10. WILDLIFE RESOURCES

10.1. Introduction

The Project area, including the Upper and Middle Susitna River subbasins, contains a diversity of wildlife and wildlife habitats that support game and non-game populations managed by the State of Alaska, primarily within Game Management Units (GMUs) 13A, 13B, 13E, 14A, 14B, 16A, and 16B. The purposes of the wildlife studies developed for the Project are as follows:

- To provide current wildlife baseline data for the Project area
- To provide current wildlife habitat availability and use data for habitat evaluation

Information developed from the proposed studies will provide the basis for assessments of potential Project-related impacts; and development of protection, mitigation, and enhancement measures, including resource management and monitoring plans, as appropriate.

Proposed studies are focused on wildlife and their habitats within the Project area that are important for human use, that are protected by federal and state laws, and that are potentially sensitive to Project-related activities and habitat changes.

10.2. Nexus Between Project Construction / Existence / Operations and Effects on Resources to be Studied

Project construction, existence, and operation would result in five general classes of impacts on terrestrial wildlife:

- Permanent habitat loss
- Temporary habitat loss and alteration
- Barriers and hazards to animal movements
- Disturbance
- Changes in recreational and hunting patterns (AEA 2011)

The potential Project-related impacts for wildlife are further described in the Pre-Application Document (PAD) (AEA 2011).

Mechanisms for Project-related impacts may include the following:

- Direct and indirect loss and alteration of wildlife habitats from Project construction and operation.
- Potential physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities and related indirect effects, including habitat connectivity and genetic isolation.
- Potential direct mortality due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches.
- Potential direct, indirect, and cumulative impacts on predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development.

- Potential direct behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation.
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development.
- Potential direct mortality due to vehicle strikes, exposure to contaminants, attraction to garbage and human activity, and protection of life and property.
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development.

10.3. Resource Management Goals and Objectives

The Alaska Department of Fish and Game (ADF&G) is responsible for the game animal management, protection, maintenance, and improvement of Alaska's fish and game resources in the interest of the economy and general well-being of the state (AS 16.05.020). The mission of ADF&G is "to protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle." The guiding principles of ADF&G include providing "the greatest long-term opportunities for people to use and enjoy Alaska's fish, wildlife, and habitat resources," and maintaining "the highest standards of scientific integrity and providing the most accurate and current information possible" (ADF&G website: www.ADF&G.alaska.gov). Federal projects with potential impacts to wildlife are also subject to review under the Fish and Wildlife Coordination Act (16 U.S.C. § 661a *et seq*.) and where applicable to the Endangered Species Act (16 U.S.C. § 1531).

ADF&G monitors populations and manages subsistence and sport hunting and trapping for game mammals (5 AAC 85.045 – moose; 5 AAC 85.025 – caribou; 5 AAC 85.055 – Dall's sheep; 5 AAC 85.015 and 85.020 – bears; 5 AAC 85.025 – wolf and wolverine; 5 AAC 85.065 – small game; 5 AAC 85.060 – fur animals) through regulations set by the Board of Game (AS 16.05.255). The Federal Subsistence Board, which comprises representatives from the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and U.S. Forest Service, oversees the Federal Subsistence Management Program (57 FR 22940; 36 CFR Parts 242.1–28; 50 CFR Parts 100.1–28) with responsibility for managing subsistence resources on federal public lands for rural residents of Alaska.

Most of GMU 13 (except Subunit 13D, south of the Glenn Highway), including the Upper Susitna River basin, currently is managed by ADF&G under a predator control program instituted in response to the state's intensive management law, passed in 1994. Bears in GMU 13 are of interest both as predators of caribou (*Rangifer tarandus*) and moose (*Alces americanus*) and as important game species. GMU 13 is an intensive management area where predator control measures are implemented to increase caribou and moose populations. In GMU 13, predator control measures have included land-and-shoot harvest of wolves (*Canis lupus*) and liberalized regulations for the harvest of wolves and bears.

Eagles, raptors, and all migratory birds are protected by federal laws and agreements, including the Bald and Golden Eagle Protection Act (BGEPA: 16 U.S.C. § 668) and the Migratory Bird

Treaty Act (MBTA: 16 U.S.C. § 703), and a recent memorandum of understanding (MOU) concerning the implementation of Executive Order 13186 with regard to protection of migratory birds (FERC and USFWS 2011). That agreement was created to establish a voluntary framework to ensure that both agencies cooperate to conserve birds and their habitats by identifying and mitigating potential adverse effects resulting from the development of energy infrastructure. The MOU defines bird "species of concern" as those species—including several raptors—that are listed as sensitive or of conservation concern by various management agencies, agency working groups, and non-governmental conservation organizations (FERC and USFWS 2011; also see ABR, Inc. 2011 and AEA 2011).

The MBTA is enforced by the U.S. Fish and Wildlife Service (USFWS) and, in practice in Alaska, is used primarily to monitor and regulate waterfowl harvest; ensure that land-clearing activities occur outside of the bird nesting season to prevent destruction of bird nests; and to encourage development of appropriate avoidance and mitigation measures for federally regulated development projects and activities.

10.4. Summary of Consultation with Agencies, Alaska Native Entities, and Other Licensing Participants

Agencies, Alaskan Native entities, and other licensing participants were involved in developing wildlife study plans. During four terrestrial resources workgroup meetings, agencies and other entities gave input on needed wildlife studies and study methods. A meeting with USFWS helped design the eagle and raptor survey. Comments regarding wildlife studies were received in letters from the Alaska Department of Natural Resources (ADNR) Office of Project Management and Permitting (OPMP), ADF&G, Alaska Department of Environmental Conservation (ADEC), and USFWS. A white paper from ADF&G and follow-up e-mails detailed wildlife study needs.

Summary tables of comments and responses from formal comment letters filed with FERC through November 14, 2012, are provided in Appendix 1. Copies of the formal FERC-filed comment letters are included in Appendix 2. In addition, a single comprehensive summary table of comments and responses from consultation, dated from Proposed Study Plan (PSP) filing (July 16, 2012) through release of Interim Draft RSPs, is provided in Appendix 3. Copies of meeting summaries from release of the PSP through the interim draft RSP are included in Appendix 4, organized chronologically.

Literature Cited

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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. http://www.ferc.gov/legal/maj-ord-reg/mou/mou-fws.pdf.

10.5. Moose Distribution, Abundance, Movements, Productivity, and Survival

10.5.1. General Description of the Proposed Study

The moose study is being conducted by the Alaska Department of Fish and Game (ADF&G). The moose study began with a late-winter population survey in March 2012 and deployment of radio collars in October 2012 and will continue through 2013 and 2014. Although beyond the scope of the FERC licensing study process, ADF&G will continue to survey and monitor radio-collared moose throughout the lifespan of the radio collars deployed for the study (approximately 2016).

This study plan outlines the objectives and methods for characterizing moose distribution, movements, population size, productivity, and habitat use in the study area through geospatial analysis. Radio telemetry surveys via fixed-wing aircraft will be used to monitor distribution, productivity, harvest potential, and habitat use of moose in the study area. In addition to standard Very High Frequency (VHF) radio collars, satellite-linked Global Positioning System (GPS) collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls. Winter surveys will be flown to enumerate moose in and near the reservoir inundation zone. GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002; Kellie and DeLong 2006) and traditional count methods in portions of the study area will be used to generate population estimates. Browse surveys will be used to monitor habitat utilization of the inundation zone, access and transmission corridors, and area downstream from the Project area.

Study Goal and Objectives

The goal of the study is to obtain sufficient population information and use of the study area to evaluate the potential effects of the Project on moose.

Specific study objectives include the following:

- Document the moose population and composition in the study area.
- Assess the relative importance of the habitat in the inundation zone, proposed access/transmission corridors, and the riparian area below the Project.
- Document the productivity and calf survival of moose using the study area.
- Document the level of late winter use of adults and calves in the proposed inundation area.
- Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project.
- Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement.
- Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 big-game distribution and movements study (AEA 2012).

10.5.2. Existing Information and Need for Additional Information

Moose studies during the early 1980s for the original Alaska Power Authority (APA) Susitna Hydroelectric Project were comprehensive, and annual monitoring of moose populations in the general area has been conducted by ADF&G; however, more recent data specific to this Project are needed to accurately characterize the current moose population size, distribution, and habitat use. New information is also needed to assess current issues pertaining to human use of the moose population in the Project region.

For management purposes, moose in Game Management Unit (GMU) 13 are monitored annually using aerial trend-count surveys. Within GMU subunits 13A, 13B, and 13E, a group of continuous count areas (CAs) are surveyed annually (including CA 14; Figure 10.5-1); additional trend-count areas are surveyed periodically. These surveys, which provide managers with population composition and general trend data, have been conducted in this area since the 1950s.

Additional areas such as CA 7, which includes Watana Creek in GMU 13E (Figure 10.5-1), are not surveyed regularly. CA 7 was surveyed annually between 1980 and 1986 (776–1,284 moose observed; 0.9–1.5 moose per square mile). The most recent aerial trend-count survey in that area was conducted in 2001 (776 moose observed; 0.9 moose per square mile). In addition, an intensive population survey was conducted in spring 2012, a year of heavy snowfall. A total of 441 moose (381 adults and 60 calves) were observed in an area of 277.7 square miles, for a density estimate of 1.6 moose per square mile. The density estimate is likely to increase after the estimate is adjusted for sightability (R. Schwanke, ADF&G, 2012, pers. comm.). An additional intensive population survey will be conducted for the area downstream from the proposed dam location.

Changes in hunter access due to the proposed Project will be evaluated. Hunter demand for moose in GMU 13 is very strong and continues to grow. Due to this trend and with implementation of moose population composition objectives in the early 1990s, the GMU 13 moose population composition has been monitored closely to maintain a sustainable harvest and high hunter satisfaction rates. Existing annual monitoring efforts for moose in GMU 13A and 13E address abundance, distribution, and recruitment for the purposes of assessing annual moose population trends and related harvest regulatory strategies. These data, however, are insufficient to address potential Project-related impacts or to identify potential mitigation for moose. Data collected through standard VHF radio telemetry, satellite-linked GPS telemetry, and aerial surveys of population composition, density, and calf production will document currently used areas, as well as provide data on the timing and duration of seasonal range use and the proportion of the regional moose population that uses the Project area. Previous habitat evaluations were based on vegetation cover types that were mapped within 16 kilometers (10 miles) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). However, that vegetation mapping was conducted over 30 years ago.

Both the vegetation and wildlife habitat mapping and the wildlife habitat evaluation will be updated during Project studies (see Sections 11.5 and 10.19, respectively). The wildlife habitat evaluation completed in the early 1980s was based largely on vegetation types. The current study will go beyond vegetation mapping to document both habitat use by moose and the actual biomass removed by browsing. Moose locations derived from this study will be used to develop a stratified sampling design (Paragi et al. 2008) and to identify habitats that may be suitable for

treatment to enhance habitat for moose and other wildlife species using early successional stages of vegetative communities.

The information developed will be used to inform development of appropriate protection, mitigation, and enhancement measures for the Project in support of ADF&G management objectives for moose in GMU 13.

10.5.3. Study Area

The moose study area will include the majority of GMU 13E east of the Parks Highway and the Alaska Railroad and from the Denali Highway south to upper Chunilna Creek (Figure 10.5-1). The study area will also include a small portion of northwestern GMU 13A, from Kosina Creek east to the Oshetna River drainage. The study area encompasses the reservoir inundation zone, access and transmission corridors, and associated Project infrastructure. The study area is somewhat larger than the Project area to fully evaluate the seasonal movements and habitat preferences of moose likely to use the Project area.

10.5.4. Study Methods

10.5.4.1. Moose Distribution, Movements, Productivity, and Survival

To delineate moose movements in the Project area, as well as to evaluate productivity and survival, a sample of cow and bull moose will be equipped with VHF collars. Additionally, GPS collars will be deployed on bulls and cows to detect fine-scale movements by both sexes.

Moose will be captured and collared in late March and October–December, depending on various factors including the physical condition of the moose and the timing of hunting seasons. VHF collars are expected to function for 5 to 7 years, whereas GPS collars have a 2-year life span. If unexpected collar malfunctions or hunting losses occur, additional captures and collar replacement outside of the outlined schedule may be required to maintain a sufficiently large sample size.

In October 2012, 40 GPS collars were deployed on 26 cows and 14 bulls. At the same time, 10 VHF collars were deployed on 7 cows and 3 bulls. The GPS collars are scheduled to drop off on November 1, 2014, for retrieval and downloading of all data stored in the collars. Another 50 VHF radio collars will be deployed in March 2013 on 33 cows and 17 bulls. The two separate capture periods will help to address the spatial variability of a migratory moose population, as well as potential loss of collared animals during the hunting season. The large sample size of radio-collared moose, with a 2:1 ratio of cows to bulls, is expected to adequately record movements and productivity of moose in the study area and to provide context on the relative importance of the Project area in terms of available habitat throughout the year.

Monthly aerial radio-tracking surveys in fixed-wing aircraft will be conducted to document the distribution of radio-collared moose in the study area. During the spring calving (May 10–June 15) and fall hunting seasons (September 1–20), aerial surveys will be conducted weekly to document more frequently the distribution of moose in the study area. Additionally, to accurately document productivity and associated calf loss, surveys will be conducted daily during calving. Small fixed-wing airplanes (Piper PA-18 or similar) will be used for these radio-tracking flights.

Fine-scale movements will be monitored with the 40 GPS collars deployed in October 2012. Due to the relatively consistent annual moose habitat use and movement patterns, the relatively short 2-year life span of GPS collars should be sufficient for documenting fine-scale movements of moose in the study area. Considering that the Project area is used year-round by moose, gathering daily locations with the use of GPS collars is the only way to ensure that habitat use and travel patterns, particularly during calving, hunting season, and the rut for both sexes are accurately identified.

GPS locations of collared moose will be used to evaluate spatial distribution and movements of cows and bulls. Location, date, reproduction, and survival status will be documented for each moose located during scheduled radio-tracking flights. Data mapping and spatial analyses will be accomplished using ArcGIS software.

10.5.4.2. Population Monitoring

Moose populations will be evaluated using three survey techniques. Conventional survey methods pertaining to optimal snow conditions, daylight, flight patterns, and other factors (Ballard and Whitman 1988) will be used for all surveys to maximize survey precision, maintain consistency among surveys, and facilitate comparisons with existing datasets. To assess winter use of the reservoir inundation zone, ADF&G surveyed the area in late winter (March 20–22) 2012 and will do so again in 2013. Due to the seasonal absence of antlers, it will not be possible to distinguish bulls from cows during late-winter surveys, but numbers of calves and adults will be reported.

Intensive population estimates use GSPE techniques (Ver Hoef 2002; Kellie and DeLong 2006) or the Gasaway method (Gasaway et al. 1986). The timing of population estimates will depend on weather conditions and snow cover, logistical considerations, and potential scheduling conflicts with other concurrent moose surveys. The preferred approach is to estimate moose populations above and below the proposed dam within the study area during one GSPE sampling event, currently planned for November 2013. A total of at least 200 randomly selected 6-square-mile sample units will be surveyed. If suitable survey conditions do not occur in November 2013, then the GSPE survey will be rescheduled for March 2014. Sample units will be flown at a high search intensity (>6.5 minutes per square mile). Counts will be corrected for sightability using established methods (Gasaway et al. 1986; Kellie and DeLong 2006).

Previously established trend count areas CA 7 and CA 14 (Figure 10.5-1) were surveyed in November 2012 and will be surveyed again in November of 2013 and 2014 to obtain current data for comparison with data from previous years.

10.5.4.3. Moose Browse Survey and Habitat Assessment

Techniques developed by Seaton (2002) and used subsequently by Paragi et al. (2008) and Seaton et al. (2011) will be used to estimate the proportion of browse biomass removed by moose. Current annual growth (CAG) of important browse species such as willow (*Salix* spp.), aspen and balsam poplar (*Populus* spp.), and Alaska birch (*Betula neoalaskana*) will be estimated. Only plants with CAG between 0.5 meters (1.6 feet) and 3 meters (9.8 feet) in height will be sampled. Three plants per species at each sample plot will be selected and 10 twigs on each plant will be measured. The diameter at the base of CAG (or the point where twig is browsed, if older than last annulus) and the diameter at the point of browsing will be noted. The

duration of sampling will be 8 to 10 days each year in March 2013 and 2014. Sampling must occur after most of the winter browse activity has occurred but before spring green-up. Small helicopters will be used to access study plots. The browse study will be conducted for two years to account for annual variability in snow depth and other conditions.

The seasonal use and importance of the inundation zone and access/transmission corridors will be quantified primarily by analysis of GPS and VHF telemetry data to determine moose movements and habitat preferences. Browse utilization surveys will further refine the relative importance of habitat within the study area by documenting the impact of moose on vegetation. Browse utilization surveys will cover available habitat above and below the dam within the extent of the GSPE survey grid. Studies conducted for the Botanical Resources Program in preparation for the Project licensing process—Vegetation and Wildlife Habitat Mapping in the Upper and Middle Susitna Basin (Section 11.5), Riparian Vegetation Study Downstream of the Proposed Susitna–Watana Dam (Section 11.6), and Wetland Mapping Study in the Upper and Middle Susitna basin (Section 11.7)—will help to identify areas where potential habitat improvement may be considered to mitigate for the loss of habitat in the Project area.

10.5.5. Consistency with Generally Accepted Scientific Practice

Moose movement patterns and productivity and survival in the Project area will be studied by marking animals with radio and GPS satellite collars. The combination of these two collar types will provide both broad-scale and local-scale information on movement patterns in the Project area. These data will be necessary to evaluate broad (seasonal) movements and more local-scale movements within those areas expected to be affected by Project development. The use of these two collar types represents a robust approach to collecting data on moose movement patterns, productivity, and survival that are widespread in Alaska and elsewhere. The outlined sample sizes should be more than sufficient for an accurate and precise representation of moose distribution, movements, and productivity within the study area.

The capture methods employed in this study will be standard capture, handling, and monitoring techniques for moose (Schmitt and Dalton 1987). Helicopters and chemical immobilization techniques will be utilized for moose captures. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the State of Alaska for animal capture and monitoring are in-hand.

Moose population monitoring will be conducted by intensively surveying randomly located plots and extrapolating those data to the study area, a technique that is widely used in Alaska and is the appropriate sampling design for determining population levels of ungulates that are widely dispersed across the landscape (Gasaway et al. 1986; Ver Hoef 2002; Kellie and DeLong 2006).

Moose browse will be studied using methods developed by ADF&G for studies in Interior Alaska to estimate the proportion of browse biomass removed (Paragi et al. 2008; Seaton et al. 2011). These currently are considered to be the most appropriate methods for quantifying moose browse in Alaska.

10.5.6. Schedule

This study is a multi-year effort that began in 2012 with a late-winter population survey in the reservoir inundation zone and initial collar deployment and radio-tracking in the fall and early winter. To meet the needs of the FERC study process, the Initial Study Report (ISR) will be

completed by February 2014 and the Updated Study Report (USR) will be completed by February 2015 (Table 10.5-1), and will include the results of the browse surveys and habitat assessment. Because the battery life of some of the radio collars will extend beyond December 2014, however, ADF&G will continue to survey and monitor those collared moose throughout the collar life span (approximately 2016) and will produce a final technical summary report at that time. However, the 2.5 years of study information that will be summarized in the Updated Study Report is expected to provide sufficient information to assess the potential impacts of the Project on moose.

VHF collars and GPS collars were deployed in October 2012 and will be monitored at least monthly for the life of the study. In March 2013, more VHF collars will be deployed for monitoring at least monthly. Another population survey of adults and calves in the reservoir inundation zone and adjacent habitats will be conducted in March 2013, and winter browse surveys will be conducted in March 2013 and 2014. Radio collars will be tracked every two weeks during May 10–June 15 in 2013 and 2014, including daily monitoring during calving (May 15–31) each year. Radio collars also will be tracked weekly during September 1–20 in 2013 and 2014. Post-rut aggregation composition surveys will be conducted in CA 7 and CA 14 in November 2013 and 2014 and the GSPE survey of the areas above and below the proposed dam will be conducted in November 2013 (or March 2014). Any remaining GPS collars will be retrieved in March 2015.

In 2014 and 2015, licensing participants will have opportunities to review and comment on the study reports (ISR in early 2014 and USR in early 2015). Updates on the study progress will be provided during Technical Workgroup meetings which will be held quarterly in 2013 and 2014.

10.5.7. Relationship with Other Studies

As is depicted below (Figure 10.5-2), the moose study will rely on the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) to identify habitats that are likely to receive higher levels of use by moose, which will then be used to stratify and allocate sampling effort for GSPE surveys and browse surveys. If the GSPE effort is accomplished in 2012 (before preliminary mapping is available from the 2013–2014 study), then the best available vegetation mapping information will be used, including historical mapping from the original APA Susitna Hydroelectric Project. Data from tracking radio collars, from winter population surveys, and from the browse surveys will be used for habitat ranking in the Evaluation of Wildlife Habitat Use (Section 10.19). Geospatial analysis of habitat and their values will be used to quantify potential effects and to evaluate potential PM&E measures, as appropriate, in the impact assessment that will be conducted in 2015 for the FERC License Applications.

The primary potential impacts of Project construction and operation, as described in the Pre-application Document (AEA 2011), are moose habitat loss and alteration, blockage of movements, and increased mortality due to subsistence and recreational harvest facilitated by improved hunter access along transmission and access corridors. Data on the population, distribution, productivity, and habitat use of moose in the study area will be used to assess Project impacts in the impact assessment that will be conducted in 2015 for the FERC License Application. Location data, population data, and browse intensity data can be plotted on the wildlife habitat map that will be developed for the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) to identify important moose habitats

or to provide quantitative or semi-quantitative estimates of habitat value. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission corridors, and related Project infrastructure onto the habitat map and evaluating the loss of important moose habitats. Indirect habitat loss and alteration and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on moose. By incorporating population data from the various surveys into the analysis, the number of animals affected can be estimated. In this way, the Geographic Information System (GIS) analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on moose populations. The concurrent investigation of riparian habitats downstream of the dam site (Floodplain and Riparian Instream Flow Study [Section 8.6] and Riparian Vegetation Study Downstream of the Proposed Susitna–Watana Dam (Section 11.6) will provide additional data with which to assess impacts on moose, establishing baseline conditions and modeling riparian succession in areas in which habitat or browse availability may be affected by altered flow regimes. Harvest data collected by ADF&G and USFWS for the Wildlife Harvest Analysis (Section 10.20) will be used to establish baseline harvest levels and to monitor increased harvest that may result from improved access. Data on the movements of radio-collared moose can be used to assess potential blockage of movements in the inundation area. Any necessary protection, mitigation, and enhancement (PM&E) measures will be developed by examining the seasonal distribution and abundance of moose among habitats in relation to the geographic extent and seasonal timing of various Project activities.

10.5.8. Level of Effort and Cost

The cost of this multi-year study is estimated to total approximately $750,000.

10.5.9. Literature Cited

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10.5.10. Tables

Table 10.5-1. Schedule for implementation of the Moose Distribution, Abundance, Movements, Productivity, and Survival study.

Activity	2012	2013				2014				2015
	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Initial deployment of VHF and GPS collars, with monitoring at least monthly	—	—	—	—	—	—	—	—	—	—
Deployment of remaining VHF collars, with monitoring at least monthly		—	—	—	—	—	—	—	—	—
Monitor radio collars every two weeks and daily during calving			—	—			—	—		
Conduct adult/calf population survey of inundation zone and adjacent habitat		—								
Conduct winter browse survey		—				—				
Conduct GSPE survey for areas above and below proposed dam					—	.....				
Conduct post-rut aggregation composition surveys in CA7 and CA14	—				—				—	
Initial Study Report						—Δ				
Updated Study Report										—▲
Remove GPS collars									—	—

Legend:

——— Planned Activity
..... Follow-up activity (as needed)
Δ Initial Study Report
▲ Updated Study Report

10.5.11. Figures

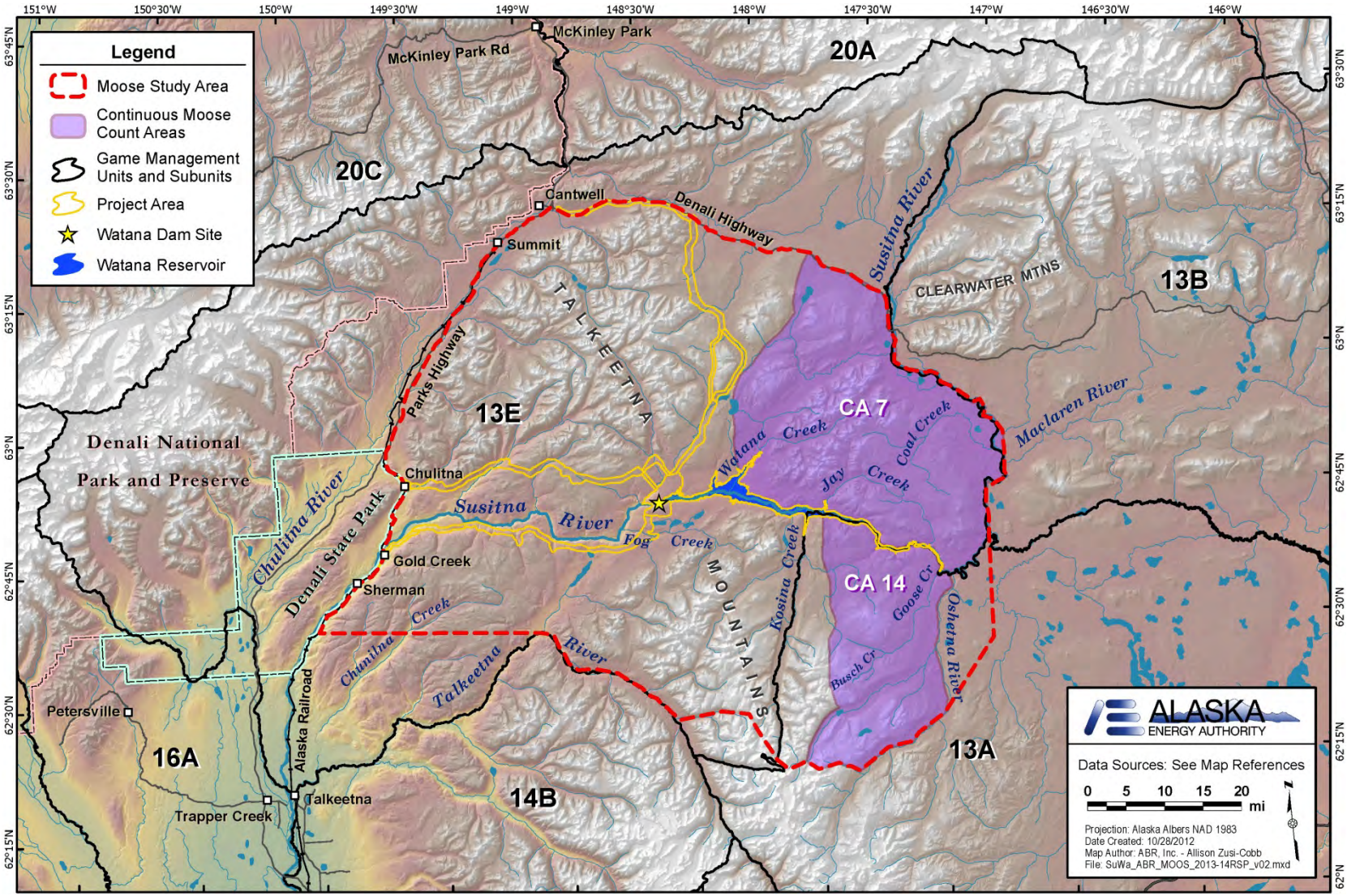

Figure 10.5-1. Moose study area.

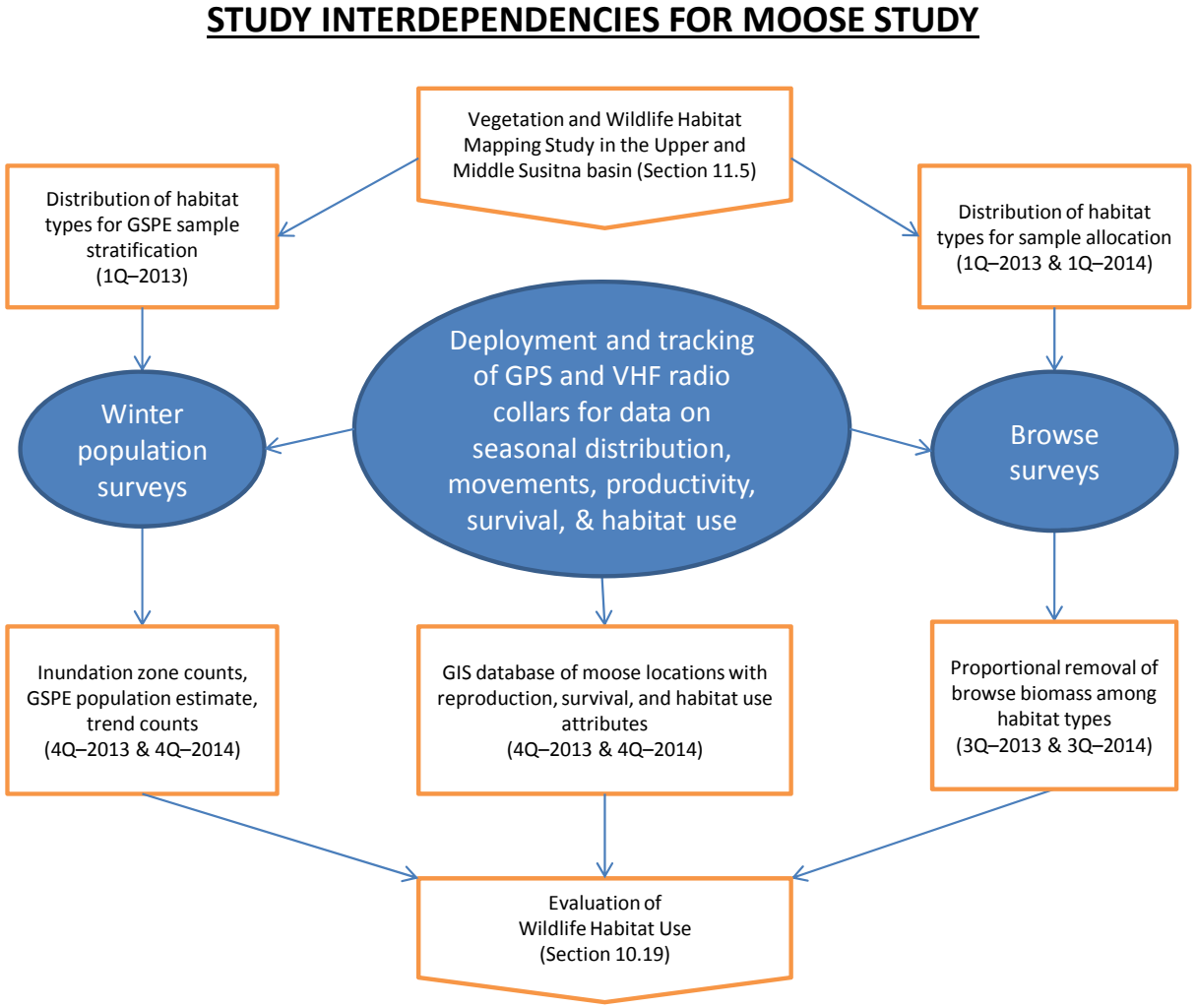

Figure 10.5-2. Interdependencies for moose study.

10.6. Caribou Distribution, Abundance, Movements, Productivity, and Survival

10.6.1. General Description of the Proposed Study

This study plan outlines the objectives and methods for characterizing caribou distribution, movements, population size, productivity, group size, and density in the Project area through radio telemetry and geospatial analyses. Aerial radio-tracking surveys via fixed-wing aircraft will be used to monitor seasonal distribution and range use in the study area, including characterization of calving areas, rutting areas, wintering areas, and migration/movement corridors. In addition to standard VHF radio collars, satellite-linked GPS collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls.

This study is a multi-year effort that is being conducted by the Alaska Department of Fish and Game (ADF&G). ADF&G began the caribou movement study in 2012 by deploying radio collars. This study supplements ADF&G's ongoing caribou research in the region by increasing the sample size of radio-collared cows and by radio-collaring bulls in both the Nelchina and Delta herds to better delineate the seasonal movements and range use of each herd. Radio collars were deployed in October 2012 and will be monitored for the remainder of this study. GPS/satellite collars deployed in October 2012 will be removed in October 2014.

Study Goal and Objectives

The goal of this study is to obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors.

The study has four specific objectives:

- Document seasonal use of and movement through the Project area by both females and males of the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH).
- Assess the relative importance of the Project area to both the NCH and DCH.
- Document productivity and survival of caribou using the Project area.
- Analyze data from historical caribou studies and synthesize with recent data for the NCH and DCH, as a continuation of the caribou task of the 2012 study (AEA 2012).

10.6.2. Existing Information and Need for Additional Information

The current population objective for the NCH was established to ensure consistently high sustainable harvest levels for Alaskan hunters (Tobey and Schwanke 2009). ADF&G's management objectives for the NCH in Game Management Unit (GMU) 13 and GMU subunit 14B are to maintain a fall population of 35,000 to 40,000 caribou, with minimum ratios of 40 bulls to 100 cows and 40 calves to 100 cows; and to provide for an annual harvest of 3,000 to 6,000 caribou (Tobey and Schwanke 2009). ADF&G's management objectives for the DCH in GMU 20A are to maintain sex ratios of at least 30 bulls to 100 cows and at least 6 large bulls to 100 cows; reverse the decline of the herd and increase the midsummer population to 5,000–7,000 caribou; and sustain an annual harvest of 300 to 700 caribou (Seaton 2009).

The caribou study for the original Alaska Power Authority (APA) Susitna Hydroelectric Project began in 1980 and continued through 1985. The objectives of the study were to determine the population status of the NCH, delineate subherds, and identify range use, movement patterns, migration routes, and migration timing (ABR 2011). Three resident subherds were identified and the proposed reservoir was found to intersect migration routes used by pregnant cows moving to calving grounds during late April and May and cows and calves moving to summer range during late June and July (Pitcher 1982). Caribou use of the Project area currently is complicated by range expansion and mixing of DCH animals with those from the NCH (Seaton 2009).

Caribou range use and movement studies during the early 1980s for the APA Susitna Hydroelectric Project are insufficient to accurately characterize current caribou use of the Project area. Since 1985, the number of NCH caribou has increased significantly. The NCH is a moderately large herd, numbering 40,233 caribou in 2011 (ADF&G, unpublished data), whereas the DCH is much smaller, numbering 2,985 caribou in 2007 (Seaton 2009). Both the NCH and the DCH use portions of the Project area extensively. A related change has been increased use of summer and winter range in the northwestern portion of the NCH range in GMU subunit 13E, northwest of the Project location. Because the NCH continues to calve in the eastern Talkeetna Mountains in GMU subunit 13A, south of the Project location, changes in summer and winter range could mean more caribou will cross through the Project area during seasonal migrations to and from the calving grounds. Hence, although the existing information suggests that NCH animals are more likely to cross the inundation zone, it is possible that some DCH animals may do so as well. The proposed study will elucidate the current movement patterns of both herds.

Current annual monitoring efforts for the NCH and DCH by ADF&G identify general herd distribution, productivity, and annual survival for the purpose of assessing annual herd trends and related harvest strategies, but more data are needed to meet the needs of the Project. Therefore, this study has been designed to provide additional data, much of it at finer temporal and spatial scales than previously available, to assess potential Project-related impacts and to help identify potential mitigation measures for caribou in the Project area. Mixing of the two caribou herds since the mid-1990s in the northern portion of the Project area between the Susitna River and Butte Lake has been a more recent development that adds a level of complexity to range use and importance for the two herds (Seaton 2009). In addition, established vegetation exclosures in the NCH range can be used to monitor abundance of lichens in an ungrazed area for assessment of range conditions.

Documentation of currently used areas, along with information on the timing, duration, and proportion of the regional population that uses those areas, can be used to develop any necessary protection, mitigation, and enhance measures, as appropriate. This information also will be useful for mitigating inadvertent disturbance from unrelated field studies for the Project.

10.6.3. Study Area

The caribou study area will reflect use of the Project area by the NCH and the DCH. The study area will include most of GMU 13E east of and including Broad Pass (Figure 10.6-1). The study area also will include drainages emptying into the Upper Susitna River in GMU 13B, as well as a small portion of northwestern GMU 13A from Kosina Creek east to the Oshetna River. The study area encompasses the reservoir inundation zone, associated infrastructure, and potential access and transmission line corridors from the west and the north. Downstream areas in the Middle Susitna River basin that could be affected by changes in stream flows, temperatures, and

ice conditions that could alter conditions for river crossings traditionally used by caribou will be included as well. The study area must be somewhat larger than the areas of primary focus, because of the history of caribou movements in the area and the need to fully evaluate caribou migration routes and habitat preferences.

10.6.4. Study Methods

ADF&G began a caribou movement study in 2012 by deploying new VHF and satellite-linked GPS radio collars, with more collars scheduled for deployment in subsequent years of this study. This study supplements ADF&G's ongoing caribou research in the region by increasing the sample size of radio-collared cows and by radio-collaring bulls in both herds to better delineate the seasonal movements and range use of each herd. In addition, GPS collars will be deployed on bulls and cows to detect fine-scale movements for both herds. Some captures will occur in the month of April to target caribou overwintering in the Project area, with additional captures occurring in October to target migratory caribou.

To address fine-scale movements—both temporally and geographically—at least 60 GPS collars will be deployed (40–45 on NCH animals and 15–20 on DCH animals). Up to 70 percent of the GPS collars will be deployed on cows. Considering that the proposed reservoir inundation zone is primarily used during migration, gathering daily locations with the use of GPS collars is the only way to ensure that travel corridors and travel patterns are identified accurately. Small piston-powered (Robinson R-44) helicopters and chemical immobilization techniques will be used for caribou captures and small fixed-wing aircraft (Piper PA-18 or similar) will be used for radio-tracking flights.

Due to limited battery life, the GPS collars will need to be removed after two years for retrieval of all data stored on board; the collars then will be refurbished and redeployed to gather additional data to further describe movements and range utilization and incorporate annual differences. All GPS collars eventually will be removed to ensure that all data stored onboard the collars is retrieved. Standard VHF radio collars will be deployed with the expectation that they will remain on the animals.

The VHF collars deployed in April 2012 (8 on DCH bulls and 7 on NCH bulls) will be monitored for the remainder of this study, whereas the GPS collars deployed in May 2012 (4 each on NCH and DCH bulls) will be monitored until the collars are retrieved in April or May 2014 for data downloading and collar refurbishing. Radio collars deployed in October 2012 (55 GPS collars on females and 15 VHF collars on bulls) will be monitored for the remainder of this study, and the GPS collars will be removed in October 2014. Collar failures are not anticipated, although a small percentage may malfunction, requiring capture and replacement outside of the schedule outlined.

All existing radio collars deployed on NCH and DCH caribou will be monitored monthly within the Project area via aerial radio-tracking. During spring and fall migration periods, as well as the calving season, additional flights will be conducted more frequently (every two weeks).

