and at times exceed the powerhouse hydraulic capacity.

Reservoir operation and power studies have traditionally used historic flow records as the basic hydrologic input data. AEA proposes to use Watana reservoir inflows developed directly from USGS records as the basic hydrologic input dataset for the reservoir operation and power studies. However, based on the MWH analysis, for the licensing studies, AEA plans to consider alternative hydrologic input datasets, which account for potential future hydrologic change.

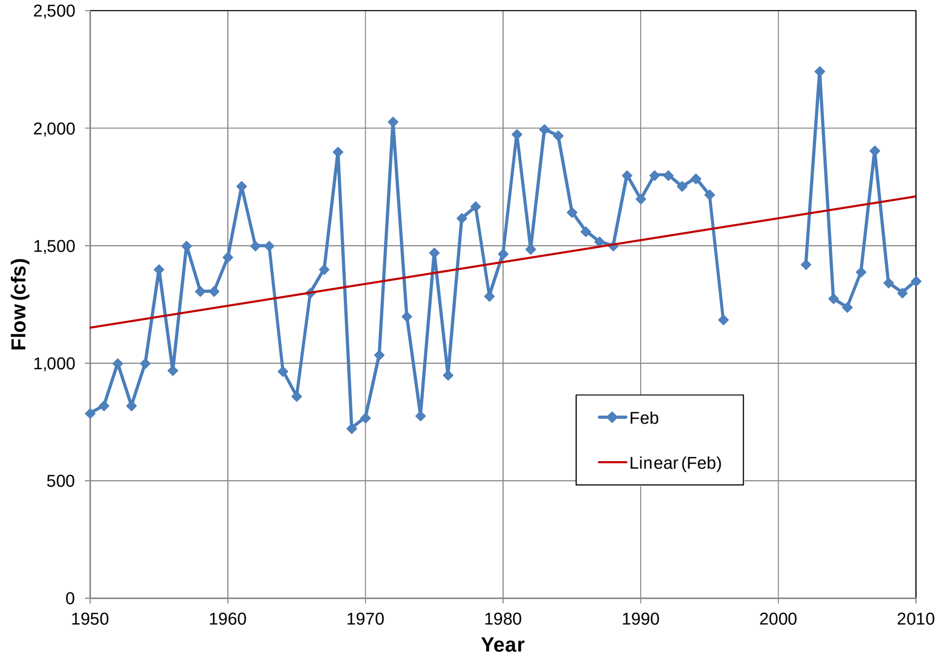


Figure 4.4-10: February recorded flows (cfs) – Susitna River at Gold Creek (RM 136.5).

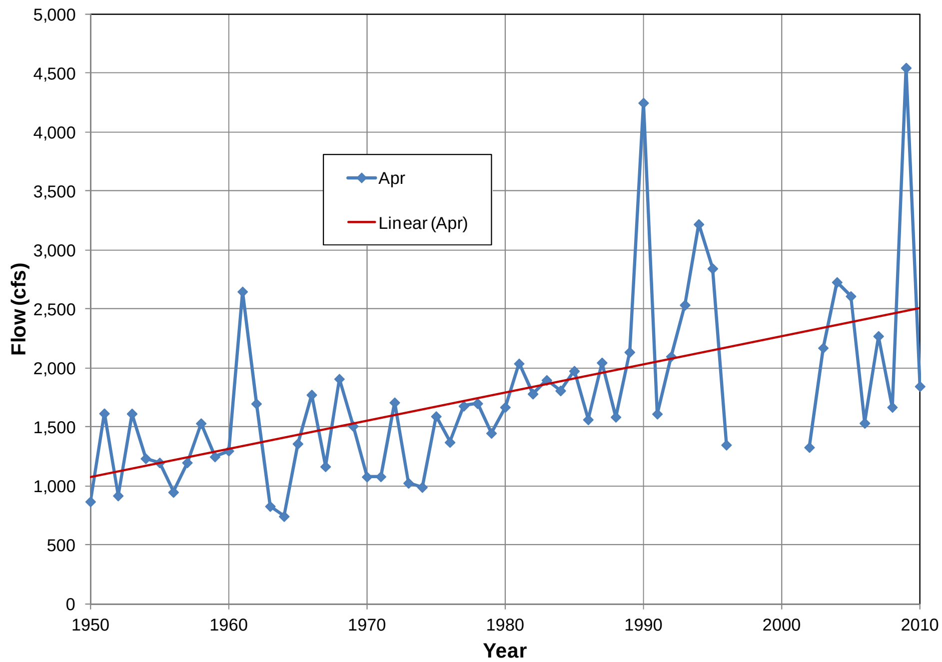


Figure 4.4-11: April recorded flows (cfs) – Susitna River at Gold Creek (RM 136.5).

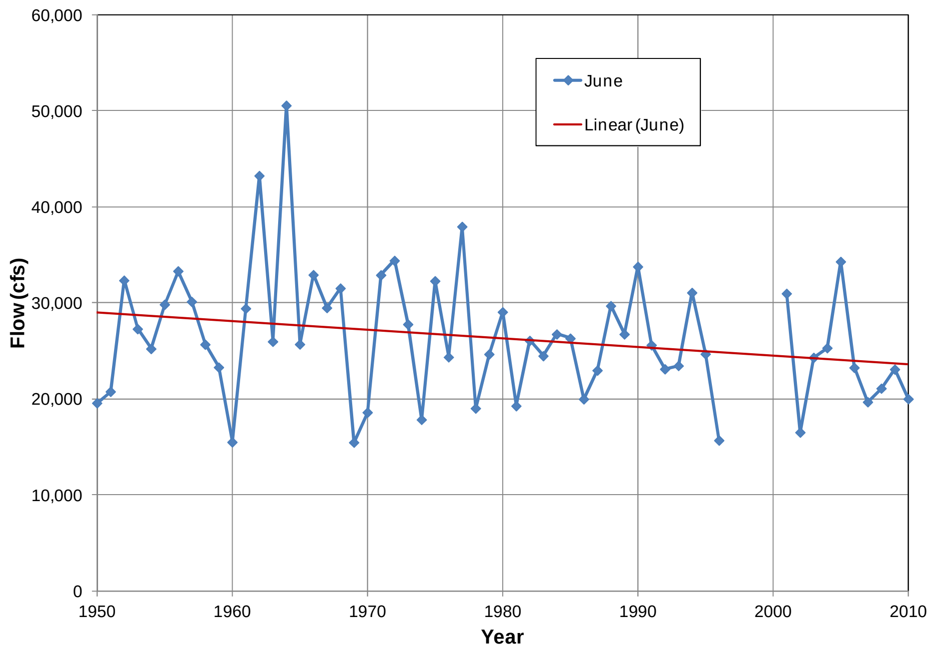


Figure 4.4-12: June recorded flows (cfs) – Susitna River at Gold Creek (RM 136.5).

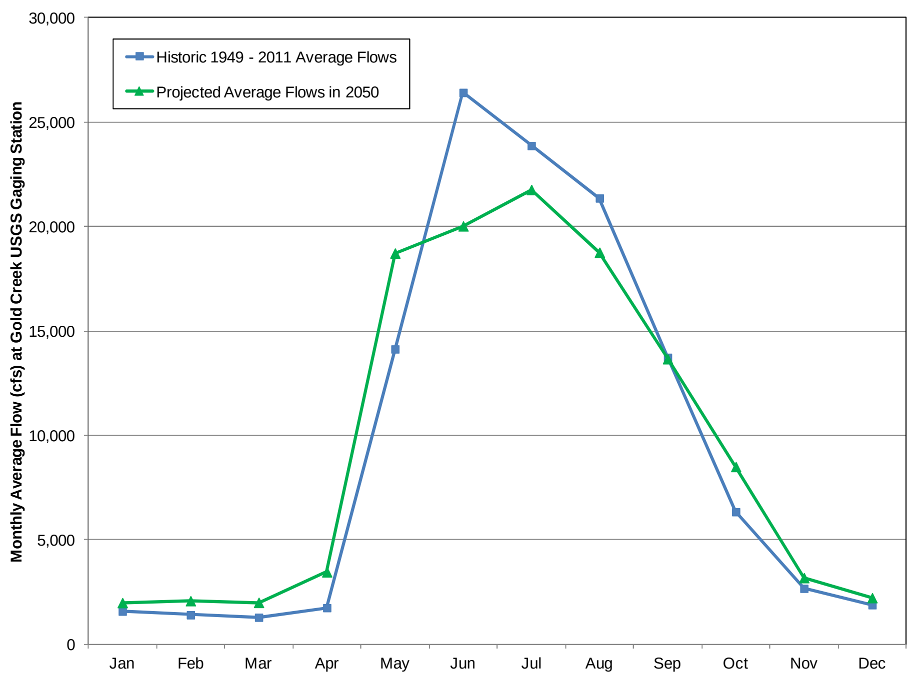


Figure 4.4-13: Average annual recorded flows (cfs) – Susitna River at Gold Creek (RM 136.5).

4.4.2. Existing and Proposed Water Uses

Instream flow uses of the Susitna River include fish, wildlife, riparian vegetation, navigation and transportation, recreation, waste assimilative capacity, freshwater recruitment to Cook Inlet estuary, downstream water rights, hydroelectric power generation, and water required to maintain the desirable aesthetic characteristics of the river itself. Irrigation, water supply, and industrial uses are limited. Considerable work on instream flow needs, primarily for anadromous and resident fisheries, was undertaken in the early 1980s. Instream flows would be required for the mainstem Susitna River, side channels, and sloughs, particularly in the reach between Devils Canyon and Talkeetna.

4.4.2.1. Water Rights

Water rights in Alaska are issued by the ADNR under the Alaska Water Use Act (AS 46.15). A water right allows a specific amount of water from a specific water source to be diverted, impounded, or withdrawn for a specific use. Water Rights were examined for the Susitna Project in 1981 as part of the Susitna Project Feasibility Study (Dwight, Linda Perry 1981). That study examined water rights for 18 different areas in the Susitna River basin. The only significant uses of surface water in the Susitna basin occur in the headwaters of the Kahiltna and Willow Creek township grids. The principal use of the water rights is for mining operations on a seasonal basis. There were no surface water withdrawals from the Susitna River on file with ADNR. Further, groundwater appropriations on file with ADNR for the mainstem Susitna River corridor were minimal, both in terms of numbers of users and the amount of water being withdrawn. An analysis of topographic maps and overlays showing the specific location of each recorded appropriation within the mainstem Susitna corridor indicated that neither the surface water diversions from small tributaries nor the groundwater withdrawals from shallow wells were likely to be adversely affected by the proposed Susitna Project as configured at that time.

An August 2011 search of the ADNR website for water rights along the Susitna River corridor from the proposed Watana Dam site to Cook Inlet revealed that additional water rights have been granted since the 1981 assessment (www.dnr.alaska.gov/mlw/mapguide/water). Of the 40 townships reviewed, only 12 included surface or groundwater water rights, with a total of 110 water appropriations. Similar to the findings of the 1981 study, most of the appropriations were relatively small and would not likely be adversely affected by the proposed Susitna-Watana Project.

4.4.2.2. Fisheries Resources

The Susitna River supports populations of both anadromous and resident fish. Important commercial, recreational, and subsistence species include pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), coho (*O. kitutch*), sockeye (*O. nerka*), and Chinook salmon (*O. tshawytscha*), eulachon (*Thaleichthys pacificus*), rainbow trout (*O. mykiss*), Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), and Dolly Varden (*Salvelinus malma*). Natural flows presently provide for fish passage, spawning, incubation, rearing, overwintering, and outmigration. These life-history stages are correlated with the natural hydrograph. Salmon migrate upstream and spawn on the receding limb of the spring hydrograph and throughout most of the summer. The eggs incubate during the low-flow winter period, and fry outmigration occurs in association with spring breakup. Rainbow trout and grayling spawn during the high flows of the breakup period with embryo development occurring during the early summer. Further information on Susitna River basin fisheries is presented in Section 4.5 of this PAD.

4.4.2.3. Navigation and Transportation

Navigation and transportation on the Susitna River from the headwaters to the proposed Watana Dam site is limited, being primarily related to hunting and fishing access to the Tyone River after launching at the Denali Highway. However, some recreational kayaking, canoeing, and rafting also occur in this reach. Devils Canyon rapids offer 11 mi of some of the most challenging whitewater in the world, which for that reason is rarely accessed. The river is used for navigation up to Portage Creek (RM 149), which is at the downstream end of Devils Canyon. This entire reach is navigable under most flow conditions, although abundant floating debris during extreme high water and occasional shallow areas during low water can make navigation difficult. Downstream of Devils Canyon, the Susitna River is used for sport fishing, hunting, recreational boating, sightseeing, and transportation of some supplies. Access to the river is gained from four principal boat launch sites (Talkeetna, Sunshine Bridge, Kashwitna Landing, and Willow Creek), from several minor tributaries, and from Cook Inlet.

4.4.2.4. Recreation

The summer recreation uses of the Susitna River include recreational boating, kayaking, canoeing, sport fishing, hunting access, and sightseeing. In winter, recreation uses include snow machines and dogsleds. See Section 4.10 for additional information.

4.4.2.5. Wetlands, Riparian Vegetation, and Wildlife Habitat

Wetlands cover large portions of the Susitna River basin, including riparian zones along the mainstem Susitna River, sloughs, and tributary streams. Wetlands generally support a greater diversity of wildlife species per unit area than most other habitat types in Alaska. In addition, riparian wetlands provide winter browse for moose and during severe winters can be a critical survival factor for this species. They also help to maintain water quality throughout watersheds. Water storage in wetland complexes may also be an important source of streamflow during low-flow months, especially in smaller tributaries to the mainstem Susitna River.

The physical processes affecting riparian vegetation include freeze-up, spring ice jams, and flooding. In the middle Susitna River downstream of Devils Canyon both flooding and freeze-up are believed to be important factors affecting vegetation. Because of the braided morphology of the river channel downstream of Talkeetna, flooding is likely to be the dominant factor influencing riparian vegetation in this reach.

See Sections 4.6, 4.7 and 4.8 for additional information.

4.4.2.6. Waste Assimilative Capacity

The primary source of pollution in the Susitna River watershed is placer mining operations (ADEC 1978). Although suspended sediment may be introduced into the watershed, no biochemical oxygen demand (BOD) is exerted on the system, and therefore, the waste assimilative capacity remains unaffected by the mining activities. BOD discharges in the watershed include one municipal discharge in Talkeetna, two industrial wastewater discharges at Curry and Talkeetna, and three solid waste dumps at Talkeetna, Sunshine, and Peters Creek.

4.4.2.7. Freshwater Recruitment to Cook Inlet Estuary

The Susitna River is the most significant contributor of freshwater to Cook Inlet, and as such, has a major influence on the salinity of upper Cook Inlet. High summer freshwater flows associated with the occurrence of snowmelt, rainfall, and glacial melt cause reduced salinities. During winter, low flows permit the more saline ocean water to increase Cook Inlet salinities. The large Cook Inlet tides increase the mixing of freshwater and saltwater. Salinity measurements were recorded at the mouth of the Susitna River during spring tides and high flows of 90,000 cfs on August 18 and 19, 1982 and during low flows on February 14, 1983 to determine if salinity penetration occurs upstream of the mouth of the river; no saltwater intrusion was detected.

4.4.3. Water Quality

4.4.3.1. Alaska State Water Quality Standards

The State of Alaska has promulgated Water Quality Standards for the Protection of Aquatic Life and Wildlife (Table 4.4-8). Within the Susitna River basin, primary concerns are for the protection of anadromous and resident fish species. Hence, much of this water quality section is focused on the parameters that have the potential to affect anadromous and resident fish.

Water quality parameters that exceed state standards are of interest because of the proposed Project's potential to influence these parameters (either positively or negatively), thereby having a potential effect on anadromous and/or resident fish. Locations in the drainage where exceedances have occurred are identified. The purpose of the analysis presented below is to identify locations where existing conditions for important fish populations may be degraded, as well as the potential cause or causes of the degradation.

Turbidity measurements were summarized from existing datasets, but not evaluated against criteria and not interpreted further. The turbidity criterion is based on comparison against a natural background measurement and requires several observations from the same location within a specified period of time. Unless turbidity exceedances were identified at a location and within a reviewed report it was not possible to appropriately determine a turbidity exceedance from existing data. In addition, the Susitna River and several of the tributaries are glacially fed and are naturally quite turbid.

The Alaska State Water Quality Standards for metals concentrations and other xenobiotics are reported in Table 4.4-9. Most water quality criteria for metals are dependent on the hardness of the source water measured concurrently with the metals concentrations. Due to the nature of the available water quality data, determining specific metals criteria for individual sample collections was not achievable. Companion water quality data (e.g., hardness) used to determine effective concentrations of metals toxicity to aquatic life were not available. Therefore, metal exceedances of state criteria that are hardness-dependent have not been determined. Metal concentrations found in the Susitna River and its tributaries are compared to known toxic thresholds, thereby providing valuable information on the potential impact of metals on fish populations.

Table 4.4-8. Alaska State Water Quality Standards for the Protection of Aquatic Life and Wildlife (18 AAC 70, May 2011).

Parameter	Criteria
Color (platinum-cobalt scale)	Color or apparent color may not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. For all waters without a seasonally established norm for aquatic life, color or apparent color may not exceed 50 color units or the natural condition, whichever is greater.
Fecal Coliform Bacteria	Not applicable.
Dissolved Oxygen (DO)	DO must be greater than 7 mg/l in waters used by anadromous or resident fish. In no case may DO be less than 5 mg/l to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish for spawning (see note 2). For waters not used by anadromous or resident fish, DO must be greater than or equal to 5 mg/l. In no case may DO be greater than 17 mg/l.
Total Dissolved Solids (TDS)	TDS may not exceed 1,000 mg/l. A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life.
pH	May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions.
Temperature	May not exceed 20°C at any time. The following maximum temperatures may not be exceeded, where applicable: Migration routes 15°C Spawning areas 13°C Rearing areas 15°C Egg & fry incubation 13°C For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.
Sediment	The percent accumulation of fine sediment in the range of 0.1 mm to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5 percent by weight above natural conditions (as shown from grain size accumulation graph). In no case may the 0.1 mm to 0.4 mm fine sediment range in those gravel beds exceed a maximum of 30 percent by weight (as shown from grain size

Parameter	Criteria
	accumulation graph). In all other surface waters no sediment loads (suspended or deposited) that can cause adverse effects on aquatic animal or plant life, their reproduction or habit may be present.
Turbidity	May not exceed 25 nephelometric turbidity unit (NTU) above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions.
Toxic and Other Deleterious Organic and Inorganic Substances	The concentration of substances in water may not exceed the numeric criteria for aquatic life for fresh water and human health for consumption of aquatic organisms only shown in the *Alaska Water Quality Criteria Manual*, or any chronic and acute criteria established in this chapter, for a toxic pollutant of concern to protect sensitive and biologically important life stages of resident species of this state. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance or aquatic life, except as authorized by this chapter. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.
Total Dissolved Gas	The concentration of total dissolved gas may not exceed 110 percent of saturation at any point of sample collection.

1 For water supply over a 30 day period, the geometric mean of fecal coliform (FC) may not exceed 20 FC/100 ml, and not more than 10 percent of the samples may exceed 40 FC.

Table 4.4-9. Alaska State Water Quality Standards for Toxics and Other Deleterious Organic and Inorganic Substances (December 2008).

Parameter	Acute Criteria (CMC)	Chronic Criteria (CCC)
Aluminum, Total recoverable	**750 µg/L** (1-hr avg)	**87 µg/L** (4-day avg)
Ammonia, (total ammonia nitrogen in mg N/L)	**1.77 to 28.1** Criteria are pH dependent[1] (1-hr avg)	Criteria are pH and temperature dependent[2] (30-day avg)
Arsenic, Dissolved	**340 µg/L** (1-hr avg)	**150 µg/L** (4-day avg)
Barium	No Criteria	No Criteria
Cadmium, Dissolved	Criteria Hardness Dependent[3] (1-hr avg)	Criteria Hardness Dependent[3] (4-day avg)
Chloride, Dissolved	**860,000 µg/L** (1-hr avg) Applies to dissolved chloride when associated with sodium.	**230,000 µg/L** (4-day avg) Applies to dissolved chloride when associated with sodium.
Copper, Dissolved	Criteria Hardness Dependent[3] (1-hr avg)	Criteria Hardness Dependent[3] (4-day avg)
Iron	No Criteria	**1,000 µg/L**
Lead, Dissolved	Criteria Hardness Dependent[3] (1-hr avg)	Criteria Hardness Dependent[3] (4-day avg)
Manganese	No Criteria	No Criteria

Parameter	Acute Criteria (CMC)	Chronic Criteria (CCC)
Mercury, Dissolved	**1.4 µg/L** (1-hr avg)	**0.77 µg/L** (4-day avg)
Mercury, Total	**1.694 µg/L**	**0.9081 µg/L**
Nickel, Dissolved	Criteria Hardness Dependent[3] (1-hr avg)	Criteria Hardness Dependent[3] (4-day avg)
Selenium, Total recoverable	See Note[4] (1-hr avg)	**5.0 µg/L** (4-day avg)
Zinc, Dissolved	Criteria Hardness Dependent[3] (1-hr avg)	Criteria Hardness Dependent[3] (4-day avg)

1 pH values in the Susitna River range from 6.8 to 8.6. Using Appendix C in the Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances the criteria for Total Ammonia Nitrogen as N would range from 1.77 to 28.1 mgN/L.

2 Chronic criteria for Ammonia should be calculated based on pH and temperature when early life stages of fish are present as shown in Appendix D of the Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances.

3 To calculate dissolved metals criteria please refer to the table in Appendix A of the Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances.

4 The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 g/l and 12.82 g/l, respectively.

4.4.3.2. Overview of Water Quality Conditions

As described above, the Susitna River is characterized by large seasonal fluctuations in flow. These flow variations, along with the glacial origins of the river's water, strongly influence the water quality of the river. Water quality data are presented according to season: ice breakup, summer, and winter. Breakup water quality data were considered to be collected during the month of May. However, as discussed above, breakup may start in April, particularly in recent years due to the effects of climate change. The summer data period was considered to extend from the end of breakup (June 1) until the water temperature dropped to essentially 0˚ C (32˚ F). Winter was considered to extend from the end of summer to the beginning of breakup (May 1).

Although the Susitna River is relatively pristine, a number of parameters exceeded state water quality standards. These parameters, the location and season during which the criteria were exceeded, and the respective source of the criteria limits, are identified in Table 4.4-10. Note that water quality standards generally apply to human-induced alterations and constitute the degree of degradation that may not be exceeded. Because there are no industries except for placer mining operations, no significant agricultural areas, and no major cities adjacent to the Susitna, Chulitna, and Talkeetna rivers, the measured levels of these parameters are considered to be background conditions.

Table 4.4-10. Location of water quality criteria exceedances in the Susitna River drainage.

Reach Number	Bounds of Reach (Susitna River Mile)	General Description	Water Quality Criteria Exceedance
1	313 – 184	Upper Susitna River, including headwaters and tributaries above the proposed Watana Dam site	Aluminum Iron
2a	184 - 150	Middle Susitna River and tributaries from below proposed Watana Dam Site through Devils Canyon	Total Dissolved Gas Temperature for Migration Aluminum
2b	150 – 98	Middle Susitna River and tributaries from the mouth of Devils Canyon to the Susitna – Chulitna – Talkeetna confluence	Temperature for Migration Aluminum Iron Total Mercury (Mainstem at Gold Creek)
3	98 – 0	Lower Susitna River from Susitna – Chulitna – Talkeetna confluence to mouth at Cook Inlet	Temperature for Spawning (Talkeetna River) Dissolved Oxygen pH Iron Mercury

4.4.3.3. Water Temperature

4.4.3.3.1. Mainstem Susitna River

During winter (October through April), the entire mainstem Susitna River is at or near 0 ˚C. However, there are a number of small discontinuous areas with groundwater inflow where temperatures are approximately 2 ˚C (36˚ F). As spring breakup occurs the water temperature begins to rise, with the downstream reaches experiencing warming first. During summer, glacial melt is near 0 ˚C, but as the river flows across the wide gravel floodplains downstream of the glaciers, the water begins to warm. By the time the Susitna River reaches the proposed Watana Dam site, summer temperatures are as high as 14 ˚C (57˚ F) (Appendix 4.4-1). Further downstream there is additional warming, but because of significant tributary inflow, temperatures are cooler at some locations. Maximum recorded temperatures at Gold Creek and Susitna Station are approximately 15 ˚C (59˚ F) (Appendix 4.4-1). In August, temperatures begin to drop, reaching 0 ˚C in late September or October.

4.4.3.3.2. Sloughs

Water temperatures in sloughs along the middle Susitna River from Devils Canyon to the Chulitna-Talkeetna river confluences are important for anadromous fish spawning. As measured in the 1980s, intergravel temperatures were relatively constant at each location during the winter but exhibited some variability between locations. At most locations, intergravel temperatures were about 2-3 ˚C (36-37˚ F). Surface water temperatures in sloughs showed more variability and were generally lower than intergravel temperatures (Trihey 1982c). During higher flow periods in the spring and summer, when the heads of most sloughs are overtopped, slough water temperatures correspond closely to mainstem temperatures. However, once the flow at the heads of the sloughs is eliminated, spring and summer slough water temperatures tend to diverge from mainstem temperatures. Water temperatures in sloughs during late summer and early fall can exhibit marked diurnal variations caused by increased solar warming of the shallow water during the day and subsequent long wave re-radiation at night. For example, during the summer of 1981, Slough 21 (RM 142) had a diurnal temperature range of 4.5-8.5 ˚C (40-47˚ F)at the water's surface but a constant intergravel temperature of 3 ˚C (37˚ F).

4.4.3.3.3. Tributaries

Tributaries to the Susitna River are generally cooler than the mainstem. During the early 1980s, continuous water temperatures were monitored by both the USGS and the ADF&G in the Chulitna and Talkeetna rivers near Talkeetna, and by ADF&G in the Indian River (RM 138.6) and Portage, Tsusena, Watana, Kosina, and Goose Creeks, and the Oshetna River. Both the Talkeetna and Chulitna rivers are cooler than the Susitna River. The Talkeetna River was 1-3 ˚C (34-37˚ F) cooler on an average daily basis and the Chulitna River was an additional 0-2 ˚C (32-36˚ F) cooler, being closer to its glacial headwaters. Steep-walled tributaries like Portage Creek were consistently cooler than flatter terrain streams like Indian River, which are more easily influenced by solar and convective heating. There were noticeable diurnal fluctuations in the tributary water temperatures, although not as extreme as in the sloughs.

Winter stream temperatures are usually very close to 0 ˚C, as all the tributaries become ice covered. Groundwater inflow at some locations creates local conditions where temperatures are above freezing, but the overall temperature regime is dominated by the extremely cold ambient air temperatures.

In 2008 and 2009, the Cook Inlet Keepers measured water temperatures in 13 tributaries of the lower Susitna River basin. The maximum water temperatures of these tributaries during June, July, and August typically exceeded the temperature criteria for protection of salmon spawning areas (i.e., 13 ˚C, 55˚ F).

4.4.3.4. Dissolved Gases

4.4.3.4.1. Dissolved Oxygen

Dissolved oxygen (DO) concentrations are generally high throughout the Susitna River. Winter values average 11-16 mg/l, while average summer concentrations are between about 11 and 14 mg/l. These average concentrations equate to summer saturation levels between 97 and 105 percent. Winter saturation levels decline slightly from summer levels, averaging 98 percent at Gold Creek and 80 percent at Susitna Station.

4.4.3.4.2. Total Dissolved Gas

Total dissolved gas (TDG) concentrations were monitored in the vicinity of Devils Canyon during 1981 and 1982. Limited 1981 data revealed saturated conditions of approximately 100 percent above the Devil Creek rapids. However, downstream TDG concentrations in the Devils Canyon area were measured in the supersaturation range of 105-117 percent (Schmidt 1981). From August 8 to October 6, 1982, a continuous tensionometer was installed immediately downstream of Devils Canyon. The data revealed a linear relationship between TDG and discharge at Gold Creek. TDG ranged from 106-115 percent for discharges from 11,700 to 32,500 cfs (ADF&G 1983). Computations yielded decay rates that suggest variations in the rate of decay of supersaturation with discharge, distance downstream, and channel slope and morphology characteristics (ADF&G 1983; Peratrovich et al. 1983). In 1985, TDG measurements at the proposed Watana Dam site varied from 97-101 percent during summer and from 97 - 99 percent during fall (Appendix 4.4-1). Alaska water quality standards specify a maximum TDG concentration of no higher than 110 percent.

4.4.3.5. pH

Average pH values in the Susitna River basin tend to be slightly alkaline, with values ranging between 6.8 and 8.5. Low pH levels are common in Alaskan streams and are attributable to the acidic tundra runoff (i.e., humic, tannic, and fulvic acids). At Denali, pH variations between 7.1 and 7.6 occurred during winter, while the summer range was 7.4-7.9. Winter pH levels at the Gold Creek station have been measured between 7.6 and 8.0; the range of summer values were 6.8-8.3. Generally, these pH values are within the State's water quality standard of 6.5-8.5.

4.4.3.6. Nutrients

Of the four major nutrients (carbon, silica, nitrogen, and phosphorous), phosphorous is the limiting nutrient in the Susitna River because it is in a form that is unavailable to microflora. Studies of glacial lakes in Alaska (ADF&G 1982b) and Canada (St. John et al. 1976) indicate that over 50 percent of the total phosphorous occurred in the biologically inactive particulate form (Peterson and Nichols 1982). The bio-available phosphorous, namely orthophosphates, is typically 0.1 mg/l or less throughout the Susitna River basin (Appendix 4.4-1).

Based on sampling conducted in the 1980s, nitrate nitrogen exists in low to moderate concentrations (< 0.9 mg/l) in the Susitna River. Summer concentrations at Gold Creek varied between 0.02 mg/l and 0.25 mg/l. During winter, the range of variability was reduced, with the concentration being about 0.15 mg/l. Maximum recorded concentrations in the watershed of 1.2 mg/l occurred at the Talkeetna River monitoring station.

4.4.3.7. Chlorophyll-a

Chlorophyll-*a*, a measure of algal biomass, is low in the Susitna River due to the low penetration of light in the sediment-laden waters. The only chlorophyll-*a* data available for the Susitna River were collected at the Susitna Station gage (RM 25.8). Values up to 1.2 mg/m^3 (chlorophyll-*a* periphyton, uncorrected) were recorded. However, when the chromospectropic technique was used, values ranged from 0.004 to 0.029 mg/m^3 for three samples in 1976 and 1977. All recorded values from 1978 through 1980 were less than detectable limits when analyzed using the chromographic fluorometer technique. With the high suspended sediment concentrations and turbidity values in the upper Susitna basin, it is expected that chlorophyll-*a* values would be low.

4.4.3.8. Turbidity and Vertical Illumination

The Susitna River is typically clear during the winter months, with turbidity values at or near zero. Turbidity values measured by the USGS in January and April 1982 were 1.1 Nephelometric Turbidity Units (NTU) or less at Gold Creek (RM 136.5),, Sunshine (RM 83.8), and Susitna Station (RM 25.8). Turbidity increases as snowmelt and breakup commence. Peak turbidity values occur during summer when glacial input is greatest. During 1982, measurements of up to 720 NTU were recorded at Vee Canyon (RM 223). At the USGS gaging station on the Chulitna River, a value of 1,920 NTU was observed. In contrast, the maximum value recorded on the Talkeetna River was 272 NTU. More current measurements for the Talkeetna River indicate that turbidity has not changed significantly, with values of 340 NTU. In the lower Susitna River, turbidity values were up to 790 NTU at Susitna Station.

Turbidity values were measured for select Middle Susitna River sloughs in 1981, and data indicated that sloughs were generally clear until their upstream ends were overtopped. At a Gold Creek discharge of 17,000 cfs, no sloughs were overtopped, and turbidity in all sloughs during the June 1981 measurements was less than 1 NTU. Corresponding turbidity at Gold Creek was 100 NTU. During July measurements, Gold Creek flow was in excess of 35,000 cfs, and the upstream ends of several sloughs were overtopped, although Slough 19 was not. Turbidity in the overtopped sloughs varied from 130 to 150 NTU, whereas turbidity in Slough 19 was 2.5 NTU, and Gold Creek turbidity was 170 NTU. During September, with Gold Creek flow at 8,500 cfs, maximum slough turbidity was 1.1 NTU, with turbidity at Gold Creek being 5.5 NTU. During overtopping, slough turbidities reflected mainstem values. Even with overtopping some sloughs maintained lower turbidity due to the dilution effect of groundwater or tributary inflow.

In general, vertical illumination through the water column varied directly with turbidity and, hence, followed the same temporal and spatial patterns described above. Although no quantitative assessment was conducted, summer vertical illumination was generally a few inches. During winter months, the river bottom was seen in areas without ice cover. However, vertical illumination under an ice cover was reduced, especially when the ice was not clear or when snow cover was present.

4.4.3.9. Metals

The concentrations of many metals monitored in the river were low or within the range characteristic of natural waters. In addition, 15 parameters were below detectable limits when both the dissolved (d) fraction and the total recoverable (t) quantities were counted. For antimony, boron, gold, platinum, tin, radium, and zirconium, both (d) and (t) were below detection limits. The dissolved fraction of molybdenum was also not detectable.

The concentrations of some trace elements, however, exceeded water quality standards for the protection of freshwater organisms (Table 4.4-10). These concentrations were likely the result of natural processes but could include depositions from air pollution, because with the exception of some placer mining activities, there were no human-induced sources of these elements in the Susitna River basin. Metals that exceeded criteria included both dissolved and total recoverable aluminum, mercury, cadmium, copper, and zinc. In addition, the dissolved fraction of bismuth and the total recoverable quantities of iron, lead, and nickel also exceeded criteria.

Metals concentrations at the Susitna River stations are presented in Appendix 4.4-1. Metals data are compared with the toxics threshold criteria in Table 4.4-11 to determine if concentrations are likely to adversely affect fish populations. Although toxics data were not available for all fish species of interest, conclusions from the toxics threshold comparison indicate that some metals concentrations exceeded the No Observed Effects Levels (NOELs) and that this pattern was consistent in multiple reaches for the same metals (Table 4.4-12). Based on the historic data, some metals concentrations would have been sufficient to have chronic effects on salmon/rainbow trout species. However, much of this information may not reflect current conditions and, therefore, may no longer be a factor in determining fish habitat suitability.

4.4.3.10. Other Water Quality Parameters

4.4.3.10.1. Total Dissolved Solids

Total dissolved solids (TDS) were found to be higher during the winter low-flow periods than during summer. TDS concentrations generally decreased in a downstream direction. At Gold Creek, TDS winter values were measured at 100-188 mg/l, whereas summer concentrations were between 55 and 140 mg/l. Downstream measurements at Susitna Station ranged from 109-139 mg/l during winter and between 56 and 114 mg/l in the summer. All values were well within state water quality standards.

4.4.3.10.2. Specific Conductance

Conductivity values, which generally correlate with TDS concentrations, provided salinity contents are reasonably low (Cole 1975), were also higher during winter than during summer. In the upstream reaches of the Susitna River, conductivity values were typically higher than in downstream reaches. At Denali, specific conductance values ranged from 351-467 µmhos/cm in winter/spring to 123-226 µmhos/cm in summer/fall. Gold Creek specific conductivities varied from 84-300 µmhos/cm in winter to 75-227 µmhos/cm in summer. Specific conductance levels at Susitna Station ranged from 180-225 µmhos/cm during winter to 96-154 µmhos/cm during summer (Appendix 4.4-1).

Table 4.4-11. Available toxics threshold concentrations that affect select fish species known to occur in the Susitna River drainage.

SPECIES	CHEMICAL	STUDY TIME	LC_{01}(µg/L)	LC_{10}(µg/L)	Mean dose LC_{50}(µg/L)	Mean dose LOEL (µg/L)	Mean dose NOEL(µg/L)
Steelhead	Aluminum				7,761		1,496
Steelhead	Antimony				19,749		5,193
Chinook	Arsenic	96hr			66,216		17,411
Steelhead	Beryllium	28day			380		
Sockeye	Cadmium (dissolved)	96hr			18		
Chinook	Cadmium (dissolved)	96hr			13		4
Steelhead	Cadmium (dissolved)	96hr			12		2
Chinook	Chromium (hexavalent)	96hr			124,152		10
Steelhead	Chromium (hexavalent)	96hr			69,000		49
Steelhead	Chromium (trivalent)	96hr			23,250		
Steelhead	Cobalt	28day			490		
Chinook	Copper	96hr			59		24
Sockeye	Copper	96hr			283		100
Steelhead	Copper	96hr			74		12
Steelhead	Iron						5,000
Steelhead	Lead	96hr			24,565		131
Steelhead	Magnesium	96hr	367,000	660,500			
Steelhead	Manganese	28day			2,910		
Steelhead	Nickel	96hr			13,841		162
Chinook	Nitrate-Nitrogen	96hr			1,310,000		
Chinook	Nitrate-Nitrogen	7day			1,080,000		
Steelhead	Nitrate-Nitrogen	96hr			1,360,000		
Steelhead	Nitrate-Nitrogen	7day			1,060,000		
Steelhead	Nitrite-Nitrogen	96hr			190 - 390		
Chinook	Selenium (IV)	96hr			19,111		102
Chinook	Selenium (VI)	96hr			112,918		6,944
Steelhead	Selenium (IV)	96hr			10,490		47
Steelhead	Selenium (VI)	96hr			24,000		2,891
Steelhead	Silver	96hr			65		0
Coho	Sulfate (Copper Sulfate)	24hr			23 - 100		
Coho	Sulfate (Copper Sulfate)	96hr			19.3 - 31.9		
Coho	Sulfate (Copper Sulfate)	30 day				500	
Sockeye	Sulfate (Copper Sulfate)	96hr			100 - 240		
Chinook	Sulfate (Copper Sulfate)	24hr			78 - 145		
Chinook	Sulfate (Copper Sulfate)	96hr			54 - 60		
Steelhead	Thallium	28day			170		
Coho	Total Suspended Solids	96hr			1,300,000	1,300,000	
Chinook/Steelhead	Total Suspended Solids					20,000 - 650,000	100,000 - 1,300,000
Steelhead	Vanadium	28day			160		
Steelhead	Zinc	96hr			915		187
Chinook	Zinc	96hr			969		861
Sockeye	Zinc	96hr			2,041		595

Note: Values taken from *Biological Evaluation for Central Puget Sound Stormwater National Pollution Discharge Elimination System Permits, January 2009.*
LC_{01}, LC_{10}, and LC_{50} = the concentration of a toxin required to cause mortality of 1 percent, 10 percent, and 50 percent of the population, respectively, after the specified duration.
LOEL = Lowest Observable Effect Level.
NOEL = No Observable Effects Level.

4.4.3.10.3. Significant Ions

Concentrations of the seven significant ions–i.e., bicarbonate, sulfate, chloride, and the dissolved fractions of calcium, magnesium, sodium, and potassium–which account for a major portion of TDS, were generally low to moderate, with summer concentrations lower than winter values. The range of concentrations recorded upstream of the proposed Watana Dam site at Denali and Vee Canyon, and downstream of the dam site at Gold Creek, Sunshine, and Susitna Station are presented in Appendix 4.4-1.

Table 4.4-12. Location of water quality conditions that present potential bioaccumulation of toxics in fish species in the Susitna River drainage.

Reach Number	Toxics Threshold Exceedance Parameter	Toxics Threshold Exceedance Location
1 (RM 313-184)	Aluminum LC_{50} and NOEL Copper NOEL Iron NOEL	MacLaren River, Summer MacLaren River, Summer MacLaren River, Summer and Mainstem at Vee Canyon, Summer
2a (RM 184-150)	NO DATA	NO DATA
2b (RM 150-98)	Cadmium LC_{50} and NOEL Aluminum LC_{50} and NOEL Copper LC_{50} Copper NOEL Iron NOEL	Mainstem at Gold Creek, Summer Mainstem at Gold Creek, Spring & Summer Mainstem at Gold Creek, Summer Mainstem at Gold Creek, Spring & Summer Mainstem at Gold Creek, Spring & Summer
3 (RM 98-0)	Aluminum LC_{50}Aluminum NOEL Copper LC_{50} Copper NOEL Iron NOEL Lead NOEL Zinc NOEL	Mainstem at Sunshine, Spring & Summer Mainstem at Sunshine, Spring, Summer& Fall; Talkeetna River, Summer Mainstem at Sunshine, Spring; Mainstem at Susitna, Winter, Spring & Summer; Talkeetna River, Summer Mainstem at Sunshine, all year; Mainstem at Susitna, all year; Talkeetna River, Spring & Summer Mainstem at Sunshine, Spring & Summer; Mainstem at Susitna, Spring, Summer, Fall; Talkeetna River, Summer Mainstem at Sunshine, Spring & Fall; Mainstem at Susitna, all year; Talkeetna River, Summer & Fall Mainstem at Sunshine, Summer; Talkeetna River, Spring

4.4.3.10.4. Total Hardness

In general, waters of the Susitna River are moderately hard in winter and soft to moderately hard in summer. In addition, there is a general trend towards softer water in the downstream direction. Total hardness– measured as the sum of the calcium and magnesium hardness and reported in terms of $CaCO_3$– ranged from 99-120 mg/l at Gold Creek during winter to 35-110 mg/l in summer. At Susitna Station, values were 75-95 mg/l and 44-66 mg/l in winter and summer, respectively (Appendix 4.4-1).

4.4.3.10.5. Total Alkalinity

Total alkalinity concentrations, with bicarbonate typically the only form of alkalinity present, were high during winter and low to moderate during summer (Appendix 4.4-1). In addition, upstream concentrations were generally higher than downstream concentrations. Concentrations at Denali were 112-161 mg/l during winter and 42-75 mg/l during summer. At Gold Creek, winter values ranged from 46 to 88 mg/l, whereas summer concentrations were in the range of 23-87 mg/l. In the lower river at Susitna Station, winter concentrations were 60-75 mg/l, and summer levels were 36-57 mg/l.

4.4.3.10.6. Free Carbon Dioxide

Free carbon dioxide (CO_2), in combination with carbonic acid and the previously discussed bicarbonates (alkalinity), constitute the total inorganic carbon components present in the Susitna River. In the upper river basin, summer measurements of free CO_2 at Denali ranged from 1.5-4.5 mg/l, and winter/spring measurements from 5.5-25 mg/l (Appendix 4.4-1). At Gold Creek, the summer and winter values varied from 1.6-33 mg/l and 0.5-16 mg/l, respectively. In the lower river basin at Susitna Station, summer data ranged from 0.4-8 mg/l, and winter data ranged from 1.8-17 mg/l.

4.4.3.10.7. Total Organic Carbon

Total organic carbon (TOC) varies with the composition of the organic matter present (McNeely et al 1979). At Gold Creek, summer TOC levels varied from 1.4 to3.8 mg/l, and winter concentrations ranged from 1.1 to1.2 mg/l (Appendix 4.4-1). Downstream at Susitna Station, TOC ranged from 2.7 to 11.0 mg/l in summer and 0.4 to 4.0 mg/l in winter. The upper threshold criterion for TOC has been suggested to be 3.0 mg/l (McNeely 1979), because water with lower levels has been observed to be relatively clean. However, as noted above, streams and rivers in Alaska receiving tundra runoff frequently exceed 3.0 mg/l (R&M Consultants 1982g).

4.4.3.10.8. Chemical Oxygen Demand

Chemical oxygen demand (COD) is a useful measure of water quality and an indirect measure of pollution. COD data are limited to observations at Vee Canyon and Gold Creek. Summer concentrations at Vee Canyon ranged from 8to 39 mg/l and winter concentrations from 6 to 13 mg/l (Appendix 4.4-1). At the Gold Creek monitoring station, summer concentrations varied from 1.3to 24 mg/l and winter concentrations from 2to 16 mg/l.

4.4.3.10.9. True Color

Color reduces the amount of light penetrating the water and can have a significant impact on the productivity of algae and macrophytes. True color, measured in platinum cobalt units, typically displays a wider range during summer than winter. This phenomenon is attributable to organic acids (especially tannin) characteristically present in the summer tundra runoff. Data gathered at Denali, with its dominant glacial origins, were 0 to 10 color units and 0 to 5 color units during summer and winter, respectively (Appendix 4.4-1). However, color levels at Gold Creek, with its significant tundra runoff, varied from 0 to 5 units during winter and from 0 to 30 units in summer; spring values were as high as 50 units. At Susitna Station, spring values have been measured at 50 units. Although they were high, it is not uncommon for color levels in Alaska to reach 100 units for streams receiving tundra runoff (R&M Consultants 1982g).

4.4.3.10.10. Bacteria

No data are available for bacteria in the upper and middle Susitna River reaches. However, because of the glacial origins of the river and the absence of domestic, agricultural, and industrial development in the watershed, bacteria levels are expected to be low. Limited data on bacterial indicators are available for the lower river basin. Data for the Talkeetna River indicate that total coliform counts were generally low, with 70 percent of the samples registering less than 20 colony-forming units per 100 ml (Appendix 4.4-1). Occasional high values have been recorded during summer months, with a maximum value of 130 colony-forming units per 100 ml. Fecal coliform concentrations were also low, usually registering less than 20 colony-forming units per 100 ml; the maximum recorded summer values were 92 and 91 units per 100 ml in the Talkeetna and Susitna rivers, respectively. Fecal streptococci data displayed a similar pattern: low values in winter and occasional high counts during summer. Recorded values likely reflected natural variation within the river originating from endemic wildlife, as there were no significant human influences throughout the basin that would affect bacterial counts.

4.4.4. Ice Dynamics

4.4.4.1. Freeze-Up

Air temperatures in the Susitna River basin increase from the headwaters to the lower reaches. Although this temperature gradient is partially due to the two-degree latitudinal extent of the river, it is mostly due to the 3,300-foot elevation difference between the lower and upper basins and the climate moderating effects of Cook Inlet on the lower river reaches. The gradient causes a period (late October – early November) during which the air temperatures in the lower basin are above freezing, while the upper basin temperatures are below freezing. Frazil ice begins forming in the upper segment of the river in early October due to the cold temperatures of glacial melt and cold ambient air temperatures. Additional frazil ice is generated in the fast-flowing rapids between Vee Canyon and Devils Canyon. The frazil ice generation normally continues for a period of 3-5 weeks before a solid ice cover forms in the river downstream of Devils Canyon.

The frazil ice pans and floes jam at natural lodgement points, which are near channel constrictions or low-velocity areas. Border ice formation along the river banks also restricts the channel and allows ice cover closures or bridgings to form. From the natural lodgement points, the ice cover progresses in an upstream direction as additional ice is supplied from farther upriver. However, before the ice cover can progress upstream, a leading edge stability criterion must first be satisfied. This translates into a velocity at the upstream end of the ice front that is sufficiently low to allow the flowing ice to affix itself to the ice front, causing an upstream progression of the ice front. If the velocities at the ice front are too high, the ice flowing downstream will be pulled underneath the ice front and deposited downstream on the underside of the established cover. In reaches where the velocity permits ice deposition, a thickening of the ice cover will occur. The thickening ice cover constricts the flow downstream of the ice front by increasing the resistance, thus creating a backwater effect. The velocity upstream of the ice front is thereby reduced until the leading edge criterion is satisfied. In the thickening process, the maximum velocity attained underneath the ice deposits is about 3 ft/second.

During freeze-up, the upstream progression of the ice front on the Susitna River often raises water levels by 2-4 ft, but higher stages have also been observed. However, the water level increase in a particular reach of the river is dependent upon the prevailing discharge at which the ice cover was formed in that reach. The variability in discharge at freeze-up, and hence water level increase, coupled with the varying berm elevations at the upstream ends of sloughs, results in some sloughs being overtopped during freeze-up, other sloughs occasionally being overtopped, and still others not being overtopped.

The Susitna River is the primary contributor of ice to the river system below Talkeetna, contributing 70-80 percent of the ice load in the Susitna-Chulitna-Talkeetna Rivers (R&M Consultants 1982d). Ice formation in the Chulitna and Talkeetna rivers normally commences several weeks after freeze-up on the upper and middle Susitna River.

4.4.4.2. Winter Ice Conditions

Once a solid ice cover forms on the Susitna River, open leads still occur in areas of high velocity or ground water upwelling. These leads shrink during cold weather and are the last areas in the main channel to be completely covered by ice. Ice thickness increases throughout the winter. The ice cover averages over 4 ft thick by breakup (R&M Consultants 1982d), but thicknesses of over 10 ft have been recorded near Vee Canyon.

Some of the side-channels and sloughs upstream of Talkeetna have open leads during winter due to groundwater upwelling. Winter groundwater temperatures, generally varying between 2 and 4 ˚C, contribute enough heat to prevent the ice cover from forming (Trihey 1982a). These areas are often salmonid egg incubation areas.

4.4.4.3. Breakup

The onset of warmer air temperatures in the lower Susitna River basin occurs several weeks earlier than in the middle and upper basins. The low-elevation snowpack melts first, causing the river discharge to increase. The rising water level puts pressure on the ice, causing fractures to develop in the ice cover. The severity of breakup is dependent upon the snow melt rate, the depth of the snowpack, and the amount of rainfall, if it occurs. A heavy snowpack and cool air temperatures into late spring, followed by a sudden increase in air temperatures, may result in a rapid rise in water elevation. The rapid water level increase initiates ice movement, and when coupled with ice left in a strong condition due to the cooler early spring temperatures, can lead to numerous and possibly severe ice jams, which result in flooding and erosion, as occurred in 1982 (R&M Consultants 1982h). Local velocities during severe ice jams may reach 10 fps.

Breakup floods can result in high flows through the side channels and sloughs in the Middle Susitna River reach (i.e., above Talkeetna). The flooding and erosion that occur during breakup are believed to be the primary factors influencing channel morphology in the middle Susitna River (R&M Consultants 1982d).

4.4.5. Bedload and Suspended Sediments

The USGS collected bedload and suspended sediment data in 1981 and 1982 in the Susitna, Chulitna, and Talkeetna rivers. Data were collected monthly in 1981 during July, August, and September, and weekly from June throughAugust 1982, with two samples in September. Very little data have been collected since.

Gravel-bed streams such as the Susitna River are essentially inactive most of the time (Parker 1980). Parker indicates that the conditions necessary for mobilization of a gravel bed typically occur for only several days or weeks during the year during high-flow periods. The gravel "pavement" is maintained between transport events.

4.4.5.1. Upper Susitna River

The Susitna River and its major tributaries experience extreme fluctuations in suspended sediment concentrations as a result of glacial melt and runoff from snowmelt or rainfall. The West Fork, Susitna, East Fork, and Maclaren glaciers are the primary sources of suspended sediment in the upper river. Commencing with spring breakup, suspended sediment concentrations begin to rise from their average winter levels of approximately 10 mg/l. During summer, values as high as 5,690 mg/l have been recorded at Denali, the gaging station nearest the glacially-fed headwaters. Downstream of the mouth of the Maclaren River to the proposed Watana Dam site, there are no significant glacial sediment sources. Hence, concentrations decrease due to both the settling of the coarser sediments and dilution by the inflow from several clear-water tributaries. However, at high flows, when erosion is more prevalent, the tributaries can become significant contributors of suspended sediment. Maximum summer concentrations of 2,620 mg/l have been observed at Gold Creek. Table 4.4-13 shows suspended sediment concentrations at Gold Creek in 1952. Estimates of the average annual suspended sediment load for Denali and Cantwell are 2,965,000 and 6,898,000 tons per year (R&M Consultants 1982c). The latter figure is the estimated suspended sediment load upstream of the proposed Watana reservoir. R&M Consultants also estimated that between 20 and 25 percent of the suspended sediment is less than 4 microns (0.004 millimeters) in diameter.

In general, bed material size ranges from coarse gravel to cobble throughout the upper Susitna River. The 1980s studies estimated that movement of the medial bed material size could occur above 35,000 cfs. R&M Consultants (1982d) suggest that an armor layer consisting of cobbles and boulders exists throughout most of the river.

Table 4.4-13 Suspended sediment at Gold Creek (RM 136.5) – May to September 1952.

May				June			July			August			September		
		Suspended Sediment			Suspended Sediment			Suspended Sediment			Suspended Sediment			Suspended Sediment	
Day	Mean Discharge (cfs)	Mean Concentration (mg/1)	Tons Per Day	Mean Discharge (cfs)	Mean Concentration (mg/1)	Tons Per Day	Mean Discharge (cfs)	Mean Concentration (mg/1)	Tons Per Day	Mean Discharge (cfs)	Mean Concentration (mg/1)	Tons Per Day	Mean Discharge (cfs)	Mean Concentration (mg/1)	Tons Per Day
1	1,100	9	27	25,000	1,730	117,000	33,000	1,300	116,000	41,900	1,390	157,000	30,000	870	a70,50
2	1,200	13	a42	23,500	2,030	129,000	31,100	1,220	102,000	38,300	981	101,000	28,700	772	59,800
3	1,300	17	60	27,500	2,200	a163,000	29,500	562	44,800	32,100	826	71,600	24,500	682	45,100
4	1,400	18	a68	29,000	1,800	a141,000	27,800	544	40,880	27,100	900	65,900	21,400	602	34,800
5	1,500	19	a77	26,500	1,300	a93,000	25,900	695	48,600	24,500	900	59,500	18,000	560	a27,200
6	1,600	19	82	22,500	940	a57,100	23,600	670	42,700	23,500	909	57,700	14,800	520	20,800
7	1,600	20	a86	24,400	1,000	a65,900	22,500	560	34,000	23,600	860	54,800	12,900	420	a14,600
8	1,600	21	a91	22,300	950	a57,200	21,100	687	39,100	24,700	828	55,200	11,900	270	a8,680
9	1,500	22	a89	21,500	730	a42,400	19,700	595	31,600	25,600	824	57,000	12,400	130	4,350
10	1,400	23	87	26,800	495	35,800	18,900	429	21,900	26,200	873	61,800	12,700	70	a2,400
11	1,400	20	a76	37,300	249	25,100	17,700	662	31,600	27,400	836	61,800	13,500	54	1,970
12	1,500	18	a73	36,700	189	18,700	17,200	1,030	47,800	24,400	1,150	75,800	14,200	50	a1,920
13	1,600	18	78	34,000	290	26,600	19,500	1,190	62,700	22,400	2,190	132,000	13,500	50	a1,820
14	1,700	15	69	31,400	464	39,300	23,300	1,140	71,700	20,400	2,100	a116,000	12,300	50	a1,660
15	1,900	12	62	37,400	49	49,800	25,000	1,150	77,600	19,800	1,580	a84,500	10,800	50	a1,460
16	2,100	12	a68	42,400	562	64,300	25,400	909	62,300	18,700	1,200	a60,600	10,200	58	1,600
17	2,200	15	a89	43,300	936	109,000	25,700	756	52,500	16,500	960	a42,800	10,500	65	1,840
18	2,400	17	a110	41,300	885	98,700	25,400	860	a59,000	15,600	650	27,400	10,000	70	a1,890
19	2,600	19	133	40,200	256	27,800	25,200	990	a67,400	14,800	531	21,200	9,500	70	a1,800
20	2,800	30	a227	36,300	241	23,600	24,700	1,130	75,400	14,400	639	24,800	10,000	70	a1,890
21	3,000	50	a405	35,400	232	22,200	24,200	1,080	70,600	14,800	554	22,100	11,300	70	a2,140
22	3,400	80	734	35,600	212	20,400	23,700	837	53,600	15,100	414	16,900	15,700	73	3,090
23	3,700	270	a2,700	34,700	203	19,000	24,700	918	61,200	15,300	435	18,000	15,400	76	3,160
24	4,500	549	6,670	34,300	213	19,700	25,900	873	61,000	15,200	531	21,800	14,800	90	3,600
25	6,000	828	13,400	34,100	184	16,900	27,400	972	71,900	15,000	377	15,300	13,800	90	3,350
26	8,000	1,120	24,200	33,600	278	25,200	28,900	972	75,800	15,000	275	11,100	12,900	99	3,450
27	10,000	1,270	34,300	34,300	1,040	96,300	28,400	888	68,100	14,200	293	11,200	12,300	110	3,650
28	15,000	747	30,300	33,000	1,220	109,000	31,300	927	78,300	13,500	410	a14,900	12,000	89	2,880
29	25,000	450	30,400	33,400	1,220	110,000	38,300	1,120	116,000	13,600	568	20,900	12,000	81	2,620
30	28,000	540	40,800	33,400	1,270	115,000	41,300	1,310	146,000	15,000	720	a29,200	12,400	68	2,280
31	27,000	1,670	122,000	--	--	--	41,700	1,360	153,000	20,000	860	a46,400	--	--	--
TOTAL	168,000	--	307,603	971,100	--	1,938,000	818,000	--	2,085,000	648,600	--	1,616,200	434,400	--	336,300
Total discharge for period (cfs-days)															3,067,700
Total load for period (tons															6,284,363

Note
a = Computed from estimated concentration graph.

4.4.5.2. Middle and Lower Susitna River

Bedload data collected in 1981 indicate that the Chulitna River is the primary contributor of bedload at the Susitna-Chulitna-Talkeetna confluence (Table 4.4-14). This was confirmed by studies conducted in 1982. Susitna River bedload above the confluence was about 80,000 tons during 1982, whereas bedload in the Chulitna River was 1.2 million tons. That is, the Chulitna River had an estimated bedload volume 15 times greater than the Susitna River near the confluence. Data at Sunshine Station (RM 84) indicate that bedload is less than the sum of the upstream bedload, suggesting that aggradation may take place upstream of Sunshine.

Suspended sediment concentrations immediately downstream of Talkeetna are increased because of the contribution of the sediment-laden Chulitna River, which has 28 percent of its drainage area covered by ice year round. Maximum values of 3,510 mg/l have been recorded downstream at the Sunshine monitoring station. Downstream of Talkeetna, the Yentna River is the only other major glacial river entering the Susitna River. Other sediment sources in the Susitna River include bank erosion, talus slides, and the re-suspension of sediments. Re-suspension of sediments from sand and gravel bars during flow increases can be a significant source of sediment, especially in the wide, braided portions of the river. When flow decreases, the sediments are deposited on bars downstream. Table 4.4-15 shows suspended sediment concentrations at various locations in 1982. The 1982 data indicate that the suspended sediment load for the Susitna River above the confluence was 3.7 million tons, while the suspended sediment load for the Chulitna River was 7.1 million tons. That is, the suspended sediment load of the Chulitna was approximately twice that of the Susitna River above the confluence.

Suspended sediment discharge has been shown to increase with river discharge (R&M Consultants 1982c). Table 4.4-16 shows the increase in suspended sediment discharge at Gold Creek (RM 136.5) with the river discharge of 1953.

Table 4.4-14 1981 bedload transport data Susitna River Basin.

Station	Date	Water Discharge (cfs)	Total Bed Load Transport Rate (tons/day)
Susitna River at Gold Creek	7/22/81	37,200	2,180
Chulitna River [1]	7/22/81	31,900	3,450
Talkeetna River	7/21/81	16,800	1,940
Susitna River at Sunshine	7/22/81	89,000	3,520
Susitna River at Gold Creek	8/26/81	25,900	380
Chulitna River	8/25/81	22,500	5,000
Talkeetna River	8/25/81	9,900	800
Susitna River at Sunshine	8/26/81	61,900	4,520
Susitna River at Gold Creek	9/28/81	8,540	
Chulitna River	9/29/81	6,000	3,820
Talkeetna River	9/29/81	2,910	30
Susitna River at Sunshine	9/30/81	19,100	400

Note: Bedload data gathered approximately 4 mi below Chulitna river gaging site on 7/22/81. Data gathered at Chulitna gaging site on other dates.

Table 4.4-15 1982 Turbidity and suspended sediment analysis.

Location	Date Sampled	Date Analyzed	Turbidity[2] (NTU)	Suspended[3] Sediment Concentration (mg/1)	Discharge (cfs)
Susitna River at Vee Canyon (RM 223)	6/4/82	6/11/82	82		
	6/30/82	8/3/82	384		
	7/27/82	8/18/82	720		
	8/26/82	9/14/82	320		
Susitna River Near Chase[4] (RM 103)	6/3/82	6/11/82	140	769	35,800
	6/8/82	6/24/82	130	547	44,400
	6/15/82	6/24/82	94	170	24,200
	6/22/82	8/3/82	74	426	37,000
	6/30/82	8/18/82	376	392	30,200
	7/8/82	8/18/82	132	156	20,700
	7/14/82	8/3/82	728	729	30,800
	7/21/82	8/18/82	316	232	24,900

Location	Date Sampled	Date Analyzed	Turbidity[2] (NTU)	Suspended[3] Sediment Concentration (mg/1)	Discharge (cfs)
	7/28/82	8/18/82	300	464	30,800
	8/4/82	8/18/82	352	377	22,700
	8/10/82	8/26/82	364	282	20,000
	8/18/82	8/26/82	304	275	17,700
	8/25/82	9/14/82	244	221	16,800
	8/31/82	9/14/82	188	252	19,300
	9/19/82	10/12/82	328	439	28,700
Susitna River at Cross Section LRX-4[1], 4 (RM 99)	5/26/82	5/29/82	81		
Susitna River below Talkeetna[1,5] (approximately RM 91)	5/26/82	5/29/82	98		
	5/28/82	6/2/82	256		43,600
	5/29/82	6/21/82	140		42,900
	5/30/82	6/2/82	65		38,400
	5/31/82	6/2/82	130		39,200
	6/1/82	6/2/82	130		47,000
Susitna River at Sunshine-Parks Highway Bridge[5] (RM 83)	6/3/82	6/1182	164	847	71,00
	6/10/82	6/24/82	200	414	64,500
	6/17/82	6/2482	136	322	50,800
	6/21/82	8/3/82	360	755	78,300
	6/28/82	8/18/82	1.056	668	75,700
	7/6/82	8/382	352	507	46,600
	7/12/82	8/3/82	912	867	59,800
	7/19/82	8/18/82	552	576	60,800
	7/26/82	8/18/82	696	1,180	96,800
	8/2/82	8/18/82	544	704	62,400
	8/9/82	8/26/82	720	746	54,000
	8/16/82	8/26/82	784	728	47,800
	8/23/82	9/14/82	552	496	38,600
	8/30/82	9/14/82	292	439	39,800

Location	Date Sampled	Date Analyzed	Turbidity[2] (NTU)	Suspended[3] Sediment Concentration (mg/1)	Discharge (cfs)
	9/17/82	10/12/82	784	1,290	86,500
Chulitna River[1] (approximately 1 mi above Chulitna-Susitna Confluence	5/26/82	5/29/82	194		
	5/2882	6/2/82	272		
	5/29/82	6/2/82	308		
	5/30/82	6/2/82	120		
	5/31/82	6/2/82	360		
	6/1/82	6/2/82	324		
Chulitna River (Canyon[6]) (18 mi above the Chulitna-Susitna Confluence)	6/4/82	6/11/82	272	424	11,500
	6/22/82	8/3/82	680	813	19,500
	6/29/82	8/18/82	1,424	1600	29,000
	7/7/82	8/3/82	976	1030	20,700
	7/13/82	8/18/82	1,136	1200	22,700
	7/20/82	8/18/82	1,392	1250	23,100
	7/27/82	8/18/82	664	1010	31,900
	8/3/82	8/18/82	704	960	23,300
	8/11/82	8/26/82	592	753	21,300
	8/17/82	8/26/82	1,296	1250	21,900
	8/24/82	9/14/82	632	843	18,200
	9/1/82	9/14/82	316	523	17,300
	9/18/82	10/12/82	1,920	1550	29,200
Talkeetna River at Railroad Bridge[1,7] (0.5 mi above Susitna-Talkeetna Confluence)	5/26/82	5/29/82	17		5,680
	5/28/82	6/2/82	39		6,250
	5/29/82	6/2/82	21		5,860
	5/30/82	6/2/82	20		5,660
	5/31/82	6/2/82	44		7,400
	6/1/82	6/2/82	55		9,560
Talkeetna River at USGS Cable (6 mi above	6/2/82	6/11/82	146	340	17,900
	6/9/82	6/24/82	49	311	14,700
	6/17/82	6/24/82	28	216	11,400

Location	Date Sampled	Date Analyzed	Turbidity[2] (NTU)	Suspended[3] Sediment Concentration (mg/1)	Discharge (cfs)
Susitna-Talkeetna Confluence)	6/23/82	8/3/82	26	164	12,400
	6/29/82	8/18/82	41	321	10,700
	7/7/82	8/3/82	20	100	6,750
	7/13/82	8/3/82	132	226	8,880
	7/20/82	8/18/82	148	226	8,400
	7/28/82	8/18/82	272		14,200
	8/3/82	8/18/82	49	180	8,980
	8/10/82	8/26/82	53	212	6,980
	8/17/82	8/26/82	82	198	6,230
	8/24/82	9/14/82	68	263	5,920
	8/31/82	9/14/82	37	276	9,120
	9/20/82	10/12/82	34	301	14,800

Notes:

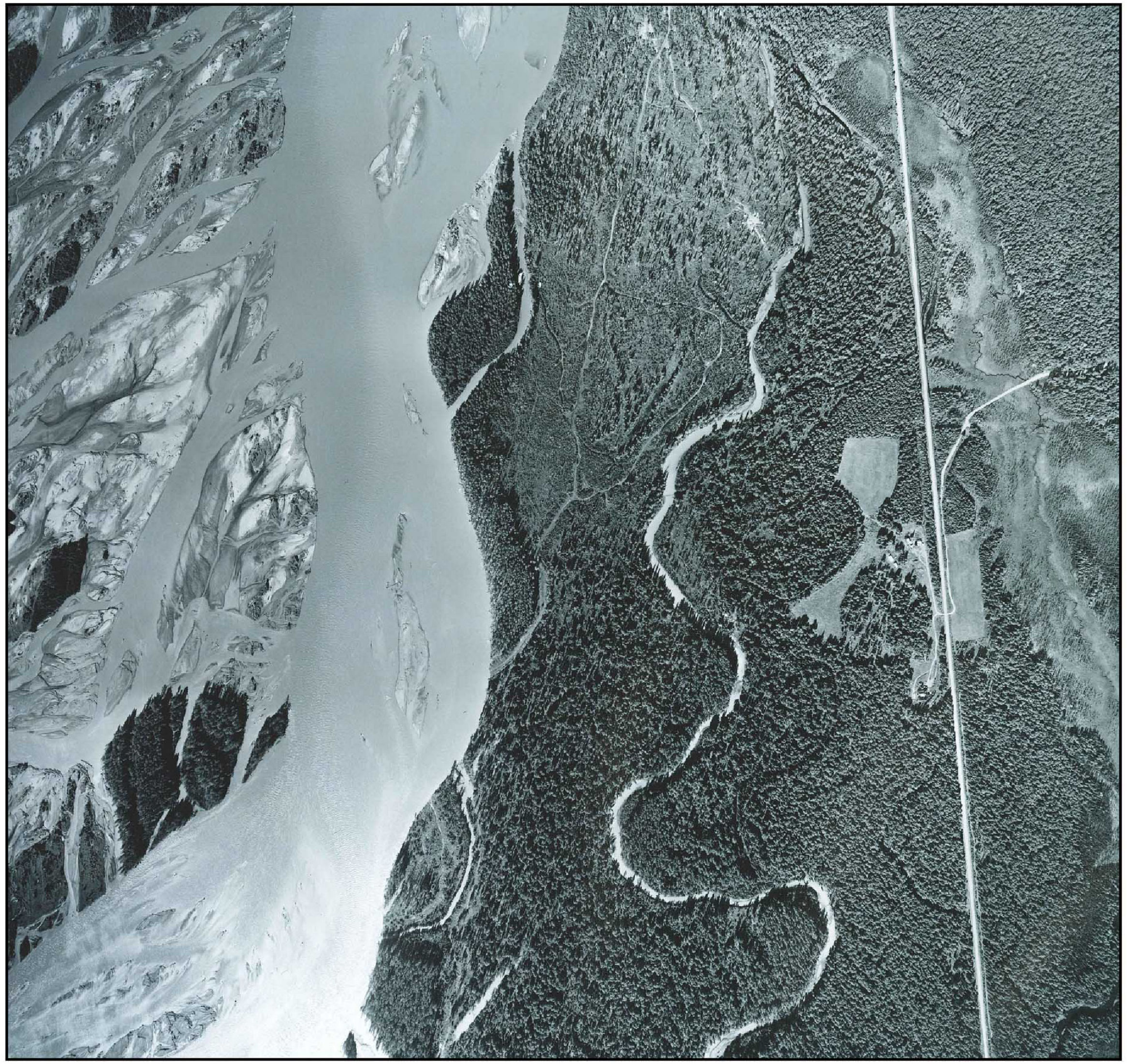
1. Samples collected by R&M Consultants. All other samples were collected by USGS.
2. R&M Consultants conducted all turbidity analysis.
3. Suspended sediment concentrations are preliminary unpublished data provided by by the U.S. Geological Survey (USGS).
4. Discharges for “Susitna near Chase” and “Susitna at LRX-4” are from provisional USGS stream gage data at the Alaska Railroad Bridge at Gold Creek.
5. Discharges for “Susitna below Talkeetna” and “Susitna at Sunshine” are from provisional USGS stream gage date at the Parks Highway Bridge at Sunshine.
6. Discharges for “Chulitna River (Canyon)” are from provisional USGS stream gate data at the Parks Highway Bridge at Chulitna.
7. Discharges for “Talkeetna at R.R. Bridge” and “Talkeetna at USGS Cable” are from provisional USGS stream gage data near Talakeetna.

Table 4.4-16 Susitna River at Gold Creek (RM 136.5) – monthly summary of suspended sediment, WY 1953.

Month	Discharge (cfs-days)	Suspended Sediment (tons)
1952		
October	254,260	30,120
November	104,900	2,700
December	52,700	
1953		
January	34,100	--
March	22,900	--
April	48,450	--
May	597,400	1,053,00
June	819,700	2,248,000
July	626,100	1,965,000
August	638,900	1,819,000
September	458,180	

USGS studies from the 1980s found that the Chulitna and Talkeetna Rivers, despite a combined smaller drainage area than the upper Susitna River, transport three times as much total sediment as the upper Susitna River (Knott and Lipscomb 1985; Knott et al. 1986; Knott et al. 1987). The Lower Susitna River Aggradation Study: Field Data (R&M Consultants 1985) reports that approximately 80 percent of the total sediment load in the Susitna River below Talkeetna originates in the Chulitna and Talkeetna Rivers. Figure 4.4-14 shows the Susitna River Channel configuration at approximately RM 97, below Talkeetna in August 1984 and August 2011. The river chanels, bars, and riparian areas have changed considerably in the 25 years between the two sets of photos.

On an annual average basis, the flow contributions from the Susitna River and the Chulitna River to the flow at Susitna Station USGS gage are similar; however, the morphology of these two systems is markedly different. The relatively stable channel morphology of the Susitna River indicates that much of the sediment generated in the headwaters is stored in the upper basin, such that the sediment supply delivered downstream of the proposed Watana Dam site more closely matches the transport capacity of the flows, or that the channel in Reach 2 downstream of Devils Canyon is coarser and the bed and banks have become armored over time. Alternately, the braided morphology of the Chulitna River indicates an excessive sediment supply relative to transport capacity.



August 1984
(source: Aerometric)

August 2011
(source: e-Terra)

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.4-14

Susitna River Channel Morphology at River Mile 91 from August 1984 and 2011

4.4.6. Potential Access and Transmission Corridors

Three corridors are being considered: Denali Corridor, Gold Creek Corridor, with two sub-options near the proposed Watana Dam, and Chulitna Corridor. The Denali Corridor would follow Deadman Creek for much of its way to the Susitna River, crossing Seattle, Shale, Burshkana, and Deadman creeks. The Gold Creek Corridor would cross Fog Creek and the upper end of Prairie Creek, if the southern route is selected, along with five unnamed streams. If the northern route is selected, an additional unnamed creek would be crossed, but this segment of the Gold Creek Corridor would not cross Prairie Creek. For the Chulitna Corridor, Tsusena Creek, Devil Creek, Portage Creek and two unnamed tributaries would be crossed in addition to Indian River.

Little water quality data are available for these streams. However, as noted in the fisheries section, many of the major streams that would be crossed are known to support populations of anadromous fish (Gold and Chulitna corridors) and/or Arctic grayling (Denali Corridor). These fish species are generally residents of clear, cold streams (Scott and Crossman 1973), and as a result water quality is generally expected to be good. In contrast, water quality conditions associated with tundra runoff may also be expected. Among the conditions that might be expected are pH levels in the 6-7 range, TOC concentrations exceeding the suggested criterion of 3.0 mg/l (McNeely et al. 1979), and true color values as high as 100 units. During periods of high flow resulting from Spring snowmelt and summer rainstorms, elevated suspended sediment and turbidity levels are expected.

4.4.7. Potential Adverse and Positive Impacts

Potential impacts to water resources may occur during three phases of Project development and existence: Project construction, initial reservoir filling, and ongoing Project operations. This section presents a provisional assessment of potential impacts based on the current Project description (Section 3) and existing water resources information. More detailed evaluations will be conducted during FERC licensing to assess the water resource related impacts of the proposed Project.

4.4.7.1. Project Construction Impacts

An approximately 1,800-foot-long segment of the Susitna River will be dewatered during construction of the main Watana Dam. The majority of construction material will come from borrow areas outside the river channel (Figure 4.1-1). Some construction material may be excavated from the dewatered reach at the dam site.

During construction, water will temporarily be diverted around the construction site via a diversion tunnel. Because there will be essentially no change in flows, no effects on downstream water temperature are anticipated. Because there will be minor ponding upstream of the diversion tunnel and an ice boom will likely be used to establish a stable ice cover, a more rapid ice front progression upstream of the proposed Watana Dam site is likely to take place, but there should be no effect on water temperatures. Ice break-up is expected to be similar to what occurs under baseline conditions.

Suspended sediment and turbidity levels will increase at the Watana Dam site and for some distance downstream. Effects downstream from Talkeetna are expected to be negligible.

Increased concentrations of nutrients and organic compounds could occur due to the disturbance of vegetation and soil cover and subsequent erosion of overburden and spoil materials.

No significant impacts on trace metal concentrations are expected from construction related disturbances to soils and rock on the river bank and in the riverbed, because contact time will be short.

Accidental spillage and leakage of petroleum products could contaminate surface water and groundwater during construction.

The wastewater and waste concrete associated with operation of a batch plant at the Watana Dam site, if discharged directly to the river, could degrade downstream water quality and result in mortality of aquatic organisms. No significant dust problems are anticipated because a modern control batch plant is planned.

Because no change in mainstem discharge is expected and no change in river water level other than in the immediate area of the Watana dam site, no groundwater impacts are expected upstream or downstream of the site.

The construction, operation, and maintenance of facilities could impact the Tsusena and Deadman creek drainage basins and nearby small lakes.

Minimal impacts to instream flow uses below the diversion are expected during construction unless flows exceed the cofferdam design flood. The construction of support facilities for the workforce may result in water quality effects, particularly as the result of the development of a water supply from a local water body and the construction and operation of a wastewater treatment plant.

4.4.7.2. Reservoir Filling

It is anticipated that it will take up to two years to complete the filling of the reservoir, depending on flows at the time. The trapping of bedload and suspended sediment within the reservoir will reduce the sediment being transported by the Susitna River, particularly from the Watana Dam to the confluence of the Chulitna and Talkeetna rivers. Bedload movement will be limited within this reach because of the existing armor layer and reduced flows. The lack of suspended sediment within this reach will significantly reduce siltation in calmer areas. The main channel would likely become narrower and more defined, and encroachment of riparian vegetation would begin. Tributary streams, including Portage Creek, Indian River, Gold Creek, and Fourth of July Creek, would extend their alluvial fans into the river. Some tributaries between the dam and Talkeetna could perch.

Overflow into most side channels would not occur because high flows would be reduced to a maximum of about 30,000 cfs immediately downstream of the Watana Dam site during reservoir filling. Backwater effects at the mouths of the side channels and sloughs in the Watana-Talkeetna reach would also be reduced, leading to vegetation encroachment in the side channels and sloughs.

At the confluence of the Susitna and Chulitna rivers, the Chulitna River is expected to expand its alluvial deposits to the east and south. Downstream of this confluence, reduced flows would decrease the frequency and amount of bed material movement.

With the commencement of initial reservoir filling, many of the physical, chemical, and biological processes common to a lentic environment should begin to appear within the reservoir, including sedimentation, leaching, nutrient enrichment, stratification, and ice cover formation.

Reservoir water temperatures will reflect inflow water temperatures, increased somewhat near the surface by the effects of solar heating. The reservoir will initially fill rapidly to a depth of about 400 ft, and the effects of surface heating will not penetrate to the depth at which the dam intake is located. Consequently, the outlet water temperatures during the first year of reservoir filling are expected to be an average of existing river water temperatures, with warming and cooling of the reservoir lagging behind that occurring in the inflow due the greater thermal mass of the reservoir relative to that of the river. The volume of water that would be stored in the reservoir is estimated to be about 2 million ac-ft in the first year. From November through April, reservoir outflow temperatures are expected to be about 4 ˚C (39 ˚F), rather than the 0 ˚C (32 ˚F) that currently exists in the river at this time of year. As the reservoir level gets closer to full, the reservoir temperatures will be similar to conditions expected during post-filling operation of the Project.

During winter of the first season of filling, the 4 ˚C water immediately downstream of the dam site would cool to 0 ˚C, but, based on water temperature modeling conducted in the 1980s, it may require a distance of more than 20 mi downstream of the dam for this cooling to occur. In the summer, the reverse would occur, with downstream water temperatures being cooler than existing conditions in the Watana to Talkeetna reach.

Downstream of Talkeetna, the Susitna River water temperatures would reflect those of the Talkeetna and Chulitna rivers, because of their higher flows. Downstream of the confluence of the Yentna River, no significant deviations from natural water temperature conditions are expected.

An ice cover is expected to form on the proposed reservoir in late November. Because of the 4 ˚C water being released in late fall and winter, there will be a delay in the formation of ice in the Watana-Talkeetna reach. In mid to late December, it is expected that ice generation would occur upstream of Devils Canyon. Freeze-up staging at this time is expected to be similar to natural freeze-up conditions. Sloughs and side channels that are currently overtopped are likely to be overtopped during the winter freeze up. Ice cover formation downstream of Talkeetna is expected to be delayed during reservoir filling because the Watana-Talkeetna reach currently contributes most of the ice for ice cover formation. During the March-April period, the 4 ˚C water being released from the reservoir, together with reduced flows, should result in less severe ice breakup conditions than what currently occur.

During the filling process, dissolved oxygen levels in the proposed Watana Reservoir should approximate riverine conditions. As filling progresses, some vertical stratification of the reservoir would begin to develop. However, because of the volume of freshwater inflow, the effects of wind and waves, and the ability to withdraw water at depth in the reservoir, the reservoir is expected to remain relatively well mixed. No significant biochemical oxygen demand is anticipated. Dissolved oxygen is expected to remain sufficiently high to support a diverse aquatic fauna.

Supersaturated total dissolved gas conditions currently exist in the Susitna River downstream of the Devils Canyon rapids. Supersaturated gas conditions can occur below high head dams as a result of water passing over a spillway into a deep plunge pool, but because all water released during reservoir filling will pass through a low-level outlet, supersaturated dissolved gas conditions are unlikely immediately downstream of Watana Dam.

It is expected that nutrient concentrations will increase for a short time during reservoir filling, especially in close proximity to the reservoir bottom, primarily due to leaching from the substrate.

Based on studies at other reservoirs, short-term increases in dissolved solids, conductivity, and most of the major ions could occur immediately after reservoir filling begins. This is attributable to the initial inundation and leaching of materials from rocks and soils on the reservoir bottom. However, the products of leaching are expected to remain in a narrow layer adjacent to the reservoir floor. Inorganic glacial sediment would quickly blanket the reservoir bottom, thereby inhibiting the leaching process. Increased levels of these parameters could occur downstream of the dam.

Because of the decreased summer flows, water levels in the mainstem Susitna River in the Watana to Talkeetna reach would likewise be reduced. This in turn would cause a reduction in adjacent groundwater levels. However, the groundwater level changes would be confined to the river floodplain area. A similar process would occur downstream from Talkeetna, but the changes in groundwater levels would be smaller because of the decreased effect of the proposed Project on river stage farther downstream.

The reduced mainstem summer flows would slightly modify groundwater relationships between the mainstem and the sloughs. The mainstem water levels upstream and downstream of a slough control the groundwater gradient in the slough, and because both levels change by the same amount for different flows, the gradient is expected to be similar to what occurs under current conditions. As long as the water levels in the slough remain above the ground level, the upwelling rate should be similar to existing conditions.

Instream flow uses are expected to be affected during reservoir filling. Impacts on fishery resources, riparian vegetation, and wildlife habitat are discussed in other sections of this PAD. Reduced summer flows could affect navigation between the dam site and Talkeetna. Minimal impacts downstream of the confluence with the Chulitna River are expected. Use of the river by snow machine and dogsled will be delayed. The potential for kayaking in the reservoir reach would be lost. Because of the reduced flows to Cook Inlet during reservoir filling (i.e., about a 10 percent reduction), localized increases in salinity are likely to occur in Cook Inlet, but previous studies indicate that the increases would not be substantial (i.e., the maximum increase would be about 1,400 mg/l during June when the greatest reduction in flows occurs).

4.4.7.3. Project Operations

The Project would be operated in a storage-and-release mode, with summer high flows stored for release in winter. Under normal hydrologic conditions, flow from the proposed reservoir would be totally regulated. Day-to-day changes are expected to be variable, but there would be significant changes from one season to the next and possibly for the same month from one year to the next.

As the sediment-laden Susitna River enters Watana Reservoir, water velocity would decrease and the larger diameter suspended sediment would settle out to form a delta at the upstream end of the reservoir. The delta formation would be constantly adjusting to the changing reservoir elevation. Trap efficiencies were estimated at 80 percent or more during the 1980s studies. Sedimentation would also occur at the mouths of tributaries flowing into the reservoir. Erosion would occur along the reservoir shoreline as the result of fluctuation in water surface elevation due to Project operations and as a result of wave action.

Downstream of the proposed Project, alteration of sediment transport would influence channel morphology, aquatic habitats, channel erosion, and flooding via the following mechanisms: regulated flows released from the proposed Project, the discontinuity in sediment supply and transport through the proposed reservoir, and sediment transport capacity below the major tributary confluences (lower Susitna).

Downstream of the Project, impacts of operations on river channel morphology from May through September would be similar to those occurring during reservoir filling. The reduction in streamflow peaks and the trapping of bedload and suspended sediments in the reservoir would continue to significantly reduce morphological dynamics upstream of the Susitna-Chulitna confluence. The mainstem river channel would become constrained and clearly defined. Channel width reduction would continue as the result of vegetation encroachment.

Elimination of bed material from the upstream basin could lead to clearer-water scour in the reach between the proposed dam and the head of Devils Canyon and possibly coarsening of the riverbed. Additionally, reduced flows could change sediment transport capacity immediately downstream of the confluences with the Chulitna and Talkeetna rivers in the lower Susitna River, which in turn could lead to some local aggradation and aggradation-induced flooding and lateral channel erosion. Conversely, reduced flows could enhance the existing stability of the reach between the mouth of Devils Canyon and the Chulitna-Talkeetna confluence. Depending on the balance between reduced flows and the sediment introduced by tributaries downstream of the dam, it is possible that there could be coarse sediment deposition within the middle Susitna River that might increase the available habitat for various life stages of salmonid species downstream of the mouth of the Canyon.

As noted above, USGS studies from the 1980s found that the Chulitna and Talkeetna rivers, despite a combined smaller drainage area than the upper Susitna River, transport three times the total sediment as the upper Susitna River (Knott and Lipscomb 1985; Knott et al. 1986; Knott et al. 1987). The Lower Susitna River Aggradation Study: Field Data (R&M Consultants 1985) reports that approximately 80 percent of the total sediment load in the Susitna River below Talkeetna originates in the Chulitna and Talkeetna rivers. Based on this information, the trapping of sediment in the proposed Watana Reservoir may only affect sediment dynamics significantly between the dam site and the Susitna-Chulitna-Talkeetna confluence (primarily downstream of Devils Canyon because the Devils Canyon reach is bedrock controlled and currently has very low sediment storage potential). The magnitude of the influence will depend largely on the natural sediment loading from the upper watershed and ability of the sediment loading from the tributaries between the dam site and the Susitna-Chulitna-Talkeetna confluence to offset sediment-related impacts of the Watana Project. The relative stability of the Susitna River morphology upstream of the Susitna-Chulitna confluence could possibly be enhanced, depending on the regulated outflows from the Project.

Side channels and sloughs are of particular importance to fisheries, so Project-induced changes to the relationships between flow and stage at which the habitats are accessible could impact fisheries. Overtopping at the upstream ends of sloughs during summer would seldom occur because of reduced flows. Movement of sand and gravel bars in the sloughs would be minimized. Vegetation encroachment in sloughs and side-channels may also occur as high flows are reduced. Other factors that could be affected by the Project include the cleaning of spawning gravels, hyporheic flows through redds, groundwater inflows, and hydraulic connectivity for outmigration to the main channel elevation. Beaver dams and debris dams previously washed out by high flows, would remain in place, unless steps are taken to remove these barriers.

After impoundment, the Watana Reservoir would exhibit the thermal characteristics of a deep glacial lake. Deep glacial lakes commonly show temperature stratification during both winter and summer. However, stratification is often relatively weak. The seasonal variation in temperature within the Watana Reservoir and for a distance downstream of the dam would change after impoundment. The timing of high and low temperatures would also change.

During June and July, water temperatures in the Watana-Talkeetna reach are expected to warm, whereas during August little heating or cooling is expected. In September, cooling of the outlet temperatures is expected. This cooling would continue throughout the winter months. However, based on previous model studies, it is expected that the post-Project temperatures will be within the same general range as natural temperatures.

During Project operation, water temperatures in the sloughs are expected to be similar to those under existing conditions for those times when the sloughs are not overtopped. Previous investigations indicated that groundwater temperatures in areas of upwelling in the sloughs reflected the long-term average water temperature of the Susitna River, which is approximately 3 ˚C (37 ˚F). Upstream of Talkeetna, the long-term average water temperature is not expected to change significantly from existing temperatures.

In the reaches downstream of Talkeetna, summer water temperatures should reflect the temperatures of the Talkeetna and Chulitna rivers. However, during fall, winter, and early spring when natural flows are low, the Susitna River will experience increased flows and as a result it will have some effect on downstream temperatures. In the early fall, the water temperatures could be above the normal temperature of 0 ˚C for several miles downstream. Later in the fall and during winter, the Susitna River water temperature near Talkeetna will be about 0 ˚C.

As noted above, an ice cover is expected to form on Watana Reservoir in late November and continue to thicken through the winter. Open water conditions are expected in the latter half of May. In the reach downstream of Watana Dam, because of the release of warmer water during the normal freeze-up period, frazil ice would not be generated for a considerable distance downstream. The reach between Watana and Devils Canyon is expected to remain ice free. Downstream of Devils Canyon a stable ice cover would form, but there would still be open leads due to high velocities and groundwater upwelling. In spring, the onset of warmer air temperatures in the lower basin occurs several weeks before those in the middle and upper reaches. This will progressively break up the cover starting from the downstream end.

However, the warmer water released from Watana Dam is expected to melt the cover between Devils Canyon and Talkeetna. The regulation of the spring flood will encourage melting in place. Hence ice jamming is expected to be significantly reduced. Between the proposed dam and the Chulitna River, the current effects on channel morphology resulting from ice forces during breakup would be effectively eliminated.

In the sloughs, during Project operations, the higher discharge at freeze-up will lead to a higher stage than under natural conditions. Consequently, discharge could be increased through those sloughs that are currently overtopped. The higher discharges could cause scouring in the sloughs, although higher backwater levels at the slough mouths would reduce velocities and the potential for scour.

Because the Susitna River is currently the main source of ice to the river below Talkeetna, the timing of ice formation downstream from Talkeetna may be delayed about a month. The higher Project winter flows, combined with the ice formation, would increase water levels downstream.

Studies at glacial lakes indicate that fine glacial sediment may pass through the reservoir. Particle diameters of 4 microns have been estimated to be the approximate maximum size of the sediment particles that will pass through Watana Reservoir. Based on the particle size distribution curve, this would imply a trap efficiency of about 80 percent. Re-entrainment of sediment from the shallow depths along the reservoir's shore during high winds would likely result in short-term elevated turbidity levels.

Turbidity patterns could have an impact on fisheries, both in the reservoir and downstream. The turbidity pattern is a function of the thermal structure, wind mixing, and re-entrainment of fine sediments along the reservoir boundaries. Based on data collected at Eklutna Lake, the potential turbidity at Watana Reservoir was estimated during the 1980s studies to be in the range of 10 to 50 NTU. Winter turbidity at the outlet is expected to be in the 10-20 NTU range, with summer values in the 20-50 NTU range, and the maximum expected values at freeze-up about 40 to 50 NTU.

Susitna River inflow to the reservoir is expected to continue to have both high dissolved oxygen concentrations and percentage saturations. The relatively weak stratification that is anticipated in the reservoir may limit the oxygen replenishment in the hypolimnion. The spring turnover will cause mixing, but the extent of mixing is unknown. It is expected that the upper 200 ft of the reservoir will maintain high dissolved oxygen. Decreased downstream flows during summer operation will cause a reduction in the levels and variation of dissolved gas concentrations below Devils Canyon.

For all but the highest flood levels when flow would be released through the spillway, supersaturated dissolved gas (nitrogen) levels are not expected to be increased by project operations.

Reservoir trophic status is determined in part by the relative amounts of carbon, silicon, nitrogen, and phosphorus present in a system, as well as the quality and quantity of light penetration. Phosphorus is expected to be the limiting nutrient in Watana Reservoir. Based on the spring phosphorus loading levels, Watana Reservoir is expected to be oligotrophic.

Metals in soils and rock may be mobilized as the result of changes in the river's hydrology resulting from Project operations, particularly if portions of the tributaries that likely supply metals-laden sediment are inundated. The leaching process is expected to result in increased levels of total dissolved solids, conductivity, significant ions, alkalinity, and metals within the reservoir immediately after impoundment. Although the magnitude of change was not quantified in the 1980s studies, the changes were not expected to be significant and were expected to diminish over time as the most soluble elements dissolved into the water. Additionally, much of the inorganic sediment carried by the Susitna River would settle in Watana Reservoir. An accumulation of inorganic sediment would retard the leaching process at the reservoir's bottom.

Dissolved solids concentrations are expected to increase near the surface of the reservoir during winter because the formation of ice at the reservoir's surface would likely force dissolved solids out of the freezing water. No significant impacts are expected either in the reservoir or downstream as the result of this process.

It is possible that there will be some precipitation of metals like iron, manganese, and other trace elements in the reservoir. Oligotrophic reservoirs with higher pH and high dissolved salt concentrations generally precipitate more metal than reservoirs with low pH and low dissolved salt concentrations. Although neither TDS nor pH is excessively high in the Susitna River, some precipitation of metals could reduce the quantities of metals in the reservoir and downstream.

Groundwater impacts along the mainstem downstream of the Project are expected to be similar to those described for reservoir filling. During winter in the Watana-Talkeetna reach, some of the sloughs will be located adjacent to an ice-covered section of river. In these areas, the Susitna River will have staged to form an ice cover at Project operation flows that are significantly higher than natural flows. The associated water level could be a few ft above normal winter water levels and would cause an increase in the groundwater table. This would in turn cause an increase in groundwater flow adjacent to an ice covered reach of river. During summer, mainstem-slough groundwater interaction would be the same as that discussed under reservoir filling, except that operational flows will be greater than the downstream flows during filling. Thus, the groundwater table will be closer to the natural elevation under normal operations than during reservoir filling.

The effects on instream flow uses will generally be the same as those described for reservoir filling.

4.4.8. Potential Protection, Mitigation, and Enhancement

4.4.8.1. Project Construction Impacts

Best management practices (BMPs) would be used to minimize or prevent adverse impacts associated with Project construction including access road construction over streams. Measures, including the use of settling ponds, would be implemented to minimize the introduction of suspended sediment.

BMPs would be implemented to reduce the risk of increased concentrations of nutrients and organic compounds resulting from ground and vegetation disturbance and subsequent erosion of overburden and spoil materials.

A Spill Prevention, Containment, and Countermeasure Plan (SPCC) would be developed to reduce the risk and potential adverse effects resulting from any spills of petroleum or other harmful substances associated with construction equipment and procedures.

BMPs would be incorporated into construction protocols to minimize the risk of wastewater and waste concrete being discharged directly into the river. A modern control batch plant is planned to prevent concrete dust issues.

BMPs would also be applied to minimize potential impacts of construction, operation, and maintenance of facilities on the Tsusena and Deadman creek drainage basins and nearby small lakes.

Measures will be implemented to minimize or prevent impacts associated with support facilities for construction crews that have the potential to affect water quality, particularly as it pertains to water supply from a local water body and construction and operation of a wastewater treatment plant.

4.4.8.2. Reservoir Filling and Project Operations

During reservoir filling, downstream flow requirements and a flood storage safety factor will be met. Natural flows will be maintained during the November through mid-April period. Temperature impacts associated with the early stages of reservoir filling would be reduced once the outlet facilities can be operated; when the outlet facilities become operational, reservoir temperatures should more closely approximate natural conditions, i.e., during the second winter of filling, outlet temperatures should be closer to 0 ˚C.

Once the Project is operating, temperature impacts to the river downstream of the dam would be minimized by taking advantage of the temperature stratification in the reservoir through the installation and operation of a multi-level intake in the Project forebay. A selective withdrawal facility could also be used to manage dissolved oxygen levels in the river downstream of the dam by withdrawing water from depths in the reservoir where dissolved oxygen concentrations are suitably high. There could be some tradeoff associated with balancing dissolved oxygen and temperature objectives for the river downstream of the Project. For all but the highest flood levels, supersaturated dissolved gas (nitrogen) levels are expected to be managed by fixed cone valves; operation of the cone valves would be influenced by reservoir inflows and summer energy demand.

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4.5. Fish and Aquatic Resources

4.5.1. Introduction

The Susitna River basin provides habitat for resident fish, i.e., those spending their entire life cycle within the river. It also provides habitat for anadromous fish; i.e., those that spawn in fresh water, spend varying amounts of time in river or lake environments in immature life stages, and then move into saltwater where they complete the maturation process (Morrow 1980).

Resident and anadromous fish are important to commercial, sport, personal use, and subsistence fisheries in the Susitna River basin. Sport fisheries occur in the Susitna River basin for the five species of Pacific salmon indigenous to Alaska, Arctic grayling, Dolly Varden, rainbow trout, burbot, and northern pike (*Esox lucius*). Pacific salmon and eulachon in the Susitna River basin support commercial fisheries (Shields. 2010), and Pacific salmon, Dolly Varden, rainbow trout, lake trout (*Salvelinus namaycush*), eulachon, whitefish, and burbot support subsistence and personal use fisheries (Oslund and Ivey 2010, Fall and Foster 1987). Non-key species (those not important to a fishery) can be important to aquatic food chains as either predator or prey species, and include round whitefish (*Prosopium cylindraceum*), longnose sucker (*Catostomus catostomus*), Bering cisco (*Coregonus laurettae*), Arctic lamprey (*Lethenteron japonicum*), threespine stickleback (*Gasterosteus acoleatus*), and sculpin (*Cottid*). Fish species (by common and scientific name) that occur or are likely to occur in the Susitna River drainage, their life history strategy, and their usage of the Susitna River are listed in Table 4.5-1.

Fish use and aquatic habitat requirements of the Susitna River drainage was extensively studied during the early 1980s in support of the APA Susitna Hydroelectric Project (APA Project). This effort, led by the ADF&G, included several additional contractors and was referred to as The Susitna Hydroelectric Aquatic Studies Program. Studies were conducted from 1980 to 1984 and included the following components (Jennings 1984):

- Relative abundance and distribution of 19 species of resident and rearing anadromous fish
- Dominant age classes and sex ratios for most of those species
- Population estimates for Arctic grayling in the Upper Susitna River Reach
- Outmigration timing for most species of juvenile Pacific salmon
- Movements of selected species of resident adult fish in the Susitna River
- Identification of spawning habitats of certain species
- Identification of overwintering habitats of certain species
- Potential changes to the availability and quality of selected habitats in relation to changes in instream flow regime
- Documented migration timing of salmon runs in the Susitna River
- Estimated population size and relative abundance of salmon in sub-basins of the Susitna River
- Estimated total slough escapements for salmon in sloughs above the Talkeetna and Chulitna Rivers confluence
- Estimated relative abundance of spawning salmon in tributaries above the Talkeetna and Chulitna Rivers confluence

- Quantified selected biological characteristics for salmon stocks in the Susitna River (i.e., sex ratio, fecundity, age, and length)
- Identification of important and/or sensitive habitat types
- Investigations of habitat suitability for selected key species and life stages of salmon and the relationship between habitat suitability and changes to the physical environment

Table 4.5.1. 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.

The Susitna Hydroelectric Aquatic Studies Program greatly advanced the understanding of aquatic resources in the Susitna watershed. Reports from this program comprise a portion of over 3,500 documents generated by the 1980s APA Project (Harza-Ebasco 1987). Since the conclusion of the 1980s APA Susitna studies, research on aquatic resources in the Susitna drainage has largely been directed at improving sustainable management of fishery resources by the ADF&G.

In early 2011, an Aquatic Resources Data Gap Analysis was conducted to review relevant, available literature to identify potential data needs for the current Susitna-Watana Hydroelectric Project (HDR 2011). A key goal of this analysis was not only to review the relevant literature from the study efforts of the 1980s, but also to identify and review relevant investigations that have been conducted over the 25 years since the 1980s APA studies were concluded.

The data gap analysis began with a review of key summary and synthesis documents that were completed near the conclusion of the 1980s APA Project. Examples include the 1985 amended draft license application (Harza-Ebasco 1985a), Draft Environmental Impact Statement (DEIS; FERC 1984a and 1984b), and 1985 Aquatic Plan of Study (Harza-Ebasco 1984a). The 1985 Aquatic Plan of Study identified remaining information needs to resolve issues raised by resource agencies regarding effects of the 1980s APA Project on aquatic resources. These recommendations were used as a starting point for review of available and relevant literature pertaining to the currently proposed Susitna-Watana Hydroelectric Project.

The Aquatic Resources Data Gap Analysis also included a review of resource-specific summary documents from the 1980s APA Project, including completion reports from the Susitna Hydroelectric Aquatic Studies Program. A database generated from the 3,500 documents library (Harza-Ebasco 1987) was queried to identify other relevant documents. Contemporary literature sources were uncovered through library searches, online searches of agency publications, and personal contacts with biologists and aquatic scientists working in the Susitna watershed.

Information was considered in terms of relevance to current FERC licensing requirements for environmental analysis of the proposed Susitna-Watana Hydroelectric Project, completeness, and the applicability of methods used. The authors used professional judgment to make this assessment, recognizing that this was a first effort beginning a long, interactive public and agency process. Identified topic areas were listed as potential data gaps with the understanding that these would be refined, modified, and further developed as the study planning process evolves. Information gaps that are ultimately determined to be worthy of future study will be determined based on analysis of Project issues and the needs of the regulatory agencies.

4.5.2. Existing Fish and Aquatic Communities

4.5.2.1. Aquatic Communities by Reach

Much of the Susitna River is an extremely complex network of channels, each with a different response to changes in mainstem discharge. While each channel is unique, they can be grouped into different channel types with similar characteristics in both morphology and general hydraulic response/sensitivity to changes in mainstem discharge. Each channel type also has similarities in species/life-stage utilization. The 1980s APA Project instream flow study was designed specifically to analyze the various channel types in the study area. The process for identifying and prioritizing major channel types involved extensive and detailed field data collection, analysis, and documentation of the hydraulic and hydrologic relationships between the major channel types and mainstem discharge.

A substantial body of well documented information relevant to current instream flow information needs is available in the environmental baseline study reports prepared for licensing of the previous Project (HDR 2011). The 1980s APA Project instream flow study efforts focused on establishing the relationships between physical variables, fluvial processes and fish resources in the middle Susitna River. Faced with the complexity of the number of environmental variables involved and the number of species of fish which inhabit the middle Susitna River, it was deemed necessary to focus only on the most important physical variables and carefully identified fish resources which were most sensitive to project-related changes (Trihey & Associates and Entrix 1985b).

4.5.2.1.1. Upper Susitna River Reach

The Upper Susitna River reach is defined as the section of river above the proposed Watana Dam (RM 184), including the upper Susitna and McLaren rivers which arise directly from large temperate glaciers of the Alaska Range. Their upper reaches traverse the wide valley south of the Alaska Range in broad, braided channels.

The Upper Susitna River reach contains at least eight species of resident freshwater fish: Arctic grayling, Dolly Varden, humpback whitefish (*Coregonus spp.*), round whitefish, burbot, longnose sucker, and sculpin. Lake trout are known to be present in Lake Lucille, but their distribution beyond that in the Upper Susitna watershed is unknown. Two other species may be present: northern pike and Alaska blackfish (*Dallia pectoralis*). One anadromous species, Chinook salmon, was documented in two tributaries to the proposed reservoir during 2003 and 2011 ADF&G sampling efforts. Juvenile Chinook salmon were found in Kosina Creek (~RM 6 – 8) in 2003 and one adult was observed in 2011 at an approximate elevation of 2,800 ft; juveniles were also found in the Oshetna River near its confluence with the Susitna River, but none were observed in 2011 (ADF&G 2003a & b, 2011c). Greater detail regarding the distribution and abundance of key fish species is provided below.

4.5.2.1.2. Middle Susitna River Reach

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. The river flows from Watana Canyon into Devils Canyon, the narrowest and steepest reach on the Susitna River. In Devils Canyon, constriction creates extreme hydraulic conditions including deep plunge pools, drops, and high velocities. The Devils Canyon rapids form a barrier to the migration of pink, chum, coho and sockeye salmon and only a few Chinook salmon have been able to make it above Devils Canyon (HDR 2011).

The Middle Susitna River reach contains at least 17 species of resident freshwater and anadromous fish. Arctic grayling, Dolly Varden, humpback whitefish, round whitefish, burbot, longnose sucker, sculpin, Bering cisco, threespine stickleback, Arctic lamprey, Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon, rainbow trout, and northern pike all inhabit the Middle Susitna River Reach. Two other species may be present: Alaska blackfish and

Pacific lamprey (*Lampetra tridentata*). Chinook salmon are the only anadromous species documented above Devils Canyon; they have been found in the Fog and Tsusena creeks (ADF&G 2003a & b, 2011c).

During the 1980s, ADF&G sampled the Middle Susitna River reach for benthic and drifting invertebrates to evaluate available fish food resources and the relationship between flow and benthic invertebrate habitat availability (ADF&G 1985a). Four side channel and side slough sites were sampled at head and mid channel locations using drift nets and modified Hess samplers (ADF&G 1985a). A total of 52 invertebrate taxa were identified in drift and benthic samples, with Chironomidae being the dominant taxon (ADF&G 1985a).

The 1980s APA Project instream flow studies focused on the middle river from below Devils Canyon (RM 150) downstream to the confluence with the Talkeetna River at RM 103 (Trihey & Associates and Entrix 1985b). APA's reasoning for the lower boundary just above Talkeetna was the assumption that cumulative flow from downstream tributaries, primarily the Chulitna, Talkeetna, Kashwitna, and the Yentna rivers, would significantly buffer the effects of the proposed project operations on habitats in the lower river.

One methodology applied in the APA Project instream flow study was the Physical Habitat Simulation (PHABSIM) component of the Instream Flow Incremental Methodology (IFIM). IFIM is one of the most widely used instream flow methods in the world for assessing the effects of flow manipulation on river habitats (Bovee et al. 1998). The PHABSIM component was a key methodology applied in the Instream Flow Relationships Reports (IFRR) prepared for the licensing of the APA Project. Because of the size and geomorphic and hydraulic complexity of the Susitna, other methods, in combination with the PHABSIM, were required to adequately characterize and model habitat flow relationships. Other methods included upstream passage studies for anadromous salmonids and wetted surface area/habitat studies of sloughs and off-channel habitats.

Specific areas were categorized into basic channel types based upon their instantaneous hydraulic and morphologic characteristics (Harza-Ebasco 1985). Side channel and slough habitats are known to be critical for salmon production in the Susitna River. All salmon species except for Chinook were found to use side channel and slough habitats for spawning. Chum salmon in particular are known to rely on groundwater upwelling areas especially in sloughs.

In general, side channels convey mainstem water more than 50 percent of the time during the summer, open water season. Side channels are less sensitive to changes in flow than the main channel but are directly affected by mainstem discharge sufficiently great to breach the upstream ends of the channels (HDR 2011). Sloughs are less responsive to mainstem discharge changes in that mainstem discharges sufficiently great to breach the upstream ends occur less than 50 percent of the time during the open water season. However, at lower discharge levels, the mainstem discharge may affect slough habitat conditions, particularly at the mouths, through backwater effects. Mainstem discharge less than that sufficient to breach the upstream end may also affect habitat conditions through the influence on groundwater upwelling.

4.5.2.1.3. Lower Susitna River Reach

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 (RM 0). An abrupt change in channel form occurs where the Chulitna and Talkeetna Rivers join the Susitna River near the town of Talkeetna. The Chulitna River drains a smaller area than the middle Susitna River 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 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 lower river tributary, supplying about 40 percent of the total mean annual Susitna River flow at the mouth (HDR 2011).

The Lower Susitna River Reach contains at least 19 species of resident freshwater and anadromous fish. Arctic grayling, Dolly Varden, humpback whitefish, round whitefish, burbot, longnose sucker, sculpin, eulachon, Bering cisco, threespine stickleback, Arctic lamprey, Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon, rainbow trout, and northern pike all inhabit the Lower Susitna River Reach. Pacific lamprey have been documented in the Deshka River (J. Buckwalter, ADF&G, pers. comm.); their use of the Sustina River other than for migration is unknown. Additionally, Alaska blackfish and Pacific lamprey may be present.

4.5.2.1.4. Potential Access and Transmission Corridors

AEA is currently evaluating three different access corridors that would provide transportation from the existing transportation network (i.e., existing road or rail systems) to the proposed Watana Dam site. There are also three proposed transmission corridors following the same general routes as the three road corridors. The corridors, labeled Denali, Chulitna and Gold Creek are described in Section 3 and shown on Figure 1-1. A new access road in either the Chulitna or Gold Creek corridors would cross streams within the Susitna River watershed; a road in the Denali corridor would cross streams within both the Susitna and Nenana River watersheds.

Recent fisheries work specific to each of the proposed road alignments' stream crossing locations has not been conducted. However, the ADOT&PF recently evaluated potential access corridors, including the Denali and Chulitna River options (HDR 2011). The analysis considered the number of fish stream crossings as one criterion, among many others, during the screening process (HDR 2011). The sources of fisheries information summarized below include the recent ADOT&PF analysis (HDR 2011); recent data from the Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog (ADF&G 2011), and data collected during the 1980s (Schmidt et al. 1984; ADF&G 1981).

4.5.2.1.4.1. Denali Corridor

A road in the Denali Corridor would cross Seattle Creek and Brushkana Creek, two major drainages within the Nenana River watershed. Deadman Creek is the major stream crossed within the Susitna River watershed.

A road in this corridor would require a total of 15 stream crossings. In the 1980s, biologists conducted fish presence surveys in the vicinity of 10 of the 15 stream crossing sites and recorded general habitat and water quality conditions (Schmidt et al. 1984). Sculpin were confirmed to be present near nine of the proposed crossing locations; Dolly Varden and Arctic grayling were present near six of the proposed crossings (Schmidt et al. 1984).

Three crossing sites had intermittent flow and were deemed unsuitable for long-term fish use; these sites were not sampled for fish presence. The ADF&G Anadromous Waters Catalog (AWC) does not list Seattle Creek as providing habitat for anadromous fish (ADF&G 2011); no anadromous fish were captured during the 1980s sampling efforts (Schmidt et al. 1984).

4.5.2.1.4.2. Gold Creek Corridor

A Gold Creek access route would require 23 stream crossings. The major streams that would be crossed by the Gold Creek access route 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.

The AWC identifies the presence of anadromous fish in Gold, Fog, Cheechako, Prairee, Jack Long, and Chinook creeks (ADF&G 2011). However, much of the available fish data were collected downstream of the proposed crossing sites (ADF&G 2011; ADF&G 1981; Schmidt et al. 1984). Anadromous fish presence is assumed in streams where upstream barriers were not documented.

Gold Creek (AWC No. 247-41-10200-2540) and Jack Long Creek (AWC No. 247-41-10200-2570) support Chinook, coho, chum, and pink salmon (ADF&G 2011). The alignment would cross two tributaries of Jack Long Creek. Although data were not collected in these tributary streams, the presence of anadromous fish is assumed at the two crossing locations since barriers were not identified. Chinook salmon presence has been identified in Cheechako Creek (AWC No. 247-41-10200-2596) and Fog Creek (AWC No. 247-41-10200-2696).