No net loss is expected to occur for existing herd monitoring programs. For those caribou currently radio-collared, if radio collars are replaced with GPS collars for this study, then new or refurbished radio collars will be redeployed on each of these animals at the end of the study.

To investigate seasonal movements and range use by bull caribou, 15 VHF collars and 8 GPS collars were deployed on bulls of both herds in April and May 2012, supplementing approximately 80 existing radio collars on NCH cows and 40 existing radio collars on DCH cows. The female segment represents the reproductive portion of the herd, as well as the leading edge of seasonal movements, supporting the higher number of collars for cows.

VHF-collared caribou must be located via fixed-wing aircraft. Monthly aerial radio-tracking flights will provide general documentation of herd distribution and the extent of herd mixing in the Project area. Additional flights (every two weeks) during spring and fall migrations will result in more precise documentation of use of the Project area by both herds. The large sample of radio-collared caribou is necessary to fully evaluate the relative importance of the Project area in terms of available herd ranges and potential movement corridors. The outlined sample sizes should be sufficient for an accurate representation of herd-wide movement patterns and range use.

Locations collected from satellite and GPS collars will be used to evaluate the spatial distribution and movements of cows and bulls from each herd. Additional locations, reproduction, survival status, and group size will be documented for each caribou located during scheduled radio-tracking flights.

Data analysis and visual representation of data will be accomplished using a Geographic Information System (GIS) running ArcGIS® software. Population estimates based on existing data will be calculated consistent with the method used to collect the data. Density estimates will be calculated at a spatial resolution suitable to evaluate potential habitat loss and alteration from the Project. Telemetry data will be used to delineate seasonal ranges and movement corridors using techniques such as kernel density estimates (Seaman and Powell 1996) and Brownian bridge (or similar) movement model techniques (Horne et al. 2007; Sawyer et al. 2009), depending on the volume and suitability of the data for use with these techniques.

10.6.5. Consistency with Generally Accepted Scientific Practices

ADF&G is the primary agency responsible for monitoring caribou populations in Alaska. The techniques used to capture, collar, and track caribou in this study have been developed by ADF&G through decades of experience working with big game species in Alaska. The methods employed in this study will consist of standard capture, handling, and monitoring techniques for cow caribou (Adams et al. 1987). In recent years, these techniques also have been used for bull caribou. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the State of Alaska for animal capture and monitoring are in-hand.

Caribou data will be analyzed according to commonly accepted statistical techniques. Spatial analyses will employ commonly accepted techniques such as fixed-kernel density estimation with least-squares cross validation or plug-in bandwidth selection (Seaman and Powell 1996; Gitzen et al. 2006).

10.6.6. Schedule

This study is a multi-year effort that began with collar deployment and radio-tracking in 2012. The schedule for 2013–2014 activities is depicted in Table 10.6-1. GPS and VHF radio collars that were deployed in 2012 will be monitored at least monthly throughout the entire year in 2013

and 2014, except during migration periods in spring (May–June) and fall (August–September), when they will be tracked more often (every two weeks) to delineate migratory movements in relation to the Project area. The Initial Study Report will be completed by February 2014 and will include analyses of data obtained through fall migration 2013, at a minimum. In April 2014, the GPS/satellite collars deployed in April 2012 will be removed to retrieve the data stored in the collars for analysis (the collars must be retrieved to obtain all data). In October 2014, the GPS/satellite collars that were deployed in October 2012 will be removed and the collars removed in April 2014 will be redeployed (after having been refurbished). The Updated Study Report will be completed by February 2015 and will include analyses of data obtained through fall migration 2014, at minimum. Project updates will be provided at Technical Workgroup meetings, which will be held quarterly in 2013 and 2014.

10.6.7. Relationship with Other Studies

As is depicted below (Figure 10.6-2), the caribou study does not require information inputs from any other Project studies, although it will benefit from preliminary studies begun in 2012 (AEA 2012), which analyzed historical data from the original APA Susitna Hydroelectric Project studies in the 1980s. The GIS database of caribou locations from VHF and GPS radio collars will be used to assess seasonal patterns of habitat use. Output from the caribou study will be used to inform the Evaluation of Wildlife Habitat Use (Section 10.19) through geospatial analysis by overlaying location and movement data on the Project habitat map to identify important areas of seasonal ranges that receive repeated use, movement corridors in relation to the proposed reservoir and Project infrastructure, and important habitat types (e.g., for which use exceeds availability). These geospatial analyses, along with results from other studies (e.g., Ice Processes Study [Section 7.6], Subsistence Study [Section 14.5], Wildlife Harvest Analysis [Section 10.20], Large Carnivores Study [Section 10.8]) will be used in 2015 to assess potential impacts and to evaluate protection, mitigation, and enhancement measures, as appropriate, during development of the FERC License Application.

The potential impacts of the Project on caribou may include direct and indirect habitat loss and alteration or blockage of movement corridors in portions of the range of both the NCH and the DCH, because animals from either herd may encounter the reservoir inundation zone, access and transmission line corridors, and other Project facilities. Other potential impacts include changes in mortality rates that may result from increased subsistence or recreational harvest facilitated by improved access or from changes in predator populations, and mortality from collisions with vehicles or unstable ice conditions in the impoundment. During the impact assessment that will be conducted in 2015 for the FERC License Application, data on the distribution, abundance, productivity, and habitat use of caribou in the study area will be used to assess Project impacts. Location data will be used to identify movement corridors. Location and abundance data can be plotted on the wildlife habitat map that will be developed by the Vegetation and Wildlife Habitat Mapping Study (Section 11.5) to identify important caribou habitats. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission facility “footprints”, and related proposed Project infrastructure onto the habitat map and evaluating the loss of important caribou habitats. Indirect habitat loss and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on caribou. Similarly, movement corridors can be compared to Project features to assess the extent to which movements and distribution

may be affected. ADF&G harvest data will be used to establish baseline harvest levels and to monitor changes in harvest that may result from improved access. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on caribou populations.

10.6.8. Level of Effort and Cost

This study is a multi-year effort that is being conducted by ADF&G. The estimated cost of the study through 2014 is approximately $610,000.

10.6.9. Literature Cited

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10.6.10. Tables

Table 10.6-1. Schedule for implementation of the caribou study.

Activity	2012	2013				2014				2015
	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Deployment of GPS/satellite and VHF collars in October 2012, with monitoring at least monthly	—	—	—	—	—	—	—	—	—	
Monitor radio collars every two weeks during migration periods			—	—			—	—		
Initial Study Report, including data obtained through fall migration in 2013					—	Δ				
Remove GPS collars deployed in April 2012							—			
Remove satellite collars deployed in October 2012 and deploy refurbished GPS collars removed in April 2014									—	
Monitoring, at least monthly, of GPS collars deployed in October 2014									—	—
Updated Study Report, including telemetry data obtained during fall migration in 2014									—	▲

Legend:

—— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.6.11. Figures

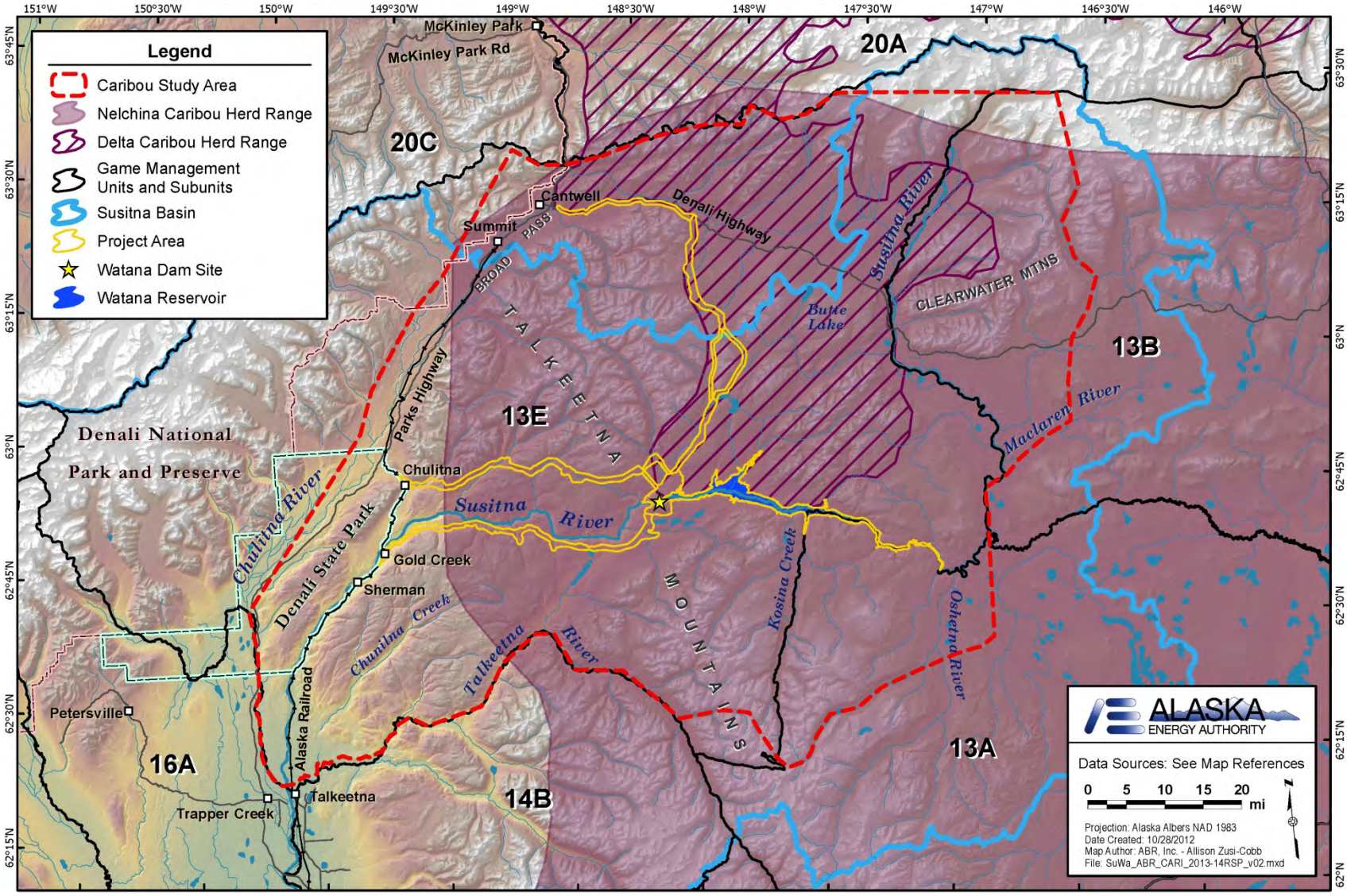

Figure 10.6-1. Caribou study area.

STUDY INTERDEPENDENCIES FOR CARIBOU STUDY

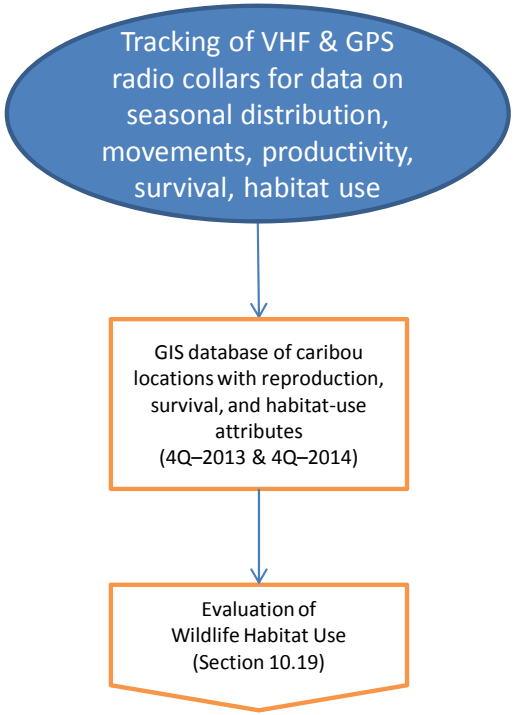

Figure 10.6-2. Interdependencies for caribou study.

10.7. Dall's Sheep Distribution and Abundance

10.7.1. General Description of the Proposed Study

The Dall's sheep study will be conducted over two years in 2013 and 2014. The study is designed to quantify how many sheep inhabit the study area, assess their distribution and habitat use, and evaluate the extent of use of two mineral licks in and near the proposed Project boundary.

Study Goal and Objectives

The goal of the study is to obtain sufficient information on the minimum population size, summer distribution, and current use of mineral licks by Dall's sheep—an important species of big game in the Project area—to use in evaluating potential Project-related effects and identifying measures to avoid, minimize, or otherwise mitigate those effects.

Four objectives have been identified for this study:

1) Estimate the current minimum population size of Dall's sheep in the study area.
2) Delineate the summer range of Dall's sheep in the study area.
3) Evaluate the current condition of mineral licks in and near the Project area.
4) Analyze and synthesize data from historical and current studies of Dall's sheep in the study area, as a continuation of the 2012 study (AEA 2012).

Data collected through aerial surveys and inspection of the mineral licks at Jay Creek and Watana Creek will document currently used areas for development of any necessary protection, mitigation, and enhancement measures.

10.7.2. Existing Information and Need for Additional Information

Dall's sheep were studied in the region during the early 1980s. Aerial surveys of the Watana Creek Hills counted 130–220 animals (Tankersley 1984). Later surveys of the Watana Hills counted 97 sheep in 1999, 50 sheep in 2003, and 63 sheep in 2007 (Peltier 2011). The sheep population in the larger management area has declined overall following a steep decline after the winter of 1999–2000 and additional declines during 2004–2007 (Peltier 2011). No sheep use of areas on Mount Watana (directly south of the proposed Watana reservoir) or near the Denali Highway access corridor was documented in the 1980s (Tankersley 1984).

During the 1980s research, mineral licks were identified on lower Jay Creek and upper Watana Creek (Tankersley 1984). Sheep used those licks mainly between mid-May and mid-June and at least 31 percent of the sheep population observed in the Watana Creek Hills in 1983 traveled 5 miles (8 kilometers) or more to the Jay Creek lick. The Low Watana reservoir proposed in the 1980s would not have inundated the Jay Creek lick at a normal maximum operating level of 2,185 feet (135 feet higher than is planned for the currently proposed Project), but may have resulted in the loss of lower areas of the Jay Creek lick and associated resting areas due to accelerated erosion, and may have inhibited sheep travel along and across Jay Creek (Tankersley 1984).

The management objective for the Talkeetna Mountains and Chulitna–Watana Hills in Game Management Unit (GMU) Subunits 13A, 13E, 14A, and 14B is to maintain sheep populations

that will sustain an annual harvest of 75 rams (Peltier 2011). This study only addresses sheep populations within portions of GMU 13E.

The proposed Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, wildlife disturbance, and changes in human activity due to construction and operation.

New information is needed for a current enumeration of sheep abundance in the study area, especially in the Watana Creek Hills, and to evaluate the current extent of seasonal use of the Jay Creek and Watana Creek licks by sheep. The primary concerns for Dall's sheep are alteration of movement patterns, changes in the use of nearby mineral licks, disturbance, and changes in harvest patterns due to increased human access. Current data on distribution, population size, and use of the Jay Creek and Watana Creek licks will be important for assessing potential impacts on the local sheep population and for developing any protection, mitigation, and enhancement measures, if necessary.

10.7.3. Study Area

The study area consists of that portion of GMU Subunit 13E located east of the Parks Highway and south of the Denali Highway, encompassing the Project facilities, potential access and transmission line corridors, and the reservoir inundation zone (Figure 10.7-1). All suitable Dall's sheep habitat within the study area will be surveyed by airplane and the mineral licks at Jay Creek and Watana Creek will be visited on the ground.

10.7.4. Study Methods

The proposed study will consist of three components:

- Aerial surveys for summer distribution and minimum population estimation.
- Inspection of the Jay Creek and Watana Creek mineral licks to assess their current condition and general level of use.
- Analysis of historical (1980s) data and synthesis with current Alaska Department of Fish and Game (ADF&G) monitoring results.

An aerial survey will be conducted each year by an experienced ADF&G biologist to document sheep distribution and to develop a minimum population estimate. All suitable sheep habitat in the study area will be covered by the survey, following ADF&G protocols for summer (July) surveys after lambing and before the sheep hunting season begins in early August.

The two site visits to the Jay Creek and Watana Creek mineral licks during May and June each year will provide a qualitative assessment of lick condition and levels of use. Alaska Energy Authority (AEA) contractors will perform these site visits rather than ADF&G personnel. Results will be compared with those from ground-based surveys of mineral licks conducted in the 1980s (Tankersley 1984). Conducting site visits in both 2013 and 2014 will provide information on annual variability, and the results of the 2013 visits will be used to modify the timing of the 2014 field visits, if necessary.

10.7.5. Consistency with Generally Accepted Scientific Practice

Aerial surveys will provide the best indication of the minimum population of sheep in the study area. These surveys are standard methods used by ADF&G for sheep in Alaska (see Harper 2011). Aerial surveys will be conducted by ADF&G personnel and pilots experienced in conducting surveys according to ADF&G protocols. Data will be analyzed in accordance with commonly accepted statistical techniques for wildlife studies.

10.7.6. Schedule

The timing of study surveys and reporting is depicted below (Table 10.7-1). Aerial surveys of all available sheep habitat within the study area will be conducted in July or early August in 2013 and 2014, and visits to mineral licks will be conducted in May and June each year. Data analysis and reporting will be conducted each year. Site visits to assess lick use will be conducted in May and June of 2013 and 2014 by an AEA contractor. Aerial surveys will be conducted over a period of about a week in July or early August of both years by ADF&G personnel. Data analysis and report preparation will be conducted from August to January. The Initial Study Report will be completed by February 2014 and the Updated Study Report will be done by February 2015. Project updates will be provided at Technical Workgroup meetings, which will be held quarterly in 2013 and 2014.

10.7.7. Relationships with Other Studies

As is depicted below (Figure 10.7-2), specific information will not be needed from other studies for the Dall's sheep study plan to proceed. Aerial surveys during summer and ground-based observations of mineral licks will provide data on the distribution and minimum population size in the study area and on the number of sheep using the mineral licks. That information will be used in the Evaluation of Wildlife Habitat Use (Section 10.19) for geospatial analyses to assess potential impacts on sheep habitat and to develop appropriate protection, mitigation, and enhancement (PM&E) measures to minimize impacts to Dall's sheep. The Large Carnivores Study (Section 10.8), Terrestrial Furbearers Study (Section 10.10), and Wildlife Harvest Analysis (Section 10.20) are expected to provide additional information that will aid in the impact assessment for sheep; however, the sheep study will not depend on information from those studies.

The potential impacts of construction and operation of the proposed Project on Dall's sheep may include the following:

- Direct loss and alteration of Dall's sheep habitats, including key habitat features such as mineral licks.
- Blockage or alteration of movements and changes in distribution due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities.
- Mortality of Dall's sheep due to Project-related fluctuating water and ice conditions in the reservoir and downstream river reaches.
- Changes in mortality that may result from altered abundance and distribution of sheep predators due to increased human activities and habitat changes resulting from Project development.

- Mortality of Dall's sheep from increased subsistence and recreational harvest.

During the impact assessment that will be conducted for the FERC License Application in 2015, data on the distribution and abundance of Dall's sheep and their use of mineral licks in the study area will be used to assess Project impacts through geospatial analysis, evaluation of the responses of Dall's sheep to other similar projects (as documented in the scientific literature), and examination of the current physical characteristics of the Jay Creek and Watana Creek mineral licks. Direct habitat loss caused by the Project will be evaluated by overlaying the reservoir, access and transmission corridors, and related infrastructure (including any predicted changes around the two mineral licks) and the summer sheep ranges delineated from aerial surveys onto the Project wildlife habitat map. Similarly, zones of potential indirect effects will be delineated around the Project footprint, based on information from the literature. Population data will be incorporated into the geospatial analysis to estimate the number of sheep that may be affected. The GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on sheep.

Harvest data from ADF&G and population data from aerial surveys will provide a baseline with which to assess changes in mortality rates that may result from increased harvest, lake ice conditions, increased predation, or altered access to important habitats.

Information from other studies also will provide useful information to consider in the assessment of potential Project impacts on Dall's sheep, in particular the Large Carnivore Study (Section 10.8), Terrestrial Furbearer Study (Section 10.10), and the Wildlife Harvest Analysis (Section 10.20).

10.7.8. Level of Effort and Cost

Aerial surveys will require one observer and one pilot in a small tandem-seat fixed-wing airplane, flying daily for up to one week each summer to survey the sheep habitat in the study area. The ground visits to mineral licks will require 2–3 days per visit (twice annually), for a total of 8–10 days over both years. All suitable sheep habitat east of the Parks Highway and south of the Denali Highway within GMU 13E will be surveyed. The study cost is expected to be on the order of $50,000 per year in 2013 and 2014, for a total of approximately $100,000.

10.7.9. Literature Cited

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10.7.10. Tables

Table 10.7-1. Schedule for implementation of the Dall's sheep study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1Q
Site visits to assess mineral lick use		—				—			
Aerial surveys			—				—		
Data analysis				—	—			—	—	
Initial Study Report					—Δ				
Updated Study Report									—▲

Legend:

—— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.7.11. Figures

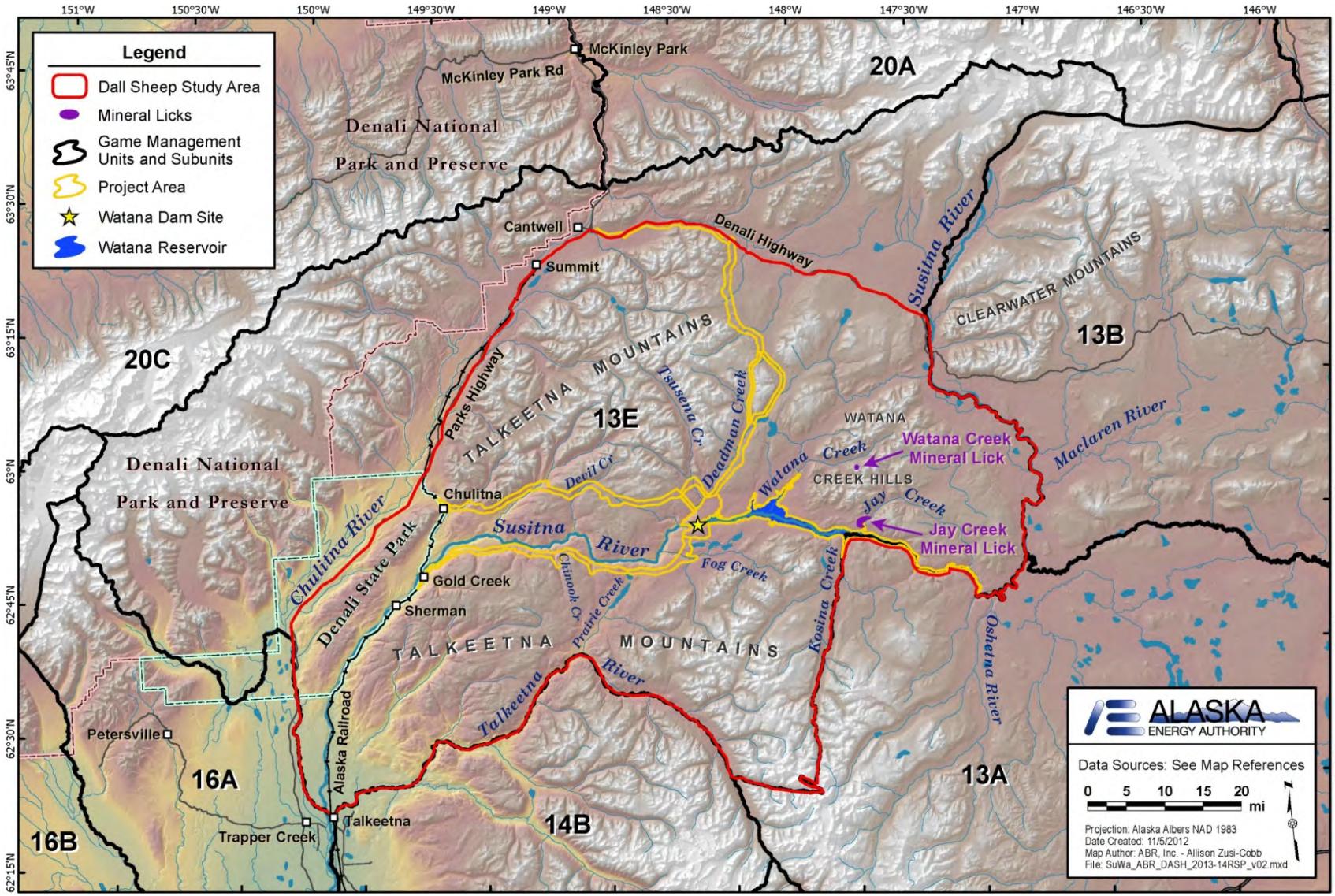

Figure 10.7-1. Dall's sheep study area.

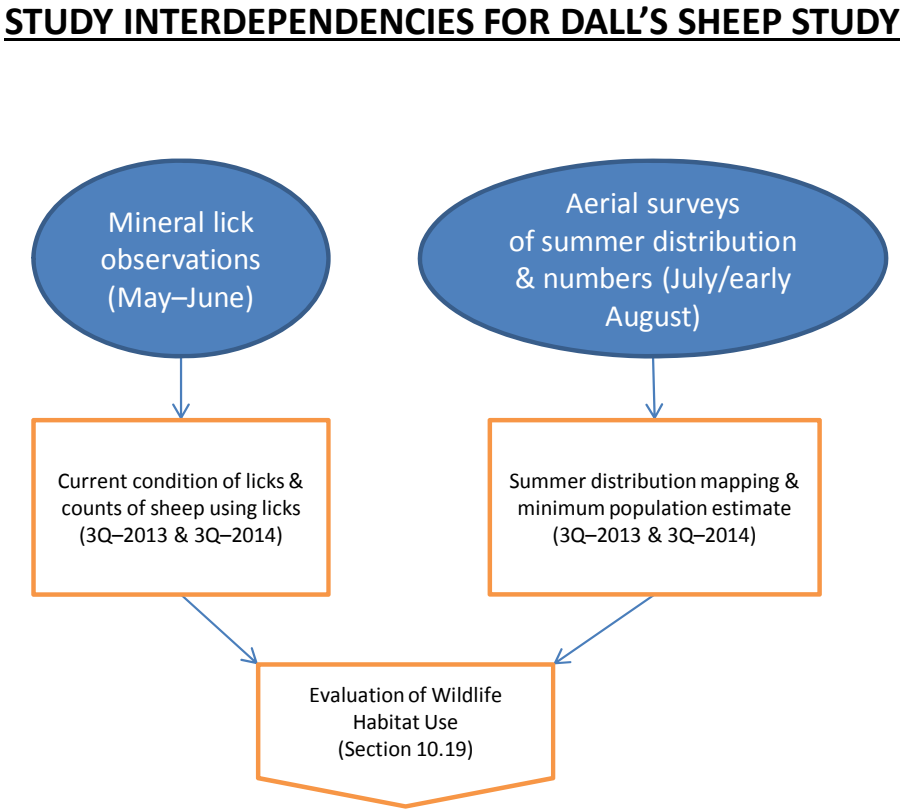

Figure 10.7-2. Study interdependencies for Dall's sheep study.

10.8. Distribution, Abundance, and Habitat Use by Large Carnivores

10.8.1. General Description of the Proposed Study

The Large Carnivores Study is a two-year (2013–2014) effort that combines (a) desktop analyses of existing data on bears and wolves from historical studies and recent and ongoing population-monitoring studies by the Alaska Department of Fish and Game (ADF&G), with (b) new field sampling focused on bears using riparian areas along spawning streams used by anadromous fish downstream from the proposed dam. Some of the information needed for this study was acquired as part of the preliminary studies begun in 2012 (AEA 2012).

Study Goal and Objectives

The goal of the study is to obtain sufficient information on three dominant predators and game animals in the region—brown bear, black bear, and wolf—to use in evaluating Project-related effects and identifying any appropriate protection, mitigation, or enhancement measures.

Project development will inundate or modify habitats used seasonally by brown bears, black bears, and wolves. In addition, the associated development infrastructure and human activities in the area during construction and operation could have indirect effects on bears and wolves through changes in prey populations—including moose, caribou, and salmon—and changes in disturbance and human hunting patterns. Data collected through this Large Carnivores Study will provide information on the value of lost, created, or altered habitats for bears and wolves in the study area.

Four primary objectives have been identified for this study:

1) Estimate the current populations of brown bears, black bears, and wolves in the study area, using existing data from ADF&G.
2) Evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may be altered by the Project.
3) Describe the seasonal distribution of, and habitat use by, wolves in the study area using existing data from ADF&G.
4) Synthesize historical and current data on bear movements and seasonal habitat use in the study area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies (AEA 2012).

10.8.2. Existing Information and Need for Additional Information

Existing information for bears and wolves is further detailed below. This study will supply baseline data essential to assess potential Project-induced impacts and facilitate the evaluation of protection, mitigation, and enhancement measures, as appropriate.

10.8.2.1. Bears

For the original Alaska Power Authority (APA) Susitna Hydroelectric Project in the 1980s, Miller et al. (1997) estimated brown bear and black bear densities in the region using a mark–resight technique. In the spring of 2000, 2001, and 2003, ADF&G used aerial line-transect

sampling (Becker 2001; Becker and Quang 2009) to estimate brown and black bear population sizes in their 26,490-square-kilometer Talkeetna Study Area. That large area extended from the East Fork of the Yentna River to the northeastern portion of the Susitna River drainage and included most of the Project area. The portion of the reservoir inundation zone located upstream from the mouth of Kosina Creek was not covered in that survey, however.

In spring 2003 and 2004, ADF&G conducted aerial line-transect sampling (Becker and Quang 2009) to estimate the population sizes of black and brown bears in a 21,528-square-kilometer area encompassing Game Management Unit (GMU) Subunits 13A and 13B (GMU 13AB Study Area). That area was bounded on the west and north by the Susitna River and extended from Kosina Creek to the Gakona River. That survey area included the part of the reservoir inundation zone that was not included in ADF&G's Talkeetna Study Area. Brown bear and black bear densities varied substantially across these large areas, showing a pronounced gradient from higher densities in the west to much lower densities in the east. The density gradient was larger for black bears than for brown bears (ADF&G, unpublished data).

The original APA Susitna Hydroelectric Project included studies of the population size and density, demography, seasonal movements, dispersal, den locations, and predation rates on moose calves by both brown and black bears from 1980 to 1985 (ABR 2011). No studies of bears were conducted downstream from Devils Canyon. The density of brown bears in the upstream area was estimated to be 29.7 bears/1,000 square kilometers over an area of 12,127 square kilometers, which was defined as the area within the mean home-range diameter from the Susitna River for brown bears (Miller 1987). Approximately 12 percent of the relocations (n = 1,720) of radio-collared brown bears occurred in the area that would have been inundated by the APA Susitna Hydroelectric Project's Low Watana reservoir; bears used that area twice as frequently as expected both in the spring and for all months combined. This pattern of use was evident for males and most females, but not for females accompanied by cubs of the year. Bears spent the highest proportion of time in the Watana inundation zone during June, when they foraged on south-facing slopes for roots, new vegetation, and overwintered berries, and preyed on moose calves. Females with young cubs tended to stay at higher elevations, possibly to reduce the risk of predation on cubs by male brown bears (Miller et al. 1997).

Brown bears preyed on moose calves from late May to early June, with predation rates declining substantially by mid-July (Ballard et al. 1990). In addition to moose calves, the Susitna bear population had access to salmon, which is unusual for brown bears in Interior Alaska. Bears, especially males, moved to the Prairie Creek drainage, a tributary to the Talkeetna River located southwest of Stephan Lake (between the Devils Canyon and Watana dam sites) during July and early August to feed on spawning Chinook salmon (LGL 1985). Despite the availability of protein-rich animal foods, berry production appeared to be a major factor limiting brown bear productivity in the Susitna study area (LGL 1985). Miller (1987) estimated berry abundance and canopy coverage within and above both impoundment zones proposed for the original APA Susitna Hydroelectric Project. Horsetails (*Equisetum* spp.), an important spring food, were more abundant outside the impoundment zones, but some sites with abundant horsetails would have been inundated by the proposed reservoir (Helm and Mayer 1985). An ADF&G study of brown bear movements and demography in GMU Subunit 13A is nearing conclusion; that study area is located south of the proposed reservoir inundation zone for this Project.

The density of black bears in black bear habitat comprised of spruce forest and shrublands along the Susitna River was estimated to be 90 bears/1,000 square kilometers in the 1980s (Miller

1987); that density estimate has not been updated since (Tobey 2008). Although black bears in the upper basin occasionally ate moose calves, berries appeared to be their most important food source (LGL 1985). Black bears spent most of their time in forested areas along creek bottoms, but moved out into adjacent shrublands during late summer as they foraged for berries, particularly in the area between Tsusena and Deadman creeks (Miller 1987). In May and June, 52 percent and 46 percent, respectively, of all locations of radio-collared bears occurred in areas that would be flooded by the proposed impoundment (Miller 1987).

The ADF&G management objective for brown bears in GMU 13 is to maintain a minimum population of 350 animals (Tobey and Schwanke 2009). The management objective for black bears in GMU 13 is to maintain the existing population of black bears with a sex structure that will sustain a harvest of at least 60 percent males (Tobey 2008). Bears in GMU 13 are of interest both as predators of caribou and moose and as important game species.

The Project could result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity and access due to construction and operation of the Project. Bears often pose management challenges for large development projects in Alaska because of their attraction to areas of human activity and associated waste-handling facilities.

10.8.2.2. Wolf

Most of GMU 13 (except Subunit 13D, south of the Glenn Highway), including the upper Susitna River basin, currently is managed by ADF&G under a predator control program instituted in response to the State's intensive management law, passed in 1994. Since 2006, the number of wolves in GMU 13 has been within the current management goal range of 135–165 wolves (3.3–4.1 wolves/1,000 square kilometers) after the end of the hunting and trapping seasons (Schwanke 2009). In neighboring GMU 14, the wolf population was estimated at 100–130 animals in fall 2004 and 145–180 in fall 2007, well above the management objective of a minimum population of 55 wolves (Peltier 2006, 2009). GMU 14 currently is not included in the State's predator control program.

The wolf study for the original APA Susitna Hydroelectric Project was conducted during 1981–1983 in the Nelchina and upper Susitna River basins, building on regional studies that began in the 1970s (see ABR 2011 for details). That study provided data on pack size, territory boundaries, den and rendezvous sites, and feeding habits, based on radio-tracking of collared animals. During the study period, 13 different packs and a lone individual used areas in or adjacent to the Devils Canyon and Watana impoundment zones proposed for the APA Susitna Hydroelectric Project. Wolf packs used almost the entire upper Susitna basin, except areas above 4,000 feet elevation; elevational use varied seasonally, probably in response to availability of prey species. In each year, 5–6 wolf packs used the areas that would have been inundated by the APA Susitna Hydroelectric Project. Den and rendezvous sites usually were located on well-drained knolls and hillsides with sandy, frost-free soils and mixed, semi-open stands of spruce, aspen, and willow. The most important potential impact on wolves from the APA Susitna Hydroelectric Project was predicted to be reduced winter availability of primary prey species (moose and caribou) in the impoundment zones. In addition, habitat loss due to inundation and facilities development would have caused wolves to adjust territory boundaries, potentially resulting in intraspecific strife.

Wolves have been studied extensively in GMU 13 since the mid-1970s and are the subject of ongoing surveys for ADF&G's intensive management program. The number of wolves and packs using the Project area currently is unknown, although it appears to be substantially lower than during the original APA Susitna Hydroelectric Project studies because of current predator control efforts in GMU 13 and 16. Research in recent years has focused on ADF&G's Nelchina study area in GMU Subunit 13A, located south of the proposed reservoir.

10.8.3. Study Area

GMU 13 is an intensive management area where predator control measures have been implemented by the State of Alaska to increase caribou and moose populations. In GMU 13, predator control measures have included land-and-shoot harvest of wolves and liberalized regulations for the harvest of wolves and bears.

The study area for spatial modeling of bear density will consist of a large region that encompasses the proposed Project area, including the reservoir inundation zone, the access and transmission corridors, and other Project features (Figure 10.8-1). The study area includes the entire area of GMU Subunit 13E plus parts of adjacent Subunits 13A, 16A, and 16B, to provide a broad regional context for the analysis of bear densities. The subunits adjacent to Subunit 13E were included in the previous ADF&G surveys (described below) that provided the source data for the spatial density modeling that will be developed for this study, and can be included in the modeling analysis with little additional effort.

Fieldwork in 2013 and 2014 will be limited to surveys of bear use of anadromous fish spawning streams in the Middle Segment of the Susitna River and its tributaries downstream from the proposed Watana dam site that contain spawning runs of anadromous fishes, as far downstream as the confluence of the Susitna River and the Chulitna River, all of which are located within GMU Subunit 13E.

No field studies are proposed for wolves. The wolf study will involve analysis of existing ADF&G data from GMU Subunits 13E and 13A, and possibly from adjacent Subunits 14B, 16A, and 20A, pending further consultation with ADF&G during study implementation.

10.8.4. Study Methods

10.8.4.1. Bears

10.8.4.1.1 Population Estimation

A multi-faceted approach will be used to address the need for current information on bears in the Project area. Re-analysis of 1980s data and synthesis with current data from other previous or ongoing ADF&G telemetry studies and other regional management studies will provide data on bear populations, movements, and habitat use in the study area (AEA 2012a).

Population estimates can be obtained from existing data collected recently in ADF&G's two line-transect study areas (described above in Section 10.8.2.1) by using complex distance models with a new gamma-like detection function (Becker, in prep.) that is consistent with point independence models (Borchers et al. 2006). By themselves, however, these estimates will not allow more detailed inference about the number of bears in areas potentially affected by the Project. The addition of spatial line-transect modeling (Hedley and Buckland 2004) will allow

computation of estimates that are both more accurate and more precise. The analytical objective is to obtain density estimates from specialized multiple-covariate, mark-resight distance models (Becker, in prep.) along small transect sections. These estimates will then be fitted with a detailed spatial model (Miller et al., in prep.) that incorporates potential explanatory variables such as elevation, aspect, habitat, and east-west and north-south gradients to derive a spatially explicit density model, from which sub-estimates can be obtained (e.g., parts of both bear survey areas that may be affected by the Project). The spatial models of Hedley and Buckland (2004) must be modified (Miller et al., in prep.) to work correctly with the more complex distance models (Becker, in prep.) used to model the initial bear densities. The spatial model must be robust because of the potential for nonlinearity between the spatial covariates and bear density (Miller et al., in prep).

The analytical work will require writing a Geographic Information System (GIS) program to subdivide the 1,238 35-kilometer-long transects from the Talkeetna Study Area and the 1,221 30-kilometer-long transects from the GMU 13AB Study Area into small (1-kilometer) segments that retain all relevant geospatial information. This work will be performed by the ADF&G Division of Wildlife Conservation. The next step is to develop an R-based program to fit a spatial model to the two datasets and then to run this code on the datasets to obtain the population estimates. This work will be done by Dr. David L. Miller, University of Rhode Island, Department of Natural Resources Science, who will work on the analysis and report preparation with Earl Becker, ADF&G Division of Wildlife Conservation.

10.8.4.1.2 Downstream Surveys

ADF&G has concluded that adequate data generally are available for brown bears and black bears in the Project area to evaluate the potential impacts of the Project, but "information on downstream use of habitat and the importance of salmon in bear diets in conjunction with impacts to salmon would aid in identifying potential impacts to bears downstream of the dam" (letter from M. Burch, ADF&G, to AEA dated November 22, 2011). ADF&G does not consider bear dens to be "sensitive" locations, however, because they are seldom reused (letter from M. Burch, ADF&G, to AEA, dated December 20, 2011).

A survey of bear use of fish-spawning streams in the Middle Segment of the Susitna River and associated tributaries downstream from the proposed Watana dam site will be conducted to assess the use of those resources by bears in the Project area. The surveys will use DNA analysis from hair samples to quantify the minimum number of bears using the downstream area and will use stable-isotope analysis of hair samples to characterize the diet of bears in the sampled area. Hair-snag stations such as single-catch snares (Beier et al. 2005) will be deployed along salmon spawning streams in the Susitna River drainage downstream from the dam site and upstream from Talkeetna, extending up tributary drainages that support spawning runs of anadromous fish. The size and design of the hair-snag sampling array will be based on the expected densities of bears, logistical considerations for access to the area, and comparison with similar studies in central Alaska, in consultation with ADF&G biologists.

DNA analysis of bear hair samples will provide information on the sex and species of bear, a minimum estimate of the number of different individuals using the sampling area, and stable isotope signatures. The isotopic signature will be used to classify the proportion of the diet made up of salmon, terrestrial meat, or vegetation (Fortin et al. 2007). ADF&G experts will be consulted by AEA during the sampling design and analysis phases of the downstream bear study.

Evaluation of berry resources in the reservoir inundation zone will be accomplished during the concurrent mapping efforts for vegetation and wildlife habitats and for wetlands (Sections 11.5 and 11.7, respectively) to assess the distribution and abundance of berry plants as forage for bears.

10.8.4.2. Wolf

ADF&G's Division of Wildlife Conservation has expressed the opinion that ongoing monitoring work will be sufficient (ADF&G memorandum to AEA; November 22, 2011), so no additional field surveys are deemed necessary for the Project. Hence, desktop analyses of existing ADF&G data will be used to meet the study objectives for wolves.

Historical reports from the original APA Susitna Hydroelectric Project study will be reviewed and synthesized, where possible, with data from other recent and current monitoring by ADF&G of wolves in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A, as a continuation of AEA's wildlife studies (AEA 2012a), initiated in 2012. Mapping of wolf pack territories and movements from existing ADF&G telemetry datasets will provide useful background information, although delineation of current pack territories will not be possible without tracking collared individuals, and the applicability of the available data to the study area needs to be evaluated. Although the findings of the wolf study conducted for the original APA Susitna Hydroelectric Project program remain relevant and could be used for the current Project analyses, the original telemetry data for wolves are no longer available and therefore cannot be reanalyzed using newer geospatial techniques.

10.8.5. Consistency with Generally Accepted Scientific Practice

Distance sampling using line transects surveyed from small airplanes (Becker and Quang 2009) is the primary method currently employed by ADF&G to obtain regional estimates of bear population density in southern Alaska. Mark–recapture analysis of genetic markers and stable isotope analysis from hair samples have been widely used in recent years. Analyses of hair samples to examine bear diets and population size have been used previously in Alaska (Fortin et al. 2007; Gardner et al. 2010).

10.8.6. Schedule

This study is a multi-year effort (Table 10.8-1), part of which began in 2012; re-analysis and synthesis of existing bear and wolf data gathered through 2011 is currently being conducted (AEA 2012a). Incorporation of new data and additional analyses will be conducted incrementally as recent and current data are obtained from ADF&G databases. Field surveys of bear use of salmon streams downstream from the proposed dam site will be conducted during mid to late summer in 2013 and 2014 to coincide with the timing of spawning runs of salmon. Evaluation of berry resources in the reservoir inundation zone will be accomplished during concurrent mapping efforts for vegetation, wetlands, and wildlife habitats. Data analysis, QA/QC, and reporting will be conducted in the fall and winter months after recent and current data are transferred from ADF&G and fieldwork is completed in late summer. The Initial Study Report and Updated Study Report will be completed within 1 and 2 years, respectively, after FERC's Study Plan Determination (i.e., February 1, 2013). Technical Workgroup meetings will be planned on a quarterly basis in 2013 and 2014.

10.8.7. Relationship with Other Studies

As is depicted in Figure 10.8-2, the Large Carnivores Study will benefit from other sources of information, including the Fish Distribution and Abundance in the Lower and Middle Susitna River Study (Section 9.6), the Vegetation and Wildlife Habitat Mapping Study (Section 11.5), and various ongoing ADF&G management projects not sponsored by AEA. The fish distribution study will supplement the State's Anadromous Waters Catalog by helping to identify fish spawning areas downstream from the proposed dam, which will in turn define the sampling areas for collection of hair samples from bears visiting those streams. The hair samples will provide the material needed for DNA analyses to enumerate the minimum number of bears using the streams and for stable isotope analyses to characterize their diets. These results then will be used to assess potential impacts and to inform development of protection, mitigation, and enhancement, as appropriate.

The Vegetation and Wildlife Habitat Mapping Study will provide the information needed to evaluate berry abundance in the proposed reservoir inundation zone. These results will also be used to assess potential impacts and to inform development of protection, mitigation, and enhancement, as appropriate. The information on berry abundance will contribute to the Evaluation of Wildlife Habitat Use (Section 10.19) to identify areas and habitats that are used heavily by bears for foraging in late summer and early fall.

Existing data collected by ADF&G will be used to model the densities of brown bears and black bears in the region in which the Project area is located, as well as for population analyses of the wolf population in the Project area. Bear locations and numbers from two of ADF&G's regional line-transect surveys conducted within the last decade will be used for spatially explicit analysis and modeling of bear densities in a larger study area that encompasses the Project area. Similarly, the size of the wolf population and densities of wolves in the Project area will be estimated using existing ADF&G data from recent and ongoing studies. Data from these analyses will be used in the Evaluation of Wildlife Habitat Use (Section 10.19) to identify areas and habitats that are used heavily by bears and wolves, and that information will be used to assess potential impacts and to evaluate PM&E measures, as appropriate.

The primary potential impacts on bears could be direct loss of habitat, changes in prey density and distribution, changes in berry production, changes in human use and hunting effort, and increased potential of mortality due to defense of life or property (DLP), or availability of anthropogenic food sources. Impacts on bears will depend, in part, on the proposed plan to control anthropogenic food sources. The primary potential impacts on wolves could be direct loss of habitat, changes in prey distribution and density, disturbance, and changes in hunting effort.

Telemetry data from the ADF&G will be used, in conjunction with bear survey data described above, to identify important habitats and high-use sites for bears and wolves in the Project area. Data on the distribution, abundance, movements, and habitat use by bears and wolves will be used to assess Project impacts. During the impact assessment that will be conducted for the FERC License Application in 2015, direct habitat loss can be estimated through geospatial analysis by overlaying the reservoir, access and transmission corridors, and other Project infrastructure on the Project habitat map (Section 10.19) to identify important habitats that would be lost. Additional indirect habitat loss and avoidance effects can be similarly estimated by applying various buffer distances, as determined from available information on anticipated

effects. Data from the bear DNA study can be used to estimate the number of animals that might be affected at various high-use areas and to assess the dietary importance of those streams to the bear population downstream of the Watana Dam. The predicted effects on bears and wolves from this study will be useful for impact assessments for prey species, such as moose, caribou, and Dall's sheep. The Wildlife Harvest Analysis (Section 10.20) will provide baseline data for evaluation of changes in harvest and other mortality that may result from improved access. Data on the seasonal distribution, abundance, and movements of bears and wolves among habitats in relation to the geographic extent and seasonal timing of various Project activities can be used to identify any necessary protection, mitigation, or enhancement measures, as appropriate.

10.8.8. Level of Effort and Cost

Sightability of bears from aerial surveys over forests is low and the large Project area makes direct observations from the ground problematic. Stable-isotope analysis of bear hair provides an indirect estimate of the major components of bear diets without requiring capture and handling of bears. Approximately one to two weeks of field time by a crew of two biologists will be required in mid-summer to establish the hair-snag grid between the proposed dam site and Talkeetna. The hair-snag stations will then be checked at weekly intervals during late summer, when use of the streams by bears is expected to be highest. The seasonal timing of sampling visits may be adjusted on the basis of results from fish surveys for the Project.

Collection of data on berry distribution and abundance in the reservoir impoundment zone will be conducted during the vegetation and wetland field surveys (see Sections 11.5 and 11.7), eliminating the need for separate field surveys.

The spatial modeling of bear density, which will be conducted in 2013 only, is estimated to cost approximately $65,000.

The study cost of the large carnivore study (including bears and wolves) in 2013 is estimated at approximately $200,000, including the bear density modeling. The cost of the large carnivore study in 2014 is estimated to be less because the bear density modeling will not be included. The total two-year cost of the overall study is estimated at approximately $325,000.

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10.8.10. Tables

Table 10.8-1. Schedule for implementation of the Large Carnivore Study.

Activity	2012			2013				2014				2015
	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Acquisition and analysis of recent and current data on bears and wolves from ongoing ADF&G projects & databases	——	——	——	——	——	——	——	——	——	——		
Spatial modeling of bear population density by ADF&G, using existing data				——	——	——	——					
Field surveys of bears along spawning streams downstream from proposed dam (hair sampling for DNA & stable isotope analyses)					——	——				——		
Evaluation of berry abundance in reservoir inundation zone (from vegetation and wildlife habitat mapping field surveys)					-----	-----				-----		
Data QA/QC and analyses						——	——			——	——	
Initial Study Report							—Δ					
Updated Study Report											—▲	

Legend:

—— Planned Activity
----- Follow-up activity (as needed)
Δ Initial Study Report
▲ Updated Study Report

10.8.11. Figures

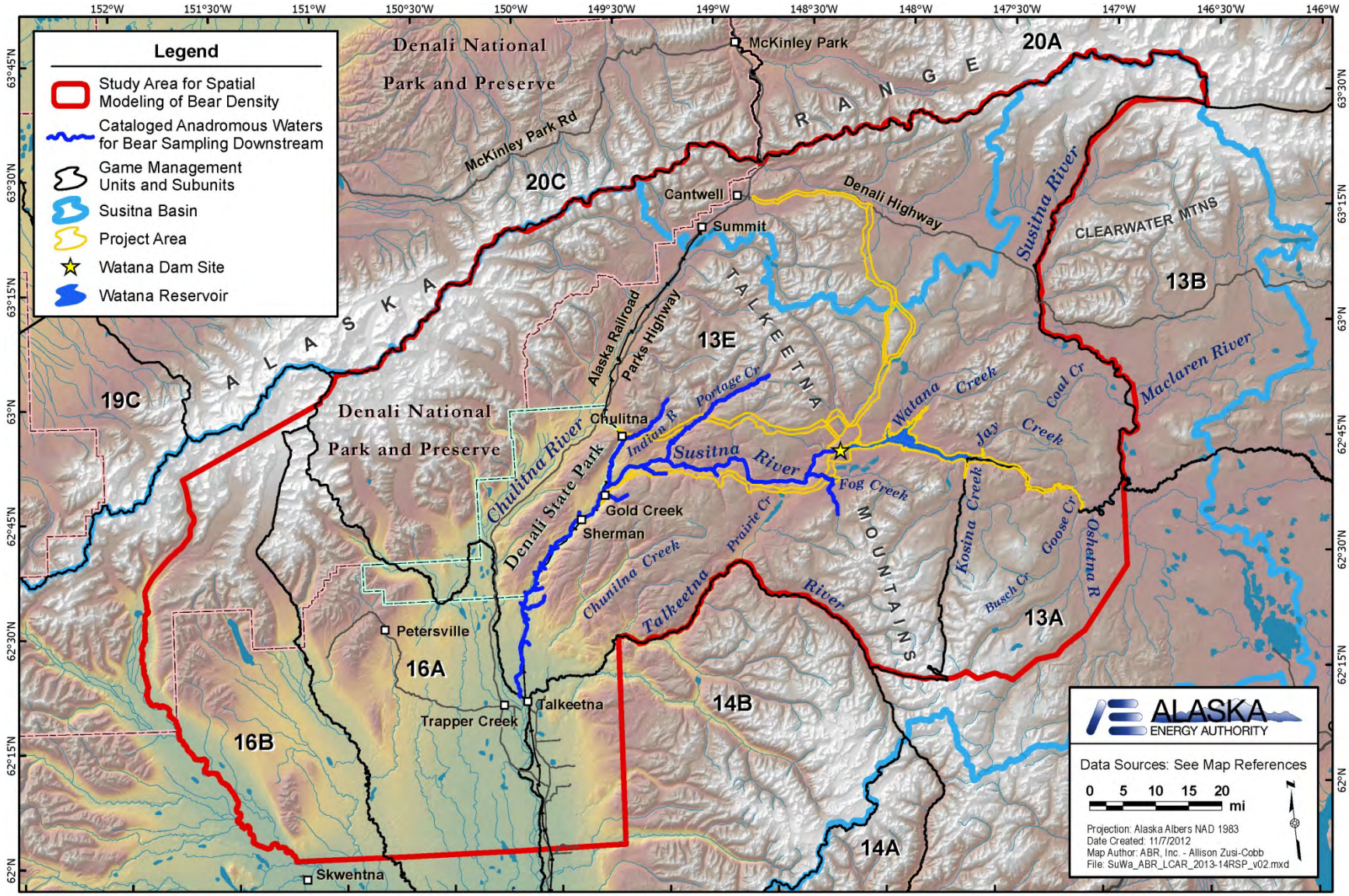

Figure 10.8-1. Study area for large carnivores.

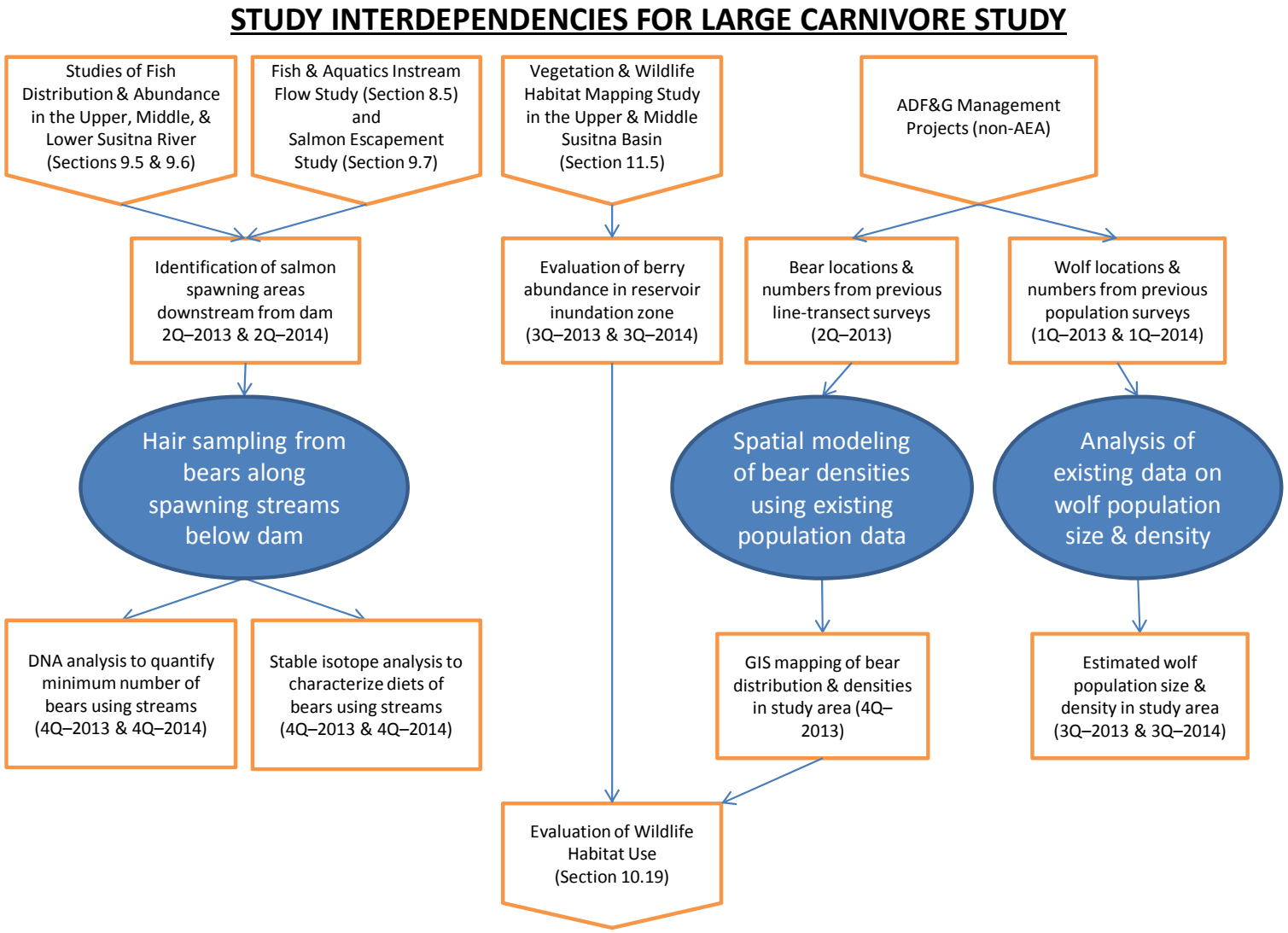

Figure 10.8-2. Study interdependencies for the large carnivore study.

10.9. Wolverine Distribution, Abundance, and Habitat Occupancy

10.9.1. General Description of the Proposed Study

The Wolverine Study is a multi-year project involving evaluation of existing information and field surveys. During 2012, previous data from wolverine monitoring efforts in the study area were assembled. In late winter of 2013, a single aerial Sample-Unit Probability Estimator (SUPE) survey will be attempted. If survey conditions are unsuitable for the SUPE in 2013, then an occupancy survey will be flown and the SUPE survey will be attempted again in late winter of 2014. Occupancy modeling will be used to estimate detection probability for wolverines in the study area and to establish a baseline for estimating population trends during and after construction of the proposed Project. Aerial surveys for the purpose of occupancy modeling will be conducted in 2013 or 2014, assuming that the SUPE survey is successful in the other year. At a minimum, an occupancy survey will be conducted in each year.

Study Goal and Objectives

The overall goal of this study is to collect pre-construction baseline population data on wolverines in the Project area (reservoir impoundment zone; facilities, laydown, and storage areas; access and transmission line routes) to enable assessment of the potential impacts from development of the proposed Project. This information will be used to estimate the number of wolverines that may be affected by the Project and to evaluate impacts on habitats used seasonally by wolverines.

Four specific objectives have been identified for this study:

1) Estimate the current population size of wolverines.
2) Establish a population index for wolverines.
3) Describe the distribution of wolverines in late winter.
4) Describe habitat use by wolverines in late winter.

10.9.2. Existing Information and Need for Additional Information

The Project will result in wildlife habitat loss and alteration, blockage of movements of mammals, disturbance, and changes in human activity due to construction and operation of the Project. The Project may result in habitat loss, reduced access, or displacement from seasonally used sensitive habitats in the Middle and Upper Susitna River basin such as denning areas, or prey calving and wintering areas, caused by increased human activity.

The Wolverine Study will provide baseline data for the study area, including a late-winter distribution assessment for development of habitat evaluation criteria. The study will provide a basis for impact assessments and for developing any appropriate protection, mitigation, and enhancement measures, which may include resource management and monitoring plans.

The Alaska Department of Fish and Game (ADF&G) conducted a mark–recapture study of radio-collared wolverines in the upper Susitna River basin for the original Alaska Power Authority (APA) Susitna Hydroelectric Project to investigate population density and distribution, habitat selection, home-range size, and seasonal movements from 1980 to 1983 (see details in ABR 2011). A total of 22 wolverines were equipped with VHF radio collars between April 1980 and April 1983, but sufficient data to estimate home-range size were obtained from only four

males and three females. Harvest records, track data, and incidental sightings were also used to help estimate distribution, population size, and food habits of wolverines in the Susitna basin. In addition to collared animals, the carcasses of 136 wolverines that had been harvested in or near the study area were examined. Habitat use by wolverines varied among seasons with respect to both elevation and vegetation types. Wolverines were located at higher elevations in summer and lower elevations during winter (Whitman et al. 1986). Collared wolverines avoided tundra habitats in winter and forested habitats in summer, probably because of seasonal changes in prey availability, and used other habitats in proportion to their availability. The most notable potential impact of the original APA Susitna Hydroelectric Project on wolverine was considered to be permanent loss of winter habitat. A potential decrease in the regional moose population as a result of the Project would have reduced the amount of carrion available to wolverines during winter. Whitman and Ballard (1984) estimated that 45 percent of the wolverines in their study area in the middle Susitna basin used the reservoir inundation zone to some degree. Improved access and a greater human presence in the region would have increased the potential for higher harvest rates of wolverines.

No recent estimate of the wolverine population is available for the study area. The relative inaccessibility of much of the area may make it a population source area or refugium (Schwanke 2010) for the wolverine population in Game Management Unit (GMU) 13. ADF&G requested that a population estimate of wolverines be developed for the Project (ADF&G memorandum to AEA; November 22, 2011).

10.9.3. Study Area

The study area (Figure 10.9-1) is substantially larger than the Project area because of the need to consolidate sampling blocks for the SUPE technique while still encompassing the reservoir inundation zone, dam site, access and transmission line corridors, and other Project infrastructure and adjacent areas. Most of the study area is within GMU subunits 13E and 13A. Depending on whether the SUPE survey or occupancy survey is conducted in 2013 (see Section 10.9.6 below), the exact boundaries may be refined further before the field survey begins in February 2013.

10.9.4. Study Methods

An aerial survey using snow-tracking and the SUPE technique (Becker et al. 2004; Golden et al. 2007) will be used to estimate the number and density of wolverines in the Project area. With this method, the survey area is divided into equal-sized sample units (e.g., 25 square kilometers; Golden et al. 2007) that are stratified on the basis of predicted density of wolverines (high, medium, and low density). Sample units are selected at random from each stratum and are surveyed soon (within 36 hours) after a significant snowfall until all tracks within the selected sample units are located. Tracks then are followed in both directions to map the entire movement path since the last snowfall, and the number of animals in the group is estimated. Data are analyzed using program SUPEPOP and formulas from Becker et al. (1998). Surveys sampling 65–70 percent of high-density sample units and 45–50 percent of medium- and low-density sample units should result in a density estimate with a coefficient of variation (CV) of <10 percent.

The SUPE methodology requires suitable conditions, including fresh snowfall followed by several days of suitable flying conditions late in the winter when adequate daylight is available.

These requirements may not be met every year. Therefore, a contingency plan is necessary. Occupancy modeling is a viable approach that can be used in conjunction with the SUPE. At a minimum, the quadrats identified for sampling in the SUPE will be flown looking for tracks. Noting presence of tracks is all that is necessary for this survey. Because occupancy modeling does not require following tracks back to their origin and forward to the animal (as does the SUPE), windblown areas and older snow are not as much of an issue. SUPE data can also be used for occupancy modeling. Using this approach will allow ADF&G to use occupancy modeling to track wolverine population trends in the study area over time, as long as the same quadrats are sampled. Sample units of 1,000 square kilometers have been used to define the coarse-scale distribution of wolverines (Gardner et al. 2010). Gardner et al. (2010) suggested using smaller sample units (100 square kilometers) if population contractions in a specific location were to be detected. Using 25-square-kilometer SUPE sampling units will allow for this kind of analysis. A meaningful result from occupancy modeling requires repeated surveys, so surveys for the purpose of occupancy modeling will be flown in both 2013 and 2014. If conditions allow, one of those will be the SUPE.

Historical reports from the original APA Susitna Hydroelectric Project study will be reviewed and synthesized, where possible, with data from other recent and current monitoring by ADF&G in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A. This portion of the work will occur as a continuation of the wildlife distribution and movements study (AEA 2012), which began in 2012. Although the findings of the Wolverine Study conducted for the original APA Susitna Hydroelectric Project remain relevant and can be used for current Project analyses, the original telemetry data for wolverines are no longer available (R. Strauch, ADF&G, 2012 pers. comm.), so cannot be reanalyzed using newer geospatial techniques.

10.9.5. Consistency with Generally Accepted Scientific Practice

The SUPE technique has been used by ADF&G for past wolverine studies in Alaska (Golden et al. 2007). The ADF&G Division of Wildlife Conservation supports the use of a SUPE survey for estimating the wolverine population when feasible (letter from the Alaska Department of Natural Resources [representing state agencies, including ADF&G] to AEA dated May 30, 2012). In recent years, ADF&G and others also have used occupancy modeling (Magoun 2006; Gardner et al. 2010) to assess wolverine populations.

10.9.6. Schedule

The schedule for this study is summarized in Table 10.9-1. A single, intensive SUPE survey will be flown in late winter (February or March) 2013 after a significant snowfall. If suitable survey conditions do not occur for the SUPE survey in 2013, then a less intensive survey will be flown for occupancy modeling and the SUPE survey will be attempted again in February or March 2014. Additional wolverine data for 2012–2013, if any, will be added if it becomes available from ADF&G, following completion of data entry, verification, and QA/QC checks. An Initial Study Report and Updated Study Report will be completed within 1 and 2 years, respectively, following FERC's Study Plan Determination (i.e., February 1, 2013). Project updates will be provided at Technical Workgroup meetings, which will be held quarterly in 2013 and 2014.

10.9.7. Relationship with Other Studies

As is depicted in Figure 10.9-2, the two types of surveys conducted for this study will provide complementary data, which will be used to derive a population estimate (SUPE survey) and to characterize current habitat occupancy in late winter and establish a population trend index for future monitoring (occupancy survey). Output from the occupancy model will be used to identify patterns of habitat use and high-value habitat in the Project area. Output from the Wolverine Study will be used in the Evaluation of Wildlife Habitat Use (Section 10.19), which, along with the population data provided directly by the Wolverine Study, as well as data gathered from other studies (e.g., Wildlife Harvest Analysis [Section 10.20]), will be used to assess potential impacts and to develop appropriate protection, mitigation, and enhancement measures for wolverines.

Potential impact mechanisms of the proposed Project on wolverine could include the following:

- Direct and indirect loss and alteration of habitat from Project construction and operation.
- Physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions, access and transmission corridors, and new patterns of human activities and related indirect effects, including habitat connectivity and genetic isolation.
- Direct and indirect impacts on predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development.
- Behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation.
- Behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development.
- Direct mortality due to vehicle strikes, exposure to contaminants, and protection of life and property.
- Potential changes in wildlife mortality rates due to increased harvest facilitated by Project development.

Wolverines typically occur at lower densities near human development (May et al. 2006; Gardner et al. 2010) and this may be the primary impact of the Project on wolverines.

During the impact assessment that will be conducted for the FERC License Application in 2015, data on the winter distribution, abundance, and habitat use by wolverines in the study area will be used to assess Project impacts of habitat loss and behavioral avoidance. Observed locations of wolverines and, where feasible, abundance data will be plotted on the wildlife habitat map of the Project area and surrounding 4-mile buffer that will be developed for the Vegetation and Wildlife Habitat Mapping Study (Section 11.5) and each habitat type will be ranked by level of use. Direct loss of preferred or important habitats can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the wildlife habitat map created for the Project (see Sections 11.5 and 10.19). Indirect loss and potential avoidance can be estimated by applying various buffer distances in the Geographic Information System (GIS), determined from available information on anticipated effects. In this

way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on wolverines. The Wildlife Harvest Analysis (Section 10.20) will provide a baseline for assessing the impacts of changes in the level of harvest.

10.9.8. Level of Effort and Cost

Multiple pilot/observer teams in small, tandem-seat airplanes (Piper PA-18 or similar) will be used to cover as much of the study area as possible within as short a time period as possible, once suitable survey conditions are achieved following a fresh snowfall. It is estimated that approximately 210 hours of flight time will be required for the SUPE and 105 hours will be required for the occupancy survey. Project costs in 2013 are expected to be approximately $115,000. A second survey for occupancy modeling is planned for 2014, costing approximately $60,000. These efforts may be switched between field seasons, however, depending on survey conditions in 2013. The total cost of the Wolverine Study is estimated at approximately $175,000.

10.9.9. Literature Cited

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10.9.10. Tables

Table 10.9-1. Schedule for implementation of the Wolverine Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1Q
SUPE survey flown in late winter after significant snowfall	——				-----				
If suitable conditions do not occur for SUPE survey, then less intensive occupancy survey will be flown	-----				——				
Data QA/QC and analyses		——	——	——		——	——	——	
Initial Study Report				——	Δ				
Updated Study Report								——	▲

Legend:

—— Planned Activity
----- Follow-up activity (as needed)
Δ Initial Study Report
▲ Updated Study Report

10.9.11. Figures

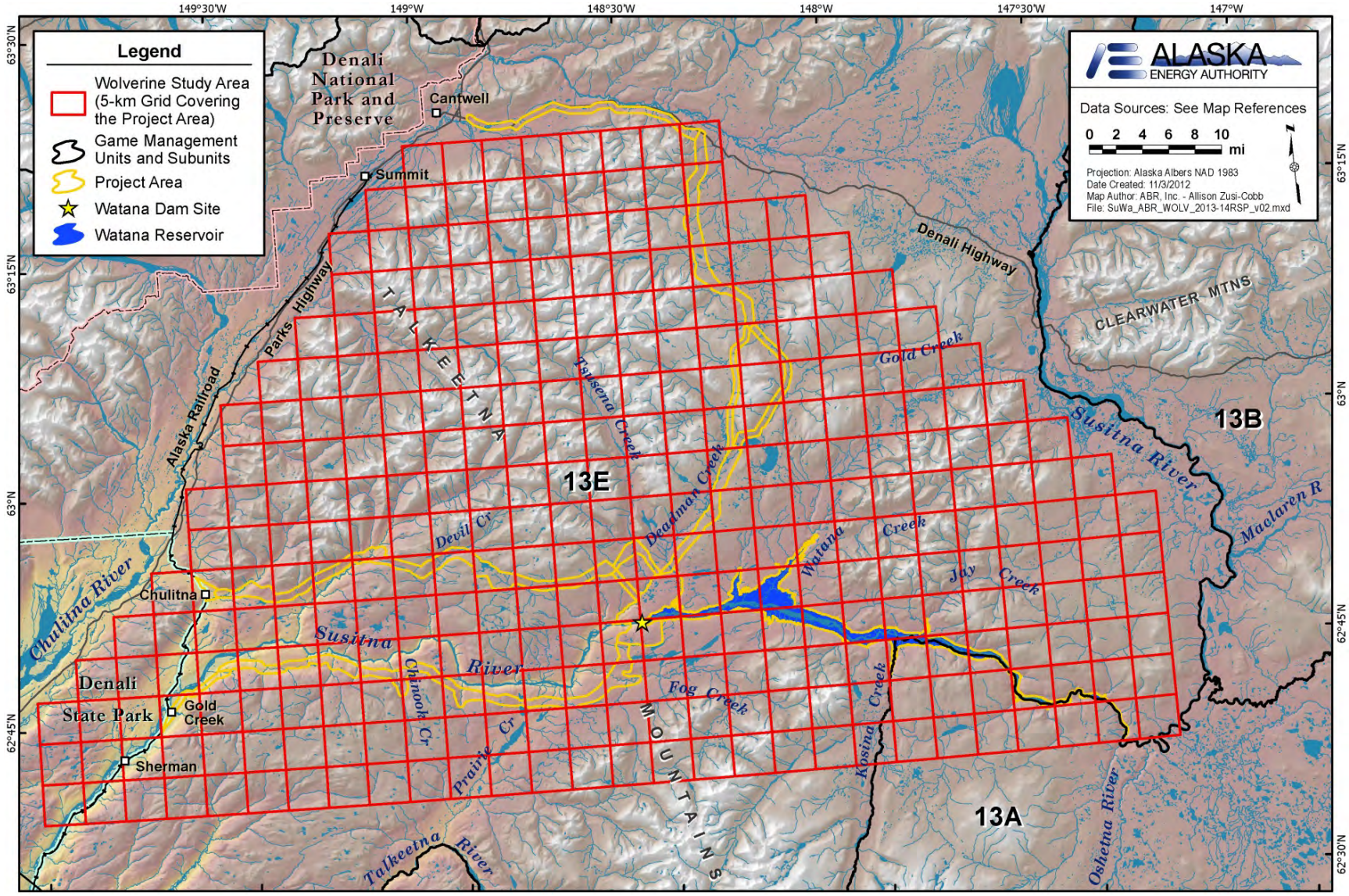

Figure 10.9-1. Wolverine study area.

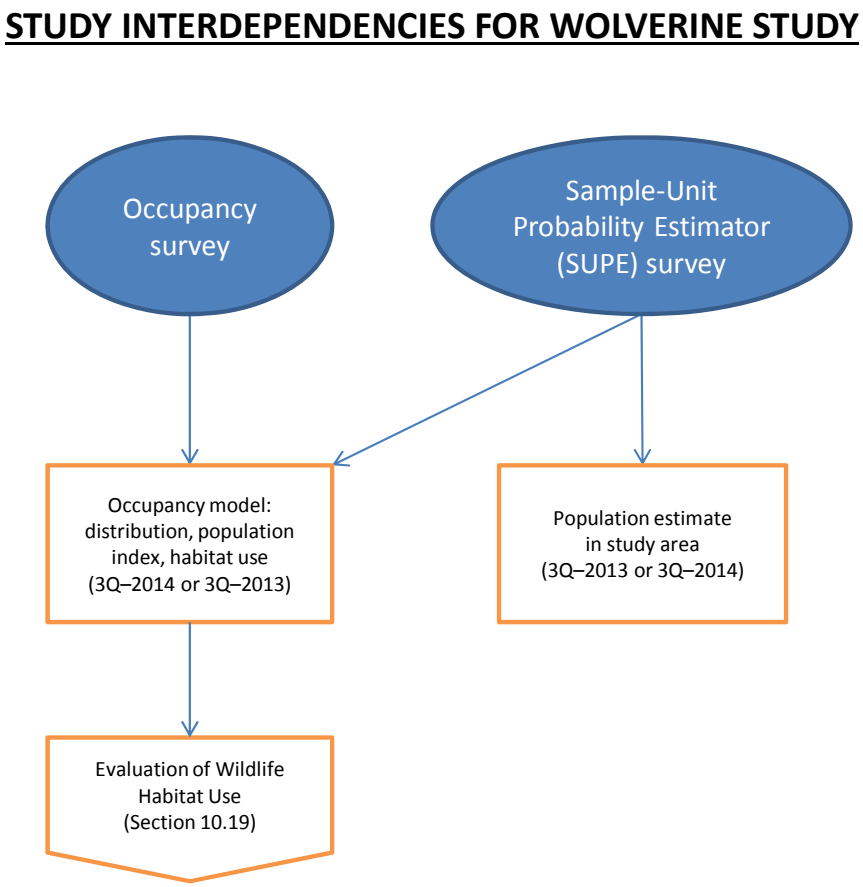

Figure 10.9-2. Study interdependencies for Wolverine Study.

10.10. Terrestrial Furbearer Abundance and Habitat Use

10.10.1. General Description of the Proposed Study

Terrestrial furbearer studies were initiated in 2012 and, as outlined here, will continue in 2013 and 2014. The terrestrial furbearer study will be conducted as part of a graduate thesis project supervised by Professor Laura Prugh of the University of Alaska Fairbanks (UAF). Data and reports pertinent to the goals of this Project will be provided by Dr. Prugh, whereas elements of the larger UAF thesis project lie outside the context of impact assessment and mitigation and are not included in this study plan or in the FERC licensing process.

Study Goal and Objectives

The goal of this study is to provide current information on the abundance and habitat use of four species of terrestrial furbearers (coyote, red fox, lynx, and marten) for use in evaluating potential Project-related impacts and identifying appropriate mitigation. The potential impacts of the Project include habitat loss and fragmentation, increased human harvest and disturbance, and changes in prey populations (AEA 2011). Accurate population estimates and habitat-use data are important for adequately determining the amount of habitat loss and identifying the relative likelihood and magnitude of changes in harvest. This information will be used to assess the potential effects of the Project on furbearer populations, which will inform development of any necessary protection, mitigation, and enhancement measures, which may include management and monitoring plans.

Red fox, lynx, and marten are ecologically important and valuable furbearers. Coyotes also are ecologically important but they are not as highly valued as furbearers. Although coyotes are widely distributed throughout Alaska, little is known about their abundance or ecological effects. The coyote is considered to be a "human commensal" species, benefiting from human activities such as road construction and agriculture (Young and Jackson 1951). Coyotes may increase in abundance as a result of the Project, and because they prey on a wide variety of large and small game, and compete with and prey on foxes and lynx, changes in coyote abundance could have effects on other wildlife resources.

Trapper surveys show that Alaskans who trap in Game Management Units (GMUs) 11 and 13 are particularly concerned about the impact of coyotes on Dall's sheep populations (Schwanke 2010). Several studies have found that coyotes are a major predator of Dall's sheep lambs (Hoefs and McTaggart-Cowan 1979; Scotton 1998; Arthur and Prugh 2010). Although preliminary results from a study of Dall's sheep survival in GMU subunit 13D showed little evidence of coyote predation (Lohuis 2011), the area where that study was conducted contains more escape terrain than does the study area. Terrain in the study area (located in GMU subunit 13E) is more similar to the area studied by Arthur and Prugh (2010) in the northern foothills of the central Alaska Range, where the coyote was the main predator of Dall's sheep lambs.

This study has five specific objectives:

1) Develop population estimates of coyotes and red foxes through fecal genotyping and genetic capture-recapture analyses using scats collected along trails and rivers throughout the study area during winter months (January–March) in 2013 and 2014.

2) Develop a population estimate of marten through DNA-based capture-recapture analysis using hair samples collected in the reservoir inundation zone using hair-snag tubes.

3) Develop a population estimate of lynx through DNA-based capture-recapture analysis using hair samples collected throughout the study area using hair-snag plates.

4) Assess prey abundance in the study area by conducting snowshoe hare pellet counts and estimating vole density using mark-recapture estimates from live trapping.

5) Compile habitat-use data for the furbearer species being studied, using aerial track surveys.

The habitat-use data and species population estimates will be used to assess the potential impacts of the Project on these populations, and to develop any necessary potential protection, mitigation, and enhancement (PM&E) measures.

10.10.2. Existing Information and Need for Additional Information

The original Alaska Power Authority (APA) Susitna Hydroelectric Project study program collected data on use of the Project area by marten (Gipson et al. 1982, 1984; Buskirk 1983, 1984; Buskirk and MacDonald 1984; Buskirk and McDonald 1989) and red fox (Hobgood 1984), but no information was collected on coyotes or lynx, aside from incidental sightings. The APA Susitna Hydroelectric Project studies indicated that marten may be impacted by the reservoir, because a substantial amount of their preferred habitat (mature spruce forest) occurs within the inundation zone. The Alaska Department of Fish and Game (ADF&G) has not conducted population estimates of small furbearers in GMU 13. Trapping reports indicate that populations have experienced normal annual and cyclic fluctuations, but no indications of long-term increases or decreases have been apparent (Schwanke 2010).