Additionally, the presence of anadromous fish in the lower portion of Slough 20 and Slough 21, downstream of barriers, is reported by Schmidt et al. 1984. All three proposed crossings on tributaries to these sloughs are located upstream of the anadromous reach; however, since sampling was not conducted the presence of resident fish is assumed.

4.5.2.1.4.3. Chulitna Corridor

A road in the Chulitna Corridor would require about 30 stream crossings. The majority of streams that would be crossed are smaller tributary streams to larger systems. However, a road in the Chulitna Corridor would also cross a few larger streams such as the Indian River, and Thoroughfare, Portage, Devils, Tsusena, and Deadman creeks.

Both the Indian River (AWC No. 247-41-10200-2551) and Portage Creek (AWC No. 247-41-1020-2585) are cataloged (ADF&G 2011) to provide habitat for Chinook, coho, chum, and pink salmon near the crossing sites. Additionally, Chinook salmon have been documented in Thoroughfare Creek (AWC No. 247-41-10200-2582-3201) near the crossing site (ADF&G 2011).

The Chulitna River alignment would also cross 10 small, unnamed tributaries of Portage Creek, the mainstem of Devils Creek and three of its tributaries, and seven smaller tributaries to the upper Susitna River (in the Swimming Bear drainages; Schmidt et al. 1984). The Chulitna alignment would also cross Tsusena Creek and two of its tributaries. Since fish presence sampling has not been conducted in many of these tributary streams and passage barriers have not been identified to date, fish presence should be assumed.

4.5.2.2. Key Fish Species

For this project, key fish species are considered those that provide a significant contribution to commercial, sport, subsistence, or personal use fisheries in the region. In some cases, forage species that provide essential nutrition to key species can also be considered key species. The fish species discussed below are considered the key species that are likely to be of greatest interest during the Project licensing. Non-key species are listed in Section 4.5.2.2.11, Non-Game Species.

4.5.2.2.1. Sockeye Salmon

The most abundant and economically valuable salmon species in the Susitna River system is sockeye salmon. The Susitna River is considered the third largest producer of sockeye salmon in upper Cook Inlet, following the Kenai and Kasilof river systems. Estimates of annual sockeye salmon run sizes into the Susitna River have ranged from 147,000 to 773,000 fish (Fair et al. 2009). Due to their commercial value, sockeye salmon in the Susitna River have been studied more extensively than other salmon species.

The ADF&G is responsible for managing the Susitna River sockeye stocks and regulates commercial fisheries for high sustained yields by achieving desired escapement goals. The annual abundance of Susitna River sockeye salmon stocks is difficult to quantify due to the nature of the large, glacially occluded watershed. Early attempts by the ADF&G to monitor escapement into the mainstem of the Susitna were abandoned due to these challenges. A Bendix side scan sonar site was established in 1976 to monitor sockeye salmon escapement on the Yentna River (Westerman and Willette 2010). The Yentna River is known to produce a large portion of the salmon in the Susitna drainage and has conditions more conducive to acoustic monitoring methods than the mainstem Susitna River. When a fish passes through the sonar beam projected across the river a sonic reflection called a "target" is returned to the transducer on the river's bank. Sonar targets are allocated to the respective salmon species in proportion to catches at an adjacent fish wheel site. Sockeye salmon escapement has been estimated for the Yentna River consistently each year since 1981 using the Bendix sonar count and fish wheel species apportionment method (Table 4.5-2). The Bendix escapement estimates became a proxy for escapement into the entire Susitna River watershed.

From 1999 to 2005, the Bendix-sonar-based Yentna River sockeye salmon escapement estimates were below the sustainable escapement goal for five of seven years. In response to this trend, a comprehensive research program was initiated by ADF&G to better quantify Susitna River sockeye salmon abundance and improve sustainable management of Susitna sockeye salmon stocks. Key study components of this effort included mark-recapture experiments and a radio telemetry study (Yanusz et al. 2007, Fair et al. 2009). Fish wheels in the lower river captured sockeye salmon for tagging. Recaptures occurred upriver by additional fish wheels and weirs.

Knowing the number of tags released and the ratio of tagged to untagged sockeye at points upriver allowed calculation of the entire sockeye escapement. Weirs were an important part of the recapture methodology. ADF&G has monitored sockeye salmon escapement by weir at Chelatna Lake, a subbasin of the Yentna, seasonally from 1992 through 1998 and from 2006 to present. Weirs have also been operated at Judd Lake, Shell Lake, also in the Yentna subbasin, and Larson Lake in the Talkeetna subbasin. Mark-recapture experiments with radio telemetry and dart tags deployed at downstream fish wheels and recaptured at upstream fish wheels and weirs were conducted (Yanusz et al. 2007, Fair et al. 2009). The mark-recapture methods also showed about three-fourths of sockeye were bound for the Yentna River, while the remainder stayed in the mainstem Susitna River (Table 3). Locations of fish wheel capture sites, weirs, and radio tracking stations and final locations of radio-tagged sockeye salmon based on 2008 aerial surveys in the Susitna River are shown in Figure 4.5-1.

The mark-recapture studies have shown that the Bendix sonar program that was used to estimate passage in the Yentna River for approximately 30 years was biased significantly low due to a selectivity of the fish wheel catches (Fair et al. 2009). ADF&G has recently transitioned to the use of Dual Frequency Identification Sonar (DIDSON), which has resulted in better detection and quantification of fish targets. However, the issue of accurately apportioning acoustic targets to the correct salmon species has not been completely resolved. Consequently, sockeye salmon passage estimates based on the DIDSON remain unreliable (Fair et al. 2009).

Table 4.5-2. Sockeye salmon in-river abundance estimates from Yentna River[a] and Susitna River[b] sonar counts, 1973 through 2009.

Year	Sonar Estimate		
	Yentna River		Susitna River
	Bendix	DIDSON	Bendix
1978			94,400
1979			156,980
1980			190,866
1981	139,401		340,232
1982	113,847		265,332
1983	104,414		175,936
1984	149,375		279,446
1985	107,124		227,924
1986	92,076		
1987	66,054		
1988	52,330		
1989	96,269		
1990	140,290		
1991	109,632		
1992	66,074		
1993	141,694		
1994	128,032		
1995	121,220		
1996	90,660		
1997	157,899		
1998	119,623		
1999	99,029		
2000	133,094		
2001	83,532		
2002	78,591		
2003	180,813		
2004	71,281		
2005	36,921		
2006	92,896	166,697	
2007	79,901	125,146	
2008	90,146	131,772	
2009	28,428	44,098	

[a] Yentna River sonar site is located at Yentna River mile 4.
[b] Susitna River sonar site was located at Susitna Station just downstream of the Yentna River confluence.
Sources: Fox 1998 and Fair et al. 2009.

Table 4.5-3. Sockeye salmon in-river abundance estimates from Yentna River and Susitna River mark recapture studies, 1974 through 2008.

Year	Mark Recapture		
	Yentna River	Susitna River[a]	Total
1974	54,978		
1981		133,489	
1982		151,500	
1983		71,500	
1984		130,071	
2006	311,197	107,000	418,197
2007	239,849	87,883	327,732
2008	288,988	70,772	359,760

[a] Susitna River estimates are upstream of the Yentna River confluence.
Source: Fox 1998, Fair et al. 2009, and Yanusz et al. 2007, 2008, and 2011.

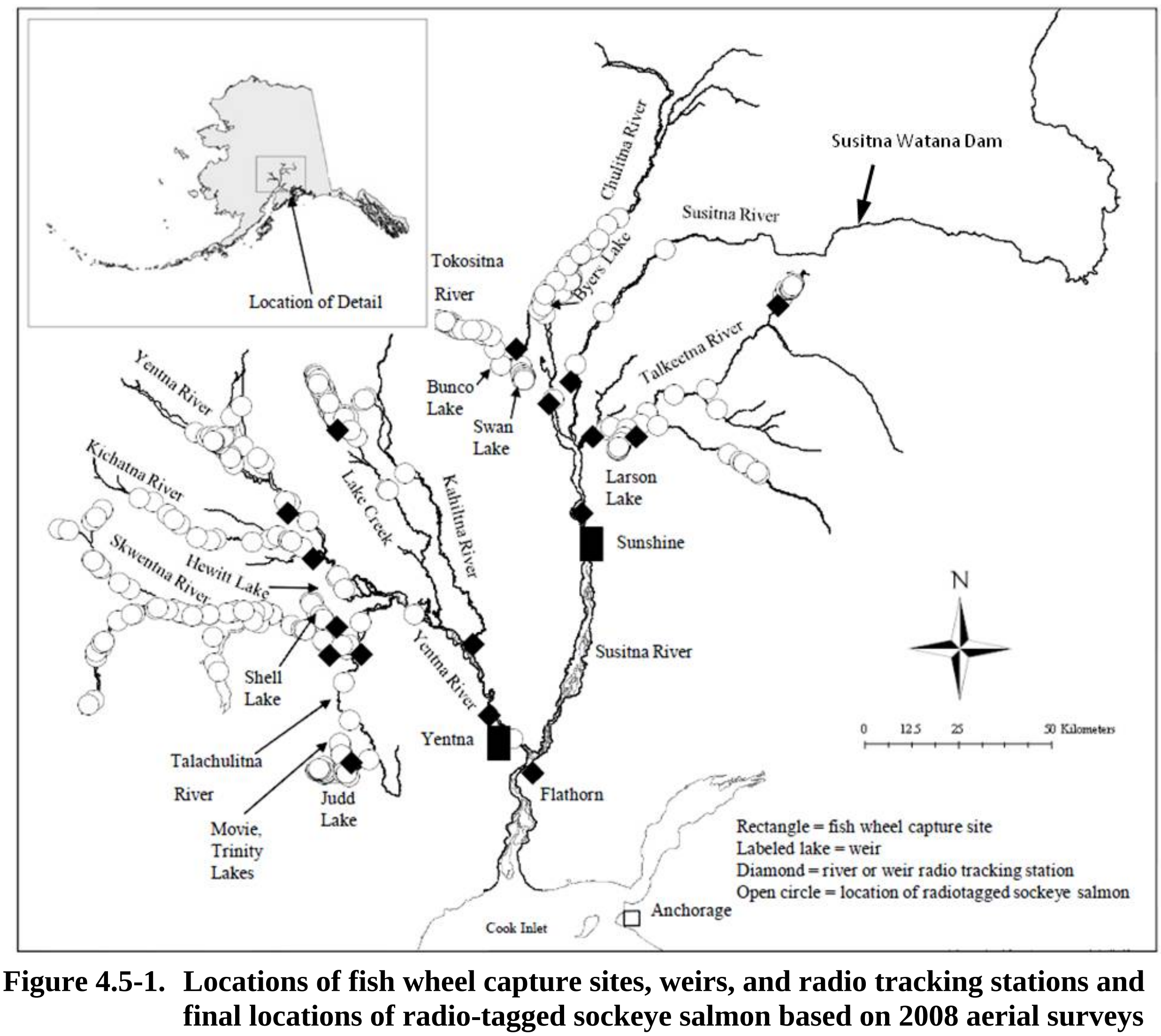

Figure 4.5-1. Locations of fish wheel capture sites, weirs, and radio tracking stations and final locations of radio-tagged sockeye salmon based on 2008 aerial surveys in the Susitna River. Image copied from Yanusz 2011.

Due to the unreliability of the sockeye salmon escapement estimated from the Bendix sonar counters, the ADF&G introduced a new approach to escapement monitoring at the 2009 Alaska Board of Fisheries meeting (Fair, 2009). ADF&G identified three lakes within the basin, Chelatna and Judd lakes of the Yentna subbasin and Lafron Lake of the Talkeetna subbasin, that had the quality and quantity of escapement data necessary for establishing a sustainable escapement goal (Table 4.5-4). The long-standing, sonar-based Yentna River goal was eliminated and replaced with two sustainable escapement goals monitored by weir counts at Chelatna Lake (20,000-65,000) and Judd Lake (25,000-55,000). An additional goal was established for the mainstem of the Susitna River, to be monitored by weir at Larson Lake (15,000-50,000).

Escapement estimates vary greatly by year and study method; the current state of knowledge finds the escapement estimates derived from mark recapture studies and weir counts to be a more reliable index of sockeye salmon escapement than the historic sonar program (Fair et al. 2009). Sockeye salmon spawning is widespread throughout the Susitna River drainage, with most occurring in tributaries and lakes. ADF&G's sockeye salmon radio telemetry study (Yanusz et al. 2007, 2011) was conducted from 2006 through 2008 and provides the most comprehensive accounting of the distribution of adult spawners completed to date. The 2006 telemetry study estimated that 42 percent of the sockeye in the lower Susitna entered Larson (17 percent), Chelatna (15 percent), or Judd (10 percent) lakes (Yanusz et al. 2007). The same study estimated that 63 percent of the sockeye in the Middle Susitna (Sunshine Station above the Yentna confluence) migrated into Larson Lake. Overall, 23 percent of the population spawned in other lakes, while the remaining 35 percent spawned in sloughs and tributary rivers and streams throughout the drainage (Figure 4.5-1). Note that this study had the primary objective of estimating in-river abundance and relied on recapture at lake outlet weirs. Sockeye salmon were radio-tagged at Sunshine so this study did not evaluate spawning locations in the Lower Susitna River and much of the Middle Susitna River. Historic studies indicated that nearly all sockeye salmon that spawn in the Middle River use slough habitats (WCC 1985).

Table 4.5-4. Sockeye salmon in-river abundance estimates from Yentna River and Susitna River lake outlet weir counts, 1973 through 2009.

Year	Weir Count			
	Yentna River		Susitna River	Total
	Chelatna	Judd	Larson	
1973		26,428		
1980		43,350		
1984			35,254	
1985			37,874	
1986			32,322	
1987			16,753	
1989		12,792		
1992	35,300			
1993	20,235			
1994	28,303			
1995	20,124			
1996	28,000			
1997	84,899		40,282	
1998	51,798	34,416	63,514	149,728

1999			18,943	
2000			11,987	
2005			9,751	
2006	18,433	40,633	57,411	116,477
2007	41,290	58,134	47,736	147,160
2008	73,469	54,304	35,040	162,813
2009	17,865	43,153	41,929	102,947

Sources: Fox 1998 and Fair et al. 2009.

Sockeye salmon migratory timing has been well described (Jennings 1984; ADF&G 1984a, 1985a; Yanusz et al. 2007). The first run of sockeye described by Jennings (1984) spawns exclusively in Papa Bear Lake and inlet streams in the Talkeetna River from mid July through early August. The second run (Jennings 1984) is abundant in the Middle Susitna River from late July through the end of August. The rate of movement of tagged second run sockeye into the middle river was documented by ADF&G. Adults, tagged at Sunshine Station, moved between 2.5 and 5.8 mi per day (mpd), from Sunshine Station to the Talkeetna Stations. The average rate of travel from the Talkeetna Station to the Curry Station ranged from 2.4 to 8.5 mpd from 1981 through 1984 (ADF&G 1981a, 1983a, 1985c).

Sockeye salmon runs into the Susitna River drainage over the past decade have been reported to be declining (Shields 2010). At the 2008 Alaska Board of Fisheries (BOF) meeting, Susitna River sockeye salmon were found to be a stock of yield concern[1]. As a result, an action plan was developed by ADF&G, identifying conservative management measures and a research plan. Studies contained in the research plan were funded beginning in 2006 and included:

- Mark-recapture and radio telemetry projects intended to estimate the number of sockeye salmon entering the system, which also allowed for the identification of spawning areas in the drainage
- Limnological investigations of numerous lakes throughout the drainage to assess production potential
- Fry and smolt population estimates in as many as seven different lakes
- Evaluation of the effects of northern pike predation and beaver (*Castor canadensis*) dams on production
- Comprehensive genetic stock identification (GSI) study of sockeye salmon fisheries in UCI to determine the river of origin of all harvested fish. Based on results from the 2006 season, minor modifications to the GSI project were implemented

Continuing studies may be conducted by ADF&G to quantify fish wheel selectivity and develop corrections for use in species apportionment of sonar passage estimates. In the meantime, escapement goals have been established and are being monitored at four lakes (Judd, Shell, Chelatna, and Larson) that are known to be the major producers of sockeye salmon in the drainage. Attempts are also being made to identify and decrease the impacts of beaver dams and northern pike predation on sockeye salmon production. At the 2011 BOF meeting, ADF&G recommended that Susitna River sockeye salmon remain a stock of yield concern. The impetus

[1] A stock of yield concern is defined in the State of Alaska's *Policy for Management of Sustainable Salmon Fisheries* (5 AAC 39.222), as a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs.

behind this recommendation is to allow more time for studies to provide information needed to formulate management strategies that will further the goal of increased yields (Shields 2010).

The average fecundity of a Susitna River female sockeye is approximately 3,350 eggs per female (ADF&G 1984b). Emergence of fry from spawning gravels occurs in March (ADF&G 1983b). Juvenile sockeye generally rear in lake habitats and outmigrate as Age 1+ or 2+ fish. In the Middle Susitna River Reach, suitable lakes are not available for rearing sockeye (Harza-Ebasco 1985a). Therefore, juvenile sockeye either migrate to the Lower Susitna River or rear in suitable areas of the Middle Susitna River during their first year (ADF&G 1983a, 1984c). It is possible that Age 0+ fish that move out of the Middle Susitna River Reach move into side channel, side slough, or tributary mouth areas in the Lower Susitna River Reach where they overwinter; however, results of outmigrant collections at the Flathorn Station in 1984 indicate that movement of Age 0+ juveniles to the estuary also occurs (ADF&G 1985d). Based on adult scale analysis, it is likely that most of these fish do not survive (ADF&G 1985c).

The Age 0+ sockeye in the Middle Susitna River grow from an average length of 30 mm in May to 56 mm by the end of August (ADF&G 1985d). The Age 0+ sockeye in the Lower Susitna River grow from an average of 36 mm in early June to an average of 60 mm in October (ADF&G 1985d). Age 1+ fish grow from an average length of 71 mm in May to an average length of 92 mm in July (Harza-Ebasco 1985a).

Outmigration of Age 1+ juveniles begins and peaks in mid May immediately after the river becomes ice free (Harza-Ebasco 1985a). Outmigration rates of Age 1+ fish then decrease, and the migration is essentially complete by mid to late June (ADF&G 1985d).

4.5.2.2.2. Chinook Salmon

The Susitna River Chinook salmon stock is fourth largest in Alaska (Ivey et al. 2009). The ADF&G has management responsibility for this species and conducts a majority of the ongoing stock assessment programs. Although Susitna River Chinook salmon make a small contribution to commercial fisheries, they are the most important species to recreational and guided sport fisheries. Sport fisheries in the Susitna drainage are managed under the Eastside Susitna and Westside Susitna subunits. Important Chinook salmon sport fishing streams in the Eastside are typically clear, and many are accessible from the Parks Highway. From 1979 to 2009, the Eastside Susitna Chinook sport harvest ranged from 1,298 in 1979 to a high of 22,688 in 1993. From 2001 to 2009, Eastside Chinook sport harvests declined from 13,504 to 3,462 (Oslund and Ivey 2010). In October 2010, the ADF&G recommended that the BOF declare Willow Creek and Goose Creek Chinook salmon as a stock of yield concern and at the regulatory meeting for the Northern Cook Inlet (NCI) Management Area, in February of 2011, the BOF enacted the recommendation.

Westside streams are remote and accessed only by boat or air; tributaries are larger and Chinook are more abundant. Westside Susitna Chinook sport harvests from 1979 to 2008 ranged from 5,768 in 1979 to 21,836 in 1991. The 2009 sport harvest of 4,713 was the lowest in 30 years (Oslund and Ivey 2010). In 2008, the popular Chinook salmon fishery in Alexander Creek was closed, and at the regulatory board meeting for the Northern Cook Inlet (NCI) Management Area in February 2011, the ADF&G recommended that the BOF declare Alexander Creek Chinook salmon a stock of management concern[2] (ADF&G 2011a).

Chinook salmon escapement in the Susitna watershed is currently monitored with aerial and foot spawning ground surveys in clear water tributaries and with limited weir counts. The ADF&G has conducted annual aerial Chinook escapement surveys on nine Eastside streams and five Westside streams since 1979 (Table 5). Spawning ground surveys are generally conducted in streams with sport fisheries (i.e. Alexander Creek, Willow Creek, Goose Creek, and others) and provide an index of escapement which is used to periodically evaluate escapement goals. Sustainable escapement goals, as defined under the Policy for Statewide Salmon Escapement Goals (5 AAC 39.223), were established in 1993 and are formally reviewed on a three-year regulatory cycle by ADF&G and the BOF.

Since 1995, a weir count project estimates the Deshka River Chinook salmon escapement. These data provide escapement trends across years but offer little information regarding the total escapement (Fair et al 2010). Total Chinook escapement is estimated for all of Upper Cook Inlet, which includes 5 major river systems, but is not apportioned further thus the total escapement for Chinook to the Susitna River is unknown.

[2] A stock of management concern is defined in the State of Alaska's *Policy for Management of Sustainable Salmon Fisheries* (5 AAC 39.222), as a concern arising from a chronic inability, despite the use of specific management measures, to maintain escapement for a salmon stock within the bounds of the SEG, BEG, or OEG or other specified management objectives for the fishery.

Table 4.5-5. Susitna River Chinook salmon escapement index counts derived from peak aerial and foot surveys of index streams, 1979 through 2006.

Susitna River			
Year	Eastside Tributaries[a]	Westside Tributaries[b]	Total
1979	5,082	39,552	44,634
1981	7,419	2,025	9,444
1982	10,700	25,224	35,924
1983	17,859	42,850	60,709
1984	25,678	27,974	53,652
1985	18,177	38,932	57,109
1986	15,828	32,330	48,158
1987	26,535	23,936	50,471
1988	26,255	40,963	67,218
1989	23,117	4,818	27,935
1990	25,040	28,042	53,082
1991	21,773	19,425	41,198
1992	15,782	18,899	34,681
1993	13,066	18,028	31,094
1994	11,904	9,423	21,327
1995	21,778	15,828	37,606
1996	22,084	16,802	38,886
1997	35,927	38,437	74,364
1998	24,393	32,958	57,351
1999	24,306	30,260	54,566
2000	20,161	11,137	31,298
2001	23,047	15,102	38,149
2002	35,137	28,066	63,203
2003	15,341	24,294	39,635
2004	22,567	54,421	76,988
2005	21,780	27,774	49,554
2006	16,934	23,074	40,008

[a] Eastside index streams are Willow, Deception, Little Willow, Sheep, Goose, Montana, Clear, Praire, and Portage creeks and Chulitna, Indian, and Kashwitna rivers. Honolulu, Byers, Troublesome, Bunco, Birch, Sunshine, and Larson creeks are sometimes included.
[b] Westside index streams are Alexander, Peters, Lake and Cache creeks and the Talachulitna and Deshka rivers. Donkey, Red, Red Salmon, Canyon, and other creeks are sometimes included.
Source: Ivey 2009

Abundance and distribution of adult and juvenile Chinook salmon above Devils Canyon and the proposed Watana dam site is poorly understood (HDR 2011). Prior to 1982, Devils Canyon was thought to provide a barrier to upstream migration of all salmon (Acres 1982). Subsequent studies conducted by ADF&G, however, reported that a few Chinook salmon (20–45 individuals) were observed in small tributaries upstream of the Canyon (ADF&G 1983a, ADF&G 1984a). In 1984 Chinook spawning was documented above Devils Canyon at Chinook Creek (RM 156.8 n=15) and Fog Creek (RM 176.7; n=2) (ADF&G 1985a). In 2003 ADF&G conducted electrofishing in the upper Susitna above Watana Canyon. Juvenile Chinook salmon were observed in Kosina Creek (RM 201) and as far upstream as the mouth of the Oshetna River (RM 225) (ADF&G 2011c). In 2011, ADF&G completed further Chinook presence investigations and observed adults at Kosina Creek. No other adults have been observed in these tributaries, but the presence of rearing juveniles suggests the possibility of Chinook spawning this far upstream.

Limited radio telemetry data exist for Chinook salmon. A small number of radio transmitters were placed in Chinook salmon at RM 103 in 1981 and 1982. Results did not contribute to the understanding of habitat utilization with the majority of the few fish tagged tracked to tributaries below the tagging location (ADF&G 1984a) however; one tagged Chinook was tracked to Devils Canyon as far as RM 150 (Figure 4.5-2). Recent radio telemetry studies of Susitna salmon stocks conducted by ADF&G have not included Chinook salmon.

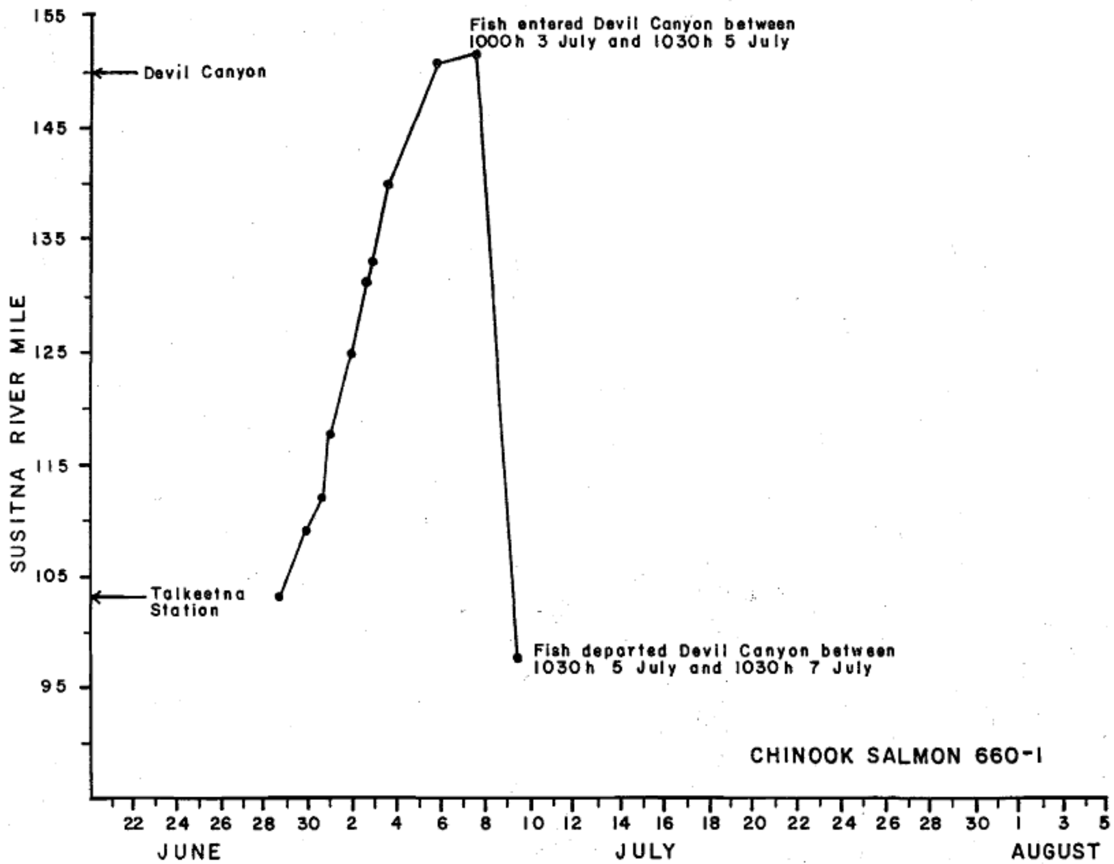

Figure 4.5-2 Movement of radio tagged Chinook salmon 660-1 in the Susitna River drainage during June and July, Adult Anadromous Investigations. Source: ADF&G 1983a

Chinook salmon enter the Susitna River in late May and early June soon after the river becomes ice free. In general, 90 percent or more of the Chinook escapement moves past the Flathorn Station (RM 8) and the Susitna Station (RM 26) prior to July 1 each year (ADF&G 1983a, 1985c). Once the adults move into the river, they begin to disperse into various tributaries to spawn. Movement of Chinook past the Sunshine Station (RM 80) begins in early June, peaks in mid to late June and is essentially complete (more than 90 percent) by early July (ADF&G 1983a, 1985c).

Movement of adult Chinook into the Middle Susitna River begins in early June and continues to mid-July, with 90 percent of the migration past Curry Station (RM 120) completed by late July (ADF&G 1983a, 1985c). Adult Chinook that reach Sunshine Station enter one of the three major upper subbasins of the Susitna River Drainage: the Chulitna River, the Middle Susitna River, or the Talkeetna River. The rate of movement of adult Chinook from the Sunshine Station upstream into the Middle River is 1.8 to 3.3 mpd from Sunshine to Talkeetna Station and 2.2 to 4.3 mpd between the Talkeetna and Curry Stations (ADF&G 1983a, 1985c).

The average fecundity of female Chinook has not been estimated for the Susitna River, but Morrow (1980) reports average fecundities for Alaska between 4,200 to 13,600 eggs per females (Harza-Ebasco 1985a). Emergence of fry in Alaska occurs in March or April (Harza-Ebasco 1985).

Chinook fry remain near their natal areas in tributaries for one to two months before beginning a downstream movement into rearing and overwintering areas (ADF&G 1984c). The initial downstream movement may result from territorial behavior by juveniles (Harza-Ebasco 1985). Some Age 0+ Chinook fry move into the Susitna mainstem and have been collected throughout the basin during summer (Harza-Ebasco 1985). The remainder of the Age 0+ juveniles apparently remain in natal tributaries for initial rearing and overwintering (ADF&G 1984c). In general, approximately 40 percent of the juvenile Chinook (all ages) in the Middle Susitna River Reach are found in mainstem associated habitats from May to November. Approximately 60 percent are found in tributary habitats during the same period (Harza-Ebasco 1985).

The Age 0+ juveniles that move into the mainstem of the Middle Susitna River generally occupy areas with moderate water velocity (less than 1.5 fps), shallow depths (less than 2 ft), and complex habitat (ADF&G 1984c). If complex habitat is not available, juveniles use turbid water for cover (ADF&G 1984c, WCC 1985). In the Lower Susitna River, the highest densities of Age 0+ fish were collected in tributary mouths characterized by deep, low velocity, clear water (ADF&G 1985d).

In May, Age 0+ Chinook averaged between 40 and 45 mm in length (ADF&G 1985d). By October, average length of Age 0+ fish ranged from 60 to 80 mm (ADF&G 1985d). From September through November, Age 0+ fish move into clear water areas such as tributaries, tributary mouths, and side sloughs where they overwinter (WCC 1985, ADF&G 1984c). Age 1+ juveniles average between 85 to 95 mm in length in late May (Harza-Ebasco 1985), indicating they grow during the winter. Average lengths of outmigrating Age 1+ fish are between 100 and 120 mm at the end of July and early August (Harza-Ebasco 1985).

Outmigration patterns of juvenile Chinook salmon from the Middle Susitna River differ between Age 0+ and 1+ fish (Harza-Ebasco 1985). Age 0+ juvenile outmigration, as determined from outmigrant trapping rates at Talkeetna, occurs at a relatively constant rate throughout the summer, with two peak outmigration periods recorded in 1982, i.e., late June/early July and mid-August (ADF&G 1984c). In 1983, several peak outmigration events were observed (ADF&G 1985d). A similar, relatively constant rate of outmigration was observed at the Flathorn Station in the Lower Susitna River Reach (ADF&G 1985d). Age 1+ fish begin to outmigrate from the Middle Susitna River Reach in early May, and migration is essentially complete by mid-July (ADF&G 1984d, 1985d). Outmigration for the Lower Susitna River Reach peaks in mid-June and is completed by early August (ADF&G 1985d).

It is not clear whether Age 0+ outmigrant juvenile Chinook survive once they enter salt water (Harza-Ebasco 1985). Although a large portion of the outmigrating juveniles are Age 0+ fish, scale analysis of returning adults indicates that fish outmigrating as Age 0+ juveniles account for less than 5 percent of the total escapement (ADF&G 1985c). Based on scale analyses, it is estimated that more than 95 percent of the adult Chinook salmon returning to the Susitna River outmigrated as Age 1+ juveniles (ADF&G 1985c).

In general, adult Chinook salmon return to the Susitna River to spawn as Age 5 and 6 fish, with considerable variation in age composition between years (ADF&G 1984b, 1985c). Each year some Age 3 and 7 fish are also present in the population and occasionally may constitute a significant portion of the spawning population (ADF&G 1984b).

4.5.2.2.3. Pink Salmon

Susitna River pink salmon stocks contribute to both commercial and sport fisheries in the northern Cook Inlet area. Two distinct stocks of pink salmon use the Susitna River to spawn. All pink salmon follow a two-year life history and return to spawn as Age 2 fish. The two stocks are distinguished as even-year fish (those which spawn in even-numbered years) and odd-year fish. Pink salmon are generally more abundant in even years and are widely dispersed using a minimum of 40 tributaries within the Susitna River basin for spawning (ADF&G 1985b).

Estimates of pink salmon escapement were made from mark-recapture studies at Flathorn Station (below the Yentna River confluence) in 1985 (Thompson et al. 1986). The point estimate of total escapement was 479,500 fish with a standard deviation of 83,700 fish. An estimated 42,600 pink salmon reached sunshine station, suggesting that most spawning occurs in the lower river. Mark-recapture studies of pink salmon were also conducted by ADF&G in 2009 and 2010. The objective of these studies was to understand the proportion of west bank oriented fish at Susitna Station that are destined for the Yentna River (Willette 2011, pers. comm.). These data have not yet been reported.

Pink salmon enter the Susitna River in late June to early July and are numerous in the lower river at Yentna Station (RM 28) from the second week of July to the third week of August (Jennings 1984; ADF&G 1984a). The rates of upstream movement of pink salmon ranged from 2.6 to 7.7 mpd from the Sunshine Station to the Talkeetna Station and from 5.7 to 17.0 mpd from Talkeetna to Curry (ADF&G 1985c).

Incubation of pink salmon embryos begins with deposition of eggs in August (Harza-Ebasco 1985). Emergence of fry probably occurs in March and April (Harza-Ebasco 1985). The estimated fecundity of pink salmon in the Susitna River is 1,500 eggs per female (ADF&G 1984b). After emergence from the spawning gravels, juvenile pink salmon move out of the tributaries and the Middle Susitna River Reach almost immediately with no increase in size (Harza-Ebasco 1985). Peak outmigration of pink salmon juveniles occurs by mid June and is complete by mid July (ADF&G 1985d).

4.5.2.2.4. Coho Salmon

Susitna River coho salmon stocks contribute to both commercial and sport fisheries in the northern Cook Inlet management area. Presently, the ADF&G has only limited ability to gauge run size of coho stocks as they enter the fresh waters of the Susitna River (Oslund and Ivey 2010). From 1997 to 2003, a weir was operated on Willow Creek, and a weir has operated on the Deshka River since 1995 (Oslund and Ivey 2010). Fish wheels operated in conjunction with sonar have been used to estimate coho salmon abundance in the Yentna River from 1981 to 2008 (Table 6) (Westerman and Willette 2010). However, since this sonar program was designed to estimate sockeye salmon escapement the study timing does not coincide with the entire coho migration and the species apportionment based on fish wheel catch affects the accuracy of these estimates (Ivey 2009).

A four-year spawning distribution study targeting Susitna coho salmon was started by ADF&G in 2009 (Merizon et al. 2010). This study has used radio telemetry methods and described spawning distribution throughout the Susitna River drainage.

Coho mark-recapture studies using in the mainstem Susitna and Yentna River began in 2010 with the objective of generating abundance estimates. A total of 6,993 coho were marked in the Lower Susitna River. At upstream fish wheels in the mainstem Susitna 643 coho were captured, of which, 23 were mark-recaptures. At upstream fish wheels in the Yentna River 6,134 coho were captured, of which, 176 were mark-recaptures (Cleary 2010). Preliminary in-river abundance from 2010 studies is estimated at 60,000 coho in the mainstem Susitna and 136,000 coho in the Yentna River (Yanusz and Merizon 2010). In 2011, ADF&G intended to continue with data collection, review and generate abundance estimates, increase the sample size at the mainstem sites by using larger wheels to fish deeper, and refine data collection methods (Cleary 2010).

Based on 2010 radio telemetry studies, coho salmon spawning locations are identified throughout the main channels, side sloughs, and smaller tributaries. Approximately 2/3 of the total coho run was found to spawn in the Yentna River. Many coho were found to spawn within the Middle Susitna River which includes the important and most accessible sport fishery tributaries including the Deshka River, Willow Creek, Sheep Creek, and Montana Creek (Figure 4.5-3).

Table 4.5-6. Susitna River Coho salmon in-river abundance derived from sonar and weir counts and from peak aerial and foot surveys of index streams, 1981 through 2006 (Ivey 2009).

Susitna River			
Year	Westside Tributaries[a]		Total
	Yentna River[b]	Deshka River[c]	
1981	17,017		
1982	34,089		
1983	8,867		
1984	18,172		
1985	9,181		
1986	23,457		
1987	6,279		
1988	12,173		
1989	25,695		
1990	21,346		
1991	57,275		

1992	29,073		
1993	37,752		
1994	25,173		
1995	74,406	12,824	87,230
1996	34,420		
1997	13,670	8,036	21,706
1998	24,769	6,773	31,542
1999	37,933	4,563	42,496
2000	40,921	26,389	67,310
2001	47,077	29,927	77,004
2002	75,090	24,612	99,702
2003	45,222	17,305	62,527
2004	92,343	62,940	155,283
2005	76,890	47,887	124,777
2006	132,889	59,419	192,308

[a] Some years include Rabideux Creek index counts which range from 20 to 656 fish.
[b] Yentna River estimates are from sonar counts with species apportioned by fish wheel catch. All estimates from 1985 - 2006 are partial because the Yentna River sonar project was designed to estimate sockeye and shut down before the end of the coho run.
[c] Weir count located at Deshka River mile 7. 1998, 1999, 2002, and 2005 are incomplete counts due to the weir being underwater during high flows for extended periods of time.
Source: Ivey 2009

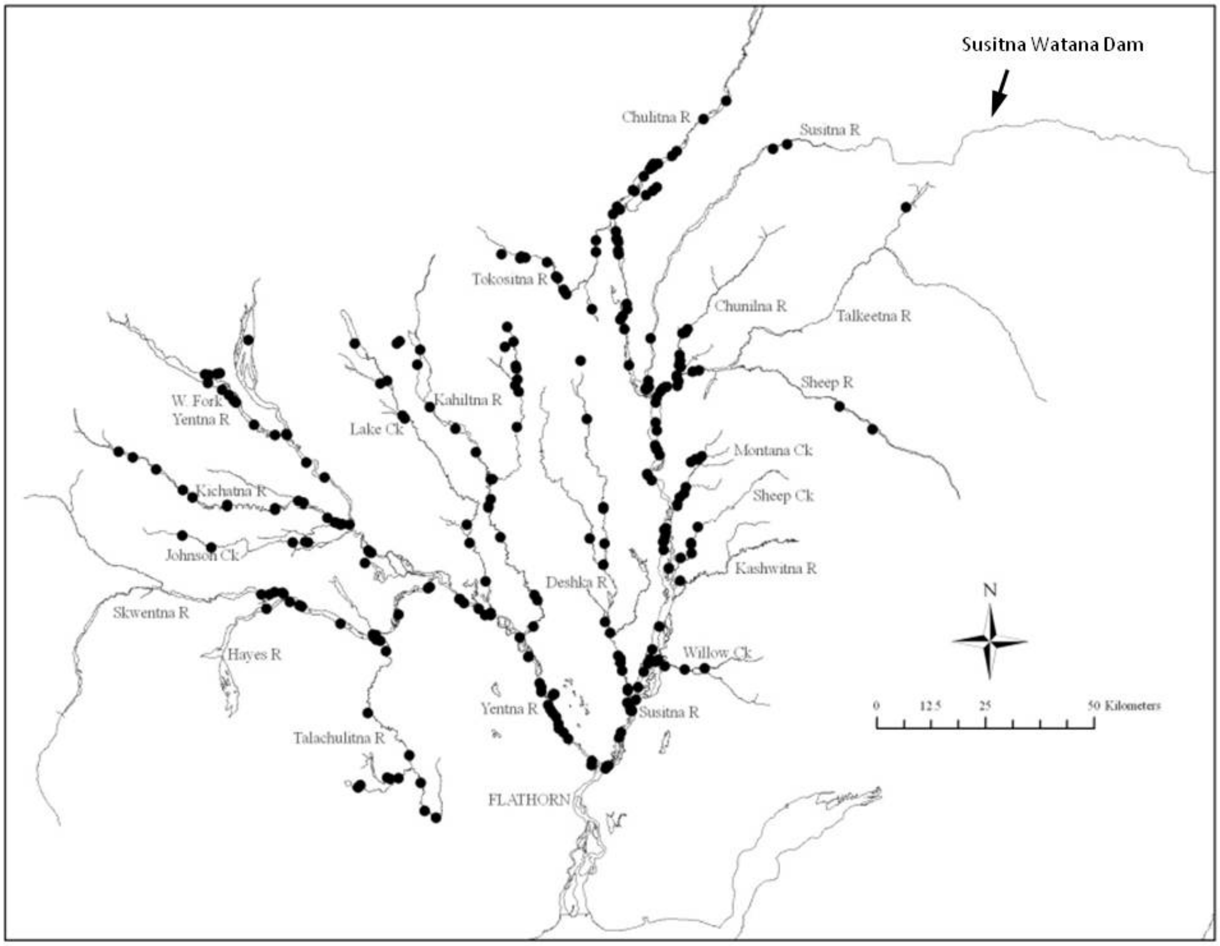

Figure 4.5-3. Final locations of 300 radio-tagged coho salmon based on 2009 aerial surveys in the Susitna River. Image copied from Merizon 2009.

Coho salmon enter the Susitna River in mid-July and are abundant in the lower Yentna River from the third week of July until the third week of August (ADF&G 1984b, Jennings 1984). The majority of coho pass Sunshine Station (RM 80) between the end of July and the end of August. Coho salmon are numerous in the Talkeetna to Devils Canyon segment of the middle Susitna after the last week of July.

Mark-recapture estimates of annual escapement into the Susitna above RM 80 were made as part of the APA Project environmental studies from 1981 to 1984 (ADF&G 1984b, 1985e). Annual estimates averaged 86,000 fish (Jennings 1984). It should be noted that significant coho salmon stocks returning to tributaries below RM 80 are excluded from this estimate. In 2002, ADF&G estimated the total abundance of coho in the entire drainage at 663,000 fish (Willette et al. 2003).

The movement of adult coho from Sunshine Station upstream into the middle Susitna River varies from year to year. The rate of migration from Sunshine Station (RM 80) to Curry Station (RM 120) averaged 4.0 mpd in 1981, 5.3 mpd in 1982, 1.4 mpd in 1983, and 2.9 mpd in 1984. Movement rates from the Talkeetna Station to Curry Station averaged 11.3 mpd in 1981, 10.0 mpd in 1982, 5.7 mpd in 1983, and 2.8 mpd in 1984 (ADF&G.1981a, 1983a, 1984c).

Incubation of coho embryos begins in mid September in the Susitna River (Harza-Ebasco 1985). Average fecundity is approximately 2,800 eggs per female (ADF&G 1983a, 1984b, 1985c). Emergence of fry from the spawning gravels occurs between late April and early May (ADF&G 1984c). There are two distinct patterns of juvenile rearing and outmigration (Harza-Ebasco 1985). The majority of juvenile coho rear for two complete years prior to outmigrating as Age 2+ fish (Harza-Ebasco 1985). However, a significant number of the juvenile coho rear for only one year and outmigrate as Age 1+ fish (Harza-Ebasco 1985).

After emergence from the spawning gravels, juvenile coho initiate a general downstream movement within the tributaries (Harza-Ebasco 1985). Some of the Age 0+ juveniles move out of their natal tributaries into the mainstem (Harza-Ebasco 1985). The remainder of the coho apparently stay in the tributaries for rearing and overwintering (Harza-Ebasco 1985). At Age 1+, more coho juveniles move out of the tributaries for rearing and overwintering (Harza-Ebasco 1985). Age 1+ juveniles also remain in the tributaries, overwinter for a second year, and outmigrate as Age 2+ fish (ADF&G 1984c, 1985d).

Juvenile coho that move into the mainstem of the Middle Susitna River Reach generally move into clearwater areas including tributaries, tributary mouths, upland sloughs, and side sloughs (ADF&G 1984c, 1985d). Juvenile coho prefer low-velocity clearwater areas with complex habitat diversity (Harza-Ebasco 1985). During the fall, juvenile coho move into upland and side sloughs to overwinter (Harza-Ebasco 1985).

The average length of Age 0+ juvenile coho in the Middle Susitna River Reach increased from approximately 40 mm in May to 70 mm in September, as measured at the Talkeetna Station outmigrant trap (ADF&G 1985d). In the Lower Susitna River Reach, the average length of Age 0+ coho increased from approximately 40 mm in June to approximately 90 mm in late September and early October (ADF&G 1985d). Age 1+ juveniles in the Middle Susitna River Reach grew from an average length of 70 mm in June to over 115 mm in October (Harza-Ebasco 1985). In the Lower Susitna River Reach, the average length of Age 1+ juveniles increased from 90 mm in May to approximately 110 mm in October (ADF&G 1985d). No length increase was evident based on the few Age 2+ juvenile coho collected in each sampling period could be estimated (ADF&G 1985d).

In 1983, outmigration of Age 0+, 1+, and 2+ juveniles from the Middle Susitna River Reach was relatively constant through the summer (Harza-Ebasco 1985). A major peak of outmigrating Age 0+ juveniles in August coincided with the redistribution of the fish to overwintering habitats in the Lower Susitna River Reach (ADF&G 1984c). In 1984, Age 0+ juveniles outmigrated in early August, and Age 1+ and 2+ fish outmigrated in June (ADF&G 1985d).

Outmigration of Age 0+ juveniles from the Lower Susitna River Reach peaked in late August and again in early October in 1984 (ADF&G 1985d). Peak outmigration of Age 1+ and 2+ fish occurred in early September (ADF&G 1985d).

Based on scale analyses of returning adult coho, it is likely that most of the outmigrating Age 0+ fish do not survive once they move into saltwater (Harza-Ebasco 1985). The majority of the adult population outmigrated as Age 1+ or Age 2+ juveniles (Harza-Ebasco 1985).

The age composition of adult coho indicates two predominant life histories in the population that spawns in the Susitna River (Harza-Ebasco 1985). The majority of the spawning population consists of Age 4 fish that outmigrated from freshwater as Age 2+ juveniles (Harza-Ebasco 1985). The remaining adults return to spawn as Age 3 fish that outmigrated from freshwater as Age 1+ juveniles (Harza-Ebasco 1985). A few coho adults return to the river as Age 2 or 5 adults (ADF&G 1983a, 1984b, 1985c).

4.5.2.2.5. Chum Salmon

Susitna River chum salmon stocks contribute to both commercial and sport fisheries in the northern Cook Inlet area. In 2008, chum salmon stock status was brought before the Alaska Board of Fisheries and the Matanuska-Susitna Borough issued a resolution to ADF&G to declare Susitna River chum salmon a stock of concern, enumerate escapement, and set escapement goals. In response, the Alaska State Legislature established funding for the Cook Inlet Salmon Task Force to examine conservation and allocation issues (Merizon et al. 2010). In 2009, ADF&G initiated a four-year (2009–2012) study to apply radio transmitters to chum salmon in the lower river. The objective of the study is to estimate drainage wide escapement and distribution. Radio tagged fish were tracked by fixed stations and by aerial surveys. Results from 2009 are published (Merizon et al. 2010). Results from 2010 remain unpublished. Objectives for the 2011 season will include ground-based tracking, which will provide more precise locations of spawning salmon and their associated habitats (Merizon, 2011, pers. comm.). Susitna River chum salmon are not currently listed as a stock of concern by the Alaska Board of Fisheries (BOF 2011).

Chum mark-recapture studies in the mainstem Susitna and Yentna River began in 2010 with the objective of generating in-river abundance estimates. A total of 4,598 chum were marked in the Lower Susitna River. At upstream fish wheels in the mainstem Susitna 1,291 chum were captured, of which, 14 were mark-recaptures. At upstream fish wheels in the Yentna River 6,191 chum were captured, of which, 158 were mark-recaptures (Cleary 2010). Preliminary in-river abundance from 2010 studies is estimated at 155,000 chum in the mainstem Susitna and 136,000 and 202,000 chum in the Yentna River (Yanusz and Merizon 2010). In 2011, ADF&G intended to continue with data collection, review and generate abundance estimates, increase the sample size at the mainstem sites by using larger wheels to fish deeper, and refine data collection methods (Cleary 2010).

During the 1980s APA Project study years of 1981–1983, the annual chum salmon total escapement in the Susitna River averaged 356,200 fish (Jennings 1984). The total chum salmon escapement was derived by summing the population estimates at Yentna Station (RM 28) and Sunshine Station (RM 80) and adding five percent to account for fish spawning in other portions of the basin. The majority (83 percent) of Susitna River chum salmon entered the Talkeetna-Chulitna subbasin.

Adult chum salmon use the widest range of habitats for spawning of any of the Pacific salmon using the middle reach. Based on estimated escapements past each of the sampling stations, over 95 percent of the total chum salmon in the Susitna River spawn in areas upstream of the Sunshine Station at RM 80 (ADF&G 1985d). A four-year spawning distribution study targeting Susitna chum salmon was started by ADF&G in 2009 (Merizon et al. 2010). This study used radio telemetry methods to characterize spawning distribution throughout the Susitna drainage. Chum salmon were found to use tributary, side slough, side channel, and mainstem areas for spawning within the middle reach. Approximately ½ of the total Susitna River run spawns in the Yentna River (Figure 4.5-4).

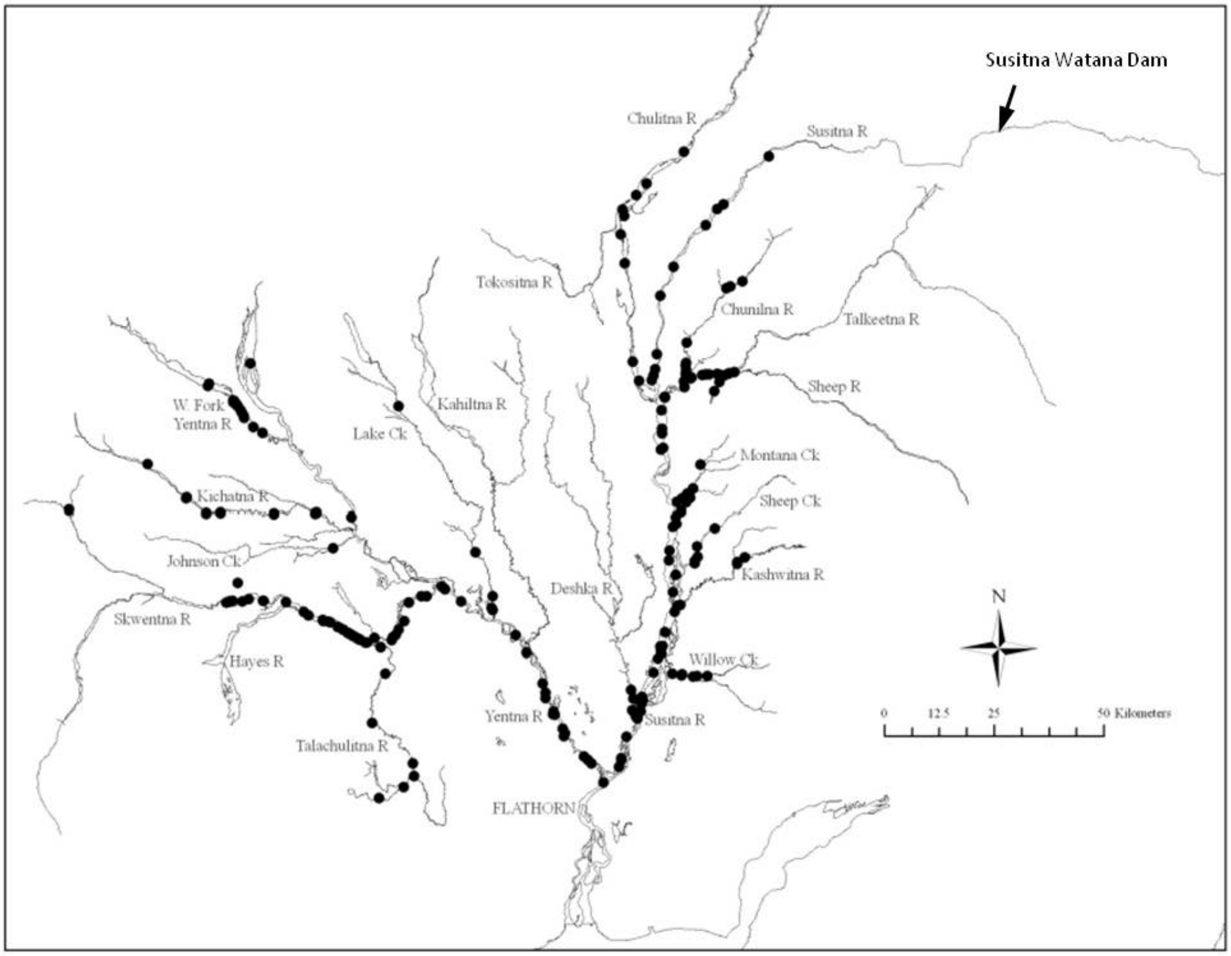

Figure 4.5-4. Final locations of 239 radio-tagged chum salmon based on 2009 aerial surveys in the Susitna River. Image copied from Merizon 2009.

Chum salmon enter the Susitna River in late June and are abundant in the lower river at Yentna Station by the third week of July (Jennings 1984, Merizon et al. 2010). Migration of chum salmon past the Sunshine Station generally begins in early July and is essentially complete by the end of August each year. Peak movement of chum past the Sunshine Station (RM 80) generally occurs in the last week of July or the first week of August (ADF&G 1981b, 1983a, 1985c). The average rates of movement upstream from Sunshine to Talkeetna ranged from 3.3 mpd in 1981 to 5.8 mpd in 1984. From Talkeetna to Curry (RM 120), average movement rates ranged from 4.2 mpd in 1981 and 1982 to 8.5 mpd in 1982 and 1984 (ADF&G 1981b, 1983a, and 1985c).

In the Susitna River, incubation of chum embryos begins with deposition of the eggs in mid August to late September (Harza-Ebasco 1985). Emergence of the fry from the spawning substrate occurs in February and March (ADF&G 1984c, 1985d). The fecundity of chum salmon is approximately 3,200 eggs per female (ADF&G 1984c).

After emerging from spawning gravels, juvenile chum remain near their natal areas until early to mid-May (Harza-Ebasco 1985). Then they begin a general downstream movement out of the Middle Susitna River Reach (Harza-Ebasco 1985). All juvenile chum outmigrate from the Middle Susitna River Reach by the end of July (ADF&G 1984c, 1985d). Based on studies conducted in the 1980s, juvenile chum increased in length from 40 mm in May to 48 mm in July (ADF&G 1985d).

Outmigration from the Lower Susitna River Reach into the Cook Inlet similarly occurs between late May and mid-July (ADF&G 1985d). Peak outmigration of juvenile chum occurs in mid-June for both the Middle and Lower Susitna River Reaches (ADF&G 1985d).

In general, the majority of the returning adults were Age 4 chum, followed by Ages 3 or 5 (ADF&G 1981b, 1983a, 1984b, 1985c). In 1983, Age 5 fish were most abundant (Harza-Ebasco 1985). A few returned at Age 6 (Harza-Ebasco 1985). All chum salmon returning to spawn in the Susitna River outmigrated as Age 0+ juveniles (ADF&G 1981a, 1983a, 1984b 1985c).

4.5.2.2.6. Arctic Graying

Arctic grayling contribute substantially to the sport fisheries of the Susitna River and its tributaries (Harza-Ebasco 1985). Silt-laden glacial systems, such as the Susitna River, are believed to support relatively few Arctic grayling; however, such systems may provide essential migratory channels and overwintering habitat (ADF&G 1981c). During ice breakup from April to June, adults migrate from ice-covered lakes and large rivers into clear, gravel bottomed tributaries to spawn (Morrow 1980). Arctic grayling reach sexual maturity between Ages 2 and 7 and are capable of spawning several times during their lifetime (Harza-Ebasco 1985). After spawning, the adults move from spawning areas (Harza-Ebasco 1985). In late August, a downstream migration to overwintering areas begins in large rivers and deep lakes (Harza-Ebasco 1985).

During 1980-1981, Arctic grayling were captured in all three Susitna River reaches, from RM 10.1 through the proposed impoundment area above RM 184 (Harza-Ebasco 1985).

During the 1980s studies, there was no evidence of Arctic grayling spawning at any sampling locations between Devils Canyon and Cook Inlet (Harza-Ebasco 1985). It is thought that adult Arctic grayling form the mainstem Susitna River below Devils Canyon migrate into non-glacial tributaries to spawn in late April or May (Harza-Ebasco 1985). In the Upper Susitna River Reach, Arctic grayling fry were captured at the Watana Creek study area in 1981, indicating spawning in the immediate vicinity (Harza-Ebasco 1985).

Arctic grayling population estimates were calculated (Table 4.5-7) based on mark–recapture data from 1981 and 1982 for the proposed impoundment zone. In the Upper Susitna River Reach, adult Arctic grayling spawned in tributary pools (ADF&G 1983c). These spawning pools had low water velocity, were three to six ft deep, and had sand to 1-inch diameter gravel substrate (ADF&G 1983c). Juvenile Arctic grayling were found in small schools (less than 25 fish) in tributary side channels, side sloughs, and sides of pools (ADF&G 1983c). These habitats were characterized by low water velocity, shallow depth, and cover (ADF&G 1983c). During early summer in the mainstem Upper Susitna River Reach, juvenile Arctic grayling occurred at mouths of tributaries and clear water sloughs (ADF&G 1983c).

Table 4.5-7. Arctic grayling population estimates in the Upper Susitna River Reach proposed impoundment zone, during 1981 and 1982.

Location	1981	1982
Oshetna River	2017	2,426
Goose	1,327	949
Jay	1,089	1,592
Kosina	2,787	5,544
Watana		3,925
Deadman	979	734
Tsusena	1,000	
Fog	176	

Source: ADF&G 1981c and 1983c

4.5.2.2.7. Eulachon

The eulachon is an anadromous member of the smelt family that spends most of its life in the marine environment (Harza-Ebasco 1985). Adults are believed to live at moderate ocean depths in close proximity to shore (Harza-Ebasco 1985). In the northern portion of its range, eulachon spawn in May and June (Harza-Ebasco 1985). Eulachon are an important forage species for beluga whales (*Delphinapterus leucas)* and are harvested as part of a small commercial and subsistence fishery.

During 1982, the spawning migration appeared to be composed of two segments: an early run that started prior to May 16 and ended about May 31, and a late run that started about June 1 and ended about June 10 (ADF&G 1983a). The second run was approximately 4.5 times larger in than the first run (Harza-Ebasco 1985).

Eulachon used the Lower Susitna River reach at least as far upstream as RM 58 in 1981 and RM 48 in 1982 (ADF&G 1983a). In 1982, eulachon spawned in riffle areas and offshore of cut banks on unconsolidated sands and gravels (ADF&G 1983a). Spawning occurred at water temperatures between 3.0 °C (37 °F) and 9.5 °C (49 °F) (ADF&G 1983a). Eggs are fertilized in the water column, attach to the substrate, and hatch after 20 – 40 days, at which time the larvae are flushed to the ocean.

4.5.2.2.8. Dolly Varden

Three forms of Dolly Varden have been identified: an anadromous form that generally inhabits coastal streams, a resident freshwater form that inhabits rivers and lakes, and a dwarf resident freshwater form that occupies stream and lake habitats (Morrow 1980). There are many life history types to the species Dolly Varden, and it is likely that the Susitna River basin supports numerous different populations with various life histories and growth rates.

Within the Susitna River drainage, Dolly Varden inhabit areas from the Oshetna river (RM 233.4) to the Cook Inlet (ADF&G 1981c, d, 1983c, 1984c, 1985d).

In the Upper Susitna River reach, Dolly Varden are found in tributary plunge pools (ADF&G 1983c). In the Middle and Lower Susitna River reaches, Dolly Varden are found at tributary mouth habitat (ADF&G 1981d).

Based on available data, Dolly Varden from the Middle and Lower Susitna River reaches presumably move into tributaries during the summer to rear and feed (Harza-Ebasco 1985). In November and December, they move into the mainstem to overwinter (Harza-Ebasco 1985). Sexual maturity is reached around Age 4 (ADF&G 1984c).

In the Upper Susitna River reach, Dolly Varden populations are apparently small and widely distributed (ADF&G 1983c). Total lengths of fish collected in this reach ranged from 120 mm to 205 mm (Harza-Ebasco 1985).

Seasonal movements of the population in the Upper Susitna River reach appear to be similar to those described for the Lower and Middle Susitna River reaches (Harza-Ebasco 1985).

4.5.2.2.9. Rainbow Trout

Rainbow trout inhabiting the Susitna River constitute one of the northernmost populations of this species (Morrow 1980). Within the Susitna River, rainbow trout populations are found up to and in Portage Creek at RM 148.8 (Harza-Ebasco 1985).

During spring and summer, rainbow trout are distributed in clearwater areas associated with tributaries and tributary mouths (ADF&G 1984c). By mid-September, rainbow trout move to tributary mouth areas and presumably move into the mainstem to overwinter (Harza-Ebasco 1985).

Spawning activity probably occurs in late May to early June in upper reaches of tributaries (Harza-Ebasco 1985). This is based on the inability to capture juvenile rainbow trout at locations associated with the mainstem in early to mid summer (Harza-Ebasco 1985). Juveniles were collected more frequently in the lower portions of tributaries as winter approached (ADF&G 1984c, 1985d). Growth of juvenile rainbow trout was similar to other northern populations (ADF&G 1981d).

Habitats suitable for rainbow trout include clearwater areas with velocities less than 0.5 ftps and depths greater than 2 ft (Harza-Ebasco 1985). Rainbow trout are also associated with areas containing complex habitat such as undercut banks, large woody debris, and substrate particles greater than 3 inches (ADF&G 1984c).

Movement of rainbow trout during the summer and winter months has been documented through tracking of radio-tagged fish (Harza-Ebasco 1985). Based on those results, rainbow trout apparently move freely from tributary to tributary during summer and throughout the mainstem during winter (ADF&G 1981d, 1983b, 1984c, 1985b). In summer, the mainstem serves principally as a migratory pathway; whereas, in winter, the mainstem serves as a holding area (ADF&G 1985d).

4.5.2.2.10. Burbot

Burbot mature between ages 3 and 6 and may live 15 to 20 years (Harza-Ebasco 1985). Burbot are widely distributed throughout the mainstem Susitna River. Adults have been found at tributary and slough mouths and in turbid mainstem areas (Harza-Ebasco 1985). Burbot are typically sedentary but may move considerable distances during fall before spawning in winter

(ADF&G 1983c). Burbot occurred in all three reaches of the Susitna River and an upstream distribution was not determined (ADF&G 1981c).

In the Upper Susitna River reach, burbot were located in mainstem habitats with backwater-eddies and gravel substrate (ADF&G 1983c). In the Middle and Lower Susitna River reaches, burbot were found in slough mouth habitat, mainstem habitat, and side channel complexes (Harza-Ebasco 1985).

In the Susitna River, spawning occurs from November to February (ADF&G 1981d). Although no spawning activity was observed, the increase in density of adult fish at the mouth of the Deshka River and the migration of radio-tagged adult fish to the mouth of the Deshka River indicated a high probability that spawning occurs in that area (ADF&G 1985c).

4.5.2.2.11. Non-game Species

These non-game species also occur in the Susitna River drainage:

- **Bering cisco** is a member of the whitefish family that occurs from the Beaufort Sea to Cook Inlet (Harza-Ebasco 1985). While populations of anadromous and resident freshwater forms exist, the Susitna River populations appear to be strictly anadromous (Harza-Ebasco 1985). Bering cisco were collected in the Lower Susitna River reach between RM 70 and RM 98.5 in the early 1980s (ADF&G 1983a). Spawning of Bering cisco does not appear to occur in the Middle Susitna River reach (Harza-Ebasco 1985). Bering cisco have been observed in the Susitna River between August and October, at the conclusion of the field season (ADF&G 1983a), presumably they are in the system later in autumn. Spawning is believed to occur in October.
- **Round whitefish** are distributed all across Arctic and Interior Alaska (Harza-Ebasco 1985). In the Susitna River basin, densities of round whitefish were greatest in the Middle Susitna River Reach, between Devils Canyon and Talkeetna (Harza-Ebasco 1985).
- **Humpback whitefish** consist of a complex of three closely related species of whitefish: humpback whitefish, Alaska whitefish, and lake whitefish (Harza-Ebasco 1985). Due to similar appearance and overlapping distributions, data collected on the three species have been reported under the general heading of humpback whitefish (Harza-Ebasco 1985). Field crews captured humpback whitefish most frequently from the Cook Inlet to the Talkeetna River (ADF&G 1981c).
- **Longnose sucker** were collected throughout the study area from Cook Inlet to the Upper Susitna River reach (Harza-Ebasco 1985). Downstream of Devils Canyon, longnose suckers were more abundant than upstream of the canyon (Harza-Ebasco 1985). Adults congregate in spawning areas during late May and early June (Harza-Ebasco 1985). During other times of the year, adults disperse in the mainstem (ADF&G 1983c, 1985d). Juveniles appear to use clearwater sloughs and tributary mouth habitats to a greater extent than adults (ADF&G 1983d).
- **Threespine stickleback** in the Susitna River basin display both anadromous and resident freshwater life histories (Harza-Ebasco 1985). These life-history types are differentiated by various morphological features (von Hippel and Weigner 2004). In the Susitna River basin, they have been observed from Devils Canyon to Cook Inlet (Harza-Ebasco 1985).
- **Slimy Sculpin** were abundant in the Susitna River basin (Harza-Ebasco 1985). Up to three other sculpin species may exist in the Susitna River (Harza-Ebasco 1985). They

were present in nearly all clearwater habitats in the Susitna Basin and the adults and juveniles occupied these habitats and exhibit little movement between habitats (Harza-Ebasco 1985).

- **Arctic lamprey** were captured in the Susitna River during 1981and 1982 (ADF&G 1981d, 1983d). ADF&G speculated that approximately 30 percent of the Arctic lamprey in the Susitna River were anadromous (ADF&G 1981d). Arctic lamprey were captured in the Susitna River from the beginning of May–mid October in 1982 (ADF&G 1983d).
- **Northern pike (invasive)** were illegally introduced into the Yenta drainage from the Yukon drainage during the 1950s (SANPCC 2010). Since then, several floods allowed for the spread of northern pike to the rest of the Susitna drainage (SANPCC 2010). Throughout Southcentral Alaska and specifically the Susitna drainage, juvenile salmon and trout are preferred prey for pike (Rutz 1996, 1999). The loss of salmon due to pike predation can adversely affect ecosystem functions (SANPCC 2010).
- **Lake trout** were collected during the 1980s near the Upper Susitna River Reach (Harza-Ebasco 1985). Lake trout are present in Lake Lucille (J. Buckwalter, ADF&G, pers. comm.). However, it is unknown if lake trout inhabit any lakes in the proposed impoundment zone.
- **Pacific lamprey** are an anadromous fish that has been reported in nearby rivers (Nemeth et al. 2010) as well as the Deshka River (J. Buckwalter, ADF&G, pers. comm.).

This species may occur in the Susitna River drainage:

- **Alaska blackfish (invasive),** though not captured in the Susitna River, may have been introduced to the basin.

4.5.3. Federally Designated Habitats

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) is the federal law that governs U.S. marine fisheries management. In 1996 Congress added new habitat conservation provisions to that act in recognition of the importance of fish habitat to productivity and sustainability of marine fisheries, which includes freshwater habitat used by anadromous species.

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a federal Fishery Management Plan (FMP). The MSA requires federal agencies to consult with the National Marine Fisheries Service (NMFS) on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (MSA §305[b][2]).

Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The NMFS EFH guidelines further interpret the EFH definition as follows:

- Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate
- Substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities

- Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem
- “Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle

The EFH mandate applies to all species managed under a federal FMP, which includes all five species of Pacific salmon. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically, accessible to salmon. NMFS has designated the anadromous fish stream maps prepared by ADF&G (ADF&G 2010) as the definition of EFH within freshwater habitats in Alaska. This stream catalogue designates anadromous waters throughout much of the Susitna watershed and along the mainstem of the Susitna River to the mouth of the Oshetna River at approximately RM 225 (Figure 4.5-5). EFH maps are subject to update as new information becomes available.

Cook Inlet has also been designated as EFH for the juvenile and adult stages of several Gulf of Alaska marine species including: Pacific cod, sculpin species, walleye pollock, and eulachon. Although these marine species may be present in Upper Cook Inlet and may enter the Susitna River estuary, existing information suggests that they are likely not abundant except for seasonal presence of eulachon (Pentec 2005; Moulton, 1997; Dames & Moore 1983).

In addition to EFH, portions of Cook Inlet have been designated by NMFS as critical habitat for the endangered Cook Inlet beluga whale (see Section 4.8 of this PAD). The Susitna River estuary and adjacent portions of Cook Inlet are within the critical habitat designation. Some Susitna River fish species, including salmon and eulachon, are important forage species for belugas and have been listed as primary constituent elements in the critical habitat designation.

4.5.4. Potential Adverse and Positive Impacts

The Draft Environmental Impact Statement for the 1980s APA Project determined that potential environmental impacts would occur as a consequence of Project development (FERC 1984). FERC regulations require “a description of any known or potential adverse impacts and issues associated with construction, operation, or maintenance of the proposed project, including continuing and cumulative impacts.” The greatest downstream effects on aquatic habitats were expected within the Talkeetna to Devils Canyon reach of the Susitna River (Middle River). Downstream from Talkeetna, the inflow from the Talkeetna and Chulitna rivers was expected to reduce the magnitude of change in physical processes under with-project conditions (Jennings 1984).

Specific, quantified impacts of the currently proposed Susitna-Watana Project are unknown at this time and will require comprehensive analysis. While the design and operation of the currently proposed project may differ from the previously evaluated project, the types of impacts are likely to be similar. To evaluate the potential impacts and protect aquatic resources and habitats, current conditions must be described at a level of reliability necessary to detect and explain possible future changes caused by the proposed hydroelectric development. Additionally, establishing a complete and accurate assessment of baseline conditions is essential to developing and implementing Project mitigation and for monitoring the long-term effectiveness of that mitigation.

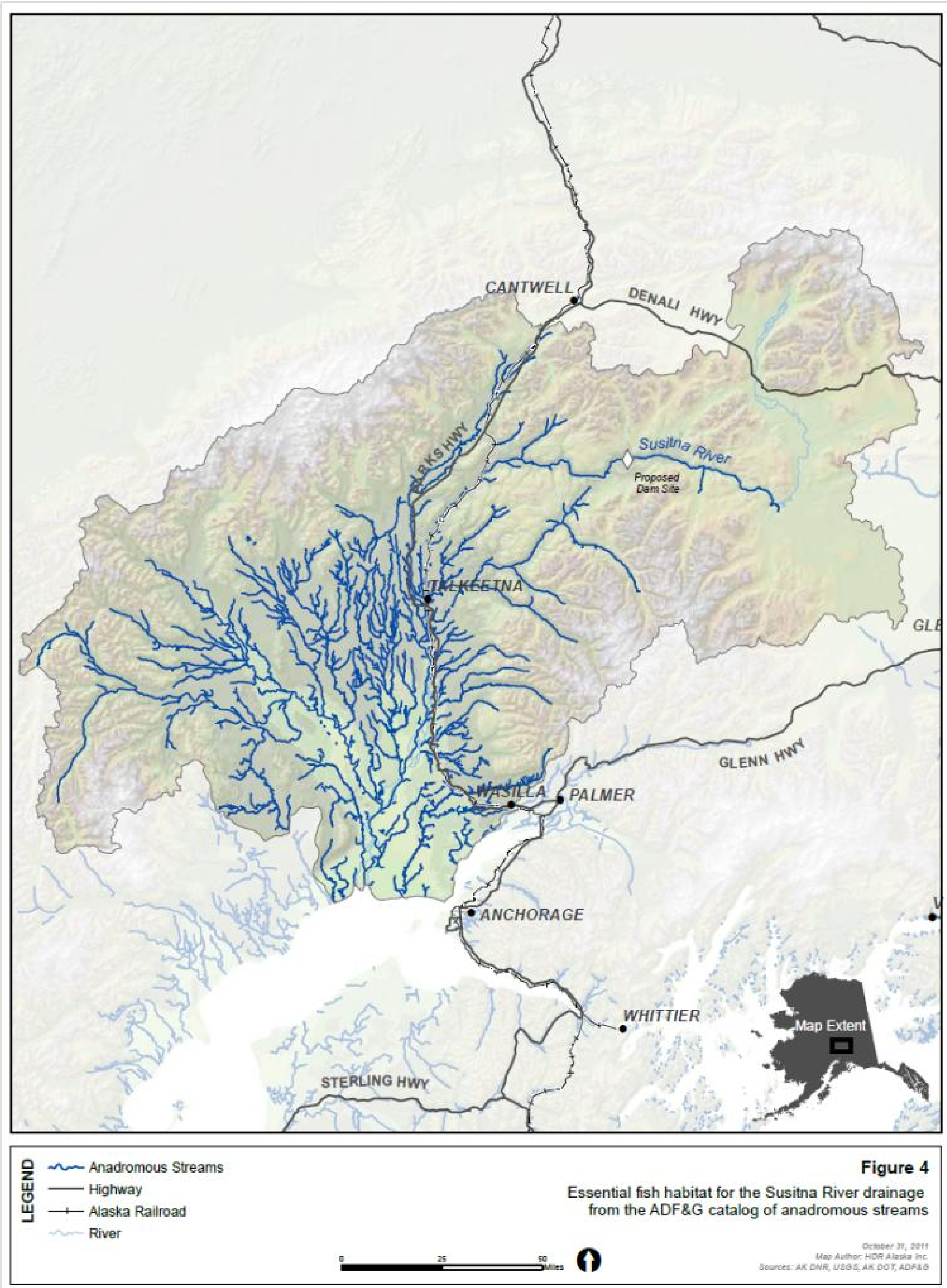

Figure 4.5-5. Essential Fish Habitat for the Susitna River Drainage

Impacts identified for the Watana portion of the 1984 APA Project based on the results of the original study program (FERC 1984), as well as by the ongoing outreach program conducted as part of the current FERC licensing process, were used to identify potential impacts of the proposed Susitna-Watana Project, as described below. The following sections include both potential adverse and beneficial impacts of the proposed Susitna-Watana Project.

4.5.4.1. Adult Salmon

Known or potential impacts and issues associated with construction, operation, or maintenance of the proposed Project, including continuing and cumulative impacts to adult salmon, are listed below:

- Alteration of flow in the lower river resulting in habitat changes: impacts may be adverse or beneficial depending on species.
- Restricted access to spawning sloughs due to changes in flow: access to sloughs used for spawning (mainly by chum and sockeye salmon in the middle river) may be restricted by reduced summer flows during reservoir filling and operation. Impacts may vary according to the site-specific topography of the sloughs.
- Impediments to salmon migration upstream to tributary spawning habitat: decreases in mainstem flows in the middle river during reservoir filling and operation may potentially cause reduced depths of tributary mouths, increased scour, back-cutting of tributary beds, and perching.
- Loss of side channel and mainstem spawning habitat: decreased mainstem flows in the Middle River from May through July could result in decreased water depths and velocities in some locations and dewatering in others. This may alter the availability or suitability of some spawning habitat.
- Alterations to stream temperature may affect spawning timing and incubation duration: impacts will depend on Project operating characteristics and ability to control the temperature of water released from the powerhouse.
- Increased fishing pressure: sport fishing may increase for all salmon species throughout the middle Susitna River due to improved access.
- Shifts in relative abundance: alteration of salmon habitat in the middle river due to changes in flows, sediment transport, and temperatures may affect the abundance of each species of salmon.
- Fish injury or mortality resulting from elevated total dissolved gas concentrations: supersaturated total dissolved gas concentrations occur at times under natural conditions in the Susitna River downstream of the Devils Canyon rapids. For all but the highest flood levels, supersaturated dissolved gas (nitrogen) levels resulting from the Project are expected to be managed by fixed cone valves. As a result, little effect on fish due to total dissolved gas concentrations is anticipated.
- Reduced salmon production above Talkeetna: production for all five species may be reduced, especially during the second and third years of filling of the Susitna-Watana reservoir.
- Salmon production above the proposed dam site would be eliminated: a relatively small number of Chinook may currently spawn or rear above the proposed dam site.
- Potential impacts on commercial, sport, or subsistence fisheries: changes in catch may be approximately proportional to changes in the size of the spawning stocks.

4.5.4.2. Resident and Rearing Anadromous Fish

Known or potential impacts and issues associated with construction, operation, or maintenance of the proposed Project, including continuing and cumulative impacts to resident and rearing salmon, are listed below:

- Permanent loss of riverine habitat at the Susitna-Watana dam construction site, with accompanying loss of existing fish populations that are dependent on that habitat.
- In the area of inundation, conversion of river habitat to lake habitat in the Susitna River and lower reaches of several tributary streams.
- Potential creation of a lake-based fishery.
- During reservoir filling and operation, downstream of the confluence with the Chulitna and Talkeetna rivers, growth rates of juvenile salmon and resident species may be suppressed by cool temperatures.
- During reservoir operations, potential redd dewatering may occur during winter above Sherman due to reduced ice staging.
- During Project operations, reduced stranding of fry during freshet flows may be expected due to stabilization of flow.
- Potential increases in incubation rates due to warmer water temperatures in winter and autumn may occur. Early-spawning pink and chum salmon (mid-July) may complete development to emergence stage by mid to late October.
- Winter silt loading resulting from Project operation may reach levels detrimental for downstream redds.
- Stabilization of flows and reduction in summertime turbidity may increase benthic productivity and food availability for juvenile salmon in the middle river.
- Stable winter flow may alter the distribution of rearing fish, with the potential for increased survival in some areas and decreased survival in others.
- Depletion of woody debris above the Chulitna River confluence may occur due to attenuation of peak flows that erode wooded riverbanks and blockage of upstream sources of this debris. Progressive washout downstream may result in degradation of rearing habitat.
- Potential advancement of the timing of salmon smolt out-migration due to warmer water temperatures in winter and early spring and earlier breakup of ice. This is identified as a potential detrimental effect because early entrance to cold coastal waters could result in reduced survival.
- A large reduction in salmon production could occur during the second and third years of reservoir filling. However, this lost production could be partially offset by increased production in other systems because salmon that would normally continue to migrate up the Susitna River would select the warmer water of the Talkeetna River. All five salmon species could increase their use of the Devils Canyon to Talkeetna reach during reservoir operation, although the rate of return to higher production levels would vary depending on species, life cycle, and strength of returning year classes following completion of filling.

4.5.4.3. Aquatic Macroinvertebrates

Known or potential impacts and issues associated with construction, operation, or maintenance of the proposed Project, including continuing and cumulative impacts macroinvertebrates and periphyton, are listed below:

- Increases in aquatic plant and invertebrate productivity in the Susitna River due to decreases in summertime turbidity and stabilization of flows.
- Increased benthic algae and invertebrate production on the submerged riverbed in the reservoir during both filling and operation of the dam – decrease in wetted surface area due to reduced summer flows.
- No changes in aquatic plant and invertebrate communities are expected during open-water season downstream of the confluences of the Chulitna and Talkeetna rivers, due to the overwhelming influences of these rivers on both flow and turbidity.
- Within the Susitna River and clearwater tributaries located within the proposed reservoir, poorly developed benthic invertebrate communities (due to oligotrophic water quality and seasonally high silt loading) may be displaced by inundation. Gradual replacement with benthic species and zooplankton typical of reservoirs would occur.
- Zooplankton communities would develop in the reservoir and have potential to be a food source for fish that could supplement the availability of riverine invertebrates downriver. However, the reservoir would also be expected to be oligotrophic, so that zooplankton populations might not be extensively developed. Biomass of the ensuing community of zooplankton would likely be limited by fluctuating water elevations (affecting littoral zones) and heavy sedimentation rates (affecting deep zones).

4.5.5. Potential Protection, Mitigation, and Enhancement

APA stated the objective of the aquatic resources mitigation planning for the Susitna Hydroelectric Project, during the 1980s, was to provide habitat of sufficient quality and quantity to maintain natural reproducing fish populations (Harza-Ebasco 1985a). A hierarchical approach to mitigation was developed as follows:

- Avoid impacts through design features or schedule activities to prevent loss of resources.
- Minimize impacts by controlling flow releases and by implementing best management practices.
- Rectify impacts by restoring disturbed areas to provide fish habitat and reestablishing fish in restored areas.
- Reduce or eliminate impacts over time through monitoring, maintenance, and proper training of Project personnel.

Based on impact assessment for the APA Project, APA developed proposed PM&E measures (Harza-Ebasco 1985a). Some of these measures may be appropriate to the proposed project. Project evaluation species were selected to assess impacts to species with high human use, dominance in the ecosystem, and sensitivity to project impacts (Harza-Ebasco 1985a). Life stages and habitat use were selected for the evaluation species, and mitigation measures were proposed to maintain habitat (Harza-Ebasco 1985a). Various flow regimes were considered to address the issue of flow alteration and its effect on evaluation species and their habitats (Harza-Ebasco 1985a).

The creation of the Susitna-Watana reservoir will affect the downstream temperature regime of the Susitna River, thus potentially impacting incubation timing of resident and anadromous fish, benthic invertebrates, and outmigration timing of anadromous fish (Harza-Ebasco 1985a). Multi-level gates at the power intake could be used to regulating the temperature of downstream releases (Harza-Ebasco 1985a).

In order to avoid nitrogen supersaturation, the use of fixed-cone valves is proposed.

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4.6. Wildlife and Botanical Resources

4.6.1. Introduction

This section incorporates both information prepared for the wildlife data-gap analysis for the Project (ABR 2011b) and material prepared in the early 1980s to support the FERC license application for the original APA Susitna Hydroelectric Project (APA 1985a, 1985b). As identified in the data-gap analysis, a number of information deficits exist. Therefore, adaptations of older data are used here (ABR 2011b). Similarly, preliminary predictions of Project-related impacts have been adapted from the draft amended application for the APA Project, which closely resembled the project currently being proposed.

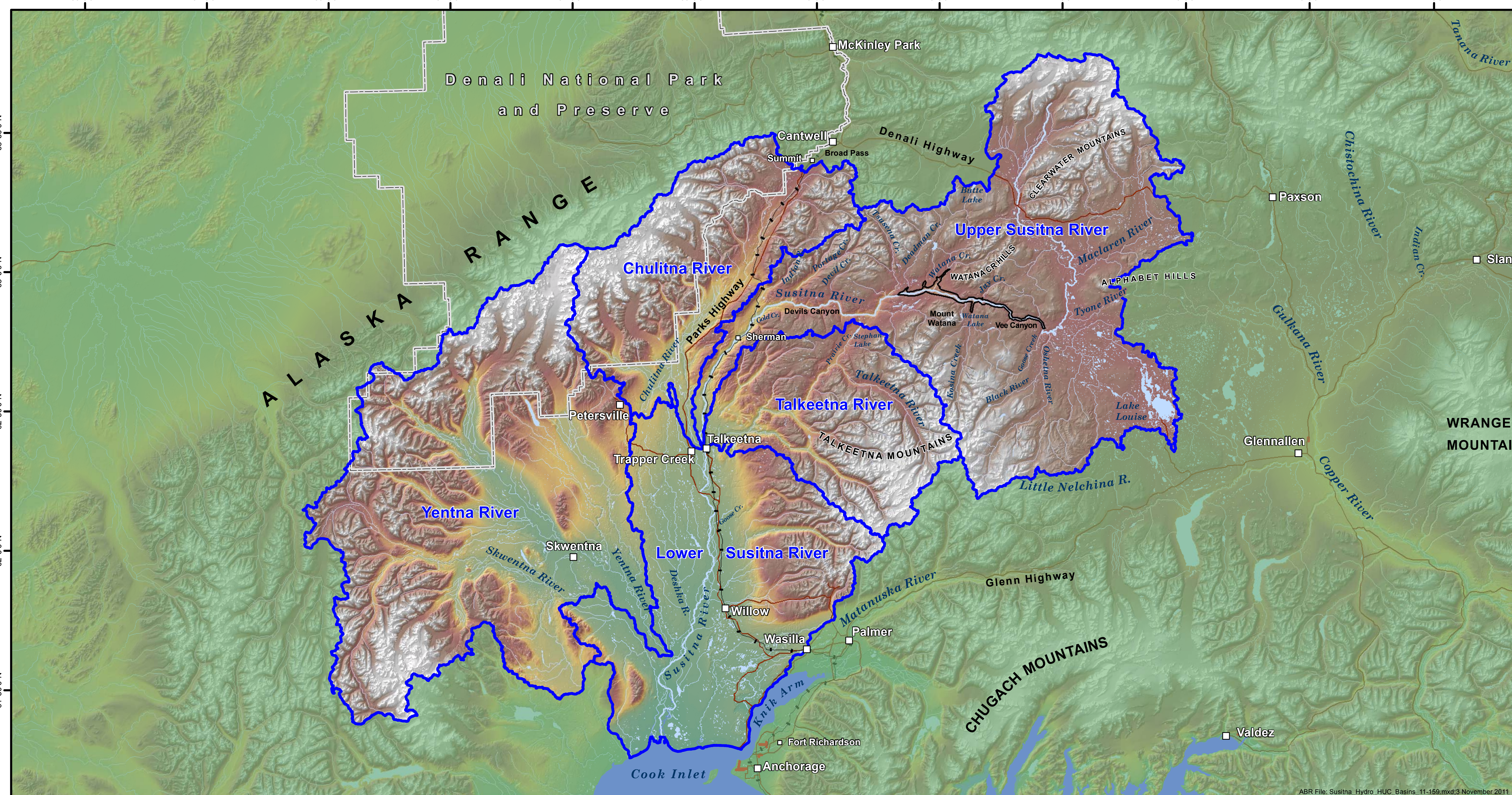
Three reaches of the Susitna River are recognized:

- Upper—from the proposed Watana dam site upstream to the headwaters of the drainage;
- Middle—from the Watana dam site downstream to the confluence with the Chulitna River, just upstream from the community of Talkeetna;
- Lower—from the Chulitna confluence downstream to the mouth of the Susitna River at Cook Inlet.

The upper and middle reaches are included in the Upper Susitna River subbasin (Figure 4.6-1). Specific study areas varied among the different species and taxonomic groups of wildlife, depending on their distribution and movements.

For the purposes of wildlife population management and reporting, the State of Alaska is divided into 26 game management units (GMUs). The Susitna River basin contains all or parts of GMUs 13E, 13A, 13B, 14A, 14B, 16A, and 16B (Figure 4.6-2). GMU subunits are subdivided further into Uniform Coding Units (UCUs) for harvest reporting. There are 136 UCUs in and near the entire Susitna River basin, each comprising one or more small drainage basins.

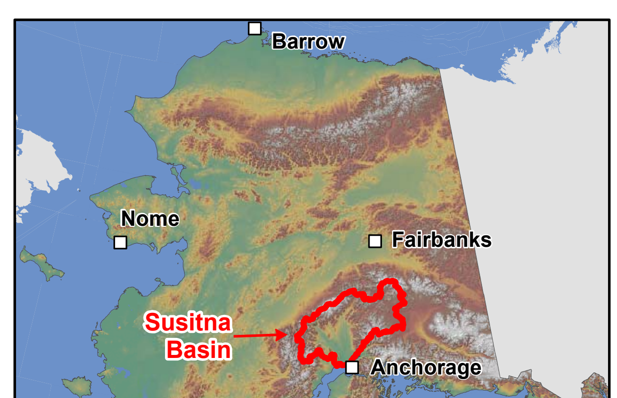
Botanical resources in the project area function primarily as wildlife habitat and wetlands (discussed later in Section 4.7).



LEGEND

- Proposed Watana Reservoir
- National Hydrography Dataset Subbasin*
- Roads
- Railroad

*Subbasins are based on the 4th level Hydrological Unit Code (HUC) boundaries. Dataset was produced by the USGS, NRCS, and the EPA and can be downloaded from http://nhd.usgs.gov/



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ALASKA ENERGY AUTHORITY

Date: Nov 2011
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State of Alaska
Susitna-Watana Hydroelectric Project FERC No. 14241

Figure 4.6-1

Regional Overview of the Susitna River Basin and Subbasins

4.6.2. Wildlife

4.6.2.1. Descriptions of Wildlife Populations and Habitat Use

4.6.2.1.1. Mammals

At least 38 species of terrestrial mammals occur in the Susitna River basin (Table 4.6-1). The bulk of the wildlife studies conducted for the APA Project focused on mammals, especially big game and certain furbearers. Moose (*Alces americaus*), caribou (*Rangifer tarandus*), Dall's sheep (*Ovis dalli*), brown bear (*Ursus arctos*), black bear (*Ursus americanus*), wolf (*Canis lupus*), and wolverine (*Gulo gulo*) for example, were the focus of studies because of their ecological importance and management concerns for human use, whether consumptive (subsistence and sport hunting) or nonconsumptive (wildlife viewing). The APA Project studies were conducted during 1980–1982 (Phase I) and 1983–1984 (Phase II) in a broad area surrounding the two dams and reservoirs proposed for that project, depending on the species. Detailed research reports were prepared for individual species and summary progress reports on the big game studies provided overviews of the research results and data gaps from Phases I and II (ADF&G 1981, 1982, 1983, 1984a). No study efforts as comprehensive as the APA Project program have been undertaken in the region since the mid-1980s, but ADF&G has continued species-specific studies for research and management of selected species in various portions of the Susitna basin.

A number of information sources regarding the distribution and abundance of mammals are available for the region in various map atlas efforts (ADF&G 1973, 1978, 1985a, 1985b) and related products from the Susitna River Basin Study (USDA 1985a, 1985b) and the Susitna Area Plan (e.g., the fish and wildlife element map atlas; ADF&G 1984b), but the information in those maps has not been updated recently. Among those mapping efforts only selected information on some species from the Alaska Habitat Management Guides (AHMG) project (ADF&G 1985a, 1985b) has been digitized for specific projects. The AHMG project produced useful summaries of wildlife species distribution and seasonal concentration areas through a statewide series of reference maps. The summaries were based on literature review and the expert judgment of research biologists and area wildlife biologists (no local or traditional knowledge component was incorporated) and forms the basis of much of the mapping still used today.

4.6.2.1.1.1. Moose

The moose is a species of primary importance in Southcentral Alaska. It is a keystone species that shapes vegetative communities and is a major prey species for large carnivores, as well as being one of the most hunted mammals for human consumption. GMU 13 is an important area for moose hunting due to its accessibility and proximity to Anchorage and Fairbanks (Figure 4.6-2). Moose densities in GMU 13 were low in the early 1900s, increased in the 1940s, and peaked in the mid-1960s (Tobey and Schwanke 2008). Numbers then declined over the next 10 years, reaching a low in 1975 due to severe winters, increased predation, and large human harvests of both bulls and cows. The population increased during 1978–1987, by an average 5 percent annually, and then declined by a total of 47 percent in the early 1990s. Populations reached a low in 2001. After wolf control resumed in GMU 13 in 2003, moose numbers started to rebound (Tobey and Schwanke 2008). In a further effort to increase moose numbers, the hunting season was liberalized for brown bears, which in some areas may kill up to 50 percent of moose calves within the first 6 weeks of life (Tobey and Schwanke 2008).

Table 4.6-1. Terrestrial mammal species reported to occur in the Susitna River basin (reprinted from ABR 2011b).

English Name(s)	Scientific Name
Cinereus shrew, masked shrew, common shrew	*Sorex cinereus*
Pygmy shrew	*Sorex hoyi*
Dusky shrew, montane shrew	*Sorex monticolus*
Water shrew	*Sorex palustris*
Tundra shrew (formerly lumped with arctic shrew)	*Sorex tundrensis*
Alaska tiny shrew	*Sorex yukonicus*
Little brown myotis, little brown bat	*Myotis lucifugus*
Coyote	*Canis latrans*
Wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Lynx	*Lynx canadensis*
River otter	*Lontra canadensis*
Wolverine	*Gulo gulo*
Marten	*Martes americana*
Ermine, short-tailed weasel	*Mustela erminea*
Least weasel	*Mustela nivalis*
Mink	*Neovison vison*
Black bear	*Ursus americanus*
Brown bear, grizzly bear	*Ursus arctos*
Moose	*Alces americanus*
Caribou, reindeer	*Rangifer tarandus*
Mountain goat	*Oreamnos americanus*
Dall's sheep	*Ovis dalli*
Hoary marmot	*Marmota caligata*
Arctic ground squirrel	*Spermophilus parryii*
Red squirrel	*Tamiasciurus hudsonicus*
Beaver	*Castor canadensis*
Meadow jumping mouse	*Zapus hudsonius*
Northern red-backed vole	*Myodes rutilus*
Brown lemming	*Lemmus trimucronatus*
Singing vole	*Microtus miurus*
Root vole, tundra vole	*Microtus oeconomus*
Meadow vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethicus*
Northern bog lemming	*Synaptomys borealis*

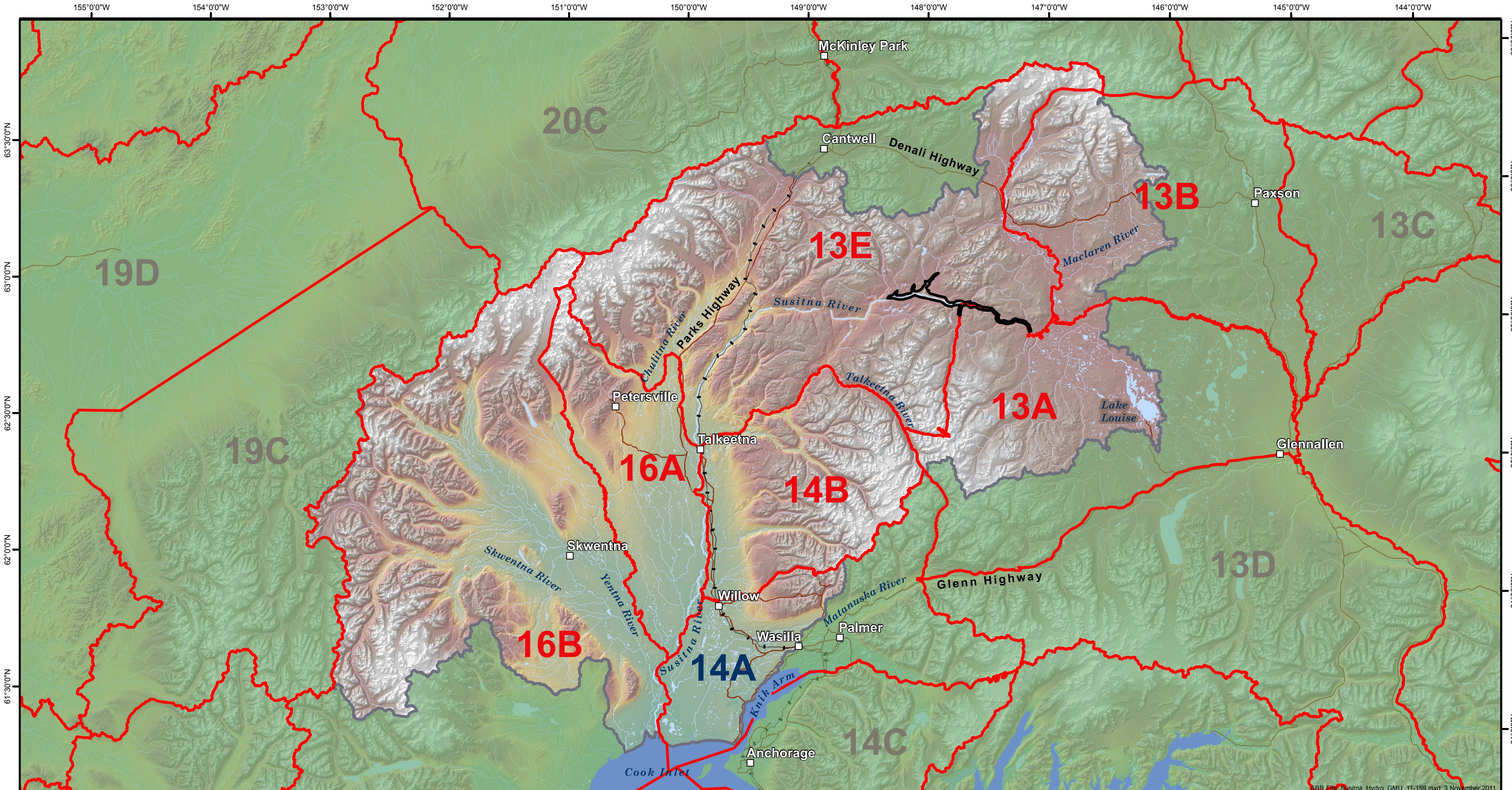
English Name(s)	Scientific Name
Porcupine	*Erethizon dorsatum*
Collared pika	*Ochotona collaris*
Snowshoe hare, varying hare	*Lepus americanus*

Sources: Kessel et al. (1982); APA (1985b: Appendix E7.3); MacDonald and Cook (2009); continental modifiers of English names (e.g., *North American* river otter) have been dropped from this list.

The current management objective for the moose population of GMU 13 is 20,000–25,000 animals, while maintaining fall population ratios of at least 25–30 calves:100 cows, 25 bulls:100 cows, and 10 yearling bulls:100 cows (Tobey and Schwanke 2008). Trend counts in various parts of GMU 13 show an increasing population and an average of 0.5 moose/km² (1.3 moose/mi²) among trend count areas (specific areas counted as a metric of moose population trends). In fall 2007, ratios of 32 bulls:100 cows and 22 calves:100 cows were recorded (Tobey and Schwanke 2008). The most recent density estimates for GMUs 13, 14, and 16 were in the range of 0.19–0.58 moose/km² (0.5–1.5 moose/mi²) (Harper 2008). The highest moose densities in GMU 13 tend to occur on the southern slopes of the Alaska Range (Subunits 13B and 13C) and in the eastern Talkeetna Mountains (Subunit 13A). The lowest densities occur in the Lake Louise flats (Subunit 13D).

Moose typically are found in subalpine habitats during the fall rut and post-rutting period, and then move to lower elevations as snow depth increases. Earlier movements may occur where wolf densities have been reduced in riparian areas at lower elevations. Known wintering areas in GMU 13 include the southern Alphabet Hills, the upper Susitna River, the eastern foothills of the Talkeetna Mountains, the Tolsona Creek burn, and the Copper River floodplain in the eastern part of the unit. Winter survival of moose is strongly related to snow depth, with mortality increasing markedly when snow depth exceeds 0.75 m (30 in) (Tobey and Schwanke 2008). Calves are most severely affected, followed by yearlings, adult bulls, and cows. Deep snow also results in lower survival of calves the following spring. Moose mortality during severe winters does not appear to be density-dependent.

Baseline studies of moose in the Susitna River basin began several years before the formal APA Project study program commenced in 1980. The moose studies for the APA Project were divided into upstream and downstream (above and below Devils Canyon) components, with different investigators and objectives. The upstream study began with radio-collaring in 1976 and ended in January 1986 (Ballard and Whitman 1988, Ballard et al. 1991). The downstream studies began in 1980 and continued through 1986 (Modafferi 1987), with monitoring of population dynamics continuing through 1991 using some of the animals collared for the APA Project studies (Modafferi and Becker 1997).



LEGEND:

- ADFG Game Management Units*
- Susitna Basin
- Proposed Watana Reservoir
- Roads
- Railroad

*ADFG Game Management Units and Subunits were downloaded April 2011 from http://dnr.alaska.gov

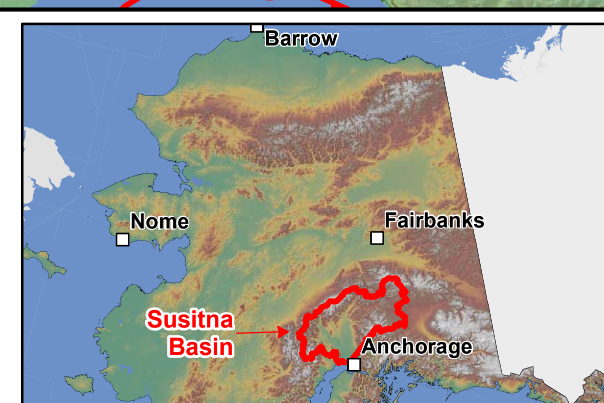


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Figure 4.6-2

Game Management Units and Subunits in and near the Susitna River Basin

4.6.2.1.1.1.1. Upper Susitna River Subbasin

In the Upper Susitna subbasin, Taylor and Ballard (1979) began radio-collaring moose in 1976–1977, and that work was continued later for the APA Project (Ballard and Whitman 1988). Between 1976 and 1985, 463 moose, comprising 218 neonates, 61 calves aged 5–10 months, and 184 adults, were equipped with either visual collars or VHF (very high frequency) radio-collars (Ballard and Whitman 1988). Twelve subpopulations were identified throughout the original APA Project study area, which included most tributaries of the Susitna River upstream of the mouth of Portage Creek (just below Devils Canyon) (Figure 4.6-3). Early studies conducted for the APA Project found the highest density of moose upstream of the proposed Watana dam site, between Watana Creek and Jay Creek at elevations of 650–850 m (2,133–2,789 ft) (Taylor and Ballard 1979, Ballard and Whitman 1988).

All moose exhibited seasonal movements within their home ranges, but the magnitude varied substantially. Moose were classified as resident if seasonal ranges overlapped between summer and winter, or as migratory if they did not. Ballard et al. (1991) reported that home-range sizes averaged 290 km^2 (112 mi^2) for resident moose and 505 km^2 (195 mi^2) for migratory moose. Distances between the summer and winter ranges of migratory animals ranged from 1 to 93 km (0.6–58 mi) (Ballard and Whitman 1988); the moose that moved the farthest were those that summered in the Clearwater Mountains north of the Denali Highway and wintered along the Susitna or Maclaren rivers.

Three periods of major movements were identified: autumn and spring migrations and movements during the rut (breeding season) (Figure 4.6-4). During rut in late September and early October, some moose made distinctive movements to upland areas not used at other times of the year. Most movements of radio-collared sedentary moose occurred from higher elevations in the summer to lower elevations in winter (Ballard and Taylor 1980). Fall migration began between late October and November and appeared to be correlated with the first heavy snowfall (>0.3 m, or 1 ft). Figure 4.6-5 shows moose overwintering ranges during 1977–1982 (Ballard et al. 1983a, cited in FERC 1984). Spring migration occurred more gradually, from mid-April through mid-July. General calving ranges during 1977–1982 are shown in Figure 4.6-6 (Ballard et al. 1983a, cited in FERC 1984).

Ballard and Whitman (1988) documented 170 crossings of the Susitna River, by 59 (52 percent) of 113 radio-collared moose, in the two impoundment zones for the APA Project. Crossings occurred in all months of the year but were common during late winter, peaking in April, when moose occupied winter ranges at lower elevations. These numbers are conservative because of the nature of VHF radio-telemetry, which requires tracking from aircraft, unlike the more frequent monitoring that is now possible using satellite or GPS radio-telemetry.

Vegetation types dominated by spruce and willow were used preferentially by moose. Taylor and Ballard (1979) recorded 70 percent of moose observations (n = 376) in spruce-dominated habitats (three of their nine habitat types were dominated by spruce) and reported that most locations where calves were first seen (n = 20) were in spruce-dominated habitats. Areas with relatively low browse biomass, such as habitats with a spruce overstory, were used heavily by moose during winter regardless of the lower volume of food, because more browse was available due to shallower snow cover (Ballard et al. 1991). Moose used lower-elevation areas more often during severe winters and moose survival declined during severe winters (Ballard and Whitman 1988, Ballard et al. 1991). The number and density of moose using the Watana impoundment zone varied widely among winters of moderate severity (1981–1983 and 1985), ranging from 42 to 580 (0.2 to 2.3 moose/km² or 0.4–6.0 moose/mi²) (Ballard and Whitman 1988).

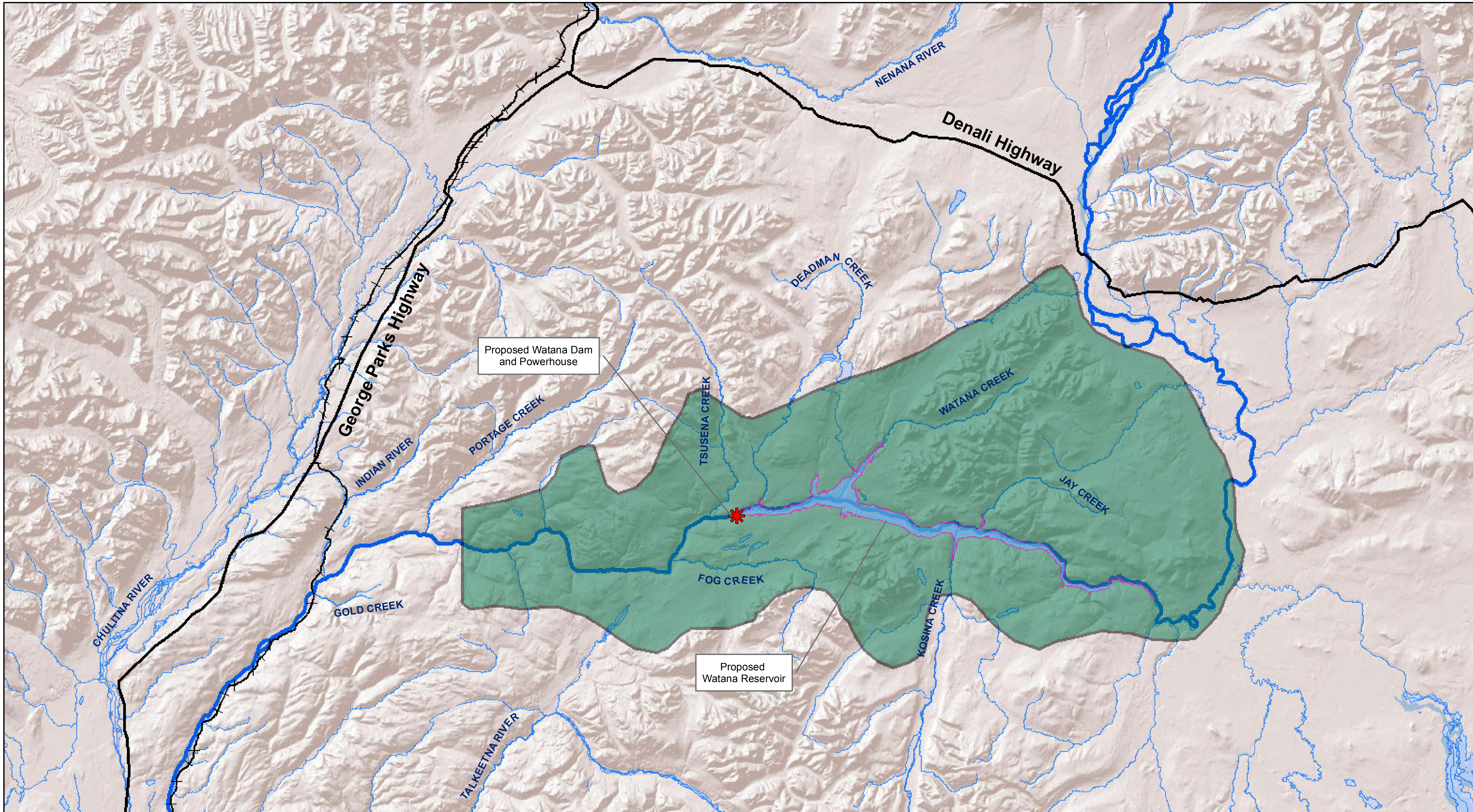
Radio-tracking of collared calves in the APA Project study area showed that predation, primarily by brown bears, was responsible for 83–86 percent of the mortality of moose calves (Ballard et al. 1981a, Ballard and Whitman 1988), with 94 percent of the deaths occurring before July 19. Ballard et al. (1990) found that brown bears killed 46 percent of the calves in their study, black bears killed 9 percent, and wolves killed 7 percent. Elsewhere in interior Alaska (north of Tok), the highest predation rates on adult moose by brown bears were attributed to killing of cow moose during calving by male bears (Boertje et al. 1988). Bear densities and predation rates on moose calves were independent of moose density and were thought to be more related to factors such as availability of alternative foods. Relocation of brown bears from a 3,346-km² (1,292-mi²) study area in Southcentral Alaska lowered bear density by 60 percent and resulted in a significant ($P < 0.05$) increase in moose calf survival from birth to November (Ballard and Miller 1990).

4.6.2.1.1.1.2. Lower Susitna River Subbasin

The Lower Susitna River drainage has long been known as an important wintering area for moose. Modafferi (1987) summarized the downstream studies conducted for the APA Project, which focused on identifying subpopulations and seasonal movements of moose using the Susitna River floodplain, as well as identifying candidate lands for mitigation of potential habitat loss caused by the APA Project. VHF telemetry was used to study the movements and habitat use of 51 female and 18 male moose during April 1980–June 1985, and aerial censuses and other surveys were conducted repeatedly (6–11 times) during winter from December 1981 to December 1986. A population survey was conducted using stratified random sampling in March 1985.

Fourteen subpopulations were identified in the downstream study area from Devils Canyon downstream to Cook Inlet. Although some moose used the Susitna River floodplain year-round, most used the floodplain primarily in winter when snow levels restricted foraging in other habitats (Figure 4.6-7) (Modafferi 1987). Some moose of each sex migrated up to 25 km (15 mi) from summer or fall ranges to winter on the floodplain, whereas the summer/fall ranges of other moose were smaller and coincided with floodplain winter range. The highest densities of moose occurred in open forest habitats, especially on high-relief islands near Cook Inlet where prevailing winds precluded deep snow accumulation. Overall, the greatest numbers of moose used low-relief floodplains where dynamic river flows maintained early succession plant communities that provided high-quality forage. On a late-winter survey in March 1985, 91 percent of the moose were found in 36 percent of the 353 sample units surveyed (4,252 mi², or 11,013 km²); in those units, density ranged from 2 to 13 moose/mi² (0.8–5 moose/km²) (Modafferi 1987).

Snow depth was the principal factor contributing to variation within and between years in moose counts on the middle and lower Susitna River floodplain. For the area downstream of Devils Canyon, maximum winter counts of moose on the floodplain ranged from 369 animals in a mild winter with shallow snow cover to 934 animals in a severe winter with deep snow cover (Modafferi 1987). In view of the generally low densities of predators in the lower Susitna valley at the time of their studies, Modafferi and Becker (1997) concluded that malnutrition was the principal cause of mortality in severe winters.



Legend

- Proposed Watana Dam and Powerhouse
- Moose Study Area
- Proposed Watana Reservoir
- Highway
- Alaska Railroad
- Susitna River
- Selected Tributaries and Nearby Streams

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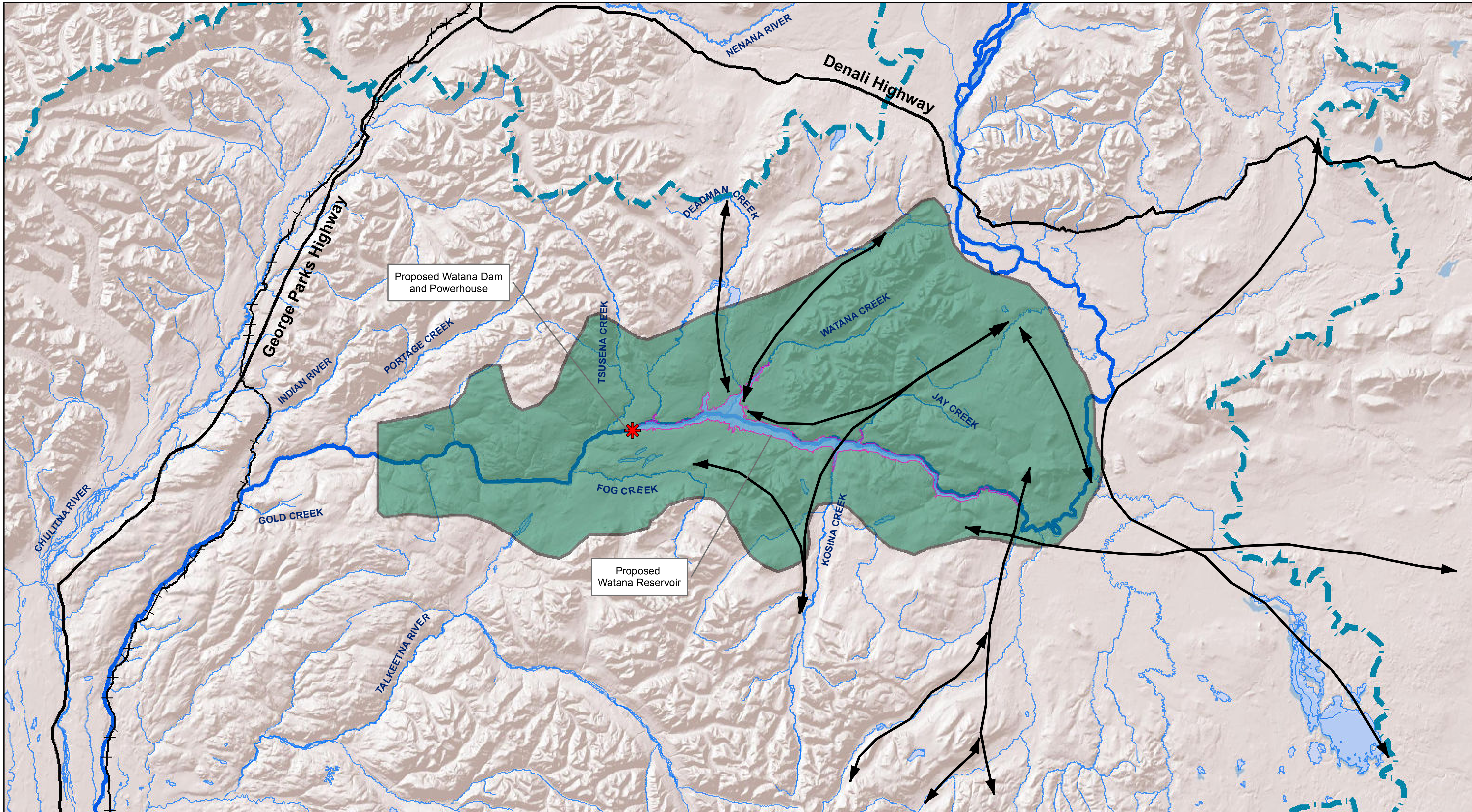
Figure 4.6-3

Moose Study Area

source: APA 1985b



Legend

- Proposed Watana Dam and Powerhouse
- Susitna River
- Selected Tributaries and Nearby Streams
- Susitna River Basin
- Highway
- Alaska Railroad
- Moose Study Area
- Moose Movement

N

0 5 10 20 Miles

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Figure 4.6-4

Moose Movement

source: APA 1985b

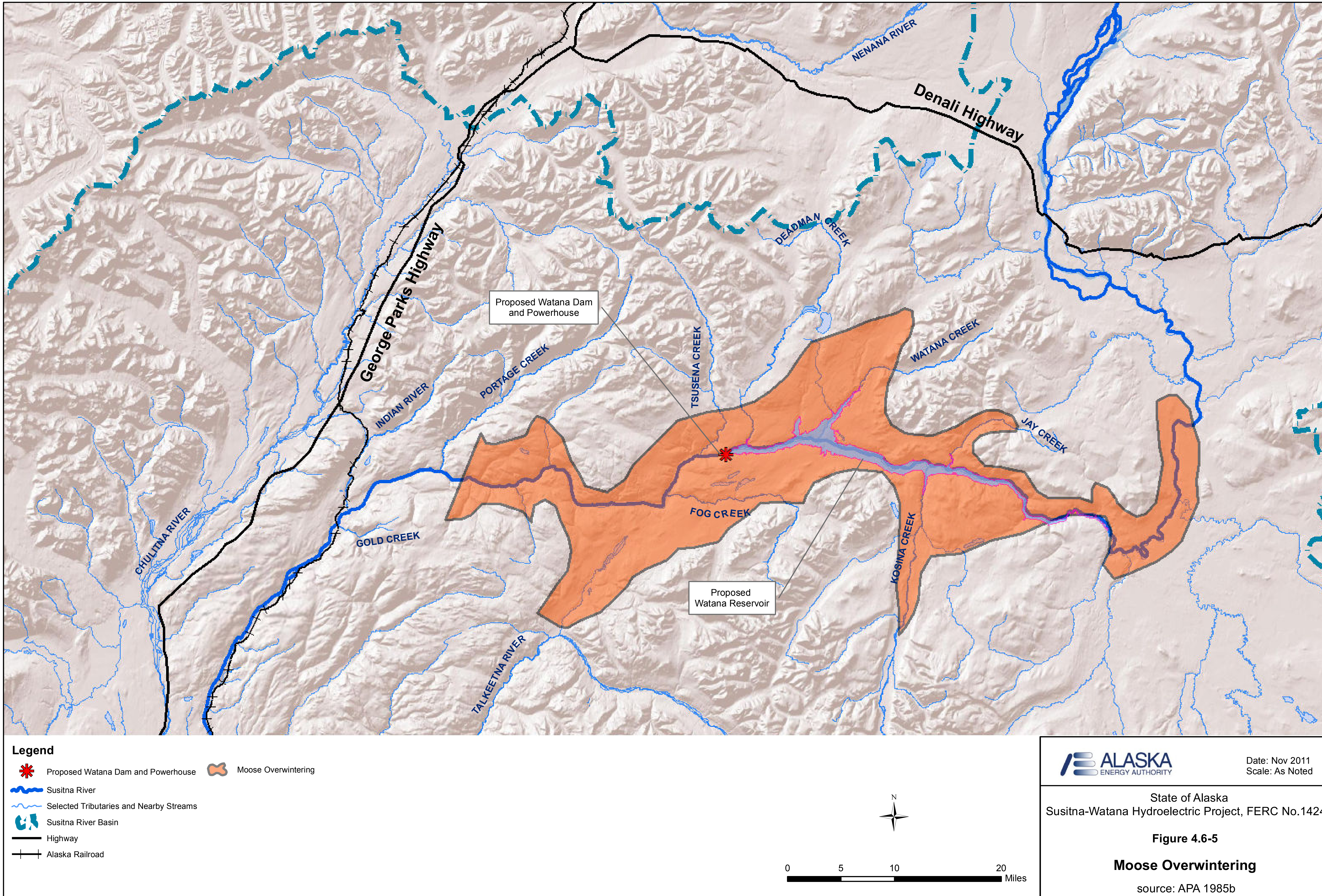

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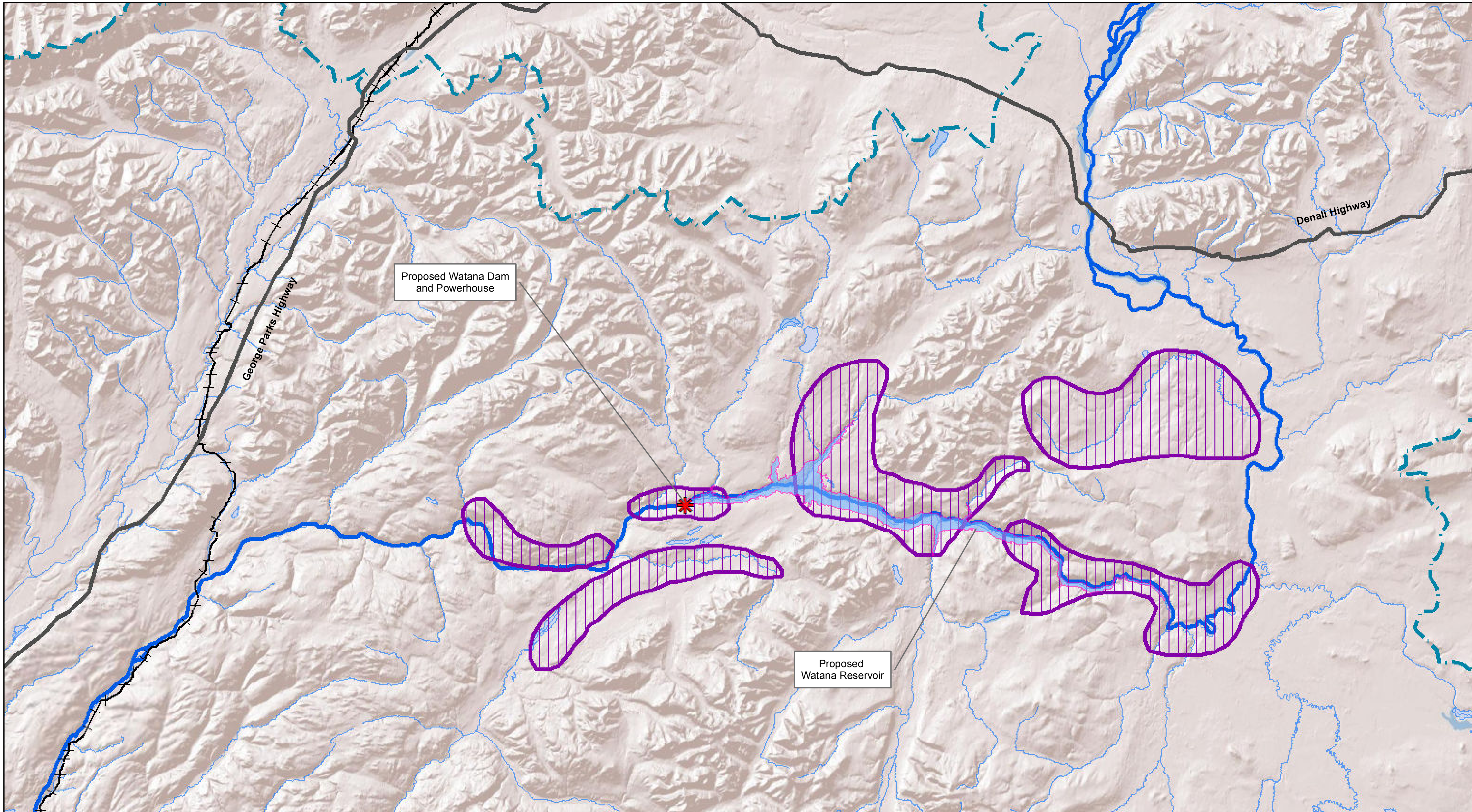
Figure 4.6-5

Moose Overwintering

source: APA 1985b



Legend

- Proposed Watana Dam and Powerhouse
- Proposed Watana Reservoir
- Selected Populated Place
- Highway
- Alaska Railroad
- Susitna River
- Selected Tributaries in Susitna River Watershed
- Susitna River Basin
- Moose Calving Area

N

0 4.25 8.5 17 Miles

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Figure 4.6-6

Moose Calving Areas

source: APA 1985b

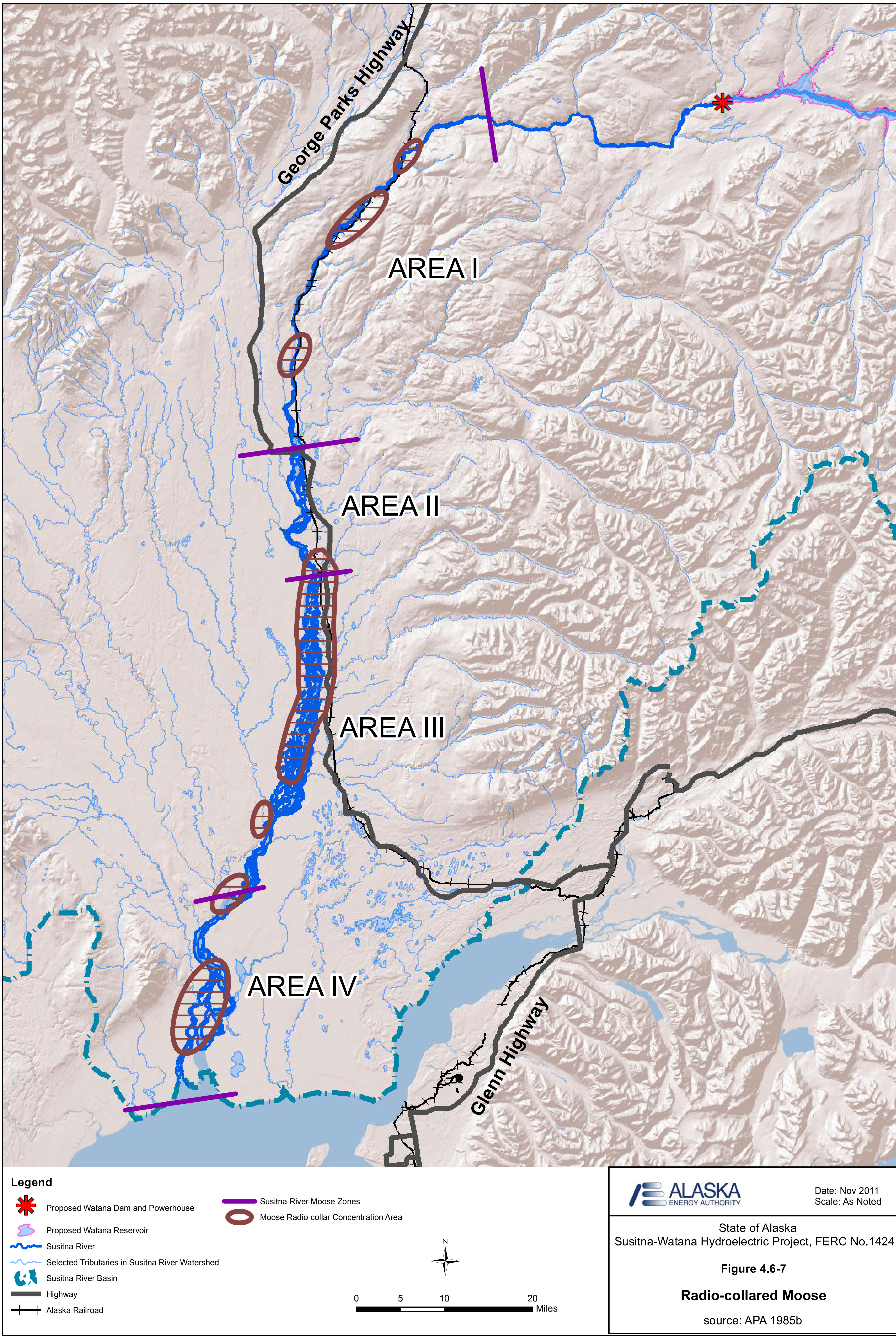

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Figure 4.6-7

Radio-collared Moose

source: APA 1985b

4.6.2.1.1.2. Caribou

Caribou herds in Alaska generally are delineated by ADF&G on the basis of their fidelity to calving grounds, following the herd concept proposed by Skoog (1968). Caribou that occur in the upper Susitna River basin belong primarily to the Nelchina Herd. Figure 4.6-8 illustrates the historical range of the Nelchina Herd, which comprises a large area extending from the Talkeetna Mountains eastward across the Nelchina Basin and Lake Louise Flats to the Wrangell Mountains, and northward from the Chugach Mountains to the Alaska Range (Skoog 1968; Hemming 1971; LGL 1985a; Pitcher 1982).

Since the first herd-size estimates became available in the late 1940s, the Nelchina Herd peaked at approximately 70,000 caribou in the early 1960s, then declined precipitously to 7,000–10,000 by the early 1970s (Figure 4.6-9; estimates before 1955 (red bars) likely underestimated the true herd size, judging from the 1955 and 1956 estimates). During the period of the original APA Susitna Hydroelectric Project studies, the herd increased from 18,713 animals to 27,528 animals by 1985 (Pitcher 1982 and 1987); continued to grow to about 50,000 animals by 1995, declining and remaining fairly stable, in the range of 30,000–35,000 caribou since. The size of the Nelchina Herd has remained near ADF&G's population management objective of 35,000–40,000 animals in fall; the most recent herd size estimates were 32,569 in fall 2007 and 32,288 in fall 2008 (Tobey and Schwanke 2009).

Caribou investigations in 1980–1985 identified three resident subherds in the area surrounding the two proposed APA Project reservoirs. About 400 caribou were estimated to reside year-round in the headwaters of the Talkeetna River south of the APA Project impoundment zones. Nearer the Susitna River, the Chunilna Hills had a resident group of about 250 caribou, and about 1,500 caribou used the upper Susitna, Nenana, and Chulitna river drainages year-round. Two additional subherds were suspected to occur in the western Talkeetna Mountains and in the Clearwater Mountains along the southern slopes of the Alaska Range. Recent caribou management reports have not discussed the subherds that Pitcher (1987) described during the APA Project studies, so the current status of those groups is not clear. Some of the Global Positioning System (GPS) collars mentioned above were deployed in the area north of the Susitna in the area previously occupied by the Nenana–Susitna subherd, and indications are that a subherd still occupies the upper Susitna drainage.

For as long as records have been kept on the herd, the primary calving grounds of the Nelchina Herd have been centered between the Little Nelchina River and Kosina Creek, south of the upper Susitna River and southeast of the proposed Project (Figure 4.6-10). The average elevation of females located during calving was 1,141 m (3,742 ft). Primary summer range for females was on the northern and eastern slopes of the Talkeetna Mountains (Figure 4.6-11). During spring, calving, and summer, males tended to use habitats at lower elevations and females used highland tundra–herbaceous habitats. During summer and fall, Nelchina caribou disperse over a broad area extending from the Denali Highway near Butte Lake (north of the proposed Watana reservoir) as far east as the Gulkana River (Tobey and Schwanke 2009). During rut in October, caribou were spread from the Talkeetna Mountains east to the foothills of the Wrangell Mountains. Spruce forests were used primarily during rut and winter. The winter distribution is more extensive, ranging from Cantwell and Broad Pass on the west, east through the Alphabet

Hills and Mentasta Mountains, to the area around Tok and almost to the Alaska–Yukon border, in GMU 20E. Formerly, GMU 20E provided high biomass of winter forage (lichens) in old (>50 years) burns, but much of that area burned in 2004, reducing winter forage availability. ADF&G currently maintains an annual sample of 40–60 radio-collared animals in the herd to track seasonal distribution, movements, and productivity (Tobey and Schwanke 2009). The telemetry dataset for the Nelchina Herd consists almost entirely of VHF radio-collars, but 20 GPS collars were deployed on Nelchina females during 1999–2003 (B. Dale, ADF&G, pers. comm.).

Wolves, grizzly bears, and Golden Eagles prey on caribou in the study area. Predator management programs have reduced the number of wolves in the range of the Nelchina Herd since 2001 and calf survival has increased (Tobey and Schwanke 2009).

Caribou from the adjacent Delta Herd to the north have begun moving into the Nelchina Herd range in recent years. During 2006–2008, radio-telemetry revealed that some caribou from the Delta Herd crossed from the north into the upper Susitna drainage along the Denali Highway as far as Butte Lake (Seaton 2009), mixing with Nelchina Herd animals. As many as 15 percent of the females from the Delta Herd may calve south of the Alaska Range (west of the Parks Highway) and some Delta Herd animals now spend most of the summer in GMU 13, but thus far the herds have remained separate during censuses (B. Dale, ADF&G, pers. comm.). Delta Herd animals remain north of the Susitna River and do not use the area of the proposed Watana reservoir, but they occur along the Denali Highway near the potential Project access road route.

Spring migration to calving grounds in the eastern Talkeetna Mountains sometimes crossed the upper portion of the proposed Watana impoundment zone. Historical records indicated that the reservoir would intersect a major migratory route used by pregnant females moving to calving grounds during late April and May, and by females and calves moving from calving grounds to summer range during late June and July (Pitcher 1982). Crossings generally were infrequent but, during spring migration in 1984, 50 percent of female caribou in the main Nelchina Herd crossed the Susitna River from north to south within the proposed Watana impoundment zone (LGL 1985a). Skoog (1968) considered the geographic area in which the Watana impoundment zone was located to be among the most important year-round areas for the herd. Habitat loss was not considered to be an important concern, as only a relatively small area of apparently low-quality habitat would be inundated by the reservoirs (Pitcher 1982). The area of the Devils Canyon impoundment zone was used little by caribou, but the proposed access road from the Denali Highway would have traversed historical summer and winter range.

Because of its proximity and accessibility to residents of Fairbanks and Anchorage, the Nelchina Herd has long been an important resource for hunters. The management goal is to provide for an annual harvest of 3,000–6,000 caribou; actual annual harvests per regulatory year (July 1–June 30) were lower, estimated at 1,087–3,090 animals from 2003/2004 through 2007/2008 (Tobey and Schwanke 2009). Since 1977, Nelchina caribou have been hunted by permit only, and since 1990 almost all permits have been issued only for state and federal subsistence hunts.

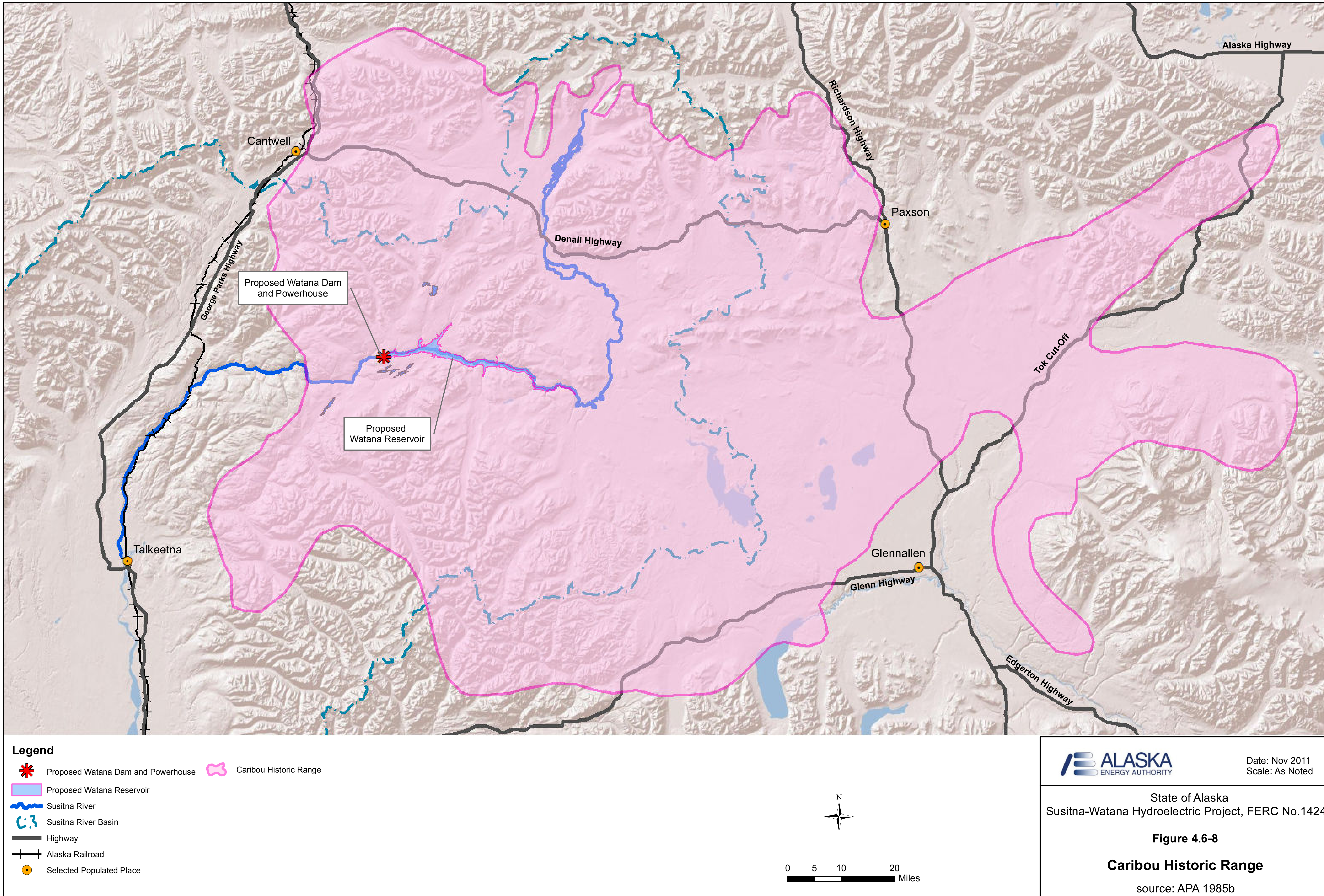

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Figure 4.6-8

Caribou Historic Range

source: APA 1985b

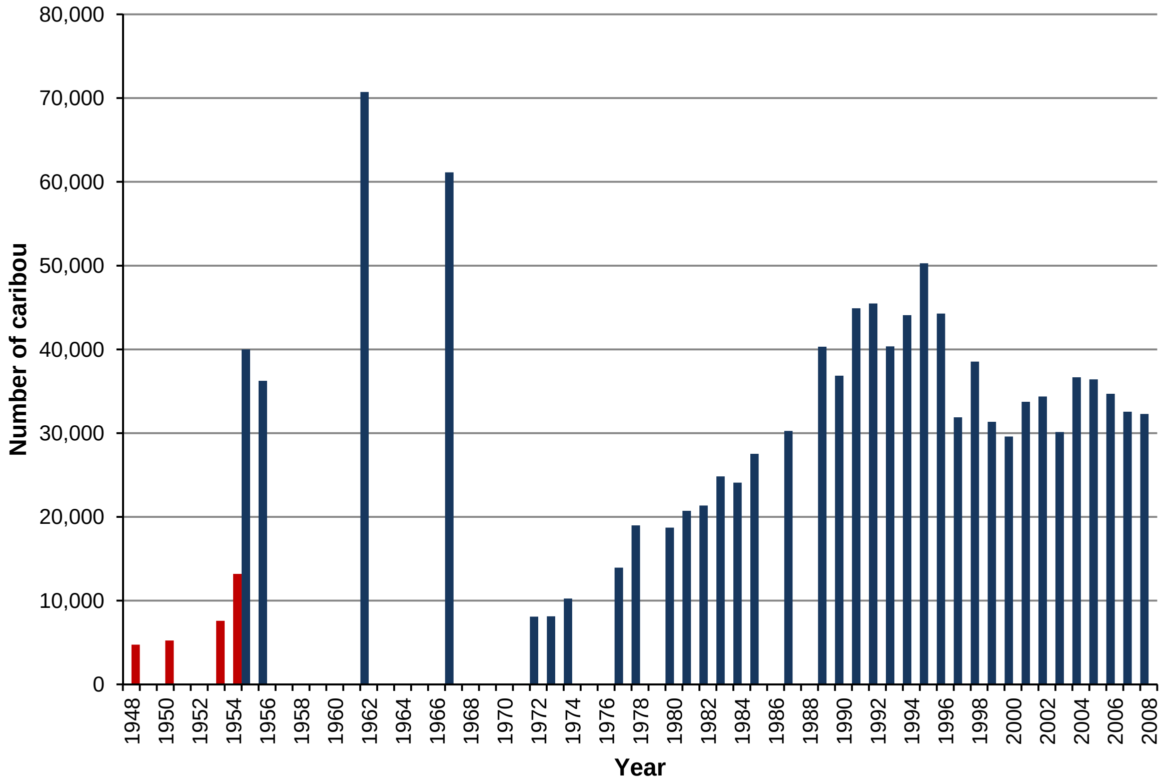

Figure 4.6-9. Estimated population size of the Nelchina Caribou Herd, 1948–2008. Sources: Watson and Scott 1956; Siniff and Skoog 1964; Skoog 1968; Hemming and Glenn 1968; Bos 1973, 1974; Davis 1978; Pitcher 1982, 1987; Tobey 1993, 2001, 2005; Tobey and Kelleyhouse 2007a; Tobey and Schwanke 2009.

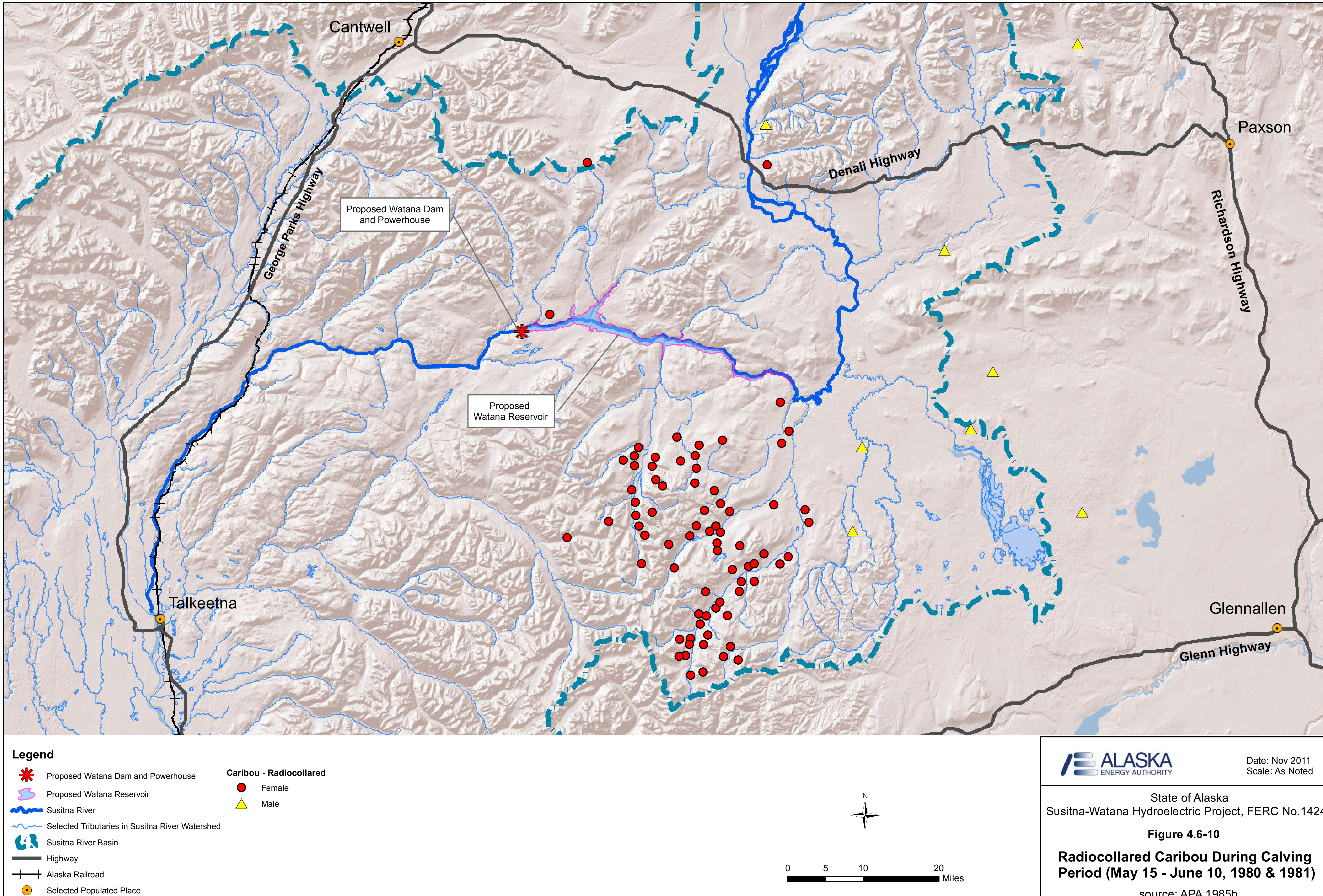

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Figure 4.6-10

Radiocollared Caribou During Calving Period (May 15 - June 10, 1980 & 1981)

source: APA 1985b

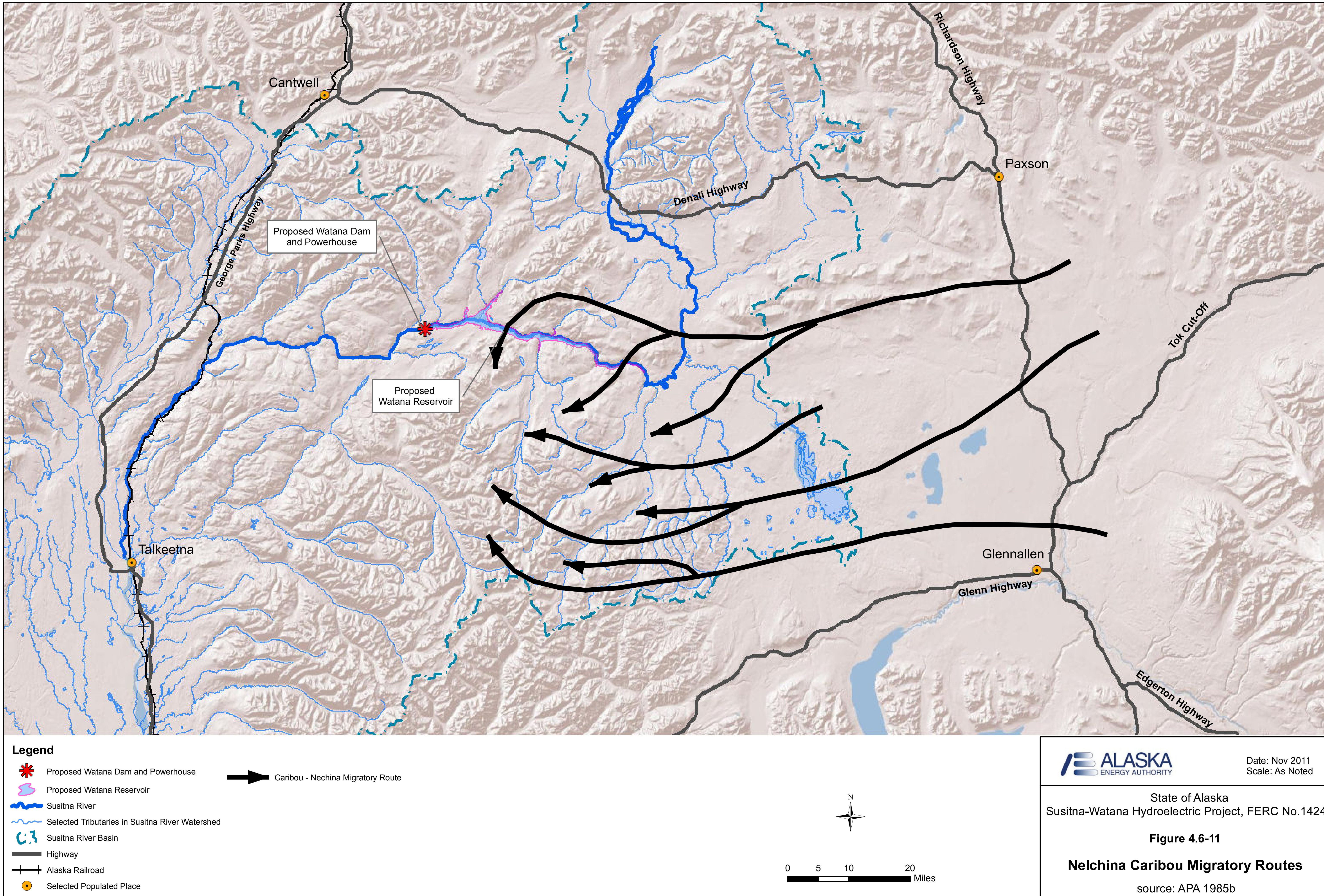

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Figure 4.6-11

Nelchina Caribou Migratory Routes

source: APA 1985b

4.6.2.1.1.3. Dall's Sheep

Dall's sheep occur in the mountains surrounding the proposed Project. ADF&G conducts periodic aerial surveys and compiles harvest reports for sheep in subunits 13A, 13E, 14A and 14B (Talkeetna Mountains and Chulitna–Watana Hills), but the Watana Creek Hills, located north of the proposed Watana reservoir, have received little attention since the APA Project studies ended (Figure 4.6-2). According to the most recent report available, surveys were conducted in the Watana Hills in 1999 and 2003, producing counts of 97 sheep (18 percent lambs) and 50 sheep (14 percent lambs), respectively (Peltier 2008a). In the overall reporting region (subunits 13A, 13E, 14A and 14B), the estimated sheep population has varied substantially through time: 2,500–3,000 in the mid-1970s; ~2,500 in the late 1980s; 2,000–2,500 in 1994 and 2,500–3,000 in 1999, followed by a steep decline to ~1,750 after the severe winter of 1999–2000 (Peltier 2008a). The population subsequently increased from 2000 to 2003, but declined again during 2004–2007. Lohuis (2010) noted that, in general, the sheep population in Southcentral Alaska had declined since 1990. A 3-year study to identify factors limiting population growth of sheep began in 2009 in the central Chugach Mountains (southeast of the Talkeetna Mountains), examining population dynamics in relation to disease and weather factors (e.g., formation of ice layers) that adversely affect sheep.

During 1981–1983, ADF&G surveyed three areas of sheep habitat near the Watana and Devils Canyon dams proposed for the APA Project (Figure 4.6-12, Tankersley 1984): Mt. Watana (south of the Susitna River), Portage Creek–Tsusena Creek–Denali Highway (near the potential access corridor north of the Susitna River), and the Watana Creek Hills (nearest to the proposed Watana reservoir). The study employed aerial surveys in March and June and ground observations of sheep using mineral licks during May–July in the study area. During the Phase I study in 1980–1981, sheep were discovered using a mineral lick below alpine habitat on lower Jay Creek in the Watana Creek Hills, adjacent to the proposed Watana reservoir. Several licks were located along that creek, extending upstream 6.5 km (4 mi) above its confluence with the Susitna River. Another mineral lick, the East Fork lick, was located along Watana Creek, about 12 km (7.5 mi) north of the Jay Creek lick. Investigators quantified use of the lick areas by different sexes and ages of sheep, recorded the seasonal timing of lick use, and collected soil samples for chemical analysis. Sheep used mineral licks primarily between mid-May and mid-June. A minimum of 46 different sheep were recorded using the Jay Creek licks. At least 31 percent of the sheep population observed in 1983 traveled 8 km (5 mi) or more to the Jay Creek lick. Sheep traveled to the area even though another, smaller lick with similar chemical characteristics was located in their alpine range.

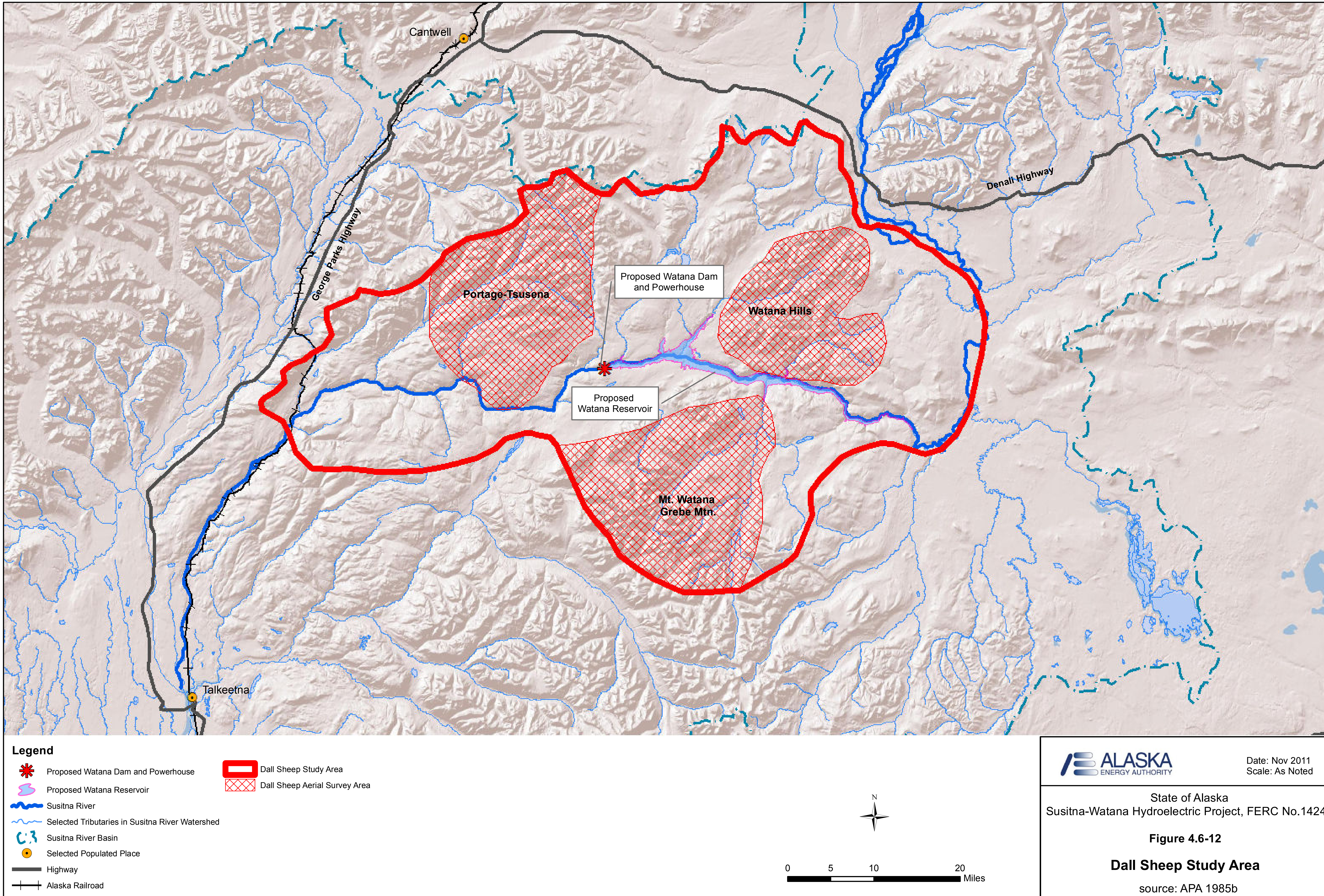

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Figure 4.6-12

Dall Sheep Study Area

source: APA 1985b

4.6.2.1.1.4. Brown Bear

The Alaska Department of Fish and Game periodically estimates brown bear density in various parts of GMU 13 (Figure 4.6-2). Since 1979, those estimates have ranged from 16 to 41 bears/1,000 km² (386 mi²) (Tobey and Kelleyhouse 2007b). Regardless of the method used, Subunits 13A and 13E appear to have some of the highest brown bear densities in interior and northern Alaska (Tobey and Kelleyhouse 2007b). Density estimates in 1985 (27.1 bears/1,000 km²) and 1995 (40.8 bears/1,000 km²) indicate that the population was increasing during that period. In 2000, 2001, and 2003, line-transect surveys were completed in portions of Subunit 13E, producing a preliminary estimate of 32.2 bears/1,000 km².

GMU 13 has been designated by ADF&G for intensive management, so reducing the bear population is a management priority to boost the survival rates of moose and caribou for human consumption. Plans to accomplish population reduction, rely on liberalized bear hunting regulations involving longer seasons and higher bag limits (one bear per hunter per year vs. one bear every four years previously), increasing the mean annual harvest of brown bears from 61 animals during 1975–1978 to 139 animals during 2005–2008 (Miller et al. 2011). Although final results are not yet available, preliminary results comparing capture–mark–resighting (CMR) surveys conducted recently in Subunit 13A West with previous CMR survey results, suggests that the brown bear population in that area may have declined approximately 20 percent after two decades of higher harvests (B. Dale, ADF&G, pers. comm.).

Studies in the western Susitna basin (south of the Alaska Range between the Yentna and Chulitna rivers) during 1998–2000 found that habitat use by brown bears varied significantly within years and among seasons for different bears, and habitat use also differed between daytime and night-time periods. Brown bears foraged heavily at salmon spawning streams and salmon consistently composed a major portion of their diet, making an important contribution to body condition (Belant et al. 2006). Black bears avoided salmon streams occupied by defensive brown bears and instead foraged heavily on berries (Belant et al. 2006, 2009). The importance of salmon to brown bears specifically and to terrestrial ecosystems in general were discussed by Hilderbrand et al. (1999a, 1999b, 2004), who reviewed the role that spawning salmon play in transporting marine-derived nutrients into terrestrial ecosystems, where their consumption by bears and a variety of other wildlife species plays a crucial role in nutrient cycling.

All previous studies of brown bears in relation to the APA Project were conducted upstream of Devils Canyon; no downstream study was conducted for this species. Brown bears were studied from 1980 to 1985, during which time 97 bears were equipped with VHF radio-collars (Miller 1987). Density was estimated at 27.9 bears/1,000 km² (386 mi²; Miller 1987, Miller et al. 1997). Bears used the Watana reservoir inundation 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 (COY). 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 COY tended to stay at higher elevations, possibly to reduce the risk of predation on cubs by male brown bears.

No dens were found in the area that would have been inundated by either of the proposed APA Susitna Hydroelectric Project reservoirs. Den sites were found at elevations in the range of 613–1,625 m (2,010 to 5,330 ft), mostly above the maximal water surface elevation of the proposed Watana reservoir (610 m [2,000 ft]). Miller (1987) mapped approximate den locations and provided detailed descriptions of den sites and dates of entrance and emergence.

Important sources of food for brown bears in the Susitna study area were ungulates, salmon, and berries. Attention was focused heavily on predation rates of brown bears on moose calves (Miller 1987, Ballard and Miller 1990, Ballard et al. 1990). 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, southwest of Stephan Lake (between the proposed Devils Canyon and Watana dam sites), during July and early August to feed on spawning Chinook salmon (LGL 1985a). Despite the availability of protein-rich animal foods, berry production appeared to be the major factor limiting brown bear productivity in the Susitna study area (LGL 1985a).

Miller (1987) estimated berry abundance and canopy coverage within and above both impoundment zones proposed for the original APA Project. Crowberries (*Empetrum nigrum*) were most abundant in the impoundment zones, whereas blueberries (*Vaccinium* spp.) and lowbush cranberries (*Vaccinium vitis-idaea*) were distributed more evenly across the area. 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 APA Susitna Hydroelectric Project reservoirs (Helm and Mayer 1985).

The APA Project study included data on river crossings by bears to facilitate post-construction comparisons (Miller 1987). Brown bears frequently crossed rivers. Of 658 point locations for males, 14.9 percent were on the opposite side of the Susitna River from the preceding location, as were 9.1 percent of 1,668 locations for females. Home ranges of male bears were larger than those of females, so were more likely to span the river. Miller (1987) cited Simpson (1986), who stated that grizzly bears in the vicinity of the Revelstoke Reservoir in British Columbia “would cross a river but not the reservoir.” Also at Revelstoke, Bonar (1985) noted “the radio-collared bears [of both species] haven't crossed as often as they did before the water came up.”

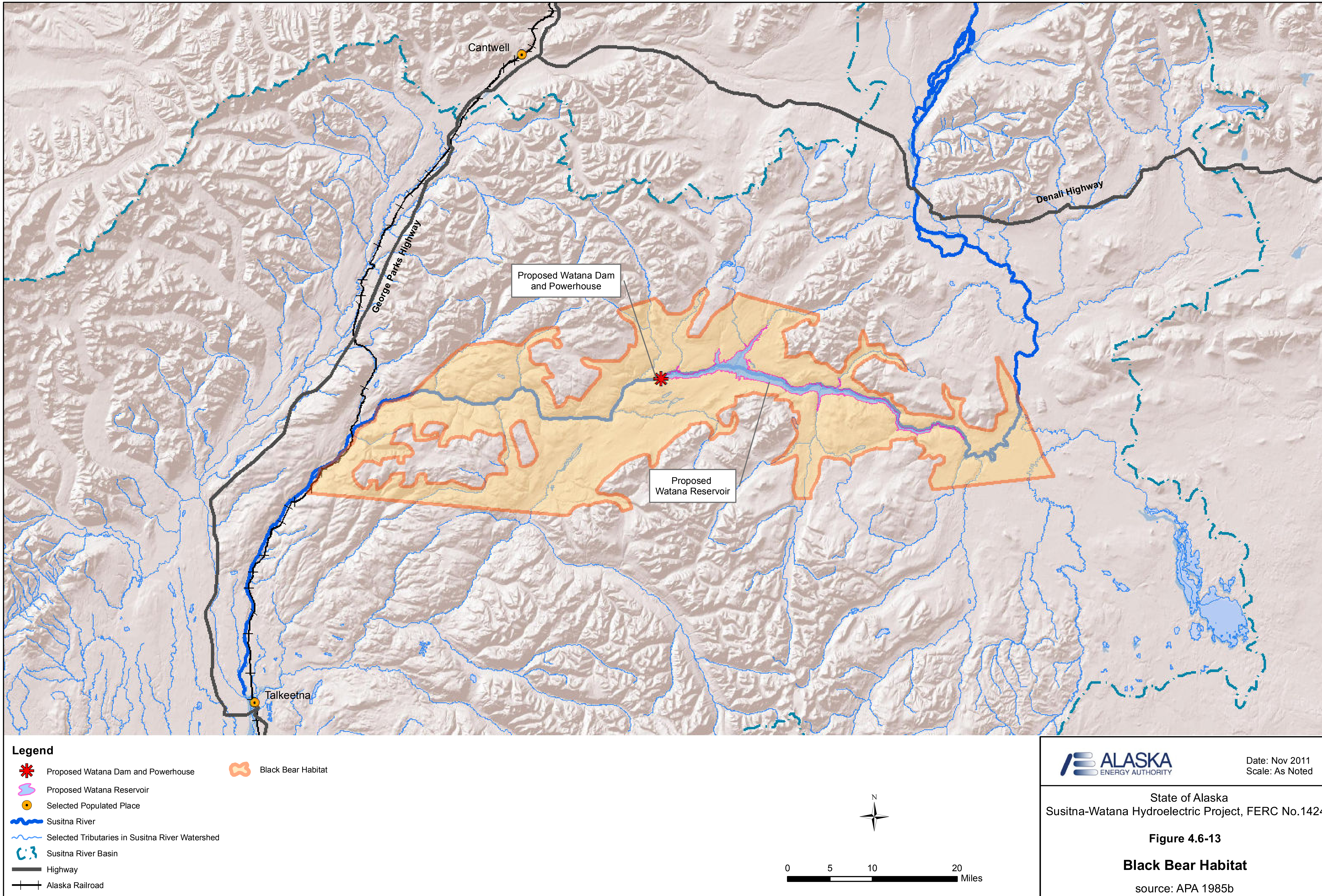
4.6.2.1.1.5. Black Bear

There are no current estimates of population size for black bears in the upstream or downstream study areas along the Susitna River. The most recent report for GMU 13 (Tobey 2008) cited population estimates from the original APA Project studies and the GMU 14 report (Peltier 2008b) contained no population estimates.

Black bear studies for the APA Project were conducted only upstream from Devils Canyon, with the exception of a dietary study in the downstream area. Suitable habitat in the upstream study area was primarily in the immediate vicinity of the Susitna River and its major tributaries (Figure 4.6-13). In contrast to the upstream area, black bear habitat occurred over most of the downstream study area (Miller 1987). At the time of the original APA Project studies, a standardized method for estimating black bear density had not yet been developed (LGL 1985a, Miller 1987). The density of 89.7 bears/1,000 km² (386 mi²) that was estimated for a portion of the study area should, therefore, be interpreted cautiously.

Black bears were particularly abundant in the APA Project impoundment zones during May and June, presumably foraging for overwintered berries and newly emerged plants such as horsetails, and preying on moose calves (the same spring food resources used by brown bears). Of 54 dens found in the vicinity of the proposed Watana reservoir, 30 (55 percent) were in the area that would have been inundated. The rate of reuse of individual dens in the upstream area was high, suggesting that availability of den sites was limited. The historical studies also included data on stream crossing behavior of radio-collared bears to facilitate post-construction comparisons (Miller 1987). Black bears made extensive seasonal movements up and down the river, remaining within the forested habitats along the river.

Although black bears in the upstream area occasionally ate moose calves, berries seemed to be their most important food source (LGL 1985a). 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, near the proposed Watana reservoir (Miller 1987). The potential for human–bear conflicts was higher in those areas because the shrublands were favored sites for camps, borrow areas, and permanent residences (Miller 1987). Berries were an important food for black bears in the downstream area as well. In contrast to the upstream area, movement data showed that black bears in the downstream area moved to riparian areas in July and August. Miller (1987) hypothesized that those black bears were eating salmon along river sloughs; however, he conducted a scat study in late August and concluded that black bears were foraging almost exclusively on the berries of devil’s club (*Oplopanax horridus*) rather than salmon.



ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.6-13

Black Bear Habitat

source: APA 1985b

4.6.2.1.1.6. Wolf

Most of GMU 13 (except Subunit 13D, south of the Glenn Highway; Figure 4.6-2), 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. Wolves have been the target of a number of control programs over the decades, beginning before statehood. Wolves in the Nelchina Basin were reduced to an extremely low level by federal predator control in the late 1940s and early 1950s. After those control efforts ceased in 1959, the population recovered to 300–400 wolves by the mid-1960s and early 1970s, then declined to about 275 animals as harvest increased in the mid 1970s. After land-and-shoot hunting using airplanes was discontinued in 1988, the wolf population of GMU 13 increased rapidly, peaking at 12.4 wolves/1,000 km^2 (386 mi^2) in 1999–2000, for an estimated population of 520 animals (Schwanke 2009). Land-and-shoot hunting was reinstated in January 2004 and the population subsequently declined to about 380 wolves by fall 2004 (Kelleyhouse 2006) and to 254 wolves (6.3 wolves/1,000 km^2) by fall 2007 (Schwanke 2009). Since 2006, the number of wolves has been within the current management goal range of 135–165 wolves (3.3–4.1 wolves/1,000 km^2) for the unit, after the end of the hunting and trapping seasons. Shooting wolves from aircraft has been permitted by ADF&G since the winter of 2006–2007. The wolf population in GMU 13 has consistently shown the potential to increase by 60–120 percent between spring and fall, under general hunting and trapping regulations (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). None of GMU 14 is included in the state's predator control programs, however. Lice infestation has been a problem for wolves in Subunit 14B and adjacent Subunit 16A since at least fall 1998, possibly reducing wolf population size and harvest rates. On the western side of the Susitna River (downstream from about Willow), the western half of Subunit 16A and all of Subunit 16B are included in the state's current predator control program.

In other research in the region, Golden and Rinaldi (2008) investigated the spatial dynamics of wolves in relation to prey availability and human activity in the Nelchina Basin, including investigation of the use of snowmachine trails by wolves. The study ended early after the radio-collared study animals were killed as part of a predator control program, however. Rinaldi (2010) reported that the movements of five packs containing GPS-collared wolves were not influenced in consistent ways by snow conditions and prey distribution. Although they traveled faster on snowmachine trails and used trails more when snowmachine activity was low, wolves neither selected nor avoided linear features.

The wolf study for the APA Project was conducted in the Nelchina Basin and upper Susitna River basin between October 1981 and December 1983 (Ballard et al. 1982, 1983b, 1984), as a continuation of regional research begun in 1975 (Ballard et al. 1981b, Ballard et al. 1987, Ballard and Dau 1983). Wolf packs used almost the entire upper Susitna basin, except for areas above 1,219 m (4,000 ft) elevation. Elevational use varied seasonally, probably in response to changes in relative availability of prey species. For example, the Watana pack depended heavily on moose as a source of food. Within the range of this pack, both moose and wolves occurred at the lowest elevations in February, then generally moved to higher elevations until October before moving downward again during winter.

During the APA Project study period, 13 different packs and a lone individual were documented using areas in or adjacent to the two impoundment zones proposed for that project. In any year, 5–6 wolf packs used the areas that would have been inundated by the APA Susitna Hydroelectirc Project impoundments. Territory sizes of seven intensively monitored packs in 1982–1983 ranged from 329 to 1,559 km^2 (127–602 mi^2) and averaged 1,171 km^2 (452 mi^2).

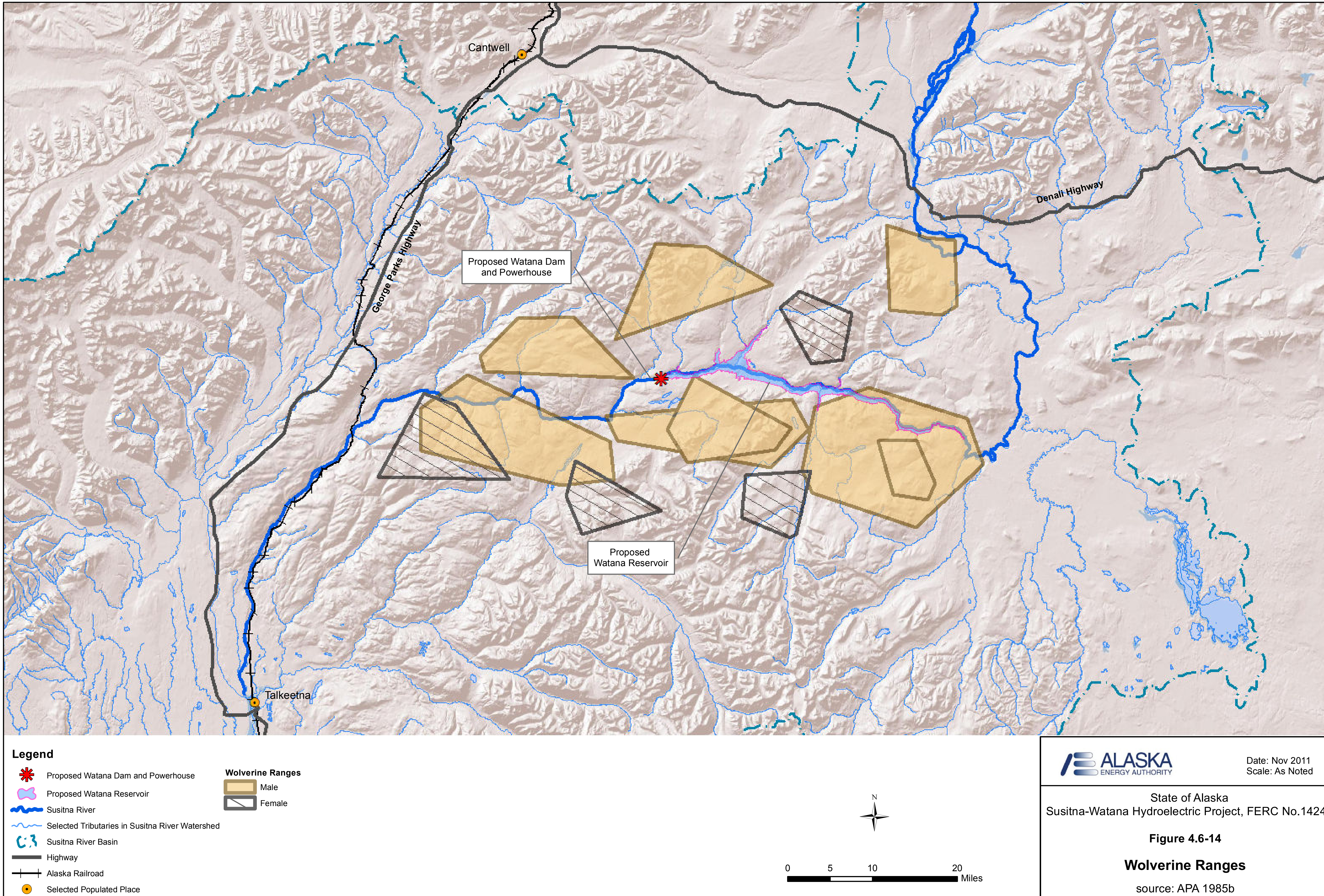
Den and rendezvous sites usually were located on knolls or hillsides with sandy, frost-free soil and mixed, semi-open stands of spruce, aspen and willow (Ballard and Dau 1983). Wolves generally selected sites with south or east exposures and often used dens formerly occupied by red foxes (*Vulpes vulpes)*. The mean elevation for all sites (den and rendezvous) was 777 m (2,550 ft) and the mean distance to water was 257 m (843 ft). The average distance between a den site and its nearest concurrently used neighbor was 45.3 km (28.1 mi). The authors noted that suitable sites for wolf dens appeared to be numerous in the area and that human encroachment was unlikely to result in a shortage of den sites as long as red fox densities remained similar to historical levels.

4.6.2.1.1.7. Wolverine

No further research on wolverines has been conducted in the Susitna basin since the APA Project study ended. During a radio-telemetry study between April 1980 and April 1983 (Figure 4.6-14), ADF&G found that the average annual home-range size of wolverines in the region was 535 km^2 (207 mi^2) for males and 105 km^2 (41 mi^2) for females (Gardner and Ballard 1982; Whitman and Ballard 1983, 1984; Whitman et al. 1986). The sex ratio for the total of 158 wolverines captured for the study or harvested by trappers was 50:50 and approximately 30 percent of the harvested animals were juveniles.

Habitat use by wolverines varied among seasons, with respect to both elevation and vegetation types. The mean elevations at which wolverines were located were 1,043 m (3,422 ft) in July and 818 m (2,684 ft) in January (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 spring and summer diet of wolverines consisted mainly of arctic ground squirrels, other small mammals, and ground-nesting birds, whereas caribou and moose carrion were important winter foods.

New survey techniques have been developed to evaluate the distribution and density of wolverines over large areas of Alaska (Golden et al. 2007, Becker et al. 1998, Magoun et al. 2007, Gardner et al. 2010). Hence, estimates of population density from the earlier APA Project study are not directly comparable.



Cantwell
Denali Highway
George Parks Highway
Proposed Watana Dam and Powerhouse
Proposed Watana Reservoir
Talkeetna
Legend
Proposed Watana Dam and Powerhouse
Proposed Watana Reservoir
Susitna River
Selected Tributaries in Susitna River Watershed
Susitna River Basin
Highway
Alaska Railroad
Selected Populated Place
Wolverine Ranges
Male
Female
N
0
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20
Miles
ALASKA ENERGY AUTHORITY
Date: Nov 2011
Scale: As Noted
State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241
Figure 4.6-14
Wolverine Ranges
source: APA 1985b

4.6.2.1.1.8. Beaver

Beavers (*Castor canadensis*) are common in freshwater aquatic habitats bordered by woody shrub and forest vegetation in the Susitna River basin. 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 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). No recent studies have been conducted on the beaver population in the Susitna River basin. The furbearer reports produced by ADF&G contain general abundance information obtained from trapper questionnaires, but not drainage-specific population data.

Aerial surveys for beaver (and muskrat, *Ondatra zibethicus*) were conducted in the upstream study area during spring and summer 1980 (Gipson et al. 1982). No active beaver lodges or bank dens were found on the Susitna River upstream of Devils Canyon (Gipson et al. 1982). Colonies in the vicinity of the two impoundment zones proposed for the original APA Susitna Hydroelectric Project occurred mostly in lakes between 610 and 730 m (2,000 and 2,400 ft) elevation, relatively close to the planned water-surface level of the proposed Watana reservoir. Colonies also were present in slow-moving sections of most of the larger tributaries, particularly Deadman Creek (Figure 4.6.1).

Beavers were the only furbearers included in the Phase II studies for the APA Project. The beaver was the species selected to predict downstream impacts of the APA Project on furbearers, and was studied almost exclusively in the downstream study area (Gipson et al 1982, 1984; Woolington et al. 1984, 1985; Woolington 1986). Studies employed both aerial surveys to identify locations of lodges and caches and estimate population levels and overwinter survival, as well as boat surveys in summer to assess beaver sign. The river was surveyed in three sections: Devils Canyon to Talkeetna, Talkeetna to Goose Creek, and Goose Creek to the Deshka River. 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. Little to no sign of beaver activity was found in any section of the mainstem of the Susitna River during summer surveys (Gipson et al. 1984). Above Talkeetna, beaver numbers may be limited by a lack of lodge or bank den sites, and high water velocity also may prevent year-round occupation (Gipson et al. 1984). Away from the Susitna River, beaver sign was found along slow-flowing sections of most tributaries, including Portage Creek, the Indian River (especially along a tributary of the Indian River flowing out of Chulitna Pass), streams along the alternative access-road route between Gold Creek and Devils Canyon, and Prairie Creek (Gipson et al. 1984).

Spring and fall counts of lodges and food caches were conducted in the middle reach of the Susitna between Talkeetna and Devils Canyon (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. The number of fall food caches detected varied substantially (Woolington 1986). Observer experience and hydrologic regime were thought to have the greatest effect on the number of caches detected. Beavers build caches during fall as water levels drop and stabilize to winter flow levels. If surveys are conducted before water levels stabilize, cache construction may not yet be underway. It also was possible that the initiation date of cache construction varied by habitat (main channel, slough, side channel, etc.), although Woolington (1986) found little evidence to support that idea. The beaver population inhabiting the floodplain in that reach of river was estimated by assuming that each cache represented five beavers. Between 1982 and 1985, that population was estimated at 70–220 beavers.

Overwinter survival of colonies during 1983–1984 was high due to a mild spring in 1984; 23 of 27 colonies survived. Two lodges along the main channel and one along an upland slough were partially destroyed by ice during breakup (Woolington et al. 1984). During 1984–1985, at least 23 of 45 colonies successfully overwintered (Woolington et al. 1985). All evidence of caches or lodges was destroyed during breakup at 10 sites, 7 of which were on the main channel. Flooding caused by ice jams destroyed lodges in two sloughs and one side channel. Survival of colonies was higher in sloughs than in side channels. Survival was lowest in the main channel. Overwinter survival estimates were considered essential to assess the effects of river flooding and ice-scour on beaver colonies (Woolington et al. 1985).

During summer, beavers fed primarily on a variety of herbaceous plants, whereas during fall and winter they ate mostly willows (*Salix* spp.), balsam popular (*Populus balsamifera*), and some birch (*Betula* spp.) (Gipson et al. 1984). Alders (*Alnus* spp.) typically were not eaten, but beavers used them preferentially for construction purposes.

Habitat use varied among years, which may have been due to variability in August and September flows (Woolington 1986). When flow rate was high, the number of caches constructed along the main channel was low, but when flow rates were stable by August, then caches were distributed fairly evenly among the main channel, side sloughs, and upland sloughs.

4.6.2.1.1.9. Other Furbearers

Other species of furbearers occurring in the Susitna River basin include river otter (*Lontra canadensis*), marten (*Martes americana*), mink (*Neovison vison*), ermine (*Mustela erminea*), least weasel (*Mustela nivalis*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), lynx (*Lynx canadensis*), and muskrat (*Ondatra zibethicus*). No detailed studies of furbearers in the Susitna basin have been conducted since the original APA Project studies ended. ADF&G management reports for furbearers (e.g., Schwanke and Tobey 2007) do not include data on density, population estimates, or habitat preferences. Rather, they present results of trapper questionnaires as a way of assessing the general abundance of furbearer species and their importance to people. Marten are considered to be the most important furbearer species for trappers in GMU 13 (Schwanke and Tobey 2007), but harvest data are unavailable because marten hides from that unit do not have to be sealed, unlike wolf, wolverine, beaver, lynx, and river otter.

The APA Project included studies specific to marten, red fox, and muskrat. Observations of coyote, lynx, and weasels, however, were recorded incidentally to other work (Gipson et al. 1982, 1984; Buskirk 1983, 1984; Buskirk and MacDonald 1984; Buskirk and McDonald 1989; Hobgood 1984).

4.6.2.1.1.9.1. Marten

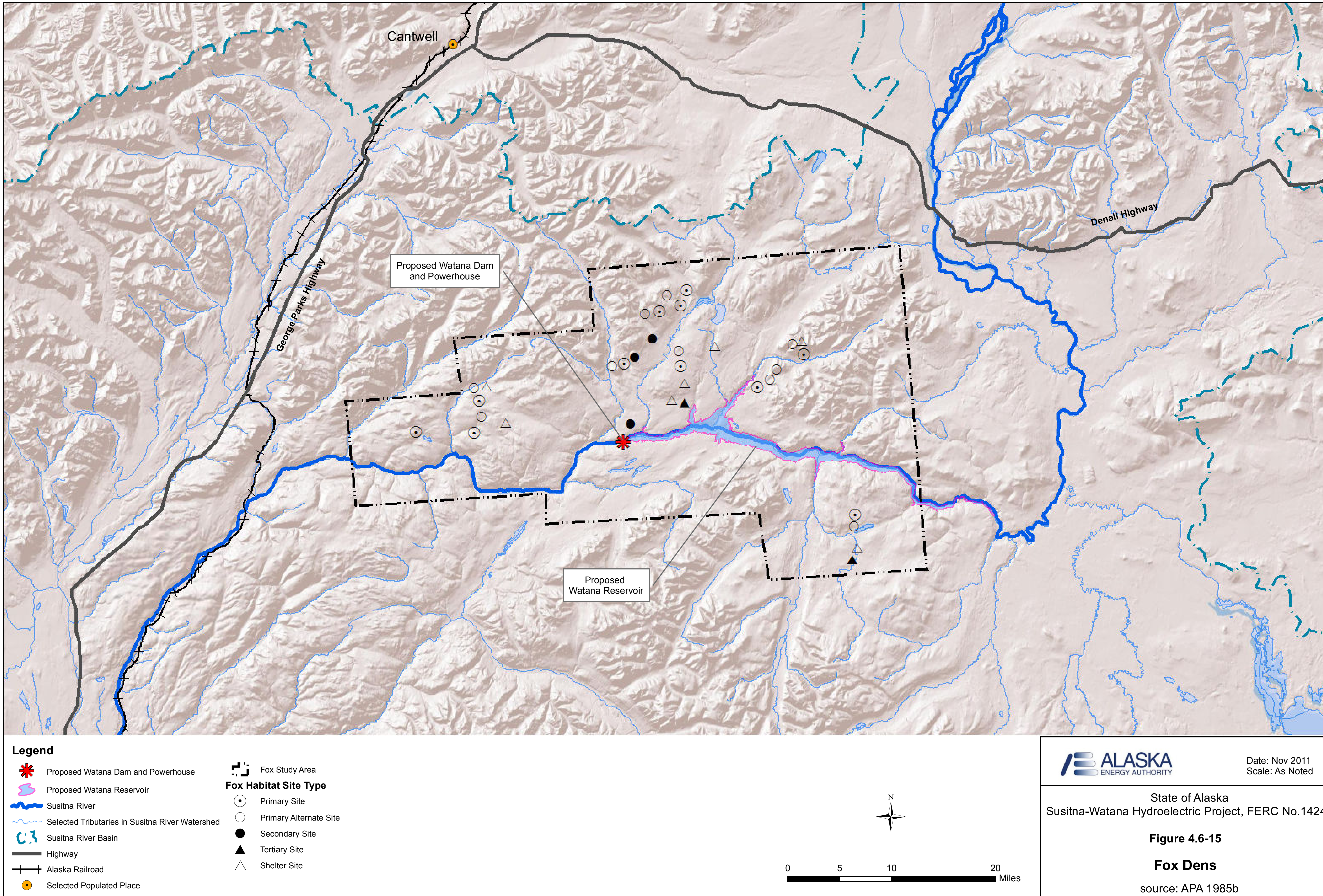
The population density of marten in the area that would have been inundated by both of the original APA Susitna Hydroelectric Project reservoirs was estimated at 84.7 animals/100 km² (38.6 mi²), based on aerial track surveys, estimates of home-range size, and habitat associations (Gipson et al. 1984). Marten occurred from Portage Creek to the Tyrone River, but their density was highest between Devil Creek and Vee Canyon (Gipson et al. 1982) (Figure 4.6.1). The total population of marten in both impoundment zones was estimated as a minimum of 218 animals, but aerial track surveys suggested that the population could be up to twice that number (Gipson et al. 1984). Nearly three times as many marten were estimated to inhabit the Watana impoundment zone as the Devils Canyon impoundment zone (Gipson et al. 1982). Marten rarely crossed water that would require them to swim; the Susitna River and larger creeks formed home range boundaries (Gipson et al. 1982).

Marten were most common in coniferous and mixed forest below 1,000 m (3,281 ft) elevation (Gipson et al. 1982). Habitat use in the study area was measured by the numbers of tracks observed during winter in different vegetation types (Gipson et al. 1984). Marten tracks occurred most frequently in forest and woodland cover types and less frequently in shrub cover types, in relation to the availability of those types in the survey area (Gipson et al. 1984). Winter resting sites typically were located in old or active squirrel nests (Gipson et al. 1984). Food habits were studied by analyzing marten scat and gastrointestinal tract contents (Gipson et al. 1984). Microtine rodents and squirrels were the most important food classes during fall, winter, and spring. Too few marten scats were collected during summer to include in seasonal analyses.

4.6.2.1.1.9.2. Red Fox

Denning surveys showed that the most red fox dens by far occurred on the north side of the upstream reach of the Susitna River (Figure 4.6-15), despite extensive searches on the south side (Gipson et al. 1982). Typical den locations were 1,000–1,200 m (3,280–3,936 ft) elevation on south-facing slopes with sandy soils and a good view of the surrounding area; most dens were adjacent to lakes. The population density in the study area was estimated at 1 family/83 km² (32 mi²; Gipson et al. 1982).

Winter surveys found most fox tracks at 516–1,129 m (1,692–3,704 ft) elevation and track density increased with distance upstream from Devils Canyon (Gipson et al. 1982). Track densities were similar on both sides of the river except for the area between Kosina Creek and the Tyone River, where tracks were more abundant on the south side of the river, most likely due to the presence of dispersing foxes. A major dispersal period occurred in mid-November (Gipson et al. 1984), when dispersers generally moved toward the upper reaches of the river, crossing from the north side to the south side. On the south side of the river, the habitat above Vee Canyon transitioned to marshy flats, which provided good foraging habitat for foxes (Gipson et al. 1982). Radiotelemetry data showed that dispersing foxes readily crossed the Susitna River (Gipson et al. 1982).



Cantwell
George Parks Highway
Denali Highway
Proposed Watana Dam and Powerhouse
Proposed Watana Reservoir
Legend
Proposed Watana Dam and Powerhouse
Proposed Watana Reservoir
Susitna River
Selected Tributaries in Susitna River Watershed
Susitna River Basin
Highway
Alaska Railroad
Selected Populated Place
Fox Study Area
Fox Habitat Site Type
Primary Site
Primary Alternate Site
Secondary Site
Tertiary Site
Shelter Site
N
0 5 10 20
Miles
ALASKA ENERGY AUTHORITY
Date: Nov 2011
Scale: As Noted
State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241
Figure 4.6-15
Fox Dens
source: APA 1985b

4.6.2.1.1.9.3. Muskrat

Aerial surveys for muskrat pushups were flown upstream from Gold Creek during spring 1980 (Gipson et al. 1982). Muskrat sign was seen most often in lakes on plateaus above the river valley, at 610–730 m (2,001–2,395 ft) elevation. Muskrat in the upstream area appeared to depend on fairly small, isolated areas of wetland habitats. Muskrat 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.

4.6.2.1.1.9.4. Other Species

Other species, including river otter, mink, and weasels, were included in track surveys flown along the Susitna River upstream from Devils Canyon (Gipson et al. 1982). River otters were distributed fairly evenly throughout the upper Susitna drainage below 1,200 m (3,936 ft) elevation. During a November survey, large numbers of otter tracks were seen on shelf ice along the Susitna River; those otters may have been feeding on grayling as the fish left tributaries to overwinter in the Susitna. Mink tracks were observed along all major tributaries below 1,200 m elevation; 50 percent of all mink tracks were in the upper reaches of the Watana impoundment zone. Most (87 percent) of the weasel tracks recorded were in the upper reaches of the study area near the Oshetna River; overall, 80 percent of weasel tracks were found in black spruce woodland or medium-height shrubland. Studies of furbearers in the downstream area were limited to a single August survey of beaver and muskrat along the Susitna River from Devils Canyon to Cook Inlet (Gipson et al. 1982).

4.6.2.1.1.10. Small Mammals

Small mammals found in the Susitna River basin include the snowshoe hare (*Lepus americanus*), porcupine (*Erithizon dorsatum*), hoary marmot (*Marmota caligata*), arctic ground squirrel (*Spermophilus parryii*), red squirrel (*Tamiasciurus hudsonicus*), pika (*Ochotona collaris*), several species of voles, mice, and shrews, and the little brown bat (*Myotis lucifugus*) (Table 4.6-1). The meadow jumping mouse (*Zapus hudsonius*) was not recorded during the original APA Susitna Hydroelectric Project studies but has since been documented from the middle Susitna River (MacDonald and Cook 2009). The occurrence of the northern flying squirrel (*Glaucomys sabrinus*) in the region is unknown and in need of clarification (MacDonald and Cook 2009) but, if present, the species probably does not occur in the middle or upper reaches.

The species composition, relative abundance, and habitat use of small mammals in the middle and upper Susitna River basin were studied in 1980 and 1981 along 49 trapline transects (using both snap-traps and pitfall traps) located in a variety of different habitat types (Kessel et al. 1982). The little brown bat and water shrew were not captured during the APA Project study but were included in the list of species based on sight records and tracks, respectively (Kessel et al. 1982), and on specimen data collected in the surrounding region since the APA Project studies ended. The study area for small mammal studies 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 mi) on each side of the Susitna River. No surveys of small mammals were conducted downstream of Sherman.

The most abundant and widespread small mammal species in the study area were the cinereus shrew (*Sorex cinereus*), northern red-backed vole (*Myodes rutilus*), and arctic ground squirrel. Red-backed voles and ground squirrels were thought to be the most important prey species for predators (both birds and mammals) in the upper Susitna River basin. Population levels of most shrews and voles varied considerably during the study period, but their relative abundance rankings remained unchanged. Patterns of habitat occupancy among these species indicated that shrews and red-backed voles were habitat generalists, exploiting a wide range of vegetation types, whereas meadow voles, tundra voles, singing voles, and lemmings were habitat specialists, using a narrower range of tundra and herbaceous vegetation types. Meadow voles and singing voles were the most selective, with the former preferring wet and mesic sedge–grass meadows and the latter preferring herbaceous shrub tundra. Habitat occupancy patterns were affected by changes in density and probably by competition among species.

Six species of small mammals occurring in the study area were not sampled directly by Kessel et al. (1982): arctic ground squirrel, hoary marmot, collared pika, red squirrel, porcupine, and snowshoe hare. Of those species, the arctic ground squirrel was the most abundant in the upstream study area and was considered to be ecologically important. Collared pikas and hoary marmots were locally common in alpine habitats, whereas red squirrels, snowshoe hares, and porcupines were fairly common to uncommon in forest and shrub habitats at lower elevations. Snowshoe hares, which constitute an important prey species for predators throughout interior Alaska, generally were restricted in the upper basin to areas east of Watana Creek. Localized high-density pockets of hares occurred in the vicinities of Jay Creek, Goose Creek, and the lower Oshetna River. Long-term information on hare abundance, provided by several local residents, suggested that the low numbers of hares in 1980 and 1981 were typical for the area, rather than representing a low phase in a population cycle.

No detailed studies of small mammals in the Susitna River basin have been conducted since the original APA Project studies. Species inventories are available in neighboring regions such as Denali National Park and Preserve (Cook and MacDonald 2003) and Fort Richardson near Anchorage (Peirce 2003), and long-term population monitoring (1992–2005) of three species of voles was conducted in Denali National Park and Preserve (Rexstad and Debevec 2006).

The most noteworthy change since completion of the original APA Project studies is the recognition and description of a new species — the Alaska tiny shrew (*Sorex yukonicus*; Dokuchaev 1997), the smallest mammal in North America. The earliest specimen was trapped in 1982 near the upper Susitna River during the original APA Project study, but was identified at the time as a cinereus shrew. By the late 1990s, the species had been recorded over a broad area of interior, western, and northern Alaska, and inventory and monitoring efforts on national parklands in 2000 through 2003 added greatly to the knowledge of the species. By 2007, the total number collected statewide had increased to 38 specimens from at least 22 locations (MacDonald and Cook 2009). Early information on habitat affinities indicated it occurred primarily in riparian habitats, but as trapping efforts expanded, it also was captured in scrub habitats.

The Alaska Natural Heritage Program classifies the Alaska tiny shrew as “unrankable” globally (GU), presumably because little information is available, and as “vulnerable” in the state (S3; AKNHP 2011a), probably due to its restricted range and relatively few populations. The species is listed as a sensitive species by BLM (2010a), presumably because of its S3 ranking by AKHNP. That ranking warrants further scrutiny, however, in view of the species' cryptic nature, the possibility of misidentification, the difficulty of capture, and its widespread distribution, as documented by inventory work in various parts of the state in the relatively brief time since the species was described (MacDonald and Cook 2009). Shrews generally are underrepresented in older studies due to sampling methods used at the time.

Other changes since the original APA Project studies have involved taxonomic and nomenclatural changes for various species. For example, the tundra shrew was split from the arctic shrew, which no longer is considered to occur in Alaska, and the names of several genera have changed (MacDonald and Cook 2009).

4.6.2.1.1.11. Marine Mammals

Two species of marine mammals, the harbor seal (*Phoca vitulina*) and the Cook Inlet beluga whale , seasonally utilize the Susitna River delta area.

All marine mammals are afforded protection under the Marine Mammal Protection Act (MMPA); additionally, Cook Inlet beluga whales are classified as endangered under the ESA and critical habitat has been designated for the whales that includes the Susitna River area. The Cook Inlet distinct population segment (DPS) of the beluga whale is the most abundant marine mammal in upper Cook Inlet and, specifically, in Susitna delta area. Cook Inlet beluga whales are discussed in Section 4.8.1.3.

Harbor seals also frequently occur in the delta.The Gulf of Alaska stock of harbor seals, which includes Cook Inlet seals, is not classified as a strategic or depleted stock and is not listed under the ESA (Allen and Angliss 2010). New genetic information on harbor seals in Alaska which indicates the current division of Alaskan harbor seals into the Southeast Alaska, Gulf of Alaska, and Bering Sea stocks needs to be reassessed. The most recent population estimate for this stock was 45,975 (Allen and Angliss 2010).

Harbor seals are more abundant in lower Cook Inlet than in the upper inlet, but they also occur in upper Cook Inlet throughout the year. A traditional haulout site is located near the West Forelands, although harbor seals have also been reported to haulout intermittently near the Susitna River delta and in Turnagain Arm at Chickaloon Bay (Nemeth et al. 2007).

In Cook Inlet, harbor seals are year-round residents; they move into the upper inlet in summer, coinciding with movements of their anadromous fish prey such as eulachon and salmon. Harbor seals occasionally forage near river mouths during summer and fall salmon runs when fish aggregate there typically in large numbers. During salmon runs, seals have been observed in upper Cook Inlet in the Susitna River and are believed to enter other Cook Inlet rivers (e.g., Shelden et al. 2008; Shelden, Rugh, et al. 2009; Shelden, Goetz, et al. 2009). Harbor seals were seen at the Susitna Delta during offshore surveys from May through October 2006 (Nemeth et al. 2007). Harbor seals were seen in 71 different events, totaling 130 individual seals. Harbor seals were sighted during all months of the study period, with two-thirds of sightings occurring in May and June. Harbor seals were seen on 72 occasions during offshore surveys, for a total of 130 individual harbor seals. The most seals sighted were in the mouth or delta of the Susitna River during June, with seals sighted adjacent to, or hauled out on the mudflats. The most common group size was one or two individuals, however, on June 2, a group of 48 were observed; eight of the seals in this large group in the water adjacent to the mudflats and the remaining 40 were hauled out on the edge of the mudflats. Sightings declined steeply in July with only four sightings in the Susitna Flats area. From July through October, harbor seals were rarely seen in the Susitna Flats area (Nemeth et al. 2007). During winter, seals are absent from the upper inlet and have likely moved into the lower inlet.

4.6.2.1.2. Birds

At least 142 bird species are known or are likely to occur in the Susitna basin (Table 4.6-2), of which 135 were recorded in the upper and middle basins during the APA Project studies in 1980–1981 (Kessel et al. 1982). All migratory species of birds are protected under the federal Migratory Bird Treaty Act and several migratory bird conventions. Eagles also are protected under the federal Bald and Golden Eagle Protection Act.

Since the original APA Project studies ended in the 1980s, a number of bird species have been identified by various entities as being of conservation or management concern. Most relevant to this analysis is the *Memorandum of Understanding between the Federal Energy Regulatory Commission and the U.S. Department of the Interior United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, “Responsibilities of Federal Agencies to protect Migratory Birds,”* which went into effect on March 30, 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 (1) listed by USFWS as Birds of Conservation Concern (USFWS 2008); (2) priority migratory species identified in various bird conservation plans (BPIF 1999; Kushlan et al. 2002, 2006; ASG 2008); (3) species or populations of waterfowl of high or moderately high continental importance (NAWMP 2004); (4) species listed as threatened or endangered under the ESA (which also are listed as Birds of Conservation Concern, USFWS 2008); and (5) gamebirds of management concern (USFWS 2009a). In addition to those lists, the State of Alaska identifies “featured species” in its comprehensive Wildlife Conservation Strategy, and BLM has created a list of sensitive species (BLM 2010a) and a related “watchlist” of species about which concern has been expressed (BLM 2010b), but which have not been classified as sensitive species.

The resulting list of 103 special status bird species potentially occuring in the Susitna River basin can be found in Section 4.8.1.2 (Table 4.8-2).

Table 4.6-2. Bird species recorded, or likely to occur, in the Susitna River basin (reprinted from ABR 2011b).

English Name	Scientific Name	Status[1]	Relative Abundance[2]
Greater White-fronted Goose	*Anser albifrons*	M	uncommon
Snow Goose	*Chen caerulescens*	M	uncommon
Brant	*Brant bernicla*	M	not present
Canada Goose	*Branta canadensis*	M	uncommon
Trumpeter Swan	*Cygnus buccinator*	B	fairly common
Tundra Swan	*Cygnus columbianus*	M	uncommon
Gadwall	*Anas strepera*	M, S	rare
American Wigeon	*Anas americana*	B	fairly common
Mallard	*Anas platyrhynchos*	B	common
Blue-winged Teal	*Anas discors*	M	rare
Northern Shoveler	*Anas clypeata*	B	uncommon
Northern Pintail	*Anas acuta*	B	common
Green-winged Teal	*Anas crecca*	B	fairly common
Canvasback	*Aythya valisineria*	M	uncommon
Redhead	*Aythya americana*	M	uncommon
Ring-necked Duck	*Aythya collaris*	M	rare
Greater Scaup	*Aythya marila*	B	common
Lesser Scaup	*Aythya affinis*	B	common
Harlequin Duck	*Histrionicus histrionicus*	B	fairly common
Surf Scoter	*Melanitta perspicillata*	B	fairly common
White-winged Scoter	*Melanitta fusca*	M	fairly common
Black Scoter	*Melanitta americana*	B	fairly common
Long-tailed Duck	*Clangula hyemalis*	B	fairly common
Bufflehead	*Bucephala albeola*	M	uncommon
Common Goldeneye	*Bucephala clangula*	B	fairly common
Barrow's Goldeneye	*Bucephala islandica*	B	fairly common
Common Merganser	*Mergus merganser*	B	uncommon
Red-breasted Merganser	*Mergus serrator*	B	uncommon
Ruffed Grouse	*Bonasa umbellus*	R	rare
Spruce Grouse	*Falcipennis canadensis*	R	fairly common
Willow Ptarmigan	*Lagopus lagopus*	R	common
Rock Ptarmigan	*Lagopus muta*	R	common
White-tailed Ptarmigan	*Lagopus leucura*	R	uncommon
Red-throated Loon	*Gavia stellata*	B	uncommon
Pacific Loon	*Gavia pacifica*	B	uncommon

English Name	Scientific Name	Status[1]	Relative Abundance[2]
Common Loon	*Gavia immer*	B	fairly common
Horned Grebe	*Podiceps auritus*	B	uncommon
Red-necked Grebe	*Podiceps grisegena*	B	uncommon
Double-crested Cormorant	*Phalacrocorax auritus*	?	rare
Osprey	*Pandion haliaetus*	M	rare
Bald Eagle	*Haliaeetus leucocephalus*	B	uncommon
Northern Harrier	*Circus cyaneus*	B	fairly common
Sharp-shinned Hawk	*Accipiter striatus*	B	uncommon
Northern Goshawk	*Accipiter gentilis*	B	uncommon
Red-tailed Hawk	*Buteo jamaicensis*	B	uncommon
Golden Eagle	*Aquila chrysaetos*	B	fairly common
American Kestrel	*Falco sparverius*	M	rare
Merlin	*Falco columbarius*	B	uncommon
Gyrfalcon	*Falco rusticolus*	R	uncommon
Peregrine Falcon	*Falco peregrinus*	M	unknown
Sandhill Crane	*Grus canadensis*	M	uncommon
American Golden-Plover	*Pluvialis dominica*	B	common
Semipalmated Plover	*Charadrius semipalmatus*	B	uncommon
Spotted Sandpiper	*Actitis macularius*	B	common
Solitary Sandpiper	*Tringa solitaria*	B	uncommon
Wandering Tattler	*Tringa incana*	B, M	uncommon
Greater Yellowlegs	*Tringa melanoleuca*	B	uncommon
Lesser Yellowlegs	*Tringa flavipes*	B, M	fairly common
Upland Sandpiper	*Bartramia longicauda*	B	rare
Whimbrel	*Numenius phaeopus*	B	uncommon
Unidentified turnstone	*Arenaria* sp.	M	rare
Surfbird	*Aphriza virgata*	B	rare
Sanderling	*Calidris alba*	M	rare
Semipalmated Sandpiper	*Calidris pusilla*	B, M	uncommon
Least Sandpiper	*Calidris minutilla*	B	fairly common
Baird's Sandpiper	*Calidris bairdii*	B	uncommon
Pectoral Sandpiper	*Calidris melanotos*	M	uncommon
Long-billed Dowitcher	*Limnodromus scolopaceus*	M	uncommon
Wilson's Snipe	*Gallinago delicata*	B	common
Red-necked Phalarope	*Phalaropus lobatus*	B	fairly common
Black-legged Kittiwake	*Rissa tridactyla*	M	rare
Bonaparte's Gull	*Chroicocephalus philadelphia*	B, S	uncommon
Mew Gull	*Larus canus*	B, S	common

English Name	Scientific Name	Status[1]	Relative Abundance[2]
Herring Gull	*Larus argentatus*	M, S	uncommon
Arctic Tern	*Sterna paradisaea*	B	fairly common
Parasitic Jaeger	*Stercorarius parasiticus*	M	rare
Long-tailed Jaeger	*Stercorarius longicaudus*	B	fairly common
Great Horned Owl	*Bubo virginianus*	R	uncommon
Snowy Owl	*Bubo scandiacus*	M	rare
Northern Hawk Owl	*Surnia ulula*	R	uncommon
Short-eared Owl	*Asio flammeus*	B?, M, S	uncommon
Boreal Owl	*Aegolius funereus*	R	rare
Belted Kingfisher	*Megaceryle alcyon*	B	uncommon
Yellow-bellied Sapsucker	*Sphyrapicus varius*	?	rare
Downy Woodpecker	*Picoides pubescens*	R	uncommon
Hairy Woodpecker	*Picoides villosus*	R	uncommon
American Three-toed Woodpecker	*Picoides dorsalis*	R	uncommon
Black-backed Woodpecker	*Picoides arcticus*	R	rare
Northern Flicker	*Colaptes auratus*	B	uncommon
Olive-sided Flycatcher	*Contopus cooperi*	B	uncommon
Western Wood-Pewee	*Contopus sordidulus*	B	rare
Alder Flycatcher	*Empidonax alnorum*	B	uncommon
Say’s Phoebe	*Sayornis saya*	B	uncommon
Eastern Kingbird	*Tyrannus tyrannus*	A	accidental
Northern Shrike	*Lanius excubitor*	B	uncommon
Gray Jay	*Perisoreus canadensis*	R	common
Black-billed Magpie	*Pica hudsonia*	R	uncommon
Common Raven	*Corvus corax*	R	common
Horned Lark	*Eremophila alpestris*	B	common
Tree Swallow	*Tachycineta bicolor*	B	fairly common
Violet-green Swallow	*Tachycineta thalassina*	B	fairly common
Bank Swallow	*Riparia riparia*	B	common
Cliff Swallow	*Petrochelidon pyrrhonota*	B	common
Black-capped Chickadee	*Poecile atricapillus*	R	uncommon
Boreal Chickadee	*Poecile hudsonicus*	R	fairly common
Brown Creeper	*Certhia americana*	B	uncommon
American Dipper	*Cinclus mexicanus*	R	uncommon
Golden-crowned Kinglet	*Regulus satrapa*	M	uncommon
Ruby-crowned Kinglet	*Regulus calendula*	B	common
Arctic Warbler	*Phylloscopus borealis*	B	fairly common
Northern Wheatear	*Oenanthe oenanthe*	B	uncommon

English Name	Scientific Name	Status[1]	Relative Abundance[2]
Townsend's Solitaire	*Myadestes townsendi*	B	uncommon
Gray-cheeked Thrush	*Catharus minimus*	B	fairly common
Swainson's Thrush	*Catharus ustulatus*	B	fairly common
Hermit Thrush	*Catharus guttatus*	B	common
American Robin	*Turdus migratorius*	B	common
Varied Thrush	*Ixoreus naevius*	B	common
American Pipit	*Anthus rubescens*	B	common
Bohemian Waxwing	*Bombycilla garrulus*	B	common
Lapland Longspur	*Calcarius lapponicus*	B	abundant
Smith's Longspur	*Calcarius pictus*	B	uncommon
Snow Bunting	*Plectrophenax nivalis*	B	fairly common
Orange-crowned Warbler	*Oreothlypis celata*	B	uncommon
Yellow Warbler	*Dendroica petechia*	B	rare
Yellow-rumped Warbler	*Dendroica coronata*	B	common
Townsend's Warbler[3]	*Dendroica townsendi*	?	?
Blackpoll Warbler	*Dendroica striata*	B	fairly common
Northern Waterthrush	*Parkesia noveboracensis*	B	fairly common
Wilson's Warbler	*Wilsonia pusilla*	B	common
American Tree Sparrow	*Spizella arborea*	B	abundant
Savannah Sparrow	*Passerculus sandwichensis*	B	abundant
Fox Sparrow	*Passerella iliaca*	B	fairly common
Lincoln's Sparrow	*Melospiza lincolnii*	B	uncommon
White-crowned Sparrow	*Zonotrichia leucophrys*	B	abundant
Golden-crowned Sparrow	*Zonotrichia atricapilla*	B	uncommon
Dark-eyed Junco	*Junco hyemalis*	B	common
Rusty Blackbird	*Euphagus carolinus*	B?, M, S	uncommon
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	B	common
Pine Grosbeak	*Pinicola enucleator*	R	uncommon
White-winged Crossbill	*Loxia leucoptera*	B, S	fairly common
Common Redpoll	*Acanthis flammea*	R	abundant
Pine Siskin	*Spinus pinus*	B	uncommon

[1] M = migrant (transient); B = breeding; S = summering; R = resident; ? = uncertain (Kessel et al. 1982; APA 1985b: Appendices E5.3 and E6.3).
[2] From Kessel et al. (1982) and APA (1985b: Appendices E5.3 and E6.3).
[3] Added here by ABR, based on probable occurrence in lower basin (Matsuoka et al. 1997).

4.6.2.1.2.1. Raptors

The FERC license application for the APA Project (APA 1983) provided information on 53 nesting locations used by raptors and ravens in the middle and upper Susitna River basin. Those locations were discovered during raptor surveys conducted in 1974 (White 1974), 1980-1981 (Kessel et a1. 1982), and during field work on other avian species in the project area in 1982. Later surveys identified 14 more raptor nesting locations, bringing the total to 67 (Roseneau 1984, APA 1985b). Raptor surveys were not conducted downstream in the lower Susitna drainage, but some eagle nest locations were recorded there during moose surveys (Modafferi 1987).

White (1974) found 10 active nests in the area he surveyed, including two Gyrfalcon (*Falco rusticolus*), one Bald Eagle (*Haliaeetus leucocephalus*), and seven Common Raven (*Corvus corax*) nests, along with 14 inactive nests (eight ravens and three each of Golden Eagle [*Aquila chrysaetos*] and Bald Eagle). Active sites located during the two years of study by Kessel et al. (1982) included four Common Ravens, one to two Gyrfalcons, and one Northern Goshawk (*Accipiter gentilis*) nest. Kessel et al. (1982) reported a linear nesting density for Bald Eagles of 0.04 nest/km (0.07 nests/mi) along the upper Susitna River. No Peregrine Falcons (*Falco perigrinus*) were found nesting in the APA Project study area in the early 1980s (Kessel et al. 1982). In 1984, two previously known nesting locations of Golden Eagles were reevaluated and seven more eagle nests (five Golden Eagles, and two Bald Eagles) were found (LGL 1984); five of the eagle nests were in outlying areas not previously surveyed and two nests were in previously surveyed areas along the river. A total of 33 eagle nests (23 Golden Eagle and ten Bald Eagle) were located in the APA Project area in the middle Susitna basin in 1984, but only four of the Golden Eagle nests and seven of the Bald Eagle nests were active that year (Roseneau 1984). Kessel et. al (1982) and Roseneau (1984) include text descriptions of historic nest locations, but maps were not included.

The USFWS surveyed approximately 805 linear km (500 mi) of river within the Susitna drainage basin for nesting Bald Eagles in May 1988 (Parker 1988), locating 69 nests (49 active), of which 26 nests (20 active) were on the Susitna River. Linear density ranged from zero to 0.18 nests/km (0.29 nests/mi), with the highest density occurring on the Susitna River from Talkeetna downstream to the mouth. All nest trees were black cottonwoods (*Populus tricocarpa*), except for two white spruces (*Picea glauca*). A nest tree was typically the largest in a stand of cottonwoods, and was located within 18 m of the river. It was estimated that 58 Bald Eagle nesting territories occurred on the Susitna River, with five additional territories farther away from the river in the Susitna Flats. The nest occupancy rate on that survey was 71 percent, much higher than the 22 percent reported by King (1980; cited in Parker 1988). The difference may be attributable to a difference in survey timing; the 1980 survey was conducted in mid-April, when some nests may not yet have been occupied.

Ritchie and Ambrose (1996) summarized information on nesting distribution, breeding ecology, and migration of Bald Eagles in interior Alaska, including portions of the Susitna River. Most nests along the Tanana River were within 100 m of a shoreline. Along the Tanana and the Susitna rivers, most nest trees were balsam poplars, but white spruces were used commonly. Birds, especially waterfowl, were an important part of the diet of Bald Eagles, particularly in the spring. Salmon were the most important food in late summer and fall. Eagles typically began nesting activities in late April and most young fledged by late August. Recaptures of banded birds indicated that some Bald Eagles nesting in interior Alaska wintered at widespread locations in the continental U.S. The numbers of nest territories were estimated for several individual drainage areas, including the Susitna basin (150–250 nesting pairs). For interior Alaska overall, the number of nesting pairs was estimated at 525–725, with a fall population (including subadults and nonterritorial adults) of over 2,000 birds. The population of Bald Eagles appeared to be increasing, attributed to a combination of factors: (1) restrictions on organochlorine pesticides since 1973, (2) decreased persecution of eagles by humans in Alaska, (3) expanding eagle populations elsewhere in North America, and (4) warming climate.

Using aerial transect surveys, NRC (2010) surveyed Bald Eagle nest sites during 25-30 April 2010 in the Matanuska–Susitna Borough, including the Susitna River floodplain downstream to the mouth from the vicinity of Trapper Creek, the area between the Susitna River and Knik Arm, and the area around Wasilla and Palmer (Figure 4.6.1). A partial survey was flown along the middle reach of the Susitna River up to Indian River, locating seven nests. In all, 221 nest locations were recorded on that survey, of which approximately 101 were active nests.

Two previously undescribed eagle nests (one of each species) and a raven nest were found in a small survey area, including 4 km (2.5 mi) of the Susitna River, near the locations of proposed boreholes at a prospective material site south of the Watana dam site in late June 2011 (ABR 2011a), suggesting that nest distribution may have expanded since the original APA Project studies.

4.6.2.1.2.2. Waterbirds and Shorebirds

Annual population surveys of breeding waterfowl are conducted by USFWS throughout Alaska, and several transects within the Stratum 2–Nelchina survey area are located in the upper Susitna River basin (Mallek and Groves 2009a), east of the proposed Watana reservoir. The westernmost transect (oriented northeast–southwest) in that stratum parallels the Oshetna River and the northeast–southwest stretch of the Susitna River just upriver from the Oshetna (Figure 4.6.1). Ten transects, sampling 135 km^2 (52 mi^2), extend from that western transect eastward across the Nelchina and Copper River basins to Chistochina and Indian River. Twelve species were recorded on surveys of that area in 2009; the most abundant taxa were the two species of scaup (*Athya* spp.), Bufflehead (*Bucephala albeola*), scoters (*Melanitta* spp.), Mallard (*Anas platyrhynchos*), and American Wigeon (*Anas americana*) (Mallek and Groves 2009b).

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: Figure 1). The population of Trumpeter Swans (*Cygnus buccinator*) summering in Alaska has increased since 1975 and breeding has expanded into peripheral habitat. In Unit 3–Gulkana, the count of swans was highest in 1995 (~4,500 adults and young), with slightly lower numbers in 2000 and 2005. In Unit 5–Cook Inlet, the count of swans was highest in 2005 (~2,600 adults and young), an increase of over 1,000 from the 2000 census.

For the original APA Project studies, lakes, ponds, and wetlands were surveyed in 1980 and 1981 for waterfowl and shorebirds using ground-census methods during the breeding season and aerial surveys during migration (Figure 4.6-16, Kessel et al. 1982). Brood surveys were conducted on foot in July 1981 to document the presence of breeding waterbirds (adults with young). Aerial surveys were conducted by helicopter for migrating waterbirds (loons, grebes, and waterfowl) in spring 1981 and fall 1980 and 1981. Little survey effort was expended along the middle reach of the Susitna downstream to Talkeetna.

To quantify the use of waterbodies by migrating waterbirds and identify those used most heavily by various species and groups, a relative “importance value” was derived for each surveyed waterbody in each season, incorporating the number of species, the number of birds, and the density of birds on the waterbody in relation to the overall numbers and densities recorded on the surveys. Kessel et al. (1982) compared the use of waterbodies on the Susitna plateau with those in the upper Tanana River valley in east–central Alaska and concluded that the Susitna plateau, comprising mostly high-elevation subalpine habitats, was not a major migratory route for waterbirds.

4.6.2.1.2.3. Landbirds

Breeding landbirds and some shorebirds were studied for the original APA Project using a modified territory-mapping technique on repeated visits to 12 census plots, each 10 ha (24.7 ac) in size, during 20 May–3 July 1981 (Kessel et al. 1982). Except for the alpine tundra site, each plot was established in a uniform area of one of the major woody habitats used by birds in the region (one plot per habitat type). The alpine tundra plot included several of the common habitats found at higher elevations in the study area. More than 60 habitat variables were measured on the plots for analysis of habitat selection and avian community data were summarized in terms of species composition, richness, diversity, and breeding density and biomass. The relative abundance of species was determined to be largely a function of habitat availability, with Common Redpoll (*Acanthis flammea*), Savannah Sparrow (*Passerculus sandwichensis*), White-crowned Sparrow (*Zonotrichia leucophrys*), Lapland Longspur (*Calcarius lapponicus*), and Tree Sparrow (*Tachiycineta bicolor*) being the most abundant landbird species (Kessel et al. 1982).

Wintering birds were surveyed in the 12 APA Project census plots in February 1981 (MacDonald and Cooper 1981) and resident birds were censused later in the project during early winter (29 November–1 December 1984), midwinter (23–25 January 1985), and late winter (27–29 March 1985), along two line transects in the Devils Canyon area and four transects in the Watana area (LGL 1986). Thirteen species were recorded during the winter surveys in 1981 (MacDonald and Cooper 1981) and 11 species were recorded in 1984–1985 (LGL 1986). In total, 16 species were seen in at least one winter survey. The most abundant resident birds were ptarmigan and redpolls in 1981 and Boreal Chickadee and Gray Jay in 1984–1985.

Survey methods for breeding landbirds have been further refined and standardized since the original APA Project studies. Several roadside routes on the Denali and Parks highways have been surveyed as part of the North American Breeding Bird Survey (http://www.pwrc.usgs.gov/bbs/) since the 1980s, providing supplemental information on regional species composition and abundance. Landbirds have been monitored in Denali National

Park and Preserve over the last couple of decades, and several sites have been established there as part of the Monitoring Avian Productivity and Survivorship (MAPS) Program (http://www.birdpop.org/maps.htm). McIntyre (2006) reported changes in the abundance of selected species in Denali National Park and Preserve.