Major advances in the estimation of predator population sizes have occurred since the original APA Susitna Hydroelectric Project studies were conducted in the 1980s. A large body of literature has accumulated on the use of noninvasive genetic techniques to obtain population estimates for numerous species around the world. Many studies of wolves, bears, wolverines, coyotes, foxes, lynx, marten, river otters, and other species have successfully used noninvasive techniques to estimate population sizes (Mowat and Paetkau 2002; Waits and Paetkau 2005; Petit and Valiere 2006; Long et al. 2008).

Marten is the most economically valuable furbearer in GMU 13 (Schwanke 2010). Loss of habitat combined with increased access could lead to unsustainable levels of harvest and population declines in marten and other furbearers. Thus, current population estimates are needed to serve as a baseline for assessing the impact of the Project and for developing any necessary PM&E measures.

The wildlife data gap analysis completed for the Project (ABR 2011) recommended using a combination of aerial track surveys and noninvasive capture–recapture techniques to determine current habitat use, movement patterns, and population sizes of furbearer species. In general, aerial track survey techniques are appropriate and will be adopted, in particular for assessing habitat use. However, aerial tracking methods may be inappropriate for estimating population sizes of small terrestrial furbearers and mark-recapture studies are preferred. The aerial snow-track survey method that provides estimates of population size is known as the survey-unit probability estimator (SUPE; Becker et al. 1998, 2004) and the SUPE model was recommended by ADF&G for the Project to obtain population information on wolverines. The method is appropriate and has been well-tested for large furbearers such as wolves and wolverines, which

often travel over long distances in open habitats where tracks are possible to follow from the air. Similarly, beaver and muskrat sign are also easy to see from the air.

However, the SUPE method has several assumptions and requirements that make it impractical for population surveys of smaller terrestrial furbearers and ADF&G, in comments on the gap analysis and preliminary study plans, recommended against its use for species other than wolverine for the following reasons. First, the method requires following the full length of a track from its end, where the animal is seen, back to its start, when the last snowfall ended. Small furbearers often travel in tightly meandering routes within dense brush or forests and their tracks can be obscured by snowshoe hare tracks. Coyotes prefer to travel on trails broken by other species (e.g., wolf and moose trails) because they have high foot loading and avoid traveling in deep snow (Murray and Boutin 1991), making their tracks easy to lose. Second, aerial tracking relies on weather conditions that are uncommon (a fresh snowfall followed by several days of calm weather) and a SUPE survey can take several days per species to conduct (Becker et al. 1998). Therefore, it is unlikely that weather conditions and availability of experienced personnel would allow sufficient time to complete SUPE estimates for other furbearers in the study area in addition to the planned SUPE estimates for wolves and wolverines. In addition, the SUPE has not been tested on smaller furbearers. Validations of SUPE population estimates in areas with known population sizes have occurred for wolves and cougars only, with mixed results (Vansickle and Lindzey 1991; Patterson et al. 2004; Choate et al. 2006). Thus, although aerial track transects may be useful for obtaining information on habitat use and movement patterns of smaller furbearer species, accurate estimation of population sizes requires different methods. As outlined below, mark-recapture methods are preferred for estimating population size of terrestrial furbearers smaller than wolves or wolverine.

10.10.3. Study Area

The terrestrial furbearer study area (Figure 10.10-1) will include all terrestrial areas that are safely accessible by snow machine within a 10-kilometer (6.2-mile) buffer zone surrounding the areas that will be directly altered or disturbed by Project construction and operations, including facility sites, laydown/storage areas, the reservoir inundation zone, and access road and transmission line corridors. Carnivores are wide-ranging animals that occur in low densities, so sampling will need to extend upstream on the Susitna River above the inundation zone and as far as 10 kilometers on either side of the inundation zone and access/transmission corridors. This wider sampling is needed to obtain adequate sample sizes to calculate population density estimates of furbearers, especially because this study will occur during the low phase of the hare cycle when coyote and lynx numbers will be at cyclic lows. Although density estimation of furbearers will require sampling over a larger study area, all samples will be geo-referenced so that a total count of furbearers occupying the Project-affected area can be determined.

10.10.4. Study Methods

10.10.4.1. Sample Collection

Snow machine transects will be established along creeks and rivers throughout the study area (i.e., along road and transmission corridors and the inundation zone). Transect placement and length will depend on the terrain. Ideally, 4–5 transects, each approximately 30 km long, will be established along natural animal movement corridors in the study area, such as creeks and rivers.

Transects along the Susitna River and Denali access corridor may be relatively long (40–50 km), with shorter transects extending up side drainages (e.g., Watana and Tsusena creeks). Transects will be placed to ensure roughly equal coverage of the study area and to avoid gaps where furbearers would not be encountered. Transects will be traveled daily on a rotating basis, so that each transect will be traveled every week, from late January to early April in 2013 and 2014, and all canid and felid scats will be collected. Scats will be collected with ziplock bags and then placed within autoclave bags to prevent cross-contamination. Scats will be stored frozen, which preserves DNA for analysis.

Unlike canids, lynx and marten do not preferentially travel on rivers and trails. Therefore, hair snags will be used to obtain genetic material from those species. Lynx habitat within the study area (i.e., areas with tree or shrub cover) will be divided into approximately 50 blocks. Each block will be 25 square kilometers (9.65 square miles) in size, approximately the average size of a lynx home range (Slough and Mowat 1996; Vashon et al. 2008). Two hair-snag plates will be placed in each block, in locations that are accessible and likely to be encountered by lynx in the area. Hair-snag plates will consist of an attractant that will cause lynx to rub and a barb to collect a hair sample (Zielinski et al. 2006). Hair-snag stations will be checked bi-monthly during late January–early April in 2013 and 2014, and all hairs found on barbs will be placed in coin envelopes and stored in a dry location to preserve the DNA. Because marten home ranges are small and a comprehensive survey of the entire study area would be impractical, the marten survey will be restricted to the inundation zone. This zone, which is approximately 125 square kilometers (48.3 square miles) in size, will be divided into 25 5-square-kilometer (1.9-square-mile) blocks, roughly corresponding in size to the home range of female martens reported in this area during the 1980s (3 to 6 square kilometers [1.2 to 2.3 square miles]; Buskirk 1983). Two hair-snag tubes will be placed within each block in locations likely to be used by marten, as described by Williams et al. (2009).

Snowshoe hare abundance will be determined by counting fecal pellets in 8–10 plots within the study area. Pellet counts correspond closely to snowshoe hare density (Krebs et al. 1987). The study area will be divided into 4–5 blocks of equal size, and two pellet-count plots will be randomly placed within each block, one in spruce forest and one in riparian habitat. Fifty circular plots with a radius of 0.5 meter (1.6 feet) will be spaced 15 meters (49.2 feet) apart at each site, and all pellets will be counted and cleared from the plots. In the first year of the study, pellets will be aged, based on appearance, to estimate whether they are more or less than a year old (Prugh and Krebs 2004).

The abundance of voles will be estimated by using live-trapping and mark–recapture methods in 8–10 plots. Two trapping grids will be established in spruce forest and in grassy meadow habitats. Each grid will consist of 50 live-trap sites spaced 10 meters (32.8 feet) apart. The traps will be operated for 1–5 nights. Captured voles will be weighed, ear-tagged, identified to species and sex, and released. The proportion of recaptured tagged individuals to unmarked individuals will be used to calculate an estimate of population abundance.

10.10.4.2. Genetic Analyses

The outer surface of each frozen scat will be scraped with a scalpel, and shavings will be placed in 2-ml vials. DNA from hair samples will be extracted using Qiagen® kits (a commercially available DNA assay). Mitochondrial analyses will be used to determine the species identification and sex of individuals that deposited each hair and scat sample. Genotypes will be

determined by amplifying DNA at six loci. Amplification will be repeated two to three times to verify accuracy because DNA from feces and hairs sometimes is degraded and errors can occur (Miller et al. 2002).

10.10.4.3. Habitat Use

Habitat use will be evaluated by conducting helicopter surveys of tracks in snow. Experienced observers (such as ADF&G biologists or UAF graduate students) will fly predetermined transect lines at slow speed and will use global positioning system (GPS) receivers to record the locations of tracks encountered. These locations will be overlaid on habitat maps using ArcGIS® software (ESRI, Redlands, California) to examine patterns of habitat use in the study area for each furbearer species. This design is based on the helicopter-based track surveys that were conducted in the Project area in the 1980s (Gipson et al. 1984). Surveys using fixed-wing aircraft are not feasible because the aircraft cannot be flown slowly enough to detect and record tracks of small furbearers in forested habitats (S. Buskirk, University of Wyoming, personal communication, September 20, 2012).

10.10.4.4. Statistical Analyses and Data Interpretation

Once reliable genotypes are obtained, each genotyped sample is considered to be a "capture" event. Spatially explicit capture–recapture (SECR) population estimates and confidence intervals will be produced using the SECR package in program *R* (Efford et al. 2009; Efford 2011). By including location data in the density estimation, this recently developed method combines distance sampling and mark–recapture modeling techniques to better account for capture heterogeneity. Survival, recruitment, and population growth rates will be estimated between years using open mark–recapture estimators such as Cormack–Jolly–Seber and Pradel models in the RMark package (Laake and Rexstad 2008).

Nearly all methods to estimate population density assume the population is closed to births, deaths, immigration, and emigration. Violations of this assumption can inflate population estimates. Several measures will be implemented to address this issue. First, temporal subsets of data for which the assumption of population closure may be valid will be analyzed. For example, estimates can be obtained from samples collected during a single month, during which time the per-capita odds of a death, dispersal, or immigration event are relatively low. Traditional mark-recapture methods require several capture "sessions," but accurate and precise estimates can be obtained using spatially explicit methods from a single session (Efford et al. 2009). Although estimates from temporal subsets may be less precise (resulting in wide confidence intervals) than estimates obtained from pooling samples during each winter season, they will allow evaluation of the potential bias in the pooled estimates.

Because lynx and coyote population dynamics are closely tied to the hare cycle, which is currently in the low phase, the number of detected individuals of these species may be low. Based on other studies conducted in Alaska and the Yukon (e.g., Buskirk and McDonald 1989; O'Donoghue et al. 1997; Prugh et al. 2005), it is estimated that samples will be obtained from approximately 10–25 individuals of each of the four furbearer species per year within the study area. However, the precision of mark–recapture estimates is based largely on recapture rates, rather than on the number of individuals captured (Pollock et al. 1990). Because a field crew will be working intensively in the study area and collecting samples continuously throughout the

winter, recapture rates are expected to be quite high (0.7–0.8) and the population estimates fairly precise.

Natural cycling of snowshoe hare numbers and wolf control efforts by ADF&G in the study area may influence lynx and coyote abundance in the study area, making it difficult to isolate the effects of Project activities on these species. To assess these potentially confounding factors, abundance estimates and trends found in this study will be compared with findings from a similar study being conducted in nearby Denali National Park and Preserve (DNPP) and the Stampede corridor. Trends found in the DNPP/Stampede may indicate how furbearer populations are fluctuating in response to the hare cycle in the absence of wolf control and in the absence of Project activities. Hare-pellet counts will be conducted in the DNPP/Stampede area as well as in this study area. Comparing baseline furbearer surveys in the Project area with surveys in the DNPP/Stampede area may indicate how wolf control is affecting furbearers in this study area. Furbearer harvest records may provide information on harvest levels in each area. This comparison may be useful in subsequently determining which changes in furbearer populations may be due to the Project activities and which changes may have occurred due to other factors. Because marten and red foxes rely heavily on microtine rodents and other prey rather than hares (Buskirk and MacDonald 1984; Gipson et al. 1984), the hare cycle is not expected to be a confounding factor in the assessment of Project impacts on their populations.

10.10.4.5. Data Products

This terrestrial furbearer study will provide pre-construction baseline data for the study area, including habitat-use data for use in developing habitat evaluation criteria. The terrestrial furbearer study will provide a basis for impact assessment and for developing appropriate PM&E measures.

The following data will be produced from this study:

1) Population estimates, with confidence intervals, for coyote, red fox, lynx, and marten in 2013 and 2014.
2) Estimates of survival, recruitment, and population growth for coyotes, red foxes, lynx, and marten between 2013 and 2014.
3) Habitat use and selection data based on aerial track surveys.
4) Snowshoe hare abundance estimates from pellet-count data in spruce and willow habitats.
5) Vole density estimates from live-trapping in meadow and forest habitats.
6) Genetic samples from furbearers in the study area, which will be stored for at least five years after the study is completed.

An Initial Study Report will be prepared in 2014 and an Updated Study Report will be prepared in 2015, each summarizing the study results produced to date, including an examination of the population dynamics and habitat use of terrestrial furbearers in the study area. Geographic Information System (GIS) mapping with layers showing the locations of study transects, furbearer snow tracks, and genetic samples collected during the study will also be created. The Updated Study Report will summarize the results for both years of study.

10.10.5. Consistency with Generally Accepted Scientific Practice

Noninvasive genotyping is a well-established technique to obtain reliable population estimates of coyotes, red foxes, lynx, and marten. Fecal genotyping was used successfully to monitor coyote population dynamics from 2000 to 2002 in the central Alaska Range (Prugh and Ritland 2005; Prugh et al. 2005; Prugh et al. 2008).

10.10.6. Schedule

This study includes data collection, analyses, and reporting during both 2013 and 2014 and extending into the first quarter of 2015 (Table 10.10-1). In August 2012, prey abundance data were collected in the study area. Hare-pellet count grids were established and pellet counts were conducted. Live-trapping of voles was also conducted in newly established trapping grids.

Selection of sampling sites and fieldwork will occur during January–March 2013 to collect genetic samples and conduct track surveys. Laboratory analyses of genetic samples will be conducted during April–August 2013 and field surveys for snowshoe hare pellet counts and vole density estimates will occur in August 2013. Data analyses and preparation of the Initial Study Report will occur during September–December 2013, with the Initial Study Report being completed by February 2014. A similar schedule will be followed in 2014, with fieldwork during January–March, genetic analyses during April–October, hare and vole sampling in August, and final data analyses and report preparation during September–December. The Updated Study Report will be completed by February 2015. Updates on the study progress will be provided during Technical Workgroup meetings which will be held quarterly in 2013 and 2014.

10.10.7. Relationship with Other Studies

As depicted in Figure 10.10-2, the terrestrial furbearer study will initially benefit from information from the Vegetation and Wildlife Habitat Mapping Study (Section 11.5), which will provide preliminary habitat mapping data for the allocation of sampling sites for hare and vole population indices. Otherwise, no data from other studies will be required for this study. Ground-based winter surveys for hair and scat samples and aerial surveys of winter tracks will be conducted in 2013 and 2014, providing the basis for DNA-based, spatially explicit capture–recapture analyses to estimate the population sizes of the study species and to derive estimates of recruitment and survival. The winter track surveys will provide information on winter distribution and habitat use of terrestrial furbearers to inform the Evaluation of Wildlife Habitat Use Study (Section 10.19) and are also likely to provide incidental observations of aquatic furbearers for that study (Section 10.11). The population data from this study will be used in combination with the Wildlife Habitat Evaluation Study to assess potential impacts and to develop appropriate PM&E measures for terrestrial furbearers, as appropriate.

All four species of terrestrial furbearers are predators and could be affected both directly by Project activities and features and indirectly by effects on prey species. The primary impacts of the Project on terrestrial furbearers could include the following:

- Direct and indirect habitat loss and alteration, including potential effects on prey species.
- Potential direct behavioral impacts to wildlife, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation.

- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in hunting, vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development.
- Potential direct mortality due to vehicle strikes, exposure to contaminants, and attraction to garbage and human activity.
- Potential changes in wildlife mortality rates due to increased subsistence and sport harvest facilitated by Project development.
- Potential physical and/or behavioral blockage and alteration of movements due to reservoir water and ice conditions.

Data on the distribution, abundance, and habitat use of terrestrial furbearers in the study area will contribute to the assessment of Project impacts that will be conducted in 2015 for the FERC License Application. Using GIS software, species abundance data recorded among different habitat types can be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans. Direct effects of habitat loss and alteration by the Project can be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map and then quantifying the acreage of habitats affected. Indirect effects can also be assessed by applying various buffer distances, estimated from the available information on the anticipated effects. Data collected in this study of terrestrial furbearers can be used in combination with information from the literature to conduct a GIS analysis of the geographic extent, frequency, duration, and magnitude of Project effects on terrestrial furbearer populations. For coyotes, foxes, lynx, and marten, population data from the terrestrial furbearer study will provide context for assessing the magnitude of potential population-level impacts of direct and indirect habitat loss. For snowshoe hares, pellet counts conducted by the Terrestrial Furbearer Study will provide semi-quantitative assessment of population effects. Any necessary PM&E measures will be developed, as appropriate, by examining the distribution and abundance of species among habitats in relation to the geographic extent and seasonal timing of various Project activities.

Separate studies of prey species in the Project area, including the Dall's Sheep Study (Section 10.7), the Willow Ptarmigan Study (Section 10.17), and the Small Mammal Study (Section 10.12), will provide additional information on the impact of predatory terrestrial furbearers on prey species and will improve the assessment of potential Project-related impacts for all species. Existing data analyzed for the Large Carnivores Study (Section 10.8) and any additional surveys by ADF&G to estimate wolf numbers in the region for ongoing state management programs will contribute to an understanding of the relationship between large and small furbearer populations and may help to assess whether future changes in furbearer abundance may be related to changes in wolf density, prey availability, or Project-related impacts. The Wildlife Harvest Analysis (Section 10.20) will help to predict the potential Project-related changes in harvest of terrestrial furbearers and other predators in the study area.

10.10.8. Level of Effort and Cost

This study will require two field seasons to assess furbearer abundance prior to Project construction. The first field season will involve substantial time spent scouting safe travel routes

and establishing protocols. Fieldwork will be conducted by a crew of two persons. Supervision, data analysis, writing reports, and attending meetings are expected to require one month of the study lead's time per year. Genetic analyses will be conducted by an experienced technician. Several fixed-wing airplane trips will be needed during each winter field season for access to field sites and to haul snow machine fuel and miscellaneous field supplies. Approximately 18 hours of helicopter time will be required to conduct aerial track surveys each year. Materials to make hair-snag stations and other consumables for genetic analyses will be required. Genetic analyses for fecal and hair samples cost more than traditional genetic analyses (~$50/sample instead of ~$30) because samples need to be analyzed 2–3 times to check for errors due to low DNA quality or quantity. The total cost of the study is estimated to be $410,000 for both years, including aircraft support.

10.10.9. Literature Cited

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10.10.10. Tables

Table 10.10-1. Schedule for implementation of the Terrestrial Furbearer Study.

Activity	2012		2013				2014				2015
	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Final selection of sampling sites; field surveys to collect genetic samples; aerial surveys of tracks			—				—				
Genetic analyses				—	—			—	—	—	
Snowshoe hare pellet counts and vole density estimates	—				—				—		
Data analyses						—	—			—	
Initial Study Report							—	Δ			
Updated Study Report										—	▲

Legend:

— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.10.11. Figures

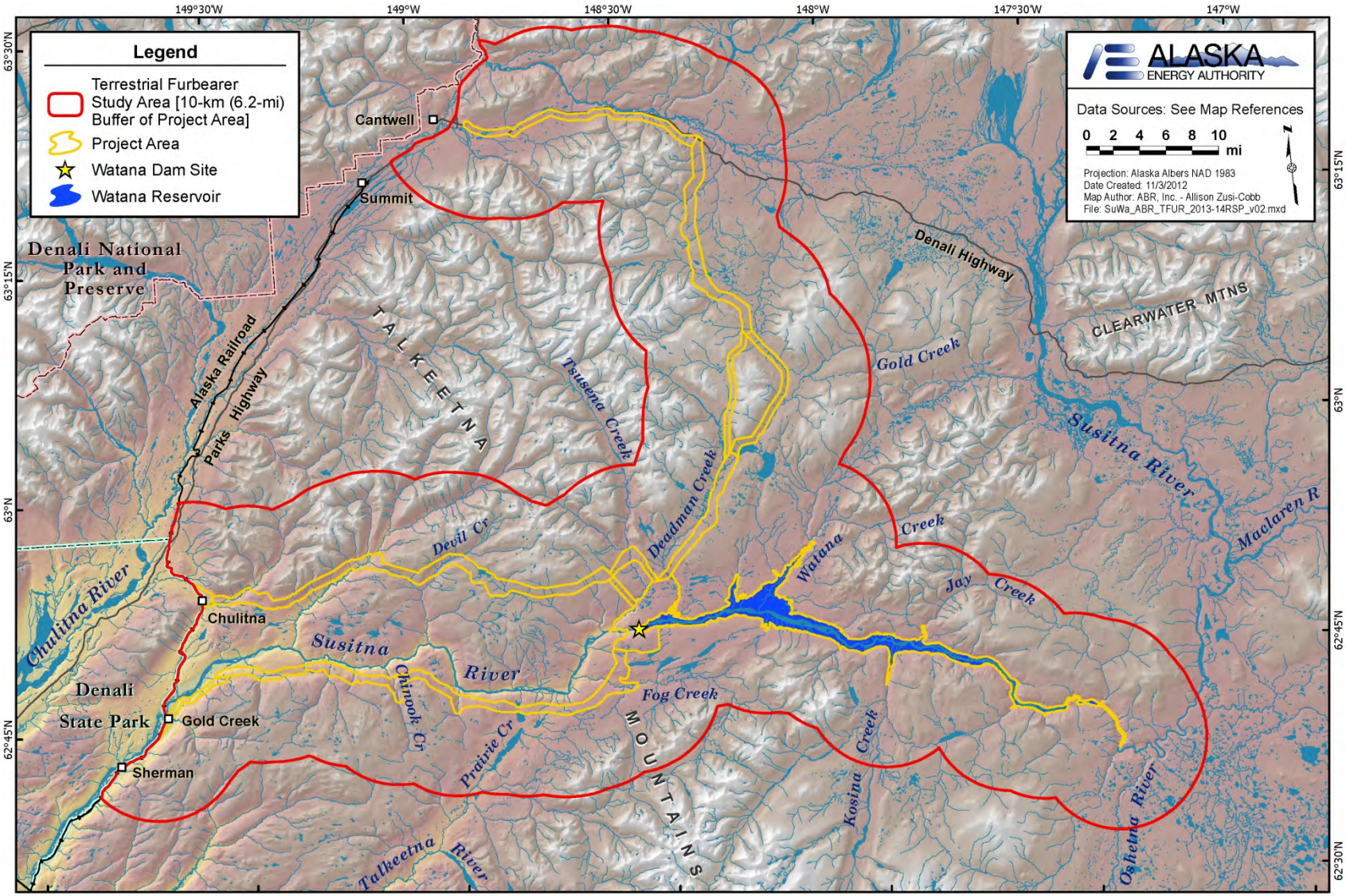

Figure 10.10-1. Terrestrial furbearer study area.

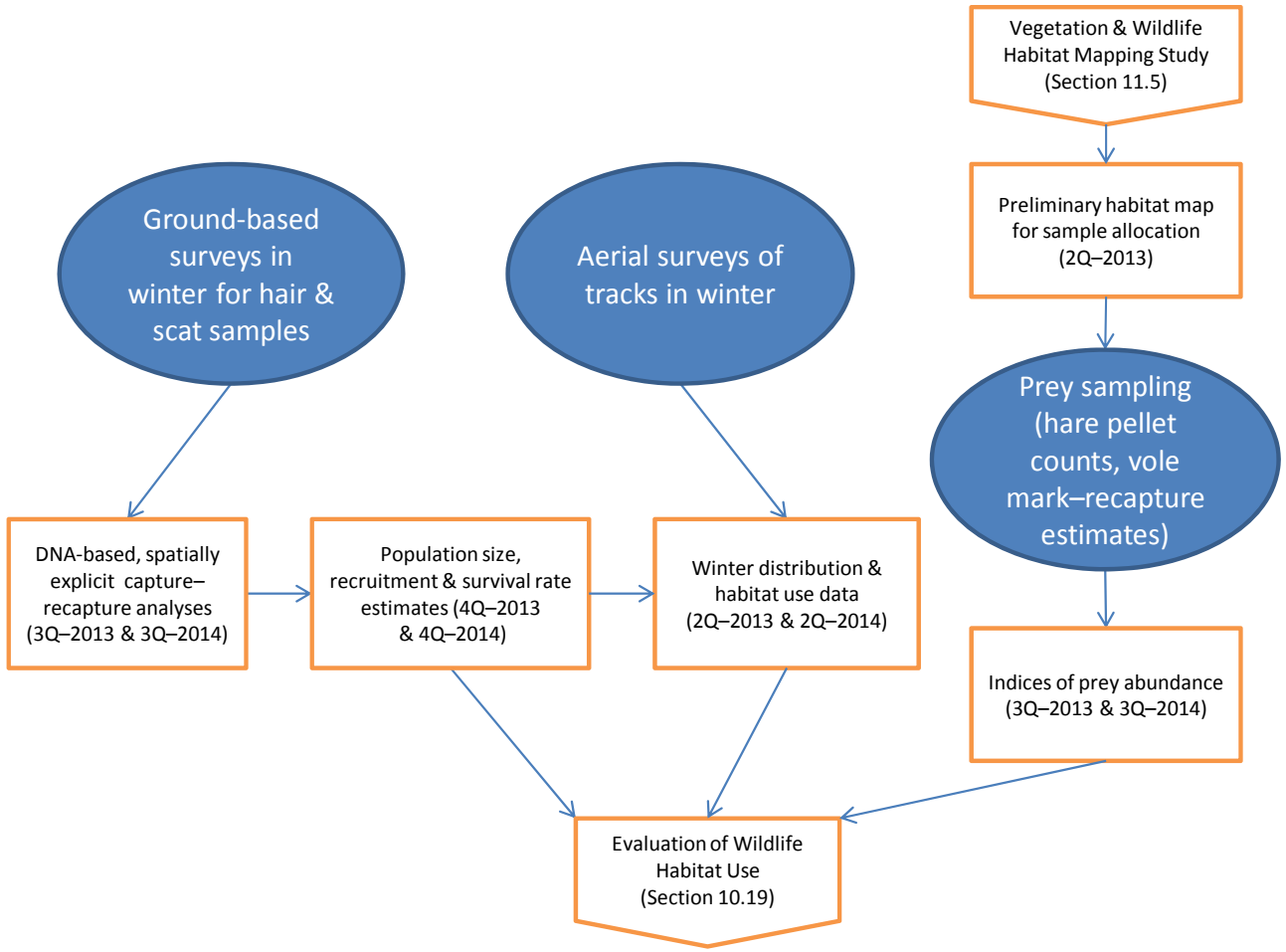

Figure 10.10-2. Study interdependencies for Terrestrial Furbearer Study.

10.11. Aquatic Furbearer Abundance and Habitat Use

10.11.1. General Description of the Proposed Study

The Aquatic Furbearer Study will be conducted in 2013 and 2014. The study has been designed to assess the distribution of aquatic furbearers among habitats, to estimate population size for beavers, and to assess the relative abundance of other aquatic furbearers. Additional work will be done to provide information on the food habits and diets of piscivorous furbearers (river otter and mink) to inform the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7).

Study Goal and Objectives

The goal of the Aquatic Furbearer Study is to collect baseline data on aquatic furbearers in the study area to enable assessment of potential Project-related impacts. This information will be used to develop appropriate mitigation measures. Four species of aquatic furbearers occur in the Project area. The beaver is the most prominent aquatic furbearer statewide in terms of ecological and economic importance. Other aquatic furbearers in the Project area include river otter, mink, and muskrat (AEA 2011).

Five specific objectives have been identified for this study:

1) Delineate the distribution and estimate the current population size of beavers.
2) Describe the distribution and relative abundance of river otter, mink, and muskrat.
3) Describe habitat associations of aquatic furbearers.
4) Review available information on food habits and diets of piscivorous furbearers (river otter and mink) as background for the Mercury Assessment and Potential for Bioaccumulation study (Section 5.7).
5) Collect hair samples from river otters and mink to characterize baseline tissue levels of mercury for the Mercury Assessment and Potential for Bioaccumulation Study.

10.11.2. Existing Information and Need for Additional Information

Studies of aquatic furbearers for the original Alaska Power Authority (APA) Susitna Hydroelectric Project proposed in the 1980s focused primarily on beavers and secondarily on muskrats; limited track surveys were conducted for river otters and mink. Beavers, which were selected to predict downstream impacts of the APA Susitna Hydroelectric Project on furbearers, were studied mainly downstream of the proposed dam site (Gipson et al 1982, 1984; Woolington et al. 1984, 1985; Woolington 1986). Aerial surveys were used to locate lodges and caches and to estimate population levels and overwinter survival. Boat surveys in summer were used to detect beaver sign. Surveys were conducted using boats and airplanes between Devils Canyon and Cook Inlet during summer 1980 and 1982; in general, beaver sign increased substantially with distance downriver from Devils Canyon (Gipson et al. 1982, 1984). Side channels and sloughs were the habitat types used most often. Caches, lodges, and dens were found most often in habitats that had silty banks, willows, and poplars nearby. Little or no sign of beaver activity was found in the mainstem Susitna River during summer surveys (Gipson et al. 1984). Away from the Susitna River, beaver sign was found along slow-flowing sections of most tributaries,

including Portage Creek, Indian River (especially along a tributary flowing out of Chulitna Pass), streams along the access alternative between Gold Creek and Devils Canyon, and Prairie Creek (Gipson et al. 1984).

Fall and spring counts of beaver lodges and food caches were conducted between Devils Canyon and Talkeetna (Gipson et al. 1984; Woolington et al. 1984, 1985; Woolington 1986). Fall counts were conducted annually during 1982–1985 and spring counts were conducted in 1984 and 1985. Between 1982 and 1985, the population in that area was estimated at 70–220 beavers. Aerial surveys for beavers (and muskrats) were conducted in the upstream study area during spring and summer 1980 (Gipson et al. 1982). Beaver colonies in the vicinity of the original APA Susitna Hydroelectric Project impoundment zones occurred mostly in lakes between 610 and 730 meters (2,000 and 2,400 feet) elevation. Colonies also were present in slow-moving sections of most of the larger tributaries, particularly in Deadman Creek. No active beaver lodges or bank dens were found on the Susitna River upstream of Devils Canyon (Gipson et al. 1982), however.

Aerial surveys for muskrat pushups were flown upstream from Gold Creek during spring 1980 (Gipson et al. 1982). Muskrat sign was observed most often in lakes on plateaus above the river valley, at 610–730 meters (2,001–2,395 feet) elevation. Muskrats in the upstream area appeared to depend on fairly small, isolated areas of wetland habitats. Muskrats were also seen along slow-moving sections of creeks and at locations where creeks drained into larger streams, particularly near the Stephan Lake/Prairie Creek and Deadman Lake/Deadman Creek drainages.

Tracks of river otters and mink were recorded in the upper Susitna basin during the APA Susitna Hydroelectric Project studies in the 1980s, but the number of animals present was not estimated. Tracks were widespread but not abundant, although several unusually heavy concentrations of tracks (presumably representing a small number of animals spending an extended period in one area) were noted near river ice in early winter, the time of year when track surveys were conducted.

Data on the distribution, relative abundance, and movements of aquatic furbearers in Game Management Unit (GMU) 13 is limited to that collected for the APA Susitna Hydroelectric Project, and that information is now 25–30 years old. Annual furbearer reports produced by the Alaska Department of Fish and Game (ADF&G) contain general abundance information obtained from trapper questionnaires (Schumacher 2010), but reports do not include drainage-specific population data. Current data on the abundance and distribution of aquatic furbearers is unavailable for GMU 13.

Current data on the abundance, distribution, and habitat use of aquatic furbearers is needed to enable analysis of Project impacts. A large body of research demonstrates that the beaver is a keystone species that exerts profound ecological effects on hydrology, geomorphology, vegetation, nutrient cycling, the productivity of aquatic and riparian habitats, and the distribution and abundance of fishes and other aquatic organisms (Butler 1995; Collen and Gibson 2001; Müller–Schwarze and Sun 2003; Rosell et al. 2005). As was the case for the APA Susitna Hydroelectric Project, current information on the abundance and distribution of beavers will be required. Additional data will also be needed to assess the current abundance and distribution of river otter and mink, particularly along the mainstem Susitna River and its clearwater tributaries in the reservoir inundation zone. These baseline data will be collected as input for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7), which was recommended by the U.S. Fish and Wildlife Service (USFWS) in response to the request for comments and study

requests on the Pre-Application Document/FERC Scoping Document 1 for the Project (letter from USFWS to AEA dated May 31, 2012).

10.11.3. Study Area

The study area for aquatic furbearers will vary according to the species being surveyed (Figure 10.11-1). Because of their ecological importance in riparian habitats, beavers will be surveyed in the riparian study area from the reservoir inundation zone downstream to the confluence of the Susitna and Chulitna rivers, as well as in other portions of the Project area. Aerial surveys of muskrats will be restricted to water bodies and wetland areas in the Project area, including the reservoir inundation zone. In addition to covering all portions of the Project area, winter track and transect surveys for river otters and mink will focus on the stream survey area, consisting of the mainstem Susitna River above the dam site and on tributary streams draining into the reservoir inundation zone, as well as on similar river and tributary stretches immediately downstream from the dam site. Surveys will extend upstream along tributaries at least 3 miles (Figure 10.11-1) to provide comparative data on the extent of use of those drainages in comparison with the Susitna mainstem.

10.11.4. Study Methods

10.11.4.1. Beaver and Muskrat Surveys

Aerial surveys of beaver lodges and food caches will be conducted in a small helicopter to assess the distribution and abundance of beavers in the Middle Segment of the Susitna River below the proposed dam site, the reservoir inundation zone in the upper basin, the dam and camp facilities area, and access road and transmission line corridors. A survey will be flown each year in fall, after deciduous trees have shed their leaves but before water bodies freeze, to document the distribution and abundance of active colonies, as indicated by lodges and fresh food caches (Hay 1958; Payne 1981). Aerial surveys of active colonies located on the fall 2013 survey will be flown again in spring 2014 to estimate the overwinter survival of those colonies.

An aerial survey of ponds and lakes will be conducted once each year in a small helicopter in late winter to enumerate muskrat structures ("pushups") in water bodies and wetlands throughout the Project area that could be affected directly by Project infrastructure and activities.

10.11.4.2. River Otter and Mink Surveys

Because of the low density of these species expected in the Project area based on past field surveys (Gipson et al. 1982, 1984; S. Buskirk, pers. comm.), the use of intensive ground-based fieldwork to obtain hair samples for DNA genotyping and mark–recapture population estimation over the full extent of the Project area is not considered cost-effective for the results that are likely to be produced. Instead, aerial surveys will be flown in a small helicopter at least once each year in early winter (November/December) and two to three times later each winter (February–early April) for snow-tracking of river otters and mink soon (within three days) after fresh snowfalls. The surveys generally will follow the approach described by Reid et al. (1987) and Sulkava and Liukko (2007), albeit using a helicopter rather than ground-based surveys. In portions of the Project area away from the stream survey area depicted in Figure 10.11-1, the

helicopter flight lines will parallel each side of the road and transmission alignments to locate tracks that intercept the flight lines.

In the stream survey area (reservoir inundation zone and tributaries), the helicopter will follow the courses of the Susitna River and its tributary streams extending upstream 3 miles (5 kilometers) from the Susitna River (Figure 10.11-1). Streams will be subdivided into sampling segments before the survey. It is expected that trails and tracks of river otters will be detected much more readily during these aerial surveys than will the tracks of mink, but data on both species will be recorded. Wherever encountered, river otter trails will be followed to delineate the length of river and streams traversed by the animals and to evaluate the extent of use of the mainstem river and tributaries. If it is possible to distinguish individual sets of tracks, the trails in each segment will be recorded as belonging to single or multiple animals and the minimum number of animals will be counted or estimated. Flight lines will be recorded using a Global Positioning System (GPS) receiver, as will all sightings of aquatic furbearers for entry into a geospatial database.

The results obtained using this method on the surveys to be conducted in early 2013 will be compared with the results of transect surveys flown in the same helicopter but oriented perpendicularly to the mainstem Susitna River in the stream survey area, rather than lengthwise along the watercourses. These transects will extend up to 3 miles away from the river on each side (excluding high-elevation terrain where river otters and mink are unlikely to occur) and will be spaced at intervals of approximately 3 miles along the length of the stream survey area. The transect surveys will sample terrain away from streams in an attempt to detect animals using lakes or moving between adjacent drainages.

The transect survey and the stream-course survey will be conducted sequentially on the same survey flights. The results from this dual-survey approach in early 2013 will be compared and the survey plan will be revised for the remainder of the study in late 2013 and in 2014, if warranted. Both of these survey methods will provide assessments of the distribution of river otters (and possibly mink) in the stream survey area, as well as an index of their relative abundance and habitat use.

Additional data on river otters and mink may be collected incidentally during the aerial transect surveys and ground-based sampling work conducted for the study of Terrestrial Furbearer Abundance and Habitat Use (Section 10.10). GPS coordinates of sightings and tracks will be requested from the personnel conducting those helicopter surveys, as will information on incidental captures of mink in hair-snag sampling tubes placed to collect marten hair for genotyping. Details of incidental sightings of aquatic furbearers will be requested from other researchers working on other wildlife surveys for the Project, as well as on fish and water resource studies.

10.11.4.3. Information for Mercury Assessment

Hair samples from river otters and mink will be sought for laboratory analysis to characterize preconstruction levels of mercury for the study of Mercury Assessment and Potential for Bioaccumulation (Section 5.7). ADF&G requires that the pelts of river otters be sealed by an authorized ADF&G representative, which will provide an opportunity to obtain hair samples from river otters harvested in the study area. Small amounts of hair will be taken from river otter pelts for which reliable location information is available and will be provided to the mercury

study team for mercury analysis. Because mink pelts do not need to be sealed by ADF&G, hair samples from that species are expected to be more difficult to obtain, but carcasses will be sought from any local trappers who are working in the Project area. Another potential source of mink hair samples will be from incidental captures in hair traps set for marten as part of the study of Terrestrial Furbearer Abundance and Habitat Use (Section 10.10). If sufficient samples of river otter and mink hair cannot be obtained using these methods, then hair-snag traps (DePue and Ben-David 2007; Pauli et al. 2008) will be deployed during the helicopter surveys at locations in the stream survey area where river otter and mink sign is recorded. Special attention will be paid to fish-bearing streams having areas of open water.

In addition to hair sampling, the scientific literature will be reviewed to locate and synthesize information on the food habits and diets of river otters and mink in freshwater aquatic systems, to support the pathways analysis being conducted for the Mercury Assessment and Potential for Bioaccumulation study (Section 5.7).