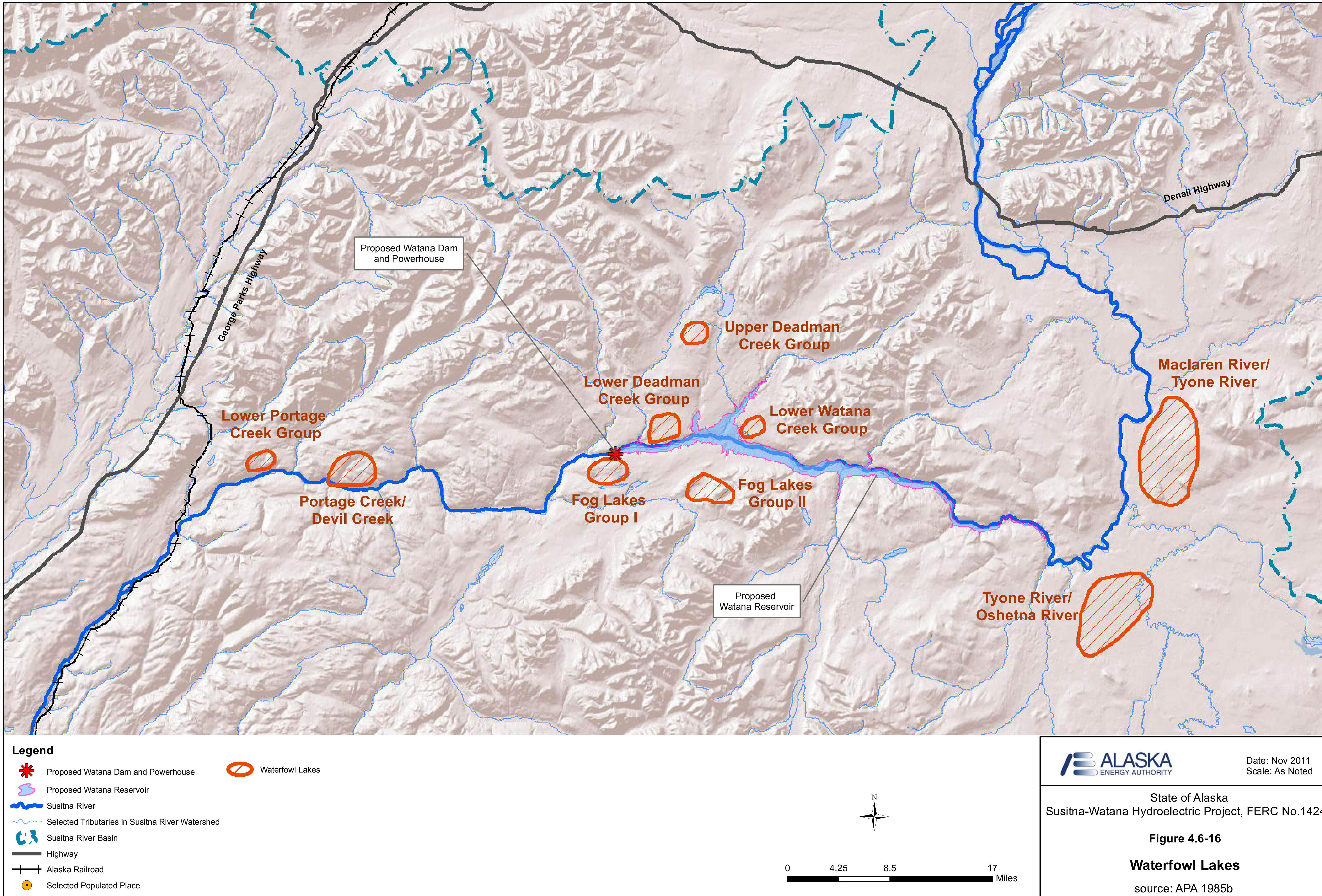


Figure 4.6-16

Waterfowl Lakes

source: APA 1985b

4.6.2.1.3. Amphibians

4.6.2.1.3.1. Wood Frog

Amphibians were not included in the original APA Project environmental program studies. However, amphibians are of increasing conservation concern worldwide because of widespread population declines and loss of local populations (Collins and Storfer 2003, McCallum 2007). Of the eight species of amphibians that occur in the state of Alaska, only one inhabits interior Alaska—the wood frog, *Lithobates* (formerly *Rana*) *sylvatica*, which is the most common amphibian in Alaska (MacDonald 2003). The species occurs in suitable habitats throughout southern Alaska and in the interior north to the southern slopes of the Brooks Range. Wood frogs appear to be common throughout interior Alaska, but few quantitative data exist to evaluate their abundance. Wood frogs have been captured in Denali National Park and Preserve and are known to occur near Healy and in the lower Susitna drainage (Cook and MacDonald 2003; Anderson 2004; Gotthardt 2004, 2005; Hokit and Brown 2006). Recent studies of wood frogs in Southcentral Alaska indicated that the species was "widespread and abundant" in developed areas along eastern Cook Inlet (Gotthardt 2004), although anecdotal reports from the Kenai Peninsula, Anchorage bowl, and the Talkeetna area suggested that wood frogs were no longer present at some historical breeding sites (Gotthardt 2005). Resource management agencies have devoted more attention to inventorying and monitoring wood frog populations due to population declines of amphibians elsewhere in North America and to reports of deformities in wood frogs elsewhere in Alaska (Anderson 2004).

Wood frogs occur in a wide variety of habitats during the year, moving into wetland areas to breed in the spring (beginning late April–early May) and then moving into adjacent wetland and upland habitats, usually within a few hundred yards of the breeding areas, during the summer (MacDonald 2003). Beaver ponds provide high-value habitat for wood frogs (Stevens et al. 2006). Egg-laying occurs in small ponds or lakes in wooded or open habitats; wood frogs reportedly avoid egg predation by fish by selecting waterbodies that are free of fish (Gotthardt 2005). Birds such as gulls prey on frogs during the breeding season. Wood frog breeding populations may vary by a factor of 10 and juvenile populations may vary by a factor of 100 among years (Berven 1990). Adult survival depends on rainfall, drought, and winter severity (Berven 1990, Anderson 2004). Wood frogs hibernate throughout the winter, entering hibernation as early as late August; the species is remarkable because of its ability to tolerate freezing during winter hibernation by producing chemicals that act as a natural "antifreeze" to prevent cell disruption (MacDonald 2003).

4.6.3. Botanical Resources

An array of plant species and vegetative communities occurs in the Project area. The areas examined for the assessment of botanical resources includes the Susitna River watershed upstream from the proposed Watana dam site, the riparian corridor encompassing the Susitna floodplain downstream from the proposed dam site to the confluence with the Chulitna River and continuing an as-yet-undefined distance farther downstream in the lower river, as well as along corridors for access roads and transmission line routes and the areas affected by infrastructure needed at the dam site. The existing information on vegetation types, plant species, and wildlife habitats pertinent to the Project can be grouped into four broad categories:

- occurrence and distribution of vegetation types;
- plant species occurrence, including rare and invasive species;
- studies of the availability and quality of browse for moose; and
- assessment of habitat values for a broad range of mammal and bird species.

4.6.3.1. Vegetation Types

Relatively recent land-cover maps (BLM et al. 2002a, 2002b) covering parts of the Susitna River basin were produced for Ducks Unlimited, Inc., in cooperation with BLM and the U.S. Air Force, based on classification of satellite imagery. Two separate mapping efforts were conducted—one for the upper Susitna River drainage and Gulkana area (BLM et al. 2002a), which covers much of the APA Project study area, and the other for the lower Susitna River drainage, Cook Inlet, and westward (BLM et al. 2002b)—but a sizable gap in map coverage occurs around the middle reach of the Susitna River (Figure 4.6-17). The classification scheme used for both maps was a modification of the Alaska Vegetation Classification (AVC) (Viereck et al. 1992), including a combination of Level III and Level IV. The classification does not differentiate among types of tall shrubs or distinguish low alder from low willow, both of which are key factors when evaluating habitat value for moose for example. Few of the field sites used to verify map accuracy were located in the Project study area, so the vegetation types mapped there may not be represented accurately. In addition, the map that covers most of the original APA Susitna Hydroelectric Project study area (BLM et al. 2002b) was based on a composite of three Landsat scenes from different years and different dates during the growing season, resulting in increased variability of spectral signatures across the scenes.

Another land-cover map of the entire Susitna basin is available through the National Land Cover Dataset (NLCD) (Stehman and Selkowitz 2010), which is based on a classification of Landsat imagery. This work was part of a nationwide land-cover mapping effort and the mapping, performed at a 30-m-pixel scale, covers Alaska in its entirety. However, that scale is coarse and the cover classes mapped are very generalized (roughly equivalent to AVC Level II); hence, this mapping is of limited use for meaningful assessments of vegetation occurrence or habitat analyses for the Project.

Fine-scale mapping was conducted specifically for the APA Project by several different groups of researchers in the early 1980s, which remains the best source of information on the vegetation communities in the Project area. All maps were hand-drawn on mylar or acetate overlaid on aerial photos and topographic maps. The University of Alaska Agricultural Experiment Station (UAAES) conducted vegetation mapping during 1980–1982, based on field work conducted in 1980 (McKendrick et al. 1982). Mapping was based on field data and air-photo interpretation, and was primarily done to the Level III vegetation classes (e.g., Willow Shrub) presented in the initial version of the AVC (Viereck and Dyrness 1980). Later, those data were incorporated into a separate mapping effort that focused on forage availability for moose, for which field work was conducted in 1984 (Kreig and Associates 1985; as reported in APA 1985a) and the revised version of the AVC (Viereck et al. 1982) was used.

The vegetation mapping by McKendrick et al. (1982) covered a narrow corridor confined to the Susitna River floodplain upstream from Talkeetna, the mapping corridor then expanded outward to the basin level at Devils Canyon and upstream of that point (Figure 4.6-17). The1982 mapping boundary (blue boundary in Figure 4.6-17) was digitized (ABR 2011b) from a scan of an original map copy included in APA (1983), but the corridor mapped downstream of Devils Canyon was not available, so is not depicted on the figure. The map scales were 1:24,000 for the areas that would have been impacted directly by the original APA Project and 1:250,000 for the remainder of the Susitna River basin. In addition, the area extending 16 km (10 mi) in all directions from the upper Susitna River from Gold Creek upstream to the mouth of the Maclaren River was mapped at a scale of 1:63,360. Two other 1:63,360-scale maps, for the proposed northern (Healy to Fairbanks) and southern (Willow to Cook Inlet) transmission-line corridors, also were prepared. The central transmission-line corridor was included on the 1:63,360-scale map of portions of the upper basin. Those maps were included in the report by McKendrick et al. (1982).

The mapping conducted subsequently by Kreig and Associates (1985 [in APA 1985a], 1987) covered much of the upper and middle Susitna River basin, from the mouths of the Maclaren, Tyone, and Oshetna rivers (upstream of the proposed Watana dam site) downstream below Devils Canyon to Gold Creek (red boundary in Figure 4.6-17, digitized from APA 1985a). Nearly 1.6 million acres were mapped in that effort, which focused primarily on quantifying habitats with regard to moose forage value. Mapping was conducted at the 1:63,360-scale and incorporated the previous mapping conducted by McKendrick et al. (1982) and existing ground data and photography provided by ADF&G, BLM, and the USFS, as well as additional ground and aerial data. The mapping used the revised AVC scheme of Viereck et al. (1982), with modifications made as a result of a workshop in March 1984. All vegetation types were mapped to at least AVC Level III and those types with high forage value for moose (mainly scrub and forest types) were mapped to AVC Level IV. Each map polygon was assigned values for understory cover of willows, dwarf birch, and alder.

The description of the occurrence and distribution of vegetation in the upper Susitna River basin provided below is based on the mapping performed by Kreig and Associates (1985; in APA 1985a). That mapping represents the most current, fine-scale vegetation mapping available for the APA Project area because the revised vegetation mapping in the final report by Kreig and Associates (1987) has not yet been located. The 1985 vegetation map encompassed both of the dam sites proposed for the APA Project and most of the currently envisioned corridors for access roads and transmission lines. It did not cover the downstream floodplain of the Susitna River between Gold Creek and Cook Inlet, however. Because neither paper nor digital copies of the vegetation maps produced by Kreig and Associates have been located, the spatial distribution of the mapped vegetation types in the upper Susitna River basin cannot be displayed here.

Ninety vegetation types were mapped by Kreig and Associates (1985; in APA 1985a); to simplify the presentation in this document, those 90 types were aggregated into 34 broader classes (Table 4.6-3), following the summary approach used by APA (1985a). In most cases, this aggregation of vegetation types involved combining the open and closed forms of forest and scrub habitats. For simplicity, areas are listed in the English units (ac) originally used by APA (1985a), rather than in metric units with English equivalents (for reference, one hectare = 2.47 ac).

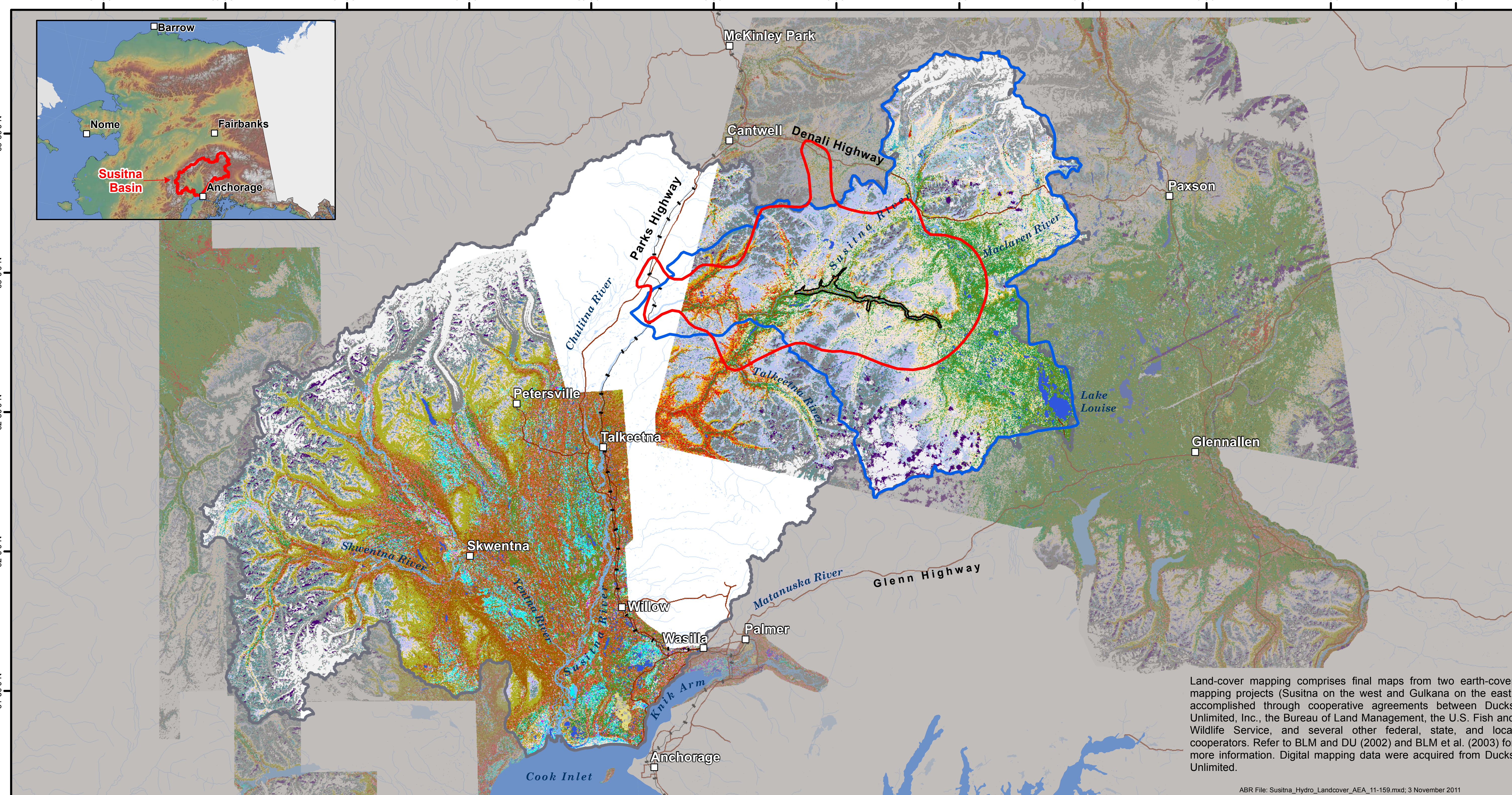
Like many areas in Alaska that encompass mountainous terrain and river drainages, the vegetation and habitat types in the Upper and Middle Susitna River basin are diverse, ranging from rocky, barren areas and dwarf-scrub alpine tundra at higher elevations to low and tall scrub, forests, and graminoid-dominated meadow habitats at lower elevations.

Table 4.6-3. Extent and relative abundance of vegetation types mapped in the upper and middle Susitna River basin for the original APA Susitna Hydroelectric Project.[1]

Vegetation Type[2]		Area (ac)	percent of Mapped Area
Conifer Forest			
White Spruce Forest		33,895	2.1
Black Spruce Forest		25,067	1.6
Black & White Spruce Forest		148,996	9.3
White Spruce Woodland		37,444	2.3
Black Spruce Woodland		819	0.1
Black & White Spruce Woodland		24,915	1.6
	Subtotal	271,136	17.0
Broadleaf Forest			
Paper Birch Forest		5,852	0.4
Birch–Aspen Forest		2,257	0.1
Other Broadleaf Forest		3,710	0.3
Broadleaf Woodland		1,420	0.1
	Subtotal	13,239	0.8
Mixed Forest			
Spruce–Birch Forest		94,031	5.9
Spruce–Birch–Poplar Forest		1,215	0.1
Spruce–Birch–Aspen Forest		3,614	0.2
Spruce–Poplar Forest		2,726	0.2
Mixed Woodland		8,819	0.5
	Subtotal	110,405	6.9
Dwarf Tree Scrub			
Conifer Dwarf Tree Scrub		37,703	2.4
Other Dwarf Tree Scrub		220	<0.05
	Subtotal	37,923	2.4
Tall Scrub			
Tall Alder Shrub		73,915	4.6
Other Tall Shrub		12,650	0.8
	Subtotal	86,565	5.4
Low Scrub			
Low Dwarf Birch Shrub		136,115	8.5
Low Willow Shrub		149,736	9.4
Low Ericaceous Shrub		8,006	0.5
Low Dwarf Birch–Willow Shrub		248,829	15.6
Low Dwarf Birch–Ericaceous Shrub		136,120	8.5
Other Low Shrub		597	<0.05
	Subtotal	679,403	42.6
Dwarf Scrub		238,248	14.9

Vegetation Type[2]		Area (ac)	percent of Mapped Area
Graminoid Herbaceous			
Wet Graminoid Herbaceous		10,621	0.7
Mesic Graminoid Herbaceous		3,550	0.2
Dry Graminoid Herbaceous		115	<0.05
	Subtotal	14,286	0.9
Forb & Bryoid Herbaceous		208	<0.05
Sparse Vegetation		38,324	2.4
Barren		74,043	4.6
Water		31,671	2.0
Cultural–Urban Developed		110	<0.05
	Total	1,595,561	

[1] Mapping conducted by Ray A. Kreig and Associates (1985), as reported in APA (1985a).
[2] Following the Viereck et al. (1982) classification system, with modifications made as a result of the Alaska Vegetation Classification workshop conducted in March 1984. Although vegetation complexes were mapped in many cases, only the major component is represented here to simplify the presentation. All open and closed types in the forest and scrub categories were aggregated (see text).



Land-cover Type

Agriculture
Aquatic Bed
Bryoid
Clear Water
Closed Deciduous
Closed Mixed Needleleaf/Deciduous
Closed Needleleaf
Closed Willow
Clouds, Smoke
Shadow - Cloud or Terrain
Coastal Marsh
Dwarf Shrub
Emergent
Fire Scar
Low Shrub - Lichen
Low Shrub - Wet
Mesic/Dry Herbaceous
Moss
Non-vegetated Soil
Open Deciduous
Open Mixed Needleleaf/Deciduous
Open Needleleaf
Open Poplar
Open Willow
Snow/Ice, Other
Rock/Gravel
Saltwater
Sand
Sparse Vegetation
Tall Shrub
Tidal Mud Flat
Turbid Water
Tussock Tundra
Urban/Developed
Wet Forb
Wet Graminoid
Woodland Needleleaf

1985 Vegetation Mapping Extent
1982 Vegetation Mapping Extent
Proposed Watana Reservoir

N
5 0 5 10 15 Miles
10 0 10 20 30 Km

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale = 1:1,525,000

State of Alaska
Susitna-Watana Hydroelectric Project FERC No. 14241

Figure 4.6-17

Extent of Regional Land-cover and Vegetation Mapping in the Susitna River Basin

4.6.3.1.1. Forest Types

Fifteen forest types were mapped in the upper Susitna River basin, including six coniferous-dominated types, four broadleaf-dominated types, and five mixed forest types. Forests occur at lower elevations and covered 394,780 acres or 25 percent of the area mapped by Kreig and Associates (1985; in APA 1985a). Coniferous-dominated forests are the most common and covered 271,136 acres or 17 percent of the mapped area. Mixed forests are less common (110,405 acres or 6.9 percent of the mapped area) and broadleaf-dominated forests are uncommon (13,239 or 0.8 percent of the mapped area).

The mean elevation of the forest areas sampled was 523 m (1,716 ft), ranging from 335 m to 792 m (1,100–2,600 ft). The average elevational limit for trees (black and white spruce, paper birch, trembling aspen, and balsam poplar) in the project area was 975 m (3,200 ft) (McKendrick et al. 1982), with a range of 853–1,067 m (2,800–3,500 ft). Black (*Picea mariana*) and white spruce are the most frequent species at or near treeline. The deciduous trees—paper birch (*Betula papyrifera*) and trembling aspen (*Populus trembuloides*)—generally occur below 701 m (2,300 ft) and balsam poplar stands are found only on floodplains. Black spruce generally occurs on wetter sites than white spruce and both species of spruce occur on colder sites than do deciduous or mixed forests. For all tree species, closed forests occur on warmer sites more often than do open forests.

4.6.3.1.1.1. White Spruce Forest

In this type, at least 75 percent of the total tree canopy cover is composed of white spruce. This type includes both open and closed stands of white spruce (approximately 83 percent of the White Spruce Forest in the mapped area was classified as open and 17 percent was classified as closed). Open white spruce forest commonly occurs on well-drained convex sites, along drainages, and near treeline, whereas closed white spruce forest typically occurs along drainages or well-drained slopes of north, northeast, and northwest aspects. The understory is composed of diamondleaf willow (*Salix pulchra*), dwarf birch (*Betula nana*), and alder, with more shrub cover in the open stands because of the sparser tree canopy. Wetter sites generally support a greater percentage of willows and drier sites support more dwarf birch. Typical ground cover species in open forests are crowberry, northern Laborador tea (*Ledum groenlandicum*), bog blueberry (*Vaccinium uliginosum*), mountain cranberry (*Vaccinium vitis-idaea*), woodland horsetail (*Equisetum sylvaticum*), bluejoint (*Calamagrostis canadensis*), feather moss (*Hypnaceae*), and lichens. Closed white spruce ground cover includes cloudberry (*Rubus chamaemorus*), nagoonberry (*Rubus arcticus*), woodland horsetail, twinflower (*Linnea borealis*), and feather mosses. White Spruce Forest covered 33,895 acres or 2.1 percent of the mapped area.

4.6.3.1.1.2. Black Spruce Forest

In this type, at least 75 percent of the tree canopy cover is composed of black spruce. This type includes both open and closed stands of black spruce (approximately 81 percent of the Black Spruce Forest in the mapping area was classified as open and 19 percent was classified as closed). Black Spruce Forest typically occurs on poorly drained, organic soils with a restrictive permafrost layer. Willows, dwarf birch, and alders occur in the shrub layer. Ground cover species include Labrador tea (both species), bog blueberry, beauverd spirea (*Spirea stevenii*), crowberry, sedges (*Carex* spp.), woodland horsetail, nagoonberry, and *Sphagnum* mosses. Black Spruce Forest covered 25,067 acres or 1.6 percent of the mapped area.

4.6.3.1.1.3. Black and White Spruce Forest

In this type, black and white spruce are codominant in the tree canopy, together comprising at least 75 percent of the total canopy cover. Both open and closed stands of black and white spruce are included in this type. This type occurs near the elevational limits of trees on moist sites, and in ecotonal areas between black and white spruce forests. Willows, dwarf birch, and occasionally alders occur in the shrub layer. Common understory species include netleaf willow (*Salix reticulata*), shrubby cinquefoil (*Dasiphora fruticosa*), bog blueberry, mountain cranberry, woodland horsetail, sedges, feather mosses, Labrador tea (both species), and crowberry. Black and White Spruce Forest is the most common forest type in the upper Susitna River basin and covered 148,996 acres or 9.3 percent of the mapped area.

4.6.3.1.1.4. White Spruce Woodland

This woodland community has low values (10–25 percent) of tree canopy cover. In this type, at least 75 percent of the tree canopy cover is composed of white spruce. This type generally occurs on well-drained sites near treeline, in areas of regenerating vegetative growth, or in ecotonal sites between white spruce forests and low-shrub habitats. This type is similar to open white spruce forests, but with more shrub cover because of the more open tree canopy. Willows, dwarf birch, and occasionally alders occur in the shrub layer. Important ground cover species are northern Labrador tea, bog blueberry, mountain cranberry, woodland horsetail, polargrass (*Arctagrostis latifolia*), fireweed (*Epilobium angustifolium*), and feather mosses. White Spruce Woodland covered 37,444 acres or 2.4 percent of the mapped area.

4.6.3.1.1.5. Black Spruce Woodland

In this woodland community, at least 75 percent of the tree canopy cover is composed of black spruce. This type occurs on cold, poorly drained sites and often transitions into peat bogs. The shrub layer includes willows and dwarf birch. Common ground cover species are Alaska bog willow (*Salix fuscescens*), swamp cranberry, Labrador tea, bog blueberry, cottongrass (*Eriophorum* spp.), sedges, and *Sphagnum* mosses. Black Spruce Woodland is an uncommon forest type in the upper Susitna River basin and covered 819 acres or 0.1 percent of the mapped area.

4.6.3.1.1.6. Black and White Spruce Woodland

In this woodland community, black and white spruce are codominant in the tree canopy and together comprise at least 75 percent of the total canopy cover. This type occurs near the elevational limits of trees on moist sites, and in ecotonal areas between black and white spruce forests. Willow, dwarf birch, and occasionally alder occur in the shrub layer. Common understory species include netleaf willow, shrubby cinquefoil, bog blueberry, mountain cranberry, woodland horsetail, sedges, feather mosses, Labrador tea (both species), and crowberry. Black and White Spruce Woodland covered 24,915 acres or 1.6 percent of the mapped area.

4.6.3.1.1.7. Paper Birch Forest

In this type, at least 75 percent of the tree canopy cover is composed of paper birch. This type includes both open and closed stands of paper birch. Paper birch forests are found on well-drained slopes, along floodplains, and in drainage ravines. Open paper birch (about 56 percent of this type) is typically found on well-drained slopes and drainages. Closed stands and drier open stands have sparse willow and alder shrub understories with low cover values. On moist sites (especially moist open sites), the shrub understory layer is better developed, consisting of willows, alders, and dwarf birch. Common ground cover species include bluejoint, Labrador tea, crowberry, bog blueberry, mountain cranberry, bunchberry (*Cornus canadensis*), oak fern (*Gymnocarpium dryopteris*), and *Polytrichum* mosses. Like all broadleaf-dominated forests in the upper Susitna River basin, Paper Birch Forest is an uncommon type and covered 5,852 acres or 0.4 percent of the mapped area.

4.6.3.1.1.8. Birch–Aspen Forest

In this type, paper birch and aspen are codominant in the tree canopy, together comprising at least 75 percent of the total canopy cover. This type includes both open and closed stands of paper birch and aspen. Birch–Aspen Forests are typically found on well-drained slopes with southern aspects. Willows and alders occur occasionally in the understory, but cover values are low. Other common understory species are prickly rose (*Rosa acicularis*) and bearberry (*Arctostaphylos* spp.). Birch–Aspen Forest is an uncommon type in the upper Susitna River basin and covered 2,257 acres or 0.1 percent of the mapped area.

4.6.3.1.1.9. Other Broadleaf Forest

Other Broadleaf Forest represents several different vegetation types, which were lumped in this document because of the low areal extent of each of the constituent types. Included in Other Broadleaf Forest are balsam poplar forests (80 percent of Other Broad Leaf Forest in the mapped area), birch–poplar forests (18 percent), and aspen forests (2 percent). Both open and closed stands of each of these broadleaf communities are included in this type. Willows and alders occur frequently in the shrub layer, along with other understory species such as bunchberry, mountain cranberry, twinflower, and highlands cranberry. Other Broadleaf Forest, as a composite type, is uncommon in the upper Susitna River basin and covered 3,710 acres or 0.2 percent of the mapped area.

4.6.3.1.1.10. Broadleaf Woodland

This woodland community has low tree canopy cover values (10–25 percent), at least 75 percent of which is composed of broadleaf trees. Broadleaf woodlands are composed of the same deciduous tree species (birch, aspen, and balsam poplar) that occur in open broadleaf forests. Because these woodland habitats are more open, however, the understory shrub and ground cover species are more prevalent and have higher cover values than in open broadleaf forests. Broadleaf Woodland is an uncommon type in the upper Susitna River basin and covered 1,420 acres or 0.1 percent of the mapped area.

4.6.3.1.1.11. Spruce–Birch Forest

In this mixed forest type, spruce (either white or black spruce or both) and paper birch are co-dominant in the tree canopy and together comprise at least 75 percent of the total canopy cover. This type includes both open and closed stands of spruce and birch (approximately 51 percent of the Spruce–Birch Forest in the mapping area is classified as open and 49 percent is classified as closed). Spruce–Birch Forest occurs commonly on well-drained south-facing slopes and along drainages (where white spruce is more dominant) and on poorly drained north-facing slopes (where black spruce is dominant). Willow and alder are present in the shrub layer of closed stands, but often provide little understory cover, while denser thickets of willow, alder, and dwarf birch are present in open stands. Typical understory species in closed stands include bog blueberry, mountain cranberry, bluejoint, bunchberry, Labrador tea (both species), and *Polytrichum* mosses. In open stands, common understory species include beauverd spirea, fireweed, bluejoint, oak fern, and feather mosses. Spruce–Birch Forest is a common forest type in the upper Susitna River basin and covers 94,031 acres or 5.9 percent of the mapped area.

4.6.3.1.1.12. Spruce–Birch–Poplar Forest

White spruce, paper birch, and balsam poplar are codominant in the tree canopy of this mixed-forest type, together comprising at least 75 percent of the total canopy cover. The type includes both open and closed stands of spruce, birch, and poplar (approximately 37 percent of the Spruce–Birch–Poplar Forest in the mapping area was classified as open and 63 percent was classified as closed). Spruce–Birch–Poplar Forest occurs on river floodplains. Willows and alders are present in the understory shrub layer. Beauverd spirea, bunchberry, northern Labrador tea, crowberry, bog blueberry, and mountain cranberry are other common understory species. Spruce–Birch–Poplar Forest is an uncommon type in the upper Susitna River basin and covered 1,215 acres or 0.1 percent of the mapped area.

4.6.3.1.1.13. Spruce–Birch–Aspen Forest

White spruce, paper birch, and aspen are codominant in the tree canopy, together comprising at least 75 percent of the total canopy cover. This type includes both open and closed stands of spruce, birch, and aspen (approximately 12 percent of the Spruce–Birch–Aspen Forest in the mapping area was classified as open and 88 percent was classified as closed). Spruce–Birch–Aspen Forest occurs on well-drained south-facing slopes. Willows, dwarf birch, and occasionally alders are present in the understory shrub layer. Other common understory species include bunchberry, twinflower, mountain cranberry, northern Labrador tea, feather mosses, and bog blueberry. Spruce–Birch–Aspen Forest is an uncommon type in the upper Susitna River basin and covered 3,614 acres or 0.2 percent of the mapped area.

4.6.3.1.1.14. Spruce–Poplar Forest

In this mixed forest type, white spruce and balsam poplar are codominant in the tree canopy, together comprising at least 75 percent of the total canopy cover. This type includes both open and closed stands of spruce and poplar (approximately 37 percent of the Spruce–Poplar Forest in the mapping area was classified as open and 63 percent was classified as closed). Spruce–Poplar Forest is similar in ecological function to Spruce–Birch–Poplar Forest and also occurs on river floodplains. Willows and alders occur in the understory shrub layer. Woodland horsetail, fireweed, bunchberry, beauverd spirea, and *Polytrichium* mosses are other common understory components. Spruce–Poplar Forest is an uncommon type in the upper Susitna River basin and covered 2,726 acres or 0.2 percent of the mapped area.

4.6.3.1.1.15. Mixed Woodland

This is a woodland community with low cover values (10–25 percent) of tree canopy. Mixed Woodland represents three different types, each codominated by spruce (either white or black spruce, or both): spruce–birch woodland (97 percent of the occurrence of this type in the mapped area), spruce–poplar woodland (1 percent) and spruce–birch–aspen woodland (2 percent). These woodland types are similar in species composition to the open mixed conifer–broadleaf forests described above. Because these woodland habitats have more open canopies, however, the understory shrub and ground cover species are more prevalent and provide more cover than in open conifer–broadleaf forests. Mixed Woodland is an uncommon type in the upper Susitna River basin and covered 8,819 acres or 0.6 percent of the mapped area.

4.6.3.1.2. Scrub Types

In the Alaska Vegetation Classification (AVC; Viereck et al. 1982, 1992), scrub habitats are dominated by dwarf trees, tall shrubs (height > 1.5 m [5 ft] at maturity), low shrubs (<1.5 m and >0.2 m [8 in.]), and/or dwarf shrubs (< 0.2 m). By definition, scrub types have <10 percent canopy cover by forest (trees of height > 5 m [16 ft] at maturity) and shrubs comprise at least 25 percent of the total canopy cover. In the upper and middle Susitna basin, scrub habitats are a prominent feature of the landscape. As a group, scrub habitats covered 1,042,131 acres or 65 percent of the area mapped by Kreig and Associates (1985; in APA 1985a). Low scrub was by far the most common scrub type and covered 679,403 acres or 43 percent of the mapped area. Dwarf scrub also was common and covered 238,248 acres or 14.9 percent of the mapped area. Tall scrub (86,565 acres or 5.4 percent of the mapped area) was less common and dwarf tree scrub (37,923 acres or 2.4 percent of the mapped area) was the least common scrub type.

4.6.3.1.2.1. Conifer Dwarf Tree Scrub

At least 75 percent of the dwarf tree canopy cover is composed of conifer species. This type includes woodland and open and closed stands of dwarf conifers (approximately 20 percent of the Conifer Dwarf Tree Scrub in the mapping area was classified as woodland, 69 percent was classified as open, and 11 percent was classified as closed). The woodland form of Conifer Dwarf Tree Scrub is usually a black spruce type occurring on wet, poorly drained sites with a restrictive permafrost layer; these types often transition into bog habitats. In such areas, the understory shrub layer is composed of willows and dwarf birch. Other common understory species include bog rosemary, Labrador tea, cotton grasses, horsetails, Alaska bog willow, buckbean (*Menyanthes trifoliata*), narrow-leaved burred (*Sparganium angustifolium*), marsh cinquefoil (*Potentilla palustris*), and *Sphagnum* mosses. The woodland form of Conifer Dwarf Tree Scrub also can occur as dwarf white spruce and/or black spruce trees at the elevational limit of trees. The open form of Conifer Dwarf Tree Scrub is usually a black spruce type similar to the woodland form, occurring on poorly drained sites or on cold north-facing slopes, both with permafrost. The understory shrub layer includes willows, dwarf birch, and occasionally alders. Other common understory species include sedges, bluejoint, bog blueberry, Labrador tea (both species), crowberry, Alaska bog willow, swamp cranberry, coltsfoot (*Tussilago farfara*), cloudberry, cotton grasses, horsetails, and *Sphagnum* mosses. The closed form of Conifer Dwarf Tree Scrub is usually a black spruce type occurring on cold north-facing slopes with permafrost or on wet, poorly drained depressions. Common understory species include sedges, bluejoint, bog blueberry, Labrador tea, crowberry, cloudberry, woodland horsetail, and *Sphagnum* mosses. Conifer Dwarf Tree Scrub covered 37,923 acres or 2.4 percent of the mapped area.

4.6.3.1.2.2. Other Dwarf Tree Scrub

Other Dwarf Tree Scrub represents several different vegetation types, which are lumped here because the distribution of each type was fairly restricted in the mapping area. Included in Other Dwarf Tree Scrub are woodland, open, and closed forms of broadleaf dwarf tree scrub, in which 75 percent of the total dwarf tree canopy cover is composed of broadleaf species. Willows, dwarf birch, and alders are common understory shrubs in broadleaf dwarf tree scrub. Other Dwarf Tree Scrub also includes woodland, open, and closed forms of mixed broadleaf–conifer dwarf tree scrub, in which dwarf broadleaf and conifer tree species are codominant, together composing 75 percent of the total dwarf tree canopy cover. Other Dwarf Tree Scrub, as a composite type, is rare in the upper Susitna River basin (<0.1 percent of the mapped area) and covered only 220 ac.

4.6.3.1.2.3. Tall Alder Shrub

In this type, 75 percent or more of the total shrub canopy cover is composed of alder. This type includes both open and closed stands of alder (approximately 49 percent of the Tall Alder Shrub in the mapping area was classified as open and 51 percent was classified as closed). This type is strongly dominated by Sitka alder, which is often the only species in the tall shrub canopy, and especially so in closed stands. Open Tall Alder Shrub communities are found along rivers or on steep slopes above treeline. Willows occasionally occur in the shrub understory in open stands. Other common understory species include bluejoint, woodland horsetail, and twinflower. Closed stands are usually found on steep slopes above treeline, along drainages, and as pioneering communities on river floodplains. The understory species in closed stands are similar to those found in open stands. Tall Alder Shrub (both open and closed stands) also occurs frequently as narrow strips within other vegetation types on slopes adjacent to the Susitna River. Tall Alder Shrub covered 73,915 acres or 4.6 percent of the mapped area.

4.6.3.1.2.4. Other Tall Shrub

Other Tall Shrub is composed of several different plant communities, which are lumped here because each is relatively uncommon in the mapped area. Included in Other Tall Shrub are tall alder–willow shrub (82 percent occurrence of this type in the mapping area), tall willow shrub (15 percent), tall shrub birch shrub (1 percent), tall shrub birch–willow shrub (1 percent), and tall shrub birch–ericaceous shrub (1 percent). Both the open and closed forms of tall alder–willow shrub (72 percent open, 28 percent closed) and tall willow shrub (22 percent open, 78 percent closed) are included in this type. Tall alder–willow shrub communities are usually found on steep slopes above treeline, as riverine communities along drainages, and on floodplains. Common understory species include polargrass and Bigelow sedge. Tall willow shrub communities occur commonly as riverine habitats along stream drainages, as pioneering communities on floodplains, and on slopes above treeline. The shrub layer often is composed of feltleaf willow (*Salix alaxensis*), grayleaf willow (*Salix glauca*), and diamondleaf willow. Understory species include sedges, polargrass, arctic dock (*Rumex arcticus*), woodland horsetail, fireweed, and bluejoint. Other Tall Shrub, as a composite type, is uncommon in the upper Susitna River basin and covered 12,650 acres or 0.8 percent of the mapped area.

4.6.3.1.2.5. Low Dwarf Birch Shrub

Low Dwarf Birch Shrub typically occurs on convex, well-drained sites and is strongly dominated by dwarf birch, which comprises 75 percent or more of the total low-shrub canopy cover. Approximately 41 percent of this type in the mapping area occurs in an open form and 59 percent in a closed form. This type also includes the open and closed forms of a variant community (low dwarf birch–grass shrub). Important associated species are willows, Labrador tea, crowberry, bog blueberry, mountain cranberry, beauverd spirea, sedges, bearberry, cloudberry, nagoonberry, fescue grass (*Festuca* spp.), *Stereocaulon* lichens, *Nephroma* lichens, reindeer moss (*Cladonia rangiferina*), and feather mosses. Low Dwarf Birch Shrub is a common low-scrub habitat in the upper Susitna River basin and covered 136,115 acres or 8.5 percent of the mapped area.

4.6.3.1.2.6. Low Willow Shrub

In this type, at least 75 percent of the total low-shrub canopy cover is composed of willow species. Approximately 64 percent of this type in the mapping area occurs in an open form and 36 percent in a closed form. This type also includes the open and closed forms of a variant community, low willow–grass shrub. Low Willow Shrub communities occur along drainages, in wet concavities, on wet flat benches, and on slopes and along streams at higher elevations. Common understory species in open communities include vanilla holygrass, fescue grass, netleaf willow, burnet, northern anemone, ragwort, gentian, Arctic dock, cloudberry, shrubby cinquefoil, bog blueberry, and *Stereocaulon* lichens. Common understory species associated with closed communities include sedges, Arctic dock, polargrass, shrubby cinquefoil, horsetails, hairy butterwort (*Pinguicula villosa*), saussurea, and meadow bistort (*Polygonum bistorta*). Low Willow Shrub is a common low-scrub habitat in the upper Susitna River basin and covered 149,736 acres or 9.4 percent of the mapped area.

4.6.3.1.2.7. Low Ericaceous Shrub

At least 75 percent of the total low-shrub canopy cover is composed of two ericaceous species, Labrador tea and bog blueberry. Approximately 86 percent of this type in the mapping area occurs in an open form and 14 percent in a closed form. Also included in this type is a third variant community, open low ericaceous–grass shrub. Each of the component communities included in Low Ericaceous Shrub occurs on steep, dry slopes above treeline. Common species in the understory include Arctic willow, netleaf willow, diamondleaf willow, dwarf birch, crowberry, mountain cranberry, sedges, fescue grass, four-angle mountain heather (*Cassiope* spp.), bearberry, white mountain-avens (*Dryas octopetala*), wormwood, polargrass, feather mosses, club mosses, and *Polytrichum* mosses. Low Ericaceous Shrub is an uncommon type in the upper Susitna River basin and covered 8,006 acres or 0.5 percent of the mapped area.

4.6.3.1.2.8. Low Dwarf Birch–Willow Shrub

Low dwarf birch and willows are codominant and together comprise at least 75 percent of the total low-shrub canopy cover. Approximately 58 percent of this type in the mapping area occurs in an open form and 42 percent in a closed form. This type also includes the open and closed forms of a variant community, low dwarf birch–willow–grass shrub. Each of the component communities in Low Dwarf Birch–Willow Shrub occurs on moist slopes. Common species in the understory include bog blueberry, woodland horsetail, sedges, mountain cranberry, Labrador tea, coltsfoot, crowberry, fescue grass, polargrass, bearberry, fireweed, netleaf willow, feather mosses, wormwood (*Artemesia alaskana*), and bluegrass. Low Dwarf Birch–Willow Shrub is a common low-scrub habitat in the upper Susitna River basin and covered 248,829 acres or 15.6 percent of the mapped area.

4.6.3.1.2.9. Low Dwarf Birch–Ericaceous Shrub

Low dwarf birch and ericaceous shrubs are codominant and together compose at least 75 percent of the total low-shrub canopy cover. Approximately 86 percent of this type in the mapping area occurs in an open form and 14 percent in a closed form. This type also includes the open and closed forms of a variant community, low dwarf birch–ericaceous–grass shrub. Each of the component communities included in Low Dwarf Birch–Ericaceous Shrub occurs on well-drained convex slopes. The dominant low-shrub species in this type are dwarf birch, Labrador tea, and bog blueberry. Common species occurring in the understory include mountain cranberry, crowberry, polargrass, Arctic bluegrass, fescue grass, bearberry, wormwood, sedges, netleaf willow, Arctic willow, and feather mosses. Low Dwarf Birch–Ericaceous Shrub is a common low-scrub habitat in the upper Susitna River basin and covered 136,120 acres or 8.5 percent of the mapped area.

4.6.3.1.2.10. Other Low Shrub

Other Low Shrub is composed of two related plant communities, which are lumped here because each is rare in the mapping area. Included in Other Low Shrub are low alder shrub (54 percent occurrence in the mapping area) and low alder–willow shrub (46 percent). Both the open and closed forms of low alder shrub (79 percent open, 21 percent closed) and low alder–willow shrub (82 percent open, 18 percent closed) are included in this type. Other Low Shrub occurs along streams and on slopes at higher elevations. Common species occurring in the understory include bluejoint, sedges, bog blueberry, mountain cranberry, twinflower, and four-angle mountain heather. Other Low Shrub, as a composite type, is rare in the upper Susitna River basin (<0.1 percent of the mapped area) and covered only 597 ac.

4.6.3.1.2.11. Dwarf Scrub

Several different plant communities occur in the Dwarf Scrub type in the upper and middle Susitna River basin. Included in this type are the open and closed forms of Dwarf Scrub, dwarf ericaceous shrub, dwarf willow shrub, dwarf mat and cushion–grass shrub, and dwarf birch–ericaceous shrub. The open Dwarf Scrub communities (approximately 87 percent of the mapped type) are found on dry, windy ridges and rocky areas usually above treeline. Typical species in these communities include roundleaf willow, Arctic willow, polar willow, netleaf willow, diapensia, bog blueberry, mountain cranberry, crowberry, red fescue (*Festuca rubra*), Labrador tea, and alpine azalea (*Loiseleuria procumbens*). The closed Dwarf Scrub communities (approximately 13 percent of the mapped type) also are found on dry slopes and ridges at higher elevations. Typical species include four-angle mountain heather, sedges, netleaf willow, Arctic willow, bog blueberry, mountain cranberry, diapensia, crowberry, alpine azalea, purple reedgrass (*Calamagrostis purpurascens*), red fescue, and white mountain-avens. Dwarf Scrub, as a composite type, occurs commonly in mountainous parts of the upper Susitna River basin and covered 238,248 acres or 14.9 percent of the mapped area.

4.6.3.1.3. Herbaceous Types

In the AVC (Viereck et al. 1982, 1992), areas classified as herbaceous can be dominated by herbaceous vascular and/or nonvascular plants, but these areas must have < 25 percent cover of woody plants. In the upper and middle Susitna River basin, herbaceous habitats are not well-represented on the landscape. As a group, herbaceous habitats covered 14,494 acres or 0.9 percent of the upper Susitna River basin area mapped by Kreig and Associates (1985; in APA 1985a). The graminoid herbaceous types are by far the most common, covering 14,286 acres or 0.9 percent of the mapped area. Herbaceous habitats dominated by forbs, mosses, or lichens are rare and covered only 208 acres (<0.1 percent of the mapped area).

4.6.3.1.3.1. Wet Graminoid Herbaceous

Three different plant communities occur in the Wet Graminoid Herbaceous type in the upper and middle Susitna basin, all dominated by cotton grasses and sedges: wet sedge meadow, wet sedge–herb meadow, and wet sedge–moss bog. Wet Graminoid Herbaceous communities occur on wet concave sites, which typically have standing water and often are underlain by permafrost. These areas often are strongly dominated by cotton grasses and sedges. Other common species include buckbean, marsh cinquefoil, swamp horsetail, and *Sphagnum* mosses. Wet Graminoid Herbaceous, as a composite type, is uncommon in the upper and middle Susitna basin and covered 10,621 acres or 0.7 percent of the mapped area.

4.6.3.1.3.2. Mesic Graminoid Herbaceous

Mesic Graminoid Herbaceous communities occur on moist flat sites, typically without standing water. These communities often are dominated by bluejoint, Bigelow sedge, and tussock cottongrass. Other common species include diamondleaf willow, dwarf birch, Labrador tea, bog blueberry, mountain cranberry, and Arctic bluegrass (*Poa arctica*). Mesic Graminoid Herbaceous is an uncommon type in the upper and middle Susitna basin and covered 3,550 acres or 0.2 percent of the mapped area.

4.6.3.1.3.3. Dry Graminoid Herbaceous

Dry Graminoid Herbaceous communities are grasslands, often dominated by fescue grass and red fescue. These grasslands occur on well-drained, dry rocky slopes and steep south-facing slopes. Other common species in this type include purple reedgrass, shortstalk sedge (*Carex podocarpa*), tufted hairgrass (*Deschampsia cespitosa*), timothy (*Phleum pratense*), arctic wormwood, netleaf willow, white mountain-avens, and mountain cranberry. Dry Graminoid Herbaceous is a rare type in the upper and middle Susitna basin (<0.1 percent of the mapped area) and covered only 115 ac.

4.6.3.1.3.4. Forb and Bryoid Herbaceous

Three different plant communities occur in the Forb and Bryoid Herbaceous type in the upper and middle Susitna basin. Included in this type are forb-dominated communities (dry forb herbaceous) and moss- and lichen-dominated communities. Dry forb herbaceous communities occur on dry, rocky, well-drained tundra slopes. No species are strongly dominant, but characteristic forb species include three-tooth saxifrage (*Saxifraga tricuspidata*), arctic wormwood, diapensia, moss campion (*Silene acaulis*), alpine bistort, mountain harebell (*Campanula lasiocarpa*), arctic cinquefoil, and dwarf fireweed. Both the moss- and lichen-dominated communities in the mapping area occur most commonly on well-drained rocky slopes. The dry moss communities often include *Rhacomitrium* and *Dicranum* mosses, and the dry lichen communities are characterized by *Cladonia*, *Cetraria*, and *Stereocaulon* lichens. Forb and Bryoid Herbaceous, as a composite type, is rare in the upper Susitna River basin and covered only 208 acres (<0.1 percent of the mapped area).

4.6.3.1.4. Sparse Vegetation

Plant communities were treated as sparsely vegetated when 5-10 percent of an otherwise barren area was vegetated with forest, scrub, or herbaceous communities. Sparse Vegetation covered 38,324 acres or 2.4 percent of the mapped area, but no information was presented in APA (1985a) on the landscape features associated with this type.

4.6.3.1.5. Barren

A map polygon was classified as barren or barren bedrock if less than 5 percent of the area was vegetated. Barren sites covered 74,043 acres or 4.6 percent of the mapped area, but no information was presented in APA (1985a) on the landscape features associated with this type in the mapping area.

4.6.3.1.6. Water

In the vegetation mapping for the upper Susitna River basin, this type includes open water in lakes, ponds, rivers, and streams. Also included in this type, however, are freshwater aquatic herbaceous communities, often with emergent vegetation, which occur in standing water along the margins of waterbodies. Characteristic species in the latter habitats include yellow pond lily (*Nuphar polysepala*), common marestail (*Hippuris vulgaris*), narrow-leaved burreed, common bladderwort (*Utricularia macrorhiza*), sedges, and horsetails. The Water type covered 31,671 acresres or 2.0 percent of the mapped area.

4.6.3.1.7. Cultural–Urban Developed

Developed areas with gravel fill were rare in the mapping area for the upper Susitna River basin and covered only 110 acres (<0.1 percent of the mapped area).

4.6.3.2. Plant Species Occurrence

In 1980 and 1981, floristic surveys were conducted in the Susitna basin upstream of Talkeetna by McKendrick et al. (1982). Those survey data provide information on the numbers and distribution of plant species that occurred in those portions of the project area at that time. In the middle and upper basin above Gold Creek and in the Susitna floodplain downstream to Talkeetna, 295 vascular plant species, belonging to 151 genera and 57 families, were identified (McKendrick et al. 1982: Table 2). Of that total, 255 species were identified in the basin above Gold Creek and 76 species were identified downstream from Gold Creek.

Of the 57 vascular plant families represented in the floristic data collected by McKendrick et al. (1982), eight families had the greatest number (13–23) of species recorded: Cyperaceae (sedges), Poaceae (grasses), Asteraceae, Ericaceae (heath family), Ranunculaceae, Rosaceae, Salicaceae (willows and poplars), and Saxifragaceae. Within the nonvascular flora, 11 genera of lichens (including at least 12 species) and 7 moss taxa were identified. The focus of the floristic surveys was on vascular plants, which probably accounts for the low numbers of nonvascular taxa recorded. Likely a majority of the nonvascular species or genera occurring in the area were not identified.

Of the 76 vascular plant species found in the Susitna floodplain downstream, 54 also were found in middle and upper basin above Gold Creek, leaving only 22 additional species found in the downstream area. The sites sampled downstream from Gold Creek, however, were confined to the floodplain, which reduced the number of habitats represented and the niches available for plant species in relation to the much greater diversity of habitats sampled in the middle and upper basin farther upstream. The greater sampling effort upstream also may have contributed to a larger number of species being recorded there.

4.6.3.2.1. Invasive Vascular Plant Species

No surveys of invasive vascular plants were conducted as part of the origina APA Susitna Hydroelectirc Project studies, primarily because the risk of invasive species was not considered a major concern at the time. Resource agencies have become increasingly concerned, however, about the potential for invasive plant species to become established as a result of construction activities associated with new developments. As a result, the USFS, NPS, BLM, Alaska Natural Heritage Program, and other stakeholders formed the Alaska Committee for Noxious and Invasive Plants Management (CNIPM) and developed the Strategic Plan for Noxious and Invasive Plants Management in Alaska (Graziano 2011). The CNIPM has developed a statewide mapping program and provides internet updates regularly as new surveys are conducted (http://aknhp.uaa.alaska.edu/maps/akepic/). Based on invasive plant surveys conducted along the road systems near the Susitna basin and on other regional surveys, 22 invasive plant species have been identified that potentially could occur in areas disturbed by development of the Project (Table 4.6-4). 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 monoculture stands along roadsides, trails, and river bars. The ability of this species to colonize linear features in the landscape is especially problematic because they act as corridors for dispersal.

Table 4.6-4. Invasive vascular plant species that may occur in areas disturbed during development of the proposed Susitna–Watana Hydroelectric 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

[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.

4.6.3.2.2. Species of Important Commercial, Recreational, or Cultural Value

Commercial use of forest resources in the Project area has been limited to small logging operations along the Susitna River floodplain in the lower basin (ADNR 1991, 2010). Vegetation in the upper basin is almost entirely undisturbed, cannot be accessed by roads, and is not addressed in the most current forestry and land management plans for the region (ADNR 1991, 2010). Lands with highest forestry potential within the Project area are located in the Susitna River floodplain downstream from the confluence with Portage Creek.

Although plant species generally do not provide direct recreational value to humans, as components of plant communities they are an essential part of the landscape that provides the setting for a number of recreational uses in the Susitna River basin. Recreation activity is widespread in the Susitna River basin and includes summer sport fishing, boating, hiking, climbing, hunting for big game, and snowmachine use, skiing, and trapping in the winter months.

A number of plant species in the Susitna River basin are of cultural importance. Probably the most important are the tree species, especially spruce and birch and, to a lesser extent, poplar and aspen, which provide a source of wood used by local residents for home building and/or heating (ADNR 2010). The total consumption of wood for these local uses, however, is probably relatively small on a basin-wide basis. Other species of cultural importance, in this case for subsistence uses, include those berry-producing plants that predictably produce a harvestable fruit crop in localized areas. The primary species of importance in this regard are highbush cranberry, crowberry, dwarf blueberry, bog blueberry, mountain cranberry, nagoon berry, cloudberry, raspberry, trailing black currant, and red currant.

4.6.3.3. Inventory of Moose Browse

A substantial amount of vegetation-related research for the APA Project focused on the availability and quality of forage for moose. The most important browse species for moose were shrubs, including willows, dwarf birch, and mountain cranberry (Steigers et al. 1983; Helm and Mayer 1985). The vegetation types with the highest availability of moose browse on the middle and lower Susitna River were late successional forests, including mature balsam poplar stands and mixed stands of white spruce and paper birch (UAAES and TES 1981; TES 1982; Steigers et al. 1983; UAFAFES 1985). Steigers et al. (1983) also found high availability of moose browse in dwarf birch–willow stands. In the upstream project area, late-successional forests occurred primarily in the floodplain of the Susitna River.

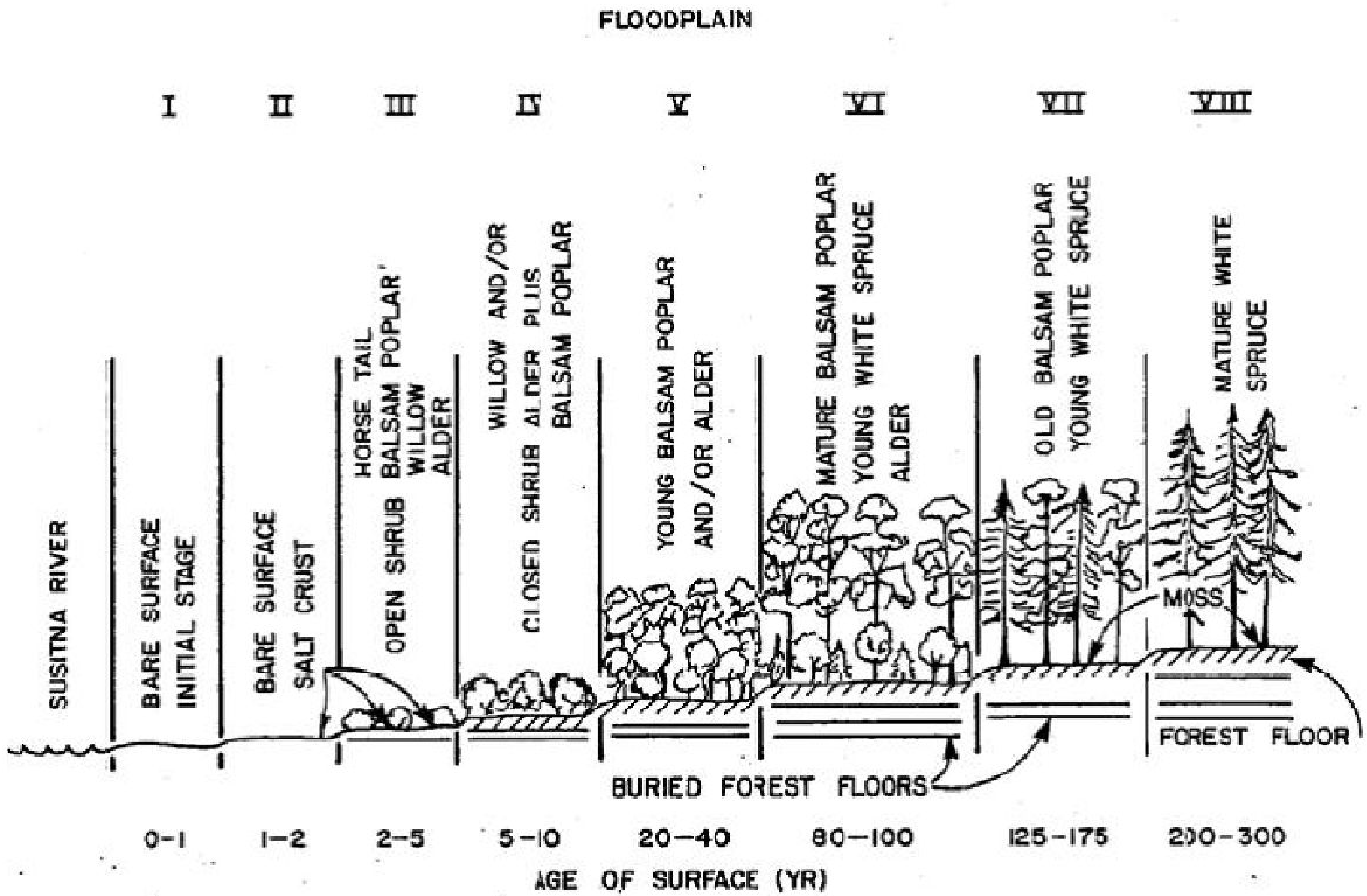
Steigers et al (1983) conducted browse inventory and plant phenology studies in the middle Susitna River basin, as well as an inventory and assessment of an area in the Alphabet Hills (east of the upper Susitna River) before prescribed burning by BLM and USFS. The browse inventory quantified shrub stem density, browse availability, browse use, and current annual growth biomass by vegetation class. Dwarf birch–willow vegetation was the most valuable type for moose browse. The hypothesis that moose focused on eating herbaceous plants during spring after snowmelt was not supported by the data. The study in the Alphabet Hills suggested that fire could increase the potential of forested vegetation classes as moose habitat and that shrubs were the primary food source of moose in these types.

Helm and Mayer (1985) studied plant phenology in areas inhabited by radio-collared moose in the proposed impoundment zones. Transects sampled along different elevations provided observations of shrub, forb, and graminoid phenology. Moose used the areas heavily during spring, before calving. Fecal analysis of moose pellets showed that moose in the area were eating mostly willows, mosses, resin birch, and mountain cranberry, with willows being the most important component; forbs and sedge were not significant forage plants for moose.

The majority of the area mapped in the Susitna basin for the APA Project was covered by low mixed shrub, woodland and open black spruce stands, sedge–grass tundra, mat and cushion tundra, and birch shrub (UAAES and TES 1981). Less than 3 percent of the area mapped for the Phase I vegetation study was occupied by deciduous or mixed coniferous–deciduous forests, which occurred on the Susitna River floodplain and would have been lost to inundation. Plant succession and available moose browse in the Susitna River floodplain would have been affected downstream of the dam sites due to altered water flow (UAFAFES 1985). To understand the potential effects of altered flow, the authors of that study examined successional patterns and abundance of vegetation types (Figure 4.6-18). They concluded that the most valuable successional stage for moose browse on the middle and lower Susitna River was late successional forests, including mature stands of balsam poplar and mixed stands of white spruce and paper birch, because they occupied a large proportion of the vegetated floodplain area downstream (48–72 percent) and had high browse diversity, even though the stem density of browse was lower than in earlier successional stages.

Habitat use by moose in the lower Susitna drainage was conducted by Collins and Helm (1997) in the early 1990s, in conjunction with a companion study of floodplain ecological succession (Helm and Collins 1997, described further in Section 4.8 under Riparian Ecology). The investigators were two of the authors for the APA Project study of riparian succession (UAFAFES 1985). Browse availability was the principal factor influencing winter habitat selection by moose, and early shrub and old balsam poplar successional stages were most important to wintering moose. Browse availability depended on winter snow depth. Feltleaf willow (*Salix alaxensis*) was the most important browse species, with a utilization rate of 76 percent in a winter with average snow depth. Unvegetated sites, dry sloughs, and frozen river channels accumulated significantly less snow than other sites and were used preferentially by moose for access to foraging areas as snow cover deepened. The authors concluded that, unless flow of the Susitna River was affected by hydroelectric development, habitat enhancement for moose should focus on upland sites rather than on riparian habitats on the floodplain, because normal river flow rejuvenated early successional stages without human intervention.

Collins (2002) also studied moose forage use and plant secondary compounds in the Oshetna River and Tyone Creek drainages south of the upper Susitna River, in the Nelchina study area of Testa (2001, 2004). Use of feltleaf willow was highest in winters with deep snow, when diamondleaf willow (*Salix pulchra*) plants were mostly buried by snow. Moose used dwarf birch possibly because lower levels of tannin provided more digestible protein. Moose had low reproductive rates even when winter browse availability was not limited, and browse did not appear to be limiting to the population until the protein-limiting effect of tannins was taken into account. Because of tannins in browse plants, moose in the study area may be experiencing severe nutritional limitation in winter.



ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.6-18

Vegetation Succession

source: APA 1985b

4.6.3.4. Wildlife Habitat Evaluation

The habitat evaluations used in the State of Alaska's Susitna Area Plan (ADNR 1985) and local Matanuska–Susitna Borough land-use planning efforts were derived from the APA Project and Susitna River Basin Study efforts (ADF&G 1984b, USDA 1985b) and from the AHMG map atlases (ADF&G 1985a, 1985b). Since then, no resource mapping efforts have been undertaken that are as comprehensive in coverage as those early efforts, described below. Several reports prepared in the early 1980s for the APA Project addressed the topic of wildlife habitat evaluation, as did the contemporaneous Susitna River Basin Study (USDA 1985a, 1985b).

Wildlife habitats were evaluated for the APA Project using vegetation cover types mapped within 16 km (10 mi) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). Wildlife experts who worked on the APA Project assigned habitat-value scores ("life requisite values") for various wildlife species, using numerical rankings of seasonal (spring/early summer, late summer/fall, winter) values for cover and food and for reproduction. In all, 21 habitats were ranked for 146 species (116 bird species and 30 mammal species) and the rankings were summed across all seasons for each species and habitat type (Appendix 4.6-1). Those sums were totaled across all species to produce overall numeric scores for each habitat type. Four general categories of relative habitat value were designated: "excellent" and "good" habitats had mean scores that were above the average value and "fair" and "poor" habitats had below-average mean scores. Open mixed forest, closed mixed forest, wet sedge–grass meadow, and white spruce woodland were the habitat types receiving the highest rankings in the project area and were considered to be of "excellent" value to wildlife. Habitat types classified as "good" included open white spruce forest, balsam poplar forest, lake, open black spruce forest, black spruce woodland, closed birch forest, willow shrub, and open birch forest. Habitats categorized as "fair" included mixed low shrub, sedge–shrub tundra, sedge–grass tundra, birch shrub, tall shrub, grassland, and mat-and-cushion tundra. River and rock habitats were ranked the lowest and were considered of "poor" value.

The Susitna River Basin Study (1985a) was a major collaborative effort among the USDA, State of Alaska, and USFWS to inventory resources in the Susitna River watershed and provides information on which to base land-use planning decisions and land sales. One of the reports generated for that study was a regional evaluation of wildlife habitats (USDA 1985b). The watershed was split into four subbasins: Beluga, Willow, Talkeetna, and Upper Susitna (the latter subbasin covered most of the area of interest for the Project), but it is important to recognize that these subbasins were not defined hydrologically (as in Figure 4.7-1). The inventory data developed for the Upper Susitna subbasin were confined to the Talkeetna Mountains south of the Project area and part of the Lake Louise flats east of the Project area, however, and were not as detailed as for the other subbasins. Therefore, most of the inventory data presented in the report (USDA 1985b) applied to the lower basin, but not the middle and upper basin. Fish and wildlife modeling and mapping were done to varying degrees. The technical analyses consisted of collaborative work to model the fish and wildlife values of basin lands and to assist ADF&G in creating fish and wildlife "element" maps that could be used to assess land-use alternatives.

Habitats were evaluated in terms of their ability to provide seasonal food and cover for selected wildlife species, their ability to support a diversity of wildlife species, and their relative abundance within the basin (USDA 1985b). A wildlife species diversity model was applied to identify and map those vegetative communities (habitats) that were capable of supporting the highest diversity of wildlife species. Cover types identified as having high diversity included open mixed forest, open conifer forest, tall shrub (riparian willow or mixed species), open deciduous forest, closed mixed forest, and low shrub (willow, resin birch). Types with moderate diversity included closed conifer forest, closed deciduous forest, open short black spruce forest, *Sphagnum* bog with shrubs, tall shrub alder, and grassland.

A "habitat scarcity" model was developed to incorporate a regional perspective in the development of fish and wildlife element maps (USDA 1985b). Relative scarcity of different habitats was assessed by determining how much area each type covered (minimum mapping unit was 40 ac) and then comparing that with the area of subbasin that each type would cover if all types were equally abundant. Habitat scarcity rankings were derived for 12 cover types in the Upper Susitna subbasin:

- Very Scarce (types covering <1.6 percent of the subbasin): open mixed forest; open conifer forest; tall shrub alder–willow (riparian); closed conifer forest; closed deciduous forest; open short black spruce forest; *Sphagnum* bog, with or without shrubs; grassland (*Calamagrostis*);
- Scarce (1.6–4.5 percent): closed mixed forest;
- Neither Scarce nor Abundant (4.6–8.5 percent): low shrub willow–resin birch;
- Abundant (>8.5 percent): tall shrub alder; tundra.

After completing the diversity and scarcity models, a "habitat synthesis" model was created to use computerized inventory data to develop fish and wildlife element maps (ADF&G 1984b). The final modeling effort combined the habitat diversity and scarcity results to identify those cover types that were not abundant, that supported the greatest variety of wildlife species, and that provided year-round moose range. This exercise identified 197,152 acres (11.8 percent) of the Upper Susitna subbasin as being of high value for fish and wildlife, consisting of Very Scarce and Scarce types having high species diversity, Very Scarce types having moderate diversity, and shrub tundra and low shrub willow–resin birch types (USDA 1985b).

4.6.4. Potential Adverse and Positive Impacts

4.6.4.1. Wildlife

Five general classes of impacts on terrestrial vertebrates may occur as a result of Project construction and operation:

1. Permanent habitat loss from inundation and placement of project facilities, gravel pads and roads;

2. Temporary habitat loss and alteration resulting from reclaimed and revegetated areas such as borrow sites, temporary rights-of-way, transmission corridors, and from local alteration of climate and hydro1ogy;

3. Creation of barriers, impediments, and hazards to animal movements;

4. Disturbance associated with project construction and operation; and

5. Consequences of increased human access and changes in recreational and hunting patterns not directly related to project activities.

Riverine, riparian, forest, shrubland and wetland habitats as well as specific habitat components such as raptor nest trees will be permanently lost within the Project footprint, including the access road, project facilities and impoundment area. While the creation of the reservoir will create habitat for some species during some portions of the year, the reservoir will impact mammal movement, migration patterns and distribution. Development of riparian habitat along the reservoir will be limited by the large annual water surface elevation fluctuations and potential shoreline erosion. Vegetation within the transmission corridors will be permanently altered from forest or tall shrub communities to low shrub and herbaceaous communities. The species composition and structural complexity of vegetation will also be altered along the edges of the transmission corridors, access road, project facilities and reservoir. There will be temporary impacts to vegetation at borrow sites and other sites temporarily impacted during construction activities until these areas are restored following construction. In addition, the composition and extensiveness of riparian habitat below the Project will be altered due to Project-induced changes to streamflow, water temperature and ice processes. Changes in the botanical resources due to project construction and operation are discussed in Section 4.6.4.2. These changes will benefit some animal species while displacing others.

The Project will impact big game species such as moose, caribou, Dall's sheep, black bear, brown bear, and wolf and furbearers including beaver, marten, wolverine, river otter and red fox. The effects on big game and furbearers would result from habitat loss by inundation; interference with movements due to the impoundment zone, changes in ice cover and disturbance from project construction and operations; habitat alteration along project facilities and in the riparian corridor below the dam; and consequences of increased human access afforded to hunters, trappers, recreationists, and poachers, including harvest, disturbance and displacement or abandonment of the area, collision mortality and increased likelihood of killing nuisance animals. Species-specific potential impact mechanisms are indicated in Table 4.6-5

Birds would be affected primarily by habitat loss to inundation and disturbance of nests, particularly for raptors such as eagles. Waterbirds using lacustrine habitats would experience minor impacts due to the small area of lakes and ponds that would be affected. Trumpeter swans nesting on lakes in the Project area could be adversely affected by low-flying aircraft. Birds using fluvial habitats would experience a substantial loss of habitat. Sandbars, islands, and riparian shoreline areas used for feeding, roosting, and loafing by shorebirds would be flooded. The reservoir drawdown zone could be used as loafing habitat for migrant shorebirds, but food availability would be low. Although the middle basin is not an important migration corridor, the open-water areas within the impoundment may be used for loafing by early migrants before other waterbodies are open. Although fish and invertebrate prey are expected to be present, the impoundment is likely to offer only low densities of food for migrant or resident species. Open-water areas downstream from the Watana dam may benefit migrant waterfowl and shorebirds and provide winter habitat for dippers and possibly a few species of waterfowl. Although the large impoundment would greatly increase the surface area of water in the middle basin, the drawdown of the reservoir would reduce its value as lacustrine habitat.

Project development is expected to eliminate breeding habitat for thousands of landbirds. The losses would be disproportionately large for species restricted to forested habitats. Habitat alteration would affect the distribution and abundance of species, again with birds restricted to closed forest habitats suffering losses, whereas species associated with habitat edges, disturbed habitats, and artificial habitats would benefit. Ravens and gulls are likely to increase in numbers in the basin.

Only those species of small mammals that are restricted to forest habitats are expected to experience a decrease in regional abundance. Porcupines, snowshoe hares, pygmy shrews, and red squirrels will be most affected. Although they are found in nearly every vegetation type in the proposed Project area, red-backed voles are most common in spruce and cottonwood forests and are likely to decrease in abundance in the basin. Meadow vole abundance may increase in the basin due to the creation of disturbed and revegetated areas. The major impact of the Project on small mammals will be local alterations in the distribution and abundance of species.

The APA Project habitat analysis described earlier (TES 1982) identified a disproportionately large impact on wildlife habitats ranked as being of “excellent” and “good” value, based on diversity of use, seasonal value for food and cover, and reproduction.

Table 4.6-5. Potential impacts of the proposed Susitna–Watana Hydroelectric Project on terrestrial wildlife and botanical resources (adapted from LGL 1985a).

Moose

- Removal of material from borrow sites could result in temporary loss of winter habitat.
- Maintenance of early successional vegetation along transmission line corridor may improve habitat quality.
- Altered flow regime downstream of dam would alter floodplain habitat for wintering moose.
- Open and warmer water in downstream areas may alter plant phenology and affect spring forage and cover.
- Hoar frost deposition on floodplain vegetation may render some browse unavailable and increase metabolic demands of moose eating frost-bearing forage.
- Drifting snow from frozen impoundment surface and in the transmission line corridor, and delayed melting of those drifts, may inhibit or prevent use of winter and early spring forage.
- Drifting snow from frozen impoundment surface may impede moose movements south and southwest of the reservoir and reduce the value of the Fog Lakes area as winter range.
- Open water downstream from dam in winter may restrict moose movements across the river and to island wintering areas, perhaps blocking access to critical winter forage or spring calving areas and may result in mortality of moose attempting to cross the river.
- Increases in moose density caused by displacement of moose and predators following impoundment and by blockage of migration movements could increase predation, possibly driving moose populations to low levels that may be maintained by predation.
- Increased hunting and poaching would result in increased mortality.
- Thin or unstable shore ice and floating ice or debris may cause direct mortality of moose attempting to cross the impoundment.
- Increases in train and automobile traffic and plowing of snow from rights-of-way would increase collision mortality.
- Access corridor traffic, village activities, dam construction, aircraft overflights, and associated disturbances may alter distribution of moose.

Caribou

- In spring, ice at the impoundment edges, drifting ice floes, and floating debris may cause mortality of caribou attempting to cross the impoundment.
- Increased access by hunters and poachers would result in increased harvest.
- Construction and recreational traffic would cause increases in collision mortality.
- Increased predation may lead to increased mortality.
- The impoundment could reduce productivity by presenting a barrier to movement.
- Access roads and associated traffic may block or alter herd movements, preventing caribou from reaching foraging or calving areas and also increasing energy demands (particularly for pregnant cows or cows with calves).
- Construction and impoundment-clearing may prevent caribou from reaching foraging areas, thereby reducing productivity.
- Aircraft may disturb caribou, causing increased energy demand and calf mortality.
- Drifted snow south and southwest of the reservoir may block caribou movements to forage.
- Increased recreation and development of lands near the Project may change range use, alter migration patterns, and cause abandonment of calving areas, thus reducing productivity.

Dall's Sheep

- The impoundment may partially flood the Jay Creek mineral lick area and may block movement to licks on the east side of Jay Creek.
- Portions of the Jay Creek lick complex below maximum fill level may be affected by leaching and erosion, leading to the loss of lick sites.
- The impoundment may contribute to delayed spring plant development and increased snow accumulation on

south-facing slopes of the Watana Creek Hills.
- The impoundment may block movement between the Watana Creek Hills and Talkeetna Mountains populations.
- Ice on slopes of the Jay Creek mineral lick area may cause accident-related mortalities in early spring.
- Disturbances from recreational boating on the impoundment may reduce or prevent sheep use of the Jay Creek mineral lick area.

Brown and Black Bears
- Clearing of transmission corridors may improve habitat by enhancing food production.
- Potential declines in moose or salmon populations may reduce food supply, thereby reducing productivity.
- Local climatic changes resulting from the reservoir and an extended open-water period in the river downstream of the reservoir may alter vegetation composition or production and affect food supply.
- Impoundment and construction and use of access roads may block movement to forage or dispersal of juveniles.
- The impoundment may force black bears into closer proximity with conspecifics and brown bears, temporarily increasing mortality.
- Increased human activity may cause bears to abandon foraging habitat, thus affecting weight gain and productivity, and cause bears to abandon dens.

Wolf
- Reduction in moose and other prey abundance would reduce carrying capacity.
- Inundation of parts of home ranges may alter distribution of wolf packs.
- Wolf numbers may increase near the impoundment.
- The impoundment and dam facilities may hinder access to caribou and moose calving areas.
- Access routes would be used by wolves when hunting.
- Open water downstream from the dam may hinder movement.

Wolverine
- Reduction in density of small mammals and grouse may affect movements, population density, and productivity.
- Increased carrying capacity of moose and ptarmigan along the transmission-line corridor may result in increased wolverine carrying capacity.
- The impoundment and dam facilities would change wolverine home range boundaries and alter habitat use patterns.

Lynx
- Transmission-line corridor would result in permanent loss of forest habitat.
- Habitat alteration at borrow sites would result in loss of forest habitat for species such as lynx, weasels.

Coyote, Red Fox
- Construction and operation of the Project may increase coyote abundance near developed areas.
- Early successional plant communities in areas reclaimed from construction activities may provide increased availability of small mammals, benefitting predators, such as coyotes, red foxes, weasels
- Open water downstream from the impoundment may hinder mammal movements in winter.

Aquatic Furbearers
- Higher water temperatures downstream of the impoundment could maintain open water for longer periods benefiting beaver, muskrat, river otter.
- Downstream flow variations may freeze or flood beaver lodges and/or food caches.
- Habitat alterations downstream of the impoundment may affect river otters, mink, beaver, and muskrats
- The Project would result in water quality changes to the Susitna River that may impact fish populations, prey to river otters.
- Early successional plant communities in areas reclaimed from construction activities may provide increased

availability of small mammals and birds, also benefitting predators such as marten, mink.

Waterbirds

- Project construction would result in loss of river, stream, and lacustrine habitats for waterbirds, including shoreline nesting habitats.
- The transmission line corridor would cross waterbird nesting areas or movement corridors and would increase the probability of mortality from transmission-line collisions.
- Increased hunting and poaching may result in increased mortality of gamebirds.

Raptors

- Impacts of erosion, blowdowns, etc., on forest vegetation may result in loss of nest sites and habitat alteration for bald eagles, golden eagles, gyrfalcons and other tree nesting raptors.
- Increased air traffic, construction, and recreation may result in disturbance and nest abandonment.
- Human activities along the transmission-line corridor may result in loss or abandonment of nesting locations.
- Potential losses of raptors by shooting resulting from increased recreation.
- Potential electrocution of raptors at transmission towers and power poles.
- Potential losses of peregrine falcons from collisions with high-tension wires and other man-made obstructions.
- Potential adverse impacts on salmon and other fish in downstream areas may affect habitat quality for bald eagles.
- Potential improvement of peregrine falcon nesting habitat due to impoundment.

Landbirds

- Clearing for the access corridor and borrow sites would alter forest habitats.
- Vegetation encroachment on downstream river floodplains may increase breeding habitat for some species.
- Effects of erosion, blowdowns, etc., on forest vegetation may result in a loss of nest sites and forest habitats.
- Presence of transmission lines, towers, and vehicles would result in collision mortality.

4.6.4.2. Botanical Resources

Impacts on vegetation from the Project would occur in severalways:

- Direct loss of vegetative cover within the impoundment zone, access road, and Project facilities;
- alteration of vegetation adjacent to the project footprint and within the transmission corridor;
- temporary alteration of vegetation during construction within the upland borrow pits, temporary housing, etc;
- disturbance from construction and operations/maintenance activities, followed by alterations in plant community types;and
- alteration of riparian habitat below the Project from changes in the stream flow regime.

These impacts are described in more detail below.

4.6.4.2.1. Direct Loss of Vegetation

Using acreages calculated for Stage I (Low Watana) of the APA Project as the best available information (pending preparation of a unified GIS database for the current project), construction of the Project would result in the direct removal or inundation of vegetation in an area of approximately 21,430 acres (APA 1985a). This acreage includes the proposed dam and impoundment, access road, construction camp and village, quarry and borrow sites, airport, transmission line switchyards, and construction roads (Table 4.6-6). Of the acreage that would lost, 4,146 acres are water and 69 acres are barren. Removing those amounts leaves a total of 17,213 acres of vegetation that would be lost from development of the Project.

Forests and woodlands make up the vast majority (13,874 acres or 81 percent) of the affected area. Spruce forests and woodlands account for 7,107 acres or 51 percent of the forest types that would be lost. Mixed forests and woodlands, primarily spruce–birch and spruce–birch–aspen forests, also account for a substantial amount of the forested area that would lost (6,039 acres or 44 percent of the forest types affected). Broadleaf forests make up the remaining 728 acres (5 percent) of the forest types that would be lost. Dwarf tree scrub and low scrub combined account for 3,132 acres (or 18 percent) of the vegetation that would be lost. Small areas of tall scrub (88 ac), dwarf scrub (60 ac), herbaceous vegetation (35 ac), and sparse vegetation (14 ac) would be lost; in combination, those areas constitute one percent of the vegetation types that would be lost from development.

The total area of 17,213 acres of vegetation that would be lost includes 1,459 acres that would be revegetated after the completion of the construction phase (see Table 4.6-6). Initially, grassland habitats would be created in those areas to quickly establish a vegetation layer to minimize erosion; over time, those areas would undergo succession to scrub and forest types, depending on drainage and site conditions.

Table 4.6-6. Acreage of vegetation types expected to be lost to Stage I (Low Watana) development for the original APA Susitna Hydroelectric Project[1] (reproduced from APA 1985a).

Vegetation Type[2]	Impoundment & Dam	Access Road[3]	Camps & Villages[4]	Quarry & Borrow Sites[5]	Other Facilities [6]	Total
Conifer Forest						
White Spruce Forest	1,066	21	0	1	0	1,088
Black Spruce Forest	1,636	3	0	16	8	1,663
Black & White Spruce Forest	3,135	6	0	245	5	3,391
White Spruce Woodland	348	1	0	7	6	362
Black Spruce Woodland	377	0	0	0	0	377
Black & White Spruce Woodland	77	9	1	139	<0.5	226
Subtotal	6,639	40	1	408	19	7,107
Broadleaf Forest						
Paper Birch Forest	242	0	0	8	0	250
Birch–Aspen Forest	389	0	0	0	0	389
Other Broadleaf Forest	89	0	0	0	0	89
Broadleaf Woodland	0	0	0	0	0	0
Subtotal	720	0	0	8	0	728
Mixed Forest						
Spruce–Birch Forest	4,013	0	0	194	39	4,246
Spruce–Birch–Poplar Forest	0	0	0	14	0	14
Spruce–Birch–Aspen Forest	1,333	0	0	0	0	1,333
Spruce–Poplar Forest	389	0	0	51	0	440
Mixed Woodland	6	0	0	0	0	6
Subtotal	5,741	0	0	259	39	6,039
Dwarf Tree Scrub						
Conifer Dwarf Tree Scrub	1,709	0	0	27	0	1,736
Other Dwarf Tree Scrub	0	0	0	0	0	0
Subtotal	1,709	0	0	27	0	1,736
Tall Scrub						
Tall Alder Shrub	63	6	0	17	0	86
Other Tall Shrub	0	2	0	0	0	2
Subtotal	63	8	0	17	0	88
Low Scrub						
Low Dwarf Birch Shrub	12	77	214	93	32	428
Low Willow Shrub	164	158	10	4	1	337
Low Ericaceous Shrub	7	0	0	0	12	19
Low Dwarf Birch–Willow Shrub	125	158	63	10	15	371
Low Dwarf Birch–Ericaceous Shrub	<0.5	25	<0.5	183	33	241
Other Low Shrub	0	0	0	0	0	0
Subtotal	308	418	287	290	93	1,396
Dwarf Scrub	0	60	0	0	0	60

Vegetation Type[2]	Impoundment & Dam	Access Road[3]	Camps & Villages[4]	Quarry & Borrow Sites[5]	Other Facilities[6]	Total
Graminoid Herbaceous						
Wet Graminoid Herbaceous	25	1	0	9	0	35
Mesic Graminoid Herbaceous	0	0	0	0	0	0
Dry Graminoid Herbaceous	0	0	0	0	0	0
Subtotal	25	1	0	9	0	35
Sparse Vegetation	14	0	0	0	0	14
Barren	68	1	0	0	0	69
Water	4,146	<0.5	12	0	0	4,158
Total	19,433	528	300	1,018	151	21,430

1 Indicated all facilities and features for which total clearing would occur; revegetation of some areas would occur following construction (see footnotes below); does not include transmission-line rights-of-way, in which only tall vegetation would be cleared.

2 Based on the Alaska Vegetation Classification (Viereck et al. 1982), with modifications (see text). Although vegetation complexes were mapped in many cases, only the major component is represented here to simplify the presentation; all closed and open types in the forest and scrub categories were aggregated.

3 Included only the Denali Highway–Watana access road alternative; assumed average clearing width for that 43.6-mile road was 100 ft, of which approximately 40 ft (or 211 out of 528 ac) would be revegetated after road construction.

4 Included Watana construction camp and permanent village; approximately 200 acres would be rehabilitated after construction.

5 Included 33 percent of the area of the APA Susitna Hydroelectric Project Quarry Site A, 67 percent of the area of Borrow Site D, and 67 percent of the area of Borrow Site E. All quarry and borrow site areas would be revegetated after construction.

6 Included the airport (44 ac), Watana construction roads (80 ac), and transmission-line switchyards at Watana (12 ac) and Gold Creek (16 ac); approximately 30 acres of the construction roads would be revegetated after construction.

4.6.4.2.2. Effects of Erosion and Deposition

Erosion is a persistent problem at dam construction sites in northern latitudes (APA 1985a). Erosion following the clearing of vegetation may result from several factors, including the destabilization of slopes (especially glacial till), blowdown of trees near cleared areas, thawing of permafrost, desiccation of exposed soils, and changes in drainage patterns.

Three factors are primarily responsible for slope instabilities: changes in the groundwater regime, the magnitude of water-level fluctuations in the reservoir, and thawing of permafrost (APA 1985a). Slope stability studies noted in APA (1985a) indicate that areas particularly vulnerable to vegetation loss from erosion include side slopes of the canyons from the south abutment of the Watana dam site (RM 184) upstream to Vee Canyon (RM 225), along Watana Creek (RM 194), and at the upper limits of the Watana reservoir.

The Watana reservoir generally would occupy the steeply sloping sidewalls of the river canyon. Those areas have bedrock-controlled slopes with little or no overburden and are quite stable. The major areas of slope instability are expected along Watana Creek, where lacustrine slopes overlie frozen tills. These areas currently are unstable and likely will remain so or become more unstable after reservoir filling.

Assuming the Watana impoundment is similar to other northern reservoirs, the drawdown zone in areas where there is some overburden would remain partially or totally unstable after dam construction and filling, until bedrock or gravel/cobble/boulder substrates are exposed. The drawdown zone in the impoundment would remain essentially unvegetated, resulting in a barren area between the maximum and minimum pool elevations. Shoreline recession would be likely, with consequential further loss of vegetation (APA 1985a). Except during a series of drought years, vegetation would not be expected to invade the drawdown zone and no effects on vegetation from ice shelving would be expected. Although some of the evolving shoreline above the drawdown zone would be colonized by early seral stages consisting of characteristic grass and herbaceous species, stabilization of the upper shoreline may require 30 years or more.

4.6.4.2.3. Vegetation Alteration from Wind and Dust

Blowdown (also called wind throw) of trees is a recognized problem in cleared areas (APA 1985a). Wind speeds increase near reservoirs due to the greater fetch across cleared areas. Because northeasterly winds predominate in the Project area during most of the year, the greatest blowdown potential would be in the black spruce stands on the south side of the Watana dam site. The shallow rooting depth typical of black spruce (30 cm, 12 in) predisposes such trees to blowdown.

Wind-generated dust would be expected to occur during construction activities, particularly during and following clearing of vegetation. The direct effects of dust on plants vary with plant species and the chemical composition of the dust. For example, densities of cottongrass would likely increase, but stiff clubmoss, sphagnum moss, and some fructicose lichens may decrease in abundance when exposed to dust (APA 1985a).

4.6.4.2.4. Effects of Altered Drainage and Changes in Solar Radiation

Local alteration of drainage patterns and surface water flow may result from clearing, ditching, and other construction activities. Blocking drainage patterns may cause waterlogging of soils, thermal and hydraulic erosion, and shifts of surface flow to adjacent drainages (APA 1985a). The resulting changes in surface water flow gradually would cause changes in plant communities over time. The time required for those changes to occur, and the extent of the changes, would depend on the extent of hydrologic alterations and on plant succession dynamics.

Soils cleared of vegetation usually absorb more solar radiation than do vegetated soils; consequently, unvegetated soils thaw sooner in spring and deeper over the summer. Conversely, with less insulation, soils freeze earlier and deeper in the winter. The resulting changes in surface-water hydrology would cause changes in plant communities over time.

4.6.4.2.5. Indirect Effects of Vegetation Removal

Methods of vegetation removal may have indirect effects on existing vegetation nearby. Spruce budworm disease, which occurs in areas adjacent to the Susitna watershed (APA 1985a), may be more likely to invade the area if spruce trees are cut but not removed or burned. Clearing also may enable other insects and decay organisms to increase in abundance.

4.6.4.2.6. Local Climatic Changes and Effects on Vegetation

The presence of the Watana reservoir would moderate local seasonal temperatures and would promote delayed onset of cold temperatures in fall and prolonged colder temperatures in spring (APA 1985a). These effects were expected to be localized around the impoundment, extending up to one to five mi away from the shoreline, depending on the width of the reservoir, with the maximum effect expected to occur along the prevailing windward shoreline. Slight precipitation increases in both summer rainfall and early winter snowfall precipitation would be expected to occur near the windward shoreline. Similarly, hoar frost deposition may form on vegetation near the impoundment margins during fall before ice formation on the reservoir surface. However, hoar frost currently forms in areas not influenced by open water in the river, and the reservoir would not be expected to increase the severity of hoar-frost formation.

The reservoir would act as a heat sink or cold sink, depending on the season. This effect may delay spring plant phenological development by a maximum of three to five days near the windward shoreline (APA 1985a). Plant phenology in and near the river canyon currently is influenced by a number of other factors, such as yearly ambient temperature variations, elevation, slope, aspect, and vegetation type. Other factors such as plant species, site history, snow depth, soil water content, and depth of the moss insulating layer also influence plant phenology. Because so many local factors combine to influence plant phenology, the moderating influence of localized temperature depressions during early spring would be difficult to detect. Factors such as the warming effect of light reflectance from surface waters or ice onto surrounding vegetation, and the warming and subsequent thawing of permafrost soils near the reservoir, may positively influence early spring plant growth. Dust deposition along impoundment shorelines may promote early snowmelt, thereby exposing the underlying vegetation for use by moose. Because of these many interrelated factors, any measurable change in plant phenology would not be reliably ascribed to the effects of any particular impact. Similarly, changes in plant species composition would not be expected to occur because of changes in local climate.

Another thermal effect of the impoundment would be its moderation of diurnal temperature changes, such that local night temperatures during May and June would be higher, and daytime temperatures would be lower, than before development. Average fall temperatures near a lake of similar size to the proposed Watana reservoir were characterized by a 9.9° F (5.5° C) lower maximum and a 4.0° F (2.2° C) higher minimum than temperatures away from the lake (APA 1985a). The effects of these thermal changes on the vegetation would be difficult to predict quantitatively.

4.6.4.2.7. Effects of Increased Human Use on Vegetation

During the filling of the proposed Watana reservoir and the operational stage of the facility, project personnel would have an impact on vegetation in the upper Susitna basin. The most severe human-use impacts likely would be associated with off-road vehicles (ORVs) and accidental fires, assuming that no regulation of project personnel is enforced to mitigate these impacts. Similar, but more extensive, impacts would be expected from increased use of the area by the general public.

4.6.4.2.7.1. Off-road Vehicles

The effects of ORV use on vegetation varies with season, soil moisture and depth, the presence or absence of permafrost, vehicle weight, frequency of use, and other factors (APA 1985a).

The ground layer of vegetation is more susceptible to damage by ORVs than are other layers, and is most susceptible to damage in summer. In winter, snow and ice layers minimize damage to the underlying vegetation and organic mat. Dry habitats (e.g., alpine areas) are less susceptible to damage by ORVs, but often require long periods to recover if damaged. A few passes of light-track vehicles over relatively dry, well-drained soils may result in slight compaction of the organic and/or plant layer, a net soil temperature gain, and deeper thaw of the active soil layer. The typical result is minor subsidence and an influx of ground water. In contrast, tundra and wetlands, especially sites with underlying permafrost, are the most vulnerable habitats. Repetitive off-road traffic or use of heavy vehicles in moist areas is likely to remove vegetation and also the underlying organic mat. This impact would in turn cause soil temperature increases, deeper thaw, subsidence to 1 m (3 ft) or more, groundwater input, and severe erosion that may last 5 to 50 years or more (APA 1985a).

Near the Denali Highway, after ORV use, gullies were observed as wide as 8 m (26 ft) and up to 3 m (10 ft) deep, with severe side erosion and cave-ins, as well as active transport of sediment downhill (APA 1985a). A similar effect was noted when firelines were established on Wickersham Dome, near Fairbanks (APA 1985a). These effects would be most severe where ground-ice content is high. When removed or substantially reduced, the organic layer of tundra soils in such areas may require more than a century to regenerate. However, some grasses, such as b1uejoint, may invade mineral substrates on such sites rapidly.

4.6.4.2.7.2. Fire

The increased numbers of people in the Project area would be likely to cause increased incidence of fires. Fire is a natural factor shaping plant communities in the region, so increased fires would cause changes in plant communities similar to those already observed there.

Wildfire is a common and natural phenomenon throughout the conifer forests of interior Alaska. Characteristics affected by fire in these forests include: live biomass, dead and decaying biomass, available nutrients, soil temperature and soil moisture. Fire in black spruce forest greatly reduces the overstory biomass, although standing dead snags may persist. Intense burning partially or completely oxidizes organic constituents of the forest floor, releasing large quantities of available nutrients such as phosphorus. Soil temperatures become warmer through enhanced absorption of solar radiation. Permafrost, where present, recedes because of several factors including changes in albedo and loss of vegetative insulation. Thus, the active layer significantly increases in depth (APA 1985a).

Although the magnitude of tundra fires is extremely variable, in most cases many signs of the fire disappear after six to eight years. Recovery takes much longer in areas with abundant lichen cover, however (APA 1985a). In shrubland and forest, a variety of successional patterns may result from a fire, depending on fire intensity and burning patterns, vegetation type, soil moisture and temperature, time of year, and post-fire weather patterns. For example, some willow species, while highly adapted for reseeding burned areas, produce seeds that are viable for only short periods of time in the spring or fall (APA 1985a).

Trees and shrubs—including aspen, birch, willow, and alder—resprout and grow vigorously after fires. Shallow-rooted shrubs such as cranberry are destroyed in areas heavily burned to mineral soil, but burning to mineral soil is necessary for the establishment of willow seedlings (APA 1985a). In the short term, increased productivity of browse plants such as willow, aspen, and birch is likely as a result of the release of soil nutrients. Many berry-producing plants also increase in density after fire (APA 1985a). Production of moose browse, especially willow, often reaches high levels during the shrub stage after a fire. In one study referenced by APA (1985a), the amount of willow browse available to moose increased 680 percent, from 6.5 to 44.1 kg/hectare (5.8 to 39.3 pounds/acre), within 3–7 years after a fire in black spruce forest. Similarly, BLM (unpublished data, cited in APA 1985a) reported a 1,280 percent increase in willow density, from 1,800 to 23,000 stems/hectare (728 to 9,308 stems/acre), within 7 years after a moderate-intensity fire in a white spruce forest.

The ecological effects of fire on Alaskan vegetation have received considerable attention, and the accumulated knowledge allows a degree of prediction of the effects of a given type of fire on a specific area (APA 1985a). This knowledge, plus increasingly effective fire-control methods, has resulted in fire being used as a land-management tool to create desired vegetation changes.

4.6.5. Potential Protection, Mitigation, and Enhancement

4.6.5.1. Wildlife

PM&E measures will be defined during course of licensing studies and at the appropriate stage of the licensing efforts. However, the following list of proposed mitigation measures is summarized from the draft amended FERC license application (APA 1985b) and encapsulates the outcome of the large amount of effort that was devoted to impact assessment and mitigation planning for the APA Project (LGL 1985a, 1985b). These measures can provide a starting point for PME identification relative to the proposed Project.

4.6.5.1.1. Avoidance

- Using best management practices in transmission-line design to avoid electrocution of raptors.
- Prohibition of public access to project during construction.
- Prohibition of hunting and trapping by employees.
- Local adjustment of access route to avoid site-specific habitat loss or disturbance of wildlife.
- Implementation of waste-control measures, educational measures, and strict enforcement of state regulations prohibiting intentional feeding to avoid creating attractive nuisances that result in the destruction of nuisance animals.

- Preparation of BMP manuals for project design, construction, and maintenance: oil-spill contingency planning, erosion and sedimentation control, handling of liquid and solid wastes, handling of fuels and hazardous materials, and water supply.
- Adjusting placement of the Watana camp sites to avoid habitat loss and disturbance of spring brown bear and fall moose concentration areas near Tsusena Butte.

4.6.5.1.2. Minimization

- Delaying the start, and scheduling the timing, of vegetation-clearing operations to minimize the effects of habitat losses on moose, bears, marten, and nesting birds (especially raptors).
- Specific siting and use of side-borrow techniques during road construction and consolidation of infrastructure to minimize habitat losses for wildlife.
- Selective clearing and retention of shrubs and small trees (up to 3 m [10 ft] tall) in transmission line corridors to minimize habitat losses for some wildlife species.
- Minimization of aircraft-related disturbance through establishment of altitude restrictions and seasonal, spatial restrictions on air traffic near specific wildlife habitat areas deemed to be sensitive.
- Minimization of disturbance of sensitive wildlife areas through spatial and temporal (seasonal) restrictions on ground-based activities associated with project construction and operation, with special emphasis on eagle nests.
- Realignment of access road and use of specific methods, such as side-borrow techniques, to minimize disturbance of caribou range-use areas.
- Minimizing the amount of forested areas disturbed during access road and transmission line construction to minimize habitat losses for black bear, marten, small mammals, and landbirds, along with clearing of the narrowest corridors possible, retention of vegetation in middle of transmission line corridor, delay of impoundment clearing.
- Limit access during Project operation.
- Regulating traffic volume on access road to minimize traffic-related disturbance and vehicle-related injuries and mortality of caribou and other wildlife.

4.6.5.1.3. Rectification

- Revegetation and fertilization of disturbed sites to partially rectify the effects of vegetation removal and provide forage for moose and bears for up to 30 years.
- Creation of new soil exposures at the Jay Creek mineral licks used by Dall's sheep, if monitoring indicates loss of use of lick areas as a result of project construction or activities.

4.6.5.1.4. Reduction

- Institution of monitoring programs to provide the information needed to reduce impacts over time during the life of the project.

4.6.5.2. Botanical Resources

The expected impacts on botanical resources could be minimized in several ways, including:

- Minimizing the overall project footprint, by co-locating process roads and transmission lines and using excavated material at dam site for construction of Project facilities;
- Disposing of spoil from excavation work in the impoundment area, and
- Discouraging ORV use in the project area to minimize trail propagation and erosion effects.
- BMPs for erosion and sediment control.
- BMPs to prevent the spread of invasive plant species.

In addition, agency input into engineering design and construction planning of civil works would be sought in an effort to further minimize potential vegetation impacts. A comprehensive restoration plan would be developed to guide revegetation of areas to be rehabilitated following construction. During the permitting process, habitat enhancement and preservation likely would be considered as potential options to mitigate habitat losses from construction of the Project.

Minimizing the project footprint would reduce both the areal extent of vegetation to be removed and the volume requirements for material extraction from borrow sites. Minimizing the size of the project footprint could also be accomplished by (1) using road alignments and pad locations that follow well-drained upland terrain with soils suitable for use as construction material; (2) using side-borrow and balanced cut-and-fill road and railroad construction techniques; and (3) incorporating a flexible or variable road-design speed to avoid the necessity for deep sidehill cuts with excessive fill requirements. The borrow and quarry sites identified by APA (1985a) were close to the dam site, so the lengths of haul roads were minimized and the areas of disturbance were centralized as much as possible.

Disposal of spoil from construction and borrow excavations would create the potential for vegetation impacts through direct burial and clearing for spoil disposal sites. A cost-effective way to avoid additional vegetation losses for spoil disposal would be to deposit the spoil within the impoundment zone. However, this option would be limited by the need to prevent fine sediments from being entrained in surface water flow. Thus, the locations for spoil disposal within the impoundment zone must be selected carefully in areas in which water would pond during reservoir filling, well away from turbulent flows associated with intake structures.

Rehabilitation of temporary vegetation impacts would be conducted to the maximal extent possible. Provided that appropriate hydrologic and soil characteristics are not extensively altered, vegetation recovery could proceed at various rates, depending on slope, aspect, elevation, soil types, moisture and drainage conditions, and other factors. Without restoration of mineral and organic soils, recovery of scrub and, especially forest, habitats in the project area could take 150 years or more. Some semblance of the original pattern of vegetation lost may be restored within 150 years if areas to be restored are prepared for rehabilitation, but predictions of how plant succession would proceed on these lands are difficult. Because rehabilitation procedures for disturbed lands in Alaska are best developed on a site-specific basis, preparing a comprehensive restoration plan for the original APA Susitna Hydroelectric Project was designated as a task for the detailed engineering-design phase (APA 1985a). An individual restoration plan should be developed for each area to be rehabilitated. Guidelines and best management techniques for erosion and sedimentation control would be followed (e.g., Densmore et al. 2000, Wright and Hunt 2008).

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4.7. Wetlands, Riparian, and Littoral Resources

4.7.1. Introduction

This section describes the wetlands, riparian, and littoral habitat areas surrounding, and potentially affected by, the Project and conforms to the content requirements of 18 CFR § 5.6(d)(3)(vi). The assessment area includes potential effects, both direct and indirect, caused by access road and transmission-line corridors; hydrologic changes, including flooding of terrestrial areas; dam facilities; and filled areas. The information presented in this section relies heavily on the findings of studies conducted for the APA Project in the early 1980s, as summarized in the reports cited below and in the draft amended FERC license application (APA 1985). Additional information is incorporated from the terrestrial wildlife data-gap analysis completed for the Project (ABR 2011).

4.7.1.1. Wetlands and Littoral Habitats

A cooperative agreement between the APA and the USFWS in the 1980s resulted in the production of a preliminary wetlands map of the APA Project area at a scale of 1:63,360, through the National Wetlands Inventory (NWI) program (USFWS 1984). The NWI maps for the APA Project area were based on the vegetation mapping done by McKendrick et al. (1982), and incorporated additional modifications from stereoscopic interpretation of aerial photos. The original vegetation classes were converted into wetland classes using the classification scheme of Cowardin et al. (1979). Although the APA Project differs from the currently proposed Project, wetlands constituted <10 percent of the project area habitats for the original APA Project (APA 1985). Wetland types in the project area consisted of Riverine (rivers, creeks, and gravel bars) and Palustrine wetlands (bogs, marshes, forested lowlands, shrublands, and meadows) and open waters (ponds), but were dominated by Palustrine forested and scrub–shrub and Riverine habitats. No lakes (and therefore, littoral habitats) were considered likely to be impacted directly by the APA Project. Because mapping was not finalized by the time the amended license application (APA 1985) was submitted to FERC, a table of wetland classes identified during the APA Project study was prepared and is reproduced here as the best summary of wetlands occurrence in the area of the proposed Project (Table 4.7-1).The plant species most commonly found in wetlands in the project area are listed in Table 4.7-1 and descriptions of wetland vegetation types are provided in Section 4.6 (Botanical Resources).

An update of mapping of existing wetlands has not been conducted yet for the Project. Figures 4.7-1 and 4.7-2 provide an indication of the occurrence of wetland habitats in areas potentially affected by the project.

Table 4.7-1. Wetlands (NWI classes[1]) mapped for the APA Susitna Hydroelectric Project (adapted from USFWS 1984).

NWI Class / NWI Code	Description
Lacustrine (Lakes)	
L1UBH	Permanently flooded, open-water areas greater than 8.1 hectares (20 ac) in size. The water depth usually exceeds 2 m (6.6 ft).
Riverine (Rivers and Streams)	
R3UBH (formerly R3OWH)	Permanently flooded, open-water channels of upper perennial rivers and streams.
R3USC	Seasonally flooded river flats and bars within upper perennial river channels.
Palustrine (Ponds)	
PUBH (POWH)	Permanently flooded, small open waterbodies (ponds). Vegetation is generally lacking within the open-water area, but aquatic beds or emergents may provide sparse cover (<30 percent) along the pond edge.
PUB/AB3H (formerly POW/AB3H)	Permanently flooded ponds supporting aquatic (floating- leaved) vegetation. Dominant plants include yellow pond lily (*Nuphar polysepala)* and pondweed (*Potamogeton* spp.).
Palustrine Wetlands	
PEM1B	Saturated, emergent, bog-type wetlands in depressions below the tree line, and high-elevation sedge–grass tundra areas on poorly drained soils. Common emergent species include cottongrass (*Eriophorum* spp.), sedges (*Carex* spp.), and bluejoint (*Calamagrostis canadensis*).
PEM1C	Seasonally flooded emergent marshes occurring in the floodplain of small streams and on the periphery of ponds and lakes. Surface water is present in these areas for 1–2 months during the growing season. Species of primary importance include sedges, cottongrass, bluejoint, and horsetails (*Equisetum* spp.).
PEM1F	Semipermanently flooded emergent marshes. These marsh areas usually exhibit standing water throughout the growing season in most years. This wetland type usually occurs in wetter portions of typical emergent and shrub bog situations, and along the periphery of ponds and lakes. Dominant vegetation includes water sedge (*Carex aquatilis*), marsh horsetail (*Equisetum palustre*), buckbean (*Menyanthes trifoliata*), marsh cinquefoil (*Potentilla palustris*), and rushes (*Juncus* spp.).
PEM1H	Permanently flooded emergent marshes. These areas exhibit standing water throughout the year in all years. The dominant vegetation consists of water sedge, horsetails, and buckbean.
Palustrine Scrub–Shrub Wetlands	
PSS1A	Temporarily flooded, dense shrub areas on river and stream floodplains consisting primarily of willows (*Salix* spp.) and alders (*Alnus* spp.). This wetland type often occurs on riverbars that have become stable enough to

NWI Class / NWI Code	Description
	support persistent woody vegetation.
PSS1/USA	Temporarily flooded areas on river and stream floodplains consisting of a mix of shrubs and unvegetated riverine flats. Shrub species are primarily willows and alders.
PSS1B	Saturated, dense shrub wetlands usually occurring in seepage areas on slopes. Tall willow and alder are the most common species.
PSS1/EM1B	Saturated bogs and moist tundra areas on poorly drained soil with 30 percent or more of the canopy consisting of low broad-leaved deciduous shrubs. The remaining portion of the canopy consists of persistent emergent vegetation. Common shrub species include dwarf birch (*Betula nana*), resin birch (*B. glandulosa*), willows, bog blueberry (*Vaccinium uliginosum*), Labrador tea (*Ledum groenlandicum*), crowberry (*Empetrum nigrum*), bog rosemary (*Andromeda polifolia*), and bearberry (*Arctostaphylos* spp.). Dominant emergent species include cottongrass, sedges, and bluejoint.
PSS1/EM1C	Seasonally flooded areas occurring on floodplains in stream and creek corridors. These wetlands are characterized by a mixture of broad-leaved deciduous shrubs and emergent vegetation. Common shrubs include tall willow and alder. Emergent species of primary importance include sedges, cottongrass, bluejoint, and horsetails.
PSS1/EM1F	Patterned bogs (string bogs and reticulate bogs) and other semipermanently flooded complexes of emergents and broad-leaved deciduous shrubs. This wetland type is sometimes found in areas influenced by beaver activity. In patterned bog areas, the shrub species include those described for PSSI/EMIB wetlands. Dominant emergent species include sedges, horsetails, marsh cinquefoil, buckbean, and rushes.
PSS4B	Saturated, closed-canopy black spruce (*Picea mariana*) scrub wetlands. The black spruce in these areas is less than 6 m in height.
PSS4/EM1B	Saturated, open-canopy black spruce scrub wetlands with an emergent understory.
PSS4/1B	Saturated, open-canopy black spruce scrub wetlands with a dense deciduous shrub understory. The deciduous shrub species include dwarf birch, Labrador tea, bog blueberry, and willows.
Palustrine Forested Wetlands	
PFO4B	Saturated, black spruce forested wetlands. These areas are characterized by a closed canopy of black spruce.
PFO4/SS1B	Saturated, open-canopy black spruce forested wetlands with an understory of broad-leaved deciduous shrubs. The areal coverage of the black spruce is between 30 percent and 50 percent.
PFO4/SS4B	Saturated, open-canopy black spruce forested wetland with an understory of scrub black spruce.
PFO4/SS1A	Temporarily flooded wetlands adjacent to streams and rivers that are a complex of black spruce on higher terraces and deciduous shrubs on lower terraces. Willows and alders are the common shrub species.

NWI Class / NWI Code	Description
PFO4/EM1B	Saturated, open-canopy black spruce forested wetlands with an emergent understory.
PFO4/1B	Saturated, closed-canopy forested wetlands consisting of a mix of broad-leaved deciduous and needle-leaved evergreen trees. Black cottonwood (*Populus trichocarpa*) and balsam poplar (*P. balsamifera*) are the dominant deciduous species. Black spruce is the dominant evergreen species.
PFO1A	Temporarily flooded, deciduous forest wetlands occurring on river floodplains. Balsam poplar and black cottonwood are the common trees on these sites.
PFO1/SS1A	Temporarily flooded wetlands on river and stream floodplains consisting of a mix of broad- leaved deciduous forest and broad-leaved deciduous shrubs. Dominant tree species are balsam poplar and black cottonwood. Willows and alders are the dominant species in the shrub areas.
PFO5C	Seasonally flooded, dead-tree forested wetlands generally found along streams and small rivers. The dead trees usually result from beaver activity.

[1] NWI = National Wetland Inventory (based on the *Classification of Wetlands and Deepwater Habitats of the United States,* Cowardin et al. 1979). NWI codes in parentheses were used in the original classification but are no longer valid.

4.7.1.2. Riparian Habitats

Ecological succession on the Susitna River floodplain is highly dynamic, both spatially and temporally. Riparian habitats are shaped largely by the responses of different plant species to disturbance by flooding and ice scour, the dominant physical processes affecting them. Until sufficient silts and sands are deposited by wind and water to provide parent material for soil development, the establishment of vegetation occurs slowly on the Susitna floodplain.

Floodplain vegetation is dominated by riverine herbaceous, scrub, and forest types and can be grouped into three successional community types, depending on the extent of recent disturbance. The description of these successional types below is based on the APA Project Phase I vegetation mapping conducted along the Susitna River from Devils Canyon to Talkeetna and on vegetation succession studies conducted in the floodplain between Gold Creek and the Deshka River (Figure 4.6-18) (McKendrick et al. 1982, UAFAFES 1985).

4.7.1.2.1. Early Successional Stages

Early successional communities accounted for five to ten percent of the vegetated habitats on the floodplain and generally become established between 5 and 25 years after island or river bar stabilization. The ground cover in these types usually is dominated by meadow horsetail and/or Drummond mountain-avens (*Dryas*); in the shrub layer, balsam poplar and/or willow are dominant. Characteristically, these communities have little total vegetative cover (often >50 percent bare ground). Plant species in these types generally have rhizomes or horizontal underground stems, which can extend for considerable distances and are effective at binding loose sand and silt. Drummond mountain-avens is especially important in stabilizing gravelly sites. In most stands, balsam poplar and willow occur at greater densities than do other woody species, but alders have relatively rapid growth rates and begin to overtop willow and balsam poplar within two to three years after establishment. Young balsam poplar and willow stands may last up to 25 years or more from the time of the last major disturbance. Aging of these stands is difficult because floods frequently bury several years' plant growth in silt, and new growth is present above the silt. This cycle may be repeated a number of times before vegetation succession advances to the mid-successional stage.

4.7.1.2.2. Mid-successional Stages

Deposition of sands and silts that raise the elevation of river bar and island sites above the level of frequent flooding is necessary for the transition of vegetation from the early successional to the mid-successional stage. Mid-successional stands accounted for about 20 percent of the vegetated habitats surveyed in the Susitna floodplain. Thinleaf alder and balsam poplar, which develop into tall shrubs or immature trees, dominate these stands. The alder type is the first phase and appears to dominate from 25 to 50 years after stabilization. Balsam poplar appears to dominate from 50 to 90 years after stabilization, but stands of this type are much less common than are the younger alder-dominated stands. As noted earlier, alder overtops balsam poplar during the transition from early to mid-successional stages. After about 20 years, however, the balsam poplar that remains increases rapidly in height, thereby overshadowing the alder and developing into the immature balsam poplar stands of the mid-successional stage. In both alder and balsam poplar stands, there is very little bare ground. As balsam poplars become more dominant and the trees become larger, their density and that of thinleaf alder and feltleaf willow decline. Other shorter shrub species, such as Sitka alder, prickly rose, and highbush cranberry, increase in density in the balsam poplar-dominated stands, however.

4.7.1.2.3. Late Successional Stages

As the balsam poplar stands of the mid-successional stage mature, white spruce may appear in the canopy. Mature and decadent balsam poplar stands dominate from 90 to 170 years after stabilization. Eventually the large balsam poplars die, leaving space for the development of more balsam poplar or white spruce and paper birch, if no disturbances interrupt the process. Mixed paper birch–white spruce forests probably dominate from 170 to 300 years or more after stabilization. Mature and decadent (gradually dying) balsam poplar stands were found on 25 to 40 percent the vegetated floodplain, and mixed stands of birch and spruce occupied 23 to 32 percent of the area studied. Mixed birch–spruce forest types had the greatest variation in stand structure of the vegetation types found on the floodplain, and there is some evidence that these stands are self-perpetuating. Upon reaching over-maturity, the birch overstory tends to fall, making the spruce more susceptible to wind-throw, and thereby allowing a shrubby paper birch–alder–highbush cranberry–prickly rose community to develop. That shrub community then progresses again to the mixed birch–spruce forest stage.

4.7.1.2.4. Riparian Ecology

Descriptions of the potential effects of the APA Project on the riparian ecology of the Susitna River drainage focused on the river reaches downstream from the proposed Watana dam and impoundment. There is no current detailed description of riparian areas upstream of the proposed dam. In general, the upstream riparian areas are confined to a narrow canyon with fairly steep slopes, a well-defined river channel, and very few islands; in contrast to downstream, where the floodplain is better-developed with a wider variety of riparian habitats. The successional stages described above by UAFAFES (1985) were considered to be generally applicable to the "middle river" (defined in that study as extending from the Oshetna River mouth downstream to the Chulitna River confluence, thus including parts of the upper and middle reaches defined for the Project). The vegetation types that would have been affected by the APA Project Stage I (Low Watana) reservoir consisted principally of open and closed white and black spruce forest, as was described in Section 4.6. Those types are common in the riparian zone upstream from the proposed Watana dam.

A number of recent studies provide further background regarding ecological interactions on riparian floodplain habitats downstream from the Project. Helm and Collins (1997) examined the dynamics of vegetation succession on the Susitna floodplain at 29 sites located from Chase (above Talkeetna) downstream to the mouth of the Deshka River (near Willow). That paper was based on field work conducted in the early 1980s during the original APA Susitna Hydroelectric Project studies, supplemented with additional work conducted in 1995, plus comparisons with historical aerial photos from 1951. The same successional stages were described as above — Early Shrub (*Dryas*, juvenile poplar, willow, horsetail), Intermediate (alder, young poplar), and Late (old poplar, birch–spruce). The youngest stage of succession comprised four distinct communities based on substrate texture. The effects of a variety of factors—flooding, ice scour, wind, browsing by herbivores, and human activities such as logging—were assessed and a conceptual model of successional pathways was developed. The authors concluded that the major factors influencing vegetation succession were sedimentation and erosion from flooding and herbivory by wildlife. Vegetation establishment varied annually in relation to precipitation and flooding.

Nutrient dynamics on the Susitna floodplain are influenced by both downstream and upstream sources. The presence of spawning salmon in freshwater systems is an important, well-documented mechanism through which marine-derived nutrients (especially nitrogen and phosphorus) are transported into terrestrial ecosystems (Cederholm et al. 1999, Naiman et al. 2002), where they are cycled further by the wildlife that feed on salmon (Hilderbrand et al. 1999, 2004; Helfield and Naiman 2006). In the floodplain of the Tanana River (interior Alaska), hyporheic water is an important source of nitrogen for willows on early successional silt bars (Koyama and Kielland 2011). That source of nitrogen may explain the sustainability of highly productive plant communities on the floodplain despite the apparently inadequate rates of nitrogen mineralization in the soil. Several recent studies have shown that subsurface hydrology directly affects nitrogen availability in the floodplain forests of Interior Alaska (e.g., Lisuzzo et al. 2008). Thus, flow regimes affect nutrient availability for plants through changes in hydrology as well as sediment input.

The riparian zones of Alaska rivers, including the Susitna, provide important foraging habitats for herbivores, principally moose, snowshoe hares, and beavers, which exert profound effects on vegetation succession and nutrient cycling (Helm and Collins 1997, Collins and Helm 1997, Kielland et al. 1997, Butler and Kielland 2008). Changes in habitat distribution and productivity of important forage species, such as willows, poplars, and paper birch, may affect the populations of these mammals. Conversely, herbivory is an important factor affecting the species composition and successional patterns of riparian vegetation (Kielland et al. 1997, Hanley 2008). Thus, effects on herbivore populations may lead to changes in riparian plant communities. More generally, because aquatic and terrestrial food webs in riparian zones are interdependent (Ballinger and Lake 2006), changes in flooding regimes can affect transfer of energy between riparian and terrestrial ecosystems in ways that are difficult to predict.

4.7.2. Potential Adverse and Positive Impacts

4.7.2.1. Wetlands, Waters, and Littoral Habitats

Wetland impact analysis of the Project footprint, including the impoundment zone, Project facilities, construction sites, and three alternative access corridors alternatives being considered (Figures 4.7-1 and 4.7-2), will be generated after the USFWS releases the new digital versions of the NWI mapping for spatial analysis and new detailed wetland mapping is completed. The direct loss of wetlands as a result of inundation and fill placement during development of APA Project Stage I (Low Watana; analogous to the Project) was quantified in the draft amended FERC application for the APA Project (APA 1985) and is reproduced in Table 4.7-2. The primary wetland types lost to the Watana dam, impoundment, and spillway would include black and white spruce and balsam poplar forests; scrub–shrub; and forest–scrub–shrub complexes. The Denali Corridor alternative is similar to an alignment considered for the APA Project. The wetland types primarily affected within the Denali Corridor would be primarily scrub-shrub (Table 4.7-2).

Impacts are prioritized on the basis of resource vulnerability, the probability of the impact occurring, and the duration of the impact. Direct losses of wetland habitats are judged to be most important because of the certainty and the permanence of the impact. The importance of the loss of specific wetland types depends on the magnitude of the acreage lost in relation to their total abundance in the project area and their regional significance. Indirect changes in plant communities are considered less important than direct losses because changes are less predictable and often of shorter duration than permanent losses.

The greatest wetland impacts from the APA Project would have occurred on the northern side of the Susitna River, where the slope to the river edge generally is not as steep as on the southern side, particularly in the area of the proposed Watana reservoir (APA 1985). Palustrine scrub–shrub, forested and forest–shrub lowlands, and rivers and streams were the wetland types that would be affected most. Approximately 45 percent of the black spruce woodland (Palustrine scrub–shrub) in the vegetation mapping area was predicted to be lost. The losses of these and other vegetation types represented important habitat losses for some wildlife, especially black bear, moose, marten, beaver, raptors, small mammals, and passerine birds.

Based on data collected in July 1981, wetlands in the project area support low densities of waterbirds in the summer (10 adults/40 hectares [100 ac]). Scoters, scaup, Mallard, American Widgeon, swans, Arctic Tern, and other waterbird species were found during surveys. Although the lakes and ponds in the project area were used more by migratory birds during spring and fall migrations, the density and diversity of bird species were lower in the Susitna project area than in other areas of interior Alaska (Kessel et al. 1982). Emergent wetland types along the margins of ponds and lakes are the most valuable to breeding waterfowl, providing food, cover, and nesting areas. None of the lakes in the general vicinity of the project area were expected to be affected by the APA Project, but some small ponds would have been affected by the impoundment and dam, access roads, and construction camps.

Indirect wetland losses may occur as a result of erosion, permafrost melting, landslides and mass wasting, ORV use, blow-down of trees, and other causes (see Section 4.7.4.2 above). Although some of these losses would be short-term and would be followed by typical vegetation succession or by shifts to new vegetation types, long-term vegetation losses enduring for 30 to >100 years may occur on sites degraded by continual erosion, land slumping, or ORV use. The acreages that may be lost as a result of those factors would be small compared with the acreages lost to inundation by the proposed Watana reservoir, however.

Table 4.7-2. Acreage of wetland types expected to be lost to APA Project Stage I (Low Watana) development (reproduced from APA 1985).

Wetland Type[1]		Impoundment & Dam	APA Access Road[2]
Palustrine			
Forested		636	0
Forested with scrub–shrub		843	1
Forested with emergent vegetation		8	0
Scrub–shrub		1,553	41
Scrub–shrub with forest		12	0
Scrub–shrub with emergent vegetation		155	42
Emergent vegetation		36	8
Emergent vegetation with forest		16	0
Emergent vegetation with scrub-shrub		29	11
Ponds (open water)		31	1
	Subtotal	3,319	104
Lacustrine			
Lakes (open water)		0	0
Riverine			
Rivers and creeks (open water)		3,768	1
Gravel/sand bars		432	0
	Subtotal	4,200	1
Total		7,519	105

1 Based on the NWI classification system (Cowardin et al. 1979).
2 Similar to Project Denali Corridor alternative.

4.7.2.2. Riparian Habitats

The Project would affect riparian areas both upstream and downstream from the proposed dam. Project construction and operation would inundate approximately 39 mi of riparian habitat within the impoundment zone upstream from the Watana dam.

Downstream ecological effects involving vegetation and wildlife habitats were addressed in the riparian vegetation succession study by the University of Alaska–Fairbanks Agricultural and Forestry Experiment Station (UAFAFES 1985). The narrative below is summarized from that report and from APA (1985). The purpose of the riparian succession study was to provide an understanding of existing downstream floodplain dynamics and to predict the changes likely to result from construction and operation of the APA Project.

Project operations would have the effect of greatly reducing natural fluctuations in river flow throughout the year. Following construction, river levels in summer would be lower than under natural conditions. Summer flood or high-flow events would be reduced in severity and frequency. High-flow events would be notable in the middle river only if extreme flooding occurred upstream when the reservoir was nearly full. In winter, water levels would be higher than normal, and ice formed at those higher levels may encase vegetation for up to four months each winter at some locations. The duration of ice cover will change due to increased water temperatures, relative to existing conditions.

Between the Oshetna and the Chulitna rivers, summer flooding events would be fewer and less severe. No bedload sediments would be transported from the upper river because they would be trapped in the reservoir. Fine silts and clays would continue to pass through the middle river, but would not be deposited. The riverbed would likely develop an “armor” layer as fine sediments are scoured and not replaced. Due to the more uniform flow, the channel may become deeper and narrower, with some vegetative encroachment occurring upstream of the maximum ice-front progression. Below the dam, the upper portion of the middle river would no longer have winter ice cover. Below that, spring melt likely would be slower, with little or no ice jamming or associated flooding and scouring.

In the lower river, long-term aggradation would be likely to occur in the first few mi below the Chulitna River confluence, causing the Chulitna delta to expand farther toward the east bank of the Susitna River. A well-defined channel eventually would develop through that delta due to the stabilized flows in the middle river. The magnitude of changes due to high-flow events would decrease, although the difference would be less marked than in the middle river, because the lower river also is affected by floods generated in the Chulitna and Talkeetna rivers. No major changes in ice dynamics are expected in the lower river.

Reduced seasonal fluctuations in the river level potentially would affect the establishment of poplar and willows in early successional habitats on the Susitna floodplain. Seeds of those species are dispersed during spring floods (the only time they are viable). Seedlings establish and grow during summer, after the water level recedes. Reduced flooding likely would limit seed dispersal on suitable substrates and lower summer flows may affect seedling growth and survival negatively. Construction of the project may affect succession at sites where vegetation is already established. Under natural conditions, succession frequently is “reset” by summer floods and winter ice jams. With those events reduced in frequency and severity during project operation, the relative abundance of vegetation at different successional stages may be altered. Such alteration could affect forage availability for some wildlife species, such as moose and snowshoe hare, because browse abundance differs among successional stages.

Generally, the likely overall effects of the project on riparian habitats downstream would be a more stabilized floodplain, a decreased number of subchannels, and increased vegetative cover. The expected lower summer flows would have three principal effects: (1) more land would be available for possible plant colonization; (2) soil moisture levels would be drier, and (3) water level fluctuations would be reduced. The lower level of existing vegetation appears to be related to flows between the average summer flow (23,000 cfs) and the mean annual flood (52,000 cfs), except in a few locations where ice jams regularly occur. More than 75 percent of the terrain elevations representing the lower vegetation limit correspond to flows greater than 23,000 cfs, but less than 10 percent correspond to flows greater than 52,000 cfs. The absence of ice jams would result in the lower limit of vegetation coinciding with summer flows, assuming all that land is suitable for colonization by plants. Hence, the area between elevations corresponding to the post-construction summer flows and the natural summer flows likely would become vegetated, or at least would not be inhibited by floods or other disturbance factors.

Stanford et al. (2005) described the naturally shifting habitat mosaic of river ecosystems. Damming a river alters these mosaic patterns resulting in effects such as the loss of seasonal fluctuations in water level and the natural disturbance regime. These changes increase the rate of colonization by nonnative, invasive plants and senescence of native riparian species. Research in both Montana (Nyack River) and Alaska (Susitna and Talkeetna rivers) has shown that flood-related disturbance is important for maintaining habitat diversity in riparian areas (Helm and Collins 1997, Bowen et al. 2003, Whited et al. 2007, Hanley 2008). In rivers where flow is regulated by dams, changes in the flooding regime can affect the distribution of both individual species and habitat types across the landscape (Nilsson et al. 1997, Whited et al. 2007). The complexity of such interactions has been investigated using modeling (e.g., Tealdi et al. 2011) that demonstrates the important influences of uncertain flow regimes and sediment transport on riparian vegetation. In both the Nyack and Talkeetna floodplains, species richness of vascular plants was highest at sites with the finest alluvium (Mouw et al. 2008). The spatial distribution of alluvium texture was determined by flow energy, and thus could likely to be altered by hydroelectric development. In Sweden, plant species richness and dominance were affected by the distribution of anchor ice (Engstrom et al. 2011), which also would be expected to change directly downstream from dams.

4.7.3. Potential Protection, Mitigation, and Enhancement

4.7.3.1. Wetlands and Littoral Habitats

Wetland impacts from project construction will be minimized by reducing volume requirements for borrow extraction and co-locating access and transmission lines, which would reduce the overall project footprint. This reduction could be accomplished by using alignments that avoid wetlands and follow well-drained upland terrain with soils suitable for use as construction material; the use of excavated material from dam site in construction of facilities to minimize borrow sites; the location of borrow sites in upland areas; the use of side-borrow and balanced cut-and-fill road and railroad construction techniques; and incorporating a flexible road-design speed to avoid the necessity for deep side hill cuts requiring excessive fill. The borrow and quarry sites will be located near the Watana dam site, minimizing the length of haul roads and centralizing areas of disturbance. The disposal of spoil from construction and borrow excavations would create the potential for wetland impacts either through direct burial or through clearing for spoil disposal sites. A cost-effective way to avoid removing vegetation for spoil disposal would be to deposit the spoil within the impoundment areas. However, that option would be limited by the need to prevent fines from being entrained by surface water flow. Thus, locations for spoil disposal within the impoundment areas would need to be selected carefully and designated clearly in areas that would pond quietly during filling, well away from turbulent flows associated with intake structures.

Additionally, the siting and alignment of all facilities will be designed to avoid wetlands to the maximum extent feasible. Access by ORVs would be discouraged to minimize indirect wetland impacts. Agency coordination and review of detailed engineering design and construction planning of Project facilities would be conducted to minimize potential wetland impacts.

Rehabilitation of temporary impacts on wetlands would be conducted to the maximum extent possible. Provided that the appropriate hydrologic and soil characteristics are not extensively altered, wetland recovery would proceed at various rates (which are difficult to quantify), depending on factors such as slope, aspect, elevation, soil types, moisture and drainage conditions. A specific restoration plan would be developed for each area to be rehabilitated. Guidelines and best management techniques for erosion and sedimentation control would be followed (e.g., Densmore et al. 2000, Wright and Hunt 2008).

Wetland mitigation measures will be determined in conjunction with the USACE 404 permitting process.

4.7.3.2. Riparian Habitats

To mitigate direct and indirect impacts on riparian habitats, several recommendations were made for the APA Project, which may be considered for this Project (UAFAFES 1985). They identified logging of mature paper birch–white spruce stands as being the most promising option for establishing riparian habitat, because logged areas have been shown to produce abundant birch browse, as well as rose and highbush cranberry, which also are attractive forage species for herbivores. Controlled burns also could be used to create similar desirable effects. The nature of riparian habitats generally precludes extensive natural fires, and burning would release nutrients to the soil that would not occur with logging.

Flows may be manipulated to enhance riparian conditions below the Project.

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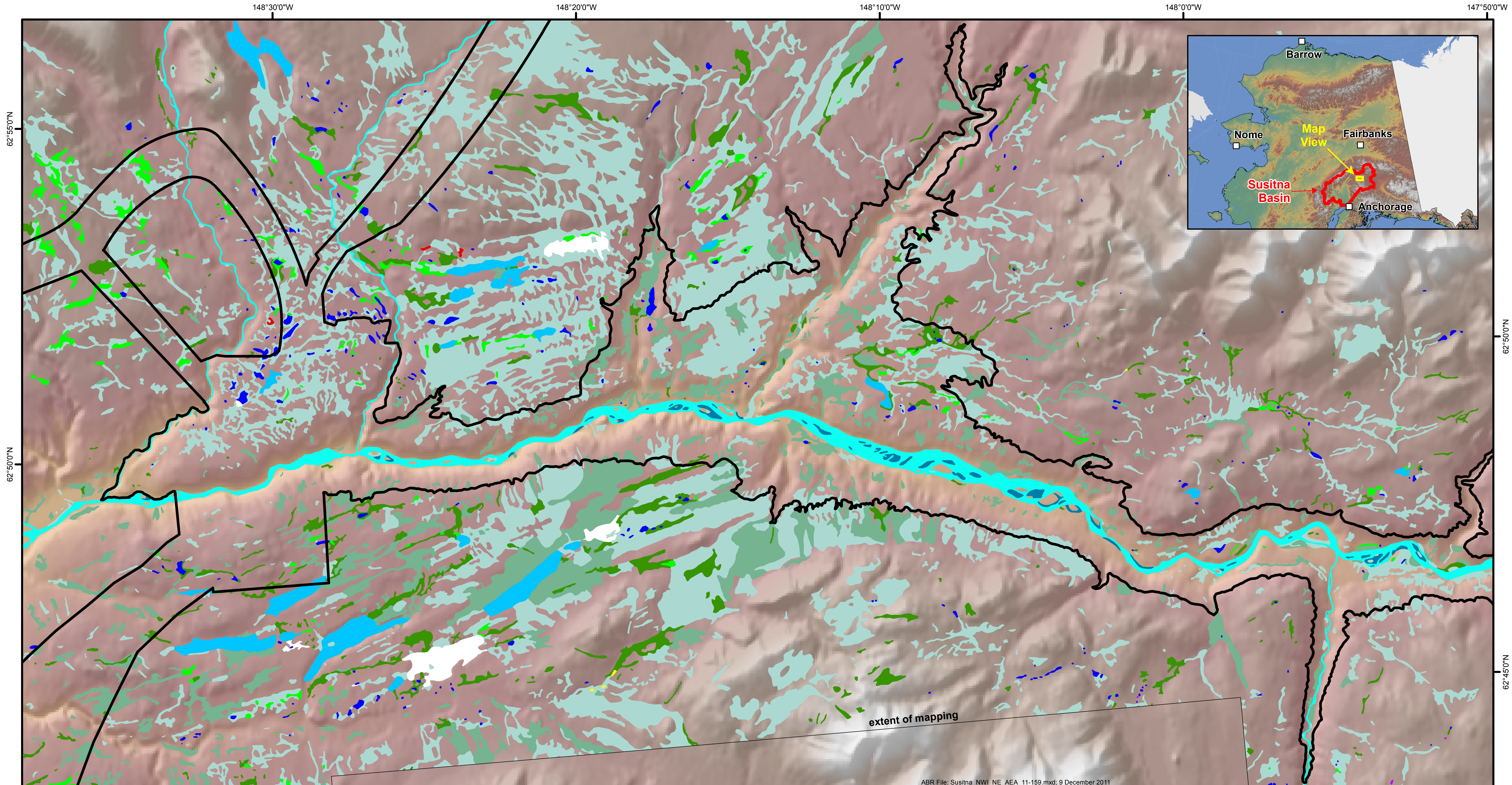

National Wetland Inventory Descriptions (Wetlands Only)

- Lake
- Upper Perennial River
- River Bar
- Pond
- Seasonally Flooded Pond
- Beaver Pond
- Aquatic Bed
- Emergent Marsh
- Emergent Wet Meadow
- Scrub Shrub
- Forested
- Unknown (to be determined)
- Study Area

Wetlands mapping is from draft digital conversion of NWI maps produced by USFWS in 1984 from vegetation mapping conducted in 1982 for the original Susitna Hydroelectric Project. Draft data were provided courtesy of the USFWS NWI office in Anchorage, AK, for presentation purposes only.

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0.5 0 0.5 1 1.5 2 Miles

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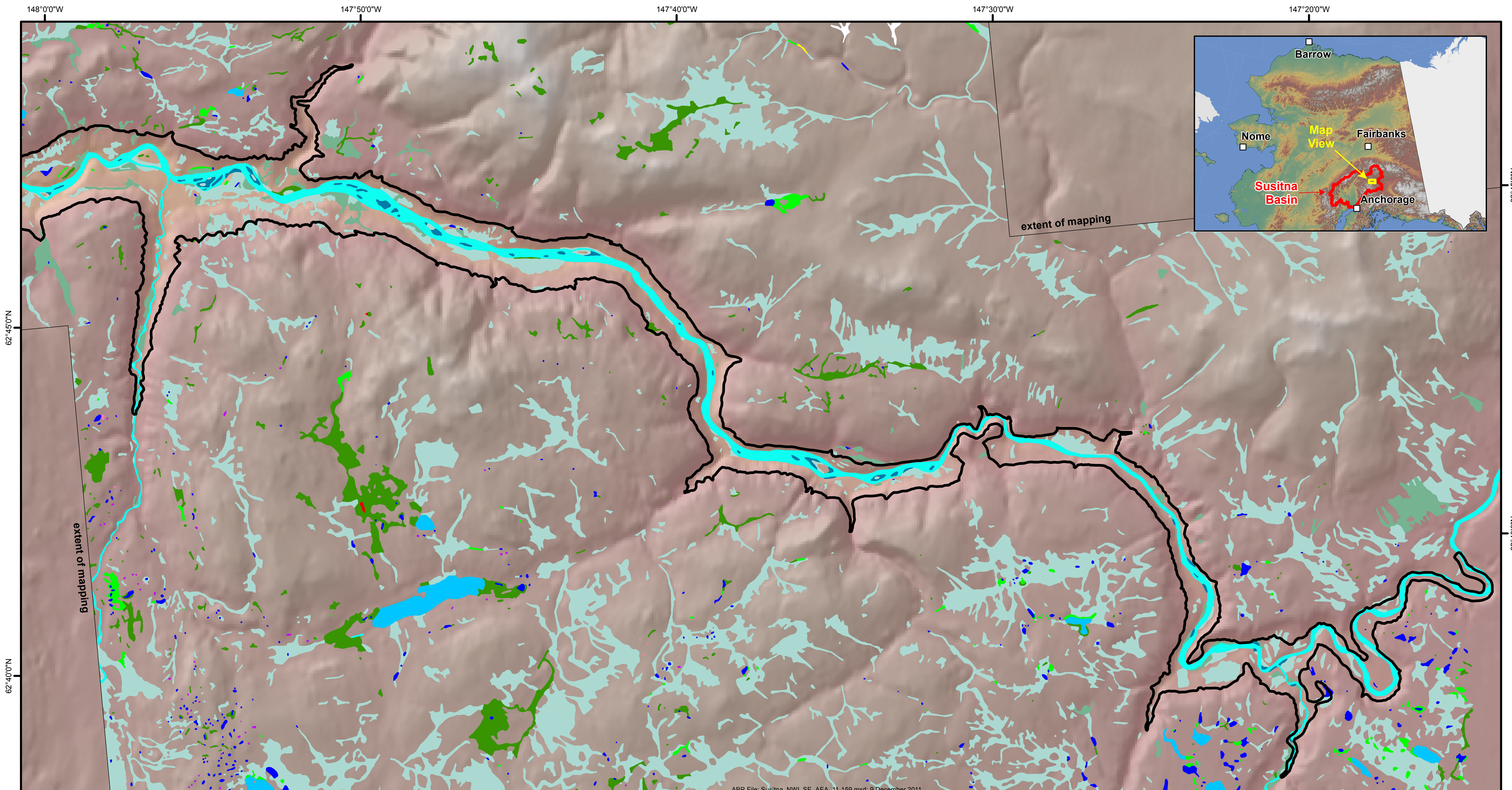
ALASKA ENERGY AUTHORITY

Date: Dec 2011
Scale = 1:103,000

State of Alaska
Susitna-Watana Hydroelectric Project FERC No. 14241

Figure 4.7-1

Wetlands Mapped in the Western Portion of the Proposed Watana Reservoir Study Area



National Wetland Inventory Descriptions (Wetlands Only)

- Lake
- Upper Perennial River
- River Bar
- Pond
- Partially Flooded Pond
- Seasonally Flooded Pond
- Beaver Pond
- Aquatic Bed
- Emergent Marsh
- Emergent Wet Meadow
- Scrub Shrub
- Forested
- Unknown (to be determined)
- Study Area

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N

0.5 0 0.5 1 1.5 2 Miles

1 0 1 2 3 Kilometers

ALASKA ENERGY AUTHORITY

Date: Dec 2011
Scale = 1:100,000

State of Alaska
Susitna-Watana Hydroelectric Project FERC No. 14241

Figure 4.7-2

Wetlands Mapped in the Eastern Portion of the Proposed Watana Reservoir Study Area

4.8. Rare, Threatened and Endangered Species

This section identifies species that have both a special state or federal conservation designation and a habitat range that intersects the general study area. It also includes a brief description of each type of conservation status.

4.8.1. Plant Species

No plant species listed or under consideration for listing under authority of the Endangered Species Act (ESA) are known or suspected to occur in areas that might be directly affected by Project construction or operation, including changes in riverine habitats downstream of the dam. The single ESA-listed plant species in Alaska occurs on the Aleutian Islands, approximately 1,300 mi from the Project area (USFWS 2011b).

The BLM has developed lists of Sensitive and Watch List plant species. The agency manages special status species on BLM-administered lands according to BLM Manual 6840 (BLM 2008a). It also includes among its special status species those species listed as threatened or endangered, and those considered as candidate or proposed species, under the ESA, as well as species that have been de-listed from the ESA in the past five years. An objective of its special status species policy pertinent to this Project is "to initiate proactive conservation measures that reduce or eliminate threats to Bureau sensitive species to minimize the likelihood of and need for listing of these species under the ESA." It further references the State Director's responsibility for "[i]nventorying BLM lands to determine which BLM special status species occur on public lands, the condition of the populations and their habitats, and how discretionary BLM actions affect those species and their habitats." Implementation of BLM policies regarding sensitive species may include "[d]etermining, to the extent practicable, the distribution, abundance, populations, condition, current threats, and habitat needs for sensitive species, and evaluating the significance of BLM-administered lands and actions undertaken by the BLM in conserving those species." Watch List species "are not subject to the [BLM] sensitive species policy, and they have no implied relevance to the NEPA process" (BLM n.d.). Sponsors of natural resource development projects recently proposed in Alaska have been required or asked to perform rare plant surveys on BLM-administered lands as part of the baseline information development effort.

The State of Alaska does not have jurisdiction over plant species based on their rarity, nor does it have any programs other than the BIOTICS Database of the Alaska Natural Heritage Program (AKNHP) for managing rare species (AKNHP 2011b). The AKNHP's BIOTICS Database tracks the locations of plants that available data indicate may be rare or imperiled on a statewide or global basis. A plant's appearance on this list does not itself confer any regulated status.

Data searches for this analysis have not identified any known occurrences of rare or other special status plant species in the approximate Project footprint (AKNHP 2008, FERC 1984, Hultén 1968, Lipkin and Murray 1997, MON 2011, Santosh 2011). The AKNHP database indicates that 19 rare vascular plant taxa with S1 (critically imperiled) and S2 (imperiled) rankings have been collected in the regional search area, which includes the Susitna River drainage (Table 4.8-1). One of these taxa, an aquatic species known as flatleaf pondweed or Robbins pondweed

(*Potamogeton robbinsii*), has been recorded in the Project area in Watana Lake (McKendrick et al. 1982), evidently representing a second record for the species in the search area (the only other record was near the Summit airstrip in 1953). *Potamogeton robbinsii* is listed as S1S2 within Alaska and as G5 (demonstrably secure globally), indicating that populations are more numerous outside Alaska. Like most rare species, many of the taxa on the list of 19 rare plant taxa considered in this assessment often occur in a narrow range of habitats (e.g., *Artemisia dracunculus* on exposed bluffs) but, given the wide array of habitats available in the Susitna basin, ranging from alpine areas to lowland forests, meadows, and aquatic habitats, it is possible that one or more of the other 18 rare plant taxa may occur in or near the Project area.

Table 4.8-1. Rare vascular plant taxa[1] that have been collected in a broad region of Southcentral Alaska, including the Susitna River drainage.

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

1 Data from the Alaska Natural Heritage Program's spatially explicit database of rare species (AKNHP 2011b).
2 State rarity rankings: S1 = critically imperiled, S2 = imperiled, and S3 = vulnerable.
3 Global rarity rankings: G2 = imperiled, G3 = vulnerable, G4 = apparently secure, G5 = demonstrably secure, T = rank of subspecies or variety, and Q = indicates uncertainty about taxonomic status that may affect global rank.
4 Recorded by McKendrick et al. (1982) in the upper Susitna River basin (Watana lake), representing the second record for this species in the region searched (see text).

4.8.2. Special Status Birds

The area considered for the potential presence of RTE birds includes the area that may be directly affected by Project construction or operation, including riverine areas downstream from the dam to the Talkeetna and Chulitna River confluences.

No bird species listed as threatened, endangered, proposed, or candidate under the federal Endangered Species Act or endangered under Alaska Statute 16.20.190 occur in the Project area

(USFWS 2009a, ADF&G 2011c). The Project area includes habitat for other birds that are identified as special status species by state and federal agencies in Alaska that will be involved in the WHP review process. The USFWS and FERC have recently developed a Memorandum of Understanding regarding protection of migratory birds (FERC and USFWS 2011). While it covers all species of migratory birds, it emphasizes Species of Concern that are identified in other documents prepared by the USFWS and multi-organization working groups. Those categories of special status species are among those described below and a complete list of special status species can be found in Table 4.8-2.

The USFWS defines Birds of Conservation Concern (BCC) as species, subspecies, and populations that are not already federally-listed as threatened or endangered but that without additional conservation actions are likely to become candidates for federal listing (USFWS 2008a). The USFWS identifies Birds of Management Concern (BMC) that present management challenges for reasons such as population declines, small or restricted populations, dependence on restricted or vulnerable habitats, or overabundance to the point of causing ecological or economic damage (USFWS 2009b).

The Boreal Partners in Flight (PIF) lists species of conservation priority using a species prioritization process found in the Landbird Conservation Plan for Alaska Biogeographic Regions (Andres 2000).

The BLM designates sensitive species and their habitats “to promote their conservation and reduce the likelihood and need for such species to be listed pursuant to the ESA” (BLM 2008a). They must be native species found on BLM-administered lands, and either: 1) be thought to be in a downward trend such that its viability is at risk in at least a signification portion of this range; or 2) depend on ecological refugia or unique habitat on BLM lands, and such areas may be threatened with alteration that might cause risk to the species’ viability there (BLM 2008a). They also include ESA-designated candidate species, proposed species, and delisted species for the period extending five years following the species’ delisting. BLM’s responsibilities include determining the “distribution, abundance, population condition, current threats, and habitat needs for sensitive species, and evaluating”...the significance of its actions in conserving those species (BLM 2008a). BLM also manages a broader group of “special status species” comprised of its sensitive species and species listed as threatened or endangered under the ESA.

The State of Alaska no longer maintains a list of Species of Special Concern. It uses its Comprehensive Wildlife Conservation Strategy (sometimes referenced as its Wildlife Action Plan) to assess the conservation needs of particular species (ADF&G 2011c). In that plan, it identified featured species (FS). The ADF&G developed its featured species list based on a set of 11 criteria that includes declines in abundance or productivity, deformity, disease or other mortality, rarity, at-risk species, endemics, seasonal use of restricted local range, sensitivity to environmental disturbance, status of species is unknown, species is representative of a broad array of other species in a particular habitat, and international importance (ADF&G 2006).

Three other plans cited in the Memorandum of Understanding between FERC and USFWS regarding migratory bird species identify conservation objectives and priorities for various bird species. These include: the North American Waterfowl Management Plan (NAWMP), the North

American Waterbird Conservation Plan (NAWCP), and the Alaska Shorebird Conservation Plan (ASCP) (NAWMP 2004; Kushlan et al. 2006; Alaska Shorebird Group 2008).

Table 4.8-2 Special status bird species that may occur in the study area.

Common Name	Scientific Name	Conservation Status[1]
American Three-toed Woodpecker	*Picoides dorsalis*	FS
American Dipper	*Cinclus mexicanus*	PIF
American Golden-plover	*Pluvialis dominica*	ASCP
America Wigeon	*Anas americana*	BMC, NAWMP
Bald Eagle	*Haliaeetus leucocephalus*	FS
Bank Swallow	*Riparia riparia*	FS
Belted Kingfisher	*Megaceryle alcyon*	FS
Blackpoll Warbler	*Dendroica striata*	BLM-S, PIF, FS
Black Scoter	*Melanitta americana*	BMC, NAWMP
Black-backed Woodpecker	*Picoides arcticus*	PIF, FS
Blue-winged Teal	*Anas discors*	BMC, NAWMP
Bohemian Waxwing	*Bombycilla garrulus*	PIF
Boreal Owl	*Aegolius funereus*	PIF, FS
Boreal Chickadee	*Poecile hudsonicus*	FS
Brant	*Brant bernicla*	BMC
Brown Creeper	*Certhia americana*	FS
Canada Goose	*Branta canadensis*	BMC, NAWMP
Canvasback	*Aythya valisineria*	BMC, NAWMP
Cliff Swallow	*Petrochelidon pyrrhonota*	FS
Common Loon	*Gavia immer*	FS, NAWCP
Common Goldeneye	*Bucephala clangula*	BMC, NAWMP
Dark-eyed Junco	*Junco hyemalis*	FS
Gadwall	*Anas strepera*	BMC, NAWMP
Golden Eagle	*Aquila chrysaetos*	BLM-S, FS
Golden-crowned Sparrow	*Zonotrichia atricapilla*	PIF
Gray-cheeked Thrush	*Catharus minimus*	BLM-W, PIF
Greater white-fronted Goose (Tule)	*Anser albifrons*	BMC, NAWMP
Green-winged Teal	*Anas crecca*	BMC, NAWMP
Great gray Owl	*Strix nebulosa*	FS
Great-horned Owl	*Bubo virginianus*	FS
Greater Scaup	*Aythya marila*	BMC, NAWMP
Gyrfalcon	*Falco rusticolus*	PIF, FS
Harlequin Duck	*Histrionicus histrionicus*	BMC, NAWMP
Hairy Woodpecker	*Picoides villosus*	FS

Common Name	Scientific Name	Conservation Status[1]
Hermit Thrush	*Catharus guttatus*	FS
Horned Grebe	*Podiceps auritus*	BCC, FS, NAWCP
Hudsonian Godwit	*Limosa haemastica*	ASCP, BLM-W
Lesser Yellowlegs	*Tringa flavipes*	BCC,BMC,FS, ASCP
Lesser Scaup	*Aythya affinis*	BMC, NAWMP
Long-tailed Duck	*Clangula hyemalis*	BMC, NAWMP
Mallard	*Anas platyrhynchos*	BMC, NAWMP
Merlin	*Falco columbarius*	FS
Northern Shrike	*Lanius excubitor*	PIF
Northern Flicker	*Colaptes auratus*	FS
Northern Harrier	*Circus cyaneus*	FS
Northern Goshawk	*Accipiter gentilis*	FS
Northern Hawk Owl	*Surnia ulula*	FS
Northern Shoveler	*Anas clypeata*	BMC, NAWMP
Northern Pintail	*Anas acuta*	BMC, NAWMP
Olive-sided Flycatcher	*Contopus cooperi*	BCC, BLM-S, PIF, FS
Osprey	*Pandion haliaetus*	FS
Pacific Loon	*Gavia pacifica*	FS, NAWCP
Peregrine Falcon[2]	*Falco peregrinus anatum*	BCC, FS
Pine Grosbeak	*Pinicola enucleator*	FS
Pine Siskin	*Spinus pinus*	FS
Redhead	*Aythya americana*	BMC, NAWMP
Red-throated Loon	*Gavia stellata*	BCC, BLM-W, FS, NAWCP
Red-breasted Nuthatch	*Sitta canadensis*	FS
Red-necked Grebe	*Podiceps grisegena*	FS, NAWCP
Red-tailed Hawk	*Buteo jamaicensis*	FS
Ring-necked Duck	*Aythya collaris*	BMC, NAWMP
Rusty Blackbird	*Euphagus carolinus*	PIF, BCC, BLM-S, FS
Short-eared Owl	*Asio flammeus*	BLM-S, FS
Sharp-shinned Hawk	*Accipiter striatus*	FS
Smith's Longspur	*Calcarius pictus*	BCC, PIF, FS
Snow Goose	*Chen caerulescens*	BMC
Solitary Sandpiper	*Tringa solitaria*	BCC, BMC, FS, ASCP
Surf Scoter	*Melanitta perspicillata*	BMC, NAWMP
Surfbird	*Aphriza virgata*	ASCP
Townsend's Warbler	*Dendroica townsendi*	BLM-W, PIF, FS
Trumpeter Swan	*Cygnus buccinator*	BLM-S, BMC

Common Name	Scientific Name	Conservation Status[1]
Tundra Swan	*Cygnus columbianus*	BMC
Upland Sandpiper	*Bartramia longicauda*	BCC, BMC, ASCP
Varied Thrush	*Ixoreus naevius*	PIF, FS
Violet-green Swallow	*Tachycineta thalassina*	FS
Western Wood-pewee	*Contopus sordidulus*	PIF
Whimbrel	*Heteroscelus incanus*	BCC, BMC, ASCP
White-tailed Ptarmigan	*Lagopus leucurus*	PIF
White-winged Crossbill	*Loxia leucoptera*	PIF, FS
White-winged Scoter	*Melanitta fusca*	BMC, NAWMP
White-crowned Sparrow	*Zonotrichia leucophrys*	FS
Wilson's Warbler	*Wilsonia pusilla*	FS
Wilson's Snipe	*Gallinago delicata*	BMC

[1] Conservation Status: FS = Featured Species (ADF&G 2006); BCC = Birds of Conservation Concern (USFWS 2008); BMC = Birds of Management Concern (USFWS 2009b); PIF = Boreal Partners in Flight Working Group (Andres 2000); NAWMP = the North American Waterfowl Management Plan (NAWMP 2004); NAWCP = North American Waterbird Conservation Plan(Kushlan et al. 2006); ASCP = Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2008); BLM-S = BLM Sensitive Species; BLM-W = BLM Watch List Species (BLM n.d.; AKNHP 2011b)

[2] Previously listed as Threatened under ESA, the American Peregrine Falcon was de-listed August 1999

The Bald and Golden Eagle Protection Act provides for the protection of the Bald Eagle and the Golden Eagle by prohibiting, except under certain specified conditions, the taking, possession, and commerce of such birds. The USFWS developed the *National bald eagle management guidelines* in May 2007, which should be followed to comply with the Eagle Act. Protection of Bald Eagles has included definition of zones around nest trees that are guidelines for avoidance of disturbance. The primary zone extends 330 ft from the nest tree, and land clearing or construction may be discouraged year round. Human disturbance is discouraged particularly during the spring-summer nesting season. A secondary zone ranges to a distance of 660 ft from the nest, and human disturbance must be minimized during the breeding season, but construction may be possible outside the nesting season. A third zone that extends up to one-quarter to one-half mile from the nest, depending on topography and line of sight to the nest, permits most activities, timber clearing, construction blasting, and similar major disturbances outside the breeding season (USFWS 2007).

Some activities and projects are eligible for federal permits under the Bald and Golden Eagle Protection Act. The regulation set forth in 50 CFR § 22.26 provides for issuance of permits to "take" bald eagles and golden eagles where the taking is associated with, but not the purpose of, the activity and cannot practicably be avoided. Most take authorized under this section will be in the form of disturbance; however, permits may authorize non-purposeful take that may result in mortality (50 CFR § 22.26).

4.8.3. Special Status Mammals

The Distinct Population Segment of beluga whale that inhabits Cook Inlet (CIBW) was listed as an endangered species under the Endangered Species Act (ESA) on October 22, 2008 (73 FR 62919) and a depleted stock under the Marine Mammal Protection Act. Section 7 of the ESA requires that federal agencies must ensure they do not fund, authorize, or carry out any actions (e.g., issuance of a FERC license) that would jeopardize the continued existence of the listed species, or destroy or adversely modify designated critical habitat. Beluga whale occurrence and habitat use in the Susitna River area are discussed in the Project data gap analysis for aquatic resources (HDR 2011).

No other terrestrial or marine mammals listed (threatened, endangered, proposed, candidate) under the ESA are likely to use the study area (USFWS 2009a, NOAA 2011a). There are no state-listed endangered mammal species in the area potentially affected by the Project (ADF&G 2011c). The little brown bat (*Myotis lucifugus*) is listed as a featured species by the ADF&G and likely occurs in the study area (ADF&G 2006). The Alaska tiny shrew (*Sorex yukonicus*) is the only mammal listed by the BLM as sensitive that may be in the Project area (BLM 2010aa); AKNHP 2011b).

This analysis summarizes knowledge related to CIBW mammal use of the Susitna River, its mouth, and delta, for use in identifying potential impacts of the proposed Susitna-Watana Hydroelectric Project.

Five stocks of beluga whale occur in Alaskan waters: Cook Inlet; Bristol Bay; eastern Bering Sea; eastern Chukchi Sea; and Beaufort Sea (Allen and Angliss 2010). The Cook Inlet stock is an isolated population likely confined to Cook Inlet throughout the year (Rugh et al. 2000; Hobbs et al. 2006; Hobbs and Shelden 2008; Hobbs et al. 2008; NMFS 2008). The estimated abundance for the CIBW was 340 individuals in 2010 (Shelden et al. 2010).

Aerial surveys of CIBWs were carried out in 1982 and 1983 as part of the original licensing effort (Harza-Ebasco 1985), confirming the summer aggregation of belugas at the Susitna Delta also documented by more recent surveys (NMFS 2008; Shelden et al. 2010). A time series of data from annual aerial surveys of CIBWs exists for the period between 1993 and 2010 (NMFS 2008; Shelden et al. 2010). Surveys are conducted at the peak of seasonal use of the study area during June and July to support annual abundance estimates. Additional surveys are conducted in August to document presence of calves.

4.8.3.1. Cook Inlet Beluga Whale Occurrence

Aerial surveys conducted since 1993 have consistently documented high CIBW use of Knik Arm, Turnagain Arm, Chickaloon Bay, and the Susitna River delta areas of the upper inlet (NMFS 2008). Satellite tagging data further support the high use of these areas by belugas (Hobbs et al. 2005).

Several factors likely influence beluga whale distribution in Cook Inlet. Prey availability, predator avoidance, sea-ice cover and other environmental factors, reproduction, sex and age class, and human activities play an important role in beluga seasonal distribution within Cook Inlet (Rugh et al. 2000; NMFS 2008). Seasonal movement and density patterns as well as site fidelity appear to be closely linked to prey availability, coinciding with seasonal salmon and eulachon concentrations (Moore et al. 2000). CIBWs forage intensely during the summer when prey availability is high and locally concentrated near river mouths (Huntington 2000; Moore et al. 2000). This seasonal feeding is presumably important in providing energy storage and reserves for the winter. Availability of prey species appears to be the most influential environmental variable affecting Cook Inlet whale distribution and relative abundance (Moore et al. 2000). The patterns and timing of eulachon and salmon runs have a strong influence on beluga whale feeding behavior and their movement during the spring and summer (Nemeth et al. 2007; NMFS 2008). The presence of prey species may account for the seasonal change in beluga group size and composition (Moore et al. 2000). Belugas frequent areas near coastal mud flats and river mouths in Cook Inlet from spring through fall (Goetz et al. 2007; NMFS 2008). Beluga whales tend to concentrate at rivers and bays in upper Cook Inlet during summer and fall, then disperse to waters in the mid-inlet during winter and spring (NMFS 2008).

CIBWs exhibit site fidelity to distinct summer concentration areas and are reliably found annually in these areas (Seaman et al. 1986), typically near river mouths and associated shallow, warm, and low-salinity waters (Moore et al. 2000). Aerial surveys conducted in late April and early May reported beluga whales in the upper inlet as eulachon runs reached the Susitna and Twenty mile rivers (NMFS 2008). During the summer, beluga whales are frequently observed along Susitna Flats, gathering at the Susitna and Little Susitna rivers and other small streams on the western side of Cook Inlet, following runs of eulachon, Chinook salmon, and coho salmon (Hobbs and Shelden 2008; NMFS 2008; Allen and Angliss 2010). In late summer and fall, beluga whales aggregate near the mouths of streams on the western side of the inlet south from Susitna Flats to Chinitna (NMFS 2008).

CIBWs appear to calve primarily in the Susitna Flats portion of upper Cook Inlet (Huntington 2000). Calves represented 7-8 percent of whales observed in the Susitna Flats area during various surveys, including aerial and boat-based surveys (Funk et al. 2005; McGuire et al. 2008; McGuire et al. 2009). However, during 2009 photo-identification surveys, 63 percent of whale groups photographed in Knik Arm contained neonates, compared with 47 percent of groups in Susitna, indicating there may be more than one nursery area in upper Cook Inlet (McGuire et al. 2011).

The traditional ecological knowledge (TEK) of Alaska Natives and NMFS aerial survey data document a historical contraction of the summer range of CIBWs (Huntington 2000; NMFS 2008; Rugh et al. 2010; Carter and Nielsen 2011). While belugas were once abundant and frequently sighted in the lower inlet during summer, they are now primarily concentrated in the upper half of the inlet (Rugh et al. 2010). Potential explanations for the range contraction include:

- Habitat change;
- Predator avoidance; or
- Use of spatially limited optimal habitat by a remnant population.

The first indication of a possible recovery may be reoccupation of more peripheral habitats (Rugh et al. 2010).

Large groups of belugas arrive at the Susitna River mouth in the spring during eulachon runs in May and June, and suggesting that Cook Inlet beluga whale distribution is associated with the seasonal presence of prey species (Calkins 1984; Hazard 1988; Nemeth et al. 2007; NMFS 2008). Eulachon runs in the Susitna River number in the several hundred thousand individuals during May, with several million fish present in June (Calkins 1989). Eulachon filled the stomach of one beluga whale harvested at the Susitna delta in 1998 (NMFS 2008), suggesting the importance of Susitna River spring eulachon runs to CIBWs. In summer, as runs of eulachon decline in abundance, belugas begin feeding heavily on Pacific salmon (NMFS 2008).

4.8.3.2. Cook Inlet Beluga Whale Critical Habitat

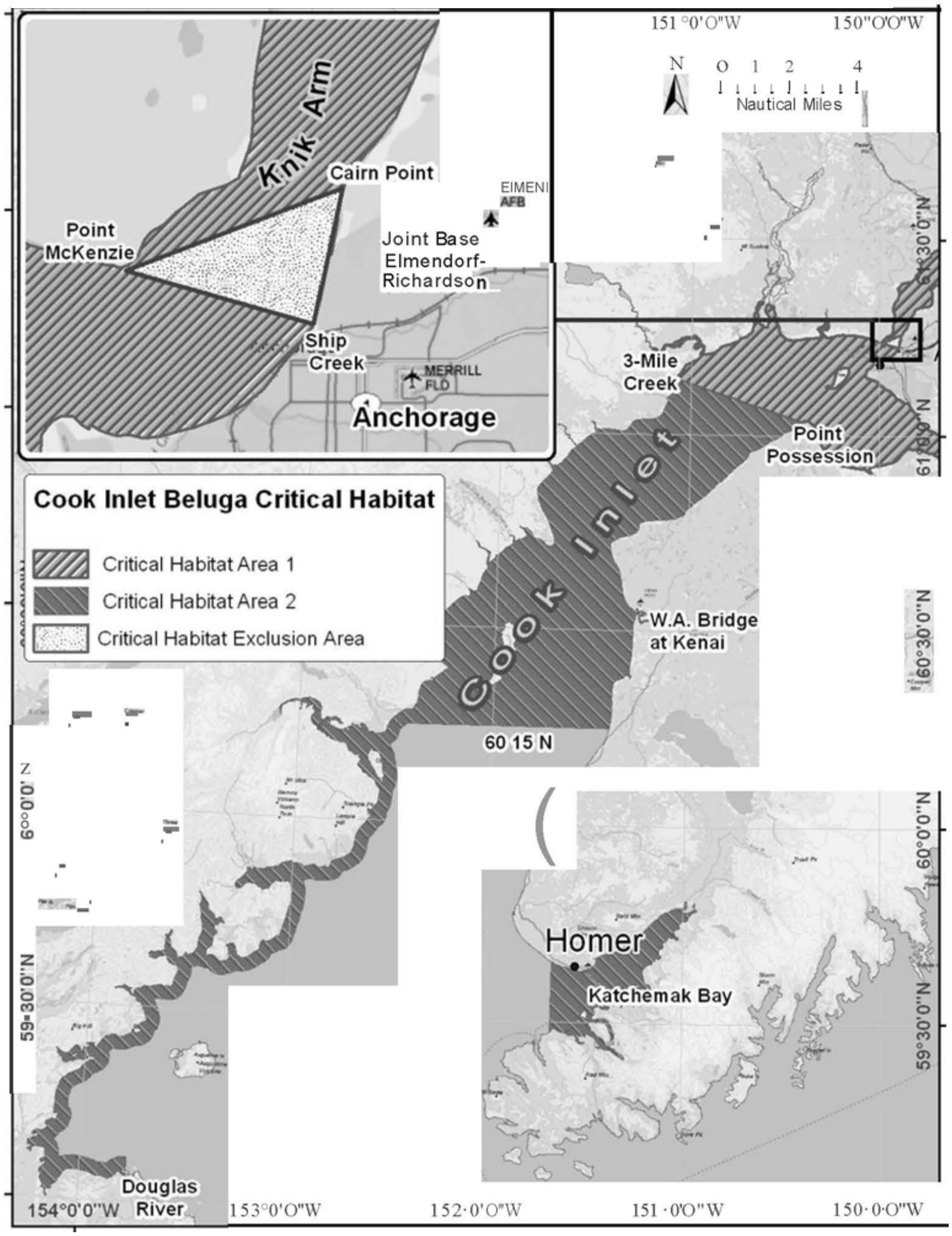
Critical habitat was designated for CIBWs by the NMFS on April 11, 2011 (76 FR 20180). The critical habitat area includes upper Cook Inlet from the upper end of Knik and Turnagain arms to an area south of Kalgin Island, Kachemak Bay, and near shore areas extending from Tuxedni Bay to Kamishak Bay (Figure 4.8-1). Proposed critical habitat for the Cook Inlet beluga whale is present in lower reach and mouth of the Susitna River. The lower Susitna River, mouth, and delta are located in Area 1 of the designated critical habitat.

NMFS identified five primary constituent elements (PCEs) in the final ruling that are essential to the conservation of CIBWs:

- **PCE 1** -Intertidal and subtidal water of Cook Inlet with depths <30 ft (mean low lower water) and within 5 miles of high and medium flow anadromous fish streams
- **PCE 2** -Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), eulachon, Pacific cod (*Gadus macrocephalus*), walleye pollock (*Theragra chalcogramma*), saffron cod (*Eleginus gracilis*), and yellow fin sole (*Limanda aspera*)
- **PCE 3** -Waters free of toxins or other agents of a type or amount harmful to CIBWs
- **PCE 4** -Unrestricted passage within or between the critical habitat areas
- **PCE 5** -Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by CIBWs

Although PCEs 1-5 are present in the lower Susitna River and its mouth, only PCEs 1 and 2 could potentially be directly affected by the proposed hydroelectric project. Potential effects of the Susitna-Watana Project on Cook Inlet beluga whale critical habitat are described below.

Figure 4.8-1 Cook Inlet beluga whale critical habitat



Source: http://www.[ala.noaa.gOY/newsreleases/images/cibelugachmap.jpg

4.8.3.3. Cook Inlet Beluga Whale use of the Susitna River area

Available information indicates that the Susitna River mouth and delta are vital habitats for the Cook Inlet beluga whale. The lower reach of the Susitna River lies within critical habitat Area 1. Area 1 critical habitat contains shallow tidal flats, river mouths, or estuarine areas, and is important as foraging and calving habitat. These habitats may also serve other biological needs, such as molting or escape from predators (Shelden et al. 2003).

Area 1 critical habitat has the highest concentrations of belugas from spring through fall as well as the greatest potential for adverse impact from anthropogenic threats. Intensive summer feeding by belugas occurs in the Susitna delta area. Risk from harm from anthropogenic factors in Area 1 is increased by the fact that whales occur here in high densities.

Though belugas are known to enter Cook Inlet area streams, information on their distribution and occurrence of is limited[18]. The NMFS (NMFS 2008) identified beluga "feeding hotspots" in Cook Inlet as the Susitna and Little Susitna rivers, Knik Arm from Eagle Bay to the Eklutna River, the Ivan River, the Theodore River, the Lewis River, the Chickaloon River, and Chickaloon Bay. Whales may gather in estuaries or river mouths in order to carry out biologically important, such as:

- Calving or breeding, because warm water may facilitate thermoregulation in neonates and/or adults (Calkins 1989; Moore et al. 2000; NMFS 2008)
- Feeding in spring when blubber resources are lowest (Calkins 1989; NMFS 2008)
- Escaping predators (Shelden et al. 2003; NMFS 2008)
- Sheltering during storms (Calkins 1984; Huntington 2000)

HDR (2010) reviewed CIBW presence upriver of the mouths of various tributaries of Cook Inlet. Whales were found to be present upriver in spring, summer, and autumn (approximately April-September). Documented presence of whales upriver was confirmed for the Susitna River, Kenai River, Twenty mile River, Placer River, Knik River, and Beluga River (as far upriver as Beluga Lake at RM 30. Bird Creek, Chickaloon River, Glacier Creek, Fox River, Ivan River, Lewis River, Little Susitna River, McArthur River, and Theodore River (HDR 2010).

Tags applied to adult salmon migrating up the Susitna River at RM 20, 22 and 80 during the 1980s APA Project Aquatic Studies Program were recovered in January 1986 from the stomach of a male beluga whale found stranded in Turnagain Arm (Calkins 1989). Since it is unlikely that a spawning adult salmon would migrate up to 80 miles downstream to exit the river, and belugas are not known to feed on dead or dying fish, (Calkins 1989) the whale may have taken the salmon upriver. In spite of this, crews manning fish-tagging stations along the Susitna River did not see whales upstream of RM 3 (Calkins 1989).

Traditional hunting areas for beluga whales included upriver feeding locations in the Susitna, Little Susitna, Ivan, Theodore, and Lewis rivers (Calkins 1989). According to traditional ecological knowledge, CIBWs are known to ascend the Susitna River at least as far as the power lines near RM 5 and occasionally as far as RM 30 to 40 (Huntington 2000).

Whales have also been observed above tidewater in seven other Cook Inlet streams, including the nearby Beluga River, Kenai River, and streams entering both Knik and Turnagain Arms (HDR 2010), indicating a pattern of frequenting upriver habitats.

4.8.4. Special Status Fish

No fish species listed under the ESA may be found in the project area (USFWS 2009a, NOAA 2011a). The State of Alaska does not identify any fish species as endangered which may be in the Project area or affected by the Project. Three salmon stocks in the Susitna watershed have been designated as “stocks of concern” by the ADF&G and the Alaska Board of Fisheries (BOF). A “stock of concern’ is defined by the Alaska *Policy for Management of Sustainable Salmon Fisheries* (5 AAC 39.222) as a salmon stock that exhibits a yield, management or conservation concern. A conservation concern is the highest level of concern under this policy and none of these stocks have this status. Susitna River sockeye salmon were established as a stock of “yield concern” under this policy in 2008. A “yield concern”, is defined as a chronic inability, despite specific management efforts to maintain expected harvestable surpluses above the stock’s escapement needs. The BOF also found the Willow and Goose Creeks Chinook salmon stock to be a yield concern in February of 2011. ADF&G provided a stock status report, action plan, and research plan for these stocks at the February 2011 BOF meeting (ADF&G 2011d).

The Alexander Creek Chinook salmon stock was designated a stock of “management concern” under the policy in February 2011. A “management concern” is a higher level of concern than a “yield concern” and results from a chronic inability to achieve the sustainable escapement goal for the stocks despite the use of specific management efforts. Stock status reports, action plans and research plans were developed for these stocks (ADF&G 2011d, 2011e) and the BOF modified fishing regulations to address the concern (Alaska Board of Fisheries 2011).

4.8.5. Special Status Amphibians and Reptiles

No amphibian or reptile species listed under the ESA may be found in the project area (USFWS 2009a). The BLM does not show any amphibians or reptiles on its Alaska sensitive or watch lists (BLM n.d.). The ADF&G lists the wood frog as a featured species, and it is likely to found in the Project area (ADF&G 2006).

4.8.6. Essential Fish Habitat

The Project area includes essential fish habitat (EFH), as explained below. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) is the federal law that governs U.S. marine fisheries management. In 1996 Congress added new habitat conservation provisions to that act in recognition of the importance of fish habitat to productivity and sustainability of U.S. marine fisheries which includes freshwater habitat utilized by anadromous[3] species. The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. The MSA requires federal agencies to consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (MSA §305[b][2]).

Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The NMFS EFH guidelines further interpret the EFH definition:

- "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities
- "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem
- "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle

The EFH mandate applies to all species managed under a federal fishery management plan, which includes all five species of Pacific salmon. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon and includes those waters identified in ADF&G's *Catalog of waters important for the spawning, rearing, or migration of anadromous fishes* (ADF&G 2011a). This catalog designates anadromous waters in the main stem of the Susitna River extending upstream to the mouth of the Oshetna River at approximately river mile 225.

4.8.7. Relevant Biological Opinions, Status Reports, and Recovery Plans

The following reports may be pertinent to the only ESA-listed species potentially affected by the project:

Biological Opinions:

- Fort Richardson – US Army, Section 7 Consultation Biological Opinion on the Resumption of Year-Round Firing Opportunities at Fort Richardson, 05/2011 (NMFS 2011aa)

- Knik Arm Bridge And Toll Authority: Knik Crossing, ESA Section 7 Consultation Biological Opinion, Knik Arm Crossing, 11/2010 (NMFS 2010aa)

- Port of Anchorage Expansion, Endangered Species Act, Section 7 Consultation Biological Opinion for the Marine Terminal Redevelopment Project at the Port of Anchorage, Alaska, 07/2009 (NMFS 2009aa)

- List of additional consultation documents for projects related to the Cook Inlet beluga whale are available on the NOAA website (NMFS 2011bb)

Status Reports:

- Stock Assessment report, 2010 (Allen and Angliss 2011aa)

- Status Review Supplement for Cook Inlet, 10/2008 (Hobbs and Shelden 2008aa)

- 2008 Status Review for Cook Inlet, 04/2008 (Hobbs et al. 2008aa)

    - Not published in the FR

  - o 2006 Status Review for Cook Inlet, 03/24/2006 (Hobbs et al. 2006aa)
  - o 73 FR 14836

Recovery Plans:

- Notice of intent to prepare a recovery plan for the Cook Inlet beluga whale. 75 FR 4528, January 28, 2010 (NMFS 2010cc)
- Recovery Outline for Cook Inlet Beluga whales, 02/2010 (NMFS 2010bb)
- Conservation Plan for the Cook Inlet Beluga Whale, 10/2008 (NMFS 2008aa)
  - o Discusses the need for a Recovery Plan under the ESA

4.8.8. Potential Adverse and Positive Impacts

Potential adverse impacts to RTE species, populations, and habitats require an understanding of the project footprint, locations of construction activities, project operations, habitats, and refined inventories of RTE species and their use of affected areas relative to their full ranges. Some of the Project information is still under development or unknown. Once it is refined, the Project and species information can be analyzed to describe potential impacts to RTE species, potentially limited by lack of species information specific to the Project area.

4.8.8.1. Plant Species

The Project would not affect any ESA-listed plant species. Due to the lack of past floristic surveys conducted within the study area, potential adverse impacts to other rare or sensitive plant species cannot yet be determined. If individuals of RTE plant species occur within areas directly affected by the Project, adverse impacts could include physical disturbance or destruction through Project construction or operation. The Project could potentially eliminate individual populations of special status plants. Because no federally-listed threatened or endangered plant species live in the Project area, the stringent species protection measures of the ESA would not be applicable.

4.8.8.2. Animal Species

Construction of Project structures and Project operations would alter habitat and its use by RTE species. The only species listed under the ESA that might be affected is the Cook Inlet beluga whale. The beluga whale could be affected if its habitat (for example, mudflats) or prey species were affected. These prey species particularly include anadromous species: Chinook, sockeye, chum, and coho salmon; eulachon, and saffron cod (NMFS 2008aa). They could also include marine species that use the Susitna River mouth and delta: Pacific cod, walleye pollock, and saffron cod (Moulton 1997).

4.8.8.2.1. Cook Inlet Beluga Whale Critical Habitat

PCE 1 - Areas of shallow mudflats surrounding and within the Susitna River mouth and delta are part of critical habitat PCE 1. If maintenance of these mudflats is dependent on the sediment output of the Susitna River, possible changes in sediment-loading at the river mouth due to the project could affect PCE 1.

Shallow mudflat habitats have been shown to correlate highly with beluga whale presence (Goetz et al. 2007). CIBWs frequent deeper waters during the winter, and shallower areas during summer and autumn. Sediment discharged by glacial tributaries makes up the majority of substrate, as well as rain, snowmelt runoff, and the Alaska Coastal Current (Schumacher et al. 1989). Possible functions of shallow habitats:

- Concentrate prey, increasing availability to belugas (NMFS 2008)
- Provide predator escape habitat (NMFS 2008)
- Provide optimal conditions for molting, calving, and nurturing young

Shallow areas may serve to concentrate fish, with the result that belugas may preferentially use areas with favorable bathymetry over areas with greater prey concentrations (NMFS 2008). For example, belugas do not often feed at the Kenai River mouth although salmon return there in high concentrations (NMFS 2008).Belugas gather at the edge of the Susitna River delta at lower tides to feed on salmon holding in this area before they migrate upstream at higher tides, and belugas have been reported to block channel entrances to the river delta in order to feed (Huntington 2000).

Data needs for assessing potential impacts to this PCE will be fulfilled under data gaps identified under Hydrology, Ice, Sediment, Geomorphology, and Climate, Section 8.

PCE 2 - PCE 2 consists of the following primary prey species for beluga whales : Chinook, sockeye, chum, and coho salmon; eulachon; Pacific cod; walleye pollock; saffron cod; and yellowfin sole. All of these species, except yellowfin sole, have been caught offshore of the Susitna Delta (Moulton 1997). Occurrence of marine fish species in the mouth and lower (tidal) reaches of the river are unknown. Chinook, sockeye, chum and coho salmon; and eulachon spawn in the Susitna River (Harza-Ebasco 1985). Concentrations of saffron cod in the shallow near shore areas may create a valuable prey source for belugas during spring (NMFS 2008).

Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole constitute were identified as the most important food sources for CIBWs through research and TEK. Stomach sampling indicates the above species make up the majority of prey consumed by weight during the ice-free season. A hydroelectric project that could potentially affect fish stocks spawning in the Susitna River or using habitat in its mouth or delta could impact Cook Inlet beluga whale critical habitat PCE 2.

PCE 3 - PCE 3 consists of waters free of toxins or other agents of a type or amount harmful to CIBWs. Potential for effects on beluga whale critical habitat from the Project exists since the Project has potential to affect water quality and contaminant-loading of sediment of the Susitna River, although the effects, if any, will likely be attenuated by tributary inflows below Watana Dam. Upper Cook Inlet has been designated a Category 3 water body, or a water for which there is insufficient or no data to determine whether any designated use would be impaired; therefore, there are no identified water quality concerns or total maximum daily loads for Cook Inlet. Water quality of the river mouth and contaminant-loading of sediment at the mouth are unknown.

PCE 4 - Changes in water levels could change belugas access to estuarine and upriver habitats in the Susitna River. If waters become too shallow, whales may not physically be able to enter them. Belugas have been documented traveling in large, tightly packed groups in both the east and west tributaries of the Susitna River, thought to be pursuing fish (Rugh et al. 2000). Belugas may use bathymetric features such as river banks and shallow mud flats in order to increase their hunting success. Changes in water levels could affect feeding success.

PCE 5 - Noise levels in critical habitat areas are not expected to be affected by the project since no noise impacts are expected at the river mouth/delta, as the proposed dam would be more than 180 miles upriver.

4.8.8.3. Essential Fish Habitat

Construction activities and project operation could alter and affect Essential Fish Habitat. The effects will become better known as Project features are sited and additional information is developed on the salmon use of areas directly affected by Project components and flow changes. FERC will need to analyze potential adverse effects to EFH, develop appropriate mitigation measures, and consult with NMFS regarding EFH conservation.

4.8.9. Potential Protection, Mitigation, and Enhancement

Protection, mitigation, and enhancement measures (PM&Es) will be developed during the FERC licensing process.

4.8.10. References

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4.9. Aesthetic Resources

As described in APA's 1985 Susitna Hydroelectric Project FERC License Application (APA 1985a), the APA Project facilities, including the transmission line, would be located within two of Alaska's physiographic regions: the Southcentral Region and the Interior Region (see Figure 4.9-1).

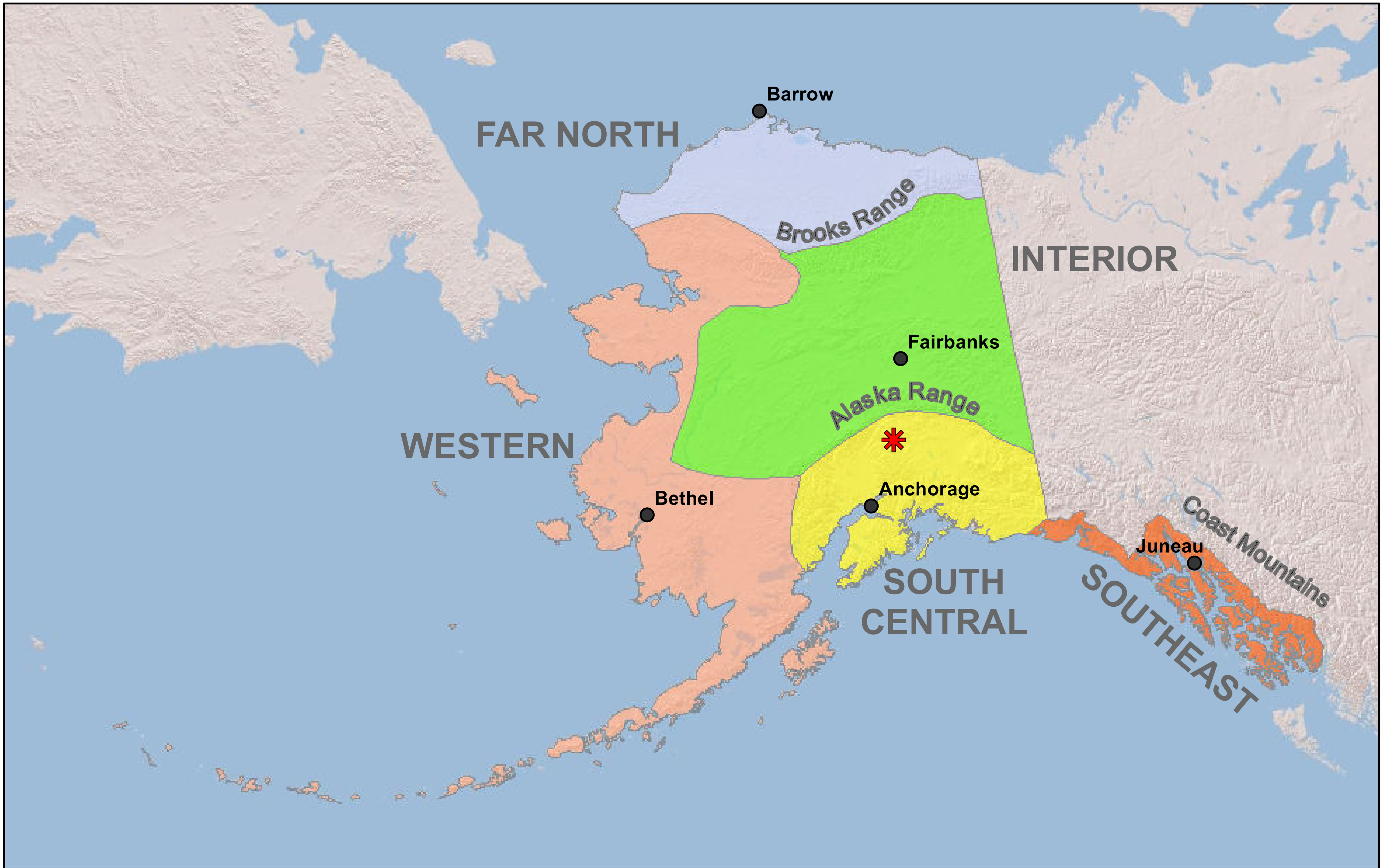
The Southcentral Region is bounded by the Alaska Range to the north and west, the Wrangell Mountains to the east, and the Chugach Mountains and Gulf of Alaska to the south. This region, which encompasses most of the Susitna Project features, is characterized by rugged mountainous terrain, plateaus and broad river valleys. Anchorage, the state's largest city, is located in the Southcentral Region.

Mount McKinley, the highest mountain in North America, is on the Southcentral Region's northwest border. Spruce-hemlock and spruce-hardwood forests, wetlands, moist and wet tundra, plateau uplands and a number of active glacially-bedded mountain valleys are also present. These diverse landscapes include a wide variety of wildlife and fishery resources.

The Interior Region is bordered by the Brooks Range to the north, the Bering Sea to the west, Canada to the east, and the Alaska Range to the south. It is generally characterized as a broad and open landscape of large, braided and meandering rivers and streams. River valleys are primarily vegetated with spruce-hardwood forests giving way to treeless tundra, brush covered highlands, and large wetland areas. The Yukon River, which bisects the Interior Region, is its most prominent natural features. Fairbanks, the state's second largest city, is located in the Interior Region.

The 39,000-square-mile Middle Susitna River basin is located entirely in the Southcentral region. The basin is bordered by the Alaska Range to the north, the Chulitna and Talkeetna Mountains to the west and south, and the northern Talkeetna Plateau and Gulkana Uplands to the east. Although the basin is not considered to be unusually scenic in comparison to other areas of Alaska, it has distinct and diverse combinations of landforms, waterforms, vegetation, and wildlife species. The deep V-shaped canyons of the Susitna River, the Talkeetna Mountains, and the upland plateau to the east are the dominant topographic forms. Elevations in the basin range from approximately 700 ft to over 6,000 ft. Distinctive landforms include panoramic tundra highlands, active and post-glacial valleys, and numerous lakes. The most well-known features in the basin are the vertical-walled Devils and Vee Canyons on the Susitna River.

Tributaries to the Middle Susitna River in the vicinity of the Proposed Project include Portage Creek, Devil Creek, Fog Creek, Tsusena Creek, Deadman Creek, Watana Creek, Kosina Creek, Jay Creek, and Butte Creek. Scenic waterfalls occur on several creeks near their confluences with the Susitna River. The most notable falls occurs on Devil Creek.



Legend

Proposed Watana Dam and Powerhouse

Alaska Regions

- Far North
- Interior
- Southcentral
- Southeast
- Western

N

0 100 200 400 Miles

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.9-1

Physiographic Regions

Wildlife species present in the middle Susitna River basin include Dall sheep, moose, caribou, grizzly and black bears, bald and golden eagles, trumpeter swans, and numerous migratory waterfowl. All five Alaskan salmon species, grayling, burbot, rainbow trout, and lake trout occur in the basin. Devils Canyon rapids serve as a barrier to upstream migration of salmon. As a result, few salmon are found upstream of the canyon.

The Denali Highway passes through the northern portion of the basin. The highway is about 135 mi long and connects Paxson Lodge on the Richardson Highway (east end) with Cantwell junction on the Parks Highway (west end). It is generally open from mid-May to October 1, and is paved only for the first 21 mi west of Paxson and 3 mi east of Cantwell. Several short roads and trails traverse the tundra to mining claims, fishing lodges, and hunting lodges. The main Susitna-Watana Project facilities are located approximately 35 mi south of the Denali Highway. Access into this part of the Susitna River basin is generally limited to hiking, float planes, all-terrain vehicles (ATVs), watercraft, and snowmachines when conditions permit.

Recent photographs of the Project region are included in Appendix 4.9-1.

4.9.1. Existing Aesthetic Resource Conditions

APA's 1985 Susitna Hydroelectric Project FERC License Application included a detailed assessment of the aesthetic resources in the vicinity of the proposed Project vicinity. This assessment included a description of landscape character types; notable natural features; viewers and views; aesthetic value ratings; visual absorption capability; and composite ratings. The assessment, which remains valid and relevant to the proposed Project, is summarized below.

4.9.1.1. Landscape Character Types

Landscape character types are a description and classification of land areas with common distinguishing visual characteristics. They are used as a frame of reference to classify physical features of an area and are based, in large part, on physiographic units. Using aerial photographs and USGS topographic maps, physiographic units were identified as part of the previous FERC licensing effort. These units were subsequently verified and inventoried in the field. The inventory included evaluations of four major landscape characteristics:

- Landforms: Physiographic units defined by their degree of enclosure, geologic history and composition, slope gradient and distinguishing landscape patterns, and notable natural features.
- Waterforms: The location of water bodies, lakes, rivers, streams, wetlands, and the pattern and character of their occurrence. Rarity is also noted.
- Vegetation: A description of the vegetation patterns that exist within the basin. Special or unusual vegetation occurrences are noted.
- Views: A description of special visual characteristics within a landscape character type, panoramic views, and potential viewers.

Landscape character types identified in the vicinity of the proposed Project are graphically shown on Figure 4.9-2 and described in detail in Appendix 4.9-2. These landscape character types include:

- Mid Susitna River Valley
- Susitna River Near Devil Creek
- Susitna River
- Vee (River) Canyon
- Susitna Upland Wet Tundra Basin
- Portage Lowlands
- Chulitna Moist Tundra Uplands
- Chulitna Mountains
- Wet Upland Tundra
- Talkeetna Uplands
- Talkeetna Mountains
- Susitna Upland Terrace
- Susitna Uplands

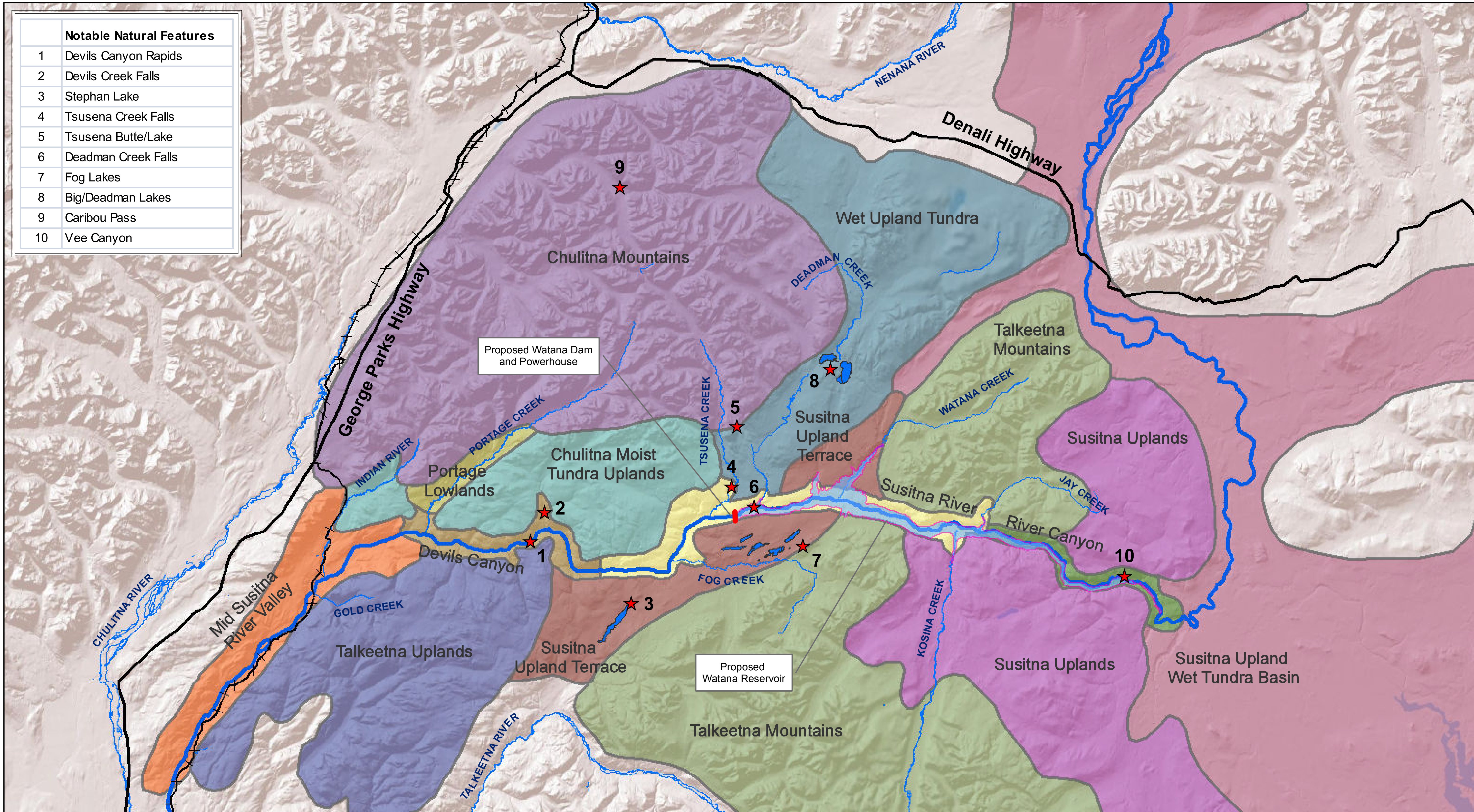
4.9.1.2. Notable Natural Features

Notable natural features may serve as destinations for visitors and residents seeking recreation opportunities. Notable natural features were identified during the previous FERC licensing effort. The location of these features is shown on Figure 4.9-2. Photographs of these features (taken as part of the previous FERC licensing effort) are included as Appendix 4.9-3.

Devils Canyon, which surrounds an 11-mile stretch of the Susitna River, begins just downstream of the mouth of Devil Creek and ends approximately 1.5 mi upstream of Portage Creek. High volumes of glacial water, steep inaccessible canyon walls and large boulders highlight this turbulent and dynamic landscape. Four sets of rapids, known collectively as Devils Canyon rapids, encompass approximately five mi of the canyon. These rapids are Class VI (the most difficult rating) on the International Whitewater Scale. Between the Class VI rapids, the fast-moving whitewater is rated Class II or Class III. Because of the extreme challenge that the rapids present, few kayakers are known to have attempted to run Devils Canyon.

Two large waterfalls pass through narrow gorges on Devil Creek, just upstream of its confluence with the Susitna River. Vertical rock walls and colorful vegetation punctuate the settings.

Stephan Lake, a large waterbody located at the base of the Talkeetna Mountains, has one fishing/hunting lodge and several cabins (collectively known as Stephan Lake Lodge) along its shore. Wetlands and gentle hills covered with mixed woods and tundra comprise the lake's natural shoreline. Stephan Lake is used as a staring place for kayaking and rafting on the Talkeetna River. A trail leads southwest from the lake to nearby Murder Lake and Daneka Lake.



	Notable Natural Features
1	Devils Canyon Rapids
2	Devils Creek Falls
3	Stephan Lake
4	Tsusena Creek Falls
5	Tsusena Butte/Lake
6	Deadman Creek Falls
7	Fog Lakes
8	Big/Deadman Lakes
9	Caribou Pass
10	Vee Canyon

Legend

- Notable Natural Features
- Proposed Watana Dam and Powerhouse
- Proposed Watana Reservoir
- Highway
- Alaska Railroad
- Susitna River
- Selected Tributaries and Nearby Streams

Landscape Character Types

- Chulitna Moist Tundra Uplands
- Chulitna Mountains
- Devils Canyon
- Mid Susitna River Valley
- Portage Lowlands
- River Canyon
- Susitna River
- Susitna Upland Terrace
- Susitna Upland Wet Tundra Basin
- Susitna Uplands
- Talkeetna Mountains
- Talkeetna Uplands
- Wet Upland Tundra

N

0 5 10 20 Miles

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Figure 4.9-2

Landscape Character Types

A spectacular rocky canyon covered with mixed woods and tundra, and a series of rapids and cataracts provide the backdrop for Tsusena Creek Falls. The falls are located on Tsusena Creek, approximately three mi above its confluence with the Susitna River.

Located at the edge of the Chulitna Mountains, Tsusena Butte Lake was created by a glacial moraine. The Tsusena Creek valley includes a large variety of tundra landscapes and colorful rock formations.

Similar to other tributary falls that flow into the Susitna River, Deadman Creek Falls occurs in a steep, small-scale rocky canyon.

The Fog lakes are a series of large, linear lakes on the south side of the Susitna River. They occur in a gently rolling to flat landscape covered with wetlands, mixed forest, and open tundra vegetation.

Big Lake and Deadman Lake are picturesquely set between three large, tundra-covered buttes. There are many outstanding views from the lakes into the middle Susitna River basin.

Two long lakes, surrounded by glaciated mountains, are located in a narrow valley known as Caribou Pass. Wetlands and tundra cover the valley floor where the middle fork of the Chulitna River has its headwaters.

Vee Canyon is a narrow, vertical, rocky canyon that encloses the Susitna River for over a mile. Located upstream of the confluence with Jay Creek, the canyon includes a double hairpin bend, a deeply cut channel, and a stretch of whitewater rapids. The canyon's steep ridges, varied coloration, and rock formations make it a visually interesting feature.

4.9.1.3. Viewers and Views

Aesthetic resource assessment requires an understanding of who the viewers are, when and where they view the landscape, what they can see, and what preconceptions they bring with them about views.

Existing viewers in the vicinity of the Project include hunters, anglers, guides, flyers, boaters, packrafters, motorists, and hikers. Concentrated at places such as Stephan Lake, many of these viewers are attracted to the area because of its remote setting and recreational opportunities. The Parks Highway has been recognized as both a National and Alaska State Scenic Byway.

Significant views of the Project vicinity were identified as part of the previous FERC licensing effort. These views incorporate foreground (0-0.5 mile from viewer), middleground (0.5-3 mi from viewer), and background (greater than 3 mi) landscape elements. There are many important foreground views within the valleys of Chulitna Mountains, within the Parks and Denali Highway corridors, within the Alaska Railroad corridor, and within the Susitna River corridor. Panoramic views, which incorporate middleground and background landscape elements, include:

- From Parks Highway, looking northwest towards the Alaska Range
- From Denali Highway, looking north towards the Alaska Range

- From Deadman Creek, looking northeast to southeast towards the Clearwater Mountains
- From Big Lake and Deadman Lake vicinity, looking south across the Susitna River towards the Talkeetna Range
- From high ground located north of the Susitna River and west of its confluence with Tsusena Creek, looking south across the Susitna River towards the Talkeetna Range

4.9.1.4. Aesthetic Value Ratings

Each landscape character type was evaluated for its aesthetic value (high, medium, low) during the previous FERC licensing effort. Aesthetic value was defined as a relative measure of the visual landscape based on the following three characteristics:

- <u>Distinctiveness</u>: The visual impression of an area, based on patterns of landforms, waterforms, rocks, vegetative patterns, etc.
- <u>Uniqueness</u>: The relative scarcity or commonality of the landscape and natural features. Due to Alaska's varied and numerous high quality landscapes and natural features, uniqueness is assessed at statewide and Project area scales.
- <u>Harmony and Balance</u>: The degree to which all elements of the landscape form a unified composition. This includes how well man-made elements are integrated into the natural setting.

The characteristics above were evaluated by on on-site examination of each landscape character type. This on-site examination also considered visibility and the potential for views.

4.9.1.5. Visual Absorption Capability

Each landscape character type was evaluated for its visual absorption capability during the previous FERC licensing effort. Visual absorption capability was defined as the relative ability of a landscape to absorb physical change. Each landscape character type was rated as high, medium, or low, based on aesthetic value, topographic enclosure, vegetative cover, ground plane color, and visibility. Each landscape character type was also evaluated through on-site examination with respect to potential project facilities.

The ratings for aesthetic value and visual absorption capability are included in Appendix 4.9-4.

4.9.1.6. Composite Ratings

The aesthetic value rating and visual absorption capability rating for each landscape character type were combined to create a composite rating as part of the previous FERC licensing effort. The range of relationships can be stated as follows:

- The most durable and easily altered landscape character types are those with a high visual absorption capability and low aesthetic character rating.
- The most fragile and difficult to alter landscape character types are those with a low visual absorption capability and high aesthetic character rating.

These relationships, and others, are illustrated in Table 4.9-1, below.

Table 4.9-1. Aesthetic Impact Potential Composite Ratings.

	Aesthetic Value			
		High	Medium	Low
Visual Absorption Capability	Low	9	7	4
	Medium	8	5	2
	High	6	3	1
	(High) <------------ Aesthetic Impact ------------> (Low)			

Composite Ratings 9 and 8 describe landscapes with high aesthetic value and moderate to low ability to visually absorb Project features. Facility designs should be similar in character and equal in boldness with the landscape, or remain visually subordinate to the natural surroundings.

Composite Ratings 7, 6, and 5 describe landscapes with moderate to high ability to visually absorb Project features. Facility designs may visually dominate the landscape, but should relate to the surrounding form, line, color, and texture to be compatible with the surroundings.

Composite Ratings 4, 3, 2, and 1 describe landscapes with low to moderate aesthetic value and high ability to visually absorb Project features. New elements may add to aesthetic quality by introducing visual interest and/or complementing the landscape.

4.9.2. Potential Adverse and Positive Impacts

The potential visual impacts described below are based on the Project as currently envisioned. Development of the proposed facilities would change the visual character of portions of the Project area from an undeveloped, remote setting to an area characterized by development and increased human activity and noise. Temporary visual and noise impacts would be generated by construction personnel, traffic, materials, staging areas, and worker camps.

The Project would have positive visual impacts. The access roads, reservoir, and recreational facilities would provide new recreational and viewing opportunities to the public. Viewing of the notable natural features in the vicinity would substantially increase as a result of Project access and recreational facilities. Additionally, the dam is expected to be visually interesting to many.

Anticipated aesthetic impacts associated with construction and operation of the Project are described below.

4.9.2.1. Watana Dam and Reservoir

Construction of the dam and associated structures, the impoundment area, and the construction camp would substantially alter the landscape, especially in the Middle Susitna River Valley Landscape Character Type and in the southern portion of the Wet Upland Tundra Landscape Character Type. The currently remote and largely undisturbed Susitna River valley would become an area of increased human activity, noise and development.

The dam and reservoir would become the most prominent visual feature in the previously natural setting of the middle Susitna River basin. The geometric lines and forms of the dam and associated structures would contrast with the natural forms, lines, colors, and textures of the valley. These structures would be viewed by Project personnel, support staff, recreationists in the area, and individuals flying overhead.

Visual changes resulting from the Project may include inundation of Vee Canyon rapids and Deadman Creek Falls, which are notable natural features of local or regional importance. Much of Vee Canyon and its scenic rock formations would remain, since its location in the upper reaches of the Watana Reservoir prevents complete inundation. The other notable natural features described in 4.9.1.2 would not be directly affected by the Project. Indirect visual changes on Devils Canyon and Devil Creek Falls could result from changes to hydrology in the Susitna River immediately below the proposed dam.

A maximum reservoir drawdown would generally take place in the spring (April and May) and would result in exposure of substantial silt bars. In places, these silt bars would be more than a mile wide and visible to people near the reservoir once the snow and ice cover melted. They would be visible from late spring until midsummer (i.e., until the reservoir refills each year).

4.9.2.2. Borrow Areas and Camps

While their exact locations are yet to be determined, a number of borrow areas would be located upstream and downstream of the proposed dam. The presence of borrow areas not inundated by the reservoir would create long term visual impacts. Borrow areas along the river below the dam would be in full view from the dam area. Borrow areas located above the reservoir shoreline would create rigid, angular forms visible to visitors in the area. Trucks and other equipment used for borrow operations would generate noise.

The development of a temporary construction camp near the proposed dam (a site near the north abutment is currently proposed) would cause short-term and long-term visual impacts. Short-term visual impacts would include roads, structures, and appurtenant facilities. Short-term noise impacts would also occur.

The development of a permanent camp near the proposed dam (a site near the north abutment is currently proposed) would cause short-term and long-term visual impacts. Short-term visual impacts would include construction of housing, offices, storage/maintenance buildings and related infrastructure. Short-term noise impacts would result from the removal of native vegetation and development of camp facilities. Operation and maintenance of the permanent camp would generate low-moderate levels of noise.

An airstrip, about 8,000 ft-long, would be built to accommodate movement of construction personnel and supplies. This airstrip would become a permanent feature; resulting in short-term and long-term impacts. Short-term visual and noise impacts would result from construction of the airstrip. Long-term visual and noise impacts would result from removal of native vegetation and use of the airstrip by planes and helicopters.

4.9.2.3. Access Routes and Transmission Facilities

Access routes and transmission facility alignments have yet to be finalized. Figure 1-1 describes 3 potential corridors. These corridors have been labeled "Denali," "Chulitna," and "Gold Creek."

Construction of road and transmission routes could result in substantial visual impact to the landscape. Cutting, filling, and vegetative clearing would take place. Areas of potential erosion could be created. Borrow areas located adjacent to the access routes could create rigid, angular forms visible to visitors in the area. Some people may consider the access routes to be a visual intrusion that detracts from their enjoyment of the natural landscape. At the same time, the access routes would provide new access to scenic views for visitors and recreationists. Such views would include panoramic scenes of the Alaska Range, Clearwater Range, and Talkeetna Mountains.

Transmission towers could be 100 ft or more in height. Some single steel-pole structures could be used for angles and steep slopes. The right-of-way could be 300-500 ft wide. The transmission line towers and conductors would be silhouetted against the sky from various viewpoints along the road and from viewpoints near the dam. Through wooded areas, the cleared right-of-way would be highly visible from the air.

4.9.3. Potential Protection, Mitigation, and Enhancement

APA’s 1985 Susitna Settlement Plan (APA 1985b) and associated 1985 Susitna Hydroelectric Project FERC License Application included Visual Resource PM&E measures. These measures, many of which remain valid and relevant to the proposed Project, include best development practices, siting refinements, and design considerations intended to minimize the visual impacts identified above. These measures are described below.

Refinement of the measures will continue throughout the FERC licensing phase of the Project and into the design phase in order to reflect new or updated site-specific engineering information.

4.9.3.1. Best Development Practices

Best development practices (BDPs) are general measures typically used in construction projects to avoid or reduce impacts. BDPs commonly include measures for erosion control, educational programs for workers, rehabilitation techniques, and construction guidelines. Most BDPs can be implemented at no additional cost to a project. In addition to BDP measures identified here, measures identified in BMP manuals developed specifically for the Project would help reduce or avoid visual impacts.

Best development practices related to the Project could include:

- Consolidate structures to minimize the amount of disturbance and need for rehabilitation.
- Site facilities to minimize vegetation clearing.
- Identify areas of notable vegetation before construction that are not necessary to remove, and mark them for protection.
- Develop an environmental briefing program for construction personnel that includes visual resource concerns.
- Use fracture and bench construction methods for cut slopes to avoid uniform cut slope appearances and to provide spaces for debris to collect and vegetation to grow.
- Adhere to standard erosion control practices for areas around stream crossings.
- Feather clearings in forested areas rather than making straight-edged clearings.
- Provide dust control for roads, parking, construction areas that are not paved.
- Round cut-and-fill slopes for side borrow construction of access roads to match the rolling character of the surrounding landscape.
- Grade borrow sites for access roads to minimize steep cuts and conform to surrounding topography.
- Screen borrow sites from significant view corridors.
- Prioritize borrow sites so that sites with the least visual impact would be used first.
- Complete reclamation and revegetation as soon as borrow sites, construction camp, and other facilities are no longer being used.
- Consolidate railhead facilities to reduce the amount of disturbance and rehabilitation needed (if applicable).
- Keep parking areas at railheads dark-toned, if paved, to reduce visual contrast (if applicable).
- Use non-specular conductors unless the hazard to aircraft is too great.
- Minimize transmission line clearing and construction activities in vicinity of streams.
- Limit transmission line clearing to material that poses a hazard.
- Vary transmission line right-of-way and create openings in the forest edge where line must parallel a roadway.

4.9.3.2. Siting Refinements

Siting refinements are adjustments in the location of facilities made in the detailed design stage. They are used to reduce adverse visual impacts. In addition, siting refinements can avoid impacts that would require costly mitigation.

Siting refinements for the Project could include:

- Locate Project recreation facilities in borrow areas and in locations with good views of the dam, impoundment, and natural features.

- Refine road locations to: minimize cut and fill; select stream crossings for bridge locations; establish horizontal and vertical curves to take advantage of long side valley views; and avoid passing through forested areas, staying at the tundra edge whenever possible.
- Coordinate road siting and transmission line siting to minimize views of transmission line from roads.
- Orient roads to maximize distant views of Mt. McKinley.
- Maintain vegetated buffers between roads and borrow areas.
- Consolidate structures with the construction areas to minimize disturbance and need for rehabilitation.
- Use land forms, vegetation, and minor alignment adjustments during detailed transmission design to screen towers from significant views.
- Locate transmission lines so intervening vegetation interrupts views down the rights of way.
- Site transmission lines along natural linear features (such as the bottom of a ridge, valley, or cliff) or along edges of muskeg openings or forests (instead of siting in middle of muskeg or forests).
- Cross major roadways with transmission lines as near to perpendicular as possible to allow for maximum setback of facility structures and minimum visibility from the roadway into the right-of-way on each side.

4.9.3.3. Design Considerations

Design considerations are recommended modifications to facilities to reduce visual contrast with surroundings and/or enhance the visual quality of an area. They range widely in cost and overlap with siting refinements as part of the planning and design process. Because of design constraints imposed by weather conditions and construction cost, there may be substantial limitations on making major changes during the detailed design phase.

Design considerations for the Project could include:

- Locate recreation facilities to maximize views and interpretive opportunities.
- Use materials (stone, concrete, etc.) in the design of recreation and other Project facilities that visually integrate the facilities with the dam and natural surroundings.
- Coordinate reclamation of borrow sites with views from access roads and recreation facilities. Excavate borrow edges above reservoir water line to follow natural contours.
- Reclaim access road borrow areas according to designated post-construction land uses (campsites, trailheads, ponds, etc.).
- Make maximum use of elevated paths and pads to reduce soil and vegetation degradation in the construction camp.
- Use long spans and tall towers where transmission lines must cross valleys to retain as much existing vegetation as possible and to reduce construction impacts to slopes.

4.9.3.4. Site Restoration and Aesthetics Plan

AEA anticipates preparing a Site Restoration and Aesthetics Plan for the Project in consultation with resource agencies and other interested parties. The following elements are likely to be included in this plan:

- Introduction
- Existing Conditions
- Proposed Project Features
- Strategies for Blending Project Works into the Existing Environment
- Disposal of Cleared Vegetation and Spoil Materials
- Screening from Key Viewpoints
- Temporary Revegetation
- Permanent Revegetation
- Monitoring Program and Reports
- Procedures to Revegetate Unsuccessful Areas
- Implementation Schedule and Estimated Costs
- Consultation
- Literature Cited

Strategies for blending project works into the existing environment are likely to include the best development practices, siting refinements, and design considerations described above.

4.9.4. References

Alaska Power Authority (APA). 1985a. *Susitna Hydroelectric Project License Application*.

Alaska Power Authority (APA). 1985b. *Susitna Settlement Plan*.

4.10. Recreation and Land Use

The Project facilities, including the transmission line, would be located in the Southcentral region of Alaska. Since recreational and land use planning for the Project must fit within the framework of existing and future regional recreation and land uses, it is important to understand the regional and Project area patterns and trends.

4.10.1. Introduction

While most of Alaska's 322 million acres of public lands are available for recreation, about 168 million ac, or 46 percent of Alaska, is managed for wildland recreation. Sixty percent of America's national park acreage, the country's largest state park system, and the nation's two largest national forests (the Tongass in Southeast with 17 million ac, and Chugach in Southcentral with 5.7 million ac) though not managed exclusively for recreation, are located in Alaska. The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) placed large parts of Alaska in the nation's conservation, wilderness, and recreation systems, wild and scenic rivers, forests, wildlife refuges, and parks. Combined with the older federal reserves and an expanding state park system, these designations create opportunities for outdoor recreation unsurpassed anywhere (ADNR 2009).

Approximately 12 percent of state land is under some form of legislative designation that protects or enhances wildland recreation. Approximately 82.4 million acres of federal land and 400,000 acres of state land are designated as wilderness. Alaska's state parks are the primary roadside gateways to outdoor recreation. In addition, millions of acres of general state-owned land (managed by the ADNR, Division of Land) and federal domain land (managed by the BLM) are open to wildland recreation. These lands are becoming increasingly popular. There are few regulations imposed on users of these lands. The state also owns about 65 million acres of tidelands, coastal submerged lands, and lands under navigable waters, all having virtually unlimited potential for wildland recreation (ADNR 2009).

The Alaska Department of Transportation and Public Facilities (ADOT&PF) is also one of the most important providers of recreation within the state. Alaskans rely on roads for a broad spectrum of recreational opportunities. Alaska has over 13,250 mi of public roads, approximately 26 percent (or 3,500 mi) of which are paved. Most recreation occurs along, or is accessed from the road system. Viewing wildlife and scenery from vehicles and bicycling along the road are important components of the state's tourism industry, as well as resident recreation (ADNR 2009).

4.10.1.1. Regional Recreation

The Southcentral (a.k.a., Railbelt) region extends from the hydrographic divide of the Alaska Range on the north to the Matanuska-Susitna Borough (MSB) boundary on the west, Kodiak Island on the south, and the Alaska/Canada border on the east. It abounds with ocean shorelines, freshwater lakes, free-flowing rivers, massive mountains, wildlife, and glaciers. The diversity of landscapes and natural resources offer a wide variety of outdoor recreational opportunities. Figure 4.10-1 shows existing and proposed regional recreational amenities.

The Southcentral region contains a more developed transportation system than other portions of the state. Paved highways and gravel secondary roads provide access to many of the cities and villages in the region, as well as access to many of the recreational lands in the region. Use of planes to reach areas not accessible by road is also prevalent. The Alaska Railroad and ferry systems also serve portions of the Southcentral region. These transportation systems, combined with the population concentration, make the region's recreational opportunities more accessible and, therefore, more heavily used than in other portions of Alaska.

The bulk of the state park system acreage and units (78 units, including 19 marine parks) lie within the Southcentral region including Chugach, Denali, and Kachemak Bay state parks. Additionally, nearly 20 million acres of national park land, including Kenai Fjords National Park, Denali National Park and Preserve, and Wrangell-St. Elias National Park, the 1.9 million-acre Kenai National Wildlife Refuge, the 5.7 million-acre Chugach National Forest, and 16 state special areas (critical habitat areas, sanctuaries, and refuges) are located within this region. The Tanana Valley State Forest has 1.8 million acres (ADNR 2009).

The proposed Project is within the northwest corner of the BLM Glennallen Field Office Planning Area. The planning area includes approximately 7.1 million acres in east Alaska, including approximately 5.5 million acres of lands that are selected by the State of Alaska or Alaska Natives. Management measures outlined in the BLM's East Alaska Resource Management Plan (BLM 2006) apply only to BLM-managed land in the planning area; no measures have been developed for private, state, or other federal agency lands. The BLM prepared this Resource Management Plan to provide direction for managing public lands within the Glennallen Field Office boundaries. The primary types of regulated recreational activities on lands managed by the Glennallen Field Office are guided hunting, guided sport fishing, guided float trips, and use of BLM campgrounds and waysides.

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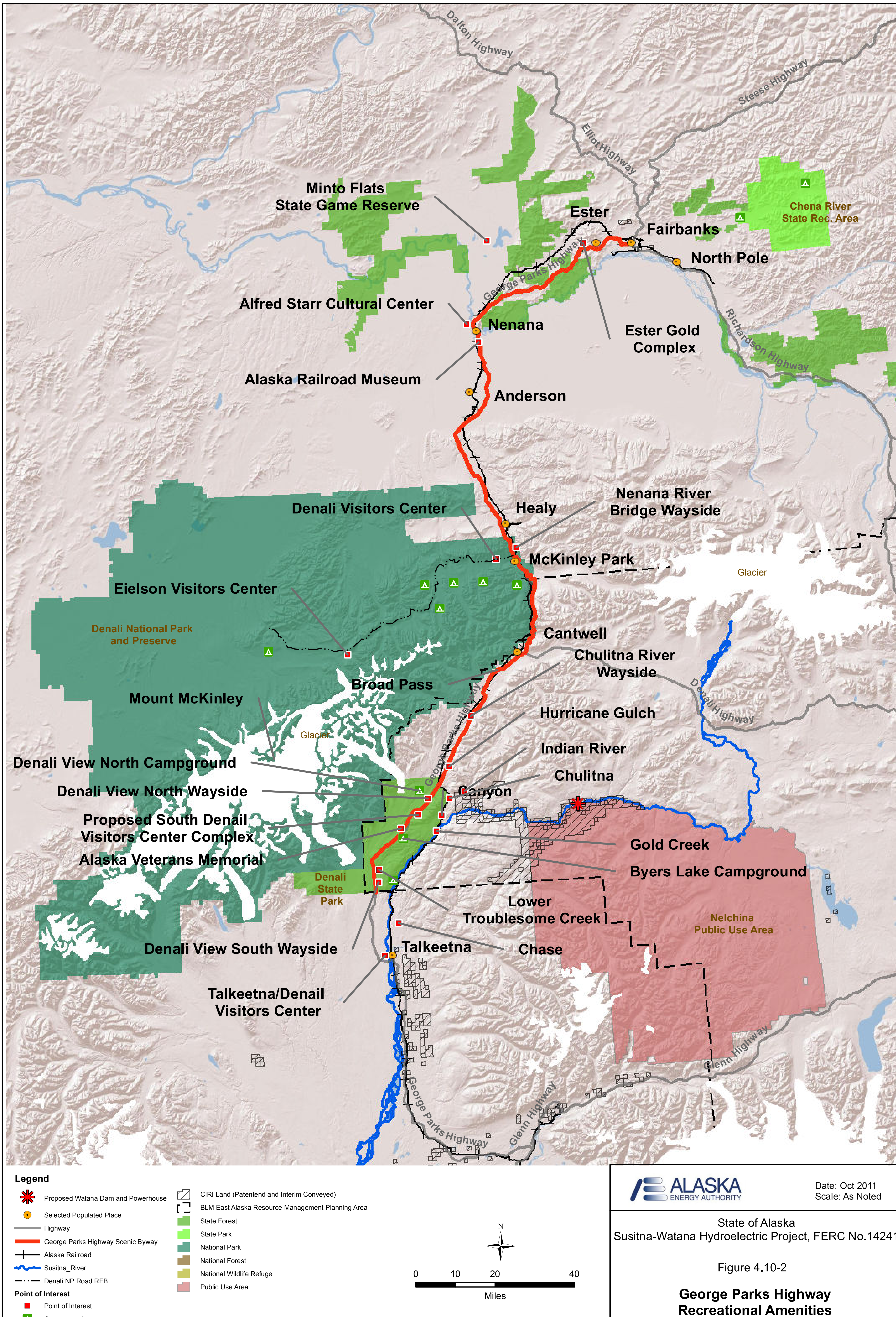
Figure 4.10-1

Southcentral Alaska Recreational Amenities



State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.10-2

George Parks Highway Recreational Amenities

The Iditarod Trail Sled Dog Race is an annual sled dog team race across Alaska. A portion of the race is run along the Iditarod National Historic Trail. Mushers and teams of 12-16 dogs cover the 1,000-1,100 mi between Anchorage and Nome in 9-15 days. A northern route is taken in even years and a southern route in odd years. The race begins on the first Saturday in March. The Iditarod began in 1973 as an event to test the best sled dog mushers and teams but evolved into today's highly competitive race. The race is the most popular sporting event in Alaska. The race crosses the lower Susitna River near the Town of Susitna.

Recreational facilities in the Southcentral region include those along the George Parks Highway, the Denali Highway, and along the Alaska Railroad right-of-way.

The George Parks Highway (numbered Interstate A-4 and Alaska Route 3) runs 323 mi from the Glenn Highway 35 mi north of Anchorage to Fairbanks in the Alaska Interior (Figure 4.10-2). The highway was completed in 1971, and given its current name in 1975. The highway, which mostly parallels the Alaska Railroad, is one of the most important roads in Alaska. It is the main route between Anchorage and Fairbanks (Alaska's two largest metropolitan areas), the principal access to Denali National Park and Preserve and Denali State Park, and the main highway in the Matanuska-Susitna Valley.