10.11.5. Consistency with Generally Accepted Scientific Practice

Survey methods for beaver colonies, muskrat structures, and winter track surveys follow standard practices for recording aquatic furbearers and their sign (Dozier 1948; Hay 1958; Payne 1981; Proulx and Gilbert 1984; Reid et al. 1987; Sulkava and Liukko 2007). The proposed methods for river otter and mink will focus on assessing distribution, relative abundance, and minimum counts of those species, rather than using the more intensive sample-unit probability estimator techniques (Becker 1991; Becker et al. 2004) required to generate population estimates with accompanying variance estimates. The aquatic furbearer surveys generally will be similar to the surveys conducted for the APA Susitna Hydroelectric Project during the 1980s (Gipson et al. 1982, 1984), except that no boat surveys of beaver are proposed because helicopter surveys will be more efficient. The use of snags to obtain hair samples is a well-established method (DePue and Ben-David 2007; Pauli et al. 2008). Habitat availability and habitat-use analyses allow an ecosystem approach to impact assessment and GIS-based analysis has become a standard method of quantifying the spatial impacts of habitat loss and alteration.

10.11.6. Schedule

As depicted in Table 10.11-1, this study will be conducted primarily in 2013 and 2014, extending into the first quarter of 2015. Several activities will be conducted during February–April 2013: (1) two or three aerial surveys, shortly after fresh snowfalls, to record tracks of river otters and mink; (2) literature review on the food habits and diets of river otters and mink in freshwater aquatic systems; and (3) collection of furbearer hair samples from trapper-harvested animals (in conjunction with ADF&G pelt sealing and direct consultation with local trappers) for mercury analysis. An aerial survey of muskrat pushups in Project area water bodies and wetlands will be conducted in April 2013. Analysis of the first winter's survey results and the literature review will continue in May. No summer work is proposed, so the next field survey will occur in October 2013, when an aerial survey of beaver lodges and fresh food caches will be flown to locate active colonies. At least one aerial survey to locate tracks of river otters and mink will be flown in November or December 2013, following fresh snowfall. Data analyses will continue through the early winter and the Initial Study Report will be completed by February 2014. The schedule of activities during the first two quarters of 2014 will match the 2013 schedule, with the addition of an aerial survey of beaver colonies in May to assess the overwinter survival of

colonies located in fall 2013. An aerial survey of beaver lodges and fresh food caches will be conducted in October 2014 to locate active colonies and an aerial survey of river otter and mink tracks will be flown following fresh snowfall in November 2014. Data analyses will conclude in early winter 2014 and the Updated Study Report will be completed by February 2015. Study progress will be presented at Technical Workgroup meetings, which will be held quarterly during 2013 and 2014.

10.11.7. Relationship with Other Studies

As depicted in Figure 10.11-2, the aquatic furbearer study will use information from, or will contribute information to, eight other studies. The Riparian Vegetation Study Downstream of the Proposed Susitna–Watana Dam (Section 11.6) and the Wetland Mapping Study in the Upper and Middle Susitna Basin (Section 11.7) both will contribute useful information for selection of aerial-survey areas, based on the distribution of suitable habitats for beaver and muskrat. The Study of Fish Distribution and Abundance in the Upper Susitna River (Section 9.5) and the Fish and Aquatics Instream Flow Study (Section 8.5) will help identify fish-bearing streams in the reservoir drainage area to be surveyed for river otter and mink tracks in winter. Incidental observations of aquatic furbearers may be provided by the Terrestrial Furbearer Abundance and Habitat Use study (Section 10.10).

Aerial survey data (GPS coordinates) on the locations of beaver and muskrat colonies and on the abundance and distribution of river otter and mink tracks will be used to evaluate the distribution of aquatic furbearers among habitats, which will be used to inform the Evaluation of Wildlife Habitat Use (Section 10.19). Estimates of population size (beavers), minimum numbers (river otter), and relative abundance (muskrat and mink) from this study will contribute information to the Evaluation of Wildlife Habitat Use (Section 10.19). The aquatic furbearer study will contribute information on beaver numbers and distribution to the Floodplain and Riparian Instream Flow Study (Section 8.6). Lastly, the aquatic furbearer study will contribute hair samples obtained from trapped animals or from hair snags for baseline characterization of mercury concentrations for the Mercury Assessment and Potential for Bioaccumulation study. Samples of mink hair also may be provided incidentally by the Terrestrial Furbearer Abundance and Habitat Use study (Section 10.10).

The potential impact mechanisms of the proposed Project on aquatic furbearer populations could involve two broad categories:

- Direct and indirect habitat loss and alteration.
- Changes in mortality rates from increased human harvest as a result of improved access.

For aquatic furbearers, direct and indirect habitat loss and alteration will occur in the impoundment area, access and transmission corridors, and other facility footprints as well as possibly downstream of the dam site, where altered flow regimes could alter riparian habitats. Variable winter flows in the Susitna River may result in direct or indirect mortality of beavers. Other potential impacts, including death or injury due to vehicle strikes or exposure to contaminants, may affect relatively small numbers of aquatic furbearers.

During the impact assessment that will be conducted in 2015 for the FERC License Application, data on the distribution, abundance, and habitat use of aquatic furbearers in the study area can be used to assess Project impacts. Location data collected for all four species of aquatic furbearers will identify important habitats in the Project area for each species. For beavers and muskrats,

additional quantitative data on the abundance of beaver colonies, muskrat pushups, and river otter groups can be used to obtain estimates of the number of animals potentially affected by Project development. For all four species, direct habitat loss and habitat alteration that would result from the Project can be evaluated by overlaying furbearer location data and the Project features (including the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors) onto the habitat map that will be developed by the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5). Additional indirect habitat loss and alteration also can be estimated by applying various buffer distances from proposed Project features, as determined from the available information on the anticipated effects. In this way, the Geographic Information System (GIS) analysis can incorporate information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on aquatic furbearers

Results from the Geomorphology Study (Section 6.5), the Floodplain and Riparian Instream Flow Study (Section 8.6), and the Riparian Vegetation Study Downstream of the Proposed Susitna–Watana Dam (Section 11.6) will provide information needed to evaluate potential effects on aquatic furbearer habitats downstream, such as those resulting from reduced spring flows. Any necessary protection, mitigation, and enhancement (PM&E) measures will be developed, as appropriate, by examining the distribution and abundance of species among habitats in relation to the geographic extent and seasonal timing of various Project activities. In addition, historical and current data on harvest of aquatic furbearers in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A will be synthesized for the separate Wildlife Harvest Analysis (Section 10.20), beginning in 2012 (AEA 2012) and continuing in 2013 and 2014 as additional data become available. Using those harvest data supplied by ADF&G and USFWS can provide preconstruction information with which to assess the potential effects of increased subsistence and recreational harvest of aquatic furbearers. Documentation of the distribution and relative abundance of piscivorous furbearers (river otter and mink) and characterization of their dietary habits will provide information for the pathways analysis being planned for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7).

10.11.8. Level of Effort and Cost

Aerial surveys using a small piston helicopter will be conducted in fall, winter, and spring beginning in 2013 and extending through 2014 to assess the relative abundance of and habitat use by aquatic furbearers in the Project area.

Beaver surveys will require up to a week of survey effort in October each year and 2–3 days in spring. Winter track surveys for river otter and mink, estimated to require approximately 3–5 days each, will be conducted in early winter (November) and two to three times in mid- to late winter (February to April), depending on the occurrence of fresh snowfall suitable for tracking. Surveys of muskrat pushups will be conducted in late winter (April) each year.

Collection of hair samples from river otters will be solicited from trappers working in the Project area and from ADF&G as part of its required pelt-sealing procedure. Collection of hair samples from mink will be more challenging, involving collection of hair samples from marten traps during the terrestrial furbearer survey, or through direct contact with local trappers, or both.

Project costs in 2013 and 2014 are estimated to be approximately $150,000 annually (not including helicopter charter costs).

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10.11.10. Tables

Table 10.11-1. Schedule for implementation of the Aquatic Furbearer Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1Q
Review of food habits and diets of piscivorous furbearers in freshwater aquatic systems, and collection of furbearer hair samples for mercury analysis	—	—		—	—				
Aerial surveys of lodges and fresh food caches to locate active beaver colonies				—				—	
Aerial survey of active beaver colonies to assess overwinter survival						—			
Aerial surveys of muskrat pushups		—				—			
Aerial surveys of river otter and mink tracks (following fresh snowfall)	—			—	—			—	
Initial Study Report				—	Δ				
Updated Study Report								—	▲

Legend:

—— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.11.11. Figures

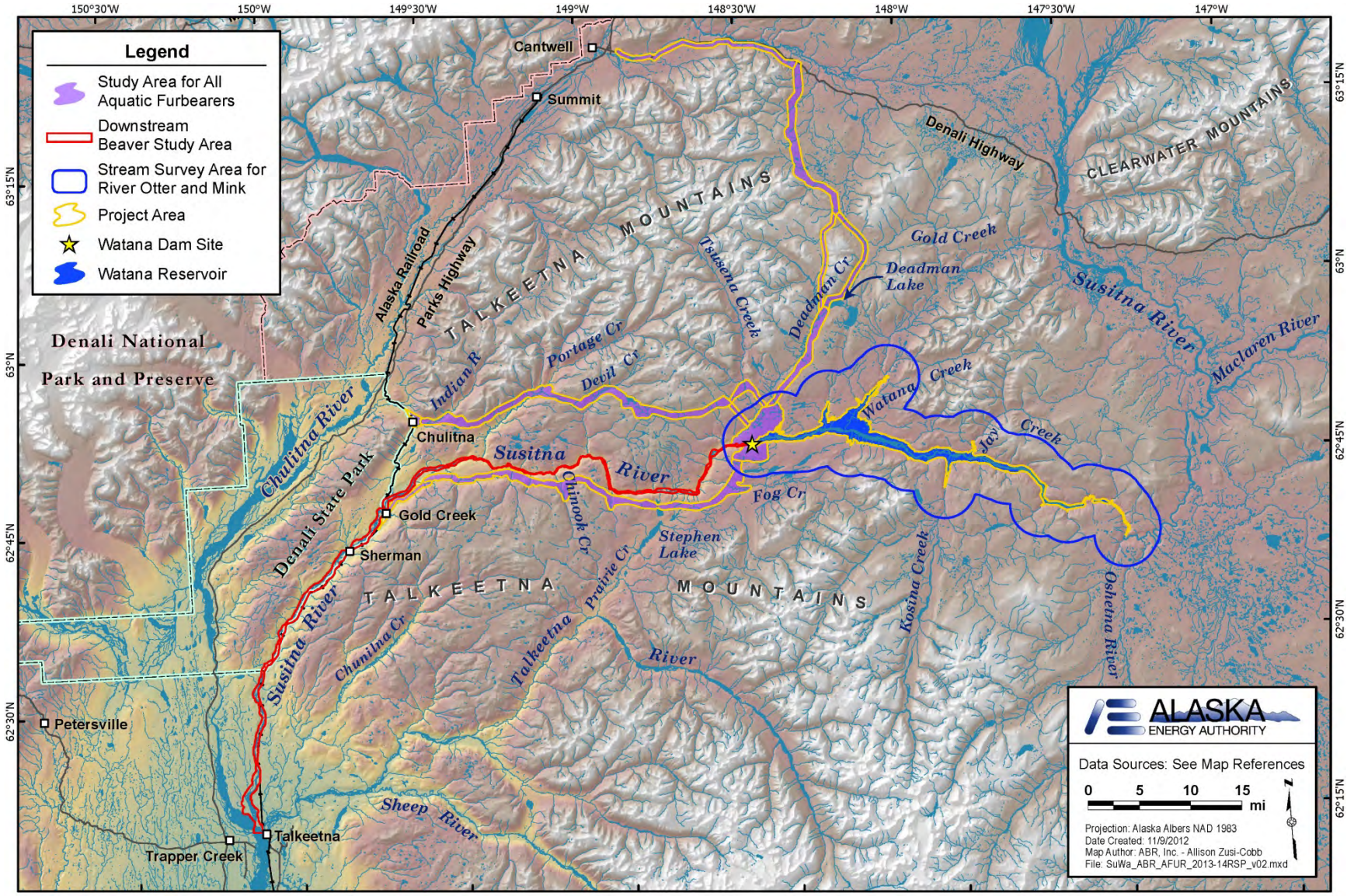

Figure 10.11-1. Aquatic furbearer study areas.

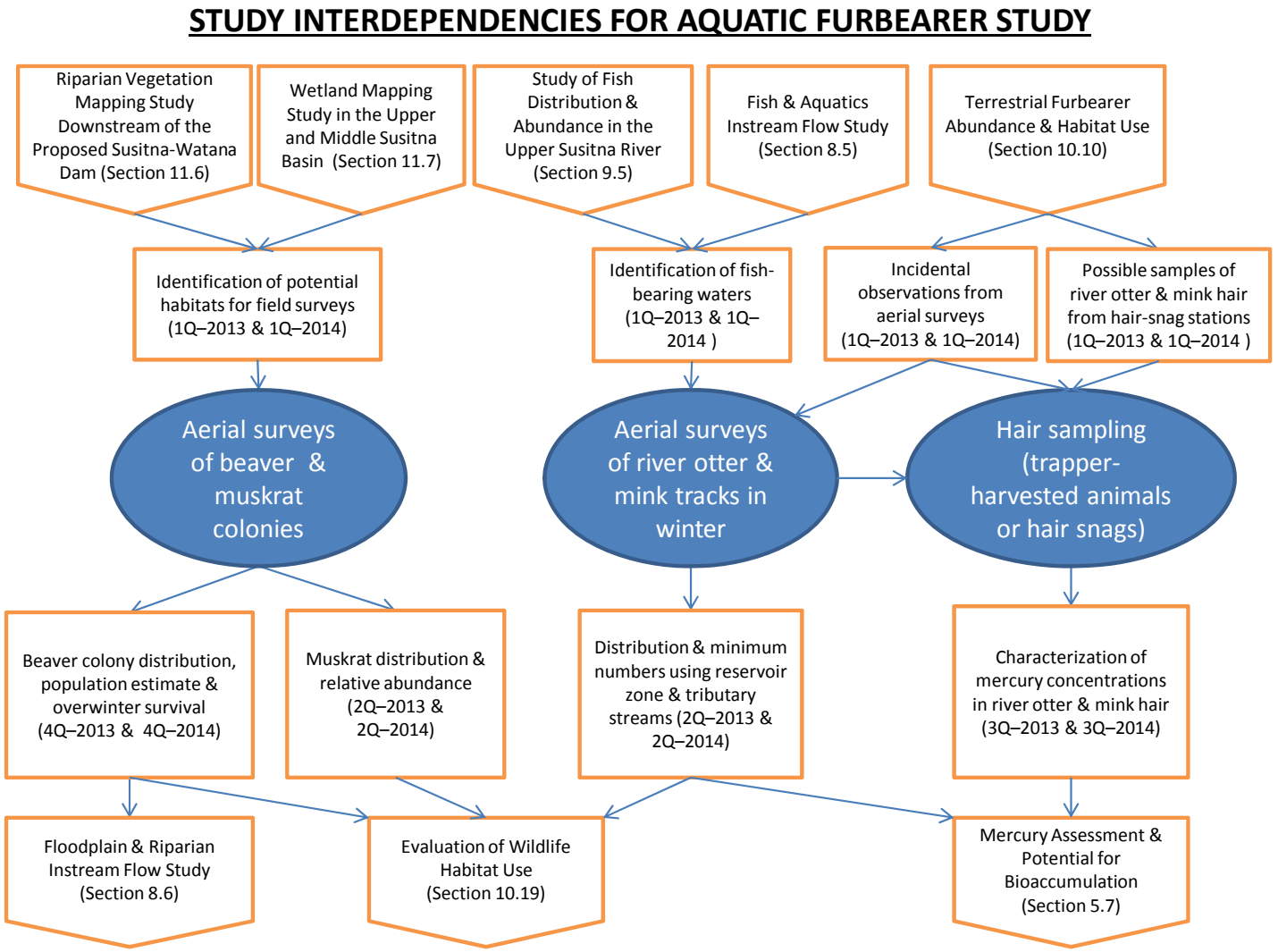

Figure 10.11-2. Study interdependencies for the Aquatic Furbearer Study.

10.12. Small Mammal Species Composition and Habitat Use

10.12.1. General Description of the Proposed Study

The Small Mammal Study will be an office-based analysis to review and synthesize available information on the occurrence and relative abundance of small mammals in the Project area. The study will describe the species of small mammals known to occur in the Project area and their patterns of habitat use. Other small mammals, including snowshoe hares (Section 10.10) and bats (Section 10.13), are addressed in other study plans.

Study Goal and Objectives

The goal of the Small Mammal Study is to synthesize baseline data on small mammals in the Project area to enable habitat-based assessments of the impacts expected to occur from development of the Project.

The Small Mammal Study has two specific objectives:

- Describe the species composition and relative abundance of small mammals in the Project area.
- Describe the habitat associations of small mammals within the Project area.

10.12.2. Existing Information and Need for Additional Information

Small mammal species in the Susitna River basin include porcupine, hoary marmot, arctic ground squirrel, red squirrel, collared pika, and several species each of voles, mice, and shrews (ABR 2011). Species composition, relative abundance, and habitat use by small mammals were studied intensively for the Alaska Power Authority (APA) Susitna Hydroelectric Project in 1980 and 1981 along 49 trapline transects (using both snap-traps and pitfall traps) located in a variety of habitat types in the middle and upper Susitna River basin (Kessel et al. 1982). The APA Susitna Hydroelectric Project study area for small mammals extended from Sherman (near Gold Creek) on the west to the mouth of the Maclaren River on the east and within approximately 16 kilometers (10 miles) on each side of the Susitna River (Kessel et al. 1982).

Since completion of the APA Susitna Hydroelectric Project studies in the 1980s, a new species of small mammal—the Alaska tiny shrew (*Sorex yukonicus*)—was recognized and described by Dokuchaev (1997) on the basis of morphological characteristics. The earliest specimen known was trapped in 1982 near the upper Susitna River during the APA Susitna Hydroelectric Project study. By 2007, the total number collected statewide had increased to 38 specimens from at least 22 widely separated locations (MacDonald and Cook 2009), indicating the species was much more widespread than originally thought, occurring in low densities. Early information indicated that it occurred primarily in riparian habitats, but it was also captured in scrub habitats as trapping efforts expanded. The Alaska Natural Heritage Program classified the Alaska tiny shrew as "unrankable" globally (GU), presumably because little information was available, and as "vulnerable" in the state (S3; AKNHP 2011), presumably due to its restricted range and relatively few populations known in North America. The species was included on the Bureau of Land Management's (BLM's) Alaska list of sensitive species (2010). Based on more recent genetic analyses, however, Hope et al. (2010) concluded that *S. yukonicus* is synonymous with the Eurasian least shrew, *S. minutissimus*, and simply constitutes the eastern population of that

species, which occurs in Siberia and farther west in Eurasia. Hence, the classification and name are likely to be revised in future taxonomic checklists.

No recent reports on small mammal studies in the middle or upper Susitna basin are available, but additional information is available from other studies in surrounding regions, including species inventories in Denali National Park and Preserve (Cook and MacDonald 2003) and on Fort Richardson near Anchorage (Peirce 2003), and long-term population monitoring (1992–2005) of three species of voles conducted in Denali National Park and Preserve by Rexstad and Debevec (2006).

The APA Susitna Hydroelectric Project studies provided a thorough sampling of the small mammal populations in the Project area. Although 30 years have elapsed since those studies, it is unlikely that species distributions or habitat-use patterns have changed significantly in the interim. Because of the often cyclical population fluctuations of small mammals and the lack of effective mitigation to offset population losses in the impoundment zone, the wildlife data gap analysis report (ABR 2011) questioned whether additional studies were warranted for the Project. Hence, after further consideration of the likely results of the field sampling described earlier in the Proposed Study Plan, and further consultation with the Alaska Department of Fish and Game and the federal Bureau of Land Management, AEA has revised this study to focus on reviewing and synthesizing all available information rather than conducting more field sampling in 2013. In view of the intensive field sampling in the 1980s by the University of Alaska Museum (Kessel et al. 1982) and its suitability for analysis by the Evaluation of Wildlife Habitat Use (Section 10.19), this study will provide useful information for evaluating the direct effects of habitat loss on small mammals as a result of Project development.

10.12.3. Study Area

The area of analysis for this study will consist of the entire Project area (Figure 10.12-1). Existing data on the abundance and habitat associations of small mammals from the original study for the APA Susitna Hydroelectric Project (Kessel et al. 1982) will be supplemented with more recent data from other regional studies and will be applied to the wildlife habitat types mapped throughout the reservoir inundation zone, associated facilities areas, and the access road and power transmission corridors.

10.12.4. Study Methods

This study will review, compile, and synthesize data on the occurrence and relative abundance of the small mammal species captured and analyzed by Kessel et al. (1982). That information will be supplemented with data from other small mammal trapping studies conducted recently in Southcentral and Interior Alaska (including, but not limited to, Cook and MacDonald 2003, Peirce 2003, Rexstad and Debevec 2006, MacDonald and Cook 2009, and specimen records maintained by the University of Alaska Museum of the North in Fairbanks and the Alaska Natural Heritage Program in Anchorage).

This information synthesis will then be applied to the wildlife habitat types mapped by the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) and will be included in the ranking of habitat values that will be the principal analytical product of the Evaluation of Wildlife Habitat Use (Section 10.19). Kessel et al. (1982) quantified habitat components and conducted detailed analyses of the abundance of small mammals in

relation to those habitat components. Standard trapping and survey methods for small mammals (e.g., Jones et al. 1996) were used in that study, providing effective sampling of voles, lemmings, and shrews by using both pitfall traps and snap-traps. Trapping data included the abundance of species captured among different habitats types, which will be incorporated into the Evaluation of Wildlife Habitat Use (Section 10.19) using a Geographical information System (GIS).

Additional information on small mammals will be collected as part of the study of Terrestrial Furbearer Abundance and Habitat Use (described in detail in Section 10.10), which began in August 2012 and will continue in August 2013 and 2014. In that study, the abundance of voles will be estimated by using live-trapping and mark–recapture methods in study plots located in spruce forest and grassy meadow habitats. Captured voles will be weighed, ear-tagged, identified to species and sex, and released. The proportion of tagged individuals to unmarked individuals will be used to calculate an estimate of population abundance. In addition, a population index for snowshoe hares will be estimated using counts of fecal pellets along transects located in selected forest and shrub habitats.

10.12.5. Consistency with Generally Accepted Scientific Practice

The Small Mammal Study will rely on data that were collected using standard trapping techniques (Jones et al. 1996). Analysis of habitat availability and use allows an ecosystem approach to impact assessment, and GIS-based analysis has become a standard, straightforward method of evaluating the impacts of habitat loss and alteration.

10.12.6. Schedule

As is depicted in Table 10.12-1, the review and synthesis of small mammal trapping data will be conducted primarily in 2013, with analytical updates occurring in 2014 after further collection of field data on vole and hare abundance and further refinement of the wildlife habitat map for the Project. Initial and Updated Study Reports will be issued in February 2014 and 2015, respectively. Study progress will be presented at Technical Workgroup meetings, which will be held quarterly during 2013 and 2014.

10.12.7. Relationship with Other Studies

As depicted in Figure 10.12-2, the Small Mammal Study will use information from the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) and the study of Terrestrial Furbearer Abundance and Habitat Use (Section 10.10). The habitat types delineated for the wildlife habitat map will be used in the review and synthesis of small mammal data. The terrestrial furbearer study will contribute estimates of vole density and snowshoe hare abundance in selected habitat types. Data on species distribution, habitat associations, and the number of captures will be used to assess the relative abundance of small mammal species among the habitat types mapped in the study area, which will be used in the habitat rankings prepared by the Evaluation of Wildlife Habitat Use (Section 10.19).

Construction and operation of the proposed Project has the potential to result in direct and indirect effects on small mammals, including the following:

- Direct and indirect habitat loss and alteration.

- Potential direct mortality due to vehicle strikes, exposure to contaminants, and attraction to garbage and human activity.
- Potential changes in mortality due to changes in the abundance or distribution of predators.
- Potential physical and/or behavioral blockage of movements due to reservoir water and ice conditions.
- Potential effects on predator species.

For small mammals, the primary impact of direct and indirect habitat loss and alteration could occur in the reservoir inundation zone, associated facilities footprints, and access and transmission corridors.

During the impact assessment that will be conducted in 2015 for the FERC License Application, data on the distribution and relative abundance of and habitat use by small mammals in the study area can be used to assess Project impacts on these populations through geospatial analysis and evaluation of the responses of the study species to other similar projects, as documented in the scientific literature. Small mammal populations could also be affected over a larger region if regional predator abundance is altered by the Project, as will be analyzed in the impact assessment using data from other Project studies (i.e., Distribution, Abundance, and Habitat Use by Large Carnivores [Section 10.8]; Wolverine Distribution, Abundance, and Habitat Occupancy [Section 10.9]; Terrestrial Furbearer Abundance and Habitat Use [Section 10.10]; Aquatic Furbearer Abundance and Habitat Use [Section 10.11]; and Surveys of Eagles and Other Raptors [Section 10.14]). Using GIS software, species presence/absence data or relative abundance data recorded among different habitat types mapped in the Project area can provide spatially explicit impact predictions. The direct and indirect impacts of the Project can be evaluated by overlaying the reservoir, related infrastructure areas, and access road and power transmission corridors onto the habitat map to evaluate direct impacts and indirect impacts on preferred habitats. The GIS analysis can be combined with information from the literature to estimate the potential geographic extent, frequency, duration, and magnitude of Project effects on small mammal populations. Additional information collected for the various studies of predators can be used to evaluate the potential area over which small mammal populations may be affected by changes in predation rates. The results of these analyses to assess Project impacts can be used to evaluate protection, mitigation, and enhancement (PM&E) measures, as appropriate.

10.12.8. Level of Effort and Cost

Most of the review and synthesis effort will occur in the first year (2013) and will be available for the Initial Study Report, but revisions will be necessary to include additional data collected on vole and hare population indices in 2014 and to incorporate the revisions made for the final wildlife habitat map in 2014 for the Updated Study Report. Total study costs are estimated to be approximately $50,000 over both years.

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10.12.10. Tables

Table 10.12-1. Schedule for implementation of the Small Mammal Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Review & synthesize results of regional studies of small mammals	——	——							
Apply results of review & synthesis to available wildlife habitat mapping		——				——			
Incorporate results from other studies (snowshoe hare & vole density estimates, wildlife habitat mapping updates)			-----	-----			-----	-----	
Initial Study Report				——	Δ				
Updated Study Report								——	▲

Legend:

—— Planned Activity
----- Follow-up activity (as needed)
Δ Initial Study Report
▲ Updated Study Report

10.12.11. Figures

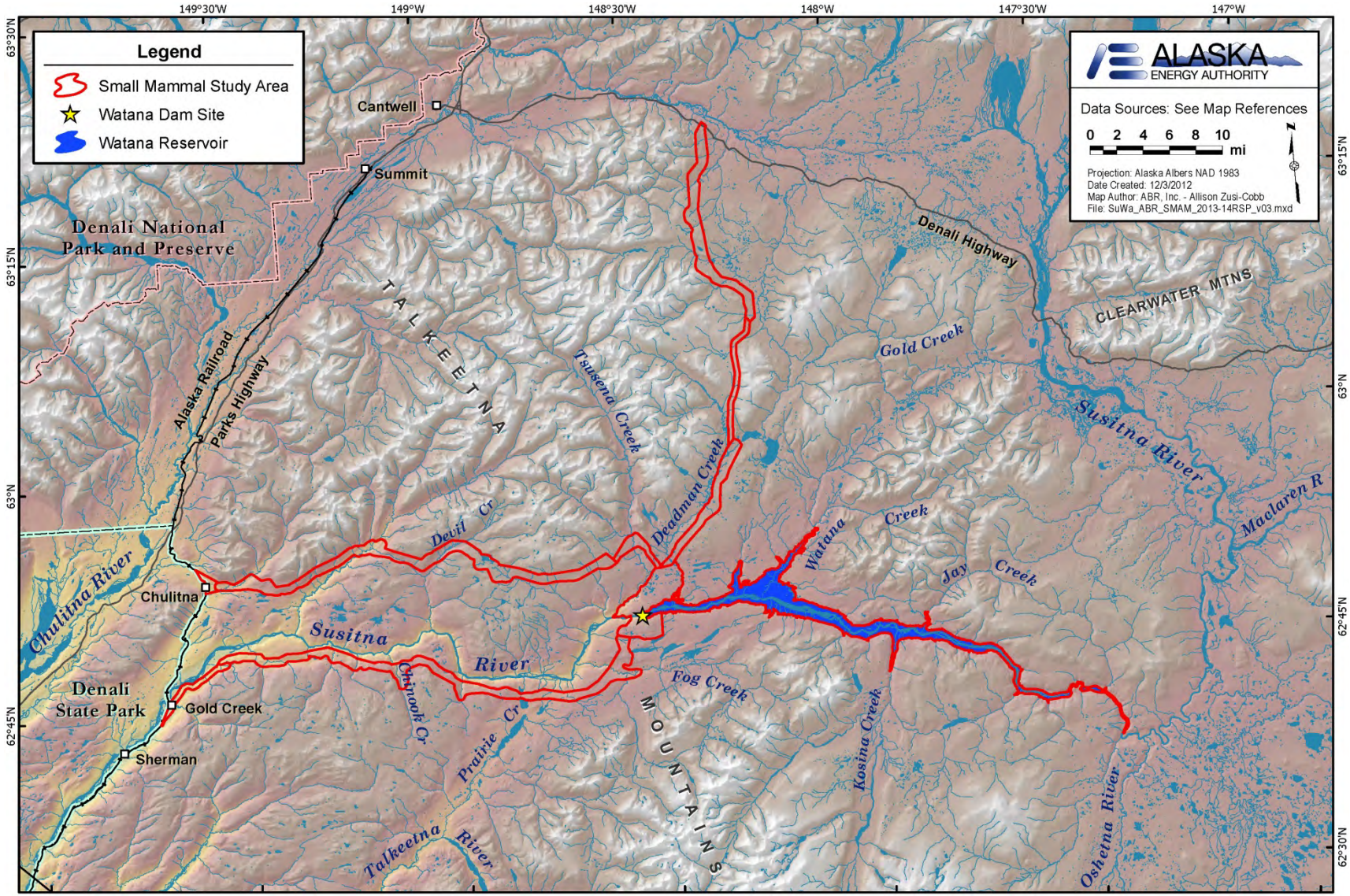

Figure 10.12-1. Study area for the small mammals study.

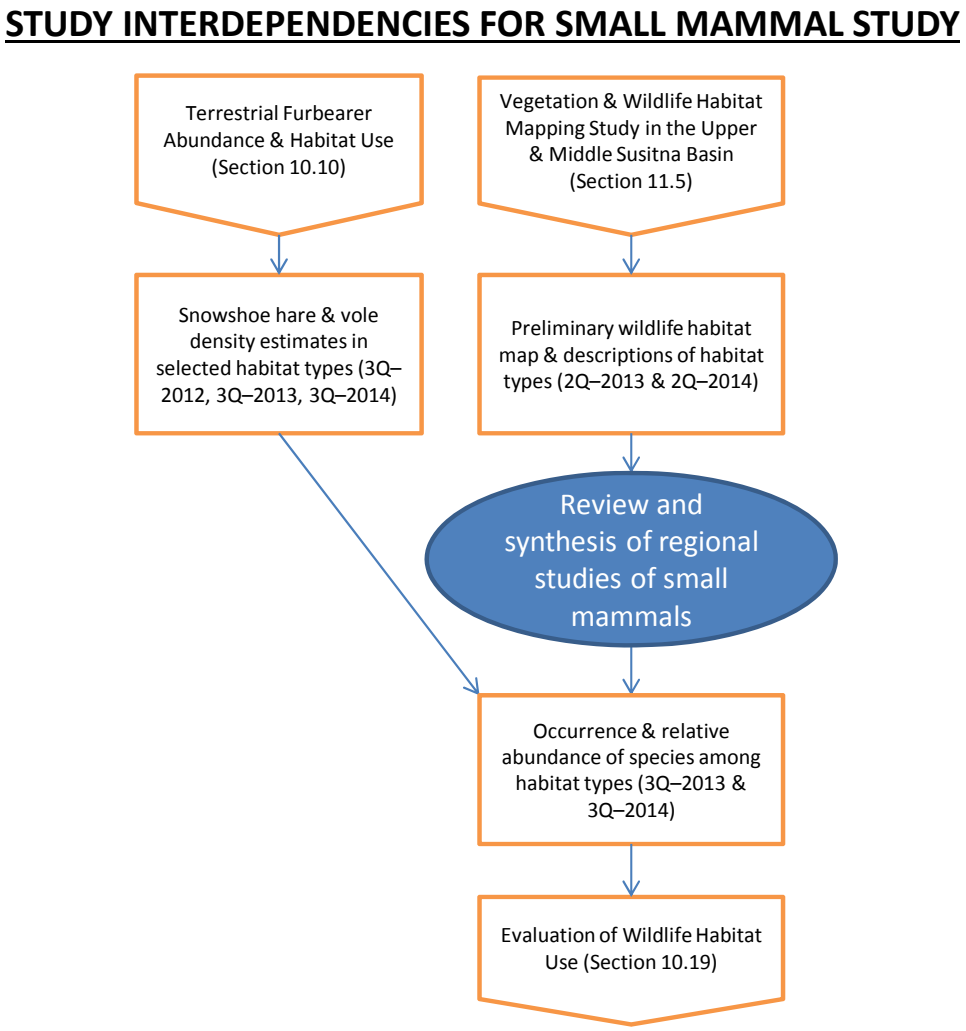

Figure 10.12-2. Study interdependencies for the small mammal study.

10.13. Bat Distribution and Habitat Use

10.13.1. General Description of the Proposed Study

The Bat Study will begin in 2013 to evaluate the occurrence and abundance of and habitat use by bats in the study area. Biologists will deploy ultrasonic acoustic detectors and will conduct a preliminary search for evidence of roosting sites, maternity colonies, and hibernacula to better understand how bats might be affected by the Project. Depending on the results of the first year of study, a second year of study may be conducted in 2014. Bats are small mammals and although this study shares similar objectives with the Small Mammal Study (see Section 10.12), the two studies require substantially different methodologies and separate efforts.

Study Goal and Objectives

The goal of the Bat Study is to collect baseline data on bats in the Susitna-Watana Hydroelectric Project (Project) area to enable the assessment of potential impacts on bats from development of the proposed Project.

The Bat Study has three specific objectives:

- Assess the occurrence of bats and the distribution of habitats used by bats within the reservoir inundation zone and associated infrastructure areas for the Project.
- Review geological and topographical data to assess the potential for roosting, maternity, and hibernacula sites in the study area.
- Examine suitable geological features (caves, crevices) and human-made structures (buildings, mines, bridges) for potential use by bats as roosting sites, maternity colonies, and hibernacula.

10.13.2. Existing Information and Need for Additional Information

Sampling for bat activity was not conducted during the Alaska Power Authority (APA) Susitna Hydroelectric Project in the 1980s, and no bats were captured during the small mammal study for that project. Only one species (the little brown bat) was included in the list of mammal species in the Project area, on the basis of a single sighting (Kessel et al. 1982). No other documentation of bats in the Project area is known to exist, but this species is distributed throughout Southcentral and Interior Alaska (Parker et al. 1997) and reports have been compiled by ADF&G in the Susitna basin downstream from the Project area (D. Tessler, ADF&G, pers. comm.). No other species have been documented in Southcentral Alaska, but at least five other species have been found in Southeast Alaska (Parker et al. 1997).

Implementation of the proposed study will provide data on bat occurrence (as passes/detector-night) in the study area and contribute to identification of potential roosting and hibernation locations in the Project area.

10.13.3. Study Area

The bat study area (Figure 10.13-1) encompasses the proposed reservoir inundation zone, the proposed dam and powerhouse, and the dam and camp facilities area, but not the access and transmission corridors.

10.13.4. Study Methods

10.13.4.1. Field Surveys and Data Management

Acoustic surveys of bats conducted with echolocation detectors are used to assess bat activity patterns and habitat associations (O'Farrell and Gannon 1999; Hayes 2000; Parsons and Szewczak 2009). Anabat® broadband acoustic detectors (Titley Electronics, Ballina, New South Wales, Australia) are used to detect and produce audible output from the ultrasonic sounds generated by bats to echolocate. These detectors are widely used for passive detection of free-ranging, echolocating bats (O'Farrell et al. 1999). Interpretation of bat acoustic data is subject to several important caveats. The number of recorded "bat passes" is an index of relative activity, but may not correlate to individual numbers of bats (e.g., 10 bat passes may represent a single bat recorded 10 different times or 10 bats each recording a single pass; Hayes 1997). Activity also may not be proportional to abundance because of variability attributable to (1) detectability (loud vs. quiet species); (2) species call rates; (3) migratory vs. foraging call rates; and (4) attraction to or avoidance of the sampling area by bats (Kunz et al. 2007; Hayes et al. 2009). However, interpreted properly, the index of relative activity may provide critical information of bat use by characterizing temporal (hourly, nightly, and seasonal) and spatial (height and location) patterns of bat activity (Parsons and Szewczak 2009).

The sampling period will extend from late May to early October 2013. Bat activity will be monitored during crepuscular and nocturnal hours (~1 hour before sunset to ~1 hour after sunrise), when bats are most active (Hayes 1997). The length of crepuscular and nocturnal periods each day fluctuates throughout the summer in Alaska, so the duty cycle of the detectors will be adjusted periodically. Anabat detectors are regularly used in Southeast Alaska and elsewhere where bats are more common than in Interior Alaska. Data will be downloaded and analyzed using Anabat *CFC Read* and *AnalookW* software (Corben 2011) to detect and quantify bat passes. A bat pass will be defined as a search-phase echolocation sequence of ≥2 echolocation pulses with a minimum pulse duration of 10 milliseconds (ms) within each sequence, separated by >1 second (Fenton 1970; Thomas 1988; Gannon et al. 2003). Bat activity will be reported as bat passes/detector-night, the standard metric for measuring bat activity (Kunz et al. 2007). The spatial and habitat relationships among detectors will likely be compared statistically using nonparametric (Kruskal–Wallis) techniques.

To maintain quality assurance and quality control (QA/QC), acoustic monitoring equipment will be checked and data cards downloaded into a database every 1–2 weeks to minimize data loss from equipment failures or other factors. The database will be checked periodically by the study project manager for inconsistencies and errors, and the entire database will be proofed again for errors before data analyses. All data will be stored on a network server with frequent backups to prevent loss of data.

The bat survey results will be examined to evaluate activity levels in different habitat types in the study area. Combined with the wildlife habitat map created for the Project (see Section 11.5), these results will allow an assessment of bat habitat loss.

The potential for roosting sites and winter hibernacula to occur in the Project area will be assessed by reviewing geological literature regarding the occurrence of suitable bedrock (e.g., limestone) in the Project area that would be conducive to the formation of caves, which are favored by little brown bats during hibernation (Parker et al. 1997). Ground searches of suitable

substrates will be conducted. Forest inventory information will be gathered from respective landowners if available, to assess presence of large-diameter dead trees for roosting habitat. Human-made structures (buildings, mines, bridges) will be investigated for potential use as roosting sites, maternity colonies, and hibernacula. The number of human-made structures within the study area is expected to be small, but identification and location of potential search areas will draw upon land ownership information available in the Project GIS database and will also be coordinated with the historic property surveys for the Cultural Resources Study (see Section 13.5).