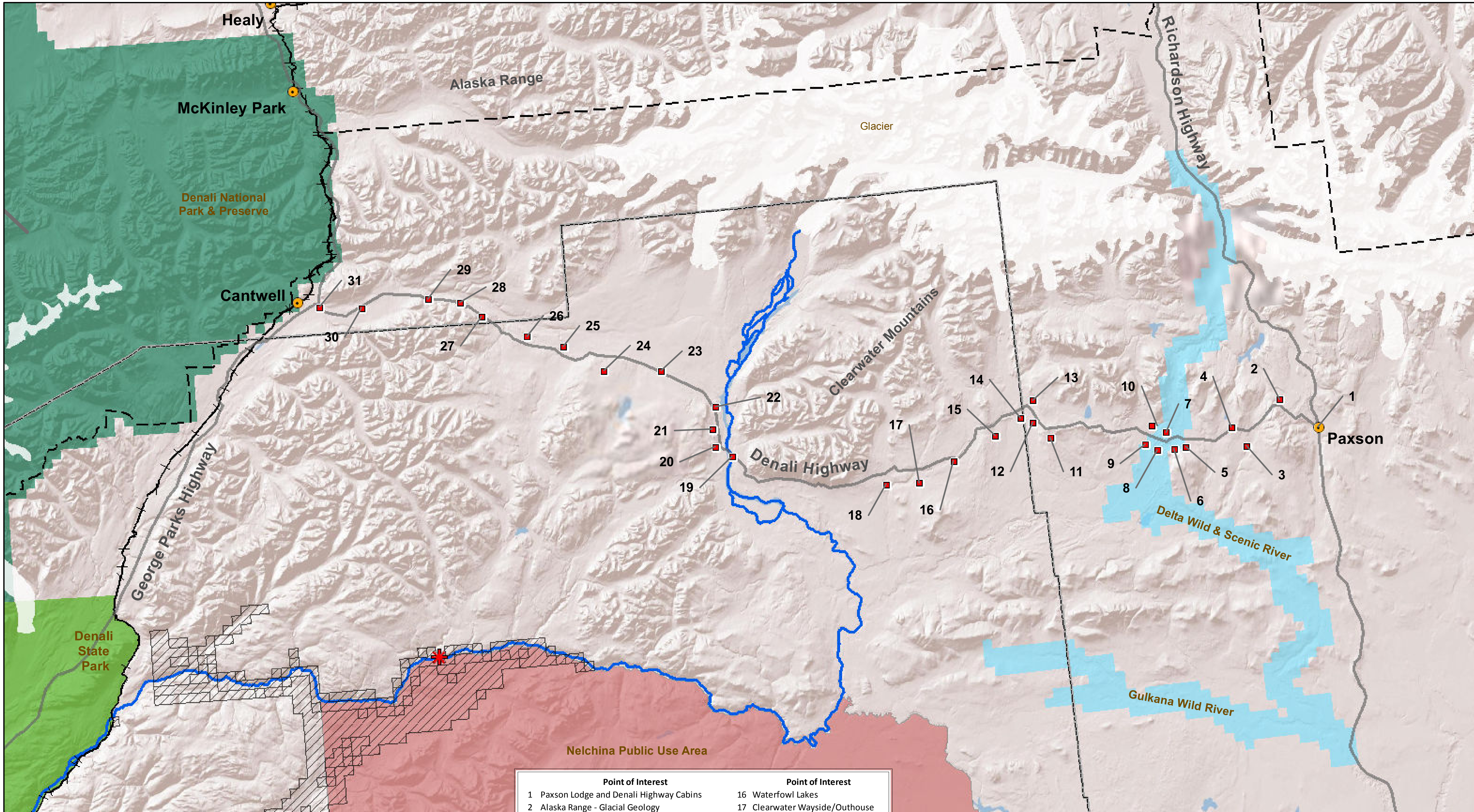
The Parks Highway, open year-round, has been recognized as both a National and Alaska State Scenic Byway. Driving along the Parks Highway for sightseeing purposes is a major recreational use.

The Denali Highway is about 135 mi long and connects the Cantwell junction (located just north of Broad Pass) on the Parks Highway with Paxson Lodge on the Richardson Highway. A loop trip originating and returning to Fairbanks is about 436 mi. A loop trip from Anchorage is close to 600 mi. Several days travel is required for either of these trips. The Denali Highway is generally open from mid-May to October 1. As described by the BLM (2008), numerous recreational amenities are located on or near the Denali Highway (Figure 4.10-3)

The Alaska Railroad extends from Seward and Whittier, in the south, to Fairbanks (passing through Anchorage), and beyond to Eielson Air Force Base and Fort Wainwright in the interior of that state. Uniquely, the Alaska Railroad carries both freight and passengers throughout its system. The railroad has a mainline over 470 mi long, and is well over 500 mi long when branch lines and sidings are included. It is currently owned by the State of Alaska. The railroad is a major tourist attraction in the summer. The Alaska railroad coach cars feature single-level seating throughout the train, with dome cars that are available for passengers to enjoy. The wide windows and domes provide a great view of the Alaskan scenery. Private cars owned by the major cruise companies are towed behind the Alaska Railroad's own cars, and trips are included with various cruise packages.

Located at the confluence of the major rivers (the Susitna, the Talkeetna and the Chulitna River) is the historic village of Talkeetna, which was established during construction of the Alaska Railroad. Panoramic views of the Alaska Range can be enjoyed and photographed from the village. Talkeetna is a popular base for flightseeing, packrafting, fishing, riverboat tours (including jetboat tours on the Susitna River upstream to the bottom reach of Devils Canyon), hiking, Nordic skiing, mushing, and mountain climbing (AlaskaTours.com 2011).

Gold Creek, located between Talkeetna and Hurricane, is a flag stop on the "Hurricane Turn" train. Hunters, anglers, those rafting down the Susitna River, homesteaders, and those with mining claims in the area frequent the area in summer. Nine seasonal use cabins are found in the Gold Creek vicinity. The town has one permanent resident. Additional stops used by recreationists along the "Hurricane Turn" line include: Curry, Chulitna, Sherman, Chase, Indian River, and Hurricane.



Legend

- Proposed Watana Dam and Powerhouse
- Selected Populated Place
- Highway
- Alaska Railroad
- Susitna_River
- BLM East Alaska Resource Management Planning Area
- CIRI Land (Patented and Interim Conveyed)
- Point of Interest
- State Forest
- State Park
- National Park
- National Forest
- National Wildlife Refuge
- Public Use Area
- National Wild and Scenic Rivers

	Point of Interest		Point of Interest
1	Paxson Lodge and Denali Highway Cabins	16	Waterfowl Lakes
2	Alaska Range - Glacial Geology	17	Clearwater Wayside/Outhouse
3	Wrangell Mountain Viewpoint	18	Eskers
4	Tangle Lakes Archaeological District	19	Susitna River
5	Tangle River Inn	20	Gracious House
6	Pavement ends/begins	21	Valdez Creek Mine Viewpoint
7	Tangle Lakes Campground	22	Alaska Range Viewpoint
8	Delta National Wild and Scenic River Wayside	23	Alaska Range Interpretive Sign
9	Tangle Lakes Lodge	24	Adventures Unlimited
10	Landmark Gap Viewpoint	25	Brushkana Creek Campground
11	Alaska Range and Maclaren River Viewpoint	26	Taiga
12	Palsa	27	Denali Highway Orientation Sign
13	Kettle Lakes	28	Nenana River
14	Maclaren River Lodge, Maclaren Glacier Viewpoint, Maclaren River Bridge	29	Mt. McKinley Viewpoint
15	Crazy Notch	30	Pavement begins/ends
		31	Junction with Parks Highway

N

0 4.5 9 18
Miles

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.10-3

Denali Highway Recreational Amenities

4.10.1.2. Project Area Recreation

Big Lake and Deadman Lake are situated between three large, tundra-covered buttes located about ten miles northeast of Deadman Creek's confluence with the Susitna River. There are many outstanding views from the lakes into the middle Susitna River basin. Private cabins exist at Big Lake.

The Nelchina Public Use Area covers about 2.5 million acres in the Talkeetna Mountains. The Public Use Area was established by the Alaska legislature in 1985 and is managed by the ADNR Division of Mining, Land, & Water. The Nelchina Public Use area is the biggest legislatively designated area on state land in Alaska. It is an outstanding area for hunting, fishing, recreation, and mining. The vast area is home for the Nelchina Caribou herd, the third largest caribou herd in Alaska. It also supports important populations of trumpeter swans, moose, Dall's sheep, and brown bear. The Susitna River forms the northern boundary of the Nelchina Public Use Area, and portions of the proposed Project area located south of the river are within its boundaries. These areas are located within Nelchina Management Area 13. Stephan Lake and the Fog lakes area also located in the Public Use Area.

Stephan Lake, a large waterbody located at the base of the Talkeetna Mountains, has one fishing/hunting lodge and several cabins (collectively known as Stephan Lake Lodge) along its shore. Private cabins also exist at Stephan Lake. Wetlands and gentle hills covered with mixed woods and tundra make up the lake's natural shoreline. Stephan Lake is used as a starting place for kayaking and rafting on the Talkeetna River. As described below, a trail leads southwest from the lake to nearby Murder Lake and Daneka Lake.

The Fog lakes are a series of large, linear lakes on the south side of the Susitna River. They occur in a gently rolling to flat landscape covered with wetlands, mixed forest, and open tundra vegetation.

Devils Canyon, which surrounds an 11-mile stretch of the Susitna River, begins just downstream of the mouth of Devil Creek and ends approximately 1.5 mi upstream of Portage Creek. Four sets of rapids, known collectively as Devils Canyon rapids, encompass approximately five mi of the canyon. These rapids are Class VI (the most difficult rating) on the International Whitewater Scale. Between the Class VI rapids, the fast-moving whitewater is rated Class II or Class III.

The Recreation Opportunity Spectrum (ROS) Class on lands managed by the BLM in the vicinity of the proposed Project is "Primitive" (BLM 2006). These lands, located within the BLM Glennallen Field Office's East Alaska Resource Management Plan Planning Area, are characterized by an essentially unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other users is minimal.

Multiple trails and routes exist in the Susitna-Watana Project area. The State of Alaska has formally identified six Revised Statute (RS) 2477 trails in the Project area. Many of these are still are used to access mining claims, fishing and hunting areas, or remote cabins from communities such as Chase, Curry, and Hurricane that exist along the rail corridor. Use of these trails is governed by the generally allowed uses defined by the State. Recognized RS 2477 public right-of-way trails in or around the Project area include (HDR Alaska 2011):

- Susitna River Trail (also referred to as the Gulkana/Denali Winter Trail, RS Trail 294: Access to this 125-mile long trail is from the Denali Highway where the highway crosses the Susitna River. The trail travels southeast, following the river to its junction with the Maclaren River. The trail continues up the Maclaren River and ultimately connects with trails originating from the Lake Louise area.
- Curry Landing Strip to Lookout Tower Trail (RS Trail 1509): This trail is access from the Curry Station along the Alaska Railroad right-of-way and travels west to the lookout tower. The trail is used to access views of the Alaska Range and Mt. McKinley.
- McWilliams/Gold Creek Trail (RS Trail 469): This trail is accessed from the railroad station and community of Gold Creek at Mile 263 of the Alaska Railroad. The trail heads east, following the base of the hills, climbs the plateau south of the Susitna River, and then continues south-southeast toward mining claims on John Creek. The trail is approximately 36 mi long.
- Indian River-Portage Creek Trail (RS Trail 100): This trail is accessed from the Chulitna Station at Mile 274 of the Alaska Railroad. It heads eastward, crossing the Indian River, and continuing east to cabins on Portage Creek. The trail is approximately eight mi long.
- Murder Lake North to Ridgeline Trail (RS Trail 80): This trail is accessed from Murder Lake and heads northwest to a ridge. Historically used for berry picking and hunting access purposes, the trail is two mi long.
- Stephan Lake to Murder Lake Trail (RS Trail 61): This trail connects the south shore of Stephan Lake to Murder Lake. The trail is approximately one-half mile long and has been used for access between landowners on Stephan Lake and Murder Lake, and as a recreational trail to access fishing on Murder Lake.
- Stephan, Murder, and Daneka Lakes Connector Trail (RS Trail 377): This trail is access from the west end of Stephan Lake, and heads southwest to Murder Lake. It then continues southward, crossing Prairie Creek and terminating at Daneka Lake. It is used to access cabins and for recreational fishing, hiking, and hunting.

Most of the lands in the Project area are currently owned by the Cook Inlet Region, Incorporated (CIRI). Visitors may access and use CIRI land on a limited basis with written permission. Guides, hunters and anglers, campers, tour operators, photographers, scientists, dog mushers and other outdoor enthusiasts are encouraged to respect CIRI land and contact the CIRI Land and Resources Department to learn more about land use policies (CIRI 2011).

Several ANCSA 17(b) easements are located in the Susitna-Watana Project vicinity. These easements (see Appendix 4.10-1) provide access through private Native lands to public lands and waters. Reserved and managed by the federal government, these easements (ADNR 2010a) include:

- 26a: Existing Stephan Lake west shore campsite, managed by BLM state office.
- 26: Existing trail, running west from 26a, managed for general public use by ADF&G.
- 27a: Existing Stephan Lake east shore campsite, managed by ADF&G.
- 28: Existing trail, running southeast from 27a.

- 46a: Existing Stephan Lake north shore campsite, managed by BLM state office.
- 46: Existing trail, running north from 46a to 14, managed by BLM district office and State of Alaska.
- 22d: Existing Fog lakes campsite, managed by ADF&G.
- 22a: Proposed trail, running south from 22d, sponsored by ADF&G.
- 14: Existing Susitna River west (Talkeetna Mountains USGS Quadrangle D-4) campsite, managed by BLM district office and ADF&G.
- 71: Existing Susitna River east (Talkeetna Mountains USGS Quadrangle D-4) campsite, managed by BLM district office and ADF&G.
- 72: Proposed trail, running north from 71, sponsored by BLM district office and BLM.
- 48: Existing general public use trail from Gold Creek to lands south of Devils Canyon.
- 18: Existing general public use trail from Chulitna to lands north of Devils Canyon, managed by State of Alaska and ADF&G.

4.10.2. Current Recreational Use of the Region and Project Vicinity

Recreational use within the Southcentral Region and within the Project vicinity is described below.

4.10.2.1. Regional Recreational Use

As described in the "Socioeconomic, Recreation, Air Quality, and Transportation Data Gap Analysis" (HDR Alaska 2011), outdoor recreation is a key part of the way of life in Alaska. Alaskans participate in wildland recreation at twice the rate of the rest of the country; 96 percent of resident survey respondents said that parks and recreation were important or very important to their lifestyle (ADNR 2009). Alaska offers a considerable amount of space and facilities for outdoor recreation. The state is home to 60 percent of the acreage of the National Park System, the nation's two largest national forests, and the nation's largest state park system (ADNR 2009).

Outdoor recreation in Alaska includes a diversity of activities. In 2009, the Statewide Comprehensive Outdoor Recreation Plan (SCORP) reported that the ten favorite activities Alaskans participate in include hiking, fishing, hunting, snow machining, cross country skiing, camping, biking, OHV riding, skiing and snowboarding, and running. Other popular activities include bird and wildlife watching, walking the dog, backpacking, berry picking, using playgrounds, driving for pleasure and sightseeing, recreational mining, mountaineering, whitewater rafting, spelunking, dog mushing, kayaking, power boating and participating in beach activities (ADNR 2009).

Ownership of outdoor equipment, an indication of the value that Alaskans place on various types of outdoor recreation, increased between 2004 and 2009, according to SCORP. Notably, ownership of ORV/ATV (28.5 percent increase), snow machine (21.3 percent), hunting (17.3 percent), and canoe and raft (14.2 percent) equipment showed the largest increases in ownership (ADNR 2009). Within the Southcentral region, access to recreation areas is primarily along the road system; facilities such as campgrounds, trails, trailheads, cabins, and boat launches are key links that provide access from the road system to more inaccessible lands and recreation areas.

Access to land for recreation is also provided by plane (float, wheeled, or ski) and boat. In addition to recreation by Alaska residents, outdoor recreation also plays a major role in attracting tourists to the state. The number of tourists visiting Alaska is expected to increase at a rate of 10 percent per year in the coming years (ADNR 2006). In the past, the majority of visitors to the Southcentral region and to the MSB, in particular, were independent travelers with interests in camping, fishing, and hiking. In recent years, however, the number of tourists who arrive in Southcentral Alaska on package commercial tours, such as cruise passengers, has been increasing (ADNR 2006). In the MSB this has been due in large part to the opening of 2 large lodges, the Mt. McKinley Princess Wilderness Lodge and the Talkeetna Alaskan Lodge, which opened in 1997 and 1999, respectively. These lodges cater primarily to cruise passengers and have resulted in a more than doubling of the borough's bed tax revenues between 1999 and 2004 (ADNR 2006). Through these lodges, many guests also participate in day "excursions" that include recreation activities such as sightseeing, tours, river rafting, hiking, and sportfishing.

Since the APA Project was first evaluated by FERC in the 1980s, Alaska's population has continued to increase. In 1980, the state had a population of 401,851. The population had increased to 710,231 by 2010. In general, the urbanized parts of the state are growing faster than rural areas, with some rural areas losing population. The MSB has been one of the fastest growing areas in the country in recent years. The 2010 population (88,995) is approximately 50 percent higher than the 2000 population (59,322). The increase in population of the Southcentral region and the MSB in particular has resulted in an increased demand for year-round recreation opportunities and facilities throughout the region (NPS 2006a).

Population growth has also spurred increasing development in the Southcentral region and in the MSB in particular. Land along the Parks Highway has experienced changes in land ownership and use as federal and state land is conveyed to the MSB government, the CIRI, the Mental Health Trust, the University of Alaska, and private landowners. The MSB believes that this growth may have significant impacts on the availability of recreational trails in the area, as few recreational trails have been formally designated and many currently cross private property. As the level of development on private parcels increases, access to many of these trails could be blocked.

The SCORP also evaluated potential recreation needs in the State of Alaska. About 74 percent of respondents were either very or somewhat satisfied with recreation facilities within an hour of their community. In addition, 84 percent of respondents felt that when allocating limited funds, that funds should be spent to maintain present facilities before developing new facilities. The desire to allocate funding toward existing facilities was also highlighted by the fact that the public rated maintaining existing trails, building roadside toilets, and improving the maintenance of existing facilities as the most important recreation needs in the state with 67, 63, and 58 percent, respectively, of respondents ranking these needs as very important. In contrast, just 39 percent of respondents felt that building new parks from existing state land was very important (ADNR 2009).

Despite the abundance of high value recreation lands, some wildland recreation opportunities are in short supply. Facilities such as campgrounds, trails, trailheads, cabins, boat launches, and other facilities are often the critical link between users and otherwise "wild" and inaccessible lands, especially along the road system and in the Southcentral region. In many parts of the state, facilities, even if primitive or limited in number, make the difference between a potential outdoor experience and a reality (ADNR 2009).

In "Recreation and Tourism in South-Central Alaska: Patterns and Prospects" (USFS 2002a) the extent and nature of recreation and tourism activities in Southcentral Alaska were described. The study area extended east and south from the Alaska Range, through the Talkeetna and Chugach Mountains and Prince William Sound, and into the Wrangell-St. Elias Mountains ending at the Canadian border. It encompasses the following places: Kenai Peninsula Borough, Municipality of Anchorage, MSB, and the Valdez-Cordova Census Area. It also encompassed the Project area. The quantitative data sources used for the study included:

- Chugach National Forest recreation use data
- National Park Service use data
- Alaska State Parks use data
- Alaska Visitor Statistics Program reports
- Regional Convention and Visitors Bureau data and studies
- Alaska Department of Transportation traffic counts
- Alaska Department of Fish and Game angler surveys and license data
- Alaska Department of Community and Economic Development business license files
- Alaska Department of Safety vehicle registration records
- Alaska cities and boroughs with sales and bed taxes
- Previous surveys and special studies for specific purposes or clients
- Prince William Sound kayak use database

The Chugach National Forest was found to be heavily used as a scenic resource by motorists and waterborne passengers, and increasingly as a road-accessible playground for fishing, camping, and commercially mediated, motor-assisted recreation. More than half of the time (recreation visitor days) people spent on the Chugach National Forest was spent viewing scenery, wildlife, and fish. Viewing was the most popular activity in all Chugach National Forest ranger districts and had been increasing steadily since 1989. Hiking also seemed to be growing, whereas camping was roughly flat, consistent with capacity constraints. Active sports, such as mountain biking and whitewater rafting, seemed to be growing fastest among summer activities. Special use permit data showed that commercially mediated recreation was occurring increasingly on the forest. Although the overall numbers of clients in activities conducted under special use permits almost doubled between 1994 and 1998, the increase in camping, kayaking, and hiking grew much faster than the overall average. Much of the guided camping activity was linked to sea kayaking. Evidence, particularly from hunting and fishing license numbers, indicated that use of the forest by nonresidents was rising faster than use by Alaska residents. These data were consistent with the perception that nonresidents were "discovering" the forest and spending some of their time on guided land tours. It seemed that facilities built and maintained by the Forest Service operate at, or near, capacity. Although there were some lulls in usage, the facilities were in excess demand during peak months. Forest staff suggested that on some hiking trails and backcountry areas, increased use was displacing users seeking a wilderness experience. Quality of scenery was important to visitors. People surveyed in 1992 and 1995 overwhelmingly reported that they were satisfied with the quality of scenery and considered it essential for a high quality recreation visit.

Primary uses of Denali State Park are camping, hiking, fishing, viewing Denali, canoeing, rafting, river boating, hunting and trapping (ADNR 2006). The primary visitor contact station for Denali State Park is at Byers Lake where there is a visitor and interpretive center for the Alaska Veterans Memorial. Buses from package tour companies usually stop once in Denali State Park, either at one of the viewpoints or at the Veterans Memorial. In 2004, the Veterans Memorial received 54,110 visitors, up from 33,619 visitors in 2003. The number of buses stopping at the visitor center increased as well, going from 853 in 2003, to 1096 in 2004. These dramatic increases could be attributed to the fact that the Denali Viewpoint South was closed until late August 2004 for construction. However, the numbers of tour buses do not include Princess Tours buses. As in Denali National Park and Preserve, most park visitation occurs during the months of June, July, and August. During the winter months, only the two public use cabins at Byers Lake remain open. State Park staff attempt to collect visitor count data whenever possible; however, the numbers can vary widely due to factors such as construction closing a site, or employee/volunteer turnover (formula used to calculate visitor counts at a site changes). Visitor calculations take into consideration the number of vehicles parked at a site, average stay, and average number of people per vehicle. General trends and ranger reports indicate that visitor numbers are steadily increasing at popular state park sites such as the Veterans Memorial and the Kesugi Ridge Trail system, and visitor numbers are predicted to continue to rise as the cruise industry continues to increase their bus traffic into the area. Based on raw data visitor counts provided by the Alaska Division of Parks and Outdoor Recreation, visitation to Denali State Park increased from 399,607 in fiscal year 1990 to 474,699 in fiscal year 1995 for an average annual growth rate of 3.5 percent. From fiscal year 1996 through fiscal year 2003 visitation dropped from 357,472 to 280,262. A variety of factors are at play in accounting for this decline (NPS 2006b):

- There has been a drop in the numbers of independent travelers that drive to Alaska due to the rising cost of gasoline.
- Popular destinations in Denali State Park have had construction projects, resulting in their closing for all or part of the visitor season: Denali View North Campground, the Alaska Veterans Memorial, Byers Lake Campground, and Denali View South.
- Budget cuts reduced the ranger staff in the park from three to one, resulting in a greater dependence upon inconsistent visitor counting by volunteer staff.

While it should be noted that the Division of Parks and Outdoor Recreation considers the reliability of state park visitation data to be questionable except for purposes of providing rough orders of magnitude in regard to visitation levels as well as past trends, general information on Denali State Park visitation includes the following:

- Non-resident visitors to Denali State Park are at least 33 percent of the total visitation, based upon vehicle license plates. This figure does not capture non-residents that fly to Alaska and rent vehicles. This has remained remarkably constant over the last 10 years.
- Peak visitation typically occurs in July.
- Summer visitors (May-August) comprise about 80 percent of the annual visitation to Denali State Park.
- The two developed scenic viewpoints (Denali View South and Denali View North and the Alaska Veterans Memorial) account for about 42 percent of the park's visitation.

- The three campgrounds in the park account for about 42 percent of the park's visitation.
- Backcountry use accounts for at least three percent of the visitation, but lack of consistent backcountry visitor counts keep park managers from having accurate data.
- Backcountry users do not have to register to use Denali State Park.
- Most visitors stop along the Parks Highway within Denali State Park at various pullouts and undeveloped scenic views.

In 1972, when the George Parks Highway opened, visitor use at Denali National Park totaled 88,615. Over the next 12 years visitor use grew at an average rate of 25,000 visitor days per year to a total of 394,426 visits in 1984. Visitation for 2007, 2008, and 2009, respectively was 458,307; 432,301; and 358,040 (NPS 2010). Based on current trends it is expected that the demand for use of Denali will increase by another 250,000 people by the end of the 2007-2017 planning period (NPS 2007).

Because of the general accessibility and minimal regulatory limitations on lands under management of the BLM's Glennallen Field Office, local dependence on these lands has strong ties to utilization of the region's hunting and fishing resources and pursuit of OHV recreation opportunities (BLM 2006). In addition to the resident population, regional urban populations depend upon the planning area to pursue recreational activities. The priorities of the recreation program are public health and safety, resource protection, visitor services, and requests for information and use authorizations. With tourism as a leading industry in the planning area, demand for recreational opportunities and providers for those opportunities will continue to grow. Demand for additional infrastructure and facilities (including interpretation) and commercial recreation opportunities will be a direct result, increasing the need for active management of the recreation resource. Use numbers on the Gulkana and Delta Rivers rose from 736 and 5,979 visitors, respectively, in 1999, to 1,271 and 7,506 visitors, respectively, in 2004. The Glennallen Field Office administers special recreation permits for commercial use recreation activities occurring on BLM-managed lands. Approximately 60 special recreation permits were issued in 2003, a slight increase in the number of permits issued over the previous ten years. These permits were mostly for uses within the Delta and Gulkana National Wild and Scenic River (WSR) areas. Commercial use on the Gulkana River was mainly focused on fishing; use on the Delta River was mainly focused on wilderness camping and paddling. Other permits were issued for heli-ski operations, hunting guides, and competitive events. Areas of concentrated recreational use in the Glennallen Field Office Planning Area include: Delta WSR Corridor Area, Gulkana WSR Corridor Area, Tiekel Area (between Glennallen and Valdez on the Richardson Highway), and the Delta Range Area.

As previously noted, the Parks and Denali highways are recreational amenities. Both packaged tours and independent travelers often drive these roads for pleasure and to view scenery and wildlife. Mountaineering, hiking, dog mushing, snowmobiling, and bicycling are also popular. Travelers use the Alaska Railroad for similar purposes (HDR Alaska 2011).

Traffic volume along the Parks Highway tends to decrease from Wasilla to the entrance to Denali National Park and Preserve. From there, volume tends to increase as the road approaches Fairbanks. Traffic on the Parks Highway can vary significantly depending on time of year, with volumes being much higher during summer than winter (HDR Alaska 2011). As described in the Alaska Department of Transportation and Public Facilities Central Region "Annual Traffic

Volume Report" for 2007-2009 (ADOTPFCR 2010), the annual average daily traffic counts (AADTC) for locations on the Parks Highway in 2007, 2008, and 2009, respectively, were as follows:

- Junction with Palmer/Wasilla Highway – 32,398; 33,420; 34,471
- Junction with Talkeetna Spur Road – 1,680; 1,520; 1,479
- Junction with Denali Highway (Cantwell) – 2,279; 2,193; 1,306
- Junction with Denali National Park Road – 3,364; 3,094; 2,892
- Junction with 28th Avenue (Fairbanks) – 14,710; 14,283; 14,716

The Denali Highway is not maintained in the winter (October 1 to mid-May), and is used primarily to access adjacent lands during summer (mid-May to September 30). As described in the ADOTPF North Region "Annual Traffic Volume Report" for 2007-2009 (ADOTPFNR 2010), the AADTCs for locations along on the Denali Highway in 2007, 2008, and 2009, respectively, were as follows:

- Junction with Richardson Highway – 115; 110; 130
- At Tangle Lakes Campground – 75; 65; 65
- Junction with Parks Highway – 280; 200; 230

Boating on the lower Susitna River is a common recreational and commercial activity. Several companies from Talkeetna, such as Denali River Guides, Mahay's Riverboat Service, and Talkeetna River Guides, advertise boating and fishing tours up river as far as the entrance to Devils Canyon. However, few, if any, go past the entrance to Devils Canyon, as the river is considered non-navigable in this area (HDR Alaska 2011).

In 2010, the Alaska Railroad had a passenger ridership of 405,135 passengers and moved 6.33 million tons of freight. Based on previous trends, passenger and freight volumes are likely to increase in the future. Most of the Alaska Railroad's passenger trips are recreation/tourism-oriented (ARC 2010). Approximately 20 people take the "Hurricane Turn" from Talkeetna to Gold Creek on an average summer weekend. Recreational use of the "Hurricane Turn" is much higher in the summer than in the spring, fall, or winter. However, winter visits to the area are becoming increasingly popular, offering Northern Lights viewing, cross country skiing, dog sledding and snowmobiling trips (Talkeetna/Denali Visitors Center 2007).

4.10.2.2. Recreational Use in the Project Vicinity

Both guided and non-guided hunting occur in the Project vicinity, particularly near Stephan, Fog, Clarence, Watana, Deadman, Tsusena, and Big lakes, as well as many of the smaller lakes. Both lodges and cabins provide field bases for hunters. Big game hunting guides operate guide businesses which use the area. Generally, the businesses provide hunting as well as other activities, including fishing and boating (APA 1985a).

Fishing pressure is currently very light in the immediate vicinity of the Project, due to its remote location. Fishing occurs either as a separate pursuit or in close association with other activities, such as hunting and trapping. Considerable fishing for lake trout, grayling, and salmon occurs in the Stephan Lake-Prairie Creek drainage. Salmon fishing occurs in lower Portage and Chunilna creeks, and in the Indian River. Fishing in Fog, Clarence, Watana, Tsusena, Deadman, Big, and High lakes appears to be associated with other activities, such as hunting, summer cabin use, and mining. There is little stream fishing elsewhere in the Project area (APA 1985a).

Trapping in the Project area occurs mostly on the south side of the Susitna River near Stephan and Fog lakes. Some trapping occurs near Tsusena Creek and Clarence and High lakes. Traps are also set using airplanes in the easternmost portions of the Susitna River valley (APA 1985a).

The ADF&G maintains harvest data and other information required for management of wildlife game species in the Nelchina Public Use Area. Available information for Management Unit 13 (Nelchina-Upper Susitna) and Subunit 13E (Upper Susitna River), which include the Susitna-Watana Project area, includes that pertaining to black bear, brown bear, caribou, Dall sheep, furbearers, moose, and wolf. This information is summarized below.

Black bears are numerous in portions of Unit 13 with suitable forest habitat. Field observations and harvest data indicate that black bears are abundant in large portions of Subunit 13E. There is no closed season in Unit 13, and the bag limit is three per year. Hunting of black bears over bait is allowed in spring. Harvest data have been available since 1973, when the sealing of black bears became mandatory. Black bear harvest in Unit 13 averaged 67 per year during the 1970s, 81 per year during the 1980s, and 93 per year during the 1990s. The reported harvest of black bears during the 2003-2004 season was 123 bears. The increasing harvest trend shows black bears are gaining in status as a desirable big game animal, and black bear hunting is more popular than in the past. Non-residents took 26 (21 percent) black bears in Unit 13 during 2003-2004. Successful black bear hunters spent an average of 4.5 days in the field in 2003-2004. Among successful 2003-2004 hunters in Unit 13, highway vehicles (32 percent) and boats (21 percent) were the most popular methods of transportation (ADF&G 2005a).

Density estimates for brown bears in the previous Susitna Hydroelectric Project study area of Subunit 13E in 1985 and 1995 were 18.75 and 23.31 independent bears/1,000 square kilometers, respectively. The average annual brown bear harvests in Unit 13 for the decades of the 1960s, 1970s, 1980s, and 1990s were 39, 59, 105, and 113, respectively. Interest in brown bear hunting and yearly harvest by recreational hunters increased over the years as seasons were lengthened and bag limits increased. Liberalization of brown bear hunting regulations started in 1980 with the initiation of a spring season. The bag limit in Unit 13 was increased to one bear a year between 1983 and 1988 and again starting in 1995. Brown bear harvests have been the highest in those years when the bag limit has been one bear per year and the resident tag fee waived. The reported 2005-2006 harvest of brown bears in Unit 13 and Subunit 13E was 135 and 54, respectively. More brown bears have been reported harvested from 13E over the years than any other subunit. Non-residents took 32 (24 percent) brown bears in Unit 13 during 2005-2006. The high cost of guided hunts appears to be limiting participation by most non-residents. Successful hunters average 4.4 days in the field in 2005-2006. Successful non-residents tend to spend about two more days in the field to take a bear than residents. The most important method of transportation for brown bear hunters in Unit 13 during 2005-2006 was four-wheelers (OHVs). Unit 13 has many far-reaching trail systems that are ideally suited to four-wheeler transportation during fall hunting season. Aircraft and highway vehicles are consistently important, while snow machine use is highly variable and dependent on snow conditions during the spring season (ADF&G 2007a).

The Nelchina caribou herd has been important to hunters because of its proximity to Anchorage and Fairbanks. Accessibility to human population centers makes the herd particularly vulnerable to overharvesting. Starting in 1977, hunting the Nelchina herd was limited by a drawing permit system with a fall hunting season and since then, all hunting of Nelchina caribou has been controlled by permits. From 1959 (the first year of statehood) to 1971 there was an annual average of 4,233 hunters, and from 1972 through 1984, there was an annual average of 1,442 hunters. For 1972 through 1984, harvests by all Alaskans averaged 779 animals. Harvest gradually increased, along with herd size, especially in the late 1980s and early 1990s. From 1985-1987, harvests by all users (subsistence and non-subsistence) of Nelchina caribou averaged 3,127, with a low of 958 (1986) and a high of 5,628 (1996). From 1998-2009, the average annual harvest by all hunters was 1,795 caribou. The Nelchina caribou herd is probably the only herd in the state with over 30,000 animals that can have its upper population limit controlled solely by human harvests. If the herd can be stabilized at 35,000-40,000, the projected annual harvests are expected to be about 3,000-4,000 caribou each year (ADF&G 2010). For subsistence hunters between 2002 and 2004, four-wheelers were the predominant method of transportation, followed by highway vehicles, boats, and snow machines. Highway vehicles have been the most important transportation method in the Unit 13 federal subsistence hunt (ADF&G 2005b).

Dall sheep harvest in the Talkeetna Mountains and Chulitna-Watana Hills (TCW, which includes Subunit 13E) is limited to adult rams. Since 1989 hunters have been allowed to harvest only full-curl (horn) rams in the TCW area. The estimated population of Dall sheep in the TCW increased from 2,000-2,500 in 1994 to 2,500-3,000 in 1999. A severe winter in 1999-2000 decreased the sheep population about 40 percent. Surveys from 2000-20001 and 2003-2004 indicated the population was recovering. The hunting season in the TCW for regulatory years 2004 through 2006 was August 20-September 20. The bag limit was one ram with a full-curl horn or larger. Hunter harvest in the TCW averaged 55 rams during 2004-2007, lower than the average harvest of 65 rams during 2001-2003 and much lower than the average of 82 rams from 1990-2000. The total number of hunters has decreased steadily. Non-residents were more successful than residents. Non-residents accounted for 14 percent of hunters, but took 47 percent of sheep during 2004-2006. This higher success rate was because non-residents are required to have a guide, and they more often use aircraft to access remote areas than residents. Most successful hunters reported using aircraft or four-wheelers to access their hunting areas (ADF&G 2008a). The Jay Creek mineral lick is frequented by Dall sheep. Peak sheep use of this mineral lick is in May and June (APA 1985b).

Historic harvest data are limited for furbearers in units 11 and 13 (Nelchina and Upper Susitna Rivers, Wrangell Mountains) prior to the initiation of sealing requirements. Wolverine and beaver sealing became mandatory in 1971, followed by lynx and land otter in 1977. Beavers and land otter are considered relatively abundant in both units 11 and 13. Lynx numbers have rebounded from the low point in 2002-2003, following a ten-year cycle that mimics that for hares. Wolverines are considered common in the more remote mountainous regions of units 11 and 13, and remain relatively scarce at lower elevations. Marten numbers appeared to peak about 1988 and have been fluctuation annually since. Coyotes are relatively abundant throughout units 11 and 13, and are commonly found in river bottoms and creek drainages. Fox and muskrat are found in both units. The beaver hunter/trapper harvest in Unit 13 from 2003 – 2006 was variable, and averaged 234 per year. Average annual land otter harvest was 39 in Unit 13 for this same period. Lynx harvest in Unit 13 increased annually between 2002 and 2006, suggesting that the population may peak again in 2008. The wolverine harvest in Unit 13 remained relatively stable between 1985 and 2006, averaging 35 per year. Harvest data for other species noted above are not available. The transport method most used by successful trappers during the 2003-2006 period was snow machine. Beaver trappers in Unit 13, however, used a wide variety of transportation methods. Other common transport methods were airplane, dog sleds, snowshoes, skis and highway vehicles. Trapping in Southcentral Alaska has become more of a weekend/recreational activity, compared to the long-line/commercial activity seen during the 1970s and 1980s. Much of the trapping (30 percent) occurs along the roadside. Many trappers in units 11 and 13 begin to pull sets by late January, as recreational snow machine activity increases (ADF&G 2007b).

Historically, Unit 13 has been an important area for moose hunting in Alaska. Annual harvests were large, averaging more than 1,200 bulls and 200 cows during the late 1960s and early 1970s. Hunting seasons were long, with both fall and winter hunter hunts. As moose number began to decline, harvests were reduced by eliminating hunts and changing bag limits. During the 1990s the harvest declined, and reached a low of 468 in 2001. Between 2002 and 2007 the population in Unit 13 steadily increased. The BLM implemented a subsistence moose hunt on federal land in 1990. This is a very popular hunt for Unit 13 and Delta Junction residents with more than 1,000 permits issued in most years. The amount of federal land open for this hunt is extremely limited, accounting for less than two percent of the moose habitat in Unit 13. The non-resident moose hunting season was closed in 2002. The success rate for moose hunters in the Unit 13 general hunt was 17 percent in 2006, up from 13 percent in 2001. Hunting effort remained steady in the general hunt during the 2005-2007 period, averaging 7.4 days per hunter for successful hunters and 7.6 days for unsuccessful hunters. The last two weeks of the season accounted for more than 60 percent of harvest between 2001 and 2007. This pattern is predictable, because moose are more vulnerable later in September. Leaf fall starts to occur at this time, bull movements increase, and onset of the rut increases the effectiveness of calling. Four-wheelers have been the most important method of transportation, accounting for 71 percent of the total moose harvest in 2006 (ADF&G, 2008b).

Wolf numbers in Unit 13 were low from about 1900 until the early 1930s, reflecting corresponding low prey densities. Wolf numbers increased after this period, and by the mid-1940s wolves were considered common. As a result of predator control between 1948 and 1953, wolf numbers declined dramatically. Following the cessation of wolf control, numbers increased rapidly. Beginning with statehood in 1959, the wolf season was closed in Unit 13 for a five-year period. In 1965, a short season was held. During the late 1960s, seasons were established that approximated current dates with no bag limits. In 1971, mandatory sealing was established and aerial shooting without a permit was prohibited. Between 1971 and 1991, an annual average of 91 wolves were sealed in Unit 13. Harvest increased through the mid-to-late 1990s, averaging 155 wolves per year. Wolves are harvested under trapping and hunting regulations. Trapping season runs from October 15 until April 30. Hunting season runs from August 10 until April 30 with a bag limit of 10 wolves per day. Hunters and trappers harvested 223 wolves in Unit 13 during the 2001-2002 season. Four non-residents took four wolves, 25 local residents took 84 wolves, and 41 non-local residents took 135 wolves. February had the highest reported wolf harvest, but there was little difference between all the mid-winter months. The change in harvest chronology between years probably reflects changes in snowfall and temperature, which influences access and trapping conditions. In recent years, use of snow machines has surpassed using aircraft as the most important method of transportation. This changes occurred not only because it became illegal to take wolves same-day-airborne, but because of improvements in snow machines. As a result, trappers and hunters are able to penetrate further into remote portions of Unit 13 (ADF&G 2003).

The Upper and Middle Susitna River has received attention for whitewater boating recreation. The rapids of Watana Canyon are rated as Class IV and are considered dangerous even for experienced boaters. The rapids of Devils Canyon have been called the "biggest whitewater on the continent and some of the biggest ever run in the world" and the "Mount Everest of kayaking". The rapids of Devils Canyon are rated as Class VI at water flows that have been successfully run; the first successful kayak run of Devils Canyon was recorded in 1976 (HDR Alaska 2011). Because of the extreme challenge that the rapids present, few kayakers are known to have attempted to run Devils Canyon.

No use information is currently available for Stephan Lake Lodge, for RS trails in the Susitna-Watana Project vicinity, or for CIRI lands.

4.10.3. Recreation-Related Goals and Needs

Recreation-related goals and objectives, contained in various state and local planning documents, are described below.

4.10.3.1. Alaska State Comprehensive Outdoor Recreation Plan

As part of its 2009-2014 SCORP planning effort, the ADNR Division of Parks and Outdoor Recreation (DPOR) posted an online survey for the general public, park professionals, and youth (ADNR 2009). Also, a telephone survey was conducted during April 2009. Information from a mail survey of recreation providers and the general public was collected in spring 2009. Five public meetings were held throughout the state. The online youth survey was taken by students at several different school districts. Through a contract with an Alaskan research firm, households throughout the state were contacted and surveyed by telephone. Respondents were questioned about their outdoor recreation activities and preferences, and their attitudes towards revenue generating programs to fund recreation facilities and programs. In addition to presenting the SCORP at public meetings, the ADNR DPOR mailed 165 surveys to many of Alaska local government's recreation professionals. The survey asked outdoor recreation providers to identify the most significant outdoor recreation needs of their community and regional area.

The biggest difference between regions is the level of satisfaction with facilities. Southeast residents registered the highest level of satisfaction, followed by Railbelt (where the Susitna-Watana Project area is located), then rural (all areas other than the Southeast and Railbelt). This is a shift from the last survey where the Railbelt residents had the highest level of satisfaction with southeast being second. The most common reason for dissatisfaction among rural residents is the shortage or absence of recreation facilities within their community or within an hour's traveling time. However, before developing new facilities, all three regions overwhelmingly support improving the maintenance of existing facilities (Railbelt 72.5 percent, Rural 86.2 percent, and Southeast 74.4 percent).

Southeast residents are the strongest supporters of non-motorized trails, more picnic areas, and an expanded cabin system. Railbelt residents, which make up 73 percent of the state's population, are the strongest supporters of more trailheads, recreational vehicle (RV) campgrounds, new parks from private land and state land, and an increase in law enforcement in the parks. Rural residents were the strongest supporters of more facilities for the disabled, boat launches, off road vehicle trails, roadside toilets, RV dump stations, more recreation programs, more visitor centers, and improved maintenance of existing parks.

Rural residents stated that the facilities are crowded when they go to use them but they also stated that there are enough parks.

Rural residents are almost twice as likely as Railbelt residents to own powerboats and are more likely to own hunting equipment, fishing equipment, ORV/ATVs, and snow machines. Railbelt residents are considerably more likely than others to own bicycles and ski equipment and for the first time dog teams at an almost two to one ratio over the rural residents. Southeast residents have more sea kayaks than the Railbelt and rural areas combined. Sport fishing is the favorite activity of southeast and Railbelt residents. Sport hunting, also an important subsistence activity, is the favorite activity among rural community residents.

Issues, goals, and recommended strategies identified in the 2009-2014 SCORP are as follows:

- Lack of Adequate Funding
- Tourism and the Economy
- Improved Access to Outdoor Recreation Resources
- Opportunities to Meet Recreation Needs in Communities

4.10.3.2. Susitna Matanuska Area Plan, 2010 Public Review Draft

The following recreation-related goals and management guidelines are contained in the Susitna Matanuska Area Plan (SMAP) Public Review Draft (ADNR 2010b).

Recreation Opportunities Goal: Lands will be provided for accessible outdoor recreational opportunities with well-designed and conveniently located recreational facilities. In addition, undeveloped lands should be provided for recreation pursuits that do not require developed facilities.

Management guidelines to achieve the recreation opportunities goal are as follows:

- Coordinate with Other Landowners and Users of an Area.
- Identify Roles of Different Public Land Owners in Providing Public Recreational Opportunities.

- Public Use Sites. Uses that adversely affect public use sites or areas should not be authorized**.**
- Private Commercial Recreation Facilities and Operations on State Land. If authorized, these uses should be sited, constructed, and operated in a manner that minimizes conflicts with natural values and existing uses.
- Commercial Recreation Leasing Processes. Given the broad scope of the SMAP, the determination of particular sites is impractical, although such uses are generally appropriate within most plan designations.
- Permits, Easements, and Leases Adjacent to Recreation Facilities. May be issued, based upon manager's determination.
- Management of Recreation Use on State Lands. ADNR is to enable a variety of uses and vehicle types, while minimizing fish and wildlife impacts and avoiding user conflicts.
- Consultation with ADF&G. To take place where important species or habitats are likely to occur.

Public Access Goals: 1) Preserve, enhance, or provide adequate access to public and private lands and resources. Provide for future trail and access needs, and protect or establish trail corridors to ensure continued public access consistent with responsible wildlife and fish habitat conservation. 2) Ensure adequate opportunities for the public's use of public resources of local, regional, and statewide significance.

Management guidelines to achieve the public access goals are as follows:

- Reservation of Public Use Easements. Before disposing of land, ADNR will reserve easements pursuant to the requirements of Alaska Administrative Code.
- Retain Access where Appropriate. Improve or preserve access to areas with significant public resource values.
- Provide Access to Non-State Lands. Reasonable access will be provided across state lands to outer public and private land.
- Ensure Management of Alaska Native Claims Settlement Act (ANCSA) 17(b) Easements. The state will identify new 17(b) easements and ensure that public access is maintained to existing 17(b) easements.
- Provide Access for Development. When an access route is constructed over state land, public access should generally be maintained.
- Limit Access where Appropriate.
- Coordinate with Borough Recreational Trails Plan.
- Consult with ADNR South Central Regional Office (SCRO) and Division of Mining, Land, and Water.
- Site and Construct Temporary and Permanent Roads or Causeways to Avoid Environmental Impacts.
- Protection of the Environment.
- Joint Use and Consolidation of Surface Access.

4.10.3.3. Matanuska-Susitna Comprehensive Development Plan, 2005 Update

As described in the MSB Comprehensive Plan, 2005 Update (MSB 2005), the Borough maintains a large number and diversity of parks, campgrounds and recreational areas. As the Borough's population continues to grow, the demand for various year-round passive and active recreational opportunities increases. The Borough should accommodate such demand with the following goals and recommendations:

Goal (Parks and Open Space, PO-1): To acquire, develop, and redevelop a system of parks, recreation facilities, community centers, and open spaces that is safe, functional, and accessible to all segments of the population.

> Policy PO1-1: Acquire parks, community centers, recreation, and open space facilities in those areas of the Borough facing population growth, commercial development, and in areas where facilities are deficient.
>
> Policy PO1-2: Develop pedestrian and bicycle linkages between schools, public facilities, neighborhoods, parks and open spaces and population centers where feasible.
>
> Policy PO1-3: Ensure adequate maintenance and operation funding prior to development of parks and recreational facilities.
>
> Policy PO1-4: Ensure that parks and open spaces are provided using the following standards to determine the need for parks: 5 acres of neighborhood parks/1,000 persons; 10 acres of community parks/3,500 persons; 15 acres of nature and open space parks/5,000 persons.
>
> Policy PO1-5: Actively promote through various land use techniques the preservation of agricultural land.

Goal (PO-2): Protect and preserve natural resource areas.

> Policy PO2-1: Work cooperatively with numerous resource management agencies, community councils, and citizens to care for lakes, wetlands, streams, rivers, and wildlife habitat and corridors while providing public access for recreational opportunities that have minimal impacts to such areas.
>
> Policy PO2-2: Preserve opportunities for people to observe and enjoy wildlife and wildlife habitats.
>
> Policy PO2-3: Identify, through analysis, potential natural resource areas throughout the Borough that should be protected.

4.10.3.4. East Alaska Resource Management Plan

The East Alaska Resource Management Plan (EARMP) replaces the Southcentral Management Framework Plan approved in 1980 and is now the base land use plan for public lands administered by the BLM Glennallen Field Office's EARMP Planning Area. The overall recreation goal for this planning area, which surrounds the Project area, is to "manage recreation to maintain a diversity of recreational opportunities" (BLM 2006).

Five Special Recreation Management Areas (SRMAs) are designated in the EARMP. These areas are managed with the specified recreational emphasis:

- Delta Wild and Scenic River Corridor Area.
- Gulkana Wild and Scenic River Corridor Area.
- Denali Highway Area.
- Tiekel Area.
- Delta Range Area.

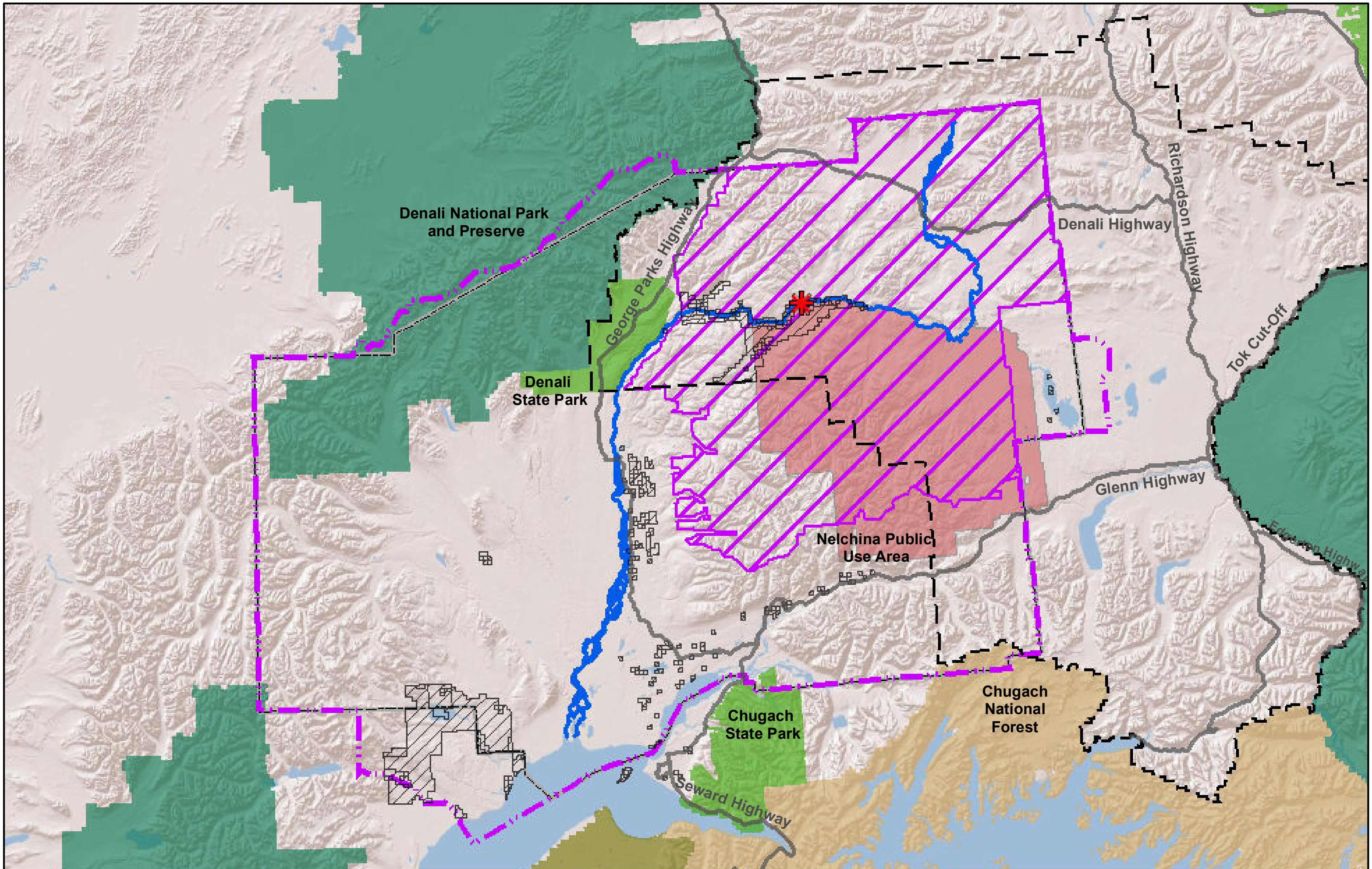
Areas outside those identified above are managed as Extensive Recreation Management Areas, with existing ROS classes maintained. Inventory and monitoring could occur and standards may be identified for trail density in these areas based on monitoring and inventory information. Some education/interpretation at trailheads may occur, particularly at 17(b) easement trailheads within these areas.

4.10.3.5. Susitna Area Plan

The Susitna Area Plan (ADNR 1985) is a land use plan for public lands in the Susitna Area. The plan designates the uses that are to occur on much of the public land within the Susitna Area (Figure 4.10-4), which covers approximately 15.8 million acres in Southcentral Alaska. Much of the land in the MSB is included in the planning area. The Project area is in the Susitna Area Plan's "Talkeetna Mountains" Subunit (11). This subunit encompasses roughly 6 million ac, the majority of which is publicly owned. The Nelchina Public Use Area (see below) lies within this subunit. Recreation goals and management guidelines included in the plan include:

- Resource protection;
- Economic development;
- The role of different public land owners in providing public recreation opportunities;
- Public use cabins;
- Private recreation facilities on public land; and
- Promotion of underutilized areas.

The Talkeetna Mountains portion of the Susitna Area Plan described recreational opportunities associated with the proposed Project.



Legend

- Proposed Watana Dam and Powerhouse
- Highway
- Susitna_River
- Susitna Area Plan Boundary
- Talkeetna Mountains Subunit
- CIRI Lands (Patented and Interim Conveyed)
- BLM East Alaska Resource Management Planning Area
- State Park
- National Park
- National Forest
- National Wildlife Refuge
- Public Use Area

N

0 10 20 40
Miles

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.10-4

Susitna Area Plan Boundaries

4.10.3.6. Nelchina Public Use Area

As described in the Nelchina Public Use Area Fact Sheet (ADNR 2000) the area is managed, in part, to:

- Protect fish and wildlife habitat, particularly caribou calving areas, trumpeter swan nesting areas, and other important habitats for moose, Dall sheep and brown bear so that traditional public uses of fish and wildlife populations may continue;
- Perpetuate and enhance public enjoyment of fish and wildlife and their habitat including fishing, hunting, trapping, viewing, photography;
- Perpetuate and enhance general public recreation in a quality environment;
- Perpetuate and enhance additional public uses described in the Susitna Area Plan; and
- Allow additional public uses of the area in a manner compatible with the purpose specified above.

4.10.3.7. Cook Inlet Region, Incorporated

Visitors may access and use CIRI land on a limited basis with written permission. Guides, hunters and anglers, campers, tour operators, photographers, scientists, dog mushers and other outdoor enthusiasts are encouraged to respect CIRI land and contact the CIRI Land and Resources Department to learn more about land use policies (CIRI 2011).

4.10.4. Protected River Segments

Twenty-five Alaskan rivers and over 3,200 river mi are protected under the National Wild and Scenic River designation. Additionally, there are six legislatively designated State Recreation Rivers, encompassing 460 river mi and 260,000 upland acres (ADNR 2009).

The Tangle Lakes and Tangle River area, accessible from the Denali Highway northeast of the Susitna-Watana Hydroelectric Project area, has been designated as part of the Delta National Wild and Scenic River.

The EARMP (BLM 2006) planning team conducted a wild and scenic river eligibility review for the planning area. The Susitna River from the headwaters to the confluence of Kosina Creek (which is located within the proposed Susitna-Watana Project boundaries) was considered. This is a glacial, free flowing river that is accessible from the Denali Highway. Jet boats go up through the East Fork. Boating occurs from the highway crossing downriver to the Maclaren River and upriver on the Maclaren to the Denali Highway. It is also possible to continue down the Susitna River to the Tyone River, upriver on the Tyone and out through Lake Louise. This river and adjacent lands provide a diversity of recreational opportunities. The river is road accessible and the potential exists for several different semi-primitive motorized experiences. In the vicinity of the Denali Highway, there are numerous opportunities to access the river for short day hikes or simply viewing the river from the highway for a roaded-natural experience. Opportunities certainly still exist for quality primitive experiences along the river corridor. This portion of the Susitna River was tentatively classified as “Scenic”. It is free of impoundments, with shorelines still largely undeveloped. Exception in this segment is where the river is crossed by the Denali Highway. In the area of the Denali Highway crossing, the river is also paralleled for a short distance by the Valdez Creek road. South of the Denali Highway, the river is paralleled at a distance by the Susitna South OHV trail, but this trail does not access the river. Powerboat use occurs on the river and is a traditional and established use.

No designations or tentative classifications apply to the Susitna River in the vicinity of the Project area.

4.10.5. National Trails System and Wilderness Areas

The Iditarod Trail Sled Dog Race is run along or near the formal 418-mile long Iditarod National Historic Trail. Mushers and teams cover the 1,000-1,100 mi between Anchorage and Nome in 9-15 days. Beginning on the first Saturday in March, the race is the most popular sporting event in Alaska. The race crosses the lower Susitna River on the Historic Trail near the Town of Susitna.

Approximately 1.9 million acres of Denali National Park and Preserve were designated a wilderness area in 1980.

No national trails system or wilderness area lands are located in the vicinity of the Project area.

4.10.6. Shoreline Buffer Zones and Adjoining Land Uses

The shoreline of the Susitna River and its tributaries in the vicinity of the proposed Project is steep, rocky, and covered with mixed woods and tundra. Areas adjacent to the shoreline are owned by the CIRI. These lands, and those managed by the BLM’s Glennallen Field Office and the ADF&G’s Nelchina Public Use Area that surround it on the north and south, are undeveloped (covered with mixed woods and tundra) and suitable for use as a shoreline buffer zone.

4.10.7. Land Uses and Management

Recreational uses and management in the Southcentral region and Project area are detailed above. Additional uses and management of these lands are described below.

4.10.7.1. Regional Land Uses and Management

Land ownership in Alaska is complex and in transition. Under terms of the 1959 Alaska Statehood Act, the State of Alaska is authorized to receive over 103 million acres of land from the federal government. To date, the state has received about 89.5 million acres of this land (ADNR 2009).

Signed into law in 1971, the Alaska Native Claims Settlement Act (ANCSA) won a unique settlement from the United States for Alaska’s Native population. The act extinguished aboriginal land claims, provided for formation of 13 regional, four urban, and 200 village ANSCA corporations, and transfer of 44 million acres of land from federal to Native corporation ownership. State and ANCSA conveyances have not been completed. The federal government (Bureau of Land Management) owes ANCSA corporations about 9 million acres and owes the state about 16 million ac. Many of these remaining claims are in conflict and will require many years to resolve. Various selections cannot be completed until actual land surveys are done, which will also take many years. Upon completion of the conveyance process, the state's largest landowner will remain the federal government, with about 220 million acres or 60 percent of Alaska. The state will own 28 percent, ANSCA corporations 11 percent, private (non-ANCSA Corporation) one percent, and municipalities, less than one percent (ADNR 2009).

The Southcentral region extends from the hydrographic divide of the Alaska Range on the north to the MSB boundary on the west, Kodiak Island on the south, and the Alaska/Canada border on the east. It abounds with ocean shorelines, freshwater lakes, free-flowing rivers, massive mountains, wildlife, and glaciers. The diversity of landscapes and natural resources offer a wide variety of outdoor recreational opportunities. The Southcentral region contains a more developed transportation system than other portions of the state. Paved highways and gravel secondary roads provide access to many of the cities and villages in the region. Use of planes to reach areas not accessible by road is also prevalent. The Alaska Railroad and ferry systems also serve portions of the Southcentral region.

The Southcentral region includes the George Parks Highway, the Denali Highway, and the Alaska Railroad. The George Parks Highway (numbered Interstate A-4 and Alaska Route 3) runs 323 mi from the Glenn Highway 35 mi north of Anchorage to Fairbanks in the Alaska Interior. The highway was completed in 1971. The highway, which mostly parallels the Alaska Railroad, is one of the most important roads in Alaska. It is the main route between Anchorage and Fairbanks (Alaska's two largest metropolitan areas), the principal access to Denali National Park and Preserve and Denali State Park, and the main highway in the Matanuska-Susitna Valley.

Most residential, commercial, agricultural, transportation and utility land use development occurs in and around Parks Highway communities and along rural sections of the Parks Highway west of the Project area. That is, small towns such as Willow, Talkeetna, Cantwell, and Healy have a mix of residential and commercial land, and transportation lands for the highway, other roads, railroad, and airstrips. Other scattered residential lands occur in agricultural, homestead or other settlements along the highway, near the railroad or area rivers (APA 1985a).

The Denali Highway is about 135 mi long and connects the Cantwell junction (located just north of Broad Pass) on the Parks Highway with Paxson Lodge on the Richardson Highway. A loop trip originating and returning to Fairbanks is about 436 mi. A loop trip from Anchorage is close to 600 mi. The Denali Highway is generally open from mid-May to October 1.

The Alaska Railroad extends from Seward and Whittier, in the south, to Fairbanks (passing through Anchorage), and beyond to Eielson Air Force Base and Fort Wainwright in the interior of that state. The Alaska Railroad carries both freight and passengers throughout its system. The railroad has a mainline over 470 mi long, and is well over 500 mi long when branch lines and sidings are included. It is currently owned by the State of Alaska.

The Chugach National Forest, located south and east of Anchorage, surrounds Prince William Sound. This 5.4 million acre forest includes the Kenai Peninsula, the Russian River, and the delta of the Copper River. The Chugach National Forest Revised Land and Resource Management Plan (USFS 2002b) sets forth the direction the Chugach National Forest will follow in the future management of lands and resources within its boundaries.

Denali State Park is approximately 324,240 acres in size. The State Recreation Areas include an additional 1,470 ac. Although much smaller than Denali National Park and Preserve to the north (6,028,203 ac), Denali State Park and its associated State Recreation Areas are very diverse area. They afford tremendous views of Denali; contains three major rivers, the Susitna, Chulitna, and Tokositna; and have three glaciers adjacent to or within its boundaries, the Ruth, Eldridge and Tokositna. Vegetation ranges from lowland spruce and hardwood forests to alpine tundra. The George Parks Highway transects the park and opens its scenery, wildlife and other natural resources to the public.

Primary uses of the park are camping, hiking, fishing, viewing Mt. McKinley, canoeing, rafting, riverboating, hunting and trapping.

The proposed Project is within the northwest corner of the BLM's Glennallen Field Office Planning Area. The planning area includes approximately 7.1 million acres in east Alaska, including approximately 5.5 million acres of lands that are selected by the State of Alaska or Alaska Natives. The BLM is responsible for management of selected lands until conveyance occurs or until the selections are relinquished back to the BLM because of over selection. The planning area also includes private land (including Native Corporation land), state land, and lands managed by other federal agencies. Management measures outlined in the BLM's EARMP (BLM 2006) apply only to BLM-managed land in the planning area; no measures have been developed for private, state, or other federal agency lands. The BLM prepared this Resource Management Plan and Final Environmental Impact Statement (EIS) to provide direction for managing public lands within the Glennallen Field Office boundaries.

4.10.7.2. Project Area Land Use and Management

The Susitna Area Plan (ADNR 1985) is a land use plan for public lands in the Susitna Area. The plan designates the uses that are to occur on much of the public land with the Susitna Area (Figure 4.10-4), which covers approximately 15.8 million acres in Southcentral Alaska. Much of the land in the MSB is included in the planning area.

The Project area is in the Susitna Area Plan's "Talkeetna Mountains" Subunit (11). This subunit encompasses roughly six million ac, the majority of which is publicly owned. The Nelchina Public Use Area (see below) lies within this subunit. In addition to private lands held by ANSCA corporations there are also numerous, scattered small parcels owned by private individuals. These holdings are generally of two types: state offered open-to-entry sites adjacent to recreational fly-in lakes; and federal, patented mining claims. The Talkeetna Mountains Subunit is managed as a multiple use area emphasizing recreation (including hunting and fishing), protection of fish and wildlife habitat, and mining. Most of this rugged, mountainous area is to remain remote and very sparsely developed. Additional road access and concentrated settlement on public lands will be contingent on a demonstrated need for such development in order to facilitate activities such as mining or dam construction. The Talkeetna Mountains portion of the Susitna Area Plan described the recreational opportunities associated with the proposed Susitna Hydroelectric Project.

The Nelchina Public Use Area covers about 2.5 million acres in the Talkeetna Mountains of Southcentral Alaska. The Public Use Area was established by the Alaska legislature in 1985 and is managed by the ADNR Division of Mining, Land, & Water. The Nelchina Public Use area is the biggest legislatively designated area on state land in Alaska. It is an outstanding area for hunting, fishing, recreation, and mining. The vast area is home for the Nelchina Caribou herd, the third largest caribou herd in Alaska. It also supports important populations of trumpeter swans, moose, Dall sheep, and brown bear. The Susitna River forms the northern boundary of the Nelchina Public Use Area, and portions of the Susitna-Watana Project area located south of the river are within its boundaries. These areas are located within the Susitna Area Plan's Talkeetna Mountains Subunit (11).

The Nelchina Public Use Area is managed for multiple uses. The broad array of activities that have taken place on these lands continues to be allowed. Guidelines were adopted in the ADNR's Susitna Area Plan (see discussion above) to maintain or enhance the special values of this area and to ensure that the variety of public uses occur compatibly. The guidelines set by the area plan cover mineral exploration and development in caribou calving areas during the calving season (May 1 to June 15). Guidelines also address road construction throughout the area.

The SMAP Public Review Draft (ADNR 2010b) establishes the land use designation for state land within the Susitna Matanuska Area and describes their intended uses. The plan directs which state lands will be retained by the state and which should be sold to private citizens, used for public recreation, or used for other purposes. It also identifies general management guidelines for major resources and land uses within the planning area, as well as guidelines for the development and use of resources for specific parcels. The Project area is located within the SMAP "Talkeetna Mountains" Region. Most lands in this region are managed for wildlife habitat, water resource, and public recreation values. All state land within this region is to be retained. This region is not considered appropriate for grazing, commercial timber harvest, or remote settlement – given its inaccessibility and unsuitable terrain. Locatable mineral exploration and development is appropriate within general domain land as well as within the Nelchina PUA, but any such activity must ensure that the numerous mineral licks are avoided or proper mitigation is provided.

The MSB Comprehensive Plan, 2005 Update (MSB 2005) provides general goals and policy recommendations to help guide future development in order to enhance our quality of life and the public health, safety, and welfare.

Land use goals and policies contained in the 2005 Update are as follows:

Goal (LU-1): Protect and enhance the public safety, health, and welfare of MSB residents.

Goal (LU-2): Protect residential neighborhoods and associated property values.

Goal (LU-3): Encourage commercial and industrial development that is compatible with residential development and local community desires.

Goal (LU-4): Protect and enhance the MSB's natural resources including watersheds, groundwater supplies and air quality.

Goal (LU-5): Recognize and protect the diversity of the MSB's land use development patterns including agricultural, residential, commercial, industrial and cultural resources, while limiting sprawl.

Goal (LU-6): New developments greater than five units per acre should incorporate design standards that will protect and enhance the existing built and natural environment.

Goal (LU-7): The MSB should actively limit sprawl through setting appropriate density standards and encouraging residential and commercial development to occur in areas that are centrally located and within close proximity to public and private services.

4.10.7.3. Project Area Wetlands and Floodplains

The Project area is characterized by an isolated subarctic environment comprised primarily of coniferous and mixed forests and low shrubs. Numerous creeks flow into the Susitna River and occasional lakes dot this remote region. Wetland mapping of much of the Alaska was completed as part of the National Wetlands Inventory, conducted by the U.S. Fish and Wildlife Service (USFWS). Federal regulations define wetlands as areas that, under normal circumstances, would support vegetation typically adapted to saturated soils. By this definition approximately one-third of Alaska is wetlands. In the Project vicinity, wetland areas include Brushkana and Upper Deadman creeks, the area between Deadman and Tsusena creeks, the Fog lakes area, the Stephan Lake area, Swimming Bear Lake, and Jack Long Creek (APA 1985a).

The U.S. Army Corps of Engineers (USACE) conducts hydraulic analyses to determine floodplains for the Federal Insurance Program of the Federal Emergency Management Agency (FEMA). Floodplains of interest to the Federal Insurance Program are defined as "the lowland and relatively flat areas adjoining inland and coastal waters, including at a minimum, that area subject to a one percent or greater chance of flooding in a given year". Due to the remote nature of the state, floodplain studies and mapping have occurred only in communities and populated regions. No floodplain studies have been prepared in the middle Susitna basin.

The USACE has mapped the 100-year flood elevation on the Nenana River at the community of Nenana and at Chulitna-on Pass-Creek, a tributary of the Chulitna River. The 100-year floodplain of the Ta1keetna, Susitna, and Chulitna Rivers has been mapped within the townsite of Talkeetna, where flooding has occurred in the past. The floodplain of the Talkeetna River at Talkeetna is wide and developed only on the south side at the mouth of the river. Open spaces in the floodplain are extensive and may come under pressure for future development (APA 1985a).

The Floodplain Information Report for Talkeetna, Alaska, is a basis for the adoption of land use controls to guide floodplain development and prevent loss and damage. Peak discharge for the Intermediate Regional Flood, or the 100-year flood, at Talkeetna is estimated to be 268,000 cfs. Peak discharge for the Standard Project Flood was estimated to be 315,000 cfs. These estimates are for the Susitna River downstream of the confluences with the Chulitna and Talkeetna Rivers (APA 1985a).

Additional information concerning wetlands and riparian areas is contained in Section 4.7 of this document.

4.10.8. Potential Adverse and Positive Impacts

Potential impacts to recreation, land use and land management are described below.

4.10.8.1. Recreation

The potential recreation impacts described below are based on the Project as currently envisioned. Access routes and transmission facility alignments have yet to be finalized. Figure 1-1 depicts the locations of three potential corridors. These corridors have been labeled “Denali”, “Chulitna,” and “Gold Creek." Development of the Project facilities would change the recreational character of portions of the Project area from an undeveloped, remote setting to an area characterized by development and increased human activity. Portions of the Susitna River and adjacent lands would be altered.

Temporary recreation impacts could be generated by construction personnel, traffic, materials, staging areas, the worker camp, and noise. The Project would 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.

As described in the 1985 FERC License Application (APA 1985a), hydroelectric development would have both direct and indirect impacts on existing recreation patterns. Direct impacts are those that result from physical changes to the existing recreation settings. Impacts to these settings might either increase or decrease the desirability and probability of continued recreation use. They may also make new types of activity possible. Indirect impacts are those resulting from changes in recreation use of the Project area, including increased demand associated with construction workers and the general public.

Construction and operation of the Project would impact recreation resources by increasing activity, altering portions of the Susitna River and adjacent land, and restricting or increasing access. These activities would result in changes in the nature of the recreation experience, changes in hunting or fishing opportunities, and/or changes in other recreation opportunities.

Increased activity in the area would affect fishing and hunting activities by disturbing fish and wildlife and by changing the perceived image of the area from “pristine” to “developed." Increased activity from Project construction and operation could include the presence of workers and their families, the transportation of personnel and materials to and from the site, and the disruption caused by operating heavy equipment in the area. Streams near the construction camp could receive increased fishing pressure from construction workers and their families. Streams such as Deadman Creek could be overfished unless additional management restrictions are instituted. The effects of such activities on fish and wildlife are discussed in more detail in sections 4.5 and 4.6 of this document.

The direct impacts of construction activities extend beyond the areas being physically disturbed. A substantial change would result as the remote character of portions of the area changes to one of heavy construction. This is an unavoidable impact only partially mitigated by careful management of remaining lands.

The development of a temporary construction camp near the proposed dam (a site near the north abutment is currently proposed) would cause short-term and long-term visual impacts. The dam would alter the river for about 39 mi upstream, changing its character from wild, with challenging rapids at Vee Canyon, to a large lake with reduced current.

Improved access would benefit many recreationists by increasing hunting, fishing, hiking, camping, and other opportunities.

Direct impacts that are unmitigatable are the loss of remote character in portions of the Project area and inundation of Class IV rapids at Vee Canyon.

Impacts on fishing would result from creation of the reservoir. Inundation of the lower reaches of clear-water tributaries in the impoundment zone would eliminate existing grayling habitat. Affected tributaries would include Deadman, Watana, Kosina, and Jay Creeks (APA 1985a). The existing level of boating activity in Devils Canyon, downstream from Devils Canyon to Talkeetna, and upstream from the dam site would be largely unaffected during construction. When reservoir filling begins, water levels downstream would decrease slightly during those one or two summer recreation seasons. Based on river navigability studies completed in 1985, this reduction in flow is not expected to appreciably affect river boating or packrafting downstream of the dam.

The dam and reservoir would change existing boating and packrafting patterns on the Susitna River. The reservoir would inundate 39 mi of the 125-mile route between the Denali Highway and the Stephan Lake Portage. During much of the year, the Vee Canyon rapids would be inundated.

The inundated portion of the Susitna River would change in character from a remote and undisturbed river environment with occasional rapids to a flatwater condition. With a loss of current, boaters and packrafters would need manual or mechanical propulsion to navigate the reservoir. Devils Canyon rapids, located downstream, would remain runnable to experts during construction, since flows would be similar to those under natural conditions. These rapids would also remain runnable during Project operation. Boaters desiring to kayak these rapids during construction would need to fly in and hike to the river below the dam site, or, if floating the river, be allowed to portage via the construction area.

Following construction, portions of the land areas associated with the Project would be used for operations. Land not required for operations would be rehabilitated. Rehabilitated areas could be used for recreation.

Once operation of the Project begins, the public may gain access to the area via road. This would increase recreation opportunities.

During operation, the reservoir drawdown would reach its low point in April and May. The reservoir would fill from June through August, reaching its highest point in early September. Lake shorelines exposed during low water would have large silt flats, steep banks, tree stumps, and slumping soils. This would limit the development of the reservoir as a major recreational attraction. Safety would be a concern to boaters or packrafters, since the reservoir's large size may lead to hazardous conditions during periods of high wind (APA 1985a).

Vee Canyon, a notable natural feature located about 38 mi upstream of the dam, would have its Class III rapids inundated seasonally. During typical water years, these rapids, located at approximately elevation 1,950 ft, would be exposed from January through June, approximately 1 month longer than in drier years. As a result, Vee Canyon rapids could still be runnable by boaters in June (APA 1985a).

The impoundment would inundate wildlife habitat. Dall sheep and caribou populations may be affected by construction of Project facilities, but not as much by the reservoir filling (APA 1985a).

New access roads could provide vehicular access into a large area previously open only to ORVs and hikers. The roads would be maintained year-round. If the Denali Corridor is chosen for the permanent access road, this could allow increased access opportunities along the Denali Highway segment which is currently closed each winter by snow.

Road improvements and access into new areas could change existing recreational patterns and recreational resources in several ways. Winter snowplowing along the Denali Highway could cause an increase in winter recreationists using the area for cross-country skiing, snowmobiling, dog sledding, and other winter sports. Denali Highway improvements could also make the area adjacent to the highway more attractive to recreationists during the summer months than it is at present. Increased Denali Highway traffic associated with commuters, truck drivers, and new local residents would introduce other potential users to the recreational opportunities adjacent to the road. Increased recreational activity would likely follow existing patterns and take the form of increased roadside camping in old gravel pits along the road, as well as hunting, fishing, and hiking (APA 1985a).

Access roads and transmission lines would pass through areas that presently have very low levels of recreational activity. Access road and transmission construction activities would affect hunting, fishing, and hiking activities that might have occurred in those areas, and users would be displaced into the surrounding areas.

The presence of transmission towers and cleared corridors would reduce the area's appeal as a remote area. The impacts of the transmission corridors on existing recreation patterns are primarily visual, as discussed previously. Positive impacts would also result, since cleared transmission corridors are commonly used by hunters and hikers.

Indirect impacts would result from the Project as access to and recreational use of the area increase. Recreational use of the Project area would begin rising once the Project is complete. Once the reservoir is filled, obstacles to boat and packraft access such as the Vee Canyon rapids would be inundated, allowing access from upstream via the Denali Highway. Currently, most boaters and packrafters travel only to the Tyone River or to Goose Creek above Vee Canyon, with the exception of the occasional whitewater boaters that continue through the Vee Canyon rapids.

Indirect impacts resulting from increased use would consist of two types: change in the general character and image of the area, and impacts from fishing, hunting, and other recreation activities (APA, 1985a).

An influx of hunters, anglers, hikers, campers, and sightseers could change the character and image of the area from primitive and remote to more accessible and well-used, especially near the access roads and dam site. Entry patterns near Project facilities would change from primarily fly-in to trips dominated by roads and vehicles. The Project would enhance the experience for the user group that accesses fishing and hunting sites via roads. The experience would be adversely affected for the user group that desires a remote fly-in experience. The enhancement of opportunities to users by opening a new area to vehicular access would be greater in magnitude than the adverse impact of the Project to the few existing fly-in users (APA 1985a).

Improved access would increase pressure on some existing fish populations. Fishing pressure on creeks in the vicinity of access roads could increase. Access roads would also provide easier access to and increase fishing pressure in nearby lakes.

Improved access would also increase pressure on game populations. Road access would increase hunting and trapping in areas that were previously accessible, for the most part, only by air. This would substantially increase pressure on species that are not heavily regulated. The Project reservoir would increase access for hunting and trapping, particularly in drainages above the dam such as Watana Creek, Kosina Creek, and Jay Creek. When public access to the reservoir is provided, hunting and trapping via boat and packraft would occur. Float planes would use the reservoir to gain access to adjacent areas for hunting.

Non-consumptive activities might increase a result of the Project. These include camping, hiking, and sightseeing, and could result in minor disruptions to wildlife populations or lead to possibly more needs for emergency services and possibly lead to some conflicts between user groups depending on seasonal use patterns. Disturbances would be greatest near Project recreation facilities, along the access roads and transmission line, and near the dam site. Over time, some wildlife would likely avoid these areas of increased human presence.

4.10.8.2. Land Uses and Management

Land use impacts would result from the construction of the following Project facilities: dams and impoundments, construction camps, recreation facilities, access roads, railhead and permanent transmission line. Some impacts would be temporary, such as with borrow sites which can be reclaimed. Other impacts, such as the inundation of lands covered by the reservoir, would be permanent.

Direct land use impacts would occur on those lands converted from current uses to Project uses. The Project reservoir would inundate approximately 20,000 ac, changing land from forest used for dispersed recreation to reservoir used for hydropower generation and potential recreation.

Additional forest and low shrub land would be temporarily or permanently disturbed for borrow and quarry sites. Placement of construction camps would convert low shrub and mixed forest land to developed community use. In addition, land would be permanently disturbed by road, transmission line corridor and recreation facilities.

Provision of access into the Susitna River basin, an otherwise remote, unroaded area, could result in changes in land uses on surrounding lands. A new, temporary population center would be established at the construction camp (and at the railhead facility). The public could access the area via a road/transmission line route, navigable river routes leading into the reservoir, and by floatplanes landing on the reservoir. New opportunities through use of the reservoir for access to surrounding lands would be opened. An increase in numbers of people would in turn increase recreational and other activity levels and put new harvest, extraction, and development pressures on fish, wildlife, and other natural resources. Current activity patterns would change, and displacement of a small number of resource users such as guides and trappers would follow. As more people are attracted to this area, peripheral commercial and other development would occur, thus stimulating the regional economy. The opportunities for additional roads extending off the access road could encourage mineral and other resource extraction. Land values may be affected. Also, an impetus for more active land management and cooperative agreements between landowners would be created to address such issues as trespassing on private land (APA 1985a).

The Project area has been relatively undeveloped, because of limited access and unfavorable economic feasibility. Without the Project, little change is likely to occur in existing land use or activity patterns. However, in the past, the CIRI and Native Villages have expressed a desire to develop the timber, mineral, and recreational potential of their lands south of the Project area with or without the Project (APA 1985a).

Within the approximate boundaries of the dam and impoundment, there are wetlands of various types, including riverine. The dam, powerhouse, borrow sites, impoundment, and appurtenant facilities would occupy some of these wetlands. The construction camp, access road/transmission line corridor, and airstrip could occupy additional wetland acreage. Potential Project impacts on wetlands are discussed in Section 4.7.2 of this document. Project impacts on designated floodplains cannot be ascertained at this time, because of the lack of data for the Middle Susitna basin. However, extensive Project-related data for the previous APA Project showed that floods up to the 50-year event would be diminished in magnitude on the middle reach of the Susitna River from Devils Canyon Dam to Talkeetna (APA 1985a).

4.10.9. Potential Protection, Mitigation, and Enhancement

Potential PM&E measures for recreation, land use, and land management are described below.

4.10.9.1. Recreation

AEA anticipates preparing a Recreation Plan for the Project in consultation with resource agencies and other interested parties. The following elements may be included in this plan:

- Existing recreation facilities
- Current and future use
- Proposed recreation facilities
- Implementation schedule and estimated costs
- Operations and maintenance
- Future recreation needs
- Consultation

Proposed recreation facilities may include: roads and parking lots, scenic overlooks, directional and informational signage, boat launches, picnic areas, campgrounds, hiking trails, and interpretive exhibits.

Borrow areas created during Project construction would be adaptively reused to create roadside pull-offs, scenic overlooks, picnic areas, and other recreational facilities.

The alignment chosen for the roads and transmission lines would avoid areas of environmental sensitivity to the maximum extent practicable and, therefore, avoid placing undesirable recreation pressure on these areas. Final alignments would also attempt to avoid disrupting areas that are known to be popular existing and potential recreational settings. (APA 1985a).

Access roads, and transmission lines would not be open to the public during construction and may be restricted or limited access after construction. Control points and/or physical barriers would prohibit access during construction to ensure public safety and site security.

Portions of the Denali Highway would possibly be upgraded as part of the Susitna-Watana Project, if the Denali Corridor is selected for road access. These upgrades would benefit recreationists.

4.10.9.2. Land Uses and Management

Potential mitigation measures associated with fish, wildlife, and botanical resources and wetlands affected by the impoundment and other Project-related activities are discussed in Sections 4.5, 4.6, and 4.7 of this document. Sections 4.3 and 4.9 describe reclamation and/or stabilization of disturbances at borrow and quarry sites.

Potential mitigation measures for indirect land use impacts are discussed in other chapters of this document. For example, potential mitigation for the influx of people into the Project area and impacts on special population/occupation groups (i.e., guides, lodge and air taxi operators) are discussed under Socioeconomic Impacts, Section 4.12. Increases in recreation opportunities and mitigation measures for increased activity levels are discussed in Recreational Resources, immediately above. Potential aesthetic resource mitigation measures are discussed above in Section 4.9. Potential mitigation measures for cultural, subsistence, and tribal resources are discussed in Sections 4.11 and 4.13.

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4.11. Cultural and Subsistence Resources

The following sections describe cultural resources, subsistence activities, potential impacts related to the Project and potential protection, mitigation, and enhancement (PM&E) measures.

4.11.1. Cultural Resources

For cultural resources, the Project study area encompasses the Watana Reservoir site, the potential transmission lines, and road corridors (Chulitna, Denali and Gold Creek corridors), including portions of the Nenana River valley to the north and the Chulitna River valley to the west of the Watana Reservoir area. As so defined, and within five mi of each of these features, the Project area contains 260 known prehistoric and historic sites that relate to human land use and settlement of the region. Archaeological research in the Project area began in 1953 with Irving and Skarland's reconnaissance surveys associated with proposed dam sites along the upper Susitna River Skarland's (Irving 1957). Nearly 25 years later, archaeological and cultural resources studies resumed with investigations associated with the proposed development of dam sites at Devils Canyon and Watana (Bacon 1978a, 1978b, 1975). A vast majority of our knowledge on the prehistory of the region stems from cultural resources investigations conducted between 1978 and 1986 associated with the APA Project, (Greiser et al. 1986; Dixon 1985; Dixon et al. 1985; Bacon 1978a, 1978b).

The Project area contains some of the earliest known sites in interior Southcentral Alaska (Railbelt) and demonstrates human land use in the region back to at least 11,000 Before Present (BP). The area lies within the traditional territories of three ethnographically-documented Alaska Native groups: the Ahtna, Dena'ina (previously called the Tanaina) and Lower Tanana Athabascans (Nenana-Toklat band). A generalized regional prehistory for the interior regions of Southcentral Alaska can be divided into four broad archaeological cultural traditions: the American Paleoarctic, Northern Paleoindian, Northern Archaic, and Athabascan traditions. Archaeological cultural "traditions" imply cultural continuity and consistent regional patterns over broad areas and time periods. The framework of Southcentral Alaskan prehistory given here differs from a standard cultural chronology which was derived in large part from the early Susitna studies (Dixon 1985); this reflects the considerable advances in archaeological methods, theory, data accumulation and synthesis that have taken place over the past three decades.

Several sites in the region have American Paleoarctic tradition components that date 11,000 to 6,000 BP, marking the earliest recognizable tradition in interior Alaska (Holmes 2001, West 1981). These early human populations were terrestrial foragers, exploiting both upland and lowland areas, focusing on bison, wapiti (elk) and sheep, but utilizing a broad range of animals including other large and small mammals, fish and birds, especially waterfowl (Potter 2008a, 2008b; Powers et al. 1983; Bowers 1980). Stone artifact types that define American Paleoarctic tradition assemblages include microblades, bifacial points; large bifacial cores and tools; burins made on flakes, endscrapers and other expedient tools made on macroblades. The American Paleoarctic tradition relates stone tool technologies observed from Alaskan sites to terminal Pleistocene stone technologies from Northeast Eurasia (Anderson 1970).

In the Nenana River valley, several sites have components that lack microblade technology (i.e., microblade cores/blades) and are dated to about 11,000 BP (Hamilton and Goebel 1999). Stone artifacts from these components include large uniface chopper-like artifacts and flake tools, and bifacially-worked projectile points or pointed-tools. Powers and Hoffecker (1989) initially proposed that the "Nenana Complex" was a precursor to the microblade-defined Denali Complex (West 1967), however, a 12,000-year old microcore-bearing component at the Swan Point site, located in the Middle Tanana Valley, now casts doubt on the exclusivity of the Nenana and Denali complexes (Holmes 2001). Some archaeologists consider the Nenana Complex to be the technological precursor to the Clovis Complex of mid-latitude North America (Goebel et al. 1992, Powers and Hoffecker 1989).

The Northern Paleoindian tradition is one of the most recently-defined archaeological traditions, and one of the least clearly defined in interior Alaskan prehistory (Kunz and Reanier 1994). Sites in interior Alaska that may contain occupations attributable to this tradition including the bifacial occupation in Component II at the Dry Creek site (Hoffecker 2008, 2005), and the lowest component at a Susitna River Valley site known as the Jay Creek Ridge site (Dixon 1999). Northern Paleoindian sites are some of the oldest, well-documented sites in Alaska, dating as old as 11,600 to 11,200 BP, with most ages clustering around 10,000 BP (Bever 2001). The stone tool assemblages from Northern Paleoindian sites show similarities in artifact forms, especially between large lanceolate projectile points, spurred gravers, and end and thumbnail scrapers. Subsistence practices within this tradition likely focused on big game such as bison, musk ox, sheep, caribou and moose (Hedman 2010, Kunz et al. 2003). Hoffecker (2005) views the Mesa Complex of the Northern Paleoindian tradition as primarily focused on bison hunting. Some archaeologists interpret the unique characteristics of the Northern Paleoindian lithic assemblages to imply temporal and cultural connections with early sites in more temperate latitudes such as the Great Plains and the American Southwest (Hoffecker 2008, 2005; Kunz and Reanier 1995).

After 6,000 BP, new technologies, including side-notched projectile point forms, begin to appear in interior Alaskan archaeological assemblages. Archaeologists generally have designated these side-notched biface assemblages as part of the Northern Archaic tradition (Workman 1978, Anderson 1968). This tradition dates to between about 6,000 and 1,000 BP in interior Alaska. The broad occurrence of the side-notched point type throughout interior Alaska and southwestern Yukon may represent the spread of a new boreal forest-oriented cultural tradition (Dixon 1985, Anderson 1968). Conversely, it may also reflect the possible diffusion of a trait or type rather than a separate archaeological tradition (Cook and Gillispie 1986). The continuity of microblade and other technologies through this period suggests that the Paleoarctic and Northern Archaic traditions may be related (Potter 2008c). Regardless of the differing interpretations of the cultural history of this period, the middle Holocene saw a shift in foraging economies of the region, from broad-based exploitation of both lowland and upland fauna to more pronounced hunting of caribou in upland areas, though a broad spectrum of animals were acquired, including large and small game, birds and fish. Bison hunting still occurred in lowland settings, though apparently at lesser frequencies (Potter 2008a, 2008b, 2008c).

The Athabascan tradition is a prehistoric culture attributed to the ancestors of northern Athabascans of Alaska (Dixon 1985; Cook 1970, 1968). Aspects of this archaeological tradition appear around 1,000 BP and continue into the historic period to about AD 1880. Aspects of this tradition continue into the historic period in the late nineteenth century up to the present time, as influences of non-native cultures increased. Early prehistoric Athabascan tradition sites are characterized by the presence of housepit and subsurface cache features associated with a variety of flaked and ground stone, bone and antler artifacts. Proto-historic (or late prehistoric) Athabascan sites include those artifact assemblages predominately characterized by Native-made items (with an increased occurrence of organic and copper tools), and a smaller amount of non-Native trade goods, such as iron and glass beads obtained through indirect contact, but datable to Hudson's Bay Company and Russian American Company fur trade and to prospector and missionary influence (AD 1740 through 1850). Faunal materials found at Athabascan tradition sites consist of a broad spectrum of boreal forest wildlife including moose, caribou, beaver, hare, small rodents, fish and birds (Reuther et al. 2008, Plaskett 1977, Rainey 1935).

The Project area is situated in the traditional territories of the Ahtna, Dena'ina and Lower Tanana Athabascans. The western territorial boundary for the Western Ahtna and northeastern boundary of Upper Inlet Dena'ina speaking groups overlap within the Project area, where several Ahtna and Dena'ina place names have been recorded (Kari 2008, Kari and Fall 2003). Within the Project area, contacts between the Lower Tanana, the Ahtna and Dena'ina were likely confined to a few traversable passes in the Alaska Range, such as the Chulitna and Nenana River valleys.

In general, protohistoric and early historic land use and settlement patterns in the Project area were associated with seasonal movements related to the distribution of subsistence resources. The timing of annual subsistence cycles and land use patterns depended on the terrain and accessibility to resources (de Laguna and McClellan 1981). Before historic contact, these Athabascan groups had semi-permanent winter and fishing villages (McKennan 1981, Townsend 1981, Osgood 1937). Temporary camps were utilized during hunting trips for large game and the trapping of small mammals. Hunting was associated with seasonal movements along trails and frozen rivers between lowland and upland regions. De Laguna and McClellan (1981: 646) give a general description of a protohistoric and early historic Ahtna seasonal round:

> "*In spring and summer people lived first in the salmon camps, after which they moved upland to meat camps, hunting small game along the way. In fall they descended once more to the rivers, trapping and hunting, until the several families gathered in the winter houses. These were usually near summer fish camps where salmon were stored. By late January or February, families again were scattering to secure what game or freshwater fish they could.*"

In areas of the Upper Susitna River, where salmon were not as abundant, whitefish, ling cod and trout were important subsistence resources (de Laguna and McClellan 1981, Irving 1957). Caribou, moose, Dall sheep, bear and small mammals were taken periodically throughout the year outside of villages (Irving 1957: 39). In late summer to fall, hunting excursions focused more on caribou. Interior Dena'ina groups appear to have had similar seasonal rounds as Ahtna groups (Townsend 1981). Lower Tanana bands used the Nenana River and other drainages in their seasonal movements from summer salmon fishing camps along the Tanana River to spring and fall moose, caribou and Dall sheep hunting grounds in the northern foothills of the Alaska Range (Schneider et al. 1984, Gudgel-Holmes 1979). Seasonal rounds and settlement patterns likely changed during the fur trading period (AD 1740 through 1850) as late fall and winter fur trapping became more of a focus than it had been during the protohistoric period.

The first documented European presence in southern Alaska was the Russians in AD 1741 and 1742, with the Bering and Chirikov expeditions who mapped the coastlines (Black 2004). Their initial settlement and exploration focused on coastal zones, but later moved into the interior regions along the easiest transportation routes; wide rivers and valleys. Subsequent European and American expeditions followed the Russian example, moving first into the coastal regions and soon after into the interior.

By the nineteenth century, the Russians had long been active in the Cook Inlet area, but it was not until 1834 that Russian explorer, Malakoff, first navigated the Susitna River (Cole 1979, Bacon 1975, Brooks 1973). After the Russians initial exploration, the Upper Susitna River was left virtually unexplored until the 1896 gold rush when hundreds of prospectors explored the Knik and Susitna River valleys. William Dickey's party became one of the first well-documented trips up the Susitna. Dickey and his men made it upstream to what is now known as Devils Canyon where they were forced to turn back, being unable to portage their boats around the canyon and continue on (Marsh 2002, Cole 1979). Very little was known about the Upper Susitna, above Devils Canyon, until the summer of 1897 when a party of nine men traveling in small boats made the first recorded trip to the headwaters, reaching that area on July 29, 1897 (Cole 1979, Bacon 1975, Eldridge 1900).

Military and scientific parties began to come into the region in 1898 to explore the areas mineral deposits and to scout routes to the interior. W.J. Jack guided George Eldridge and his team of geologists up the Susitna to Indian Creek and then up as far as the Nenana River (Cole 1979, Bacon 1975). The route up Indian Creek was used later by other scientists, geologists, prospectors and military explorers and was eventually chosen as the route for the Alaska Railroad.

In 1903, a group of gold seekers headed out from Valdez toward the Upper Susitna River. In late summer of that year, after prospecting every tributary along the Upper Susitna, they struck gold along Valdez Creek (Cole 1979, Bacon 1975). Over the next several years, miners traveled to Valdez Creek and put in claims along the creek and its tributaries, from the Susitna River to Grogg Creek. By the mid 1930s, an estimated $700,000 in gold was produced from the claims that were worked in the Upper Susitna (Bacon 1975). Valdez Creek became a prominent mining district in Alaska (VanderHoek 2011, Dessauer and Harvey 1980).

The discovery of major coal fields in the Matanuska Valley led to the construction of the Alaska Central Railroad, later renamed the Alaska Railroad, which began in Seward, Alaska, in 1903 (Fall 1987: 22). As railroad construction progressed, construction camps sprang up along the way and were quickly abandoned after use. Towns that were established at major river crossings, such as Nenana and Talkeetna, at division or section points, such as Curry and Cantwell, and at coal mining centers, such as Healy, survived beyond the construction era (Brown 1991). The Alaska Railroad connected Alaska's interior with the ice-free port at Seward, and by ship to Seattle and the rest of the world. It became an invaluable resource to the territory by generating new towns and agricultural enterprises, providing low cost freighting for mining and construction operation (Brown 1991).

After the Alaska Railroad was completed all the way to Fairbanks in 1923, Cantwell became the center for the resupply route to Valdez Creek. In the early 1920s the Alaska Road Commission (ARC) established a sled route to provide a route between Cantwell and the mining district at Valdez Creek. By the mid 1930s, the ARC improved this trail and upgraded it to a gravel road.

This road would later become the Denali Highway (completed in 1957) that followed the old routes to Valdez Creek from Paxson at the east, and Cantwell at the west (Bacon 1975). The George Parks Highway was completed in 1971. This provided a much shorter road route between Anchorage and Fairbanks, as well as Denali National Park, Healy and Cantwell.

4.11.2. Subsistence Resources

When Alaska became a state in 1959, it gained authority from the federal government for the management of fish and wildlife and the responsibility for managing subsistence. Since before statehood, Alaska's regulatory system had managed subsistence separately from recreational and commercial harvesting. In 1978, the State legislature established its first subsistence law defining subsistence as "customary and traditional uses" (AS 16.05.940 (33)) of fish and wildlife, thereby highlighting the continuing role of subsistence fishing and hunting in sustaining long-established ways of life in the state. Under this law, subsistence was established as the priority consumptive use of fish and wildlife resources (AS 16.05.258).

Subsistence surfaced as an issue for the United States federal government in 1971 when Congress passed the Alaska Native Claims Settlement Act (ANCSA). ANCSA extinguished aboriginal hunting and fishing rights in Alaska in exchange for almost $1 billion in cash and 44 million acres of land transferred to Alaska ANSCA corporations. In 1980, Congress passed the Alaska National Interest Lands Conservation Act (ANILCA). ANILCA mandated that the state maintain subsistence hunting and fishing preference for rural residents statewide or forfeit its management of subsistence uses by rural Alaska residents on federal lands. Title VIII of ANILCA contains the rural preference provision (*see also,* Code of Federal Regulations (CFR) Title 36, Part 242 or Title 50, Part 100 (36 CFR 242.1 or 50 CFR 100.1)). Section 810 of ANILCA also requires that an evaluation of subsistence uses and needs be completed for any federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands."

In 1986 the state amended its statutes to match ANILCA by limiting subsistence uses to rural residents. However, the Alaska Supreme Court ruled in McDowell v. Alaska (785 P.2d 1 (Alaska 1989)) that the rural preference violated the equal access clauses of the Alaska Constitution. This meant that the state could not provide the rural preference for rural residents required by ANILCA.

Because Alaska law no longer provided for the"rural" resident preference required by ANILCA, the federal government moved to take over management of subsistence hunting on federal public lands on July 1, 1990 (USFWS 1992). Management of subsistence fishing was complicated by a separate question involving whether the state or federal government would manage subsistence fishing on navigable waterways. The Ninth Circuit Court of Appeals ruled in Katie John. v. United States that federal agencies have jurisdiction under ANILCA to manage subsistence fishing in navigable waters in which the federal government has reserved water rights, in addition to waters running over federally-owned submerged lands.

4.11.3. Applicable Laws and Regulations

The term “cultural resources” is often used as a synonym for the legal term “historic properties” defined in the National Historic Preservation Act (NHPA) and its accompanying regulations (36 CFR 800). Historic properties include prehistoric or historic sites, buildings, structures, objects or districts eligible for listing on the National Register of Historic Places (NRHP) (36 CFR 800, 36 CFR 60). These may be resources such as prehistoric and historic sites, cultural landscapes, traditional cultural properties (TCPs) and paleontological sites. A number of laws and regulations apply to the treatment of historic properties in the vicinity of the Susitna-Watana Project.

Federal legislation includes:

- 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: Federal Energy Regulatory Commission (FERC) Licensing, Permits, Exemptions, and Determination of Project Costs
- 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 and Repatriation Act

Federal Executive Orders (EO) include:

- EO 11593: Protection and Enhancement of the Cultural Environment (1971)
- EO 12898: Environmental Justice
- EO 13007: Indian Sacred Sites (1996)

State legislation includes:

- Alaska Historic Preservation Act (Alaska Statute 41.35)

A number of ordinances, resolutions and preservation plans may affect cultural resources at the local level, including Matanuska-Susitna Borough Ordinance 87-007 and Historic Preservation

Plan (adopted 1987) and the state's Cultural Resource Management Plan for the Denali Highway Lands (VanderHoek 2011). This review does not include tribal or village council resolutions that may exist in the records of various Native organizations. Private lands are directly affected by federal cultural resources legislation, especially the NHPA and implementing regulations (36 CFR 800), as long as any aspect of the proposed action has federal involvement. Thus the Project will fall under the Section 106 review process regardless of land status within the Project area (federal, state, municipal or private). If any aspect of a project is affected by a federal undertaking (permit, license or funding), then the federal review process applies to the entire Project area.

Several publications provide guidance on cultural resources investigations, in relation to federal and state laws and regulations, including:

- Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects. Federal Energy Regulatory Commission, Washington D.C. (2002).
- National Register Bulletin Series, National Park Service, U.S. Department of Interior. (Available on-line at: http://www.NPS.gov/history/nr/publications/#bulletins)
- Historic Preservation Series, Alaska Office of History and Archaeology, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources. (Available on-line at: http://dnr.alaska.gov/parks/oha/hpseries/hpseries.htm)
- Human Remains and Cultural Resource Management in Alaska: State Laws and Guidelines. (Dale and McMahan 2007)

Under Alaska State law, subsistence refers to the practice of taking wild fish or game for subsistence uses (AS 16.05.258). Defined in Alaska State law as the "noncommercial customary and traditional uses" of fish and wildlife, subsistence uses include the following:

- Food
- Customary trade, barter, and sharing
- Homes and other buildings
- Fuel
- Clothing
- Tools and home goods
- Transportation
- Handicrafts

State law protects customary and traditional uses of fish and game resources, and the state must provide a reasonable opportunity for those uses before providing for recreational or commercial uses. To decide if a fish stock or game population is associated with customary and traditional uses, state regulation directs the Board of Game and the Board of Fish to consider eight factors, called the Eight Criteria (5 Alaska Administrative Code (AAC) 99.010(b) Boards of fisheries and game subsistence procedures). The Eight Criteria are summarized as follows:

- The length and consistency of use of the resource;
- A pattern of use that occurs on a regular seasonal basis;
- A pattern of use that is characterized by efficiency and economy of effort and cost;

- An area in which the pattern of use occurs;
- Traditional methods of handling, preparing, preserving, and storing used in the past, but not excluding recent advances;
- A pattern that includes the handing down of knowledge, skills, and values and lore from generation to generation;
- Traditional patterns of distribution and exchange including customary trade, barter, and gift-giving; and
- A pattern that includes the use of, and reliance upon, a wide diversity of fish and game that provides substantial economic, cultural, social, and nutritional elements of the subsistence way of life.

Under federal law, the term "subsistence uses" is defined as the customary and traditional uses by rural Alaska residents of fish and wildlife and other renewable resources for food, clothing, shelter and handicrafts (§803 Definitions in ANILCA P.L. 96-487, as amended). The Federal Subsistence Board determines which fish stocks and wildlife populations have been customarily and traditionally used for subsistence. These determinations identify a specific community's or area's use of specific fish stocks and wildlife populations. For areas managed by the U.S. National Park Service (USNPS) where subsistence uses are allowed, the determinations may be made on an individual basis. Like the state, the Federal Subsistence Program uses eight factors to determine customary and traditional use, which are similar to those used by the state (USFWS 2007).

Both federal and state governments have a mechanism for establishing preferences among subsistence users when a fish or wildlife population is not large enough to support harvest by all those who are eligible for subsistence uses. Under the federal program, this narrowing process is based on: customary and direct dependence upon the populations as the mainstay of livelihood; local residency; and availability of alternative resources. This is sometimes called a “Section 804” process, named for the section of ANILCA’s Title VIII that establishes it as a means of reducing the number of eligible subsistence users.

Under state management, the narrowing process is called the “Tier II” process. Tier II is an allocation system to distinguish and identify those individuals most dependent on a particular fish stock or wildlife population among all subsistence users. Tier II gives priority to users based on: customary and direct dependence; and availability of alternative resources. The state has managed several Tier II hunts, including moose and the Nelchina caribou herd in Game Management Unit (GMU) 13.

Alaska is divided into 26 GMUs, allowing the Alaska Department of Fish and Game (ADF&G) to more efficiently manage and control hunting within the state. GMU 13 consists of that area westerly of the east bank of the Copper River, and drained by all tributaries into the west bank of the Copper River from Mi Glacier and including the Slana River drainages north of Suslota Creek; the drainages into the Delta River upstream from Falls Creek and Black Rapids Glacier; the drainages into the Nenana River upstream from the southeast corner of Denali National Park at Windy; the drainage into the Susitna River upstream from its junction with the Chulitna River; the drainage into the east bank of the Chulitna River upstream to its confluence with the Tokositna River; the drainages of the Chulitna River (south of Denali National Park) upstream from its confluence with the Tokositna River; the drainages into the north bank of the Tokositna

River upstream to the base of the Tokositna Glacier; the drainages into the Tokositna Glacier; the drainages into the east bank of the Susitna River between its confluences with the Talkeetna and Chulitna Rivers; the drainages into the north and east bank of the Talkeetna River, including the Talkeetna River to its confluence with Clear Creek, the eastside drainages of a line up the south bank of Clear Creek to the first unnamed creek on the south, then up that unnamed creek to lake 4408, along the northeast shore of lake 4408, then southeast in a straight line to the northernmost fork of the Chickaloon River; the drainages into the east bank of the Chickaloon River below the line from lake 4408; the drainages of the Matanuska River above its confluence with the Chickaloon River (ADF&G 2011). GMU 13 is divided into five subsections (GMU 13A, GMU 13B, GMU 13C, GMU 13D, and GMU 13E).

In GMU 13, the state has made customary and traditional use findings for all major game resources: Dall's sheep (*Ovis dalli dalli*); black bears (*Ursus americanus*); grizzly bears (*Ursus arctos*); caribou (*Rangifer tarandus granti*); and moose (*Alces alces*) (5 AAC 99.025). Of these resources, caribou and moose are the most popular. Salmon and other fresh water fish in the Copper River, except for the Chitina Subdistrict, have also been found to be customarily and traditionally taken and used for subsistence (5 AAC 01.616). This means that all of these resources are classified as subsistence resources.

The state has also managed subsistence use of game in GMU 13 under Tier I and Community Subsistence Harvest (CSH) hunts. Under Tier I, one person from a household may obtain a permit to hunt caribou. Under CSH hunts, the Alaska Board of Game may establish community-based subsistence harvest hunt areas. If the board has established a community harvest hunt area for a big game population, residents of the community or members of a group may elect to participate in a community harvest permit hunt. Among other conditions, a person representing a group of 25 or more residents or members may apply to the department for a community harvest permit by identifying the community harvest hunt area and the species to be hunted, and by requesting that the department distribute community harvest reports to the individuals who subscribe to the community harvest permit. Community harvest hunt areas for caribou and moose have been established for Gulkana, Cantwell, Chistochina, Gakona, Mentasta, Tazlina, Chitna, and Kluti-Khah (Copper Center), collectively called the Copper Basin CSH area.

Current hunting regulations are listed in Table 4.11-1.

Table 4.11-1. GMU 13 big game regulations.

Regulations	Harvest Limits	Season
Federal Regulations, GMU 13E		
Caribou, all rural residents of Units 11, 2, 13 and Chickaloon	2 bulls	Aug. 10–Sept. 30 and Oct. 21–Mar. 31
Moose, all rural residents of Unit 13, Chickaloon, Slana and area between mileposts 216–239 Parks Highway	1 antlered bull	Aug. 1–Sept. 20
Dall sheep, all rural residents	1 ram	Aug. 10–Sept. 20
Black Bear, all rural residents	3 bears	July 1–June 30

Regulations	Harvest Limits	Season
Brown bear, all rural residents	1 bear	Aug. 10–May 31
State of Alaska Regulations		
Caribou – all of GMU 13, all Alaska residents	1 caribou	Aug. 10–Sept. 20 and Oct. 21–Mar. 31
Registration hunt	1 moose	Aug. 10–Sept. 20 and Oct. 21–Mar. 31
Community hunt	1 moose	Aug. 10–Sept. 20 and Oct. 21–Mar. 31
Drawing hunt	1 moose	Aug. 10–Sept. 20 and Oct. 21–Mar. 31
Moose, all of GMU 13, all Alaska residents		
Community hunt		Aug. 10–Sept. 20
Harvest ticket		Sept. 1–Sept. 20
Two drawing hunts		Sept. 1–Sept. 20
Dall sheep, Unit 13E, open to all Alaska residents	1 full curl ram	Aug. 20–Sept. 20
Black bear, all Alaska residents	3 bears	No closed season
Brown bear, all Alaska residents		
Unit 13E within Denali State Park	1 bear	Aug. 10–June 15
Remainder of Unit 13	1 bear	No closed season

Note(s): Table prepared by NLUR from State and Federal big game regulations, 2010–2012.
Source(s): ADF&G 2011; USFWS 2010.

Additionally, beluga whales are an important subsistence resource for Alaska Natives living on and around Cook Inlet, including Tyonek residents, who hunt for belugas near the mouth of the Sustina River. Declining populations of belugas throughout the 1990s led to co-management agreements between the Native Village of Tyonek and other Alaska Natives and National Marine Fisheries Service (NMFS) allocating harvest and identifying harvest practices. Populations continued to decline, and in 2007 Tyonek subsistence hunters voluntarily stepped down from a hunt to further support recovery of the beluga population. NMFS released a record of decision for the supplemental Environmental Impact Statement (EIS) for the Cook Inlet Beluga Whale Subsistence Harvest in 2008, which resulted in the Cook Inlet Beluga Whale Subsistence Harvest Management Plan.

The ADF&G's Joint Board of Fisheries and Game designated five nonsubsistence areas in the state of Alaska. Relevant to the proposed Project, the area north of Cantwell and Paxson is in the Fairbanks Nonsubsistence Use Area, and the areas east and south of Talkeetna (including a portion of the Nelchina Public Use Area) are in the Anchorage-Mat Su-Kenai Peninsula Nonsubsistence Use Area. Nonsubsistence areas are defined as areas where dependence on subsistence (i.e., customary and traditional uses of fish and wildlife) is not a principal characteristic of the economy, culture and way of life (AS 16.05.258(c)). In nonsubsistence areas, the Joint Board of Fisheries and Game may not authorize subsistence fishing or hunting, and the subsistence priority does not apply.

4.11.4. Potential Adverse and Positive Impacts

The potential impacts of the Project on cultural resources and subsistence activities are described below.

4.11.4.1. Cultural Resources

The study area currently encompasses the areas of potential impacts that include the dam site, Project construction site, and three potential road and transmission corridors (Chulitna, Denali and Gold Creek corridors). A total of 260 cultural resources sites presently recorded in the Alaska Heritage Resources Survey (AHRS 2011) database are situated in the Project area. Many of these sites were documented during surveys conducted between 1978 and 1986 associated with the previous Susitna Project. Two hundred and twenty-six of these sites (86.9 percent) have prehistoric remains present. Four sites (1.5 percent) have protohistoric remains, 27 sites (10.4 percent) have historic and modern remains and one site (0.4 percent) has paleontological remains. Two sites (0.8 percent) do not have an accompanying description to the AHRS database entry.

Two hundred and fifty-seven (98.8 percent) of these 260 cultural resources sites have not been evaluated for their eligibility for listing on the NRHP (AHRS 2011). This includes all of the prehistoric sites. The Susitna River Railroad Bridge (49-TLM-00006), located near the proposed Gold Creek Corridor, is listed on the NRHP. The Alaska Railroad Corporation Timber Bridge at Mile Post (MP) 267.7 (49-TLM-00265) of the Alaska Railroad, located within five mi of the proposed Chulitna and Gold Creek corridors, was determined eligible for listing on the NRHP, but has yet to be listed. The Seattle Creek Bridge (49-HEA-00353), located at MP 112.2 of the Denali Highway and within five mi of the proposed Denali Corridor, was determined not eligible for inclusion on the NRHP. Table 4.11-2 summarizes the known cultural resources within each of the Project's potential areas of impact by the period of remains present, and by status of eligibility to the NRHP as designated in the AHRS (2011) database.

Ahtna and Dena'ina place names also have been recorded in and near the Project area; these provide valuable sources of geographic information pertaining to past human land use. Simeone et al. (2011) note that over 350 Athna and 50 Dena'ina place names occur within or near the Project area. Ahtna place names are more prevalent toward the northern portion of the Project area, north of Devils Canyon, the traditional boundary of the Ahtna and Dena'ina people. Devils Canyon has both Ahtna and Dena'ina place names, and Dena'ina place names are more prevalent to the south of the canyon. Lower Tanana place names are less well-documented than Athna and Dena'ina place names, but also may be present in the northern portion of the Project area. TCPs have not yet been identified within the Project area. However, the identification of TCPs within the NRHP framework began after the formerly proposed Susitna Hydroelectric Project, and these property types may be identified through further cultural resources investigations.

Potential impacts of the currently proposed Project to historic properties may include disturbance during construction of the dam and associated facilities, access routes, and transmission lines. Additionally, those sites inundated by rising water levels at the reservoir will also be impacted. Inadvertent disturbance or vandalism to historic properties could occur due to increased land-based access for recreational activities. Aesthetic changes to a surrounding historic landscape may also affect the historic and cultural significance of a property.

Table 4.11-2. Summary of the number of known cultural resources and NRHP eligible sites within five mi of each potential area of impact.

AHRS Site Totals	NRHP Eligibility Status
Watana Dam Site	
Total # of Known Cultural Resources: 177 ▪ Prehistoric – 160 ▪ Historic – 9 ▪ Prehistoric/Historic – 2 ▪ Historic/Modern – 1 ▪ Protohistoric – 4 ▪ Paleontological – 1	# of Resources with Evaluations of NRHP Eligibility Incomplete – 177
Watana Construction Camp	
Total # of Known Cultural Resources: 40 ▪ Prehistoric – 38 ▪ Historic – 2	# of Resources with Evaluations of NRHP Eligibility Incomplete – 40
Proposed Chulitna Corridor	
Total # of Known Cultural Resources: 82 ▪ Prehistoric – 71 ▪ Historic – 7 ▪ Historic/Modern – 4	# of Resources with Evaluations of NRHP Eligibility Incomplete – 81 # of Resources Determined Eligible for Inclusion to the NRHP, But Not Currently Listed – 1
Proposed Denali Corridor	
Total # of Known Cultural Resources: 86 ▪ Prehistoric – 77 ▪ Historic – 7 ▪ Undefined – 2	# of Resources with Evaluations of NRHP Eligibility Incomplete – 85 # of Resources Determined Not Eligible for Inclusion on the NRHP – 1
Proposed Gold Creek Corridor	
Total # of Known Cultural Resources: 50 ▪ Prehistoric – 39 ▪ Historic – 8 ▪ Historic/Modern – 3	# of Resources with Evaluations of NRHP Eligibility Incomplete – 48 # of Resources Listed on NRHP – 1 # of Resources Determined Eligible for Inclusion to the NRHP, But Not Currently Listed – 1

4.11.4.2. Subsistence Resources

The proposed Project area is remote and accessible only by airplane, boat or all-terrain vehicles. The area is not close to any established communities, and construction of the dam would likely have little direct effect on subsistence. Subsistence activities would be affected if there was a decline in animal populations, a change in the distribution of animals, if the Project reduced access to subsistence resources or if the Project disrupted traditional subsistence activities.

The Project may affect the population of local species, such as small animals that live in the reservoir area. The level of impact on moose and caribou populations is debatable. The area directly affected by the Project had low use levels in the past; current data are needed. The Nelchina caribou herd is a major resource for Tier II subsistence harvests, so any adverse effects on caribou would impact subsistence users.

There is a potential for the Project to change wildlife migration patterns because of the Watana Dam, the Watana reservoir and infrastructure development such as the Denali corridor. The presence of humans and machinery during and after construction could negatively affect the distribution of animals. The construction of the access road within the Denali corridor, if open to the public, would increase access to the area and opportunities for hunting. This would increase competition for resources.

There is a potential for reduced access to resources if the proposed Chulitna corridor, Gold Creek corridor, or Denali corridor have restricted access.

4.11.5. Existing Discovery Measures

Existing discovery measures for cultural resources for cultural and subsistence resources are detailed below.

4.11.5.1. Cultural Resources

Cultural resources investigations associated with the Project area have been periodically conducted since 1953. With increased understanding of the prehistory of interior Alaska, the methods used to identify and evaluate resources also have changed over this 58 year period. Cultural resources field surveys in Alaska commonly employ site location models to stratify the study area into field survey segments. Within the survey segments, researchers identify higher and lower potential areas for the presence of prehistoric, protohistoric and early historic (before AD 1880) cultural resources (Reuther et al. 2010, 2011; Potter 2005; Gerlach et al. 1996; Mason et al. 1994; Dixon et al. 1985; Greiser et al. 1985). These models vary in approach and relative success in site discovery; they can be judgmental and intuitive-based, or more statistically oriented and less subjective. The basic premise behind many of the site location models is that prehistoric, protohistoric and early historic land use patterns are highly dependent on local natural resources, such as subsistence resources and raw materials for making tools, equipment, housing and clothing. The distributions of many of these resources are constrained by environmental variables such as topography, elevation, vegetation and surficial geology.

The 1953 field study methods consisted of an initial aerial and pedestrian reconnaissance of the then proposed Devils Canyon Dam site area, demarcating areas with a high likelihood for the location of archaeological remains (Skarland 1953). An intensive on-the-ground survey was conducted along the shores of Lake Susitna, Tyone Lake and the Tyone River, and the hills on the southwest side of Lake Louise (Irving 1953). This intensive on-the-ground survey consisted of subsurface testing at high potential landforms, and documentation of the cultural resources that were identified. Details of the methods, depth and specific locations of subsurface testing during the 1953 survey are minimal (Irving 1953).

The majority of the previous cultural resources investigations took place between 1978 and 1985 (Greiser et al. 1985, 1986; Dixon et al. 1985; Bacon 1978a, 1978b). In 1978, Bacon (1978a, 1978b) developed an initial site location model for the previously proposed Devils Canyon and Watana Dam site areas. Bacon (1978a) conducted an aerial reconnaissance to refine the model with field data from the Project area, prior to on-the-ground survey. The majority of the 1978 on-the-ground surveys concentrated on an area between Tsusena and Deadman creeks, north of the Susitna River (Bacon 1978a, 1978b). An on-the-ground survey was also conducted at the then-proposed locations for the left abutment, right abutment and spillway for the Watana Dam, along with proposed locations for an airstrip, camp pad, two material sites, access roads and a portion of a the proposed dam site at Devils Canyon (Bacon 1978a, b). This survey consisted of subsurface testing and the documentation of identified cultural resources. Subsurface testing consisted of small tests dug with entrenching tools and hand trowels. The test locations were placed throughout high potential areas at non-systematic intervals. The subsurface tests were not mapped.

Field studies conducted between 1980 and 1984, lead by the University of Alaska Museum, also focused on the Watana and Devils Canyon Dam sites and associated ancillary impacts (Dixon et al. 1985). The ancillary impacts surveyed and tested during the early to mid-1980s field studies include three transmission corridors (Healy-to-Fairbanks, Healy-to-Willow and Willow-to-Anchorage) and 12 borrow pits (Borrows A through L) that were designated as potential material sources. Alternative access routes (Corridor 1 North, Corridor 2 South and Corridor 3 Denali-North) were preliminarily surveyed. Researchers developed a site location model primarily based on environmental variables including the local geomorphology, elevation and vegetation. Landforms such as overlooks, lake margins, stream/river margins, quarry sites; caves and rock shelters, constrictions and mineral licks were considered to have a high potential for association with archaeological sites. Localized survey segments that were considered to have a high potential for sites were designated as “survey locales” (Dixon et al. 1985). One-hundred and eighty-two locations were intensively surveyed and subsurface tested during the field studies conducted between 1980 and 1984 (Dixon et al. 1985: D-1). The locations of these survey locales and sites were mapped on 1:63,360 scale U.S. Geological Survey (USGS) topographic maps (Dixon et al. 1985: 6–10). Survey locales appear to have been walked over (Dixon et al. 1984); however, written details in survey reports are minimal pertaining to the methods employed during the surface reconnaissance.

The distance between subsurface tests at each survey locale was discretionary (i.e., at the discretion of individual field crew leaders. Subsurface tests at survey locales and sites that were not chosen for systematic testing typically consisted of round shovel tests approximately 30 centimeters (cm) in diameter (12 inches (in)) and not deeper than 50 cm (20 in) (Dixon et al.

1985: 6–10). If artifacts were found in a buried context, at least one 40 by 40 cm (16 by 16 in) square test pit was excavated to acquire additional information on the stratigraphy and number of cultural components present at the locality. Tests excavated at survey locales and sites were plotted on sketch maps.

A total of 253 archaeological sites, covering an area broader than the present study area, were documented during field studies conducted between 1980 and 1984 (Dixon et al. 1985: D-1). Sixty-three of these sites were chosen for systematic testing to determine the size of each site, and gather additional field data on the types of and relative density of artifacts and features, physical integrity of the archaeological context of cultural deposits at each site, and the number and age of components. Systematic testing consisted of excavating subsurface tests along grids that were placed at the periphery of, and excavated towards, the observed cultural materials. Systematically tested sites were mapped using a transit and stadia rod. Sediment was screened through one-quarter-inch to one-eighth-inch mesh. The provenience of artifacts was recorded according to their association with natural stratigraphic units or by 5 cm (2 in) arbitrary levels. Site sizes at systematically tested sites were determined by the observed horizontal distribution of cultural remains, while sizes of non-systematically tested sites were estimated based on the local topography of landforms on which the sites were located. It is unclear how many sites within the study area have had enough information collected from which a determination of eligibility to the NRHP could be made (a part of the Section 106 process and a necessary step in site evaluation; 36 CR 800).

An important part of the 1980s Susitna studies was the application of a variety of geoarchaeological techniques. In addition to studies of regional sediment stratigraphy, some 83 radiocarbon dates were obtained in an attempt to place archaeological discoveries in chronological context. Tephrochronology (using petrographic and other methods to characterize and compare the widespread volcanic ash layers in the area) was used to provide relative dating of some sites (Dixon and Smith 1990).

In 1985, the Alaska Power Authority (APA) contracted with Historical Research Associates (HRA) to develop a predictive site location model and survey strategy for several proposed linear features, including transmission lines, access roads and railroad corridors (Greiser et al. 1985). Three transmission lines were designated as the Gold Creek–Watana (36.2 mi in length), Healy–Fairbanks (94.4 mi in length), and Willow–Anchorage (64.4 mi in length) lines which tied into existing transmission lines along the railbelt. The proposed railroad access consisted of 10.2 mi of rail from Gold Creek to Devils Canyon. Approximately 76 mi of access road was proposed between the Denali Highway and the construction site for the previously proposed Watana Dam site and Devils Canyon.

The Greiser et al. (1985) survey model assessed potential relationships between known archaeological site locations from all time periods and the characteristics of the vegetation and terrain in the Project area. About 280 linear mi of survey area were gridded into about 550 square plots, each one-half square mile in size, superimposed over the linear survey path of the proposed transmission lines and road and railroad access corridors. Eighty-nine (16 percent) of these plots were completely surveyed and five (0.9 percent) plots were partially surveyed (Greiser et al. 1986: 2–4). The survey plots were chosen to represent the variation in vegetation and terrain across the survey area.

The field survey method used during 1985 was for one or more archaeologist(s) to walk transects across each selected plot with transects spaced 30 meters (m) (98 ft (ft)) apart (Greiser et al. 1986: 2–14). Subsurface tests were systematically placed every 20 cm (8 in) to 50 m (164 ft) along each transect in a given square survey plot. Additional tests were placed at the field archaeologist's discretion on higher potential landforms. The depth of the subsurface testing varied between 30 cm (12 in) to not more than 50 cm (20 in) below the surface and sediments were screened through one-quarter inch mesh.

A total of 40 cultural resources were documented during the 1985 season, including seven prehistoric, two ethnohistoric, 15 historic and 16 recent sites (Greiser et al. 1986: 3–16, 3–22). Prehistoric site sizes were determined by systematic shovel testing along grids that radiated from the observed cultural materials. Tests were excavated at 10 cm (4 in) intervals along these grids. The recordation protocols closely followed those of Dixon et al. (1985).

In 2011, AEA drilled four geotechnical boreholes using a helicopter-carried drill rig in the vicinity of the currently proposed Watana Dam site, within an area designated as Material Site "A" in the 1979 to 1985 Susitna studies program. A cultural resources field survey was carried out by Northern Land Use Research (NLUR) in June 2011. Based on the NLUR survey, no cultural resources were encountered at any of the four localities, nor were cultural materials reported for this general area by previous investigators (e.g., Dixon et al. 1985: E-273). NLUR recommended a finding of *no historic properties affected* (36 CFR 800.4(d)(1)) (Bowers 2011).

Alaska Native place names have been documented in the Project area since at least 1953 (Kari 2008, Kari and Fall 2003, Greiser et al. 1986, Irving 1953). These names often document aspects of the way people view, use and relate to a particular landscape. Ahtna, Dena'ina and Lower Tanana place names often relate to the surrounding natural environment such as description of landforms, hydrology, vegetation, fauna and aspects of the local weather. Place names can also refer to past human history and activities such as gathering places, areas of trading, territorial boundaries and spiritual places. Thus, place names can be very useful in archaeological studies. The understanding of how people relate and use local landscapes and resources can provide a framework to understand continuity and change in past land use systems in the archaeological record. Place names and the archaeological record can often provide information pertinent to the identification and understanding of the potential significance of TCPs. Place names and TCPs are often identified and documented through archival research and oral interviews.

4.11.5.2. Subsistence Resources

The ADF&G's Division of Subsistence conducted baseline harvest surveys for Copper basin communities, including Cantwell. Two of these studies were conducted in the 1980s (McMillan and Cuccarese 1988, Stratton and Georgette 1984), while a more recent baseline survey was conducted in Cantwell from 1999 to 2000 (Simeone 2002). The USNPS has conducted recent community subsistence studies in Mentasta, Slana, Tazlina and Copper Center (results have not yet been published), and plans to conduct further studies in 2012 and 2013.

The Division of Subsistence conducted resource issue studies related to the Copper River subsistence salmon fishery (Simeone and Fall 2003, Fall and Stratton 1984, Stanek 1981, Stickney and Cunningham 1980), and Nelchina caribou (Fall and Simeone 2010, Stratton 1983, Stanek 1981). The division also produced non-issue related reports concerning different aspects of subsistence within the Copper River basin (Simeone and McCall-Valentine 2007, Simeone and Kari 2005, Simeone and Kari 2002). Reports produced by other entities include Haley and Nemeth (2002) and Reckord (1983).

The Division of Subsistence conducted baseline harvest surveys in the communities of Trapper Creek, Chase, Gold Creek and the Hurricane–Broad Pass area (Stanek and Foster 1988, Fall and Foster 1987).

Table 4.11-3 presents summary information for all resources harvested by Project area communities. Project area residents show high percentages of using wildlife resources and attempting to harvest wildlife resources during the study year. In addition, the communities have a pattern of sharing wildlife resources, with high percentages of respondents reporting giving away subsistence harvests as well as receiving harvests into their households. The average pounds harvested per household and per capita are higher in the communities listed in the table compared to harvests in Alaska's urban centers, such as Anchorage, Fairbanks or Juneau. The last Copper River Basin-wide household survey, in 1987-1988, estimated the overall per capita harvest of wild foods at 140 pounds per person. The rural harvest contrasts with the urban area per person annual average of about 22 pounds per year (Wolfe and Bosworth 1994).

Table 4.11-3. Summary data for all resources harvested by Project area communities.

Community (Year) Note 1	Percent Using (percent)	Percent Attempting to Harvest (percent)	Percent Harvesting (percent)	Percent Giving Away (percent)	Percent Receiving (percent)	Reported Harvest (lbs)	Average Lbs Harvested per Household	Per Capita Lbs Harvested
Cantwell (1999)	97.4	97.4	97.4	61.8	90.8	21,727.26	293.61	135.24
Cheesh-Na (1987) [Chistochina]	100	100	100	64.3	75	19,873.76	709.78	261.52
Chickaloon (1982)	100	--	88.9	--	--	9389.85	521.66	223.57
Chitina (1987	94.4	88.9	88.9	50	72.2	11,297.33	627.63	342.38
Gakona (1987)	92.7	100	85.5	52.1	82.6	--	284.51	95.33
Glennallen (1987)	100	91.8	91.8	64	86	--	274.61	99.49
Gold Creek (1986)	100	100	100	40	100	1,739.5	347.9	173.92
Gulkana (1987)	95	100	90	40	80	9,305.98	465.3	152.56
Hurricane–Broad Pass (1986)	100	100	100	62.5	75	4,804.3	600.54	177.93
Lake Louise (1987)	100	100	100	47.1	82.4	6,271.49	368.91	179.17
Matanuska Glacier (1982)	100	--	96.7	--	--	8,553.9	285.13	96.11
Mentasta (1987)	95.8	91.7	91.7	58.3	83.3	9,284.9	386.87	125.48
Mentasta Pass (1987)	100	100	100	70	80	4,510.81	451.08	187.95
Northway	91.7	88.3	88.3	10	31.7	7,129	798.9	243.3

Community (Year) Note 1	Percent Using (percent)	Percent Attempting to Harvest (percent)	Percent Harvesting (percent)	Percent Giving Away (percent)	Percent Receiving (percent)	Reported Harvest (lbs)	Average Lbs Harvested per Household	Per Capita Lbs Harvested
(2004)								
North Wrangell Mtns (1982)	100	--	100	--	--	2,411.3	482.26	219.24
Parks Highway (1985–1986)	86.7	90.0	83.3	33.3	56.7	--	162.7	58.1
Talkeetna (1985–1986)	94.1	91.2	85.3	50.0	69.1	--	156.3	55.05
Trapper Creek (1985–1986)	100.0	100.0	100.0	63.2	89.5	--	107.3	65.64
Upper Petersville Road (1986–1986)	100.0	94.1	94.1	29.4	76.5	--	423.1	167.26
Paxson (1987)	92.9	100	92.9	57.1	71.4	9,252.94	660.92	289.14
Paxson–Sourdough (1982)	100	--	100	--	--	3,100.9	310.09	124.04
Sourdough (1987)	100	100	88.9	44.4	77.8	2,713.25	301.47	117.96
West Glenn Highway (1987)	100	92.5	92.5	54.7	96.5	--	243.07	91.8

Note(s): Information in this table is summarized from data available online at the Alaska Department of Fish and Game, Community Subsistence Information System (CSIS) website, http://www.adfg.alaska.gov/sb/CSIS/ (accessed September 8, 2011). The community name is the one used by the CSIS. The year is the most recent community-wide information available. Updates for some resource categories are available for some, but not all communities (for example, subsistence harvests of birds or fish). The updated information is not included in this table.

4.11.6. Affected Tribes and Populations

Cultural resources and subsistence resources associated with Tribes are described below.

4.11.6.1. Cultural Resources

The communities potentially affected by the Project have different histories and cultures, but are characterized by strong ties to the land and its resources and, in some cases, through strong kinship connections. The successful completion of the Consultation and Coordination phase of the Section 106 process will require the development of an efficient and effective consultation process that addresses the letter of the laws and regulations within the context of local custom and practice. Several Alaska Native tribal entities recognized by the U.S. Department of Interior (USDOI), and established through the Alaska Native Claims Settlement Act (ANCSA) of 1971, are broadly located near the study area (HDR 2011). 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).

Twenty-two tribes recognized by the USDOI’s Bureau of Indian Affairs under 25 CFR 83.6(b) are located within or near the study area include:

- Cheesh-Na Tribal Council
- Chickaloon Village Traditional Council
- Chitina Traditional Village Indian Council
- Gulkana Village
- Healy Lake Village
- Kenaitze Indian Tribe
- Knik Tribal Council
- Mentasta Traditional Council
- Native Village of Cantwell
- Native Village of Eklutna
- Native Village of Gakona
- Native Village of Kluti-Kaah
- Native Village of Tazlina
- Native Village of Tetlin
- Native Village of Tyonek
- Nenana Native Association
- Ninilchik Traditional Council
- Northway Village
- Seldovia Village Tribe
- Tanacross Village Council
- Village of Dot Lake
- Village of Salamatoff

Regional Native Alaskan corporations that have interests within or near the Project area include:

- Ahtna, Incorporated (Ahtna)
- Cook Inlet Region Incorporated (CIRI)
- Doyon, Ltd. (Doyon)

In addition, ANCSA recognized and non-recognized village; group and urban corporations; as well as village organizations are located and may have interests near the Project area. These entities include:

- Alexander Creek, Incorporated
- Caswell Native Association
- Chitna Native Corporation
- Chickaloon Moose Creek Native Association
- Dot Lake Native Corporation
- Eklutna, Incorporated
- Gold Creek-Susitna NCI
- Knikatnu, Incorporated
- Little Lake Louise Corporation
- Lower Tonsina Corporation
- Kenai Natives Association, Inc.
- Nebesna Native Group, Inc.
- Menda Cha-ag Native Corporation
- Montana Creek Native Association
- Ninilchik Natives Association, Incorporated
- Northway Natives, Incorporated
- Point Possession, Incorporated
- Salamatkof Native Association, Incorporated
- Slana Native Corporation
- Seldovia Native Association, Incorporated
- Tanacross, Incorporated
- Tetlin Native Corporation
- Toghotthele Corporation
- Twin Lake Native Group, Incorporated
- Tyonek Native Corporation

4.11.6.2. Subsistence Resources

Several federally-recognized Tribes were identified as having potential interests within the Project region that may be affected by the proposed Project, based on the location of traditional tribal territories. Federally-recognized Tribes with lands or historical use that may be affected by the Project do not have a signed treaty with the U.S. Government identifying the rights of the Tribes. None of the identified Tribes has a reservation or trust lands directly within or adjacent to the proposed Project boundary. The Project area has been used by Tribes for subsistence for thousands of years. Tribes in the Project area are listed in Table 4.11-4.

Table 4.11-4. List of Tribes and populations in Project area.

Affected Tribes	Total Population	Estimated Tribal Population
Native Village of Mentasta	112	85
Native Village of Cheesh Na' (Chistochina)	93	50
Native Village of Gulkana	119	91
Native Village of Gakona	218	43
Native Village of Tazlina	297	100
Native Village of Kluti-Kaah (Copper Center)	328	159
Native Village of Chitina	126	25
Native Village of Cantwell	219	34
Native Village of Chickaloon	272	17
TOTALS	1784	604

Because the State of Alaska recognizes all residents of the state as subsistence users, there are other communities or populations which may have a potential interest within the Project region. These communities are listed in Table 4.11-5. The total population figure represents the minimum number of people with subsistence interests in the Project region.

Table 4.11-5. Total potential subsistence population in Project area.

Community	Total Population
Wasilla	7,831
Willow	2,102
Houston	1,912
Talkeetna	876
Trapper Creek	481
Petersville Road dispersed households	4
Chase	34
Palmer	5,937
Sutton–Alpine	1,447
Glennallen	483
Paxson	40
Slana	147
Silver Springs	114
McCarthy	28
Nelchina	59
Mendaltna	39
Lake Louise	46
Kenny Lake	355
TOTAL	21,935

Source of population figures: DCCED n.d.

4.11.7. Potential Protection, Mitigation and Enhancement

Potential PM&E measures for cultural resources and subsistence resources are described below.

4.11.7.1. Recommended Approach for Consultation on Recovery of Significant Information from Archaeological Sites

Cultural resource protection, mitigation and enhancement measures will be developed in consultation with the appropriate agencies and entities. Measures concerning archaeology will be developed in accordance with the basic principles contained in the Advisory Council on Historic Preservation's (ACHP's) "Recommended Approach for Consultation on Recovery of Significant Information from Archaeological Sites" (ACHP 2010):

- The pursuit of knowledge about the past is in the public interest.
- An archaeological site may have important values for living communities and cultural descendants in addition to its significance as a resource for learning about the past; its appropriate treatment depends on its research significance, weighed against these other public values.
- Not all information about the past is equally important; therefore, not all archeological sites are equally important for research purposes.
- Methods for recovering information from archaeological sites, particularly large-scale excavation, are by their nature destructive. The site is destroyed as it is excavated. Therefore management of archeological sites should be conducted in a spirit of stewardship for future generations, with full recognition of their non-renewable nature and their potential multiple uses and public values.
- Given the non-renewable nature of archeological sites, it follows that if an archeological site can be practically preserved in place for future study or use, it usually should be (although there are exceptions). However, a simple avoidance of a site is not the same as preservation.
- Recovery of significant archeological information through controlled excavation and other scientific recording methods, as well as destruction without data recovery, may both be appropriate treatment for certain archeological sites.
- Once a decision has been made to recover archeological information through the naturally destructive methods of excavation, a research design and data recovery plan based on firm background data, sound planning, and accepted archeological methods should be formulated and implemented. Data recovery and analysis should be accomplished in a thorough, efficient manner, using the most cost-effective techniques practicable. A responsible archeological data recovery plan should provide for reporting and dissemination of results, as well as interpretation of what has been learned so that it is understandable and accessible to the public. Appropriate arrangements for curation of archeological materials and records should be made. Adequate time and fund should be budgeted for fulfillment of the overall plan.
- Archeological data recovery plans and their research designs should be grounded in and related to the priorities established in regional, state, and local historic preservation plans, the needs of land and resource managers, academic research interests, and other legitimate public interests.
- Human remains and funerary objects deserve respect and should be treated appropriately. The presence of human remains is an archeological site usually gives the site an added importance as a burial site or cemetery, and the values associated with burial sites need to be fully considered in the consultation process.

Large-scale, long-term archeological identification and management programs require careful consideration of management needs, appreciation for the range of archeological values represented, periodic synthesis of research and other program results, and professional peer review and oversight.

4.11.7.2. Multi-Phase Program for Cultural Resources

For the previously proposed hydroelectric project in the 1980s, a multi-phase program was developed to ensure compliance with laws and regulations relating to the consideration of cultural resource issues in project planning and development. The three principal phases of the program included: data collection and analysis; impact assessment; and mitigation planning and implementation. For the currently proposed Project, it is likely that a similar multi-phase program will be developed to address cultural resource issues and concerns.

4.11.7.3. Mitigation Plan for Cultural Resources

As presently envisioned, the mitigation plan for the Project includes: avoidance; preservation in place; data recovery; monitoring; and a public interpretation and education program. These components are discussed further below. In consultation with the appropriate agencies and entities, the mitigation plan would also include a procedure for identifying, evaluating and treating cultural resources discovered after the issuance of the Project license.

4.11.7.3.1. Avoidance

Avoidance, the preferred mitigation technique, would normally be feasible only for those sites located in direct impact areas, other than impoundments and associated erosion areas and the Project dam site. Access to cultural resource sites within or in close proximity to construction laydown areas would, wherever possible, be restricted during Project construction.

4.11.7.3.2. Data Recovery (Excavation)

Data recovery (excavation) would be the principal mitigation technique employed. Based on the Susitna Project proposed in the 1980s, it is believed that the nature of the known archeological data base suggests that there are a large number of redundant site components (according to age and function). For this reason, it is anticipated that data recovery would be undertaken at a sample of sites likely to be directly impacted by the Project. The selection of sites for data recovery would be determined by a number of site factors, including but not limited to: site condition; the nature and degree of impact to the site; and the site's ability to contribute to the solution of important research questions.

Sites which would be destroyed by ground-disturbing activities associated with construction would be given priority, followed by sites which are located within the Project reservoir drawdown area. The latter would be subjected to steady erosion. Sites within the permanent pool will then be selected to fill any remaining requirements of the site selection sample procedure.

Some sites located along reservoir margins in close proximity to construction activities or within the permanent reservoir pool may be selected for preservation in place. This may take the form of the construction of protective barriers to minimize erosion, controlled burial or fencing of the site to restrict access.

4.11.7.3.3. Monitoring Program

The monitoring program for the Project would include several components. Limited monitoring of construction activities would be implemented to ensure that compliance with the mitigation program occurs. Long-term monitoring involving regularly scheduled inspections of sites along reservoir margins would be undertaken to ascertain if these sites are being adversely affected.

4.11.7.3.4. Interpretation and Education Program

In addition, a public interpretation and education program about the Project area's cultural resources would be developed for the benefit of site visitors and the public in general.

An adjunct to the education program would include an orientation for all construction and supervisory personnel to inform them about: reasons for the presence of restricted areas; restrictions on the vandalism of archeological or historic sites and on the collecting of artifacts; the nature of cultural resources sites in the Project area and how to recognize them; and procedures to be followed in the event that cultural resources are discovered or disturbed during construction.

4.11.7.4. Pre-Construction Cultural Resource Surveys

Pre-construction cultural resources surveys will be conducted along the rights-of-way for the Project's transmission lines and access roads, as part of the overall mitigation plan. AEA would, in consultation with the SHPO, determine which portions of these areas are likely to contain cultural resources. The selection of areas would be based upon the tested model of cultural resources distribution (Greiser et al. 1985). If cultural resources are located in any survey area, appropriate mitigation will be considered. The latter may include things such as changes in tower placement or movement of Project centerlines. If neither of these procedures is feasible, data recovery would be undertaken. The scope of any data recovery activities conducted in such circumstances would be developed in consultation with the SHPO.

4.11.7.5. Cultural Resource Field Study Permits

All required state and federal permits will be obtained prior to each year's field studies. The SHPO, the Alaska State Archeologist, as well as archeologists with the National Park Service and the Bureau of Land Management, will be consulted throughout the development and execution of a cultural resources program for the Project. Copies of annual field reports and reports on other aspects of the cultural resources program will be provided to these agencies on a regular basis. Consultation with these agencies will be on a continual basis regarding: the evaluation of the significance of sites in the Project area; the development, testing and implementation of a model to assess the archeological sensitivity of unsurveyed areas of the corridors associated with Project transmission lines, access roads and the railroad; and the details of the proposed mitigation plan.

4.11.7.6. Proposed Potential Subsistence Mitigation and Enhancement Measures

Proposed PM&E measures will be developed in consultation with interested parties during the licensing process.

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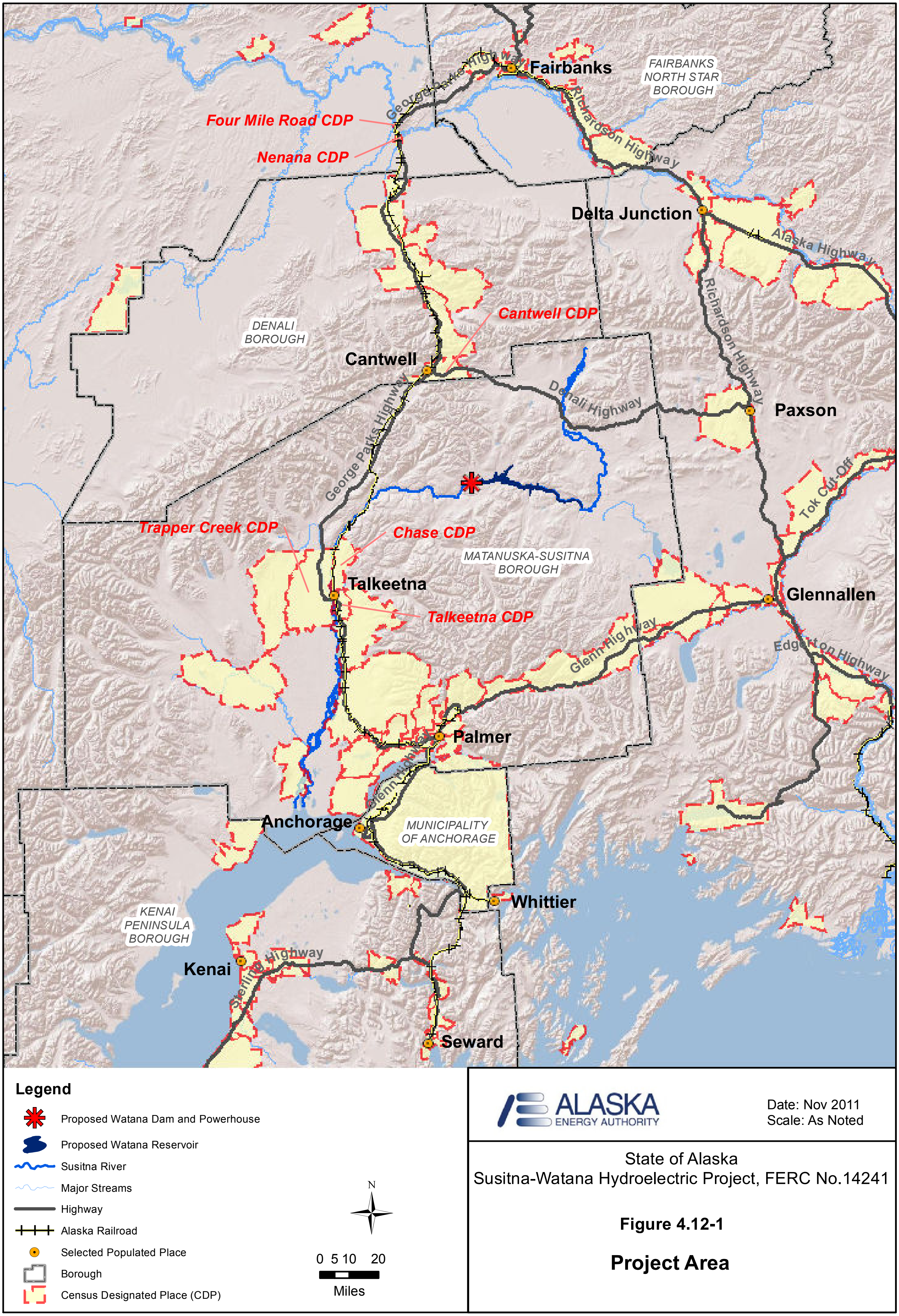
4.12. Socioeconomic Resources

4.12.1. Introduction

The Project is located within Matanuska-Susitna Borough (MSB) (see Figure 4.12-1). The nearest community is Cantwell, which is approximately 41 mi north of Watana. Cantwell is an unincorporated community with an estimated population of 219 in 2010 (U.S. Census Bureau (USCB) 2010). The nearest major town is Wasilla, with a 2010 population of 7,831 (USCB 2010). Wasilla is located approximately 91 mi south-west of Watana and approximately 130 mi south of Cantwell (distances are "as the crow flies").

Based on the current Project description, the principal areas being considered as part of this analysis are the Denali Borough and the MSB. Within the Denali Borough, the principal area under consideration is Cantwell as this is the closest community to the proposed Project. In the MSB, the Trapper Creek, Chase, and Talkeetna community council areas will be documented in greater detail due to their proximity to the proposed Project.

Information for the Railbelt has also been included to provide a regional context. For the purposes of this analysis, the Railbelt is defined as the Kenai Peninsula Borough, Municipality of Anchorage, MSB, Denali Borough, Fairbanks North Star Borough, Four Mile Road census-designated place (CDP) and Nenana CDP. When the Project description has been finalized, including the identification of the transmission line and access corridors, the areas being considered for analysis will be re-evaluated. In addition, if a transmission line is built on a new alignment, these areas being considered for analysis might also change.



ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.12-1

Project Area

4.12.2. Land Use and Real Estate

The MSB is comprised of over 24,000 square mi and contains urbanized, suburban, rural and remote areas (Mat-Su BPLUD 2005). There are 26 recognized communities, each distinguished with unique lifestyles and community values (Mat-Su BPLUD 2005). The U.S. Census Bureau (USCB) identifies the MSB as a metro area of Anchorage, Alaska (USCB 2011).

Since the first MSB-wide Comprehensive Plan was developed and adopted in 1970, the Borough has dramatically changed in terms of its economy, population and built/natural environment. For instance, in 1970 the MSB had an agricultural-based economy, a population of approximately 7,500 and limited infrastructure (Mat-Su BPLUD 2005). By 2005, retail, finance and real estate services became the primary sectors of the MSB's economy, the population increased to almost 75,000, and both public and private infrastructure grew significantly (Mat-Su BPLUD 2005).

The new growth has also brought new industries and technologies to the MSB. Some of these new industries and technologies, such as communication towers, waste incinerators, and oil and gas development, have created compatibility issues in residential neighborhoods and recreational areas (Mat-Su BPLUD 2005). Managing these and other land uses to enhance the quality of life of Borough residents, while also improving and diversifying the local economy, is one task of comprehensive planning (Mat-Su BPLUD 2005). According to the Mat-Su Comprehensive Development Plan (2005), the borough has become distinguished by its diversity in land patterns and communities.

Additional information regarding recreation land use can be found in section 4.10 of this PAD.

4.12.2.1. Parks and Open Spaces

Parks and other open spaces make a distinct contribution to the landscape and quality of life in the MSB (Mat-Su BPLUD 2005). The Mat-Su Comprehensive Development Plan (2005) notes that as the borough experiences additional growth pressures, the protection of parks and spaces is needed, and the equitable dispersion of parks and open spaces needs to be addressed. The MSB faces challenges including (Mat-Su BPLUD 2005):

- Acquiring and developing additional parkland, campgrounds and recreational areas in sections of the borough where these amenities are deficient, by providing additional neighborhood parks, community parks, campgrounds, recreational areas and open spaces;
- Providing additional pedestrian and bicycle trails and linkages, between parks, open spaces, water bodies and neighborhoods; acquiring additional pubic greenways to enhance such trails and linkages;
- Developing facilities such as restrooms and additional benches in new and existing parks and recreational areas;
- Providing ongoing renovation and maintenance of parks and recreational areas associated facilities; and
- Promoting habitat conservation through acquisition and preservation of important natural areas, including farms and open spaces.

The MSB maintains a large number and diversity of parks, campgrounds and recreational areas (Mat-Su BPLUD 2005). As the Borough's population continues to grow, the demand for various year-round passive and active recreational opportunities increases. The Mat-Su Comprehensive Development Plan (2005) includes a policy aimed at ensuring that parks and open spaces are provided using the specific standards to determine the need for parks. This policy is shown below on Table 4.12-1.

Table 4.12-1. Policy PO1-4; Park and open space levels of service.

Facility	Standard
Neighborhood Parks	5 ac / 1,000 persons
Community Parks	10 ac / 3,500 persons
Nature / Open Space Parks	15 ac / 5,000 persons

Source(s): Mat-Su BPLUD 2005

4.12.2.2. Natural Areas and Conservation

Natural areas and open spaces are noted as vital components "of the health and well being of the [b]orough" in the Mat-Su Comprehensive Development Plan (2005). In surveys and workshops, MSB citizens have consistently identified natural areas as being a key component of the borough's life quality (Mat-Su BPLUD 2005). The Mat-Su Comprehensive Development Plan (2005) asserts that the conservation and enhancement of the ecological resources found within the borough should be a primary component of the borough's land use and park planning.

The MSB has hundreds of lakes, streams and rivers that provide valuable habitat for fish and wildlife, contribute to water quality and provide recreational opportunities (Mat-Su BPLUD 2005). Open space corridors serve many important functions, including recreation, fish and wildlife habitat, and the connection of individual features that comprise a natural system (Mat-Su BPLUD 2005).

4.12.2.3. Natural Water Systems

The Mat-Su Comprehensive Development Plan (2005) indicates that the Borough has been embarking on a study/plan to address the past, current and future impacts, as well as to evaluate and record the primary functions, existing problems and future opportunities, within the Big Lake Watershed natural system. This effort is indicative of the importance of planning efforts have when addressing borough-wide watershed issues (Mat-Su BPLUD 2005). The Mat-Su Comprehensive Development Plan (2005) encourages preserving the natural drainage system to the greatest extent feasible, and discourages non-essential structures, land modifications or impervious surfaces in the drainage system to "assist in ensuring optimal natural functioning within the drainage area."

4.12.2.4. Land Use Regulations

The MSB uses both borough-wide and special use district (SpUD) zoning ordinances (Mat-Su BPLUD 2005).

4.12.2.5. Real Estate

The USCB (2011) reports that in 2009 there were 28,744 housing units in the MSB. Between 2005 and 2009, 10.2 percent of housing units were in multi-unit structures in the borough (USCB 2011). During this time period, the homeownership rate in the MSB was 79.9 percent; above the homeownership rate for Alaska overall (63.8 percent) (USCB 2011). The median value of owner-occupied housing units for 2005 through 2009 was $205,000 (USCB 2011).

4.12.3. Demographics

In the Denali Borough, the population is centered around the Parks Highway. The population of the Borough has remained relatively unchanged since it was formed (see Table 4.12-2). However, in the past 30 years the population of Cantwell has increased by almost 150 percent (from 89 to 219).

In the MSB, while a substantial amount of development is focused along the Parks and Glenn highway corridors, development is more dispersed. The MSB has grown dramatically (by almost 400 percent) in the past 30 years. Much of this growth has been in the MSB's core area, which includes Wasilla and Palmer. The northern portion of the Borough near the proposed Project, has also experienced growth but at a lower rate. These areas are less densely populated than the core area.

Tables 4.12-2 through 4.12-6 below summarize demographic characteristics, including race, gender, age, and occupation, of the Denali Borough, the MSB, and the Trapper Creek, Chase, Talkeetna, and Cantwell CDPs. (The 2010 Census does not provide information on a community council basis. For the purposes of this analysis, the CDP will be used.) Demographic characteristics for the Railbelt are also summarized in Tables 4.12-2 through 4.12-6. The MSB and Denali Borough boundaries, as well as the CDP boundaries, are illustrated in Figure 4.12-1.

Table 4.12-2. Populations of the CDPs, Boroughs and Railbelt in the Project study area.

	Trapper Creek CDP	Chase CDP	Talkeetna CDP	MSB	Cantwell CDP	Denali Borough	Railbelt
1980	No data	No data	264	17,816	89	No data	271,982
1990	296	38	250	39,683	147	1,797	386,733
2000	423	41	772	59,322	222	1,893	454,469
2010	481	34	876	88,995	219	1,826	536,049

Source(s): 2010 U.S. Census Bureau

According to the 2010 Census, the racial composition of the MSB and the Denali Borough is predominantly white (see Table 4.12-3). The highest proportion of minority residents is found in the Cantwell CDP, where approximately 23 percent of the residents are considered a minority (primarily American Indian/Alaska Native). Overall, the Denali Borough and the MSB are less racially diverse than the Railbelt population.

Table 4.12-3. Populations of the CDPs, Boroughs and Railbelt in the Project study area, by race and ethnicity.

	Trapper Creek CDP		Chase CDP		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
White	416	86 percent	34	100 percent	801	91 percent	75,540	85 percent	169	77 percent	1,637	90 percent	391,942	73 percent
Black or African American	2	0 percent	0	0 percent	3	0 percent	856	1 percent	1	0 percent	10	1 percent	21,785	4 percent
American Indian and Alaska Native	31	6 percent	0	0 percent	32	4 percent	4,901	6 percent	34	16 percent	65	4 percent	39,211	7 percent
Asian	5	1 percent	0	0 percent	4	0 percent	1,096	1 percent	0	0 percent	19	1 percent	27,919	5 percent
Pacific Islander	0	0 percent	0	0 percent	4	0 percent	221	0 percent	0	0 percent	1	0 percent	6,638	1 percent
Other	0	0 percent	0	0 percent	2	0 percent	640	1 percent	4	2 percent	14	1 percent	9,283	2 percent
Two or More Races	27	6 percent	0	0 percent	30	3 percent	5,741	6 percent	11	5 percent	80	4 percent	39,271	7 percent
Hispanic Origin (any race)	5	1 percent	0	0 percent	16	2 percent	3,301	4 percent	3	1 percent	42	2 percent	32,698	6 percent
Not Hispanic (any race)	476	99 percent	34	100 percent	860	98 percent	85,694	96 percent	216	99 percent	1,784	98 percent	503,351	94 percent

Source(s): 2010 U.S. Census.

The gender distribution in the Denali Borough and the MSB is similar to that of the Railbelt, with slightly more than half the population being male (see Table 4.12-4). The percentage of males is highest in Chase and Cantwell (64.7 and 58.4 percent, respectively).

The median age in the Denali Borough and the Cantwell, Trapper Creek, Chase and Talkeetna CDPs is higher than that of the MSB and the Railbelt (see Table 4.12-4). This is not due to significantly higher numbers of people aged 65 and over in these areas. Rather, it is due to a relatively high percentage (26 to 53 percent) of the residents in these areas who were between the ages of 45 and 59, according to the 2010 Census.

Table 4.12-4. Populations of the CDPs, Boroughs and Railbelt in the Project study area, by gender and age.

	Trapper Creek CDP		Chase CDP		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
Gender														
Male	253	52.6 percent	22	64.7 percent	453	51.7 percent	46,040	52 percent	128	58.4 percent	1,002	54.9 percent	276,035	51.5 percent
Female	228	47.4 percent	12	35.3 percent	423	48.3 percent	42,955	48 percent	91	41.6 percent	824	45.1 percent	260,014	48.5 percent
Age														
Under 5 years	32	6.7 percent	0	0.0 percent	47	5.4 percent	6,900	8 percent	12	5.5 percent	114	6.2 percent	40,386	7.5 percent
5 –9 years	22	4.6 percent	0	0.0 percent	48	5.5 percent	7,082	8 percent	13	5.9 percent	114	6.2 percent	38,262	7.1 percent
10 –14 years	20	4.2 percent	0	0.0 percent	44	5.0 percent	7,189	8 percent	11	5.0 percent	118	6.5 percent	37,839	7.1 percent
15– 19 years	28	5.8 percent	3	8.8 percent	34	3.9 percent	6,985	8 percent	16	7.3 percent	97	5.3 percent	39,028	7.3 percent
20– 24 years	18	3.7 percent	0	0.0 percent	18	2.1 percent	5,009	6 percent	5	2.3 percent	49	2.7 percent	42,615	7.9 percent
25– 29 years	18	3.7 percent	1	2.9 percent	34	3.9 percent	5,849	7 percent	8	3.7 percent	96	5.3 percent	43,063	8.0 percent
30– 34 years	17	3.5 percent	3	8.8 percent	72	8.2 percent	5,738	6 percent	16	7.3 percent	136	7.4 percent	36,761	6.9 percent

	Trapper Creek CDP		Chase CDP		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
35– 39 years	27	5.6 percent	0	0.0 percent	53	6.1 percent	5,946	7 percent	18	8.2 percent	138	7.6 percent	35,474	6.6 percent
40– 44 years	30	6.2 percent	4	11.8 percent	82	9.4 percent	6,234	7 percent	19	8.7 percent	131	7.2 percent	35,392	6.6 percent
45– 49 years	50	10.4 percent	2	5.9 percent	79	9.0 percent	7,067	8 percent	13	5.9 percent	189	10.4 percent	40,693	7.6 percent
50– 54 years	65	13.5 percent	9	26.5 percent	101	11.5 percent	7,279	8 percent	28	12.8 percent	191	10.5 percent	41,760	7.8 percent
55– 59 years	45	9.4 percent	7	20.6 percent	103	11.8 percent	6,364	7 percent	16	7.3 percent	198	10.8 percent	37,055	6.9 percent
60– 64 years	47	9.8 percent	3	8.8 percent	72	8.2 percent	4,284	5 percent	14	6.4 percent	118	6.5 percent	26,668	5.0 percent
65– 69 years	32	6.7 percent	1	2.9 percent	43	4.9 percent	2,913	3 percent	16	7.3 percent	73	4.0 percent	16,574	3.1 percent
70– 74 years	12	2.5 percent	0	0.0 percent	20	2.3 percent	1,712	2 percent	7	3.2 percent	37	2.0 percent	9,736	1.8 percent
75 –79 years	13	2.7 percent	0	0.0 percent	17	1.9 percent	1,188	1 percent	5	2.3 percent	19	1.0 percent	6,701	1.3 percent
80– 84 years	5	1.0 percent	0	0.0 percent	4	0.5 percent	730	1 percent	2	0.9 percent	5	0.3 percent	4,493	0.8 percent
85 years and over	0	0.0 percent	1	2.9 percent	5	0.6 percent	526	1 percent	0	0.0 percent	3	0.2 percent	3,549	0.7 percent
Median age	48		52		45.4		34.8		42.7		41.5		32.0[1]	

	Trapper Creek CDP		Chase CDP		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
Population 18 years and over	385	80.0 percent	32	94.1 percent	709	80.9 percent	63,276	71 percent	173	79.0 percent	1,415	77.5 percent	395,920	73.9 percent
Population 65 years and over	62	12.9 percent	2	5.9 percent	89	10.2 percent	7,069	8 percent	30	13.7 percent	137	7.5 percent	41,053	7.7 percent

Note(s):

[1] The median age for the Railbelt was calculated based on the census age range information as more detailed information was not available. The actual median age for the Railbelt may vary.

Source(s): 2010 U.S. Census.

Per capita and median household incomes are lower in the Trapper Creek and Cantwell CDPs than in the Denali Borough, MSB or the Railbelt as a whole (see Table 4.12-5). This is expected as these areas tend to have more people who live a subsistence lifestyle rather than holding a wage and salary job.

Table 4.12-5. Incomes in the CDPs, Boroughs and Railbelt in the Project study area.

	Trapper Creek CDP	Chase CDP[1]	Talkeetna CDP	MSB	Cantwell CDP	Denali Borough	Railbelt
Per Capita Income:	$18,247	No data	$21,737	$24,906	$22,359	$44,689	N/A
Median Household Income:	$27,031	No data	$56,538	$75,052	$51,875	$91,875	$62,500[2]

Note(s):

[1] Information is not available for the Chase CDP because the reference population was too small to protect the anonymity of the data.

[2] The median household income for the Railbelt was calculated based on the median household income range information as more detailed information was not available. The actual median household income may vary.

Source(s): 2005–2009 ACS.

According to the 2005–2009 American Community Survey (ACS), approximately one-third of the workforce in the MSB and the Denali Borough work in management, professional and related fields; a percent that is similar to the Railbelt as a whole (see Table 4.12-6). In Trapper Creek the occupation with the highest number of people is production, transportation and material moving, while the occupation with the largest number of people in Talkeetna and Cantwell is construction, extraction, maintenance and repair.

Table 4.12-6. Employment in the CDPs, Boroughs and Railbelt in the Project study area, by occupation.

	Trapper Creek CDP		Chase CDP[1]		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
Management, Professional and Related	21	16.8 percent	No data		86	21.1 percent	10,589	29.8 percent	14	25.0 percent	320	34.4 percent	86,292	35.0 percent
Service	6	4.8 percent	No data		101	24.8 percent	6,278	17.7 percent	10	17.9 percent	154	16.6 percent	43,024	17.4 percent
Sales and Office	33	26.4 percent	No data		60	14.7 percent	8,179	23.0 percent	9	16.1 percent	171	18.4 percent	61,598	25.0 percent
Farming, Fishing, and Forestry	0	0.0 percent	No data		0	0.0 percent	317	0.9 percent	0	0.0 percent	0	0.0 percent	1,517	0.6 percent
Construction, Extraction, Maintenance and Repair	15	12.0 percent	No data		92	22.5 percent	6,647	18.7 percent	15	26.8 percent	175	18.8 percent	31,636	12.8 percent
Production, Transportation and Material Moving	50	40.0 percent	No data		69	16.9 percent	3,530	9.9 percent	8	14.3 percent	109	11.7 percent	22,790	9.2 percent

Note(s):

[1] Information is not available for the Chase CDP because the reference population was too small to protect the anonymity of the data.

Source(s): 2005–2009 ACS.

4.12.3.1. Industry and Employment

Most employment in the Denali Borough is driven by Clear Air Force Base, Denali National Park and Preserve, Usibelli Coal Mine, and Golden Valley Electric Association. Employment dramatically increases during the summer months (from 1,000 in the winter to approximately 4,000) due to employment in tourism-related fields. A large number of these workers come from outside the borough. Residents tend to work in less seasonal industries such as government (including schools and national park personnel) and power generation (Fried 2009).

The economy of the MSB is more diverse than the Denali Borough economy. In general, employment has been growing faster than the population and the MSB now offers more employment opportunities than in the past. Two areas that have seen large increases in employment are health care and retail. Increases in these sectors mean residents can meet more of their needs without having to go into Anchorage or Fairbanks. While employment in the MSB is increasing, many MSB residents commute outside the borough for employment. A substantial number of these commuters travel to Anchorage, but many commute to places even further such as the North Slope (Fried 2010).

Table 4.12-7 and Table 4.12-8 list employment statistics for MSB and the Denali Borough as well as the Trapper Creek, Talkeetna and Cantwell CDPs, and the Railbelt.

Table 4.12-7. Employment in the CDPs, Boroughs and Railbelt in the Project study area.

	Trapper Creek CDP	Chase CDP[1]	Talkeetna CDP	MSB	Cantwell CDP	Denali Borough	Railbelt
Total Potential Work Force (Age 16 years and over)	291	No data	705	62,046	94	1,259	394,750
Total Employment:	125	No data	496	40,787	66	1,062	282,857
Civilian Employment	125	No data	408	40,300	66	948	268,470
Military Employment	0	No data	47	487	0	114	14,387
Civilian Unemployed (and seeking work)	11	No data	41	4,760	10	19	21,613
Population 16 and over not in Labor Force	155	No data	209	21,259	28	197	111,893
Class of Worker							
Private wage and salary workers	71	No data	307	25,691	27	596	174,272
Government Workers	29	No data	33	6,373	6	262	53,360
Self-employed in own not incorporated business workers	25	No data	68	3,268	23	71	18,403
Unpaid Family Workers	0	No data	0	208	0	0	822

Note(s):

[1] Information is not available for the Chase CDP because the reference population was too small to protect the anonymity of the data.

Source(s): 2005-2009 ACS.

Table 4.12-8. Employment in the CDPs, Boroughs and Railbelt in the Project study area, by industry.

	Trapper Creek CDP		Chase CDP[1]		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
Agricultural, Forestry, Fishing and Hunting, and Mining	20	16.0 percent	No data		32	7.8 percent	1,846	5.2 percent	1	1.8 percent	48	5.2 percent	10,659	4.3 percent
Construction	15	12.0 percent	No data		69	16.9 percent	5,192	14.6 percent	10	17.9 percent	27	2.9 percent	23,599	9.6 percent
Manufacturing	9	7.2 percent	No data		0	0.0 percent	779	2.2 percent	0	0.0 percent	0	0.0 percent	5,691	2.3 percent
Wholesale Trade	0	0.0 percent	No data		0	0.0 percent	685	1.9 percent	5	8.9 percent	9	1.0 percent	6,126	2.5 percent
Retail Trade	0	0.0 percent	No data		160	39.2 percent	4,848	13.6 percent	7	12.5 percent	99	10.7 percent	29,409	11.9 percent
Transportation and warehousing, and utilities	14	11.2 percent	No data		10	2.5 percent	2,341	6.6 percent	5	8.9 percent	71	7.6 percent	19,330	7.8 percent
Information	6	4.8 percent	No data		10	2.5 percent	1,021	2.9 percent	2	3.6 percent	5	0.5 percent	6,301	2.6 percent
Finance and insurance, and real estate and rental and leasing	0	0.0 percent	No data		19	4.7 percent	1,195	3.4 percent	0	0.0 percent	4	0.4 percent	12,422	5.0 percent
Professional, scientific, and management and waste management service	0	0.0 percent	No data		48	11.8 percent	2,821	7.9 percent	3	5.4 percent	265	28.5 percent	23,074	9.3 percent
Educational services, and health care and social assistance	12	9.6 percent	No data		30	7.4 percent	7,422	20.9 percent	3	5.4 percent	49	5.3 percent	53,056	21.5 percent
Arts, entertainment, and recreation and accommodation and food services	22	17.6 percent	No data		20	4.9 percent	3,250	9.1 percent	18	32.1 percent	154	16.6 percent	21,868	8.9 percent

	Trapper Creek CDP		Chase CDP[1]		Talkeetna CDP		MSB		Cantwell CDP		Denali Borough		Railbelt	
	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent	#	percent
Other services except public administration	13	10.4 percent	No data		10	2.5 percent	1,952	5.5 percent	0	0.0 percent	41	4.4 percent	12,323	5.0 percent
Public administration	14	11.2 percent	No data		0	0.0 percent	2,188	6.2 percent	2	3.6 percent	157	16.9 percent	22,999	9.3 percent

Note(s):
[1]Information is not available for the Chase CDP because the reference population was too small to protect the anonymity of the data.
Source(s): 2005-2009 ACS.

4.12.3.2. Community Identity and Quality of Life

The Mat-Su Comprehensive Development Plan (2005) states that the MSB's natural environment, with its abundant supplies of clean water, aesthetics and other natural resources, has attracted people to the community for generations. Natural systems serve many essential biological, hydrological and geological functions that significantly affect life and property in the borough (Mat-Su BPLUD 2005). The Mat-Su Comprehensive Development Plan (2005) also recognizes that the borough's natural environment provides other valuable amenities, such as scenic landscape, community identity, open space and opportunities for recreation, culture and education.

The Mat-Su Comprehensive Development Plan (2005) indicates that the Borough is a "place to work and play;" an image the community projects which attracts businesses and industries. The tourism and recreational industries have capitalized on the MSB's quality of life in recent decades (Mat-Su BPLUD 2005). The Mat-Su Comprehensive Development Plan (2005) further notes that the Borough's citizens recognize and often comment upon the important role of the natural environment plays in their quality of life; and that the Borough's challenge for the future will be accommodating new and infill growth while protecting and enhancing natural systems on public and private lands.

4.12.3.3. Education

Between 2005 and 2009 the USCB reports that 90.6 percent of MSB residents (age 25 or greater) had graduated from high school. This is close to percentage of high school graduates for the state of Alaska overall (90.7 percent) during the same time period.

Between 2005 and 2009 the USCB (2011) reports that 19.9 percent of MSB residents (age 25 or greater) had a bachelor's degree or higher. This is lower than the percentage of Alaskan residents with a bachelor's degree or higher (26.5 percent) (USCB 2011).

4.12.3.4. Commuting

From 2005 through 2009, the mean travel time to work (for workers age 16 and above) for MSB residents was 33.6 minutes; which was above the mean travel time to work for Alaskans overall (17.9 minutes) (USCB 2011).

4.12.3.5. Households, Income and Poverty

Between 2005 and 2009 the USCB (2011) reports that there were 21,956 households in the MSB, with an average of 3.86 persons per household. In 2009 the median household income was $70,442; which was higher than the median household income for Alaskan residents overall ($66,712) (USCB 2011).

The USCB (2011) states that in 2009, 8.7 percent of MSB residents lived below the poverty level. This percentage is lower than that of Alaskan residents overall living below the poverty level in 2009 (9.1 percent) (USCB 2011).

4.12.4. Public Sector (Taxes and Services)

The following section describes existing public services and facilities in the Denali Borough and the MSB.

4.12.4.1. Local Government

The Denali Borough was formed in 1990. It includes four communities (Anderson, Clear, Cantwell and Healy) and includes a number of smaller settlements. The borough includes approximately 12,750 square mi of land and 25 square mi of water. Approximately 70 percent of the borough is the Denali National Park and Preserve.

The MSB was established in 1964. The MSB includes the incorporated cities of Palmer, Wasilla and Houston. In addition, there are numerous smaller unincorporated communities such as Willow and Big Lake. The MSB consists of approximately 24,680 square mi of land and 580 square mi of water.

4.12.4.2. Water and Wastewater

In the Denali Borough, most residents and businesses use individual wells and septic systems to meet their water and wastewater needs. Both the Usibelli Mine and Healy Clean Coal Project have individual water well systems. The Clear Air Force Station provides piped water and sewer for base facilities.

According to the Draft MSB Public Facilities Plan Revision, approximately 83 percent of households in the MSB are on private well and septic systems (MSB 2009). There are more than 20,000 active septic tanks in the MSB (MSB 2009). As much of the future residential growth is expected to occur on larger lots, the MSB anticipates approximately 56,000 active septic tanks by 2030 (this forecast is based on an estimated 2030 MSB population of 137,682) (MSB 2009). There is no regional septage handling facility in the MSB. In addition, some residents rely on hauling water and outhouses, while the more densely developed areas near Wasilla, Palmer, and Talkeetna have piped systems.

4.12.4.3. Solid Waste

The Denali Borough operates a landfill at Milepost (MP) 282.2 of the Parks Highway (approximately two mi southeast of the Clear Air Force Station). It is estimated that the landfill will reach capacity around 2023 (Denali Borough 2007). The Denali Borough also operates the Cantwell Transfer Station, located at mile 213.2 Parks Highway.

Currently, The MSB Solid Waste Management Division operates several solid waste disposal facilities including (MSB 2009):

- One permitted Class I landfill near Palmer
- One unattended trench fill near Skwentna
- Twelve waste drop-off sites (waste transfer stations and dumpsters)
- One recycling facility

As of 2002, the lifespan of the landfill was estimated to exceed 70 years (MSB 2009).

In each borough, some residents dispose of their solid waste on their own property, either by burning it or by burying it.

4.12.4.4. Police

The Alaska State Troopers (AST) provide police services within the Denali Borough. There are AST posts in Cantwell and Healy. In addition, the northern portion of the Denali Borough may receive police service from the AST post in Nenana.

Within the MSB, police services are provided by the AST, the Wasilla Police Department, and the Palmer Police Department. The Houston Police Department is currently not staffed, and emergency calls are being handled by the AST (City of Houston n.d.).

4.12.4.5. Fire

Fire protection in the Denali Borough is provided by volunteer fire departments (VFD) including:

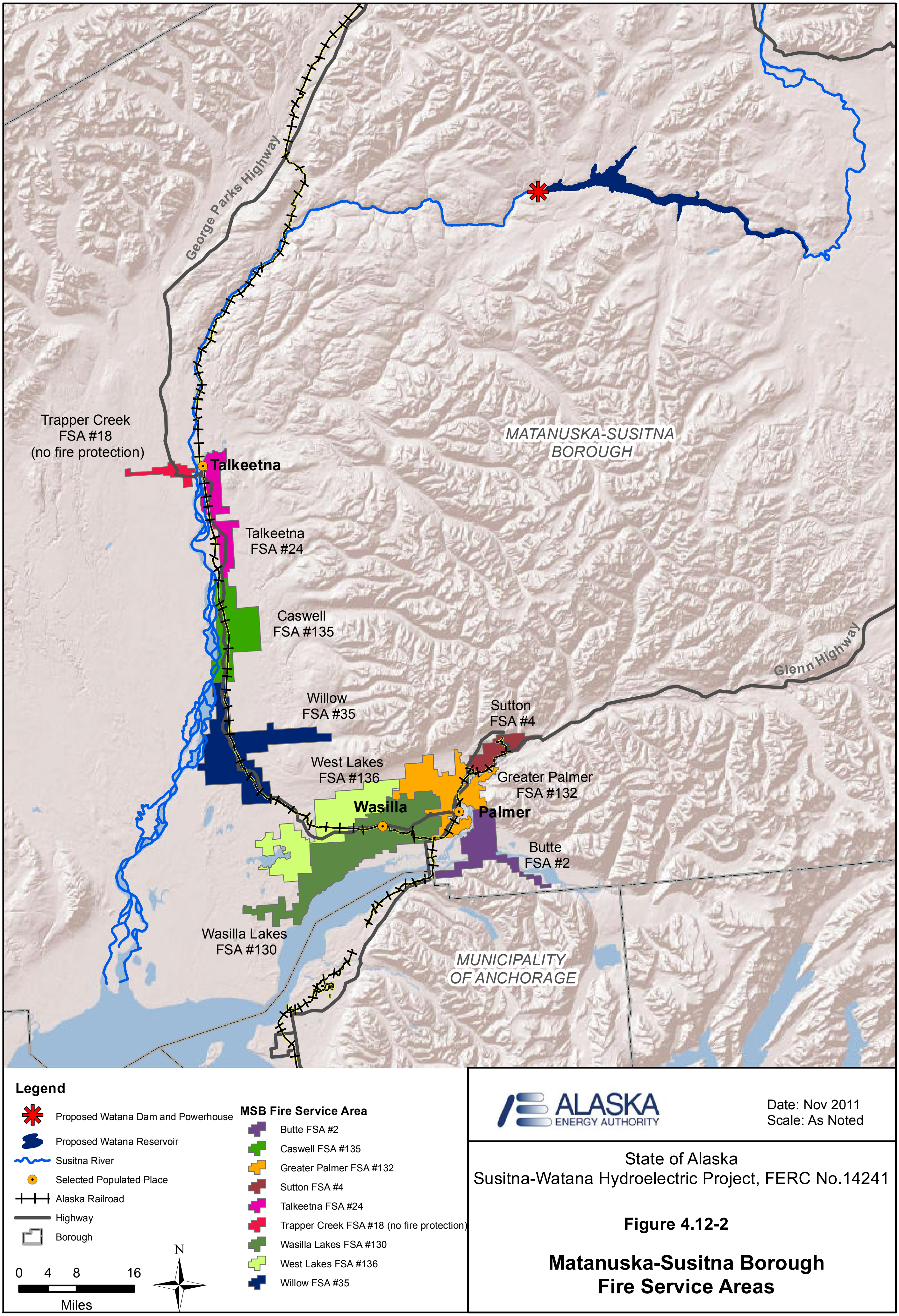
- Cantwell VFD
- McKinley VFD
- Tri-Valley VFD
- Anderson City Fire Department

The MSB Department of Emergency Services, the City of Palmer and the City of Houston provide fire department services within the MSB (MSB 2009). The MSB Department of Emergency Services provides fire coverage for areas within a Fire Service Area, but not all property in the MSB in covered by a Fire Service Area (areas outside a Fire Service Area rely on their own resources for fire protection) (see Figure 4.12-2). The MSB Fire Service is primarily a volunteer department.

Fire protection in the City of Palmer is provided by Palmer Fire and Rescue. Palmer Fire and Rescue is staffed by paid on-call volunteers who live in the City of Palmer or the Greater Palmer Fire Service Area. It operates out of six stations:

- Station 3-1; 717 S. Cobb St. (downtown Palmer)
- Station 3-2; 3 mi north of Palmer at 5955 N. Glenn Hwy (Mile 51)
- Station 3-3; 15855 E. Clark Rd. (Lazy Mountain)
- Station 3-4; 901 S. Airport Rd. (Palmer Airport)
- Station 3-5; 8200 E. Turner Rd. (Palmer Fishhook Rd.)
- Station 3-6; 645 E. Cope Industrial Way in Palmer
- Station 3-6 also functions as the Palmer Fire and Rescue Training Center.

The Houston Fire Department is housed in the Houston Emergency Services building at mile 57.3 on the Parks Highway.



ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.12-2

Matanuska-Susitna Borough Fire Service Areas

4.12.4.6. Health Care

In the Denali Borough, health care is available through the Cantwell Clinic, Anderson Health Clinic and the Tri-Valley Community Center. The Cantwell Clinic is operated by the Copper River Native Association and is a primary health care facility. The Anderson Health Clinic is a part of the Interior Emergency Medical Services (EMS) Region. Tri-Valley Community Center in Healy is a Community Health Center operated by the Interior Community Health Center. It is funded by a federal grant under Section 330 of the Public Health Service Act (DHHS 2009). Community Health Centers are required to treat all patients, regardless of their ability to pay.

In addition, there is the seasonally operated Canyon Health Clinic at Denali Park. These Denali Borough facilities are usually staffed by health aides. The government also operates the Clear Air Force Station (AFS) Medical Clinic. For more advanced health care, residents must go to facilities in the MSB, Anchorage and Fairbanks.

In the MSB, the largest health care facility is the Mat-Su Regional Medical Center. Opened in 2006, it has 74 beds and offers a wide variety of specialties and services. However, some patients still need to travel to Anchorage or to facilities outside Alaska for their medical care. The Sunshine Community Clinic, a Community Health Center in Talkeetna, is an emergency care clinic. There are numerous other clinics and private medical facilities in the MSB. The MSB Department of Emergency Services provides emergency medical care to the entire MSB.

4.12.4.7. Schools

The Denali Borough School District (DBSD) operates three schools (Anderson School, Cantwell School and Tri-Valley School) and a statewide correspondence school (Denali-PEAK), employing 27 teachers (State of Alaska 2010). According to the Alaska Department of Education and Early Development (DEED), as of October 1, 2010, there were a total of 768 students enrolled within the DBSD: Anderson School had 39 students between Kindergarten and Grade 12 (K-12), Cantwell School had 32, Tri-Valley School had 179 and Denali-PEAK had 491. An additional 27 students were enrolled in Pre-Elementary programs (DEED 2010).

In 2010, the MSB School District had a total of 17,079 students and employed 1,004 teachers at 44 schools, including 20 elementary schools, five middle schools, six high schools, four K-12 schools, a home school, six charter schools and three alternative education schools (MSB 2011; State of Alaska 2010). In the north-west part of the school district (closest to the Project location), there are three schools: Talkeetna Elementary, Trapper Creek Elementary and Su-Valley Jr./Sr. High (see Table 4.12-9).

Table 4.12-9. Schools in the MSB school district near the Project site.

School Name	Grades	Enrollment as of October 1, 2010
Talkeetna Elementary	Pre-Kindergarten to Grade 6	113 (Pre-Kindergarten students not reported)
Trapper Creek Elementary	Kindergarten to Grade 6	23
Su Valley Jr./Sr. High	Grades 7 through 12	190

Source(s): DEED 2010

4.12.4.8. Taxes/Municipal Finances

The Denali Borough is a Home Rule Borough. A Home Rule Borough has its powers and duties established through its adopted charter ratified by the voters. It can exercise any powers except those prohibited by federal or state law or by the home rule charter (DCCED 2003). The Denali Borough operates the schools and the landfill. Most other public services are not provided in the borough. The school district is the Denali Borough's biggest expense followed by the Assembly (approximately 2.1 million and 1.3 million dollars, respectively). Taxes are the borough's largest revenue source (approximately 2.3 million dollars). Table 4.12-10 summarizes the finances for the Denali Borough in fiscal year (FY) 2012.

Table 4.12-10. Denali Borough budget for fiscal year 2012.

General Fund		
	Estimated Revenues	Expenditures
Taxes	$2,290,000	
Intergovernmental, Federal	$289,387	
Intergovernmental, State	$569,068	
Other	$11,500	
Assembly		$1,272,237
Mayor		$856,794
School District		$2,069,720
Deposits to Borough Fund Accounts		$441,481
Matching Grants		$30,588
Total	**$3,159,955**	**$4,334,754**
Enterprise Funds		
Land Management Fund	$4,000	$277,420
Solid Waste Fund	$437, 652	$818,771

Source(s): Denali Borough 2011.

The MSB is incorporated as a second class borough and can levy fees and taxes which fund borough government and services. (General law boroughs obtain their powers and duties through established law. A first class general law borough can exercise powers not prohibited by law on a non-areawide basis by adopting an ordinance, while a second class borough must have voter approval to exercise non-areawide powers (DCCED 2003).) The MSB manages its school district as well as solid waste, fire protection (the MSB only organizes fire protection within a fire service area) and emergency medical services. Many other services such as water, sewer and law enforcement are managed locally by the cities of Palmer, Wasilla and Houston. Similar to the Denali Borough, the school district is the MSB's biggest expenditure (approximately 256.9 million dollars) and taxes are their largest revenue source (approximately 103.6 million dollars). Borough operations are the second highest expenditure (45.2 million dollars). Estimated expenditures and revenues for FY 2011 are shown in Table 4.12-11 and Table 4.12-12.

Table 4.12-11. MSB estimated expenditures for federal year 2011.

FY 2011 Expenditures (in millions)	
School Operations	$256.9
Debt Service	19.9
Borough operations	$45.2
Fire Service Area operations	$6.5
Road service area operations	$10.3
Enterprise operations	$11.5
Capital Projects	$12.8
Dust control program	$1.2
Miscellaneous grants	$2.6
Other service areas and E-911 operations	$1.3
Total Expenditures: $368.2 million	

Source(s): MSB 2010a.

Table 4.12-12. MSB estimated revenues for federal year 2011.

FY 2011 Revenues (in millions)	
Taxes	$103.6
Interest	$0.5
Fees	$15.1
State	$193.3
Federal	$31.5
Other	$4.1
Total Revenues: $348.1 million	

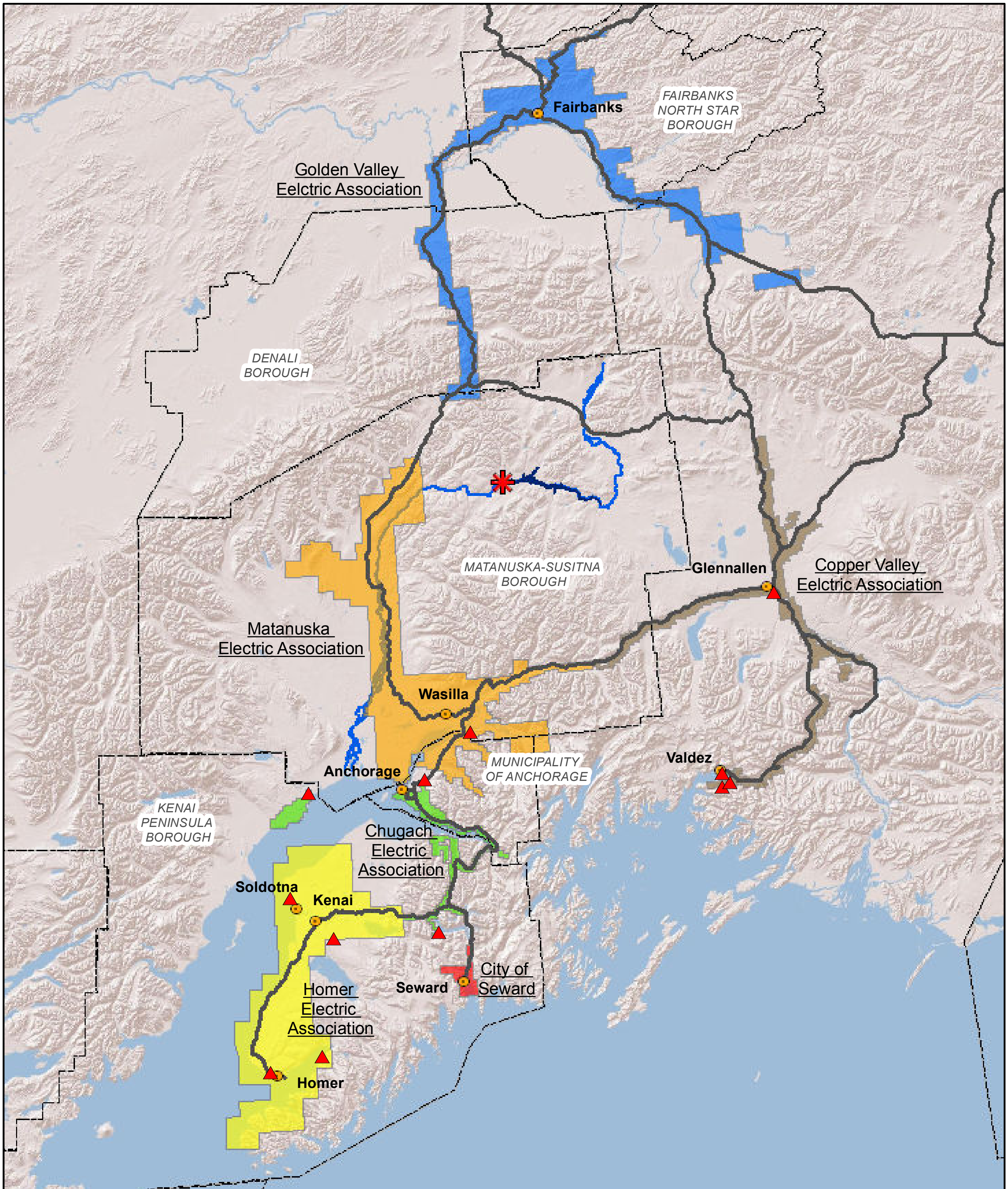
Source(s): MSB 2010a.

4.12.5. Electricity

The following electric utility companies are interconnected within the Railbelt electrical system:

- Matanuska Electric Association, Inc.
- Homer Electric Association
- Chugach Electric Association
- Seward Electrical Association
- Municipal Light and Power (ML&P)
- Golden Valley Electric Association

The service area for each utility is shown in Figure 4.12-3.



Legend

- Proposed Watana Dam and Powerhouse
- Proposed Watana Reservoir
- Susitna River
- Selected Populated Place
- Highway
- Borough
- Power Station

Railbelt Electrical Service Area

- Chugach Electric Association
- City of Seward
- Copper Valley Eelctric Association
- Golden Valley Eelctric Association
- Homer Electric Association
- Matanuska Electric Association

0 12.5 25 50
Miles

N

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.12-3

Electrical Utility Service Areas

4.12.6. Potential Adverse and Positive Impacts

The area in the immediate vicinity of the proposed Project is relatively isolated and unpopulated. Many of the Project's potential adverse impacts are related to the potential change in the location of the population. Once this has been quantified, a more detailed assessment of the socioeconomic impacts of the Project will be done.

Potential adverse impacts resulting from the construction and operation of the proposed Project are listed below. As stated previously, these impacts need to be quantified to better determine the actual impact to socioeconomic resources.

- Changes in subsistence harvesting opportunities would impact fish and wildlife populations and resources in the Susitna River watershed.
- Influxes in population would impact lifestyles in area communities, change the local real estate market, increase area traffic, alter employment opportunities, affect community identities and reputations, and increase demands on public services and facilities.
- Commercial fishing, hunting, trapping, etc., opportunities could be negatively impacted by activities associated with the proposed Project.
- Secondary development impacts on Native corporation undeveloped lands may occur.

4.12.6.1. Air Quality

Because of its remote location far from human activity, the existing air quality of the Project area is expected to be generally pristine. Only natural events such as forest fires and volcanoes could be expected to measurably impact air quality in the Project area, given the current low levels of human developments in the region. Therefore, it is not anticipated that the proposed Project would significantly alter area air quality.

4.12.6.1.1. Prevention of Significant Deterioration

The previous APA Project License Application from the 1980s provides some useful estimates of emissions from point sources and fugitive sources that would exist for portions of the projected six-year construction period for the currently proposed Project.

4.12.6.1.2. Total Suspended Particulate Matter

Information in the previously proposed APA Project license application from the 1980s indicates that ambient monitoring was conducted near a field camp in the project vicinity for total suspended particulate matter (TSP), which was previously the regulated form of Particular Matter (PM). Maximum 24-hour average TSP concentrations are cited in the previous application as being less than 10 micrograms per cubic meter ($\mu g/m^3$), based on the monitoring. The currently regulated forms of PM are particles under 10 microns (PM10) and particles under 2.5 microns (PM2.5). Since PM10 and PM2.5 represent the finer fractions of TSP, the concentrations of these regulated forms of PM are expected to be even lower than the TSP values measured earlier. Given the remoteness of the Watana site from human development, and the lack of any new emission sources in the Project area since the earlier measurements, it is expected that all size fractions of PM in the Project area would currently have concentrations less than 10 $\mu g/m^3$.

4.12.6.1.3. Regional Monitoring

The only recent regional monitoring data identified has been collected in the northeast corner of Denali National Park, approximately one mile west of the McKinley National Park Airport. This site is just over 60 mi north of the currently proposed Project location. Between 2000 and 2003, PM2.5 was monitored at this location and showed values generally far below the 24-hour average and annual average National Ambient Air Quality Standards (NAAQS). Two 24-hour concentrations over the 35 $\mu g/m^3$ NAAQS level occurred in August 2002, but these may have been of local origin, as most other 24-hour samples from the four-year period show values in the single digits, and typically a fraction of a $\mu g/m^3$ in the winter period. Notably, these high levels did not constitute a measured violation of the NAAQS, because the standard is based on the average of the 98th percentile value of measured concentrations over a three-year period.

Ozone data have also been collected for more than ten years, including up to the present, at the same Denali location where PM2.5 data were collected. These data have generally shown concentrations well below the current eight-hour ozone NAAQS of 75 parts per billion (ppb). However, for a one-week stretch in April 2008, ozone concentrations at the Denali monitor remained significantly elevated with the maximum eight-hour value on one day equaling 76 ppb. This did not constitute a measured violation because the standard is based on a three-year average of the annual 99th percentile of daily maximum eight-hour concentrations. Also, review of the meteorological data for the week of elevated ozone values in 2008 indicates that the ozone may have come from the stratosphere. A strong storm system followed by high pressure can mix some of the high ozone concentrations from the stratosphere down to ground elevation. Thus, this event was most likely due to such a natural occurrence, as opposed to manmade pollution.

4.12.6.1.4. Immediate Project Vicinity

While only TSP concentrations data have been collected in the immediate Project vicinity, expectations are that other pollutant levels in the Project vicinity are near background/natural levels, considering the lack of nearby human activity. Data from the prior 1980s Susitna Project-area TSP monitoring, and more recent data from the Denali monitoring site, will be summarized in the Project License Application.

4.12.7. Potential Protection, Mitigation, and Enhancement

PM&E measures proposed in the 1984 Project license application are listed below. These measures will likely be applied to the currently proposed Project.

- Avoiding large and rapid population influxes into communities, especially small communities. This will help prevent substantial shortages of housing, community facilities and services, cost of living increases and changes in lifestyle.
- Avoiding large traffic increases on the Denali and Parks Highways. This will help prevent increases in traffic accidents and animal road kills.
- Minimize, reduce or eliminate overtime, or compensate for significant adverse impacts resulting from Project construction worker-related population influxes and effluxes.
- Having a leave, shift and shift-change rotation schedules. This would result in different amounts and patterns of residence relocation and commuting by Project workers. Additionally, there would be different costs for transportation programs since more frequent rotations increase the number of trips per worker.
- Considering providing housing and related facilities for Project workers located near the Project construction site. To avoid large population influxes into nearby communities, single status accommodations at the Project site could be constructed for shift workers. Family accommodations and related facilities could be provided for Project workers who would be at the work site on a more permanent basis. These arrangements, together with appropriate leave and other schedules, would reduce resettlement by workers in nearby communities.
- Having a transportation program for Project workers. The presence of a transportation program in the early construction phases should have the general effect of decreasing population influxes into small communities located nearest to the Project site. These employees and their families, who would otherwise in-migrate to small communities, could retain their residences (which may be in Anchorage or Fairbanks). The type of transportation program instituted (i.e.; air, bus and/or van transportation) will affect the degree to which the Project-related population is shifted.
- Implement Project-community interaction between AEA, local agencies, state agencies and affected communities.
- Develop and implement an Impact Management Program to reduce adverse socioeconomic impacts caused by the Project.
- Providing updated information about Project features, labor needs, schedules, and Project impacts on communities to all concerned parties.
- Monitoring the socioeconomic conditions in communities affected by the Project, including the availability of housing, facilities and services.
- Developing an interdisciplinary task force to refine and implement Project mitigation measures.

The Project will comply with management plans for the state and federal lands, as well as the boroughs, in the Project area. Camps for workers will be considered during construction to avoid impacts and conflicts with area residents. Alternatively, construction workers could be bused into the site from a centralized meeting point. Mitigation measures for air emissions may be needed during the construction period. During any periods when roads or non-vegetated areas become dry and dusty, watering or other fugitive dust suppression measures will be employed to minimize migration of dust off-site.

Additional measures will be identified at a later date to address ongoing socioeconomic impacts of the Project associated with its construction and long-term operation.

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4.13. Alaska Native Resources

4.13.1. Introduction

The Susitna River basin has been a source for subsistence hunting, fishing, and gathering, travel to other areas and settlement. It is an area with a long traditional history and cultural importance to Alaska Natives in the region.

Alaska Native resources as an analysis category encompasses many resources, including (but not limited to): fish and aquatic resources, wildlife and botanical resources, subsistence resources, cultural resources, recreation and land use. As such, Alaska Native resources are discussed in general terms, acknowledging these other studies and their applicability where appropriate.

This analysis focuses on summarizing and analyzing information relating to land and other resources of interest to identified Alaska Native entities that may be affected by the Project. In order to account for the range of Alaska Native entities recognized in federal statute under the Alaska Native Claims Settlement Act (ANCSA), as well as Tribes recognized by the U.S. Department of the Interior, two main types of Alaska Native entities were reviewed for this document: Alaska Native tribes federally-recognized by the Bureau of Indian Affairs pursuant to 25 CFR 83.6(b); and Alaska Native entities defined under ANCSA (43 USC §1602; i.e., Regional Corporations, Village Corporations, Group Corporations and Urban Corporations).

The study area for Alaska Native resources encompasses a broad area, and includes the Susitna basin and Upper Cook Inlet. Because of the potential for resources within this area to be of interest to Alaska Native entities elsewhere in the state, baseline information was reviewed for all Alaska Native entities within the Cook Inlet Region, Inc. (CIRI) and Ahtna Inc. regions, as well as Alaska Native entities in the Doyon, Ltd. region with lands or interests near the northern boundary of the Susitna basin.

Of the over 229 Alaska Native groups federally-recognized as Indian tribes in Alaska, 22 are located within or in close proximity to the Project area, and may have interests in the Project (see Table 4.13-1). Additionally, there are three Regional Corporations with interests in areas that may be affected by the Project. There are also 14 Village Corporations, five Group Corporations, and one Urban Corporation with land and/or other resource interests that may be affected by the Project. These Alaska Native entities are identified in the following pages. To understand the specific nature of their respective interests, further consultation with these entities should occur, in a manner consistent with government-to-government and public involvement consultation policies, as appropriate.

4.13.2. Alaskan Native Consultation

Identified Alaska Native communities, governments, corporations, and other resources are described below.

4.13.2.1. Identified Communities and Alaska Native Tribal Governments

Historically, in what is now the lower-48 United States, tribal governments made nation-to-nation agreements with the federal government, or treaties, in which Indian tribes agreed to relinquish ownership rights to vast amounts of their traditional territories in exchange for smaller areas over which they would exercise exclusive possession and control. Many of these agreements also recognized hunting and fishing rights in areas outside "reserved" areas. These agreements created what has been described as a "trust relationship," in which the U.S. government and all agencies have a duty to protect tribal rights and resources. Despite some erosion of tribal rights by statute and judicial interpretation, courts continue to recognize Indian tribes as "domestic dependent nations," with inherent sovereignty over their own affairs. United States policy is thus predicated on an interaction with Indian tribes on a government-to-government basis. Although, with a few exceptions, the indigenous peoples in Alaska did not enter into treaties with the U.S., there are 229 Alaska Native groups within the State of Alaska that have been listed as tribal governments by the Department of the Interior.

Based on this history, the Federal Power Act, which delineates the licensing process for hydroelectric projects, defines an Indian Tribe as that:

> "*which is recognized by treaty with the United States, by federal statute, or by the U.S. Department of the Interior in its periodic listing of tribal governments in the Federal Register in accordance with 25 CFR 83.6(b), and whose legal rights as a tribe may be affected by the development and operation of the hydropower project proposed (as where the operation of the proposed project could interfere with the management and harvest of anadromous fish or where the project works would be located within the tribe's reservation).*"

Identified tribal governments with potential interests in land and other resources that may be affected by the Project are listed in Table 4.13-1.

Table 4.13-1. Federally-recognized Tribes (25 CFR §86) within the Project impact area by region.

CIRI Region	Ahtna Region	Doyon Region
Chickaloon Native Village	Cheesh-Na Tribe (formerly the Native Village of Chistochina)	Village of Dot Lake
Eklutna Native Village	Native Village of Gakona	Healy Lake Village
Kenaitze Indian Tribe	Gulkana Village	Nenana Native Association
Ninilchik Village	Native Village of Kluti-Kaah (also known as Copper Center)	Northway Village
Village of Salamatof (Kenai)	Mentasta Traditional Council	Native Village of Tanacross
Seldovia Village Tribe	Native Village of Tazlina	Native Village of Tetlin
Native Village of Tyonek	Native Village of Cantwell	
Knik Tribe	Native Village of Chitina	

4.13.2.2. Regional Corporations

The Alaska Statehood Act, enacted in 1958, authorized the new State to select approximately 104 million acres of vacant, unappropriated, unreserved federal land in the Alaska territory. Soon after passage of the Act, the State began its land selections, in some cases selecting prime lands around Native villages or lands that were important to Alaska Natives for hunting and fishing. Alaska Natives successfully challenged many of the State selections, complicating the State's selection process. In an attempt to settle the aboriginal claims of Alaska Natives, Congress passed the Alaska Native Claims Settlement Act (ANCSA) in 1971. ANCSA authorized the transfer of over 45 million acres of land and the payment of nearly $1 billion to Alaska Natives.

In contrast to the federal policy implemented with respect to Indian tribes in the lower-48 states, ANCSA uniquely relies on the establishment of State-chartered corporations. ANCSA created two tiers of Native Corporations to manage the lands transferred to the Alaska Natives and to help promote and undertake economic development: 13 Regional Corporations; and over 200 Village Corporations. ANCSA provided for Village Corporations to file applications for land selections with BLM. Upon approval of an application, the Village Corporation is conveyed title to the surface estate, and the Regional Corporation generally is conveyed title to the subsurface estate.

4.13.2.2.1. Cook Inlet Region, Incorporated (CIRI)

CIRI was founded for Alaska Natives with ties to the Cook Inlet region. CIRI has over 7,300 shareholders, approximately 1.25 million acres of surface estate entitlements and 2.25 million acres of subsurface entitlement lands within and around the Susitna basin. CIRI holdings within the Susitna basin are a mixture of selected, interim conveyance and patented land.

CIRI actively is pursuing alternative energy development through projects in Cook Inlet, near the mouth of the Susitna. CIRI projects include Fire Island Wind and Stonehorn Ridge Underground Coal Gasification (UCG). CIRI also maintains an oil and gas leasing program for much of its land holdings around Cook Inlet, including lands adjacent to the Susitna basin.

CIRI Alaska Tourism (CATC), a subsidiary of CIRI, owns and operates the Talkeetna Majestic Lodge in Talkeetna.

4.13.2.2.2. Ahtna, Incorporated (Ahtna)

Ahtna, Inc. owns approximately 1,528,000 acres from an entitlement of 1,770,000 ac, primarily in the Copper River basin. Ahtna land holdings within the Susitna basin are all interim conveyances. Ahtna has over 1,600 shareholders, most of which reside in the Copper River basin.

In 1980, seven of the eight village corporations in the Ahtna region merged with Ahtna, Inc. Consequently, Ahtna acquired surface estate rights to the seven village corporations' lands.

However, the merger agreement allowed the seven villages to maintain shareholder committees known as Successor Village Organizations (SVO), who reserve the right to withhold consent to any new development within former village lands.

Ahtna has 15 subsidiaries, including one involved in forestry and gravel sales, and one tasked with developing a tourism program and business opportunities within the Ahtna region. The Ahtna Land Department manages surface estate and gravel (excluding timber); Ahtna Minerals Company, Inc. manages subsurface estate, and Ahtna Forest Products, Inc. manages timber.

4.13.2.2.3. Doyon, Ltd. (Doyon)

Doyon has over 17,550 shareholders and 11.4 million acres of surface, subsurface estate and mixed estate land holdings. None of these holdings are located within the Susitna basin.

The nearest conveyed or selected lands are northeast of the Susitna basin, near the communities of Dot Lake, Tanacross and Northway, north of the basin, near Nenana, and northwest of the basin, near Telida, Nikolai, McGrath and Takotna. Each of these areas, however, is geographically separated from the Susitna basin by the Alaska Range.

Doyon Tourism operates the Kantishna Roadhouse in Kantishna, the Denali River Cabins and the Cedars Lodge near the entrance to Denali National Park, as well as Kantishna Wilderness Trails, which offers day trips around Kantishna. Through a joint venture with ARAMARK (a provider of food services and facilities management), Doyon Tourism is the authorized concessioner for various tours, activities and other services offered within Denali National Park and Preserve.

4.13.2.2.4. Village Corporations

Village corporations within the CIRI Region include:

- Chickaloon Moose Creek Native Association
- Eklutna, Inc.
- Knikatnu, Inc.
- Ninilchik Natives Association, Inc.
- Salamatof Native Association, Inc.
- Seldovia Native Association, Inc.
- Tyonek Native Corporation

The only remaining village corporation within the Ahtna region is Chitina Native Corporation. However, Successor Village Organizations exist for Cantwell, Chistochina, Gakona, Gulkana, Kluti-Kaah (Copper Center), Mentasta and Tazlina.

Village corporations within the Doyon Region include:

- Dot Lake Native Corporation
- Menda Cha-ag Native Corporation (Healy Lake)

- Northway Natives, Inc.
- Tanacross, Inc.
- Toghotthele Corporation (Nenana)

The Tetlin Native Corporation was originally identified by Alaska Energy Authority (AEA) for this analysis; however, during this review, its land holdings could not be verified. While Tetlin Native Corporation likely does not hold lands within the Susitna basin, its status will be verified for consultation on other resources, such as subsistence and cultural resources.

4.13.2.3. Group Corporations

ANCSA provided for the establishment of Group Corporations to hold, invest, manage and/or distribute lands, property, funds, and other rights and assets for and on behalf of members of certain small Native communities of less than 25 members. Group Corporations include:

- In the CIRI Region:
  - Alexander Creek, Inc.
  - Caswell Native Association
  - Gold Creek-Susitna NCI
  - Montana Creek Native Association
  - Point Possession, Inc.

4.13.2.4. Urban Corporations

ANCSA also provided for the establishment of Urban Corporations to hold, invest, manage and/or distribute lands, property, funds, and other rights and assets for and on behalf of members of urban communities of Natives. Four urban communities were identified as having significant Native Alaskan populations and were allowed to develop Urban Corporations. Of these four communities, only Kenai may be potentially affected by the Project. The Urban Corporation for Kenai is Kenai Natives Association, Inc.

4.13.2.5. Alaska Native Allotments

In addition to the land and other interests of the Alaska Native entities, there are 98 individual Native allotments within the Susitna basin in various stages of the adjudication and conveyance process. Native allotments are lands selected by individuals under the Alaska Native Allotment Act. The land claims applications were submitted to the U.S. Bureau of Land Management (USBLM) and are in various stages of adjudication or conveyance. Once conveyed, title to the land can be shared by any number of individuals through inheritance. An accompanying geo-database has been prepared that delineates the allotments; the owners will be identified and consulted regarding their specific interests. There are two categories of Alaska Native allotments: restricted and unrestricted. Restricted allotments are held in fee, but are subject to statutory restrictions against alienation; therefore, any land use agreements or other alienation of interests in restricted allotments must be authorized by the Bureau of Indian Affairs (BIA).

Unrestricted allotments are allotments that are no longer subject to restrictions against alienation, for instance as a result of a petition for unrestricted status by the allotee.

4.13.2.6. Subsistence Resources

The Alaska Native people that are represented by the Alaska Native entities discussed in this document consider wildlife and fish populations, particularly moose, caribou and salmon, to be important subsistence resources and central to their cultural identity. Subsistence resource information is summarized and analyzed in section 4.11 of the PAD (Cultural and Subsistence Resources). Specific information regarding subsistence resources and use areas within the Project area, as well as access routes to these resources, will need to be updated.

As discussed in section 4.11 of this PAD, beluga whales are an important subsistence resource for Alaska Natives living on and around Cook Inlet, including Tyonek residents, who hunt for belugas near the mouth of the Sustina River. Declining populations of belugas throughout the 1990s led to co-management agreements between the Native Village of Tyonek and other Alaska Natives and the National Marine Fisheries Service (NMFS) allocating harvest and identifying harvest practices. Populations continued to decline, and in 2007 Tyonek subsistence hunters voluntarily stepped down from a hunt to further support recovery of the beluga population. The National Oceanic and Atmospheric Administration (NOAA) and NMFS released a record of decision for the supplemental Environmental Impact Statement (EIS) for the Cook Inlet Beluga Whale Subsistence Harvest in 2008, which resulted in the Cook Inlet Beluga Whale Subsistence Harvest Management Plan. In October 2008, NMFS listed the Cook Inlet population of beluga whales as endangered under the Endangered Species Act.

4.13.2.7. Cultural Resources

In addition to subsistence resources, cultural resources are also of vital interest to Alaska Natives. Cultural resource information is summarized and analyzed in section 4.11 of the PAD; however, in light of their particular importance to Alaska Natives, two classes of cultural resources are identified here: ANCSA section 14(h)(1) [43 USC §1613(h)(1)] sites and National Historic Preservation Act (NHPA) sites.

The importance of cultural resources to Alaska Natives is reflected in section 14(h)(1) of ANCSA, which specifically authorized the conveyance of cemeteries and historical sites to the appropriate regional corporations. Conveyances or selections made under ANCSA 14(h)(1) within the Susitna basin will be identified. Additionally, section 106 of the NHPA requires special consideration of historic properties of traditional religious and cultural significance to “Indian Tribes,” statutorily defined to include ANCSA Native villages, Regional Corporations and Village Corporations. Any properties of traditional cultural and religious significance that may be affected by the Project will be identified and evaluated for listing in the National Register of Historic Places (NRHP), in consultation with the appropriate Alaska Native entities.

4.13.3. Potential Impacts

Impacts to Alaska Native resources specifically were not evaluated during the 1980s licensing effort. However, the draft EIS for the 1980s Alaska Power Authority (APA) hydroelectric project determined that potential environmental impacts may occur to a number of other resource categories as a consequence of the development. As previously identified in this section, Alaska Native resources as an analysis category encompasses many resources, including (but not limited to): fish and aquatic resources, wildlife and botanical resources, subsistence resources, cultural resources, recreation and land use. Consequently, previously identified environmental impacts to these classes of resources also may affect Alaska Native resources. Discussions of the impacts to these resource classes are presented elsewhere within this document and may be appropriate in identifying potential adverse impacts to Alaska Native resources but are not restated here. Instead, basic impact mechanisms are identified and discussed within the context of generally identified Alaska Native resources.

Project impact mechanisms that could affect Alaska Native resources include construction and operation of the dam and reservoir, access roads, ancillary facilities and transmission lines, and the resulting environmental impacts, such as variations in water conditions downstream of the facility during operation, direct ground disturbance during construction and operation, and the introduction of audio and/or visual elements during construction and operation.

In general, impacts to Alaska Native resources may include environmental impacts to the terrestrial and aquatic habitats of plants and animals that are of interest and/or significance to Alaska Native individuals and entities with respect to access to and use of subsistence resources; acquisition or use of individual, tribal and corporation lands for Project construction and operation; disturbance to archaeological, historic and traditional cultural sites of interest and/or significance to Alaska Native entities; impacts to Alaska Native entity financial resources, such as corporation-owned recreation and tourism businesses or natural resource development areas; and other socioeconomic impacts.

Construction and operation of the Project dam and reservoir, access roads, ancillary facilities and transmission lines could affect subsistence interests by limiting, increasing or otherwise changing access to subsistence use areas and resources, or increasing competition for such resources. The same impact mechanism may also affect Alaska Native resources by limiting, increasing or otherwise changing access to Alaska Native-owned lands, including individual allotments.

Specific potential impacts of the currently proposed Project are unknown at this time and will require comprehensive consultation and analysis. While the design and operation of the currently proposed Project may differ from the previously evaluated project, the types of impacts are likely to be similar.

4.13.4. Potential Protection, Mitigation, and Enhancement

4.13.4.1. Alaska Native Consultation Procedures and Guidelines

With the issuance of Executive Order (EO) 13175, *Consultation and Coordination with Indian Tribal Governments*, the President emphasized the trust relationship with federally-recognized tribal governments, while also recognizing the right of Indian tribes to self-government and the federal government's support for tribal sovereignty and self-determination. EO 13175 requires federal agencies to support the policy of tribal self-determination by implementing an effective process to ensure meaningful and timely consultation with tribes during the development of policies that may have tribal implications. Tribal consultation is intended to assure meaningful tribal participation in planning and decision making processes for actions with the potential to affect tribal interests. The mandates of EO 13175 apply whenever regulations, legislative comments or proposed legislation, and other policy statements or actions have substantial direct effects on Indian tribes, on the relationship between the federal government and Indian tribes, or on the distribution of power and responsibilities between the federal government and Indian tribes. Although EO 13175's mandates apply only to policymaking activities and are not binding on independent regulatory agencies like the Federal Energy Regulatory Commission (FERC), the EO does reiterate the policy of government-to-government interactions with tribes. Moreover, while EO 13175 itself applies specifically to federally-recognized tribal governments, pursuant to Pub. L. 108-199, 118 Stat. 452, as amended by Pub. L. 108-447, 118 Stat. 3267, the Office of Management and Budget (OMB) and other Federal agencies are required to "consult with Alaska Native corporations on the same basis as Indian tribes under Executive Order No. 13175."

Alaska tribal government-to-government (G2G) consultation is thus a relationship that is distinct and separate from engagement with the general public. By definition, G2G consultation requires a higher level of engagement, logistical planning and investment toward relationship building—which will be critical for the success of the Project's development. To this end, a Project-specific consultation program is being developed to identify interested tribal entities, Alaska Native corporations and communities, as well as strategies for the effective involvement of tribal governments, Alaska Native entities and rural communities within the proposed Project's study area.

Maintaining G2G relationships and proper protocols is essential to consultation under Section 106 of the NHPA, the National Environmental Policy Act (NEPA) and in FERC licensing procedures. Tribal and Alaska Native entity consultation is inherently a multifaceted process involving parties with diverse cultural backgrounds, regulatory experiences, practical needs, political realities and long-term goals. Such consultation associated with large-scale projects poses a unique set of challenges that require an understanding of a myriad of federal and state laws as they apply particularly to the FERC licensing process.

4.13.4.2. Consultation Plan

Identified Alaska Native entities listed in this document will be contacted and invited to attend regularly scheduled meetings to discuss Alaska Native resources and interests, and any concerns regarding potential Project effects to resources and land interests. Specifically, consultation will be conducted at varying levels of involvement, based on the G2G relationship between federally-recognized tribal governments and the federal government, and with Regional and Village Corporations accordingly:

- G2G consultation will be conducted, with initial contact made by FERC officials together with AEA representatives, and follow-up from AEA project managers, as delegated as appropriate by FERC.
- Meetings also will be initiated with Regional and Village Corporations. Consultation meetings with federally-recognized tribal governments will be separate from meetings with Regional and Village Corporations and other Alaska Native organizations, to recognize the unique nature of the G2G relationship and to acknowledge the potentially varying interests of tribal governments and Native Corporations.
- Confirmation of each entity's interest in the proposed Project will be assessed, as well as the mode of communication each entity would like to utilize (e.g., quarterly update meetings, e-mail communication, conference calls, etc.).
- Whenever possible, face-to-face meetings will be conducted with interested Alaska Native entities to help establish constructive, long-term relationships with Alaska Native stakeholders during the licensing process and Project development.

It is anticipated that consultation meetings will occur at varying phases of the FERC licensing process and Project development, and will overlap with consultation requirements under Section 106, NEPA and FERC licensing procedures. Meetings will occur with either smaller, focused groups or large groups as the situation requires.

4.13.4.3. Alaska Native Land Interests and Resource Database

As discussed above, a standard query language (SQL) server-based web database application has been developed to document and track Alaska Native entity status, contact information, and any documents associated with Alaska Native resource interests that may be impacted by the Project. This database will be updated periodically by Project staff as a result of further consultation and investigation during licensing and Project development, as a tool for continued and comprehensive understanding of Alaska Native resources and land interests. The database will be updated as potential impacts and proposed protection, mitigation and enhancement measures are identified and can be shared with Project stakeholders and G2G partners, to demonstrate how the Project is collating Alaska Native resource interests for understanding throughout the duration of the FERC licensing and Project development processes.

4.14. Transportation

4.14.1. Introduction

In the Railbelt region, the public transportation system is dominated by road, rail and aviation. This analysis provides additional information to characterize the current baseline conditions of the public transportation system in the Railbelt area, especially around the middle and upper Susitna River system.

In coastal communities, water-based transportation systems are important, especially the ports of Anchorage and Seward. In other communities, marine is used mostly for fishing and recreational purposes as opposed to a primary means of transportation. As a result, water-based transportation is not included in this analysis.

4.14.2. Roads

The primary road near the Project site is the George Parks Highway. The highway was completed in 1971 and is approximately 323 mi long. The Parks Highway connects the Glenn Highway to Fairbanks, providing the primary access to the MSB, Denali Borough, Denali National Park and Preserve and Denali State Park along the way. The Parks Highway is mostly a two lane highway but some segments are built to a higher standard (four lanes, divided controlled access, etc.) (ADOT&PF 2008). The section between Mile Post (MP) 132 and 248 is designated as an Alaska State Scenic Byway. (Along the Glenn Highway, mileposts do not begin with 0. Instead, they begin at MP 35 because they continue the milepost numbering of the Glenn Highway which starts at MP 0 in Anchorage.)

Also near the Project is the Denali Highway (also known as Route 8). The Denali Highway connects the Parks Highway (near Cantwell) to the Richardson Highway (near Paxton). It was opened in 1957 and is approximately 135 mi in length. It is a gravel highway but small portions of the highway (eastern 21.3 mi and western 2.6 mi) are paved. The Denali Highway is not maintained in the winter (i.e., October 1 through mid-May). The Denali Highway is used primarily to access adjacent lands for hunting, harvesting or recreational purposes.

Other than the Parks Highway, the Denali Borough has a relatively limited road network, with most roads providing local circulation and property access. By comparison, the MSB has a fairly extensive road network of arterial, collector and local roads.

Additional information regarding road use and road maps can be found in section 4.10 (Recreation and Land Use) of this PAD.

4.14.3. Rail

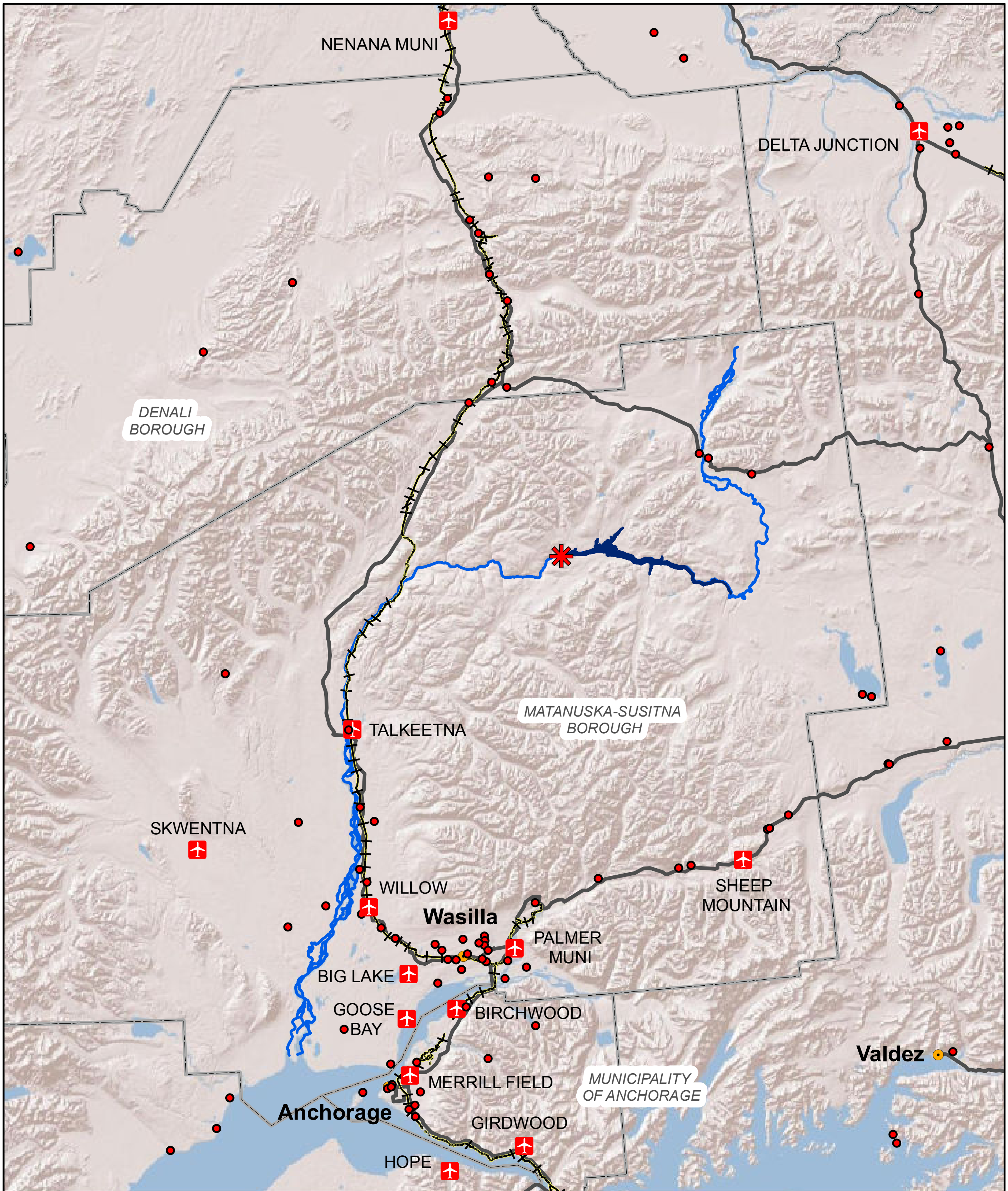
The Alaska Railroad Corporation (ARRC) is the only railroad in the Railbelt region (see Figure 4.14-1). Since 1985, the ARRC has been owned and operated by the State of Alaska. The southern terminus of the ARRC mainline is in Seward and the northern terminus is Eielson Air Force Base (AFB). In addition, there are several spur lines including one in the Denali Borough that connects the ARRC mainline to the Usibelli Coal Mine. The ARRC is currently pursuing a rail extension within the MSB (Port MacKenzie Rail Extension). The Port MacKenzie Rail Extension involves the construction of 30 to 45 mi, depending on the route, of new rail line connecting the existing rail system to the MSB's Port MacKenzie. This Project is estimated to be completed in 2014.