Through the successful completion of the proposed study, AEA will document bat use (passes/detector-night) and will identify potential roosting, maternity, and hibernating sites in the study area. Anticipated work products include characterization of overall bat activity, identification of areas of concentrated bat activity (by habitat type and season), and documentation of the locations and levels of use of all roosts, maternity colonies, or hibernacula discovered.

The Alaska Department of Fish and Game's (ADF&G's) review of the study request for the Bat Study included recommendations to document seasonal variation in bat occurrence and activity, expanded sampling that would provide habitat-specific indices of abundance, and more thorough searching of naturally occurring roosts, maternity colonies, and hibernacula. Because AEA shares ADF&G's opinion that "The Watana development is unlikely to impact large numbers of bats or affect a significant portion of the population either directly or indirectly," it is appropriate to begin the Bat Study with the objective of conducting one season of work to address ADF&G's recommendations in 2013, as described above. If seasonal concentration areas such as roosting sites, maternity colonies, or hibernacula are located, then a second season of fieldwork will be conducted in 2014.

10.13.5. Consistency with Generally Accepted Scientific Practice

The Bat Study will be conducted using standard acoustic monitoring techniques as described in Hayes et al. (2009). The U.S. Fish and Wildlife Service (USFWS) endorses the use of acoustic monitoring to help predict impacts to bats at other industrial developments (i.e., wind energy sites [USFWS 2012]). Anabat® broadband acoustic detectors are proposed for use in this study because they are used widely for passive detection of free-ranging, echolocating bats (O'Farrell et al. 1999).

10.13.6. Schedule

The schedule for this study is summarized in Table 10.13-1. Acoustic monitoring will commence by late May and continue into early October 2013. Evidence of reproductive female bats (e.g., pregnant or lactating) in Alaska has been documented in mid-June (Parker 1996), and swarming behavior (high concentrations of bat activity) in September and October can be indicative of the presence of hibernacula. The proposed study duration will capture activity patterns during these important life cycle stages.

Data management will be conducted throughout the field season and will be finalized after all sampling has been completed in October. Data analyses will be conducted in October and November. The Initial Study Report will be completed by February 2014, within one year of FERC's Study Plan Determination (February 2013). If the results of the first year of study

warrant a second season of work, AEA's Updated Study Report will recommend a second study season for 2014. Should AEA make this recommendation, the same seasonal timing of sampling and analytical events would apply in 2014 and the Updated Study Report would be completed by February 2015.

Updates on the study progress will be provided during Technical Workgroup meetings, which will be held quarterly in 2013 and, if needed, in 2014. In addition, licensing participants will have the opportunity to review and comment on the Initial Study Report and, if needed, the Updated Study Report.

10.13.7. Relationship with Other Studies

As depicted in Figure 10.13-2, the Bat Study will benefit from information provided by several other studies. Information from the Geology and Soils Study (Section 4.5) and the Cultural Resources Study (Section 13.5) will help to identify geological and human structures that are potentially suitable for use by bats as roosting sites, maternity colonies, or hibernacula. Preliminary delineation of forested and wetland habitats by the Vegetation and Wildlife Habitat Mapping and the Wetland Mapping studies (Sections 11.5 and 11.7, respectively) will be used to identify potential foraging sites for deployment of acoustic detectors. The locations of occupied roosting sites, maternity colonies, or hibernacula (if any) and abundance data from sampling of foraging habitats will be central to the evaluation of the distribution of and habitat use by bats in the study area, which will be used in turn in the Evaluation of Wildlife Habitat Use (Section 10.19). Information on the distribution and abundance of bats in the study area will be used to assess potential impacts of the Project and to develop any appropriate PM&E measures for bats, as necessary.

During the impact assessment that will be conducted for the FERC License Application in 2015, data on the distribution of bats and their presence or absence in various habitats in the study area will be used to assess Project impacts through geospatial analysis and evaluation of the responses of the study species to other similar projects, as documented in the scientific literature. Using Geographic Information System (GIS) software, species presence/absence in different habitat types will be combined with the spatially explicit wildlife habitat map of the Project area being developed under the Vegetation and Wildlife Habitat Mapping Study (Section 11.5). Although the wildlife habitats described and mapped for that study will not include caves or other geological structures suitable for use as roosting sites or hibernacula by bats, all locations of concentrated bat activity will be mapped. The direct and indirect impacts of the Project will be evaluated by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate direct impacts of habitat loss and alteration and by applying various buffer distances, as determined from the available information on the expected effects, to estimate indirect impacts. The GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on bat populations. Any necessary protection, mitigation, and enhancement measures will be developed, as appropriate, by examining the distribution and abundance of bats and their habitats in relation to the geographic extent and seasonal timing of various Project activities.

10.13.8. Level of Effort and Cost

Development of a preliminary vegetation map in 2012 and early 2013 (see Section 11.5) will enable development of a stratified acoustic monitoring plan based on major habitat types. Up to 20 Anabat detectors will be deployed between late May and early October 2013 to ensure adequate spatial coverage and study design replication in locations judged by experienced biologists to constitute suitable bat foraging or roosting habitats.

After initial deployment in late May, the Anabat detectors will be serviced approximately twice per month during the anticipated four-month field season. Hence, eight helicopter-supported site visits will be conducted. Personnel on other Project field crews may be enlisted to download and inspect the detectors, when possible, thereby reducing study costs. Up to six additional field days will be scheduled for a helicopter-supported survey of sites judged to have potential as roost sites, maternity colonies, or hibernacula.

The cost of this study in 2013 is estimated to be approximately $115,000. If, after reviewing the 2013 results, the study continues in 2014, then the cost is estimated to be similar, or possibly less.

10.13.9. Literature Cited

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10.13.10. Tables

Table 10.13-1. Schedule for implementation of the Bat Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1Q
Acoustic monitoring & roost searches		—	—	—					
Data analysis				—					
Initial Study Report					Δ				
If 2013 results warrant a second season of work, then the same seasonal timing of sampling and analysis would apply in 2014						—	—	—	
Updated Study Report								—	▲

Legend:

— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.13.11. Figures

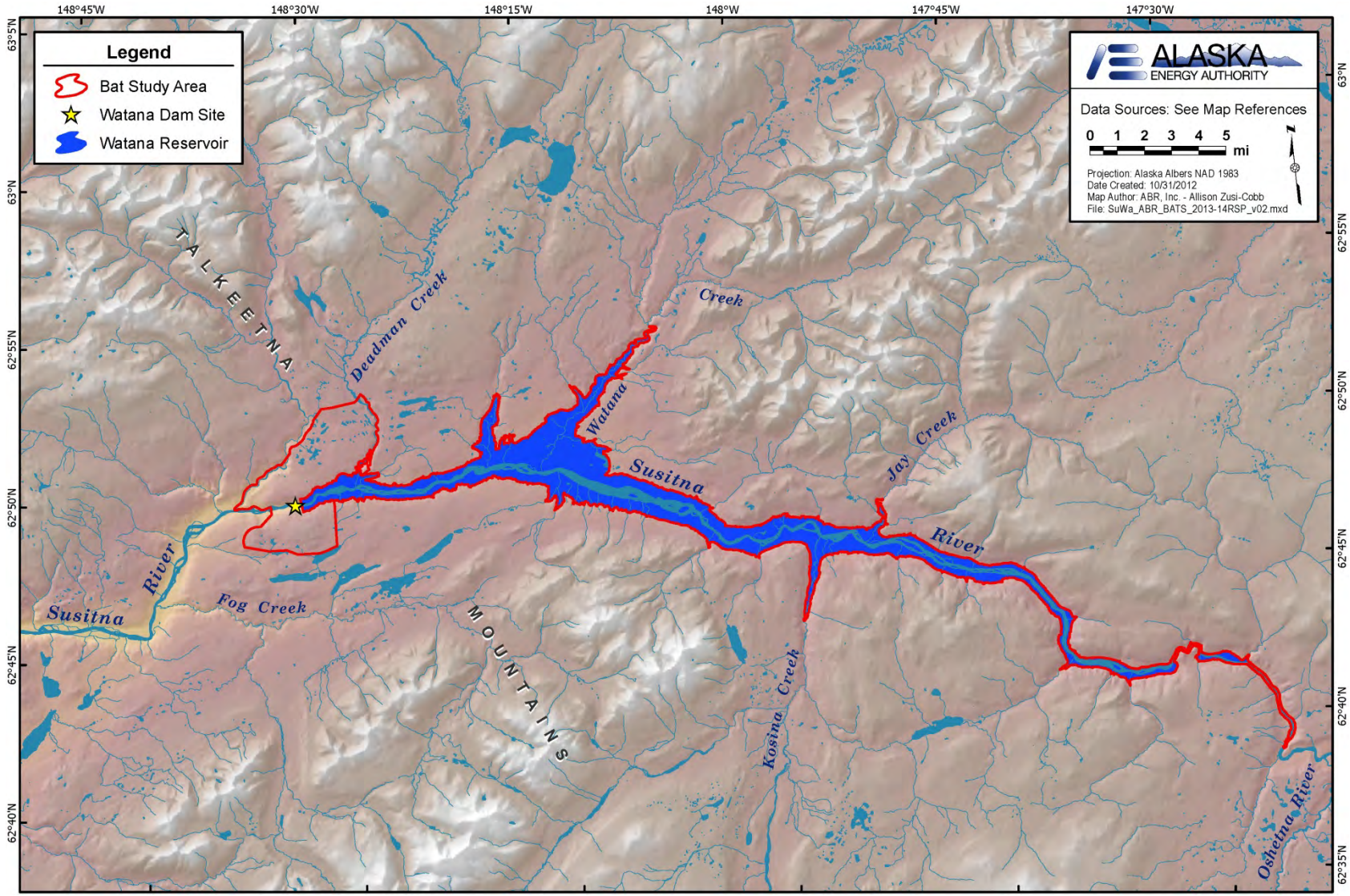

Figure 10.13-1. Bat study area.

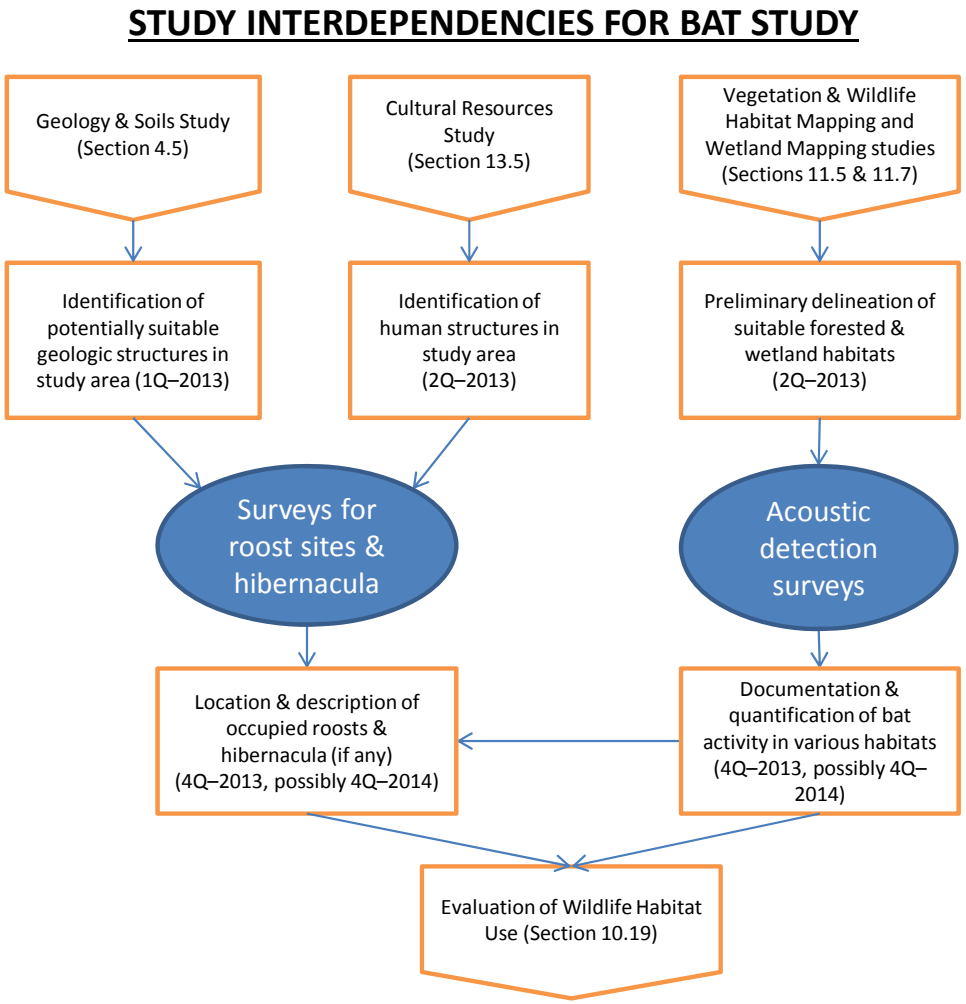

Figure 10.13-2. Study interdependencies for the Bat Study.

10.14. Surveys of Eagles and Other Raptors

10.14.1. General Description of the Proposed Study

The Surveys of Eagles and Other Raptors began in 2012 to prevent inadvertent take of raptors by providing information on raptor avoidance zones to Project personnel in the field in 2012. The Surveys of Eagles and Other Raptors will continue in 2013 and 2014, providing data for avoidance of raptor take, for the assessment of Project impacts, and ultimately for any necessary applications for federal eagle nest and take permits.

Study Goal and Objectives

The goal of the Surveys of Eagles and Other Raptors is to characterize population size, productivity, nesting phenology, and habitat use of raptor species to inform the prediction and quantification of impacts that may result from the proposed Project, and to provide information required for a possible application(s) for federal eagle take (lethal or disturbance take, see below) and/or eagle nest take permits. Common and scientific names of raptors that may occur in the Project area are listed in Table 10.14-1.

Six objectives have been identified for study:

1) Enumerate and identify the locations and status of raptor nests and territories that could be affected by Project construction and operations. Four specific tasks are associated with this objective:
   a) Review and synthesize existing nest data for eagles and other raptors: Identify and assess the status of previously recorded nest locations of various species, including geographic coordinates, annual nest activity, descriptions of nest site characteristics, and general descriptions of cliff habitat in the proximity of each site.
   b) Conduct field surveys to locate and characterize nests: Locate and map Bald Eagle and Golden Eagle nests in the Project study area, identifying all active and inactive nests and alternative nest sites. Locate and map active and inactive nests of other tree- and cliff-nesting raptor species (as well as Common Ravens) in the Project study area.
   c) Create a geospatial database of all nests and territories: The database will be used to calculate inter-nest distances, estimate local average territory size, and, with overlays of Project footprint and habitats, determine the number of nests and territories potentially affected by the Project.
   d) Calculate local average territory size for Bald Eagles and Golden Eagles: Estimates of average territory sizes (and mean inter-nest distance) are required for the applications for federal eagle nest take permits.
2) Estimate Project effects on productivity of raptors. This objective includes four specific tasks:
   a) Review existing productivity data.
   b) Determine the average and range of productivity of nests of each species (eagle/other raptor/raven).
   c) Consider impacts on productivity at the local and larger population level using current and historical data.
   d) Undertake pre- and post-construction comparisons of productivity to evaluate whether realized take is consistent with the permitted take, and to ensure that the level of take is compatible with the preservation of eagle populations.

3) Estimate effects on nesting and foraging habitats by delineating suitable habitat features in a geospatial database (this work will be conducted in the Evaluation of Wildlife Habitat Use; Section 10.19), and characterize and map habitat as suitable or not suitable for nesting and foraging for the various raptor species. These characterizations will be used in four ways:
   a) Calculate the percentage of local habitat lost.
   b) Calculate numbers of breeding pairs and productivity.
   c) Estimate whether or not a partial loss of a territory may functionally result in abandonment of the entire territory.
   d) Identify whether or not habitats adjacent to the Project area may be available for displaced nesting birds.
4) Conduct field surveys and literature reviews to identify, map, and characterize the habitat-use patterns at fall and winter communal roost sites and foraging sites of Bald and Golden eagles and other raptor species. Describe seasonal habitat use, highlighting areas or conditions that may result in impacts on raptors.
5) Conduct a study to assess the extent to which planned overhead transmission lines may pose a collision risk to migrating or nesting raptors and to identify migratory corridors (including altitudes of raptor movements) in the Project transmission line corridors.
6) Provide information on the distribution, abundance, food habits, and diet of piscivorous (fish-eating) raptors; feather samples for characterization of mercury levels; and information on the effects of methylmercury on piscivorous raptors, for use in the Mercury Assessment and Potential for Bioaccumulation study (see Section 5.7).

10.14.2. Existing Information and Need for Additional Information

Historical information from aerial surveys of raptors in the early 1980s provided the first assessment of the distribution, abundance, and vulnerability of many raptor nests located within the proposed Project impoundment zone. Those surveys highlighted Bald and Golden eagles and Common Ravens, and, to a lesser extent, raptors such as Northern Goshawks. Extensive information on raptors was collected during the 1980s for the original Alaska Power Authority (APA) Susitna Hydroelectric Project and for other surveys in the region (discussed in ABR 2011). Hard-copy maps are available of eagle nests located during the APA Susitna Hydroelectric Project studies in the early 1980s (LGL 1984). Other nest site records may exist in the files of the University of Alaska Museum of the North (AEA 2011). Other investigators and agency personnel may have information on raptor nest sites and important habitats, such as roosting sites, in or near the Project area. Similar regional databases of nest site information have been developed (Wildman and Ritchie 2000).

Surveys completed in the middle and upper Susitna River valley during the 1980s identified 23 Golden Eagle, 10 Bald Eagle, 3 Gyrfalcon, 3 Northern Goshawk, and 21 Common Raven nest sites (some sites included more than one nest site, if they were close together) (APA 1985). Although Common Ravens are not raptors, they construct both cliff and tree nests that raptors often use, are culturally significant, and are protected by the Migratory Bird Treaty Act (MBTA). Of the eagle nest sites identified in the 1980s, 5 Golden Eagle and 3 Bald Eagle sites were expected to be completely inundated by the original APA Susitna Hydroelectric Project Phase I (Low Watana) impoundment (LGL 1984).

New raptor studies are needed because most of the existing information is almost 30 years old and it is unknown how distribution, status, or other conditions may have changed. Also,

historical surveys did not cover the entire area of current interest, including access roads and power transmission corridors. More sophisticated geospatial analyses are now available that allow for more accurate assessments of the potential effects of the Project on raptors and their habitats. Finally, current data will be necessary for compliance with federal laws, especially the Bald and Golden Eagle Protection Act (BGEPA) and the MBTA, the 2011 FERC–USFWS Memorandum of Understanding (MOU), and application(s) for federal eagle nest/territory take permits.

A limited field survey for raptors was conducted in 2011 (ABR 2011) and more extensive surveys of the Project area were conducted in 2012 (AEA 2012) to provide current information needed to protect raptors by restricting Project activities near active raptor nests during pre-license field studies and construction. In 2011, surveys on June 27 were limited to the area near borehole sites drilled for the geotechnical program in the vicinity of the proposed Watana Dam. In 2012, occupancy surveys for nesting raptors were performed twice in May and productivity surveys were performed twice in July. The 2012 survey area comprised the area within a 2-mile buffer of the Project area (impoundment, access and transmission corridors, and facilities/infrastructure). Surveys were conducted from a Robinson R44 piston helicopter. Dozens of raptor nests were observed and occupied nest sites were located and mapped. In addition to Common Ravens, nests of six species of raptors were identified in the Project area in 2012: Golden Eagle, Bald Eagle, Peregrine Falcon, Gyrfalcon, Red-tailed Hawk, and Merlin. Global Positioning System (GPS) files, maps, and avoidance guidelines were distributed to Project personnel and contractors to avoid "take" of nests by disturbance.

Although transmission lines can be a source of mortality for eagles and other raptors by electrocution and collision, it is assumed that all new transmission lines and power transfer stations for the Project will be built to the "eagle-safe" standards developed by the Avian Power Line Interaction Committee (APLIC 2006), and therefore will not be likely to constitute a significant source of electrocution risk for raptors. However, significant lengths of new transmission lines will be constructed across miles of open and undisturbed landscape. As discussed in the Avian Protection Plan (APP) Guidelines (APLIC and USFWS 2005), collision risk assessments are recommended in the siting of overhead power transmission lines.

10.14.3. Study Area

The study area is subdivided into two different-sized survey areas, depending on the species of interest. For Golden Eagles, 10 miles is the survey radius typically recommended by the U.S. Fish and Wildlife Service (USFWS) for Golden Eagles (Pagel et al. 2010) in areas that contain suitable nesting habitat. After consultation with AEA, however, USFWS agreed to a 10-mile survey radius only around the reservoir inundation zone to calculate a mean inter-nest distance for this species and a 3-mile radius around proposed facilities and potential access road and transmission corridors (M. de Zeeuw and J. Muir, USFWS, pers. comm., April 2012).

For Bald Eagles and other raptor species, a radius of 3 miles around the reservoir inundation zone, proposed facilities, and centerlines of the potential access road and transmission line corridors is considered to be sufficient (M. de Zeeuw and J. Muir, USFWS, pers. comm., April 12, 2012).

Hence, the study area for the Survey of Eagles and Other Raptors encompasses: (1) a 10-mile radius around the reservoir inundation zone for Golden Eagles; (2) a 3-mile radius around the

reservoir inundation zone for Bald Eagles and other raptor species; and (3) a 3-mile buffer for all eagles and other raptors around proposed facilities and the centerlines of the potential access road and transmission line corridors (Figure 10.14-1).

All Bald and Golden eagle habitat within the relevant survey area boundaries will be surveyed. For Bald Eagles, surveys will cover the area within a half-mile of the centers of all drainages with suitable timber and within a half-mile of all shorelines of lakes with similar characteristics in the inundation zone and wherever these habitats cross proposed road and transmission line corridors. Information on other large tree-nesting birds will also be collected during those surveys. Survey routes for cliff-nesting raptors will be flown in a cliff-to-cliff survey pattern, focusing on cliffs suitable for Golden Eagle nests.

The survey methodology will obtain information for an area larger than the 1980s survey coverage, will gather information on key species in a more well-defined study impact area, and will provide information needed for eagle permitting and to develop avoidance areas and mitigation protocols to reduce the potential disturbance of nesting raptors from Project construction and operations. The nesting survey may be sectioned to include segments that match the extent of the 1980s survey to the extent appropriate for comparative purposes to evaluate trends in raptor populations and/or habitat use.

The study area for migration route surveys may be limited to specific locations along planned transmission line routes that may pose risks to migrating birds (e.g., ridgelines). These study areas will be determined in consultation with USFWS and be based on review of existing raptor migration data, topographical and wind current information, and other relevant factors.

10.14.4. Study Methods

10.14.4.1. Field Surveys

Inventory and monitoring methodologies for nest occupancy and productivity surveys will follow established aerial and ground-based protocols for eagle nest surveys (USFWS 2007; Pagel et al. 2010), using appropriately trained observers and suitable survey platforms (helicopter or fixed-wing aircraft). Modifications may be necessary to extend to the objective of identifying and monitoring the nests of other raptors. Nests of cliff-nesting raptors (including Golden Eagle, Peregrine Falcon, Gyrfalcon, and potentially Bald Eagle) and raptors using large stick nests (including Bald Eagle, Great Horned Owl, Northern Goshawk, Red-Tailed Hawk, Osprey, and potentially Golden Eagle) will be inventoried and monitored, as will raven nests.

Small to medium-sized raptor species (e.g., Short-eared Owl, Boreal Owl, Northern Hawk Owl, Northern Harrier, American Kestrel, Merlin, and Sharp-shinned Hawk) will be recorded during ground-based surveys for the breeding landbird and shorebird point-count surveys (see Section 10.16).

Raptor nest occupancy surveys will begin in spring before leaf-out (late April to late May), focusing on primary habitats for Bald and Golden eagles, but also considering primary habitats of resident species nesting in woodlands (e.g., Great Horned Owl and Northern Goshawk) and on cliffs (e.g., Gyrfalcon and Peregrine Falcon).

The nest productivity survey period will extend from mid-June to late July to verify and monitor nesting activity and to search for additional nests of later-nesting raptors. Because of the wide

range of breeding dates for all raptors considered in the study (mid-February for resident owls through early September for dispersal of Bald Eagles from nesting areas), the second survey period will encompass a broad timing window. The nesting chronology of each focal species of raptor will be considered during survey scheduling.

The same helicopter protocols will be employed for the occupancy and productivity surveys. A helicopter will be used, carrying two observers in addition to the pilot. Flight altitude and speed will follow standard survey protocols for each habitat type (Pagel et al. 2010). Observers will be seated on the same side of the aircraft during surveys. Location and nest attribute data, including substrate, species, and nest status, will be collected for entry into a geodatabase.

In any aerial survey, a key concern is quantifying the sightability of the target species to adjust density estimates for targets missed. The actual sightability of nests depends on many factors, including nest size, location, survey weather/light conditions, substrate and tree density, habitat type, observer experience, and survey platform. Although Golden and Bald eagles often construct large, conspicuous stick nests, some inconspicuous nests are likely to be missed when conducting surveys. Re-surveys of sub-samples of the study area will be performed to quantify the sightability of raptor nests in the Project area.

To prevent disturbance to Dall's sheep during the lambing period and near the Jay Creek and Watana Creek mineral lick sites, standard eagle survey protocols may need to be modified (Pagel and Whittington 2011) and helicopter surveys will be routed to avoid these areas during these periods.

The wildlife habitat map developed by the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) will be used to delineate the probable distribution of early nesting owls. Results from point counts conducted for the Landbird and Shorebird Migration, Breeding, and Habitat Use study (Section 10.16) will be combined with information from a literature review to assess the distribution, abundance, and habitat use by these owl species, which will then be incorporated into the Evaluation of Wildlife Habitat Use (Section 10.19). No winter surveys are proposed for early nesting owls because they would require logistically difficult and potentially dangerous nocturnal surveys during winter in remote areas to obtain information on only two species (Boreal Owl and Northern Hawk Owl) that are uncommon. Great Horned and Great Gray owl nests will be recorded during aerial surveys for Bald Eagles and other tree-nesting raptors.

Surveys for foraging and communal roost locations will be conducted primarily in fall and early winter. Repeated surveys of suitable protected forest stands may be necessary due to the high mobility of wintering Bald Eagles. Four aerial surveys of foraging habitat and communal roosts, primarily for Bald Eagles, will be conducted each year at intervals of 7 to 21 days between mid-October and early December. Survey numbers and timing may be adjusted in 2013 and 2014, based on the results of the initial surveys conducted in 2012. A helicopter or a fixed-wing aircraft carrying two observers will be used for these surveys. Surveys will be conducted near dawn or dusk. Information on fall fishery concentrations will be requested from Project fisheries researchers and from agency biologists to more effectively monitor potential Bald Eagle concentration areas.

Surveys to assess whether migrating raptors would be at risk for collision with Project power transmission lines will be conducted using fixed-radius migration point counts. These surveys generally will follow the USFWS's recommended point-count protocol, based on the standard

hawk migration counting protocols described in Appendix C of the *Draft Eagle Conservation Plan Guidance* (USFWS 2011). Migration point counts will be centered in plots with a radius of 800 meters and will be conducted for a period of 30 minutes each. The plot locations will be delineated along the transmission corridor alternatives before surveys begin, and the final selection of plots to be sampled will be determined by focusing on areas judged likely to concentrate migrating raptors (on the basis of topography). Survey efforts will be timed to coincide with times of day when thermal updrafts are most likely to occur (from midday through the afternoon hours).

After federal and state permits have been acquired and nests of eagles and other raptors have been vacated for the season, a sample of nests of piscivorous raptors (primarily Bald Eagle but also Osprey, if any nests of the latter species are found) in the vicinity of the proposed reservoir will be visited to obtain samples of feathers for laboratory analysis of mercury levels, which will be provided to the investigators conducting the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7). A literature review will be conducted for this study to provide basic information on the food habits and diets of, as well as the documented effects of methylmercury on, piscivorous raptors. Because this information will be provided to the investigators conducting the mercury study, it will not be included in the reports prepared for the study of eagles and other raptors.

10.14.4.2. Reporting

Reporting of inventory and monitoring data will comply with the protocols and standards described in the MOU between FERC and USFWS (FERC and USFWS 2011). Survey reports will include the following:

- Maps and associated metadata for historical eagle and other raptor nest and communal roost locations with survey extents to compare to current survey data.
- Maps and associated metadata with coordinates for current nest locations, nest activity status, fall and winter communal roost areas, and migration routes.
- Summary and mapping of suitable forest, riparian, and cliff habitats to evaluate the extent of suitable nesting habitats and facilitate nest searches within the study area.

Observations will be recorded and geo-referenced with associated habitats during raptor surveys. Some raptor nests and observations will also be recorded during breeding landbird and shorebird point-count surveys. All raptor observations will be plotted on the wildlife habitat map using field GPS coordinates. Nest characteristics will be recorded according to a protocol developed in consultation with the USFWS, including the protocol of the USFWS Alaska Bald Eagle Nest Atlas (http://alaska.fws.gov/mbsp/mbm/landbirds/alaskabaldeagles/default.htm).

The wildlife habitat map will provide the basis for an ecosystem approach to assessing the effects of development-related habitat impacts on raptors. The wildlife habitat map will facilitate quantitative spatial analyses of raptor habitat availability and changes likely to result from development, and, in combination with raptor survey data, will provide a way to assess the potential for changes in local raptor populations during construction and operations. Spatial analyses will be used to calculate the area and percentage of habitat lost and the numbers of breeding pairs and their productivity that likely would be affected; to determinate whether or not a partial loss of a given territory may functionally result in abandonment or failure of the entire territory; to identify whether or not habitats adjacent to the Project area may be “available”

(notwithstanding occupancy) for displaced nesting birds; and to assess the risk of raptor collisions with overhead transmission lines.

10.14.4.3. Data Analysis

A geospatially referenced relational database will be developed to incorporate historical and current data, including nest and roost locations for each species; occupancy, activity, and productivity data; nest type and characteristics; vegetation stand characteristics; and photographs. Suitable raptor nesting habitat will be delineated using a combination of field mapping and Geographic Information System (GIS) analysis. Existing nest locations and distribution of timber stands with suitably sized nest trees, in coordination with Project studies involving vegetation surveys and mapping, will be incorporated into the identification and delineation of suitable raptor nesting habitats. Foraging habitats will also be delineated whenever possible. Distribution of spawning salmon (determined through collaboration with Project salmon studies, Sections 9.5, 9.6, and 9.7) will be used to identify Bald Eagle foraging locations and potential aggregation areas. Distribution of fall waterfowl staging areas (determined in coordination with the waterbirds study, Section 10.15) will provide additional information for locating fall Bald Eagle foraging locations and potential communal roost areas. The distribution of Dall's sheep lambing areas and caribou calving areas, identified in part by the studies of Dall's Sheep Distribution and Abundance (Section 10.7) and Caribou Distribution, Abundance, Movements, Productivity, and Survival (Section 10.6), will provide information for Golden Eagle foraging habitat analyses.

Local Bald Eagle and Golden Eagle territory sizes will be estimated using inter-nest distances, as described in the *Draft Eagle Conservation Plan Guidance* (USFWS 2011). Recommendations will be developed for future data-gathering needs and analyses designed to evaluate potential Project-related impacts to eagles and other raptors.

10.14.4.4. Deliverables

Study products will include the following:

Geospatially-Referenced Relational Database. A geospatially-referenced relational database will be developed that incorporates all historic and current data, including nest, forage, and roost locations for each species; occupancy/activity; nest type and characteristics; stand characteristics; and photographs. This database will be expanded from the work done for the 2012 Raptor Study. All field data must be associated with location information collected using a GPS receiver in un-projected geographic coordinates (latitude/longitude) and the NAD 83 datum (or convertible as such). Migratory corridor information will be included for specific areas of concern, as discussed above.

Delineation of Suitable Eagle and Raptor Nesting and Foraging Habitats. Habitat delineation will be completed using GIS software as part of the Vegetation and Wildlife Habitat Mapping Study (Section 11.5) and the Evaluation of Wildlife Habitat Use (Section 10.19).

Study Reports. The Initial Study Report will be completed February 2014 and the Updated Study Report will be completed February 2015. The Updated Study Report will summarize the results for both years (plus 2012). These reports will include the following information:

- Discussion of nest-mapping results

- Calculation of the following:
  - Local average territory size for Bald Eagle and Golden Eagle
  - Productivity (annual, mean, range) for each raptor species and Common Raven among Project subareas (reservoir impoundment zone, access roads, power transmission corridors)
- Discussion of migration survey results
- Preliminary discussions and calculations of potential Project impacts, including the following:
  - Numbers of nests and territories that will be lost per species per subarea
  - Numbers of nests and territories otherwise affected per subarea
  - Type and level of impacts to forage and roost areas
  - Locations of any potential collision hazard areas for migrating raptors
  - Other potential impacts, including large increases in open-water habitats created by the reservoir impoundment

10.14.5. Consistency with Generally Accepted Scientific Practice

The study methods described above are consistent with generally accepted scientific practice. The field protocols may be modified to address logistical constraints imposed by the size and remoteness of the study area. The field protocols for raptor surveys generally follow established techniques for cliff- and tree-nesting raptors in North America (e.g., Anderson 2007). In addition, survey protocols and study areas will be tailored for specific species. For example, inventory and monitoring methodologies for nest occupancy and productivity surveys follow established aerial and ground-based protocols for eagle nest surveys (USFWS 2007; Pagel et al. 2010), using appropriately trained observers and suitable survey platforms (helicopter or fixed-wing aircraft). Nest characteristics will be recorded according to protocols developed in consultation with USFWS, including the protocol of the USFWS Alaska Bald Eagle Nest Atlas (http://alaska.fws.gov/mbsp/mbm/landbirds/alaskabaldeagles/default.htm). Local Bald Eagle and Golden Eagle territory sizes will be estimated using inter-nest distances as described in the *Draft Eagle Conservation Plan Guidance* (USFWS 2011). Surveys to determine if migration routes exist that may put migrating raptors at risk for collision with Project power transmission lines will generally follow USFWS's recommended migration point-count protocol, based on standard hawk migration counting protocols described in Appendix C of the *Draft Eagle Conservation Plan Guidance* (USFWS 2011).

10.14.6. Schedule

This study is a multi-year effort that began in 2012 and will continue through 2013 and 2014 into the first quarter of 2015. The data-gathering and reporting schedule is described in more detail in Table 10.14-2.

Nest occupancy and productivity surveys will be conducted periodically between late April and late July in 2013 and 2014. Occupancy surveys will be conducted between late April and late May and productivity surveys will be conducted between mid-June and late July. A minimum of two aerial surveys at least 30 days apart are recommended by USFWS for the Golden Eagle protocol (Pagel et al. 2010). Early reporting of potentially active raptor nest sites after the initial surveys in May (potentially earlier, depending on USFWS recommendations) will be used to develop avoidance measures for Project-related field study activities that have the potential to

disturb active nests. As soon as they are found, active eagle and other raptor nest sites will be reported to AEA in order to develop avoidance zones for field studies.

Raptor migration point-count surveys will be conducted during April–May and September–October in 2013 and 2014. Surveys will be conducted during peak periods of raptor migration in spring and fall.

Field survey data will be used to update the geospatially referenced, relational database of historical and current nest data in August 2013 and 2014, after occupancy and productivity surveys have been completed. At that time, the most current delineation of suitable eagle and raptor nesting habitat and the locations of active and inactive nest locations will be entered into the database and proofed.

Roosting and staging surveys will be conducted between mid-October and early December in 2013 and 2014. Surveys will be conducted periodically to identify the use of winter foraging and potential communal roost sites along the Susitna River. Four aerial surveys will be flown at intervals of 2 to 3 weeks, depending on weather and the results of preceding surveys.

The Initial Study Report and Updated Study Reports will be completed within 1 and 2 years, respectively, of FERC's Study Plan Determination (February 1, 2013). The study reports will include a summary of the study results to date. In addition, study updates will be presented at the Technical Workgroup meetings, which will be held quarterly during 2013 and 2014.

10.14.7. Relationship with Other Studies

Information from two other studies will provide useful input for planning surveys of eagles and other raptors (Figure 10.14-2). Preliminary mapping of forested habitats from the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) will help in survey planning for Bald Eagles and other tree-nesting raptors. Information on the location and timing of late-season spawning runs of salmon from the studies of Fish Distribution and Abundance in the Upper Susitna River (Section 9.5), Fish Distribution and Abundance in the Middle and Lower Susitna River (Section 9.6), and the Salmon Escapement Study (Section 9.7) will help in planning surveys of roosting and staging eagles in the fall and early winter. The geospatial database of raptor nest locations will contribute directly to the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) and to the Bat Distribution and Habitat Use study (Section 10.13) by identifying suitable cliff-nesting habitats. Seasonal location and distribution data from the nest occupancy and productivity surveys, roosting and staging surveys, and migration surveys will be used to identify high-value wildlife habitat types for different raptor species in the Evaluation of Wildlife Habitat Use (Section 10.19). Data on nest distribution, species abundance, and productivity, as well as data on the numbers and flight paths of raptors during migration surveys of the transmission corridors, will be used to inform the assessment of Project impacts in 2015 in the FERC License Application and to help identify any potential PM&E measures, as appropriate. Feathers collected from nests after the breeding season will provide samples to characterize pre-construction levels of mercury in tissues of piscivorous raptors for the Mercury Assessment and Potential for Bioaccumulation study (Section 5.7).

The primary impact mechanisms of the Project on raptors may include the following:

- Permanent direct and indirect habitat loss and alteration, including loss of nesting sites and loss and alteration of foraging habitat.
- Temporary direct and indirect habitat loss and alteration, including indirect impacts resulting from altered distribution and abundance of prey.
- Potential direct behavioral impacts, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation.
- Potential indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development.
- Potential direct mortality due to strikes with vehicles, power lines, towers, or other Project facilities; exposure to contaminants; and attraction to garbage and human activity.

Any impacts associated with habitat loss and alteration, attraction and avoidance, and direct mortality will occur primarily in the Project area, including the reservoir inundation zone, access and transmission corridors, and other Project infrastructure. Impacts associated with altered distribution and abundance of prey may occur over a larger area due to potential changes in both competing mammalian predators and prey species abundance.

During the impact assessment that will be conducted in 2015 for the FERC License Application, the impacts of direct and indirect habitat loss and alteration can be assessed through geospatial analysis. When plotted on the wildlife habitat map, raptor nest location data will allow the identification of high-value breeding habitats. Similarly, important habitats for prey species will also be identified by the Evaluation of Wildlife Habitat Use (Section 10.19). Using GIS software, the direct impacts of habitat loss can be evaluated for each raptor species by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the wildlife habitat map prepared by the Vegetation and Wildlife Habitat Mapping in the Upper and Middle Susitna Basin study (Section 11.5) to calculate loss of preferred habitats. As was noted earlier, pertinent data from other studies will be incorporated into the evaluation of potential Project-related impacts to eagles and other raptors. Indirect impacts of habitat loss and alteration and behavioral reactions (such as avoidance) can be estimated by applying various buffer distances, as determined from the literature on the effects of similar projects, including responses of both raptor and their prey. In this way, the GIS analysis can be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on raptor populations. Effects on the habitats of prey species included in the Evaluation of Wildlife Habitat Use (Section 10.19) can be incorporated into the impact assessment for raptors. Any necessary protection, mitigation, and enhancement (PM&E) measures will be developed, as appropriate by examining the distribution and abundance of raptor species and habitats in relation to the geographic extent and seasonal timing of various Project activities.