Additional information regarding railroad use can be found in section 4.10 (Recreation and Land Use) of this PAD.

4.14.4. Aviation

The largest airport in Alaska is the Ted Stevens Anchorage International Airport followed by the Fairbanks International Airport. Both airports have large volumes of passenger and cargo service. These two airports also provide the main links between Alaska and other states and countries.

In addition to two international airports, there are numerous other public airports, private airports, private landing strips and floatplane lakes throughout the Denali Borough and the MSB (see Figure 4.14-1). Many of these are private-use, privately owned airports, seaplane bases and heliports, and will not be discussed here because they are not available for public use. In addition, many lakes, rivers, gravel bars and backcountry strips exist in the study area. As these are used mainly for access to property or for recreational purposes, such as hunting or fishing, they will not be discussed further in this report.



Legend

- Proposed Watana Dam and Powerhouse
- Proposed Watana Reservoir
- Susitna River
- Borough
- Selected Populated Place
- Alaska Railroad
- Highway
- Public Airport or Seaplane Base
- Private Airport or Seaplane Base

N

0 10 20 40

Miles

ALASKA ENERGY AUTHORITY

Date: Nov 2011
Scale: As Noted

State of Alaska
Susitna-Watana Hydroelectric Project, FERC No.14241

Figure 4.14-1

Public Use Airports

Within the Denali Borough, the following publically owned airports are available for public use:

- Healy River
- Kantishna
- Clear
- Stampede
- McKinley National Park (commercial and business use of the McKinley National Park airport is not allowed unless authorized by the NPS)

The airport in Cantwell is privately owned but public use is allowed.

Within the MSB, the following publically owned airports are available for public use:

- Wasilla
- Palmer Municipal
- Big Lake
- Goose Bay
- Skwentna
- Talkeetna
- Willow
- Lake Louise (Lake Louise airport is currently closed due to safety concerns; there are plans to reconstruct the runway and re-open the airport in the future)
- Sheep Mountain
- Summit

No major improvements have been identified for airports within the Denali Borough. Within the MSB, most of the major improvements will be for the Wasilla and Palmer Municipal airports.

4.14.5. Potential Adverse and Positive Impacts

It is assumed that the majority of the impacts to the transportation network would be associated with construction. Impacts to the transportation system during the operation of the Project are not expected to be substantial based on existing information.

4.14.6. Potential Protection, Mitigation and Enhancement

Protection, mitigation and enhancement (PM&E) measures will be identified following the completion of the study process. If the Denali Corriodor is chosen for road acess, then some potential PM&Es include:

- Limiting the number of construction vehicles on the Parks Highway during peak traffic times;
- Limiting traffic on access roads to Project-related traffic;
- Establishing a flight path for Project related air traffic;
- Limiting Project-related traffic near residential properties during nighttime hours; and

- Paving the Denali Highway from Cantwell to the Denali Access Road Junction.

4.14.7. References

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City of Palmer. 2009. Palmer Airport Master Plan (Palmer AMP). Published online at http://www.cityofpalmer.org/index.asp?Type=B_BASIC&SEC={6FF51789-DA6D-4CAD-92EE-76B112D1E68C}&DE={4A2FD4F2-865C-4C79-B7AD-791500569099}. Accessed November 2011.

City of Wasilla. 2010. Wasilla Airport Master Plan (Wasilla AMP). Published online at http://www.wasillaairportfuture.com/Plans/IYS percent20AMP percent20master percent20file percent20Final percent20Draft percent20Narrative.pdf. Accessed November 2011.

5. PRELIMINARY ISSUES AND STUDIES LIST

5.1. Development of Preliminary Issues and Studies

Based on review of existing information, data gap analyses, and preliminary discussions with agencies and other stakeholders ("licensing participants" or "participants"), AEA has identified a number of issues for the proposed Project licensing. The issues for each resource area, and the corresponding study needs, are listed and described below. The identified study needs represent preliminary information regarding those studies that AEA proposes to include in its Proposed Study Plan (PSP), to be filed in June 2012 in accordance with requirements of FERC's Integrated Licensing Process (ILP). The PSP will present a detailed scope, objectives, and methodologies for each proposed study. AEA intends to hold resource workgroup meetings during the formal study planning phase in 2012 to consult with licensing participants on development of the study designs for inclusion in the PSP and subsequently the Revised Study Plan (RSP).

Resource issues and proposed studies to address those issues are summarized in Table 5.1-1. More detailed descriptions of the licensing issues and associated study needs, by resource area, are provided in Section 5.2. Also listed below under resource area subheadings are AEA's early study and information development activities planned for 2012, which will provide additional information for use during formal study planning.

Table 5.1-1. Summary of identified resource issues and corresponding studies, Susitna-Watana Hydroelectric Project licensing.

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
Water Resources: WR1 and WR3	Reservoir and Flow Routing Model Development: A HEC ResSim model to evaluate reservoir operations under various constraints and operating scenarios, as well as downstream routing effects is being developed. The HEC ResSim model is being proposed for this project due to its ability to model both aspects, reservoir operations and downstream routing simultaneously. The model will provide hourly flows and water surface elevations at selected transect locations where stream profiles and other information is known. The flow routing model is needed to serve as input to other water quality and fisheries resources modeling efforts.	WR-S1: Locate and update 1981 hydrographic river transect information for the Middle Susitna River reaches for use in HECResSim (Reservoir Simulation Model) modeling. Include additional transects for lower river reaches.
Water Resources: WR2	Water Resources River Ice Study: The overall study objective is to determine Project effects on downstream river ice formation process. Specific objectives are to (1) document the timing and process of ice cover formation, (2) identify the relationship between river ice processes and channel morphology, vegetation and aquatic habitats, and (3) forecast expected changes in river ice formation and processes as a result of Project construction and operation.	WR-S2: Document the formation and break up of river ice downstream of the proposed Watana Dam site. Document relationship between river ice process and river morphology, riparian habitat and aquatic habitats. Identify reaches most likely to experience changes in ice processes due to Project construction and operation.
Water Quality: WQ1 - WQ4	Water Quality Impacts Study: Study objectives: (1) verify baseline water quality conditions with select water quality measurements, (2) assess potential effects of Project construction and operations on temperature, turbidity, total dissolved/suspended solids, dissolved oxygen, pH, metals, and chemical/nutrient characteristics within the proposed Watana Reservoir and the mainstem river downstream of the proposed Watana Dam site (RM 184), and (3) evaluate potential effects of Project operations on total dissolved gas concentrations downstream of the proposed dam.	WQ-S1: Review of existing temperature data and models.
Geomorphology: G1 - G10 Geology/Soils: GS1 and GS2	Geomorphology Study: The study objective is to assess the potential change in Lower, Middle, and Upper Susitna River morphology, including mainstem, side channels, sloughs, and tributary mouths as a result of Project construction and operation.	G-S1: Determine bedload and suspended sediment load by size fraction at Tsusena Creek, Gold Creek, and Sunshine Gage stations to improve sediment rating curves and total bed material load calculation. G-S2: Geomorphic assessment of the Middle River reach using aerial photography to quantify how channel types change with flow and assess relative

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
		stability of channel features. G-S3: Assessment of project effects on lower river channel morphology.
Upper River Fish and Aquatic Resources: F1 - F3 Middle River Fish and Aquatic Resources: F4 - F8 Lower River Fish and Aquatic Resources: F9 - F10	Fish Abundance and Distribution Study: Study objectives: (1) characterize resident and anadromous fish species composition, spatial and temporal distribution, and relative abundance by subbasin and channel type and (2) develop habitat fish use information for impact assessment and use in the Instream Flow Study. Upper River Fish Study: Study objectives: (1) characterize resident and anadromous fish species composition, spatial and temporal distribution, and relative abundance and (2) characterize the habitat within the reservoir inundation zone. Productivity Study: Study objectives: (1) document benthic algae and macroinvertebrate taxonomic composition (to family level) and abundance in representative habitats in the Susitna River, (2) compare (using existing literature) the benthic algae and macroinvertebrate taxonomic composition and abundance to river systems having turbidity regimes (and flow/temperature regimes, if possible) similar to the turbidity estimated during Project operation, (3) estimate the effects of altered flow, temperature, and turbidity regimes on primary and secondary production/abundance, (4) identify factors currently limiting resident fish and juvenile salmonid growth (food availability, turbidity and/or water temperature) and evaluate the effects of changes in water temperature, turbidity, and food availability on resident fish and juvenile salmonid growth and habitat. Instream Flow Study: The objective of the study is to provide habitat-flow relationships necessary to quantify potential effects of Project operations and alternative flow scenarios on aquatic and riparian habitat.	F-S1: Synthesis of existing fish data. F-S2: Susitna River salmon run apportionment. F-S3: Middle River habitat utilization study. F-S4: Chinook salmon presence above Devils Canyon F-S5: 2012 Instream Flow Planning Study

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
	Potential impacts to the Endangered Cook Inlet beluga whale: Information is needed to understand any connection, if any between potential Project effects and the listed beluga whale. Information about the beluga whale prey will be needed to evaluate potential indirect effects, if any to this species.	F-S6: Cook Inlet beluga whale anadromous prey study analysis.
Wildlife Resources: W1 - W6	Big Game Study: Study objectives for moose: (1) complete population estimates for the Upper and Middle Susitna River basins and road and transmission corridors, (2) use spatial analysis of seasonal range use and movements based on telemetry data to provide information on habitat use, movements, and extent of winter range through the Project area, and (3) measure forage quality and browse intensity in the impoundment zone, access routes, and transmission corridors to quantify habitats that would be lost or altered, estimate timing of use and degree of dependency of resident and migratory populations, and compare habitat quality to other adjacent regions. Study objectives for caribou: (1) complete population estimates for the Project area including the Nelchina and Delta herds, especially estimates of sub-herd numbers and distribution in areas north of the proposed impoundment area, (2) evaluate current and historic Nelchina and Delta herds, movements, traditional migration routes across the proposed impoundment area, and sensitive seasonal distributions such as calving ranges, and (3) use spatial analysis of seasonal range use and movements based on current telemetry data from GPS/satellite collared caribou to provide information on current habitat use and movements throughout the Project area. Study objectives for Dall's sheep: (1) complete population estimate and delineate seasonal ranges in mountain regions next to the Project area, including road and transmission corridors and (2) assess current condition and use of mineral licks on lower Jay Creek. Study objectives for brown and black bears: (1) complete population estimates in the proposed Project area, (2) evaluate berry production in the impoundment zone and access corridors, (3) evaluate use of salmon spawning streams downstream from the proposed dam site	W-S1: Wildlife habitat use and movement (corresponds to big game study). Compile existing population data and extrapolate to Project areas for moose, caribou, bears, Dall's sheep, and wolves. Analyze other available ADF&G datasets for related to habitat use.

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
	including use of Prairie Creek, (4) identify denning areas. Study objectives for wolves: (1) complete population estimates, determine number of packs and individuals using the Project area, including road and transmission corridors, (2) use spatial analysis of telemetry data to map pack territories and movements, and (3) identify locations of dens, rendezvous sites, hunting areas, and other essential areas for each pack.	
	Furbearer Study: Study objectives: (1) evaluate existing data on distribution, habitat use, and movements of wolverine, beaver, river otter, mink, muskrat, and other furbearers, (2) complete current estimate of active beaver colonies in the middle and lower river, (3) complete spring surveys to evaluate overwinter survival of beaver, and (4) evaluate potential marten home range and dispersal movements between old forest stands. Small Game Mammal and Upland Gamebird Study: Study objectives for snowshoe hare, ptarmigan, and grouse: (1) evaluate existing data on distribution, habitat use, and movements and (2) evaluate seasonal habitat use, potential habitat fragmentation effects, and dispersal capabilities. Harvest Study for Big Game, Furbearers, Small Game Mammals and Upland Gamebirds: Study objectives for moose, caribou, Dall's sheep, bears, wolves, and furbearers: (1) evaluate and compile existing past and current data on harvest effort, harvest locations, hunter access, and hunter mode of travel and (2) compare current harvest locations to current patterns of seasonal habitat use and movements. Study objectives for small game mammals and upland gamebirds include: (1) evaluate and compile existing past and current data on harvest effort, harvest locations, hunter access, and hunter mode of travel and (2) compare current harvest locations to current patterns of small game mammals and upland gamebird abundance, seasonal habitat use, and dispersal capabilities.	W-S2: Past and current big game and furbearer harvest study. Compile existing harvest and hunter effort within finest available harvest units; compare past and current distribution of reported harvest and effort, compare harvest locations to seasonal movements and recommend additional data collection.

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
	Eagle and Raptor Study: Study objectives for bald and golden eagles: (1) evaluate existing data on distribution, established nest sites and pair territory locations, and foraging habitats, (2) complete current surveys to locate active nests and alternative nest sites within habitats affected by the impoundment, access road corridor, and transmission line corridors, (3) complete current surveys to document fall and winter communal roost sites, and (4) evaluate seasonal habitat use. Study objectives for cliff nesting raptors: (1) evaluate existing data on nest site locations, identify potentially suitable cliff nesting habitat locations and (2) complete current nest surveys at identified suitable cliff habitats to document use throughout the Project area. Study objectives for other raptors and owls: (1) evaluate existing data on nest site locations, identify potentially suitable nesting habitats and (2) complete current nest surveys in potentially suitable nesting habitats during late-winter early spring for owls and during early spring for other raptors throughout habitat potentially affected by the Project. Waterbirds, Seabirds, and Waterfowl Study: Study objectives: (1) evaluate existing data on nesting, brood-rearing, and migration staging distributions for waterbirds and waterfowl, (2) complete current surveys for nesting, brood-rearing, and migration staging habitats to determine abundance of waterbirds and waterfowl throughout the Project area, and (3) evaluate seasonal habitat use and movement patterns. Landbird and Shorebird Study: Study objectives: (1) evaluate existing data on nesting and migration staging habitats for landbirds and shorebirds, (2) complete current surveys for nesting and migration staging habitats to determine distribution and abundance of landbirds and shorebirds throughout the Project area, and (3) evaluate seasonal habitat use and migration routes.	W-S3: Eagle nests and raptor nest study. Compile existing nest site, tree and cliff habitat data, determine current spatial distribution of potentially suitable habitats and complete aerial and ground-based surveys.

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
	Non-Game Species of Conservation Concern Study: Study objectives for little brown bat: (1) evaluate existing data on distribution, habitat use, and movements, (2) evaluate geologic and topographic data to identify areas potentially containing Karst topography with cave features within the Project area, and (3) complete current distribution and habitat use surveys for bat species in the inundation zone, and the Middle Susitna River area. Study objectives for Wood Frog: (1) evaluate existing data on distribution, habitat use, and movements and (2) complete current distribution surveys for wood frogs throughout the Project area. Study objectives for small mammals: (1) evaluate existing data on distribution, habitat use, and movements and (2) complete distribution and abundance surveys within the inundation zone, and along road and transmission corridors. Study objectives for birds: (1) compile list of migratory bird species of concern and identify occurrence data and distribution of suitable habitats within the Project area based on existing data on distribution, habitat use, and movements and (2) complete current population and habitat use estimates for birds of concern throughout the Project area.	
Botanical Resources: B1 - B5	Vegetation Mapping Study: Study objectives: (1) determine the appropriate mapped scales, areal extents, and the Alaska Vegetation Classification level for vegetation mapping, (2) develop vegetation maps at suitable scales, and (3) provide habitat acres and distribution to support the development of related studies. Wetland-Riparian Study: Study objectives: (1) determine the appropriate scales and areal extents for wetland delineations in consultation with the USACE and compile available existing wetland mapping, (2) conduct field surveys to collect site-specific wetland data, (3) develop a wetland functional assessment, (4) determine natural fire-spread patterns in the proposed reservoir reach of the Susitna River, and (5) evaluate the relationship of wetland and riparian vegetation to the hydrologic regime.	B-S1: Vegetation and wildlife habitat mapping. Compare current and historical vegetation and land cover mapping, determine appropriate map scales, areal extents and classification level, complete preliminary mapping from recent aerial images, complete initial field verification of preliminary mapping and identify habitat/plant community associations for rare and sensitive plants. B-S2: Riparian study. Identify riparian field sites and data from 1980s studies for potential resampling, review process and succession models for predicting downstream effects, complete preliminary mapping of riparian habitats from recent aerial images including wildlife habitat elements, and complete initial field verification of preliminary mapping.

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	**Licensing Study/Information Need**	**Status – 2012 Early Information Development Activity**
	<u>Rare Plant Study</u>: Study objectives: (1) identify the locations of rare plant populations in the Project area and (2) identify potential habitat enhancement locations. <u>Noxious Weed Study</u>: Study objectives: (1) identify locations of populations of target invasive weed species in the Project area and (2) identify potential treatment locations.	B-S3: Wetland mapping. Compile current and historical wetland mapping, determine appropriate map scales, areal extents for wetland delineation, complete delineations on current photography incorporating data from vegetation mapping study, identify riparian and wetland delineation field sites and data from the 1980s studies for potential re-sampling, and select sampling locations and complete initial field surveys.
Aesthetic Resources: A1	<u>Aesthetic Resources Study</u>: Study objectives: (1) assess significance of impacts of borrow and spoil areas, transmission lines, access roads, construction camps, and dams on scenic resources and (2) assess potential effects on scenic resources due to Project operation and maintenance activities.	A-S1: Inventory BLM VRM designations. A-S2: Identify initial key viewing areas and key viewpoints.
Recreation and Land Use Resources: R1 - R6 and L1 - L2	<u>Recreation Resources and Land Use Study</u>: Potential study objectives: (1) assess potential Project-related impacts on fishing, including the availability of fish, access, and quality of experience, (2) evaluate potential Project-related impacts on recreational hunting and trapping, including the availability of resources, access, and quality of experience, (3) assess potential Project-related impacts on boating and pack rafting downstream of Devils Canyon, including access to the water and possible impediments to navigation, (4) evaluate potential Project-related impacts on non-consumptive activities (e.g., bird watching and hiking), including availability of resources, access to the resources, and quality of the experience, (5) assess potential Project-related impacts of construction worker recreational activities on fish and wildlife resources in the Susitna River watershed, (6) evaluate potential Project-related impacts due to increases in recreational use resulting from improved access, creation of the reservoir, altered stream flow, and the need to accommodate and manage recreation use, (7) assess potential changes/effects to recreationist and local resident access patterns from potential Project-related changes in freeze-up conditions in the middle reach of the Susitna River, (8) evaluate the feasibility and desirability of restrictions on recreation to	R-S1: Identify proposed recreation developments. R-S2: Informally survey recreation providers. R-S3: Collect existing recreation demand and supply data. L-S1: Title and site control research. L-S2: GIS base map updates.

Identified Resource Issue(s) [see Section 5.2 for issue descriptions]	Licensing Study/Information Need	Status – 2012 Early Information Development Activity
	reduce impacts on fish and wildlife resources in the Susitna River watershed, and (9) formulation of a recreation plan.	
Cultural Resources Issues: C1 - C4	Cultural Resources Study: Study objectives: (1) identification and significance of the potential effects on cultural, historical, and archaeological sites and (2) formulation of a cultural resources mitigation plan.	C-S1: Pre-field data assessment and information gathering and compilation.
Subsistence Resources Issues: S1	Subsistence Resources Studies: Study objectives: (1) assess potential Project-related effects on subsistence activities, (2) evaluate potential Project-related effects on the population of local animal species, including potential changes in wildlife migration patterns (addressed via Wildlife Resources studies), and (3) assess potential Project-related effects on human access to the Project vicinity (addressed via Recreation Resource studies).	S-S1: Collect and analyze existing subsistence information. Collect exisiting harvest data, resource use, subsistence land use maps, place names and traditional environmental knowledge.
Socioeconomic and Transportation Issues: So1 - So8	Socioeconomic Resources Study: Study objectives: (1) assess potential Project-related impacts to lifestyles in area communities, (2) evaluate potential Project-related changes to commercial opportunities related to fishing, hunting, trapping, etc., (3) assess potential Project-related changes in employment in area communities, (4) evaluate potential Project-related increases in demand on resources offered by the Mat-Su Borough and communities to provide public services and facilities for the Project and Project employees, (5) assess potential Project-related secondary development impacts on undeveloped ANCSA Corporation lands, (6) evaluate potential Project-related impacts resulting from residency and movement of Project construction personnel, (7) assess potential Project-related displacement and influences on residences and businesses, and (8) evaluate potential Project-related changes in economic conditions in the region. Transportation Study: The objective of the transportation study will be to assess the potential impacts to transportation systems resulting from the construction and operation of the proposed Project.	No specific socioeconomic study is being scoped, however data collection and information gathering will continue in order to inform the study plans developed in 2012.

5.2. Preliminary Issues and Information Needs

Preliminary Issues were identified from reviewing the 1980s licensing efforts, data gap reports and agency consultations as areas of potential inquiry regarding effects from the construction, presence of facilities, and operation and maintenance of the Susitna-Watana Hydroelectric Project. This listing identifies the high-level preliminary issue topics that will continue to be developed and refined through the ILP and preparation of the study plan for the Project. Some topics may drop out and other topics may be added. Each issue is given a alpha-numeric designation for reference and tracking. The key to the alpha designation is as follows:

GS- GEOLOGY AND SOILS (INCLUDED IN SECTION 5.2.3)

WR – WATER RESOURCES (SECTION 5.2.1)

WQ – WATER QUALITY (SECTION 5.2.2)

G – GEOMORPHOLOGY (SECTION 5.2.3)

F – FISHERIES AND AQUATIC RESOURCES (SECTION 5.2.4)

W – WILDLIFE RESOURCES (SECTION 5.2.5)

B – BOTANICAL RESOURCES (SECTION 5.2.6)

A – AESTHETICS (SECTION 5.2.7)

R – RECREATION (SECTION 5.2.8)

L – LAND USE (SECTION 5.2.8)

C – CULTURAL RESOURCES (SECTION 5.2.9)

S – SUBSISTENCE RESOURCES (SECTION 5.2.10)

SO – SOCIOECONOMIC AND TRANSPORTATION RESOURCES (SECTION 5.2.11)

Immediately after identifying and listing preliminary issues, this section provides summaries of AEA proposed studies that may be needed to evaluate the preliminary issues. In developing these Study Plan summaries, AEA has considered the preliminary issues, the data gap reports, and the adequacy of existing, relevant and reasonably available information to address these issues. Additionally, AEA has considered the seven criteria for study requests listed in 18 CFR § 5.9, as discussed in Section 2.5, which all licensing participants should address in making any study requests. The proposed studies should be considered preliminary and subject to modification during FERC's Scoping and subsequent Study Plan development.

After the study descriptions, a list of planned 2012 studies and information development efforts is provided. More up-to-date information on the 2012 studies is provided on the Susitna-Watana

Project website (http://www.susitna-watanahydro.org). The specific 2012 studies follow the naming convention listed above for the issues with an additional “” to designate “study.”

The preliminary issues arise from the Project’s construction, presence of facilities and/or operation and maintenance activities and have a Project nexus. The existing information from the 1980s, or any applicable work that has been undertaken in the Project area, will be used to the extent possible in conducting the studies and resolving issues. It is anticipated that some of these issues can be resolved without performing new studies. As appropriate, the existing information will be used for baseline conditions and/or built upon and supplemented with new information to address the preliminary issues.

5.2.1. Water Resources Issues

WR1: Project operations will affect flow timing and magnitude compared to current conditions in Susitna River reaches below the proposed dam, which in turn can affect fish and riparian habitats and fish movement.

WR2: Potential effects of Project operations on reservoir reach and downstream ice processes. Changes in ice processes may affect river morphology and water quality, which can affect fish and riparian habitats.

WR3: Changes in timing and magnitude of flows from Project operations on the interconnection and overtopping into side channel and side sloughs may affect fish habitat and productivity.

5.2.1.1. Project Operations HEC ResSim Model

Study Rationale and Objectives

Project operations will alter the flows and flow regime downstream of the dam and reservoir fluctuations will affect the natural resources in the reservoir area. An operations model that can predict reservoir levels and downstream hourly flow and water surface elevations at places of interest will be essential to other environmental analyses to determine effects on resources in the area. Changes in timing and magnitude of flows can change the interconnection and overtopping of side channel and side sloughs and flow routing models can provide input into further fisheries and stream morphology investigations to understand how these changes could affect aquatic habitats.

Study Area

The study area includes the Susitna River downstream to the mouth, from the upstream end of the proposed Watana Reservoir.

Study Components

The USACE Hydrologic Engineering Center (HEC) has developed a series of programs for hydrologic and hydraulic modeling including the HEC ResSim (Reservoir System Simulation) model. HEC ResSim is able to model reservoir operations under various constraints and operating scenarios, as well as downstream routing effects. The HEC ResSim model is being proposed for this Project due to its ability to model both aspects, reservoir operations and downstream routing, of the Susitna-Watana Dam project simultaneously.

The HEC ResSim model setup of the watershed will include major inflows to the Susitna River where time-series flow data is available including the Chulitna, Talkeetna, and potentially the Yentna Rivers, as well as cumulative local inflows. The model setup will also include control points at the Watana Dam site and Gold Creek, and comparison points with historic data at the Sunshine and Susitna Station USGS Gaging Stations. Reservoir and dam characteristics from the 1985 FERC application will be the initial basis of the physical and operating parameters in the model, and updated, when applicable, to reflect the current configuration. Downstream routing will be performed based on the Muskingum-Cunge channel flow routing method and will use 8-point cross-sections initially based on survey data collected in 1980 and 1981 and summarized in the Hydrographic Surveys Closeout Report, Final Draft (R&M Consultants 1981). The 1980s cross-section data will be updated as a part of the current studies. Location and elevation cross-section data were collected in the 1980s at 68 locations on the Susitna River between Talkeetna River and just upstream of Portage Creek near Devils Canyon. Data for 23 additional cross-sections was collected between Devil Creek and Deadman Creek, which is just downstream of the Watana Dam site. Additional cross sections will be needed in the Lower River as no complete transects were obtained in the 1980s and there is interest in understanding the likely changes in flows and water surface elevations in the Lower River reaches.

5.2.1.2. Water Resources River Ice Study

<u>Study Rationale and Objectives</u>

Water released for winter generation is expected to alter the natural formation and breakup of river ice by:

- Preventing or delaying in-channel (frazil and aufeis) and ice cover formation for several miles downstream of the reservoir.
- Increasing the elevation at which the ice cover forms downstream of this open reach.
- Preventing the formation of a stable ice cover on the reservoir.

The overall study objective is to determine Project effects on downstream river ice formation process. The specific objectives are to:

- Document the timing and process of ice cover formation.
- Identify the relationship between river ice processes and channel morphology, vegetation and aquatic habitats.
- Forecast expected changes in river ice formation and processes as a result of Project construction and operation.

<u>Study Area</u>

The study area includes the Susitna River downstream to the mouth, from the upstream end of the proposed Watana Reservoir.

Study Components

At a minimum, the study will include the following study components:

- The 1980s river ice studies will be thoroughly reviewed, and where possible, compiled in geo-mapping format for comparison with present day observations. If compilation of 1980s study results are available to guide study site selection, observations of river ice formation and breakup would commence in 2012-13 and continue through 2014-15. Otherwise, site specific measurement and observation would not commence until winter 2013-14.
- Document existing ice cover formation between River Mile (RM) 0 and 250 using repetitive aerial observations and videography.
- Measurement of ice thickness and surface elevation would be made between RM 80 and 150 and RM 180 and 200.
- The presence or absence of frazil ice and aufeis ice as well as the timing and process of ice cover formation on aquatic habitats between RM 98 and 150 will be documented. Particular attention will be given to the relationship that exists between river ice and vegetation, geomorphology and aquatic habitats within the reach. Some aspects are vegetation succession, wood recruitment, sediment transport, channel migration, upwelling, and fish survival.
- Information will be compiled regarding river ice and existing hydroelectric projects in arctic and sub-arctic climates outside Alaska.

Assessment of the effect of the ice process change on geomorphology, vegetation and aquatic habitat would occur within those respective studies.

5.2.1.3. 2012 Water Resources Study Components

WR-S1: Locate and update 1981 hydrographic river transect information for Middle Susitna River reaches for use in HECResSim (Reservoir Simulation Model) modeling. Identify new cross section locations and obtain relevant data at representative locations in the Lower River reach.

WR-S2: Document the breakup and formation of river ice downstream of the proposed Watana Dam site. The progression of ice breakup and formation will be documented using repetitive aerial observations. Ice thickness and ice surface elevation measurements will be made.

5.2.2. Water Quality Issues

WQ1: Potential effects of Project construction activities, such as accidental spills and releases of petroleum products or other materials, disturbance of vegetation and soil cover, increased stormwater runoff, and, increased suspended sediment/turbidity or nutrient levels within the reservoir reach and downstream of the dam.

WQ2: Potential effects of reservoir filling, Project operations, including reservoir surface elevation fluctuations, on temperature, turbidity, total dissolved/suspended solids, dissolved oxygen, pH, metals, and chemical/nutrient characteristics within the reservoir.

WQ3: Potential effect of Project operations on temperature, turbidity, total dissolved/suspended solids, dissolved oxygen, pH, metals, and chemical/nutrient characteristics of the mainstem river downstream from the proposed Watana Dam site (RM 184).

WQ4: Potential effects of the proposed spillway operations on total dissolved gas concentrations in the Susitna River downstream of the Project.

5.2.2.1. Water Quality Impacts Study

Study Rationale and Objectives

Project operations are going to impact water quality. Water quality studies will help quantify those impacts. This study has the following objectives:

- Verify baseline water quality conditions with select water quality measurements.
- Assess potential effects of Project construction and operations on temperature, turbidity, total dissolved/suspended solids, dissolved oxygen, pH, metals, and chemical/nutrient characteristics within the proposed Watana Reservoir and the mainstem river downstream from the proposed Watana Dam site (RM 184).
- Evaluate potential effects of Project operations on total dissolved gas concentrations downstream of the proposed Watana Dam site.

Study Area

The study area includes the Watana Reservoir and the Susitna River downstream of the reservoir. Study areas will likely vary and be defined during the course of the study plan development to address specific study components.

Study Components

The study will include the following study components:

- Review and summarize existing water quality information: All available previous water quantity and modeling data will be reviewed and summarized and used to the extent possible to inform any additional water quality and modeling work.
- Baseline water quality monitoring: The Susitna River and its tributaries will be monitored to determine baseline water quality conditions. Measurement of temperature, turbidity, total dissolved/suspended solids, dissolved oxygen, pH, metals, and chemical/nutrient will be collected. Monitoring stations will be established and sampling will be performed for comparison within and between sites over time.
- Evaluate and select appropriate reservoir and riverine water quality models. Ensure that the selected models have the capability to incorporate ice processes.

- Use the temperature models to simulate water temperature during the portions of the year that may be of most concern to aquatic species and ice processes. Modeling development steps include:
  - Collect/develop model inputs as necessary such as channel and reservoir geometry data, solar shading data (topographic and riparian), meteorological data (air temperature, wind speed, relative humidity, solar radiation), hydrology data, and boundary condition flow and water temperature data for the modeled river reaches and reservoirs.
  - Calibrate and validate the hydrodynamics and heat budget portions of the water temperature model(s) with empirical water temperature (river reaches and reservoirs) and meteorological data (e.g., use data collected in 2005-2008). Calibrate water travel time either with data collected in this study or data collected in another study (Instream Flow).
- Characterize modeled water temperatures (i.e., seasonal, daily, within-day temperatures) for existing, Project, and alternative flow conditions. For Project and alternative flow conditions, model a range of flow releases.
- Evaluate and select appropriate reservoir turbidity modeling approach based on empirical/literature data from other systems and numerical modeling, as appropriate. Any reservoir turbidity modeling approach will be based on a significant empirical data foundation. As appropriate, the study will use data from similar glacial river/reservoir systems and validation of the modeling approach.
- The reservoir turbidity modeling will be used in combination with mass flow/turbidity modeling in the Susitna River (downstream) to characterize turbidity for Project and alternative flow regimes. Modeling will be coordinated with the Instream Flow Study to ensure that all important habitat types are included in the modeling (main channel, side channel, side slough, upland slough, tributary mouths) along the length of the river.
- Stream temperature and meteorological monitoring will be used to establish baseline conditions and support reservoir and stream temperature modeling of potential Project effects.
- Stream turbidity monitoring within the Susitna River will be used to establish baseline conditions and used to assess potential downstream Project effects.
- Stream heavy metals concentrations (copper and aluminum) have been reported in the Susitna River during prior sampling efforts. The potential source of these elements will be assessed using geology and soils analysis. In addition, a review of previously collected data will be made to determine the form of metal reported from previous sampling (dissolved vs. total) and its potential bioavailability to aquatic organisms.

5.2.2.2. 2012 Water Quality Study Components

In addition to the above proposed studies, the following studies or study components will be started in early 2012 in advance of formal Study Plan development for the Project. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

WQ-S1: Review of existing temperature data and models. Obtain and evaluate water and meteorological temperature data, including 1980s data that was used to calibrate the SNTEMP and DYRESM temperature models that were used.

5.2.3. Geomorphology/Geology/Soils Issues

Reservoir Geomorphology Issues

G1: Potential longevity of Watana Reservoir as a result of sediment entrapment based on present day particle sizes in transport.

G2: Potential change in morphology at the upper end of the proposed reservoir resulting from sediment entrapment. Changes in the river morphology at the upper end of the reservoir may affect fish migration and habitat.

G3: Potential effects of Project operations on mass wasting, shoreline erosion, tributary mouth migration, and stability within the reservoir inundation zone. These changes may affect fish and wildlife or cultural resources.

G4: Potential temporary effects of soil erosion and sedimentation from Project construction activities, including construction and use of access roads and borrow areas, in the Susitna River.

Middle River Geomorphology Issues (Watana Dam Site (River Mile [RM 184]) downstream to Three Rivers Confluence [RM 98])

G5: Potential effects of reduced sediment load and changes to sediment transport as a result of Project operations within the Middle River. Streambed coarsening due to reduced sediment transport may alter river morphology, riparian conditions, and distribution and abundance of mainstem, side channels, and side sloughs that affect fish habitat.

G6: Potential effect of Project operations on the stability of tributary mouths and access to the tributaries within the Middle River. Potential tributary mouth morphological changes may affect fish access to tributaries.

G7: Potential effects of Project construction and operation on the recruitment and deposition of large wood within the Middle River. Changes in large wood abundance may affect aquatic habitat.

G8: Potential effects of Project and infrastructure construction (dam, access roads, borrow areas, transmission facilities) on sediment recruitment to water bodies within the Project vicinity.

Lower River Geomorphology Issues (Three Rivers Confluence [RM 98] downstream to Cook Inlet [RM 0])

G9: Potential effects of reduced sediment load and changes to sediment transport as a result of Project operations within the Lower River.

G10: Potential effects of Project construction and operation on the recruitment and deposition of large wood to the Lower River reach. Changes in large wood abundance may affect aquatic habitat.

Geology and Soils Issues

GS-1: Potential increases in erosion resulting from construction and operation of transmission lines, roads, an airstrip, and construction camp.

GS-2: Potential seismic effects on the proposed dam and other facilities.

5.2.3.1. Geomorphology Study

Study Rationale and Objectives

Project operations will influence the sediment supply and sediment transport capacity of the river due to changes in the high flow regime and entrapment of sediment in Watana Reservoir. This could have potential effects on fluvial processes and channel morphology. Project operations may influence water temperatures and the formation of ice and ice break-up that could alter river flood stage and scour processes, potentially changing river channel morphology. Within the Watana Reservoir inundation zone changes in river flow and stage, and changes in sediment transport processes, could alter channel stability upstream of the reservoir, cause changes in the morphology of tributaries entering the reservoir, and could induce erosion along the reservoir shoreline.

It is important to predict the type and magnitude of geomorphologic changes that may occur in the Susitna River due to the proposed Project. Existing data on the sediment supply and sediment transport characteristics of the river is both spatially and temporally limited to a few USGS stations.

The study objective is to assess the potential change in lower, middle and upper Susitna River morphology, including mainstem, side channels, sloughs, and tributary mouths.

Study Area

The geomorphology study would consider the reservoir inundation zone and the remaining segments of the Middle River, and the Lower River reaches.

Study Components

The overall study approach is to review existing and collect new data in order to:

- Identify channel stability and changes in channel morphology today in comparison to recent historic data using aerial photography, available channel geometry data, or other geo-referenced data sources.
- Characterize slope stability and soil conditions along the reservoir inundation zone.

- Collect channel geometry and gradient data for tributaries entering the Watana Reservoir inundation zone.
- Verify 1980s study of trap efficiency of Watana Reservoir. In combination with data collected for sediment load and particle sizes entering reservoir, and sediment transport modeling, calculate sediment accumulation rate.
- Quantify bed and suspended sediment load, timing of sediment delivery, sediment sizes, and sediment transport rates in longitudinal profile along the river.
  - Prepare sediment rating curves for existing USGS station data.
  - Collect new sediment transport and particle size data for stratified study reaches lacking data.
- Collect cross-sectional and longitudinal profile channel geometry data for representative river reaches to be used in hydraulic and sediment transport modeling.

This data would be used in combination with geomorphic principles and criteria/thresholds defining probable channel forms, and with sediment transport and hydraulic modeling methodologies to predict the potential for alteration of channel morphology.

5.2.3.2. 2012 Geomorphic Study Components

In addition to the above proposed geomorphic studies, the following studies or study components will be started in early 2012 in advance of formal Study Plan development for the Project. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

G-S1: Determine bedload and suspended sediment load by size fraction at Tsusena Creek, Gold Creek, and Sunshine Gage stations.

G-S2: Geomorphic assessment of the Middle River reach using aerial photography.

G-S3: Assessment of Project effects on Lower River channel morphology.

5.2.4. Fish and Aquatic Resource Issues

<u>Upper River Fish and Aquatic Issues (Upstream of the Watana Dam Site [RM 184])</u>

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.

Middle River Fish and Aquatic Issues (Watana Dam Site [RM 184] downstream to Three Rivers Confluence [RM 98])

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 streamflow, 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.

Lower River Fish and Aquatic Issues (Three Rivers Confluence [RM 98] downstream to Cook Inlet [RM 0])

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.

F10: Potential impacts to the Endangered Cook Inlet beluga whale.

5.2.4.1. Fish Abundance and Distribution Study

Study Rationale and Objective

The intent of the fish population studies is to address Project-induced macro-habitat changes and subsequent changes to habitat quality and fish abundance and distribution. This study has the following objectives:

- Characterize resident and anadromous fish species composition, spatial and temporal distribution, and relative abundance.
- Develop habitat fish utilization information for use in the impact assessments and the Instream Flow Study.

Study Area

The study area includes the Susitna River corridor and its tributary mouths from the proposed Watana Dam site downstream. Study areas will likely vary and be defined during the course of Study Plan development to address specific study components.

Study Components

The study will include the following study components:

- Compile and summarize existing information on fish population composition, spatial and temporal distribution, and abundance.
- Develop a sampling approach to obtain habitat utilization (including turbidity/ temperature) information in channel types (main channel, side channels, side sloughs, upland sloughs, tributary mouths, and tributaries) in selected study reaches.
- Evaluate fish movement through Devils Canyon.
- Assess access to tributary mouths based on geomorphologic studies.
- Combine results from the Water Temperature and Turbidity Study with the current fish distribution and water temperature criteria data for various species/lifestages of native and introduced species to estimate fish distributions within the Project area.
- Data reporting for Susitna River fish populations will include:
    - Spatial and temporal distribution maps of resident and anadromous fish species and lifestages for existing conditions.
    - Periodicity charts for each species/lifestage by season and location within the study area.
    - Spatial and temporal abundance estimates for resident and anadromous fish (adults and juvenile rearing and outmigration).
    - Summary of channel type and mesohabitat utilization of fishes.

5.2.4.2. Upper River Fish Study

Study Rationale and Objective

The intent of the reservoir fish habitat study is to address the change from riverine habitats to reservoir habitats and the impact of Project operations on reservoir habitat quality, tributary access, and fish distribution. This study has the following objectives:

- Characterize resident and anadromous fish species composition, spatial and temporal distribution, and relative abundance.
- Characterize the habitat within the inundation zone.

Study Area

The study area includes the area of inundation of the proposed Watana Reservoir. Study areas will likely vary and be defined during the course of Study Plan development to address specific study components.

Study Components

The study will include the following study components:

- Compile and summarize existing information on fish population composition, spatial and temporal distribution, and abundance and characterize the existing habitat.
- Characterize the expected water surface elevation patterns and approximate pool volumes of the proposed Watana Reservoir using Project operations modeling.
- Assess potential fish passage barriers at river and stream inlets to Watana Reservoir. Summarize expected water quality information (water chemistry, temperature, turbidity) with respect to thermocline location, epilimnion and hypolimnion water temperatures and dissolved oxygen concentrations for proposed Watana Reservoir using Project operations modeling and data from the water temperature/water quality modeling studies.
- Characterize the expected fish species assemblage and estimate the trophic state (e.g., oligotrophic) of proposed Watana Reservoir.

5.2.4.3. Productivity Study

Study Rationale and Objectives

The intent of the Productivity Study is to characterize the macroinvertebrate community. Project operations are going to impact the habitat in the river and have subsequent impacts on macroinvertebrate communities. This study has the following objectives:

- Document benthic algae and macroinvertebrate taxonomic composition (to family level) and abundance in representative habitats in the Susitna River.
- Compare (using existing literature) the benthic algae and macroinvertebrate taxonomic composition and abundance to river systems having turbidity regimes (and flow/temperature regimes, if possible) similar to the turbidity estimated during Project operation.
- Estimate the effects of altered flow, temperature, and turbidity regimes on primary and secondary production/abundance.
- Identify factors currently limiting resident fish and juvenile salmonid growth (food availability, turbidity and/or water temperature) and evaluate the effects of changes in water temperature, turbidity, and food availability on resident fish and juvenile salmonid growth and habitat.

Study Area

The study area includes the Susitna River downstream of the proposed Watana Dam. Study areas will likely vary and be defined during the course of Study Plan development to address specific study components.

Study Components

The study will include the following study components:

- Review and summarize historical algal and macroinvertebrate communities, and fish growth/production information in the study area.
- Document the algal and benthic macroinvertebrate communities and abundance (including different macrohabitat types).
- Document the algae/benthic macroinvertebrate community in other river systems with turbidity regimes similar to that which will occur with the Project (rivers must have applicable temperature and flow regimes and substrates).
- Evaluate changes to juvenile growth and abundance from potential Project-induced changes to temperature, turbidity and flow, and their impacts on food availability.

5.2.4.4. Instream Flow Study

Study Rationale and Objectives

The intent of the Instream Flow Study is to evaluate effects of Project operations on habitat quality and availability.

The overall study objective is to characterize aquatic and riparian habitat as a function of flow using site-specific data, ecological principles, and modeling methodologies as needed. The information developed from this study, in combination with other resource studies (e.g., water temperature, fish abundance and distribution, geomorphology, and riparian), will provide a basis for streamflow-related resource management decisions and impact analyses.

The specific objective of the study is to provide habitat versus flow relationships necessary to quantify the potential effects of the Project and other alternative flow scenarios on aquatic and riparian habitat.

Study Area

The study area includes aquatic habitats and riparian habitat (related to river flow) in the Susitna River downstream of the proposed Watana Dam. Study areas will likely vary and be defined during the course of Study Plan development to address specific study components.

Study Components

The study will include the following study components:

- Use Aquatic Resources Working Group to refine and develop Study Plan for Instream Flow Modeling.
- Compile, evaluate and validate 1980s instream flow studies.
- Stratify the study area into study reaches.

- Estimate relative abundance of mesohabitat types (e.g., pool, run, riffle) within representative channel types (main channel, side slough, upland slough, tributary mouths), in selected river reaches.
- Select target species/lifestages.
- Development of macro, meso and/or microhabitat suitability criteria for selected species life stage for use in developing habitat versus flow relationships.
- Quantify the habitat versus flow relationships for selected species.
- Use the habitat versus flow relationships to develop a time series analysis of aquatic habitat under existing and Project conditions.
- Identify the time periods, flow conditions, and life stages when habitat may be a limiting factor for selected fish species for the existing and with Project conditions.

5.2.4.5. 2012 Fish and Aquatic Study Components

In addition to the above proposed fishery studies, the following studies or study components will be started in early 2012 in advance of formal Study Plan development for the Project. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

F-S1: Synthesis of Existing Fish Population Data.

F-S2: Susitna River Salmon Run Apportionment Study.

F-S3: Middle River Habitat Utilization Study.

F-S4: Chinook Salmon and Presence Above Devils Canyon.

F-S5: 2012 Instream Flow Planning Study.

F-S6: Cook Inlet Beluga Whale Anadromous Prey Analysis

5.2.5. Wildlife Resource Issues

W1: Potential loss and alteration of wildlife habitats, including key habitat features such as den sites and mineral licks, from Project construction and operation.

W2: Potential physical and behavioral blockage and alteration of movements due to reservoir water and ice conditions; access and transmission corridors; new patterns of human activities.

W3: Potential changes in wildlife mortality rates due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches.

W4: Potential impact of changes in predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development.

W5: Potential impacts to wildlife from changes in hunting, vehicular use, noise, and other disturbances due to increased human presence resulting from Project development.

W6: Potential impacts to special status wildlife species.

5.2.5.1. Big Game Study

Study Rationale and Objective

The overall study objective is to build on existing information and develop current information on abundance, distribution, movements, and habitat use for moose, caribou, Dall's sheep, black bears, brown bears, and wolves to accurately evaluate potential Project-related effects on big game resources in the upper and middle Susitna River basins. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, wildlife-habitat relationships, salmon spawning distributions, big game harvest locations, distribution of sensitive wildlife habitats), will provide a basis for impact assessments, development of mitigation, and will inform harvest and population management decisions. Many wildlife studies conducted for the APA Susitna Hydroelectric Project focused on big game mammals because of their ecological importance and because of management concerns for human use, both consumptive (subsistence and sport hunting) and non-consumptive (wildlife viewing).

The specific objectives of the study include:

Moose

- Complete current population estimates for moose for Upper and Middle Susitna River basins and road and transmission corridors.
- Use spatial analysis of seasonal range use and movements based on telemetry data to provide information on moose habitat use, movements, and extent of winter range through the Project area.
- Measure moose forage quality and browse intensity in the impoundment zone, access routes, and transmission corridors to quantify habitats that would be lost or altered, estimate timing of use and degree of dependency of resident and migratory populations, compare habitat quality to other adjacent regions, and develop mitigation.

Caribou

- Complete current population estimates for caribou in the Project area including caribou from Nelchina and Delta caribou herds, especially estimates of sub-herd numbers and distribution in areas north of the impoundment area.
- Evaluate current and historic Nelchina and Delta caribou herd identification, movements, traditional migration routes across the proposed impoundment area, and sensitive seasonal distributions such as calving ranges.

- Use spatial analysis of seasonal range use and movements based on current telemetry data from GPS/satellite collared caribou to provide information on current caribou habitat use and movements throughout the Project area.

Dall's Sheep

- Complete current population estimate and delineate seasonal ranges for Dall's sheep in mountain regions next to the Project area, including road and transmission corridors.
- Assess current condition and use of mineral licks on the lower Jay Creek.

Brown and Black Bears

- Complete current population estimates for bears in the Project area.
- Evaluate berry production in the impoundment zone and access corridors.
- Evaluate use of salmon spawning streams downstream from the proposed dam location including the use of Prairie Creek.
- Identify denning areas.

Wolves

- Complete current population estimates for wolves, determine number of packs and individuals using the Project area, including road and transmission corridors.
- Use spatial analysis of telemetry data to map pack territories and movements.
- Identify locations of dens, rendezvous sites, hunting areas, and other essential areas for each pack.

Study Area

The study area includes all areas that will be directly or indirectly affected by Project construction and operations; including facility sites, access roads, transmission lines laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identify, compile, and evaluate existing population data.
- Spatial analyses of existing telemetry data to determine seasonal habitat use and movements.
- As appropriate, aerial and ground surveys may be used to estimate populations in the upper and middle Susitna River basins, and road and transmission corridors.
- As appropriate, ground-based surveys may be used to evaluate moose forage quality and browse intensity in the impoundment zone, access routes, and transmission corridors.
- As appropriate, ground-based surveys may be used to evaluate bear use of salmon spawning streams in the middle Susitna River Basin.
- Ground-based surveys to evaluate significant habitat features such as current use of the Jay Creek mineral licks.

- Data reporting will include:
    - Spatial and temporal distribution maps for big game mammals with emphasis on delineation and temporal use of sensitive habitats and consistently used movement corridors.
    - Detailed mapping of moose foraging habitats including quantity and quality information for impact assessment and development of mitigation.
    - Accurate population estimates for big game mammals using the Project area.

5.2.5.2. *Furbearer Study*

Study Rationale and Objectives

The overall study objective is to develop current information on abundance, distribution, habitat use and movements of terrestrial (wolverine, marten, lynx, red fox, and coyote) and aquatic (beaver, muskrat, river otter, and mink) furbearing mammals to evaluate potential Project-related effects on habitat loss and alteration; blockage or alteration of movements; changes in mortality; and changes in human harvest and disturbance. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, wildlife-habitat relationships, fish distributions, furbearer harvest locations, distribution of sensitive wildlife habitats), will provide a basis for impact assessments. Many wildlife studies conducted for the original SHP focused on furbearing mammals because of their ecological importance and management concerns for human use, both consumptive (subsistence and sport hunting) and non-consumptive (wildlife viewing).

The specific objectives of the study may include:

- Evaluate existing data on distribution, habitat use, and movements of wolverine, beaver, river otters, mink, muskrat, and other furbearers.
- Complete current estimate of active beaver colonies in the middle and lower river.
- Complete spring surveys to evaluate overwinter survival of beavers.
- Evaluate potential marten home range and dispersal movements between old forest stands.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations; including facility sites, access roads, laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identification and compilation of existing terrestrial and aquatic furbearer population size, seasonal distribution, suitable habitats, and movement data.

- Spatial analyses of existing data to determine location of sensitive habitats such as beaver lodges and cash sites; and river otter, red fox and coyote den sites.
- Winter track surveys to estimate wolverine and other furbearer population size in the upper and middle Susitna River basins, including road and transmission corridors.
- Aerial and ground-based surveys to document distribution and activity of beaver colonies and overwinter survival.
- Data reporting will include:
  - Spatial and temporal distribution maps for furbearers with emphasis on delineation of seasonal ranges and suitable habitat.
  - Detailed mapping of beaver lodges; river otter, red fox, and coyote den sites.
  - Accurate population estimates for furbearers using the Project area.

5.2.5.3. Small Game Mammal and Upland Gamebird Study

Study Rationale and Objectives

The overall study objective is to develop current information on abundance, distribution, habitat use, and movements of snowshoe hare, ptarmigan and grouse to evaluate potential Project-related effects on habitat loss and alteration; blocked movements, changes in mortality; and changes in human harvest. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, wildlife-habitat relationships, predator distributions, and harvest locations), will provide a basis for impact assessments. Currently there is little information on potential effects of increased human access on these small game resources. The area has limited human access and use and may provide refugia and source populations of snowshoe hare, ptarmigan and grouse for neighboring regions with higher human use and harvest levels.

The specific objectives for snowshoe hare, ptarmigan, and grouse include:

- Evaluate existing data on distribution, habitat use, and movements.
- Evaluate seasonal habitat use, potential habitat fragmentation effects, and dispersal capabilities.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations; including facility sites, access roads, laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identification and compilation of existing population, distribution, habitat, and movement data.
- Spatial analyses of existing data to determine distribution of suitable habitats.

- Winter track surveys to estimate snowshoe hare populations throughout the Project area.
- Aerial and ground-based surveys to document abundance, distribution, and productivity of small game and upland gamebirds.
- Telemetry samples to document seasonal habitat use, seasonal movement patterns, and dispersal capabilities.
- Data reporting will include:
  - Spatial and temporal distribution maps with emphasis on delineation of suitable and used habitats.
  - Detailed mapping of seasonal and dispersal movements with evaluation of habitats crossed.
  - Accurate population estimates for the Project area and adjacent harvested areas.

5.2.5.4. Harvest Study for Big Game, Furbearers, Small Game Mammals and Upland Gamebirds

Study Rationale and Objectives

The overall study objective is to compile and evaluate past and current human use and harvest locations and levels within the Project area for big game mammals–especially moose and caribou, furbearers, snowshoe hare, ptarmigan and grouse to evaluate potential Project-related effects on changes in access and related changes in human harvest. The information developed from this study, in combination with other resource studies (e.g., big game use and movements in the Project area; furbearer, small game mammal and upland gamebird use of the Project area; waterfowl use of the Project area; vegetation and wetland mapping; wildlife-habitat relationships; and predator distributions), will provide a basis for impact assessments, and development of mitigation. Currently there is little information on potential effects of increased human access on these game resources, although it has been noted that human access has increased since the studies completed for the APA Susitna Hydroelectric Project in the 1980s. The current Project area has limited human access and may provide refugia and source populations for neighboring regions with higher human use and harvest levels.

The specific objectives for moose, caribou, Dall's sheep, bears, wolves, and furbearers include:

- Evaluate and compile existing past and current data on harvest effort, harvest locations, hunter access, and hunter mode of travel.
- Compare current harvest locations to current patterns of seasonal habitat use and movements.

The specific objectives for small game mammals and upland gamebirds include:

- Evaluate and compile existing past and current data on harvest effort, harvest locations, hunter access, and hunter mode of travel.
- Compare current harvest locations to current patterns of small game mammals and upland gamebird abundance, seasonal habitat use, and dispersal capabilities.

Study Area

The study area includes ADF&G, Game Management Units (GMU) 13A, 13B, 13E and any additional areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas and the inundation zone for the reservoir.

Study Components

The study will include the following study components:

- Identification and compilation of existing harvest and hunter effort within appropriate harvest units.
- Development of additional data collection and harvest monitoring for hunters and trappers currently using the Project area.
- Spatial analyses of existing data to determine and compare past and current distribution of hunter and trapper reported harvests and reported effort.
- Comparison of current harvest patterns to current abundance and seasonal movements of big game, furbearers, small game mammals and upland gamebirds.
- Data reporting will include:
    - Spatial and temporal distribution maps of hunter/trapper harvest and effort by game species within minimum reporting units (Uniform Coding Units or subunits).
    - Current harvest monitoring reports including location, mode of transportation, effort expended, and game species harvested within GMUs affected by the Project and surrounding units for comparison.

5.2.5.5. Eagle and Raptor Study

Study Rationale and Objectives

The overall study objective is to develop current information on distribution, abundance, and habitat use including active nest locations for bald and golden eagles, peregrine falcons, and stick nesting raptors to evaluate potential Project-related effects on habitat loss and alteration; changes in mortality; and changes in human disturbance. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, wildlife-habitat relationships, fish distribution studies), will provide a basis for impact assessments and development of mitigation including seasonal avoidance of active nest sites for birds of management or conservation concern.

The specific objectives of the study include:

Bald and Golden Eagles

- Evaluate existing data on distribution, established nest sites and pair territory locations, and foraging habitats.
- Complete current surveys to locate active nests and alternative nest sites within habitats affected by the impoundment, access road corridor, and transmission line corridors.
- Complete current surveys to document fall and winter communal roost sites.
- Evaluate seasonal habitat use.

Cliff Nesting Raptors

- Evaluate existing data on nest site locations, identify potentially suitable cliff nesting habitat locations.
- Complete current nest surveys at identified suitable cliff habitats to document use throughout the Project area.

Other Raptors and Owls

- Evaluate existing data on nest site locations, identify potentially suitable nesting habitats.
- Complete current nest surveys in potentially suitable nesting habitats during late-winter early spring for owls and during early spring for other raptors throughout habitat potentially affected by the Project.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations; including facility sites, access roads, laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identification and compilation of existing historical nest site locations, and locations of suitable tree and cliff nesting habitats.
- Spatial analyses of existing data to determine distribution of suitable habitats.
- Late winter aerial and ground-based surveys for owls.
- Early spring (prior to leaf out) aerial and riverine-based surveys to document active tree and cliff nest sites.
- Late-spring and summer surveys to verify and monitor nest activity, and search for additional nests.
- Data reporting will include:
    - Compilation of past eagle and other raptor nest locations with survey extents to compare to current survey data.

- Early reporting of current nest locations and activity for eagles with coordinates and appropriate buffer zones to protect active eagle nests from disturbance during field studies.
- Spatial summary and mapping of suitable forest, riparian, and cliff habitats to evaluate extent of suitable nesting habitats within the Project area.

5.2.5.6. Waterbirds, Seabirds, and Waterfowl Study

Study Rationale and Objectives

The overall study objective is to develop current information on nesting, brood-rearing, and migration staging habitat use by loons, grebes, gulls, terns, geese, swans, and ducks. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, wildlife-habitat relationships, fish distribution studies), will provide a basis for impact assessments.

The specific objectives of the study include:

- Evaluate existing data on nesting, brood-rearing, and migration staging distributions for waterbirds and waterfowl.
- Complete current surveys for nesting, brood-rearing, and migration staging habitats to determine abundance of waterbirds and waterfowl throughout the Project area.
- Evaluate seasonal habitat use and movement patterns.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations; including facility sites, access roads, laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identification and compilation of existing historical nesting, brood-rearing and migration staging locations.
- Spatial analyses of existing data to determine distribution of high use habitats.
- Aerial spring surveys to determine distribution and abundance of nesting waterbirds and waterfowl.
- Ground-based surveys for nesting harlequin ducks and brood-rearing harlequin ducks and mergansers along the upper and middle Susitna River and major tributaries.
- Aerial summer surveys to determine distribution, abundance, and habitat use for brood-rearing waterbirds, seabirds, and waterfowl.
- Aerial fall surveys to determine distribution, abundance, and habitat use for migration staging by waterbirds and waterfowl.
- Data reporting will include:

  - Compilation and delineation of past waterbird and waterfowl nesting habitats, brood-rearing areas, and migration staging locations with survey extents to compare to current survey data.
  - Early reporting of current nest locations and activity for harlequin ducks in riparian habitats subject to field studies with coordinates and appropriate buffer zones to protect active nests from disturbance during field studies.
  - Spatial summary and mapping of suitable aquatic and wetland habitats to evaluate extent of suitable nesting, brood-rearing, and migration staging habitats within the Project area.

5.2.5.7. Landbird and Shorebird Study

Study Rationale and Objectives

The overall study objective is to develop current information on nesting distribution, abundance, and current use of wetland and upland habitats by landbirds and shorebirds. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, bird-habitat relationships), will provide a basis for impact assessments.

The specific objectives of the study include:

- Evaluate existing data on nesting and migration staging habitats for landbirds and shorebirds.
- Complete current surveys for nesting and migration staging habitats to determine distribution and abundance of landbirds and shorebirds throughout the Project area.
- Evaluate seasonal habitat use and migration routes.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations; including facility sites, access roads, laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identification and compilation of existing historical nesting habitat association, and migration staging areas.
- Spatial analyses of existing data to delineate habitats used by a high diversity of birds.
- Ground-based surveys for breeding landbirds and shorebirds throughout the Project area.
- Data reporting will include:
  - Compilation and delineation of high density and diversity bird habitats.
  - Delineation of potential migration routes and staging habitats.

5.2.5.8. Non-Game Species of Conservation Concern Study

Study Rationale and Objectives

The objective of this study is to develop current information on distribution, abundance, and habitat use in the Project area for non-game animals that have been identified as Covered Species in Alaska's Comprehensive Wildlife Conservation Plan and/or as species of concern by various groups as defined in the FERC/USFWS MOU on migratory birds. Preliminary reviews have identified little brown bats, wood frogs, and certain birds as species of concern that occur within the Project area. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping, wetland mapping, wildlife-habitat relationships), will provide a basis for impact assessments and development of mitigation.

The specific objectives of the study include:

Little Brown Bat

- Evaluate existing data on distribution, habitat use, and movements.
- Evaluate geologic and topographic data to identify areas potentially containing Karst topography with cave features within the Project area.
- Complete current distribution and habitat use surveys for bat species in the inundation zone.

Wood Frog

- Evaluate existing data on distribution, habitat use, and movements.
- Complete current distribution surveys for wood frogs throughout the Project area.

Small Mammals

- Evaluate existing data on distribution, habitat use, and movements.
- Complete distribution and abundance surveys within the inundation zone, and along road and transmission corridors.

Birds

- Compile listing of migratory bird species of concern and identify occurrence data and distribution of suitable habitats within the Project area based on existing data on distribution, habitat use, and movements.
- Complete current population and habitat use estimates for birds of concern throughout the Project area.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations; including facility sites, access roads, laydown/storage areas, the inundation zone for the reservoir, and the downstream Susitna River.

Study Components

The study will include the following study components:

- Identification and compilation of existing population, distribution, habitat, and movement data.
- Spatial analyses of existing data to determine distribution of suitable habitats potentially affected by the Project.
- Acoustic surveys to identify areas used by bats in the Middle and Upper Susitna River areas.
- Auditory surveys for wood frogs in the Project area during the spring breeding season around waterbodies and wetlands in the impoundment zone, in the upper river, in riparian habitats in the middle river, and along road and transmission corridors.
- Trapping surveys for small mammals, including the Alaska tiny shrew, within the impoundment zone, facility sites, road and transmission corridors.
- Various surveys for raptors, owls, waterbirds, seabirds, waterfowl, shorebirds, and landbirds as applicable with species specific surveys if standard methods are insufficient to determine presence in the Project area (such as harlequin duck, or American dipper surveys).
- Data reporting will include:
    - Early reporting of current nest locations and activity for owls and other raptors, loons, swans, and harlequin duck nests with coordinates and appropriate buffer zones to protect nest from disturbance during field studies.
    - Spatial delineations of habitats used by bats, wood frogs, Alaska tiny shrew and bird species of concern.

5.2.5.9. 2012 Wildlife Resource Study Components

Some of the components of the proposed studies discussed above will be initiated in 2012 in order to help inform the formal study plans. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

W-S1: Wildlife Habitat Use and Movement (corresponds to Big Game Study).

W-S2: Past and Current Big Game and Furbearer Harvest Study.

W-S3: Eagle Nests and Raptor Nest Study.

5.2.6. Botanical Resource Issues

B1: Losses of vegetation and wetland communities and productivity from reservoir inundation and other Project facilities development (direct effects).

B2: Changes to vegetation and wetland communities along access roads, transmission corridors, and reservoir edges from changes in solar radiation, temperature moderation, erosion and dust deposition, reservoir fluctuation, pathogen dispersal and abundance.

B3: Potential introduction of invasive plants due to Project construction.

B4: Potential changes in wetlands, wetland functions, riparian vegetation, and riparian succession patterns related to altered hydrologic regimes below the dam.

B5: Potential changes in rare plant populations related to the development of the reservoir, access and transmission facilities, and construction and operation activities including erosion and dust deposition.

5.2.6.1. Vegetation Mapping Study

Study Rationale and Objectives

The overall study objective is to develop vegetation and habitat GIS cover data both using existing information and developing Project-specific aerial image interpretation. The information developed from this study, in combination with other resource studies (e.g., wetlands/riparian study, rare plant study, invasive plant study, and various wildlife habitat studies), will provide a basis for vegetation/habitat management decisions, impact analyses, and mitigation development.

The specific objectives of the study include:

- Determine the appropriate mapped scales, areal extents, and the Alaska Vegetation Classification level for vegetation mapping.
- Develop vegetation maps at suitable scales.
- Provide habitat acres and distribution to support the development of related studies.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. The study area also includes all downstream areas that will be included in riparian vegetation and wildlife habitat studies.

Study Components

The study will include the following study components:

- Identification of available current and historical vegetation and land cover mapping data.
- Determining appropriate mapped scales, areal extents, and the Alaska Vegetation Classification level for vegetation mapping.
- Preliminary vegetation mapping from recent aerial images.
- Field verification of mapped vegetation.

- Identify locations for ground-based botanical, rare plant, invasive plant, and moose browse inventory data collection.
- Reporting of study results, including reporting that is coordinated with other pertinent studies.

5.2.6.2. Wetland-Riparian Study

Study Rationale and Objective

The overall study objective is to characterize wetland and riparian habitat, develop a wetland functional assessment, and identify potential changes related to an altered hydrologic regime and from disturbance related to Project construction and operations. The information developed from this study, in combination with other resource studies (e.g., aquatic habitat, vegetation mapping, hydrology, geomorphology, and ice processes studies), will provide a basis for wetland and riparian management decisions, impact analyses, and mitigation development.

The specific objectives of the study include:

- Determine the appropriate scales and areal extents for wetland delineations in consultation with USACE and compile available existing wetland mapping.
- Conduct field surveys to collect site-specific wetland data.
- Develop a wetland functional assessment.
- Determine natural fire spread patterns in the reservoir reach of the Susitna River.
- Evaluate the relationship of wetland and riparian vegetation to the hydrologic regime.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. The study area for riparian vegetation, but not for wetland delineation, also includes representative reaches of the Susitna River downstream of the dam site.

Study Components

The study will include the following study components:

- Determine appropriate scales and areal extents for wetland delineations in consultation with USACE.
- Compile available wetland mapping at various scales for development of wetland delineations based on current aerial photography.
- Incorporate data from the Vegetation Mapping Study and available data on natural fire patterns along the reservoir and the Susitna River.
- Identify riparian and wetland delineation field sites and data from the 1980s studies for potential resampling.
- Conduct field surveys for wetland delineations, wetland functional assessments and riparian vegetation conditions.

- Report study results, including results that are coordinated with other pertinent studies (hydrologic, ice processes, geomorphology etc.).

5.2.6.3. Rare Plant Study

<u>Study Rationale and Objectives</u>

The overall study objective is to identify the location of rare plant populations in the Project area. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping and wetland studies), will provide a basis for habitat management decisions, impact analyses, and mitigation measures.

The specific objectives of the study include:

- Identify the locations of rare plant populations in the Project area.
- Identify potential habitat enhancement locations.

<u>Study Area</u>

The study area includes all areas that can safely be accessed that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the Watana Reservoir.

<u>Study Components</u>

The study will include the following study components:

- Identification of target species.
- Identification of the study area and locations for field surveys.
- Conducting field surveys for the target species.
- Reporting of study results, including reporting that is coordinated with other pertinent studies.

5.2.6.4. Noxious Weed Study

<u>Study Rationale and Objective</u>

The overall study objective is to identify the location of target invasive plant populations in the Project area. The information developed from this study, in combination with other resource studies (e.g., vegetation mapping and rare plant studies), will provide a basis for habitat management decisions, impact analyses, and mitigation measures.

The specific objectives of the study include:

- Identify the locations of populations of target invasive weed species in the Project area.
- Identify potential treatment locations.

Study Area

The study area includes all areas that can safely be accessed that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the Watana Reservoir.

Study Components

The study will include the following study components:

- Identification of target invasive plant species.
- Identification of the study area and locations for field surveys.
- Conducting field surveys for the target invasive plant species.
- Reporting of study results, including reporting that is coordinated with other pertinent studies.

5.2.6.5. 2012 Botanical Resources Study Components

In addition to the above proposed botanical studies, the following studies or study components will be started in early 2012 in advance of formal Study Plan development for the Project. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

B-S1: Vegetation Mapping and Wildlife Habitat Mapping Study.

B-S2: Riparian Study.

B-S3: Wetland Mapping.

5.2.7. Aesthetic Resource Issues

A1: Potential effects on visual resources due to Project development and operation.

5.2.7.1. Aesthetic Resources Study

Study Rationale and Objectives

APA's 1985 Susitna Settlement Plan identified visual resource study questions and topical issues associated with hydroelectric project development. These questions and issue areas provide additional insight into information needs that will be useful to understanding the larger visual resources issue as described above along with identifying the significance of potential new noise sources resulting from construction and operation of the Project. The main Project facilities (dam, powerhouse, reservoir, camp, etc.) are located in a remote area a way from developed areas, however, the terminus portions of the Project access road and transmission facilities along with railroad siding facilities would be close to sparsely developed areas. Many of the lands within the reservoir area and potentially along access and transmission routes are on BLM lands. The BLM manages visual resources of its lands through its Visual Resource Management (VRM) system. The construction and operation of the Project will affect the scenic landscape within these settings and noise will be generated from the transportation of materials and construction personnel in the area. To understand the nature and magnitude of these changes, the following broad objectives have been defined for the visual resources studies, corresponding to many of the 1985 study efforts.

The specific objectives of the study include:

- Understanding the significance of impacts of borrow and spoil areas, transmission lines, access roads, construction camps, and dams on scenic resources.
- Identify potential effects on scenic resources due to project operation and maintenance activities.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. Additionally, the transportation corridors that will be used for construction will be within the study area for evaluations of potential increases in noise.

Study Components

The visual resource study process is outlined in APA's 1985 Susitna Settlement Plan and 1985 Susitna Hydroelectric Project FERC License Application. That process was based on the U.S. Forest Service's Visual Resource Management System (USFS 1974) and refined through field reconnaissance and professional judgment. Information generated from new visual resource studies can be incorporated into the BLM's VRM, as the BLM holds land in the Project area, not the Forest Service. Many aspects of that process are similar to the BLM's VRM system and those components including identifying:

- Landscape character types and notable natural features within the Project area will be identified and evaluated based on a high, medium, and low basis for their aesthetic value (a relative measure of scenic quality and visual sensitivity) and their visual absorption capability (a relative ability of a landscape to absorb physical change).
- The aesthetic value and visual absorption capability ratings for each landscape character type are then combined to create composite ratings grouped into categories and used to determine the degree of visual impact and potential for mitigation.

The visual resource studies will entail identifying existing landscape character, scenic integrity levels, scenic attractiveness, visual priority routes and use areas along with key view points. Landscape visibility maps and visual absorption capability classes would be created from the studies. These items will be refined through field reconnaissance and professional judgment, and used to determine the degree of visual impact and potential for mitigation of Susitna-Watana Hydroelectric Project features.

Several resource management plans may be useful and are likely relevant to visual resources in the Susitna-Watana Hydroelectric Project vicinity. These plans will be obtained and evaluated for potential use in the analysis including:

- 1985 Susitna Hydroelectric Project Settlement Plan.
- 1985 Susitna Hydroelectric Project FERC License Application.
- 2010 Susitna Matanuska Area Plan.
- ADNR Nelchina Public Use Area documents (various).
- 2009-2014 Alaska State Comprehensive Outdoor Recreation Plan.
- Recreation and Tourism in South-Central Alaska: Patterns and Prospects.
- ADF&G documents (various).
- BLM East Alaska Resource Management Plan and Environmental Impact Statement.
- 2006 Denali State Park Management Plan.
- Denali National Park documents (various).
- Cook Inlet Regional Corporation documents (various).

5.2.7.2. 2012 Aesthetic Resources Study Components

Some of the components of the proposed studies discussed above will be initiated in 2012 in order to help inform the formal study plans. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

A-S1: Inventory BLM VRM designations

A-S2: Identify initial key viewing areas and key viewpoints

5.2.8. Recreation and Land Use Resource Issues

R1: Potential flow-related effects to river access and navigation within and downstream of reservoir.

R2: Potential changes in the timing and extent of winter use of the river corridor due to Project-related changes in ice cover.

R3: Potential effects on fishing opportunities due to the Project.

R4: Potential effects on hunting and trapping opportunities due to the Project.

R5: Potential effects of recreation use by construction workers on fish and wildlife in the Project vicinity.

R6: Potential need to accommodate and manage increased recreation use due to increased access to the Project area.

L1: Changes in land use and ownership due to construction and operation of the Project.

L2: Consistency of the Project with relevant land use and management plans.

5.2.8.1. Recreation and Land Use Studies

Study Rationale and Objectives

The proposed Project will occupy a combination of BLM, State, ANCSA Corporation and possibly other private lands. Special use and occupancy permits will be needed from the BLM and State for use of these lands, and private lands will need to be acquired for some of the Project facilities. The proposed studies are aimed at providing information needed to guide recreation and land use and occupancy management decisions for the Project. The land use study provides land use information about the Project area that will be incorporated into the FERC license application and potentially right-of-way permits and use and occupancy applications submitted to the BLM and other similar information determined in conjunction with ANCSA Corporations and potentially other private land owners affected by the Project.

APA's 1985 Susitna Settlement Plan identified recreation and land management study questions and potential issues associated with hydroelectric project development. These study questions and issues which tier off of the Project issues identified in Section 5.2.7, are presented below as potential study objectives:

- Assess potential Project-related impacts on fishing, including the availability of fish, access, and quality of experience (R2).
- Evaluate potential Project-related impacts on recreational hunting and trapping, including the availability of resources, access, and quality of experience (R3).
- Assess potential Project-related impacts on boating and pack rafting downstream of Devils Canyon, including access to the water and possible impediments to navigation (R1).
- Evaluate potential Project-related impacts on non-consumptive activities (e.g., bird watching and hiking), including availability of resources, access to the resources, and quality of the experience.
- Assess potential Project-related impacts of construction worker recreational activities on fish and wildlife resources in the Susitna River watershed (R4).
- Evaluate potential Project-related impacts due to increases in recreational use resulting from improved access, creation of the reservoir, altered stream flow, and the need to accommodate and manage recreation use.
- Assess potential changes/effects to recreationist and local resident access patterns from potential Project-related changes in freeze-up conditions in the middle reach of the Susitna River.
- Evaluate the feasibility and desirability of restrictions on recreation to reduce impacts on fish and wildlife resources in the Susitna River watershed.
- Formulation of a recreation plan.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. Additionally, the transportation corridors that will be used for construction will be within the study area for evaluations of potential changes to recreation resources within a broader study area along with other regional recreation resources that could be affected by development of the Project and associated new recreation opportunities.

Study Components

The recreation resource study process has components identified from a variety of sources including APA's 1985 Susitna Settlement Plan, 1985 Susitna Hydroelectric Project FERC License Application, and AEA's "Socioeconomic, Recreation, Air Quality, and Transportation Data Gap Analysis." The general approach involves review of pertinent recreation literature, discussions regarding recreation-related plans and consultation with state and federal resource agencies and ANCSA Corporations, and completion of informal recreation and resource use surveys to support demand evaluation efforts. Additionally, a field reconnaissance program will be necessary to document, evaluate, plan and verify locations of proposed recreation sites. A six-step approach taken in the 1980s provides the outline to the proposed study as follows:

- Step 1: Determined study objectives and developed a detailed work plan. This activity included review of all relevant agency documents and their objectives and their objectives, and interviews with key agency personnel.
- Step 2: Inventoried existing recreation facilities and plans, and estimated future recreation demand with and without the Project.
- Step 3: Inventoried potential recreation sites within the Project area. This activity involved a review of relevant documents and previous studies, and extensive on-site investigations.
- Step 4: Evaluated recreation opportunities at the potential sites identified in Step 3. The sites were evaluated by defining the qualitative and quantitative aspects of their recreation potential based on information from steps 2 and 3.
- Step 5: Refined the opportunity evaluation and recommended Recreation Plan and alternatives.
- Step 6: Developed an implementation plan, including phasing, demand monitoring, and cost estimate.

The approach taken in the 1980s APA Susitna Hydroelectric Project will be replicated for the currently proposed Project.

As recommended in the Gap Report the following analyses will be updated (as part of Step 2):

- Reasonably foreseeable future recreation facilities. Private recreation facilities information.
- Recreation use, satisfaction, and attitude survey.
- Alaska Railroad passengers and whistle-stop use.
- Lodge owner survey.

- Air taxi survey.
- Guide survey.
- Survey of boaters and pack rafters exiting at Susitna Landing; Talkeetna Boat Launch and Airstrip; and Willow Creek.
- Current and future recreation commercial recreation use of Project area.
- Projected demand for recreation opportunities in the Project area.

The land use study will identify current land uses and land ownership information for all Project areas. These include open space, rural and urban residential uses, commercial and industrial uses, agriculture including irrigated farmland and transportation and utility use lands affected by the Project. Recent aerial photography, title searches, and GIS data showing land status will be used to determine the primary uses and where these land use types are affected. State, Federal and Borough plans will be reviewed and evaluated for any potential conflicts and/or consistencies with Project construction and operation plans, and the results will be quantified in tables.

The land use studies for the Project will include the following:

- Identification of all relevant comprehensive plans and land management plans, and a discussion of the Project's consistency or lack of consistency with each plan.
- If not consistent, justification for accepting the lack of consistency.
- Depiction of uses of land and resources adjacent to the project using maps, air photos, or drawings that clearly delineate the project boundary and boundaries of public lands.
- Documentation of consultation with agencies having land management or planning/ zoning authority in the area.

The studies will rely on recreational information, comprehensive plans, and land management plans described above, as well as other items revealed during the FERC licensing process.

Also, in cooperation with the ANCSA Corporations, resource agencies, the MSB, and other interested entities, AEA will develop appropriate land use and management plans for the Project. A comprehensive land use management plan, if needed, could help AEA, and other land owners, and FERC to be able to identify reasonable balance between developmental and recreational interests, and wildlife and fisheries resource values.

Several resource management plans may be useful and are likely relevant to visual resources in the Project vicinity. These plans will be obtained and evaluated for potential use in the analysis including:

- 1985 Susitna Hydroelectric Project Settlement Plan.
- 1985 Susitna Hydroelectric Project FERC License Application.
- Susitna-Matanuska Area Plan Public Review Draft.
- MSB Comprehensive Development Plan: 2005 Update.
- ADNR Nelchina Public Use Area documents (various).
- 2009-2014 Alaska State Comprehensive Outdoor Recreation Plan.
- Recreation and Tourism in South-Central Alaska: Patterns and Prospects.

- BLM East Alaska Resource Management Plan and Environmental Impact Statement.
- 2006 Denali State Park Management Plan.
- Cook Inlet Regional Corporation documents (various).
- South Denali Visitor Center Steering Committee.
- Denali National Park and Preserve Final Backcountry Management Plan: General Management Plan Amendment and Environmental Impact Statement.
- Denali National Park and Preserve Final South Denali Implementation Plan and Environmental Impact Statement.
- Consolidated General Management Plan for Denali National Park and Preserve.
- Susitna Area Plan.

5.2.8.2. 2012 Recreation and Land Use Study Components

Some of the components of the proposed studies discussed above will be initiated in 2012 in order to help inform the formal study plans. AEA is currently working with the resource agencies to determine the full scope of this work. The resulting studies or study components will be included in the Proposed Study Plan when it is filed with FERC.

R-S1: Identify proposed recreation developments.

R-S2: Informal survey of recreation providers and user groups.

R-S3: Collect existing recreation demand and supply data.

L-S1: Title and site control research.

L-S2: GIS base map updates.

5.2.9. Cultural Resource Issues

C1: Potential effects on cultural resource sites including those determined eligible for listing on the National Register of Historic Places (NRHP), including impacts due to inundation of historic properties from reservoir water levels.

C2: Potential effects of construction, operation, and maintenance activities and increased human use on traditional/tribal spiritual areas and other traditional uses (Traditional Cultural Properties) within the Area of Project Effect (APE).

C3: Inadvertent disturbance or vandalism to historic properties from increased access for recreational activities.

C4: Aesthetic changes to surrounding historic landscape may affect the historic and cultural significance of a property.

5.2.9.1. Cultural Resources Studies

Study Rationale and Objectives

The proposed Project will impact a variety of lands and landscape features within the area. Cultural resources in the area may be affected and several sets of analyses are needed to identify the appropriate changes and mitigation, if any through a formal process under Section 106 of the National Historic Preservation Act (NHPA). The proposed studies are aimed at providing information needed to evaluate the effect of cultural resources from Project development and operations. Cultural resource study objectives for proposed Project include:

- The identification and significance of loss of affected cultural, historical and archaeological sites.
- Formulation of a cultural resources mitigation plan.

Study Area

The study area will be what is defined by the APE. This will include all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. This will also include any surrounding historic landscape or area of indirect affects.

Study Components

The cultural resources study investigations will identify and revisit appropriate previously and newly recorded historic properties within the APE, update the current location and condition of each site, update or create site forms for each site, develop a prioritized list of sites and evaluate whether they are eligible for the NRHP, and evaluate the Project's effects on historic properties within the proposed FERC project boundary.

The cultural resources study components will be determined in consultation with the SHPO, BLM, FERC, Alaska Native groups and other interested participants. Prior to developing this PAD, a report summarizing data gaps was developed and these gaps provide a starting point for laying out the components of a cultural resources study program. The data gaps identified for cultural resources can help serve as the basis of the studies anticipated and include the following compoments:

- Mapping-related Activities:
  - Synthesis of existing locational data for known sites.
  - Map site locations and environmental variables.
  - Field verification of existing site locational data.
  - Identify previous survey coverage.
  - Add existing and baseline place names.
  - Identify and map prehistoric resource locations (settlement patterns, historic land use).
- Synthesis and Analysis Activities:

  - Develop historic contexts and Project significance standards (to evaluate potential eligibility to NRHP).
  - Develop site locational predictive modeling.
  - Update cultural chronology using radiocarbon and tephra sampling data.
  - Update and retrieve legacy records and artifact collections.
  - Perform oral history interviews with 1978-85 field research principals.
  - Inventory 1978-85 records.
- Identify and update information related to Traditional Cultural Properties.
- Summarize Paleontological records and develop site location model.
- Develop plan for unanticipated discoveries.
- Prepare Historic Properties Management Plan.

<u>Relevant Cultural Resource Plans</u>

Existing cultural resource management plans that are relevant to the proposed Project include:

- The Alaska Office of History and Archaeology's (operated under the Alaska Department of Natural Resources' Division of Parks and Outdoor Recreation) Cultural Resource Management Plan for the Denali Highway Lands.
- Mat-Su Borough Ordinance 87-007.
- Mat-Su Borough Historic Preservation Plan.
- Alaska's Historic Preservation Plan.

Additionally, cultural and historic preservation plans, resolutions and programs may exist in the record of various Native organizations.

In the Project licensing process, further research and consultation will be conducted to identify existing cultural resource plans that are relevant to the Project. Project design, construction and operation will be conducted in compliance with those plans identified.

5.2.9.2. 2012 Cultural Resources Studies

C-S1: Pre-Field Data Assessment and Information Gathering and Compilation.

5.2.10. Subsistence Resource Issues

S1: Potential changes in subsistence fishing and hunting opportunities due to Project-related effects on fish and wildlife populations.

5.2.10.1. Subsistence Resources Studies

<u>Study Rationale and Objectives</u>

The proposed Project will impact a variety of lands and landscape features within the area. Access to and quality of subsistence resources in the area may be affected. The proposed studies are aimed at providing information needed to evaluate the effect on subsistence resources from

Project development and operations. Potential study objectives may include: Assess potential Project-related effects on subsistence activities.

- Evaluate potential Project-related effects the population of local animal species, including potential changes in change wildlife migration patterns (addressed via Wildlife Resources studies).
- Assess potential Project-related effects on human access to the Project vicinity (addressed via Recreation Resource studies).

<u>Study Area</u>

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. Additionally, the transportation corridors that will be used for construction will be within the study area for evaluations of potential changes to access to subsistence resources within a broader study area.

<u>Study Components</u>

Prior to developing this PAD, a report summarizing data gaps was developed. The data gaps identified for subsistence resources provides a listing of the specific information needs that will be moved into study plans and are listed in Table 5.2-1.

Table 5.2-1. Summary of Subsistence Data Gaps

Data Gap	**Specific Information Needed**
Current subsistence information	Current, quantitative information on subsistence resources in the Project area
Subsistence harvesters	Information on subsistence harvesters who may currently be using the Project area for subsistence
Subsistence use area maps	Current subsistence use area maps for each community, or for all species harvested in each community Subsistence harvest or subsistence use area map information for communities, dispersed households and lodges along the road system and the Alaska Railroad
Subsistence summary tabular data	Access to subsistence summary tabular data from ADF&G
ANILCA Section 810 analysis	Data adequate to prepare an ANILCA Section 810 analysis of impacts of the Project on subsistence where federal lands may be withdrawn, reserved, leased or otherwise permitted for use, occupancy or disposition
Traditional Environmental Knowledge (TEK) documentation	TEK documentation specific to Project area
Place names	Research on place names in proposed Project area, using an integrated approach including archaeology, oral history and library research

As stated earlier in this section, current data is needed with regards to the use of the Project area for subsistence resources. Low use levels were previously reported in the area that will be directly impacted by the Project, but updated information will be needed to determine existing use levels.

Existing plans and programs regarding subsistence resources that are relevant to the proposed Project include:

- U.S. Fish and Wildlife Service's Federal Subsistence Management Program.
- Minto Flats State Game Refuge Management Plan.
- East Alaska Resource Management Plan.
- Alaska Department of Fish & Game's Wildlife Action Plan.
- Alaska Department of Natural Resources' (ADNR's) Susitna Area Plan.
- ADNR's Southeast Susitna Area Plan for State Lands.
- ADNR's Susitna Matanuska Area Plan.
- ADNR's Susitna Forestry Guidelines.
- Mat-Su Borough Forest Management Plan.
- Conservation Plan for the Cook Inlet Beluga Whale.

In the Project licensing process, additional research will be conducted to identify existing subsistence resource plans that are relevant to the Project. Project design, construction and operation will be conducted in compliance with those plans identified.

5.2.10.2. 2012 Subsistence Resources Studies

S-S1: Collect and analyze existing subsistence information. Collect exisiting harvest data, resource use, subsistence land use maps, place names and traditional environmental knowledge.

5.2.11. Socioeconomic and Transportation Issues

So1: Effects of Project construction activities on regional and local economic conditions.

So2: Effects of Project power output on regional and local economic conditions.

So3: Potential effects on economic conditions from changes in recreation use due to the Project.

So4: Potential effects to lifestyles in area communities related to increases in transportation and other construction-related activities due to the Project.

So5: Changes in direct and indirect commercial opportunities related to recreation, including fishing, hunting, and trapping, and commercial non-consumptive uses due to the Project.

So6: Potential for increased demand on services provided by Mat-Su Borough and communities related to Project construction and operation (e.g. health and human services, law enforcement, emergency services, education, etc).

So7: Secondary development impacts on undeveloped lands.

So8: Potential for air quality impacts during construction.

5.2.11.1. Socioeconomic Resources Study

Study Rationale and Objectives

The proposed Project will lead changes in socioeconomic conditions in the greater Railbelt area and local communities. The proposed studies are aimed at providing information needed to evaluate the effect of changes resulting from Project development and operations.

Socioeconomic issues are broken out into general social and economic study questions and those related to the transportation systems of Alaska.

Socioeconomic issues and study questions arose when the APA Susitna Project was previously proposed in the 1980s. Many of these remain relevant to the currently proposed Project. Potential study objectives include:

- Identify potential Project-related impacts to lifestyles in area communities (So4).
- Understand potential Project-related changes to commercial opportunities related to fishing, hunting, trapping, etc. (So5).
- Identify potential Project-related changes in employment in area communities (So6).
- Estimate potential Project-related increases in demand on resources offered by the Mat-Su Borough and communities to provide public services and facilities for the Project and Project employees (So7).
- Assess potential Project-related secondary development impacts on undeveloped ANCSA Corporation lands (So8).
- Identify potential Project-related impacts resulting from residency and movement of Project construction personnel.
- Estimate potential Project-related changes in economic conditions in the region.

The degree of socioeconomic impact resulting from proposed Project construction and operation on nearby communities, as well as on local and regional economies, will be assessed.

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. Additionally, the transportation corridors and community bases that will be used for construction will be within the study area for evaluations along with development of the Project and its associated new recreation opportunities.

Study Components

The Socioeconomic study components have been identified from a variety of sources including APA's 1985 Susitna Settlement Plan, 1985 Susitna Hydroelectric Project FERC License

Application, and AEA's "Socioeconomic, Recreation, Air Quality, and Transportation Data Gap Analysis."

Many of the Project's potential adverse impacts are related to the potential change in the size and location of the population. Once this has been quantified, a more detailed assessment of the socioeconomic impacts of the Project will be done. A preliminary summary of potential areas of study and inquiry specific to socioeconomic resources is provided in Table 5.2-2.

Table 5.2-2. Potential Socioeconomic Issues Related to the Proposed Project

Impact Issue Category	Issue
Related to social environment during construction and operation	Potential for increases in population
	Potential impacts in quality of life for existing residents (due to increased noise, traffic, development, etc.)
	Potential increase in demand for community facilities (education, public safety, etc.)
	Potential impacts on ability to fund increase in community facility demand or degradation of service quality
	Potential for increased demand for housing
	Potential impacts to community cohesion
	Availability of an additional source of electricity in case of emergency
	Potential conversion of land to industrial or transportation related purposes
	Potential impact on subsistence resources availability
	Impacts to aesthetics for residents
	Potential displacement of existing residents
	Potential for new development along access roads or the Denali Highway
	Potential for localized impacts on local particulate matter levels in the Project area due to earthmoving, aggregate mixing and construction vehicle travel on unpaved roads
	Potential improvements to air quality in the Railbelt due to a lower use of fossil fuels by existing utility plants
	Significance of ambient air quality impacts during Project construction
Related to economy during construction and operation	Potential increases in income
	Potential reduction in unemployment
	Potential for lower cost energy
	Potential for increased business opportunities during construction and

Impact Issue Category	Issue
	operation of the Project
	Potential changes in tourism and tourism related employment
	Potential for increased property tax revenue

Prior to developing this PAD, a report summarizing data gaps was developed. These data gaps help serve as the foundation for developing study plans and information needs for the licensing of the Project. The data gaps specific to socioeconomics are shown below on the Table 5.2-3.

Table 5.2-3. Summary of Socioeconomic Data Gaps

Data Gap	Specific Information Needed
Local Government Structure	
Update local government baseline to include Denali Borough	• Anderson • Clear • Cantwell • Healy • Smaller settlements (Ferry, McKinley Village, Carlo Creek, etc.)
Update baseline to incorporate MSB Community Councils	Identify baseline conditions and impacts for a community council level where appropriate
Population	
Update baseline population and demographic information	• Population • Number of households • Household characteristics • Age characteristics • Race/ethnicity • Gender • Education
Project future population and demographic information	• Anticipated population change with and without the Project • Community-level forecasts
Develop a construction-related population change estimate	Demographic information during construction period
Identify minority and low-income population for environmental justice analysis	Identification of minority and low-income communities
Income	
Update baseline income information	• Median household income • Per capita income • Population below poverty level

Data Gap	Specific Information Needed
Housing	
Update baseline housing conditions	• Existing housing stock • Forecasted housing stock • Availability • Vacancy rates • Housing tenure • Affordability • Tenure • Residential properties near dam site, impoundment area, access corridors and transmission corridors
Update vacancy rates	Expected vacancy rates
Public Services and Facilities	
To be determined as Project is refined	
Water and Wastewater	
Update baseline water and wastewater demand	• Existing water/wastewater demand • Forecasted water/wastewater demand
Update baseline water and wastewater system capacity	• Planned capacity of systems • Number of people who can be accommodated by systems
Locate well locations	Utility conflict report to determine location of wells in areas directly impacted by Project
Locate private systems	Identify private systems impacted by Project
Update baseline and projected wastewater demand and capacity	• Area served by system • Future capacity of system
Solid Waste	
Update landfill capacity information	• Verify projected capacities of landfills in each borough • Information about replacement landfill in Denali Borough
Police	
Update baseline police coverage	• Existing staffing levels • Projected staffing levels • Detachment location and coverage areas • Level of service standards
Update baseline information to include Wildlife Troopers	• Location of detachments • Existing/baseline staffing of detachments • Projected staffing needs

Data Gap	Specific Information Needed
Fire	
Update baseline fire protection in the MSB	• Service area boundaries • Station location and resources • Planned improvements (focus on stations/Fire Service Areas near Project area)
Update baseline information to include Denali Borough Volunteer Fire Departments (VFD)	• Coverage of each VPD • Station locations • Target response times • Anticipated date of exceeding capacity
Health Care	
Update baseline health care information	• Existing health care facilities • Facility capacities
Education	
Update school capacity, baseline and future enrollment	• Projected school enrollment for baseline year • Projected school enrollment for Project design year • School capacity
Electricity	
Update electric power information	• Current electrical power information
Air Quality	
Update Project emissions for construction permitting	• Construction equipment needs • Construction activity levels
Summarize baseline fossil-fuel generation emissions	• Estimates of criteria air pollutants for each plant • Breakdowns of electric generation by type
Add regional air quality data	• Summarize data for nearest regional monitors • Compare measured data against current National Ambient Air Quality Standards (NAAQS)

Local and regional land use plans relevant to socioeconomic resources include:

- MSB Comprehensive Development Plan
- Denali Borough Comprehensive Plan
- Talkeetna Comprehensive Plan
- Chase Comprehensive Plan
- MSB Draft Public Facilities Plan

In the Project licensing process, additional socioeconomic resource plans may be identified that are relevant to the Project.

No specific 2012 study activities are planned, however information gathering activities will continue to inform the basis of planning for 2013 studies.

5.2.11.2 Transportation Study

Study Rationale and Objectives

The proposed Project will lead changes in transportation conditions in the greater Railbelt area and local communities. The proposed studies are aimed at providing information needed to evaluate the effect of changes resulting from Project development and operations. Potential transportation issues related to the Project are summarized in Table 5.2-4. The objective of the transportation study will be to assess the potential impacts to transportation systems resulting from the construction and operation of the proposed Project. A more detailed evaluation on impacts to the transportation system will be conducted during the licensing effort.

Table 5.2-4. Transportation Issues Related to the Proposed Project

Impact Issue Category	Issue
Related to Project roads during construction and operation	Potential changes in existing transportation network
	Potential changes in access
	Potential increases in traffic volumes
	Potential increases in transportation related noise
	Potential impacts from the paving of the Denali Highway
	Potential increased in accidents due to conflicts between construction vehicles and other traffic
	Possible improvements to the transportation system needed to support construction activities
	Potential impacts to other resources due to the footprint of Project access roads and transmission lines.
	Potential conversion of land to transportation related uses
	Potential for increased maintenance needs on non-Project owned roads
Related to aviation during construction and operation	Potential changes in air traffic patterns
	Potential for increased noise due to increase air traffic
	Potential for airport land being unavailable for non-Project related use
	Potential for take-off and landing delays for other airport users
	Potential for Project needs to conflict with existing airport users
	Potential impacts to other resources due to the footprint of aviation related Project components
	Potential for increased air traffic in the Project area

Related to rail during construction and operation	Potential for increase in traffic delays at-grade crossings
	Potential for increased vehicle/train accidents due to increased volumes of rail traffic at at-grade crossings
	Potential conversion of land to transportation related uses
	Potential for increased noise due to increases in rail traffic
	Potential impacts to other resources due to the footprint of rail related Project components
Related to other construction needs	Possible improvements to the elements of the transportation system needed to support construction activities and limited access to those facilities while they are being improved
	Potential conflicts with existing shippers/freight traffic depending on how construction materials are sent to Alaska
	Geographic location of impacts could occur throughout Railbelt depending on how construction materials are sent to Alaska

Study Area

The study area includes all areas that will be directly altered or disturbed by Project construction and operations, including facility sites, access roads, laydown/storage areas, and the inundation zone for the reservoir. Additionally, the transportation corridors and community bases that will be used for construction will be within the study area for evaluations along with development of the Project and its associated new recreation opportunities.

Study Components

Prior to developing this PAD, a report summarizing data gaps was developed. These data gaps help serve as the foundation for developing study plans and information needs for the licensing of the Project. The data gaps identified for transportation provides a listing of the specific information needs are shown below on the Table 5.2-5.

Table 5.2-5. Summary of Transportation Data Gaps

Data Gap	Specific Information Needed
Roads	
Identify future road network	• Location of road • Roadway characteristics
Identify existing and future local roads	• Location of road • Traffic volume
Identify RS 2477 trails	• Location of existing RS 2477 corridors • Location of potential RS 2477 corridors • Status of corridor

Identify existing bridges/structures	• Location of bridges/structures • Vehicle restrictions (height, weight, width, etc.)
Update baseline and future traffic volumes and capacity	• Current traffic volumes • Roadway configuration (number of lanes, traffic signals, etc.) • Turning movements • Anticipated growth in Project area
Rail	
Identify baseline and future capacity of ARRC system	• Track usage and capacity • Number of rail cars/trains that would move each day • Time of year construction would occur • Origin of construction materials
Aviation	
Identify and locate private aviation facilities	• Construction equipment needs • Construction activity levels
Identify and assess airport capacity	• Baseline and projected takeoffs and landings • Availability of unleashed land for construction staging

Local and regional plans relevant to transportation resources include:

- Interior Alaska Transportation Plan.
- MSB Long Range Transportation Plan (LRTP).
- Palmer Airport Master Plan (AMP).
- Wasilla AMP.
- MSB Regional Aviation System Plan (RASP).

In the Project licensing process, additional transportation plans may be identified that are relevant to the Project.

No specific 2012 study activities are planned however information gathering activities will continue to inform the basis of planning for 2013 studies.

5.3 Relevant Plans

Section 10(a)(2)(A) of the Federal Power Act requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. Under 18 CFR 4.38, in developing its license application, AEA must identify relevant comprehensive plans and explain how and why the Project would or would not comply with such plans. The most current listing of the Commission's List of Comprehensive Plans is from June 2011. AEA intends to evaluate the

Project with respect to the following plans identified by FERC in the June 2011 listing, along with other relevant plans described in Section 4 and 5 of this document.

Alaska Department of Fish and Game. Susitna Flats State Game Refuge, March 1988. Juneau, Alaska.

Alaska Department of Fish and Game. 1989. Northwest area plan for state lands. Fairbanks, Alaska. February 1989. 168 pp.

Alaska Department of Fish and Game. Matanuska-Susitna Borough. 1985. Susitna Basin area plan. Juneau, Alaska. June 1985. 440 pp.

Alaska Department of Fish and Game. Matanuska-Susitna Borough. 1991. Susitna Basin recreation rivers management plan. Anchorage, Alaska. August 1991. 181 pp.

Alaska Department of Fish and Game. 1998. Catalog of waters important for spawning, rearing or migration of anadromous fishes. November 1998. Juneau, Alaska. Six volumes.

Alaska Department of Fish and Game. 1998. Atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes. November 1998. Juneau, Alaska. Six volumes.

Alaska Department of Natural Resources. 1986. Matanuska Valley moose range management plan. Anchorage, Alaska. October 1986. 256 pp.

Alaska Department of Natural Resources. Alaska's Outdoor Legacy: Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2009-2014. Anchorage, Alaska.

Bureau of Land Management. 1981. South central Alaska water resources study: Anticipating water and related land resource needs. Anchorage, Alaska. October 1, 1981. 97 pp.

U.S. Fish and Wildlife Service. Undated. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

6. SUMMARY OF CONTACTS

In accordance with 18 CFR 5.6(d)(5), this section summarizes contacts with Federal, State, Tribes, non-governmental organizations or other members of the public made in connection with preparing the PAD. AEA initiated stakeholder outreach in early 2011. These communications are summarized in Table 6-1 and copies of correspondence, meeting notes and draft documents are included in chronological order in Appendix 6-1 unless otherwise noted in the table. Stakeholder contacts are identified in correspondence or meeting notes and a corresponding Project contact mailing list is provided in Appendix 6-2.

Table 6-1. Summary of communications with stakeholders since January 2011.

Date	Communication Event	Description
April 14, 2011	Initial Coordination Meeting with FERC Office of Energy Projects, Division of Hydropower Licensing	Introductory meeting with FERC staff and AEA to discuss the planning and processes associate with licensing the Susitna-Watana Hydroelectric Project.
April 21, 2011	Aquatic/Terrestrial Pre-Gap Analysis Meeting	Meeting with stakeholders to discuss the work efforts underway for the aquatic and terrestrial resources gap analyses.
May 24, 2011	AEA Letter to CIRI	AEA requesting permission to access CIRI lands near dam site.
June 2, 2011	Tyonek Native Corporation letter to AEA	Letter granting AEA permission to enter lands for exploratory drilling near dam site.
June 4, 2011	Talkeetna Community Council Letter to State Representatives copied to State officials and AEA	Letter to Alaska Representatives and State officials transmitting questions concerns about the planning and potential effects of the proposed Project.
June 27, 2011	Stakeholder Licensing Process Meeting	Meeting with stakeholders to discuss the licensing process options of the proposed Project.

June 30, 2011	Email from Jan Konigsberg, Natural Heritage Institute/Hydropower Reform Coalition to AEA	Email regarding licensing meeting topics discussed in June 27th meeting.
July 13, 2011	Alaska Ratepayers Letter to AEA	Letter to AEA supporting development of the proposed Project and planning approach.
July 14, 2011	Utilities Information Meeting	Meeting to discuss power demand and project sizing.
July 22, 2011	AEA Letter to Talkeetna Community Council	Letter to Talkeetna Community Council transmitting preliminary responses to questions and concerns letter of June 4th.
August 3, 2011	Email from Susan Walker to AEA	Email regarding licensing meeting topics discussed at June 27th meeting.
August 5, 2011	ADF&G Letter to AEA	Letter to AEA discussing information development and licensing process needs.
August 5, 2011	USFWS Letter to AEA	Letter to AEA discussing information needs and licensing process needs.
August 18, 2011	Aquatic and Terrestrial Gap Analysis Meeting	Meeting with stakeholders to discuss the aquatic, water quality and terrestrial resources gap studies.
August 19, 2011	Initial coordination meeting with USACE	Meeting with USACE to discuss proposed Project planning and information needs related to USACE regulatory program under the Clean Water Act.
August 26, 2011	Alaska Conservation Alliance Letter to AEA	Letter to AEA discussing licensing process needs.
August 29, 2011	Public Meeting in Talkeetna	Meeting with stakeholders to discuss planning, timeline, information needs and issues regarding the proposed Project.
September 1, 2011	Anchorage Public Meeting	Meeting with stakeholders to discuss the ILP process.

September 6, 2011	Introductory coordination meeting with USGS	Meeting with USGS to discuss hydrologic information and ongoing analyses.
September 7, 2011	Introductory coordination meeting with the BLM	Meeting with BLM to discuss planning, timeline and information needs related to permit for potential use of BLM lands within the proposed Project.
September 8, 2011	The Nature Conservancy Letter to AEA	Letter to AEA regarding information sources and information needs.
September 9, 2011	Jan Konigsberg, Natural Heritage Institute Letter to AEA	Letter to AEA regarding information needs, the gap analyses, and licensing process.
September 9, 2011	USFWS Letter to AEA	Letter to AEA discussing licensing process and information needs.
September 9, 2011	NMFS Letter to AEA	Letter to AEA discussing licensing process.
September 12, 2011	Jan Konigsberg, Natural Heritage Institute Errata Notice to AEA	Errata note to September 9 letter.
September 16, 2011	AEA Letter to USACE	Letter summarizing Project licensing, expressing interest in having USACE as cooperating agency with FERC and inquiring about agency resource needs.
September 16, 2011	AEA Letter to USFWS	Letter summarizing Project licensing plans and follow up on agency resource needs and participation.
September 16, 2011	AEA Letter to NPS	Letter summarizing Project licensing plans, agency resource needs and participation.
September 16, 2011	AEA Letter to NMFS	Letter summarizing Project licensing plans, agency resource needs and participation.

September 16, 2011	AEA Letter to ADNR	Letter summarizing Project licensing plans, agency resource needs and participation.
September 16, 2011	AEA Letter to ADEC	Letter summarizing Project licensing plans, agency resource needs and participation.
September 16, 2011	AEA Letter to BLM	Letter summarizing Project licensing plans, agency resource needs and participation.
September 18, 2011	National Wildlife Federation Letter to AEA	Letter to AEA discussing information and licensing needs and concerns.
September 22, 2011	Pre-PAD Recreation Resources Information Questionnaire Transmittal	Letter to commercial recreation services providers transmitting Pre-PAD recreation resource information questionnaire.
September 29, 2011	Introductory coordination meeting with EPA	Meeting with EPA staff to discuss Project planning, information needs regarding potential resource issues and integrated regulatory processes.
September 30, 2011	Introductory coordination meeting with ADEC	Meeting with ADEC staff to discuss Project planning and regulatory issues and framework for the State water quality certification process and stormwater permitting programs.
September 30, 2011	Meeting with Cassie Thomas of NPS	Meeting to discuss potential information sources and needs.
October 13, 2011	Introductory coordination meeting with the SHPO	Meeting to discuss Project planning and overview Section 106 process.
October 24, 2011	Aquatic Resources Preliminary Issues Identification Meeting	Meeting with stakeholders to discuss the identification of potential aquatic resources issues and related information needs.

October 25, 2011	Terrestrial Resources Preliminary Issues Identification Meeting	Meeting with stakeholders to discuss the identification of potential terrestrial resources issues and related information needs.
November 2, 2011	Public Outreach Meeting with Chugiak/Eagle River Chamber of Commerce	Presentation to provide project overview and status update. Addressed questions from community members.
November 3, 2011	Meeting Ratepayers Association and Resource Development Council	Presentation to provide project overview and status update, as part of the Resource Development Council's annual conference. Meeting with Ratepayers Association to introduce key Project staff.
November 4, 2011	Meeting with Alaska Senator Thomas	Meeting with state Senator Thomas to discuss project status and identify potential constituent questions and comments.
November 4, 2011	Meeting with Alaska Interior Delegation	Presentation with Alaska Legislature's Interior Delegation and staff to provide project overview, status update, answer questions and identify potential constituent questions and comments.
November 4, 2011	Meeting with Golden Valley Electric Association	Meeting with senior staff of Golden Valley Electric Association to discuss the utilities potential power needs, current power supplies and identify potential ratepayer questions and comments.
November 4, 2011	Presentation to Osher Lifelong Learning Institute	Presentation to provide project overview and status update and to answer questions from residents of Interior Alaska.

November 9, 2011	Meeting with Alaska Conservation Alliance	Presentation to provide project overview and status update. Addressed questions from Alaska Conservation Alliance, primarily focused on environmental concerns and aquatic resources.
November 10, 2011	Meeting with Ahtna Corporation	Meeting with senior management of Ahtna Corporation to discuss resource concerns, land ownership and access issues.
November 14, 2011	Meeting with Village of Cantwell	Presentation and meeting with members of the Village of Cantwell and the community to provide a project overview, status update and to answer questions from village and community members, primarily about access and land use.
November 18, 2011	Meeting with CIRI Corporation	Meeting with senior management of CIRI Corporation to discuss cooperative relationship, and land ownership and access issues.
December 7, 2011	2012 Water Resources Studies Workshop	Meeting with stakeholders to discuss 2012 study planning for water resources and geomorphology.
December 7, 2011	2012 Aquatic Studies Workshop	Meeting with stakeholders to discuss 2012 study planning for aquatic resources.
December 8, 2011	2012 Terrestrial Studies Workshop	Meeting with stakeholders to discuss 2012 study planning for terrestrial resources.

December 8, 2011	2012 Social Sciences Studies Workshop	Meeting with stakeholders to discuss initial issue identification and study needs for recreation, land use and management, aesthetics, socioeconomics and transportation, subsistence and cultural resources.
December 13, 2011	Meeting with Knikatnu Inc.	Meeting with president of Kinkatnu to discuss cultural issues, the tribal consultation process and land ownership.
December 13, 2011	Meeting with Tyonek Corporation	Meeting with senior management of Tyonek Corporation to provide project overview and status, discuss tribal consultation process, land ownership, and cooperative relationship.