Data collected for this study will allow calculation of the numbers of nests and territories that will be lost per species per sub-area; the numbers of nests and territories otherwise affected per sub-area; the type and level of impacts to forage and roost areas; the locations of any potential collision hazard areas for migrating raptors; and other potential impacts, including large increases in the availability of open water habitats created by the impoundment.

10.14.8. Level of Effort and Cost

Occupancy/productivity for nesting raptors and fall and winter roost/forage surveys in 2013–2014 will require an estimated 10–12 days of additional fieldwork beyond the 2012 surveys due to the extended survey area for Golden Eagles. Therefore, costs for these surveys (including helicopter time, analysis, and reporting) will be approximately $500,000 per year.

Transmission corridor surveys for migrating raptors in 2013–2014 will require approximately 30 field days, and estimated costs for these (with helicopter drop-offs, literature search, analysis, and reporting) will be approximately $80,000 per year.

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10.14.10. Tables

Table 10.14-1. Raptors in the vicinity of the middle basin of the Susitna River (from Tables 4.6-2 and 4.8-2 in AEA 2011).

Common Name	Scientific Name	Conservation Status[1]	Seasonal Status[2]	Relative Abundance[3]
Bald Eagle	*Haliaeetus leucocephalus*	FS	B	uncommon
Boreal Owl	*Aegolius funereus*	PIF, FS	R	rare
Golden Eagle	*Aquila chrysaetos*	BLM, FS	B	fairly common
Great Gray Owl	*Strix nebulosa*	PIF, FS	?	rare
Great-horned Owl	*Bubo virginianus*	FS	R	uncommon
Gyrfalcon	*Falco rusticolus*	PIF, FS	R	uncommon
Merlin	*Falco columbarius*	FS	B	uncommon
Northern Harrier	*Circus cyaneus*	FS	B	fairly common
Northern Goshawk	*Accipiter gentilis*	FS	B	uncommon
Northern Hawk Owl	*Surnia ulula*	FS	R	uncommon
Osprey	*Pandion haliaetus*	FS	M	rare
Peregrine Falcon	*Falco peregrinus anatum*	BCC, FS	M	unknown
Red-tailed Hawk	*Buteo jamaicensis*	FS	B	uncommon
Short-eared Owl	*Asio flammeus*	BLM, FS	B?, M, S	uncommon
Sharp-shinned Hawk	*Accipiter striatus*	FS	B	uncommon

Notes:

1 Conservation Status: FS = Featured Species (ADF&G 2006); BCC = Birds of Conservation Concern (USFWS 2008); BLM = BLM Sensitive Species (BLM 2010); PIF = Boreal Partners in Flight Working Group (BPIFWG 1999).

2 Seasonal Status: M = migrant (transient); B = breeding; S = summering; R = resident; ? = uncertain (Kessel et al. 1982; APA 1985: Appendices E5.3 and E6.3).

3 From Kessel et al. (1982) and APA (1985: Appendices E5.3 and E6.3).

Table 10.14-2. Schedule for implementation of Surveys of Eagles and Other Raptors.

Activity	2012			2013				2014				2015
	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Aerial surveys for nest occupancy and productivity assessments (2 surveys each)	—	—			—	—			—	—		
Migration surveys (transmission corridors)					—	—						
Update geospatial database of historical and current nesting data						—	—			—	—	
Update delineation of suitable nesting habitat, old and active nest locations, historical fall and winter roost locations					—	—	—		—	—	—	
Conduct roosting and staging surveys			—				—				—	
Initial Study Report							Δ					
Updated Study Report												▲

Legend:

— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.14.11. Figures

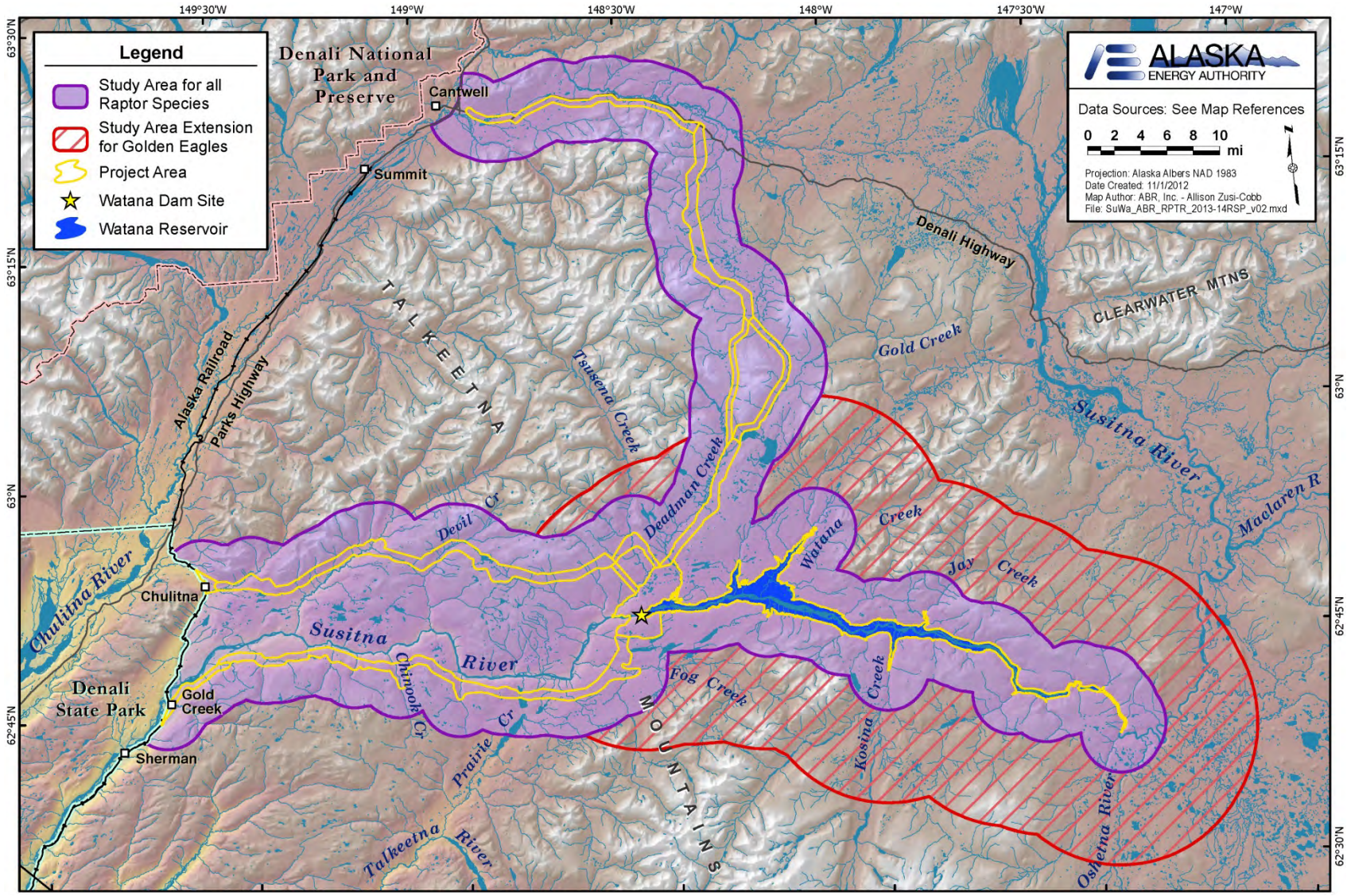

Figure 10.14-1. Study area for Surveys of Eagles and Other Raptors.

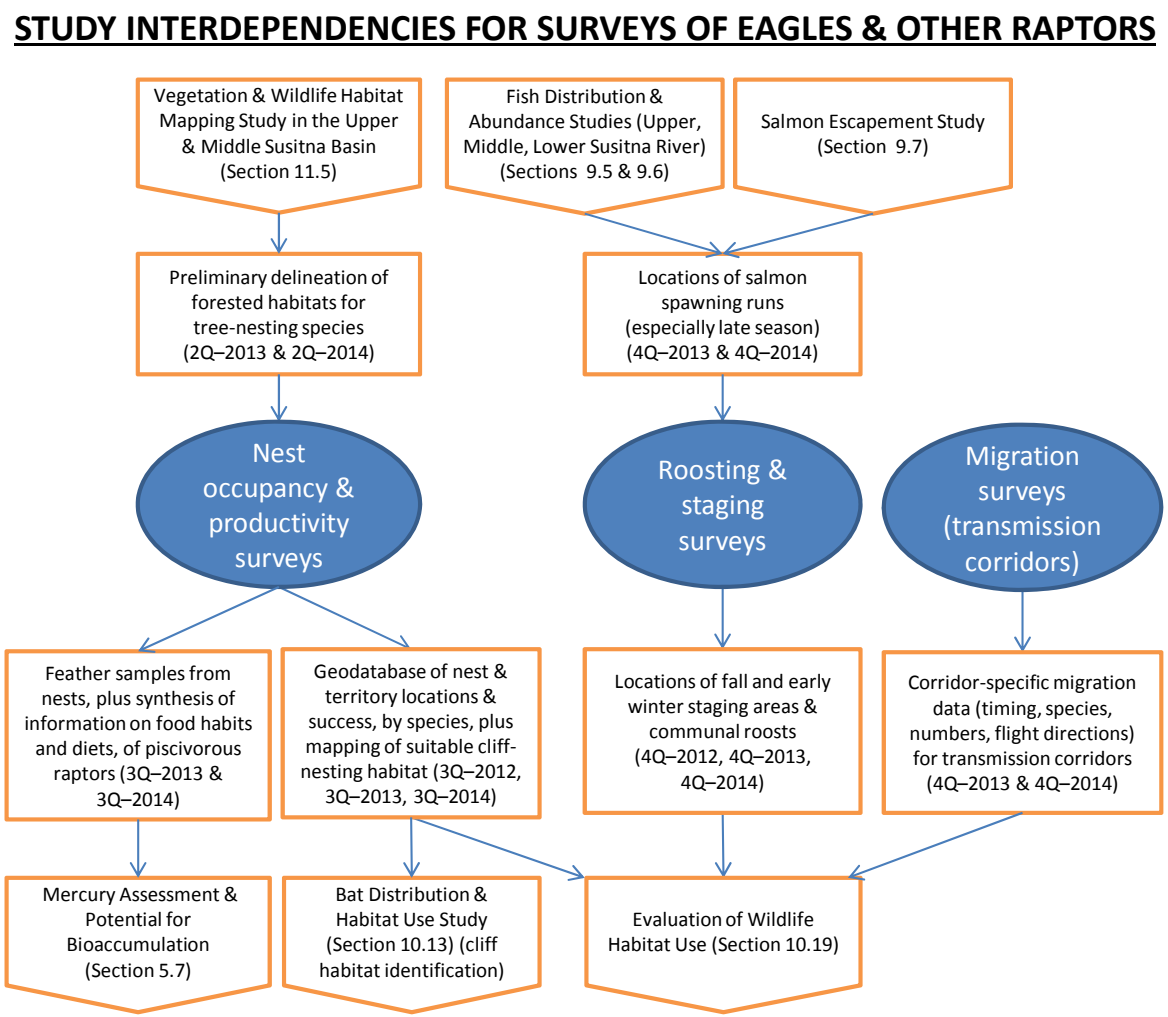

Figure 10.14-2. Study interdependencies for Surveys of Eagles and Other Raptors.

10.15. Waterbird Migration, Breeding, and Habitat Use Study

10.15.1. General Description of the Proposed Study

The Waterbird Migration, Breeding, and Habitat Use Study will be conducted over two years (2013 and 2014) and will include aerial surveys of water bodies during spring and fall migration, a study of diurnal and nocturnal migration using visual and radar sampling, breeding-pair surveys, stream surveys for Harlequin Ducks, and brood-rearing surveys. Waterbirds may use lakes, ponds, rivers, and flooded wetland areas throughout the Project area to varying degrees during spring and fall migration. Aerial surveys for staging and migration will follow a lake-to-lake pattern and will also parallel river courses. The migration study will employ intensive monitoring of migrating birds during both daytime and nighttime hours at a site located near the proposed dam and associated camp infrastructure. Surveys of breeding waterbirds (primarily waterfowl) will use a combination of full-coverage lake-to-lake surveys in most of the study area and breeding-pair transect surveys in the easternmost portion of the study area. Aerial surveys for Harlequin Ducks will focus on river and stream habitats during the pre-nesting and brood-rearing seasons. Brood-rearing surveys will be conducted by surveying open water and shoreline habitats of lakes and ponds in the study area.

Study Goals and Objectives

The goal of the Waterbird Migration, Breeding, and Habitat Use Study is to collect baseline data on waterbirds migrating through and breeding in the Project area to enable assessment of the potential impacts of the Project and to inform the development of appropriate protection, mitigation, and enhancement measures. As used here, "waterbirds" is applied broadly to include swans, geese, ducks, loons, grebes, cranes, cormorants, herons, gulls, and terns. Shorebirds frequently are included in the general category of waterbirds, but they are addressed separately for this Project under the Landbird and Shorebird Migration, Breeding, and Habitat Use Study (Section 10.16) because the ground-based survey methods for shorebirds are similar to those used for landbirds. This study plan includes breeding surveys for the Harlequin Duck, a species of conservation concern that requires specific stream-survey techniques.

This study has three objectives:

- Document the occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds migrating through the Project area in spring and fall.
- Document the occurrence, distribution, abundance, productivity, and habitat use of waterbirds breeding in the Project area.
- Review available information to characterize food habits and diets of piscivorous waterbirds documented in the study area as background for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7).

The information gained from this study will be used to evaluate waterbird habitat loss and alteration quantitatively, in conjunction with the separate Vegetation and Wildlife Habitat Mapping Study and the Evaluation of Wildlife Habitat Use Study (see Sections 11.5 and 10.19, respectively), and to estimate the number of migrating and breeding waterbirds that may be affected by the Project.

10.15.2. Existing Information and Need for Additional Information

Existing information on the distribution and abundance of waterbirds in the Project area during the breeding and migration seasons is mostly based on studies conducted in 1980 and 1981 for the Alaska Power Authority (APA) Susitna Hydroelectric Project (Kessel et al. 1982). Data from those studies were used to quantify the level of use of water bodies by migrating and breeding waterbirds. A relative "importance value" was determined for each water body surveyed in each migration season, incorporating the number of species, the number of birds, and the density of birds found on the water body in relation to the overall numbers and densities recorded on the surveys (Kessel et al. 1982). Those study results provide a good knowledge base concerning waterbird use of the Project area three decades ago; however, because the population numbers of numerous species have changed in the past 30 years, new waterbird surveys are needed to elucidate the current distribution and abundance of breeding and migrating waterbirds in the Project area.

More recent survey data on breeding waterbirds in the upper Susitna River basin has been collected annually during U.S. Fish and Wildlife Service (USFWS) waterfowl breeding population surveys (Mallek and Groves 2011a), but only a few transects of the Stratum 2–Nelchina survey area (Mallek and Groves 2011b) are located in the Project area. Those transects occur east of the proposed reservoir near the Oshetna River, an area of low topographic relief where the density of lakes, ponds, and wetlands is relatively high.

The population of Trumpeter Swans is an example of a waterbird species whose population has changed substantially in the last 30 years (Conant et al. 2007). A complete census of Trumpeter Swans on their breeding grounds in Alaska began in 1968 and was repeated at 5-year intervals between 1975 and 2005 (Conant et al. 2007). Together, two survey areas (Unit 3–Gulkana and Unit 5–Cook Inlet) include the entire Susitna River basin (Conant et al. 2007). The population of Trumpeter Swans summering in Alaska has increased since 1975 and breeding has expanded into peripheral habitat. No census was conducted in 2010, so information on the distribution and abundance of Trumpeter Swans in the Project area is out of date and new surveys are needed.

Waterbird productivity was evaluated in 1981 using ground surveys of water bodies within proposed impoundment areas and access routes associated with the APA Susitna Hydroelectric Project. Those surveys provide historical data for the area 30 years ago, but need to be updated. Current surveys addressing waterbird productivity need to be conducted in areas of proposed facility locations, road and transmission corridors, and any areas affected by the Project within and near the inundation zone.

No current information exists on the distribution and abundance of Harlequin Ducks in the middle and upper Susitna River basin. The Harlequin Duck is a species of conservation concern that nests and raises broods almost exclusively in mountain stream drainages. New surveys need to be conducted to assess the distribution and abundance of Harlequin Ducks breeding in the Project area.

10.15.3. Study Area

The study area for waterbirds will encompass lakes, ponds, rivers, streams, and flooded wetlands within a 3-mile buffer area around the Project area (Figure 10.15-1). The 3-mile buffer includes nearly all of the 65 water bodies surveyed for the original APA Susitna Hydroelectric Project in

the 1980s (Kessel et al. 1982), most of which occur in relatively discrete groupings (e.g., see Pre-Application Document [PAD] Figure 4.6-16; AEA 2011). The study area boundary has been extended farther than 3 miles in several places to include water bodies surveyed by Kessel et al. (1982), such as Stephan Lake, Clarence Lake, and other unnamed water bodies south of the Susitna River between Kosina Creek and the Oshetna River, but six large lakes surveyed (Kessel's numbers 131–136) between the mouths of the Tyone and Maclaren rivers will be omitted because they are located well upstream from the area that may be affected by the Project.

Rather than specifying a minimum water body size to be surveyed for the lake-to-lake surveys, the most efficient flight path through each water body group, and linking to other water body groups, will be determined by an experienced waterbird biologist before the surveys begin, to maximize the number of water bodies covered. That same route will be repeated on each migration and breeding-pair survey using Global Positioning System (GPS) navigation; brood surveys will concentrate on the subset of those water bodies located within 1 mile around the locations and alignments of proposed Project infrastructure, including access road and transmission corridors. The survey route will be developed by reviewing U.S. Geological Survey (USGS) 1:63,360-scale topographic maps and high-resolution aerial or satellite imagery, as available, and a GPS route file will be created for navigational use during the survey. It is anticipated that all water bodies 2 hectares (5 acres) or more in size will be surveyed, as well as many smaller ponds located between those larger water bodies. This approach will provide more complete survey coverage than selecting a random sample from all water bodies in the study area. All water bodies sampled will be entered into a Geographic Information System (GIS) database to permit measurement of their area for use in calculating waterbird density.

All rivers and streams flowing through the study area buffer will be surveyed for breeding Harlequin Ducks. These stream surveys will extend outside the 3-mile study-area buffer where necessary to cover suitable habitats farther upstream. Habitat suitability will be evaluated during the first pre-nesting survey for use in planning the three subsequent surveys.

A rectangular area has been delineated east of the upper end of the reservoir inundation zone ("transect block" in Figure 10.5-1) in an area of low topographic relief with a high density of water bodies. The transect block will be sampled during breeding-pair surveys using a transect sampling approach, rather than attempting to cover all of the water bodies completely in a lake-to-lake pattern.

10.15.4. Study Methods

10.15.4.1. Spring and Fall Migration

10.15.4.1.1. Aerial Surveys

Waterbirds use a broad range of lakes, ponds, rivers, and flooded wetlands throughout the Project area during migration. The most effective means of assessing the distribution and abundance of waterbirds over such a large area is aerial survey. Because of the distribution of water bodies in relatively discrete, irregularly spaced groupings in most of the study area, a lake-to-lake survey pattern is the most efficient survey approach, in which each lake is circled to count waterbirds in the water and on the shore. Waterbirds often use rivers and streams for staging during early spring when lakes are covered by ice, so surveys will be flown parallel to river and stream courses.

Aerial surveys of waterbirds in Alaska typically are conducted using either a fixed-wing aircraft or a helicopter, with the choice of platform depending, in part, on the topography of the survey area. Because of the canyons and mountainous terrain in the Project area, a small piston helicopter (Robinson R-44) is the preferred waterbird survey platform to ensure good visibility, survey efficiency, and safety in maneuvering.

To adequately characterize the period of migration and avoid missing migration peaks for various species of waterbirds, surveys will be conducted at 5-day intervals during the spring (late April to early June) and fall (mid-August to mid-October) migration periods, resulting in 10–11 surveys in spring and 13–14 surveys in fall, weather permitting. Each survey is expected to take approximately 2 days to complete. The spring migration surveys will transition directly into the breeding-pair surveys with no break in timing, as is described below (Section 10.15.4.2.1).

A single, experienced observer will record all data on a hand-held digital recorder, which will be transcribed later into a computer database for analysis. Data will be summarized by species, species group, lake group or river segment, date of survey, and survey area. The survey results will be used to evaluate species composition and the timing of migration and to identify water bodies important to migrating waterbirds. Flight lines will be recorded on each survey using a GPS receiver.

10.15.4.1.2. Migration Study

To acquire current information on the volume and flight directions of birds migrating through the study area, an intensive study of bird migration will be conducted using a combination of visual surveys and radar monitoring. The sampling site for the migration study will be established on the benchland just northeast of the proposed dam site, in the vicinity of the proposed Project camp. Although this study component is described here in the Waterbird Migration, Breeding, and Habitat Use Study plan, it is important to note that the sampling design will also provide data for the Landbird and Shorebird Migration, Breeding, and Habitat Use Study (Section 10.16).

Diurnal visual observations will be conducted during daylight hours (sunrise to sundown) from late April to early June and from mid-August to mid-October. Using binoculars and spotting scopes, observers will record data along four visual transect lines (oriented in the cardinal directions—north, east, south, west) during 25-minute sampling sessions, separated by 5-minute break periods during which weather data will be recorded. Data recorded for each bird observation will include date, time, species (or taxon), flock size, transect crossed, distance crossed (distance from observer), flight direction, flight behavior, minimal flight-altitude category, and an estimate of actual minimal flight altitude.

A portable marine radar that functions in both surveillance and vertical modes will be set up at the sampling site and will be powered by a portable generator. The radar (Furuno Model FR-1510 MKIII; Furuno Electric Company, Nishinomiya, Japan) is a standard X-band marine radar transmitting at 9.410 GHz through a 2-m-long slotted wave guide (antenna) with a peak power output of 12 kW. The antenna has a beam width of 1.23° (horizontal) × 25° (vertical) and a side lobe of ±10–20°. Range accuracy is 1% of the maximal range of the scale in use or 30 m (whichever is greater) and bearing accuracy is ±1°. This radar can be operated at a variety of ranges (0.5–133 km) and pulse lengths (0.07–1.0 μsec). A pulse length of 0.07 μsec will be used while operating at the 1.5-km range to sample the flight activity of small-bodied birds (e.g., songbirds). A longer pulse length (0.3 μsec) will be used while operating at the 6-km range to

sample the flight activity of large-bodied birds (e.g., waterfowl, cranes, raptors). At shorter pulse lengths, echo resolution is improved (giving more accurate information on target identification, location, and distance); whereas, at longer pulse lengths, echo detection is improved (increasing the probability of detecting a target). An echo is a picture of a target on the radar monitor; a target is one or more birds (or bats) that are flying so closely together that the radar displays them as one echo on the display monitor. The radar has a digital color display with several useful features, including true north correction for the display screen (to determine flight directions), color-coded echoes (to differentiate the strength of return signals), and on-screen plotting of a sequence of echoes (to depict flight paths). Because targets are plotted with every sweep of the antenna (i.e., every 2.5 sec) and because ground speed is directly proportional to the distance between consecutive echoes, ground speeds of plotted targets can be estimated to the nearest 5 km/h with a hand-held scale.

Radar data will be collected in several 1-hour sampling sessions throughout the night (from shortly after sunset to just before sunrise) and diurnal radar sampling sessions will be conducted during the day (shifting 3-hour blocks from morning to evening). Each 1-hour radar sampling session will consist of (1) one 10-min period to collect weather data and adjust the radar to surveillance mode; (2) one 10-min period with the radar in surveillance mode (1.5-km range) for collection of information on migration passage rates or small-bodied birds; (3) one 10-min period with the radar in surveillance mode (1.5-km range) for collection of information on ground speed, flight direction, tangential range (minimal perpendicular distance to the radar laboratory), transect crossed (north, south, east, and west), and the number of individuals (if known) of small-bodied birds; (4) one 10-min period with the radar in surveillance mode (6-km range) for collection of information on both passage rates of large-bodied birds and information on their groundspeed, flight direction, tangential range (minimal perpendicular distance to the radar laboratory), transect crossed (north, south, east, and west), and the number of individuals (if known); (5) one 5-min period to adjust the radar to vertical mode; and (5) one 15-min period with the radar in vertical mode (1.5-km range) to collect information on flight altitudes and flight behavior. All hours of radar data will be recorded using an automated image frame-grabber device (Model VGA2USB, Epiphan Systems Inc., Ottawa, Ontario, Canada) that will enable continuous collection of a record of high-quality lossless radar images, with a resolution identical to that of the radar monitor.

Nocturnal audiovisual surveys will be conducted during the first 2 hours of nocturnal radar sampling in both spring and fall, and will include two sessions of visual sampling separated by short periods during which weather data will be recorded. The sampling period will be adjusted as daylength changes during the migration periods. The observer will use binoculars during crepuscular periods and night-vision goggles during dark hours, aided by spotlights outfitted with infrared filters to illuminate targets flying overhead. For each bird or flock of birds detected visually, the following data will be collected: species or taxon, flight direction, flight altitude, and flight behavior. Weather data recorded before each radar or visual sampling session will include wind direction, average wind speed, cloud cover, ceiling height, light conditions, precipitation, air temperature, and barometric pressure.

Data collected in this study on flight volume, altitudes, and directions among all species and taxa will be compared with data collected in similar studies at Tok in the upper Tanana River valley and Gakona in the Copper River valley (Cooper et al. 1991a, 1991b; Cooper and Ritchie 1995),

the Tanana Flats and Alaska Range foothills near Healy (Day et al. 2007; Shook et al. 2006, 2011), and Fire Island (Day et al. 2005), at minimum.

10.15.4.2. Breeding Season

10.15.4.2.1. Breeding-pair Surveys

Two different survey approaches will be used for breeding-pair surveys, depending on the location of the water bodies being surveyed. In most of the study area, the same lake-to-lake survey approach will be used as during the migration surveys, with no break in timing between the spring migration and breeding survey periods. In the designated transect survey block in the easternmost portion of the study area, however, a sampling approach will be used to survey 400-meter-wide strips along transects spaced at 1-mile intervals, providing sample coverage of approximately 25 percent of the survey block.

Surveys for breeding waterbirds, primarily waterfowl, will generally follow standard USFWS protocols (USFWS 1987; USFWS and CWS 1987). The survey lines in the transect block will be aligned to cover the largest possible number of water bodies and wetlands. The placement of the transect lines, which will be oriented systematically along the long axis of the survey block, will be determined before the survey using aerial imagery or topographic maps and GIS.

Breeding-pair surveys are typically conducted in a fixed-wing aircraft; however, it is likely that a small piston helicopter will be used for all aerial surveys of waterbirds in this study. Flight altitude will be low (125–200 feet above ground level, with the lower altitude being used for the transect surveys) to permit observation of birds without having to rely on binoculars, although binoculars will be used where necessary to confirm species identity. In the lake-to-lake surveys, a single observer will record data over the entire area of the water bodies surveyed. In the transect surveys, one observer will search for waterbirds in a 200-meter (656-foot) swath on each side of the aircraft (total of two observers searching a total strip width of 400 meters, or 1,312 feet) while the pilot navigates the transect lines using a GPS receiver. Observations will be recorded on hand-held digital voice recorders for later transcription and transfer to a computer database for analysis. Survey data will be used to calculate the estimated densities of each species of waterfowl and identify areas important to breeding waterfowl.

The timing of the breeding-pair surveys will be determined by evaluating the chronology of break-up and spring melt conditions each year, which will be monitored throughout the spring migration surveys. Breeding-pair surveys typically are flown in late May or early June, depending on location and elevation, when pairs are present on territories but females are not yet spending time on nests. Survey timing can affect results because the nesting phenology of dabbling ducks is earlier than that of diving ducks, and some dabbling duck species can be missed if the survey occurs too late, after the cryptically colored females are on nests and the more brightly colored males have left the area. Two surveys, spaced about 10 days apart, will be conducted to target the expected peaks of breeding for dabbling and diving ducks. The two breeding-pair surveys will be timed to coincide with the peak presence of pairs and males of dabbling ducks and diving ducks, respectively, to account for the differences in migration timing and turnover of those two general categories of ducks. Each survey is expected to take approximately two days to complete. Weather and visibility conditions will be recorded during surveys to assess the quality of the information recorded, and surveys will not proceed unless conditions are suitable. Standard protocols (USFWS and CWS 1987, Smith 1995) will be

followed to convert raw survey counts to indicated total population indices and species-specific correction factors will be applied to the indices to derive population estimates of each species detected in the transect strips for which correction factors are available.

10.15.4.2.2. Harlequin Duck Surveys

In inland areas of Alaska, Harlequin Ducks predominantly use mountain streams for foraging and nest in adjacent shoreline habitats. Male Harlequin Ducks are only present on breeding streams during a short period in spring while courting females. Accordingly, pre-nesting surveys to quantify the number of nesting pairs occupying a stream must be conducted in that short timing window. After hatching, successful females are visible on streams with their broods, and failed breeders often group together.

Surveys for pre-nesting and brood-rearing Harlequin Ducks will be flown in a helicopter with two observers seated on the same side. Surveys generally will be flown in an upriver direction with the helicopter positioned over the bank to provide an unobstructed view of the entire width of the watercourse. Each survey is expected to take approximately two days to complete. Surveys will follow the entire length of tributary streams where suitable nesting habitat is present, even if it means flying outside of the 3-mile study area buffer. The extent of suitable habitat will be defined during the first pre-nesting survey. Observations will be recorded on hand-held digital recorders and with GPS waypoints for later transcription and transfer to a computer database for analysis. Survey data will be used to calculate linear densities (ducks per kilometer) and to identify streams used by breeding Harlequin Ducks.

To account for annual variability in the occurrence of peak numbers of breeding pairs and brood-rearing females on a stream, two years of pre-nesting and brood-rearing surveys will be conducted. Two pre-nesting surveys, spaced 7–10 days apart, will be flown in late May–early June each year and two brood-rearing surveys, spaced 7–10 days apart, will be conducted in late July–early August each year, with the exact timing to be determined using information on environmental conditions and breeding phenology each year.

10.15.4.2.3. Brood Surveys

Information on waterbirds breeding in specific areas that may be affected by Project infrastructure or activities will be collected by biologists conducting helicopter surveys of suitable lakes, ponds, streams, and flooded wetland complexes. As with the other waterbird surveys, the platform of choice will be a small piston helicopter. These surveys will be conducted at least twice during the brood-rearing period, with the first survey occurring in mid-July and the second approximately a week later, to record the presence of adults accompanied by broods of juveniles. A third survey may be flown, depending on the developmental stages of juveniles observed on the second brood survey. The brood surveys will focus on the water body groups within 1 mile around the locations and alignments of proposed Project infrastructure, excluding portions of the study area located farther than 1 mile away.

Two observers will circumnavigate water bodies in a small helicopter to search for waterbirds with broods. All waterbirds seen will be recorded on field data sheets and brood ages for waterfowl (primarily ducks) will be estimated by classifying them into one of seven age classes based on chick plumage patterns. Survey data will be used to calculate densities of broods and to estimate nest-initiation dates by back-dating (subtracting the estimated age of young and the

average incubation period). Any nest locations of piscivorous waterbirds will be recorded for collection of feathers for analysis of baseline mercury levels for the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7).

10.15.4.3. Information for Mercury Assessment

To provide tissue samples for laboratory analysis of mercury levels, feathers of piscivorous waterbirds (e.g., loons, grebes, mergansers, terns) will be collected, after the nesting season, from any nests of those species that are located during aerial surveys for this study or surveys for other Project studies. It is anticipated that some nests of loons, grebes, and Arctic Terns will be found because of their selection of nest sites on islands or shorelines, but merganser nests are unlikely to be found because they nest in tree cavities that would be difficult to locate without radio telemetry. Therefore, to supplement the collection of feathers from nests, prey remains will be collected from nest sites of Peregrine Falcons located in or near the study area. Peregrine Falcons are predators of a variety of birds, including waterbirds, and examination of prey remains is a commonly used technique to investigate their food habits. A permit will be required from the USFWS to collect any migratory bird parts.

In addition to collection of feather samples for laboratory analysis, the scientific literature will be reviewed to compile and synthesize information on the food habits and diets of piscivorous waterbirds in freshwater aquatic systems to support the risk assessment being conducted as part of the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7). This information was recommended by USFWS in comments on the Pre-Application Document for the Project (letter from USFWS to AEA dated May 31, 2012).

10.15.4.4. Reporting and Deliverables

Study products will include the following:

- **Electronic copies of field data.** A geospatially referenced relational database will be developed that incorporates all historic and current data, including nesting and brood-rearing locations for each species. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Study Reports.** The Initial Study Report will be completed in February 2014 and the Updated Study Report will be completed in February 2015. The Updated Study Report will summarize the results for both years.

10.15.5. Consistency with Generally Accepted Scientific Practice

The Waterbird Migration, Breeding, and Habitat Use Study will be conducted using standard waterfowl aerial survey techniques, including those described in the current USFWS *Standard Operating Procedures for Aerial Waterfowl Breeding Ground Population and Habitat Surveys in North America* (USFWS and CWS 1987). These same techniques have been used successfully to survey for migrant and breeding waterbirds on other large-scale projects in Alaska (e.g., PLP 2011). Stream surveys of Harlequin Ducks by helicopter have been used effectively in numerous studies in Alaska and Canada (McCaffery and Harwood 1994; Morgart 1998; Kneteman and Hubbs 2000; Paton 2000; Savage 2000; MacDonald 2003; PLP 2011). The diurnal visual and nocturnal radar techniques proposed in this plan have become standard methods for studying bird

migration (e.g., Gauthreaux 1980; Cooper et el. 1991a, 1991b; Gauthreaux and Belser 2003), including in Alaska (Cooper et al. 1991a, 1991b; Cooper and Ritchie 1995; Day et al. 2005, 2007; Shook et al. 2006, 2011).

10.15.6. Schedule

The migration study using coordinated radar and visual sampling is proposed for the spring (late April–early June) and fall (mid-August–mid-October) migration periods in 2013, with the decision to conduct a second year of sampling being dependent on the results obtained in 2013.

For the other study components described above, the same seasonal schedule will be followed in both 2013 and 2014 (Table 10.15-1). The timing of some surveys, particularly in spring and summer, will depend on ice break-up and the nesting phenology for the year. Approximately 10–11 spring migration/breeding-pair surveys will be flown between late April (start date determined by the timing of river break-up and lake moat formation each year) and mid-June at intervals of 5 days. Two breeding-pair transect surveys will be flown in the first half of June. At least two brood surveys (possibly three, depending on the developmental stages of juveniles on the second survey) will be flown beginning in mid-July each year. Two pre-nesting surveys for Harlequin Ducks will be flown in late May/early June and two brood-rearing surveys will be flown in late July/early August. Fall migration surveys will begin in mid-August and will continue until mid-October at intervals of 5 days. After each aerial survey, data will be transcribed, reviewed, and entered into a database for final quality assurance/quality control (QA/QC) review. Data analysis will be conducted progressively throughout summer and fall to allow for rapid completion in November and December. The Initial Study Report will be completed by February 2014 and the Updated Study Report will be completed by February 2015. Study updates will be provided during Technical Workgroup meetings, which will be held quarterly during 2013 and 2014.

10.15.7. Relationship with Other Studies

Except for current information each spring about river break-up conditions from the study of Ice Processes in the Susitna River (Section 7.6), which will be used to help determine the start date of spring migration surveys, the Waterbird Migration, Breeding, and Habitat Use Study will not require specific information inputs from other studies, but will provide information to several other studies (Figure 10.15-2). The various types of surveys conducted for this study will provide information that will be used in the assessment of Project impacts and development of appropriate protection, mitigation, and enhancement (PM&E) measures, which will be conducted in 2015 for the FERC License Application. The ground-based visual and radar surveys during spring and fall migrations in 2013 will be conducted concurrently with the Landbird and Shorebird Migration, Breeding, and Habitat Use Study (Section 10.16) to document the nature of migratory movements of a broad variety of birds near the proposed dam and associated facilities. Information regarding habitat use and abundance among different habitats will be incorporated into the habitat ranking matrix constructed for the Evaluation of Wildlife Habitat Use (Section 10.19), which will be used to assess the potential impacts and to develop PM&E measures, as appropriate, for the FERC License Application. Information on the food habits and diets of piscivorous waterbirds will be synthesized for use in the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7), and nest locations of waterbird species found during breeding-season surveys will be recorded to enable collection of feather samples (after the nests

are vacated) for baseline characterization of mercury levels by the Mercury Assessment and Potential for Bioaccumulation Study (Section 5.7).

The primary impact mechanisms of the Project on waterbirds may include the following:

- Permanent direct and indirect habitat loss and alteration.
- Temporary direct and indirect habitat loss and alteration.
- Direct behavioral impacts, such as attraction or avoidance, resulting from vehicular use, noise, and increased human presence associated with Project construction or operation.
- Indirect behavioral impacts to wildlife, such as attraction or avoidance, resulting from changes in vehicular use, noise, and increased human presence associated with increased subsistence or recreational access that may be facilitated by Project development.
- Mortality due to increased subsistence and recreational harvest that may be facilitated by improvements in human access that result from Project development.
- Changes in mortality due to predation that may result from changes in the abundance and distribution of waterfowl predators, including both mammalian and avian carnivores.
- Direct mortality due to strikes with vehicles, power lines, towers, or other Project facilities; exposure to contaminants; and attraction to garbage and human activity.

Impacts associated with habitat loss and alteration, attraction and avoidance, and direct mortality will occur primarily in the Project area, including the impoundment area, access and transmission corridors, and other facility footprints. Impacts associated with increased harvest and changes in predator abundance may occur over a larger area in which changes in both competing mammalian predators and prey species abundance may occur.

During the impact assessment that will be conducted in 2015 for the FERC License Application, data on the distribution, abundance, and productivity of and habitat use by waterbirds in the study area will be used to assess Project impacts on these populations. Impacts of direct and indirect habitat loss and alteration can be assessed through geospatial analysis. When plotted on the wildlife habitat map developed by the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5), the locations of breeding pairs, brood-rearing groups, and staging birds will allow identification of high-value seasonal habitats for each waterbird species. Using GIS software, the direct and indirect impacts of the Project can be evaluated for each waterbird species by overlaying the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors onto the habitat map to calculate loss of preferred or critical habitats.

Additional indirect impacts of habitat loss and alteration and behavioral reactions (such as avoidance) can be estimated by applying various buffer distances, as determined from the literature on the effects of similar projects. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on waterbird populations. Density estimates for breeding pairs and brood-rearing waterbirds in each habitat and linear densities of Harlequin Ducks can be used to estimate the number of birds potentially affected by habitat loss and alteration and by behavioral reactions that may result in avoidance. Location data for each species can be used to assess risks from power lines and other bird strikes for various Project alternatives. Industry standards and best practices (e.g., APLIC and USFWS 2005; APLIC 2006) and other literature reviews (e.g., Evans et al. 2007; Longcore et al. 2008; Gehring et al. 2009) will be consulted when designing and siting transmission lines and lighting Project facilities, to reduce the risk of attraction and

collision of birds with Project infrastructure, while still complying with other federal and state requirements for facility lighting for aviation safety. Any necessary PM&E measures will be developed, as appropriate, by examining the distribution and abundance of species among habitats in relation to the geographical extent and seasonal timing of various Project activities.

10.15.8. Level of Effort and Cost

The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting; helicopter support costs have not been included in this estimate. The aerial survey portion of the study will require an estimated minimum of 86 person-days, not including weather delays or changes in study design, as indicated below:

- Migration surveys = 20 person-days in spring; 26 person-days in fall
- Breeding-pair surveys = 12 person-days (assuming two surveys per year)
- Harlequin Duck pre-nesting surveys = 8 person-days
- Harlequin Duck brood-rearing surveys = 8 person-days
- Waterbird brood-rearing surveys = 12 person-days

The ground-based migration study employing diurnal visual and nocturnal radar and audiovisual sampling (which also will provide data for the Landbird and Shorebird Migration, Breeding, and Habitat Use Study, Section 10.16) will require a crew of four biologists working day and night shifts over a period of up to 120 days (total for spring and fall fieldwork) and is estimated to cost approximately $600,000 in 2013. The projected cost of the aerial-survey portion of the waterbird study is approximately $300,000 annually. Hence, the total cost is estimated at $900,000 in 2013 and $300,000 in 2014, for a 2-year total of $1.2 million. The decision to continue the ground-based migration monitoring task in 2014 will be based on the results obtained in 2013.

10.15.9. Literature Cited

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10.15.10. Tables

Table 10.15-1. Schedule for implementation of the Waterbird Migration, Breeding, and Habitat Use Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Spring migration surveys (ground-based visual & radar monitoring)		—				—			
Spring migration aerial surveys, transitioning to breeding-pair surveys; Breeding-pair transect surveys; Pre-nesting surveys for Harlequin Ducks		—				—			
Brood surveys in water bodies; Harlequin Duck brood surveys in streams			—				—		
Fall migration surveys (ground-based visual & radar monitoring)			—	—			—	—	
Fall migration aerial surveys			—	—			—	—	
Data QA/QC and analyses			—	—	—		—	—	—
Initial Study Report				—	Δ				
Updated Study Report								—	▲

Legend:

—— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.15.11. Figures

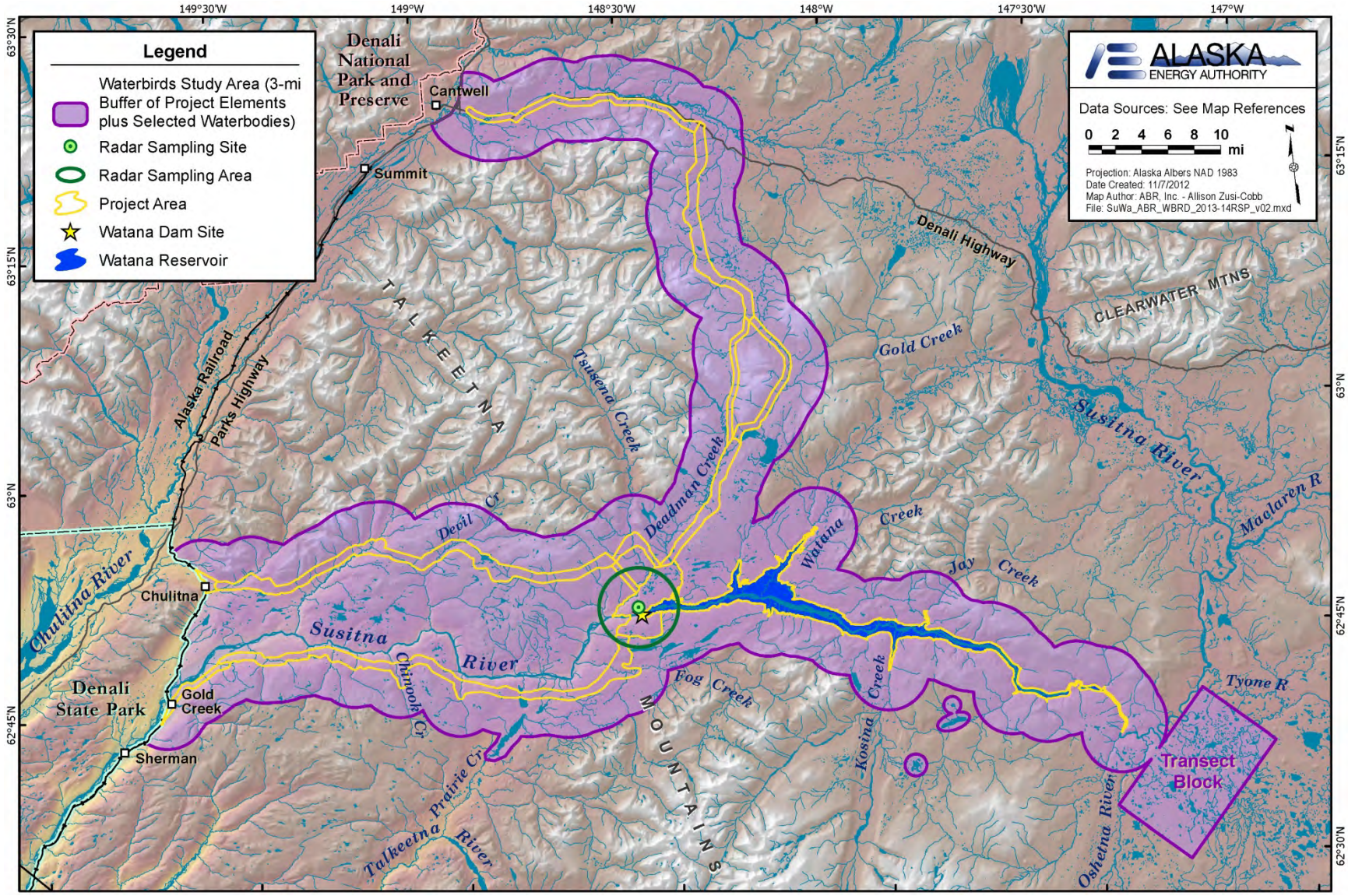

Figure 10.15-1. Waterbird Migration, Breeding, and Habitat Use Study area.

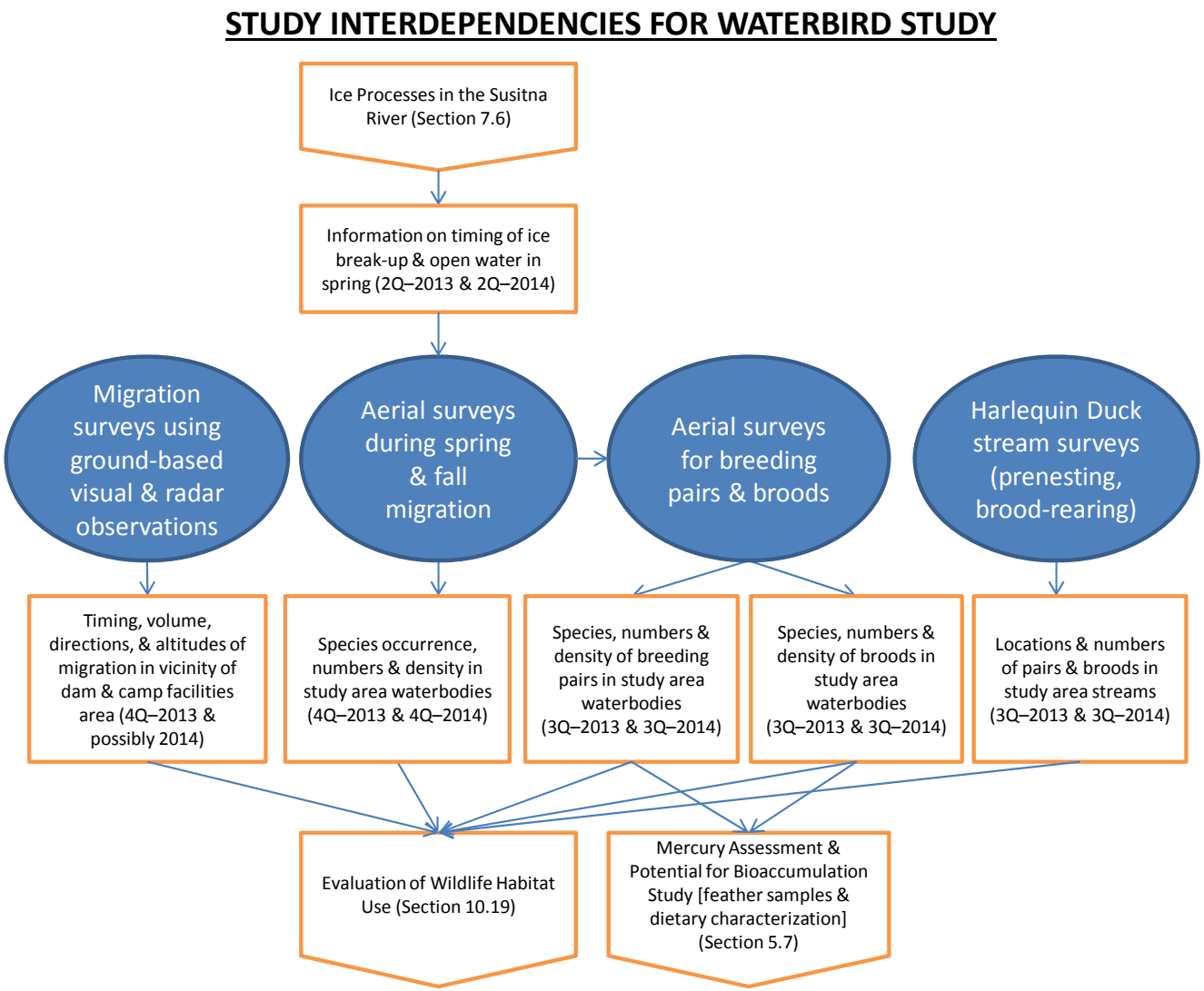

Figure 10.15-2. Study interdependencies for the waterbird study.

10.16. Landbird and Shorebird Migration, Breeding, and Habitat Use Study

10.16.1. General Description of the Proposed Study

The Landbird and Shorebird Migration, Breeding, and Habitat Use Study is planned as a two-year study (2013–2014). Results from the first year of work in 2013 will be used to update existing information and to fine-tune the field survey methods and survey areas in 2014, if necessary. The landbird and shorebird study will employ three basic survey methods: ground-based point-count surveys for breeding birds, a boat-based survey for colonially nesting swallows, and ground-based monitoring of migration using a combination of daytime visual observations and nocturnal radar sampling. The point-count surveys are intended to record all birds seen or heard and to estimate the distance to each bird detected. Point-count surveys, which were designed to count singing male passerines, are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless terrain in Alaska (Handel and Cady 2004; ALMS 2010). These methods also have been adopted for shorebirds (ASG 2008) and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations, even with a relatively large survey effort. The survey of colonially nesting swallows will focus on suitable habitats within the proposed reservoir inundation zone. The boat-based survey will identify swallow nesting colonies and potential nesting habitat.

Study Goal and Objectives

The goal of this study is to collect baseline data on the occurrence and habitat use of breeding landbirds and shorebirds in the Project area to enable assessments of the direct, indirect, and cumulative impacts on these birds from construction and operation of the proposed Project. This study will include species of conservation concern, both landbirds and shorebirds, that are known or expected to occur in the Project area (see AEA 2011), as well as numerous other species that are protected under the federal Migratory Bird Treaty Act (see Section 10.3).

The study has four specific objectives:

- Collect data on the distribution and abundance of landbirds and shorebirds during the summer breeding season.
- Identify habitat associations for landbirds and shorebirds.
- Evaluate changes in distribution, abundance, and habitat use of landbirds and shorebirds through comparison with historical data.
- Characterize the timing, volume, direction, and altitude of landbirds and shorebirds migrating through the dam and camp facilities area.

To achieve these objectives, the following surveys and analyses will be required:

- Conduct ground-based point-count surveys to collect field data on the distribution and abundance of landbirds and shorebirds in the study area during the summer breeding season.
- Conduct focused point-count and linear walking surveys in riparian and lacustrine habitats, targeting piscivorous species and other species typical of fluvial, riparian, and lacustrine habitats, which often are under-represented in standard point-count surveys.

- Conduct boat-based surveys of colonially nesting swallows in riparian habitats within the reservoir inundation zone.
- Collect habitat-use data for landbirds and shorebirds during the point-count surveys to inform the Evaluation of Wildlife Habitat Use Study (Section 10.19), which will be the first step in quantifying habitat change (i.e., gain/loss and alteration) for landbirds and shorebirds from the proposed Project.
- Review the literature on the foraging habits and diets of piscivorous and partly piscivorous landbird and shorebird species (e.g., Belted Kingfisher, American Dipper, Spotted Sandpiper), which will be used to inform the Mercury Assessment and Potential for Bioaccumulation Study (see Section 5.7).
- Conduct visual migration-watch surveys and radar sampling in the immediate vicinity of the dam, powerhouse, and camp facilities.
- Review historical (Alaska Power Authority [APA] Susitna Hydroelectric Project) data on landbirds and shorebirds for comparison with the current data from this study, to evaluate any changes in distribution, abundance, and habitat use over the intervening 30 years. Many species of migratory birds have suffered population declines in recent decades, so these comparisons may also provide information on the population status of those species in the Project area.

10.16.2. Existing Information and Need for Additional Information

In 1980 and 1981, breeding landbirds and some shorebirds were surveyed for the APA Susitna Hydroelectric Project using modified territory-mapping methods, which involved repeated visits between May 20 and July 3 to 12 study plots, each 10 hectares (24.7 acres) in size (Kessel et al. 1982; AEA 2011). Each plot was placed in an area of homogeneous habitat, as defined using Kessel's avian habitat classification (Kessel 1979). At that time, territory mapping was the standard method for surveying landbirds. Because each plot was surveyed repeatedly, substantial information on bird occurrence and habitat use was obtained for the limited area encompassed by those 12 plots. However, because only 12 plots were sampled in homogeneous habitats, the data did not adequately address spatial variability in bird occurrence and habitat use across the broader study area. Some additional information on shorebird occurrence was obtained during ground-based surveys of lakes, ponds, and wetlands for waterbirds (Kessel et al. 1982), but focused surveys for breeding shorebirds were not conducted. No studies of landbirds or shorebirds have been conducted more recently in the Project area (AEA 2011).

During the surveys by Kessel et al. (1982), four species of swallows were observed in the Project area: Tree Swallow, Bank Swallow, Cliff Swallow, and Violet-green Swallow. Violet-green and Tree swallows were considered fairly common, whereas Bank and Cliff swallows were considered uncommon, and all four species were either confirmed or suspected to nest in the study area. A nesting colony of 25 pairs of Bank Swallows was recorded along upper Watana Creek and three colonies of Cliff Swallows were observed at Watana and Clarence lakes. The distribution of avian survey plots and incomplete representation of habitat types suitable for swallows likely led to an underestimate of swallow abundance and distribution in the Project area by Kessel et al. (1982). No studies of swallows have been conducted more recently in the study area.

Because of the limitations in extrapolating results from intensive surveys of territory-mapping plots to the larger Project area, it will be necessary to study these species groups again using

currently accepted protocols (point-count surveys), which allow large landscapes to be sampled adequately and which provide more data on variability in habitat use. Because the most recent surveys for landbirds and shorebirds were conducted over 30 years ago, and because populations of these birds and their habitats have likely changed during that period, new studies are recommended. Current data on the distribution, abundance, and habitat use of landbirds and shorebirds is necessary to be able to adequately assess the impacts from the proposed Project on these species.

Point-count surveys are not always effective in riparian habitats, where the auditory capacity of observers can be reduced in some locations because of rapidly flowing water, and are sub-optimal for species such as swallows, that have highly clumped distributions (Swanson and Nigro 2003). Because much of the swallow nesting habitat in the study area is difficult to access or observe on foot, a separate survey effort has been designed to assess the distribution and abundance of colonially nesting swallows in riparian habitats.

No migration surveys for landbirds and shorebirds were conducted specifically for the original APA Susitna Hydroelectric Project studies, although information was compiled opportunistically (Kessel et al. 1982). The U.S. Fish and Wildlife Service (USFWS) is concerned about the potential for attraction of migrating landbirds and shorebirds to artificially lighted facilities constructed for the Project, potentially resulting in mortality from collisions, as expressed in comments in various meetings (see Appendices 3 and 4).

10.16.3. Study Area

The study area for the breeding landbird and shorebird point-count survey includes a 2-mile buffer zone around the proposed reservoir impoundment zone, dam and camp facilities area, access road and transmission corridor alternatives, and material sites (Figure 10.16-1). All direct and indirect effects of the proposed Project on landbirds and shorebirds and their habitats in the upper Susitna basin are expected to be encompassed by this 2-mile buffer.

The point-count and linear walking surveys in riparian and lacustrine habitats will be conducted in the primary riparian and lacustrine habitats in the inundation zone, the infrastructure area surrounding the site of the proposed dam, and in riparian habitats along the Susitna River immediately below the location of the proposed dam.

The survey area for colonially nesting swallows includes riparian habitats along the Susitna River and its tributaries within the reservoir inundation zone. The Susitna River in the inundation zone is an alluvial river located in a shallow canyon and is moderately braided with a low gradient. Tributaries to the Susitna River (e.g., Deadman, Tsusena, Watana, Jay, and Kosina creeks) are lower volume, steeper gradient, clearwater streams with deeply incised canyons along their lower reaches. Habitat features to be examined during the survey will include all riverbanks and cliffs adjacent to these rivers and streams.

The sampling site for the migration study component will be located on the adjacent benchland just above the dam site on the north side of the river (Figure 10.16-1).

10.16.4. Study Methods

10.16.4.1. Point-count Surveys

10.16.4.1.1 Study Design

The proposed methods for the breeding landbird and shorebird study are ground-based point-count surveys, in which all birds seen or heard are recorded, along with an estimate of the horizontal distance to each bird observed. Point-count surveys, which were designed to count singing male passerine birds, are now the preferred method for inventory and monitoring efforts for landbirds in remote, roadless landscapes in Alaska (Handel and Cady 2004; ALMS 2010). These methods have been adopted for shorebirds (ASG 2008) and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations, even with a relatively large survey effort.

Point-count surveys are appropriate for large development projects that affect a large area and can include many different types of habitats. The sample points can be distributed across the landscape and allocated among habitat types to ensure that all prominent habitat types are sampled. Because management agencies in Alaska are increasingly concerned with landbird and shorebird species of conservation concern (which are generally uncommon), and because it is important to sample many different occurrences of each habitat type to detect uncommmon species (which are patchy in occurrence across the landsape), this study has been designed so that point-counts are allocated in as many different occurrences of each of the prominent habitat types in the study area. In 2013, point-count sampling locations will be distributed using a pseudo-stratified random plot allocation procedure based on aerial photosignatures as the sampling strata (because a current, complete habitat map will not be available by spring 2013). The plot allocation methods may change in 2014 after a current, complete habitat map is available. This procedure will result in adequate sampling of habitats, over two years of surveys, so that habitat-use evaluations for landbirds and shorebirds will be supported by Project area-specific data. These habitat-use evaluations (see Section 10.19) are a critical link in conducting quantitative assessments of habitat loss and alteration for breeding landbirds and shorebirds.

Several species of landbirds and shorebirds are not commonly recorded in standard point-count surveys allocated randomly across available habitats, but are known to be closely associated with riparian and lacustrine habitats (e.g., Belted Kingfisher, American Dipper, Semipalmated Plover, Solitary Sandpiper, Spotted Sandpiper, Wandering Tattler). Therefore, an additional set of point-count surveys will be conducted specifically in riparian and lacustrine habitats that are expected to be affected by Project development (see Section 10.16.4.2 below). These additional surveys were requested by USFWS (see Appendices 3 and 4).

The landbird and shorebird study will be coordinated with the other wildlife studies being conducted for the Project, especially the raptor and waterbird studies, so that sightings of bird species that apply to other studies can inform the qualitative results and reporting efforts among studies.

10.16.4.1.2 Field Surveys

Point-count field surveys will follow standard protocols for point-counts in Alaska (Handel and Cady 2004; ALMS 2010). These protocols are based on the variable circular-plot point-count

methods and temporally stratified observation periods (Ralph et al. 1995; Buckland et al. 2001; Farnsworth et al. 2002; Rosenstock et al. 2002). Surveys will be conducted during early morning hours to maximize the detection of breeding species, especially singing male passerines. Standard 10-minute observation periods will be used and, to facilitate the collection of habitat-use data, the specific habitat being used by each bird observed will be recorded whenever possible. These data on the habitats being used by landbirds and shorebirds at the time of observation also will be used as an additional ground-reference data set to help in the mapping of wildlife habitats in the upper and middle Susitna basin (see Section 11.5).

As noted above, the point-count plot locations in 2013 will be selected using a pseudo-stratified random plot allocation procedure based on aerial photosignatures as the sampling strata, because it is unlikely that a current and complete habitat map will be available by spring 2013. In 2014, point-count locations will be selected again using a pseudo-stratified random plot allocation procedure, but mapped wildlife habitat types are expected to be available for use as the sampling strata (to the extent the wildlife habitat mapping is complete by spring 2014). In both years, the plot allocation will be constrained so that an adequate number of plots are placed in each mapped habitat or photosignature type. Without this constraint, an excessive number of plots would be located in the most common habitat types and far fewer would occur in uncommon types, resulting in under-sampling of uncommon habitat types. In all cases, sample points will be located in a random and spatially unbiased fashion (using the Geographic Information System [GIS]) within each mapped habitat or photosignature type, subject to the restriction of maintaining a minimum distance of 500 meters (1,640 feet) between sample points in open habitats and 250 meters (820 feet) in closed habitats. This sampling scheme will result in a selection of point-count locations that is unbiased with respect to the distribution of breeding birds on the landscape. The goal in plot allocation is to derive a set of sample points that are spread broadly across the study area and are replicated within each photosignature/habitat type to capture spatial variability in habitat use by breeding birds. Replicate sampling is also important to locate the often patchy occurrences of the less common species of conservation concern.

The point-count observers will estimate distance to birds detected on the surveys, using distance classes of 10-meter increments to 100 meters, then 100–125 meters, 125–150 meters, and >150 meters. Laser rangefinders will be used to confirm and calibrate the distance estimates. Using finer-scale distance classes in the field will allow the data to be grouped into broader categories later for analysis, if necessary. Experienced point-count observers will be used for these surveys, and all observers will receive refresher training before beginning fieldwork, to include bird identification (visual and by song and call), distance estimation to known targets, distance testing in a simulated survey, accuracy re-testing of distance estimates, and final distance testing in a simulated survey.

One extended field survey is planned in each summer breeding season in 2013 and 2014. In general, the survey is planned to begin in mid-May in each year, although survey timing may need to be adjusted to account for variability in the onset of breeding activities in response to early or late snowmelt and/or unseasonable temperature conditions in spring; local weather conditions and the activities of breeding birds in the Project area will be monitored each spring by communicating with the Project helicopter pilots and other wildlife researchers in the area (e.g., raptor biologists who will be surveying in the area in late April of each year). The surveys in May will be focused on breeding shorebirds and early nesting landbirds such as the Rusty Blackbird, a species of conservation concern in Alaska (USFWS 2008). It is likely that data on

early nesting resident birds also will be collected in the early portion of the survey period because nesting starts later at the higher elevations typical of the Project area. The point-count survey period will extend into mid-June to focus on neotropical migrant landbirds. Late-arriving flycatchers (e.g., Alder Flycatcher) will be present by early June. It is expected that some data on nesting resident birds and shorebirds will be collected during early June as well.

For the early portion of the survey period in May, point-count plots will be allocated preferentially in open habitats that are used by breeding shorebirds. These habitats include open wetlands in forested areas as well as open, dwarf scrub-dominated habitats in upland and alpine terrain. Woodland bog and tall scrub habitats in poorly drained lowlands will also be sampled because they are used by breeding shorebirds and Rusty Blackbirds. By later in the survey period (late May and early June), point-count plots will be allocated across all available habitats in the study area. As noted above, this survey will focus on neotropical migrant landbirds.

10.16.4.1.3 Data Analysis

Point-count survey data are subject to errors resulting from species-specific variability in vocalizations and behavior, observer variability in detecting birds, variability in detecting birds in different habitats, and variability in distance estimates. Consequently, to improve estimates of abundance and density, in analyses of the point-count survey data, researchers will use removal sampling (to improve the estimates of detection probabilities, especially for uncommon species; Farnsworth et al. 2002) and distance sampling (to calculate detection probabilities and densities; Buckland et al. 2001; Rosenstock et al. 2002), as recommended by USFWS during the landbird-shorebird meeting on September 6, 2012 (see Appendices 3 and 4). Observations will be stratified temporally (by point-count period) and spatially (by distance category) to estimate detection probabilities for all species, and allow corrections of the data to account for those birds that were present but not detected (Buckland et al. 2001; Rosenstock et al. 2002). Conducting both removal and distance analyses to estimate detection probabilities will result in improved estimates of abundance and density. As recommended by USFWS (see Appendices 3 and 4), existing detection functions, developed in other point-count studies in Alaska, will be used when necessary (e.g., to improve detectability estimates of uncommon species for which few observations in the study area may be available for analysis).

10.16.4.2. Riparian- and Lacustrine-focused Surveys

In May, an additional set of point-count surveys and linear surveys between point-count plot locations will be conducted specifically in riparian and lacustrine habitats that are expected to be affected by Project development. These surveys will be conducted in the inundation zone, in the infrastructure area surrounding the site of the proposed dam, and immediately below the location of the proposed dam. The surveys will target species (e.g., Semipalmated Plover, Spotted Sandpiper, Solitary Sandpiper, Wandering Tattler, Belted Kingfisher, and American Dipper) that are known to use riparian and lacustrine habitats, and which are not often recorded on point-counts allocated randomly across all available habitats. In addition to the point-count surveys in riparian and lacustrine habitats, researchers will walk along the sampled stream courses and lake/pond shorelines as they move between point-count locations. During these linear surveys, all birds observed will be recorded. The resulting data will be represented as the number of observations of each species per unit time spent in-transit to provide a standardized, relative measure of abundance across all species (following methods used by Andres et al. 1999 and

Boisvert and Schick 2007). A similar survey design for recording landbirds and shorebirds and relative levels of abundance while in transit between point-count locations was successfully completed on the Seward Peninsula in 2006 (Boisvert and Schick 2007) by the same wildlife contractors who will conduct the riparian- and lacustrine-focused surveys for this Project.

An additional goal of the riparian- and lacustrine-focused surveys will be to collect data on the distribution and abundance of piscivorous species (primarily Belted Kingfisher, but also American Dipper and Spotted Sandpiper, which occasionally consume fish) in the inundation zone and immediately below the location of the proposed dam (because elevated mercury levels could occur there in any fish that make it through the turbines). This information will be provided to the researchers conducting the mercury assessment study (see Section 5.7).

10.16.4.3. Survey of Colonially Nesting Swallows

The focal species for this survey effort include Bank Swallow, Cliff Swallow, and Violet-green Swallow. These three species are gregarious, colonial nesters that prefer riparian cutbanks and cliffs near lacustrine or fluvial waters (Kessel et al. 1982; Brown et al. 1992; Brown and Brown 2002; Garrison 2002). Bank and Violet-green swallows nest in burrows in relatively soft, sandy substrates and may form mixed-species colonies (Brown et al. 1992; Garrison 2002); data on Belted Kingfishers also are likely to be obtained incidentally because they nest in burrows in the same type of bank habitat. Cliff Swallows build nest cavities of mud and clay on rocky cliffs, bridges, and other human-made structures (Brown and Brown 2002). All three species feed on flying insects and often forage over or near water bodies (Brown et al. 1992; Brown and Brown 2002; Garrison 2002).

The swallow survey will be conducted using a motorized river boat for access to the Susitna River and tributary streams in the reservoir inundation zone. Researchers will search suitable nesting habitat and record nesting colonies. Two observers, plus the boat operator, will conduct the survey. In portions of tributary streams not accessible by boat, the survey will be conducted on foot. One observer will record the geographic locations of nesting habitat and colonies on a topographic map or aerial imagery, as well as in a hand-held global positioning system (GPS) receiver. The other observer will photograph the habitat and colonies to aid in accurate nest counts and to quantify the total area of potential nesting habitat. Both observers will assist in species identification and will estimate abundance and activity. Researchers will stop and observe active colonies for a minimum of 15 minutes, as recommended by Garrison et al. (1989), to allow accurate species identification and to obtain estimates of abundance and activity.

Accessible colonies will be closely inspected to estimate the proportion of active burrows. Researchers will check a stratified-random (spatially balanced) sample of burrows within accessible colonies using a flashlight and an angled mirror attached to an extendable rod. Burrows containing eggs, young, or adults will be considered occupied. The number of eggs or young in nests will be recorded. These data will be used to estimate the total number of active burrows in each colony and in the surveyed area as whole, thereby facilitating an estimation of population size.

The survey will be conducted in late June or early July of 2013 and 2014, depending on the snowmelt and temperature patterns in spring and early summer of each year. All three focal species normally arrive in Interior Alaska by mid- to late May and nesting occurs in June and July (Kessel et al. 1982; Brown et al. 1992; Brown and Brown 2002; Garrison 2002). Bank

Swallows may reuse old burrows or create new burrows during courtship (Hickman 1979). Therefore, surveys will be timed to occur after mating and nest establishment to reduce variability in burrow numbers (Jones 1987). Vacant, but suitable, nesting habitat will be recorded to quantify the total area of potential nesting habitat present in the study area and to inform subsequent survey efforts in 2014, which will focus on revisiting colonies located in 2013.

All accessible navigable portions of the study area will be surveyed once in 2013 and again in 2014. Changes in numbers of individuals, colonies, and nests between the two years could provide information on the variability in swallow populations and will improve abundance estimates. In addition to swallows, researchers will record incidental observations of other birds during this survey to support this and the other avian studies.

10.16.4.4. Migration Surveys

The migration survey component of this study will employ a combination of daytime visual sampling and nocturnal radar and visual sampling (using night-vision devices) during both the spring (late April to June) and fall (late August to mid-October) migration periods. This study component will be conducted in concert with the waterbirds study and is described in more detail in that study plan (see Section 10.15).

10.16.4.5. Integration of Existing Information with Current Study

The landbird and shorebird data collected in the APA Susitna Hydroelectric Project area in the 1980s (Kessel et al. 1982; AEA 2011) will be reviewed and incorporated into analyses of habitat use by these species presented in the Initial Study and Updated Study reports (see below). The primary focus will be to compare habitat-use patterns in the historical data with the results of current data analyses. The abundance and distribution information for landbirds and shorebirds from Kessel et al. (1982) will be reviewed to evaluate changes in abundance and distribution over the intervening 30 years. These historical comparisons will provide information on the recent trends for these species in the Project area, which will be useful for impact predictions and assessments.

10.16.4.6. Mercury Assessment

Scientific literature on the foraging habits and diets of piscivorous landbirds and shorebirds (primarily Belted Kingfisher, but also American Dipper and Spotted Sandpiper) will be reviewed to inform the mercury risk-assessment work (see Section 5.7, Mercury Assessment and Potential for Bioaccumulation Study) and to complement the field data gathered on the distribution and abundance of these species in the study area. To the extent possible, the information gathered will be focused on data from Alaska studies. In addition to the literature review, feathers will be collected from any kingfisher nests located during the swallow survey and will be provided to the study lead for the mercury study for laboratory analysis of methylmercury levels.

10.16.4.7. Reporting and Data Deliverables

The database and reporting deliverables for this study include the following:

- **Electronic copies of field data.** A geospatially-referenced relational database will be prepared, containing historical (APA Susitna Hydroelectric Project) data and current data

collected during this study, including representative photographs of breeding bird habitats at point-count locations. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards established for the Project.

- **Initial Study Report and Updated Study Report.** The landbird and shorebird study results will be presented in the Initial and Updated Study reports, according the schedule indicated in Table 10.16-1. The reports will include descriptions of the field survey methods, a map of the locations surveyed, and survey results with tables indicating abundance by species and habitat type.

10.16.5. Consistency with Generally Accepted Scientific Practice

The landbird and shorebird study will employ point-count surveys and analytical methods that conform to currently accepted, standard protocols for the monitoring of landbirds in remote, roadless landscapes of Alaska (Handel and Cady 2004; ALMS 2010). In recent years, these methods have also been adopted for shorebird surveys in Alaska (ASG 2008) and are especially appropriate in forested landscapes, where shorebirds typically occur in low densities and where plot-based methods would yield few observations, even with a relatively large survey effort.

The survey of colonially nesting swallows will employ the best available techniques. There currently is no standard protocol for surveying swallow colonies, but the methods proposed above follow those used elsewhere (Garrison et al. 1989; Watts et al. 1996). These methods are intended to be an improvement on point-count surveys, which are widely regarded to be inadequate for swallows and similar riparian species (Swanson and Nigro 2003).

The migration surveys will employ well-developed techniques for radar and visual sampling that have been used for similar studies in Alaska and elsewhere in North America, as is described in more detail in the waterbirds study plan (Section 10.15).

10.16.6. Schedule

The landbird and shorebird study will be a two-year effort. The schedule for the 2013 and 2014 activities is presented graphically below (Table 10.16-1). Logistics and survey planning will occur in March and April of 2013 and 2014. The radar and visual surveys of spring migrant birds (conducted in conjunction with the waterbirds study) will occur from late April to early June of 2013 and 2014. Point-count surveys and the riparian- and lacustrine-focused surveys will take place over a continuous 30-day period from mid-May to mid-June in 2013 and 2014. The swallow colony survey will take place over approximately four days between June 20 and July 10 of 2013 and 2014. Fall migration sampling (radar and visual sampling conducted in conjunction with the waterbirds study) will occur from mid-August to mid-October of 2013 and 2014. Data analysis will occur from July to December of 2013 and 2014. The Initial Study Report will be completed in February of 2014 and the Updated Study Report in February of 2015.

In 2014 and 2015, licensing participants will have opportunities to review and comment on the study reports (Initial Study Report in early 2014 and Updated Study Report in early 2015). Updates on the study progress will be provided during Technical Workgroup meetings, which will be held quarterly in 2013 and 2014.

10.16.7. Relationship with Other Studies

This study has limited information needs from other studies, as is portrayed below (Figure 10.16-2). Before the point-count surveys and the riparian- and lacustrine-focused surveys, preliminary interpretation of aerial imagery from the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5) will be conducted to establish a preliminary classification of habitats for sample allocation. A pseudo-stratified random sampling scheme will be used to allocate point-count locations and effort among habitats. Habitat-specific survey data from the field surveys will be used to describe the distribution and abundance of each species detected in each habitat sampled, and density estimates will be calculated for each species in each habitat in which it was detected. Field survey data from the swallow colony survey will be used to document the locations of swallow colonies, which will facilitate separate population estimates of those species within the surveyed area. The diurnal visual and nocturnal radar migration surveys will be conducted in conjunction with the waterbird study (Section 10.15) to provide data on landbird and shorebird migration, including timing, volume, altitude, flight directions, and any corridors identified. High-value habitats for each species will be identified and density and distribution data from the various surveys of landbirds and shorebirds will be used to inform the Evaluation of Wildlife Habitat Use Study (Section 10.19), which in turn will be used to quantify potential Project impacts and to develop any protection, mitigation, and enhancement (PM&E) measures for landbirds and shorebirds, as appropriate (see below).

Landbirds and shorebirds could be affected directly by the loss of breeding habitat from the placement of fill and from the conversion of terrestrial habitats to lacustrine habitats in the proposed reservoir. Additional indirect impacts could occur from alteration of habitats by erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Disturbance effects (displacement from breeding habitats) from construction and operations activities represent another possible source of indirect impacts. Direct impacts could occur through injury and mortality in various ways (e.g., if exposed to fuel from accidental spills or from in-flight collisions with infrastructure). Alterations in riparian wildlife habitats downstream from the proposed dam due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River are also possible, and will be addressed in the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (see Section 11.6).

The impact assessment for landbirds and shorebirds will be conducted during preparation of AEA's License Application in 2015 by first conducting habitat-use evaluations (see Sections 10.19 and 11.5) to assign habitat values for each landbird and shorebird species to each of the wildlife habitats mapped in the Vegetation and Wildlife Habitat Mapping Study (see Section 11.5). Then the various components of the Project "footprint" will be overlaid on the mapped wildlife habitat types using GIS to quantify the acreages of important breeding habitats for each species that would be lost directly to fill or inundation. The determination of acreages of landbird and shorebird habitats that may be affected indirectly by habitat alteration and behavioral disturbance will be conducted similarly by overlaying habitat alteration and disturbance buffers (surrounding the proposed Project infrastructure). The size and number of habitat alteration and disturbance buffer(s) to be used will be determined based upon the final specifications for Project construction, operations, and maintenance activities, which will be provided in the Project description. Direct impacts on landbirds and shorebirds will be assessed qualitatively by evaluating the likelihood of injury and mortality from various sources during Project construction and operations. Cumulative effects on landbirds and shorebirds in the region of the

proposed Project will be assessed by evaluating the extent of the direct and indirect impacts expected from the Project in conjunction with the existing impacts on landbirds and shorebirds in the region.

10.16.8. Level of Effort and Cost

The ground-based point-count surveys are planned to be conducted over two years (2013–2014). The point-count field surveys (late spring and early summer) will be conducted each year by a crew of eight observers (four crews of two persons each). Point-count surveys will be conducted for approximately 28 days each year, with the goal of obtaining at least 800 point-count samples each year. Helicopter support will be required for this survey with drop-off and pick-ups each day in the field. The surveys will start at first light in the morning, which in the Project area will be approximately 3:30 A.M. The bulk of the costs associated with this study are for field sampling, data analysis, and reporting.

The survey of colonially nesting swallows will focus on estimating the abundance and distribution of swallows in riparian habitats within the inundation zone. The field survey will be conducted in a short time period (estimated four days each year) and require only two observers (plus a boat operator). However, this survey has specific field equipment and safety requirements, including boating and camping equipment that will require helicopter sling transport.

The estimated cost for the landbird/shorebird component of the spring and fall migration surveys is included in the cost estimate for the waterbirds study plan (see Section 10.15), so is not listed here.

The projected annual cost of this study is in the range of $425,000–$450,000, for an estimated total of $850,000–$900,000 over both years.

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10.16.10. Tables

Table 10.16-1. Schedule for implementation of the landbird and shorebird study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1Q
Review aerial imagery & select point-count survey sites		—				—			
Point-count field surveys		—				—			
Riparian- and lacustrine-focused surveys		—				—			
Swallow colony survey			—				—		
Migration surveys (radar & visual)		—	—	—		—	—	—	
Data analysis			—	—			—	—	
Initial Study Report					Δ				
Updated Study Report									▲

Legend:

— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.16.11. Figures

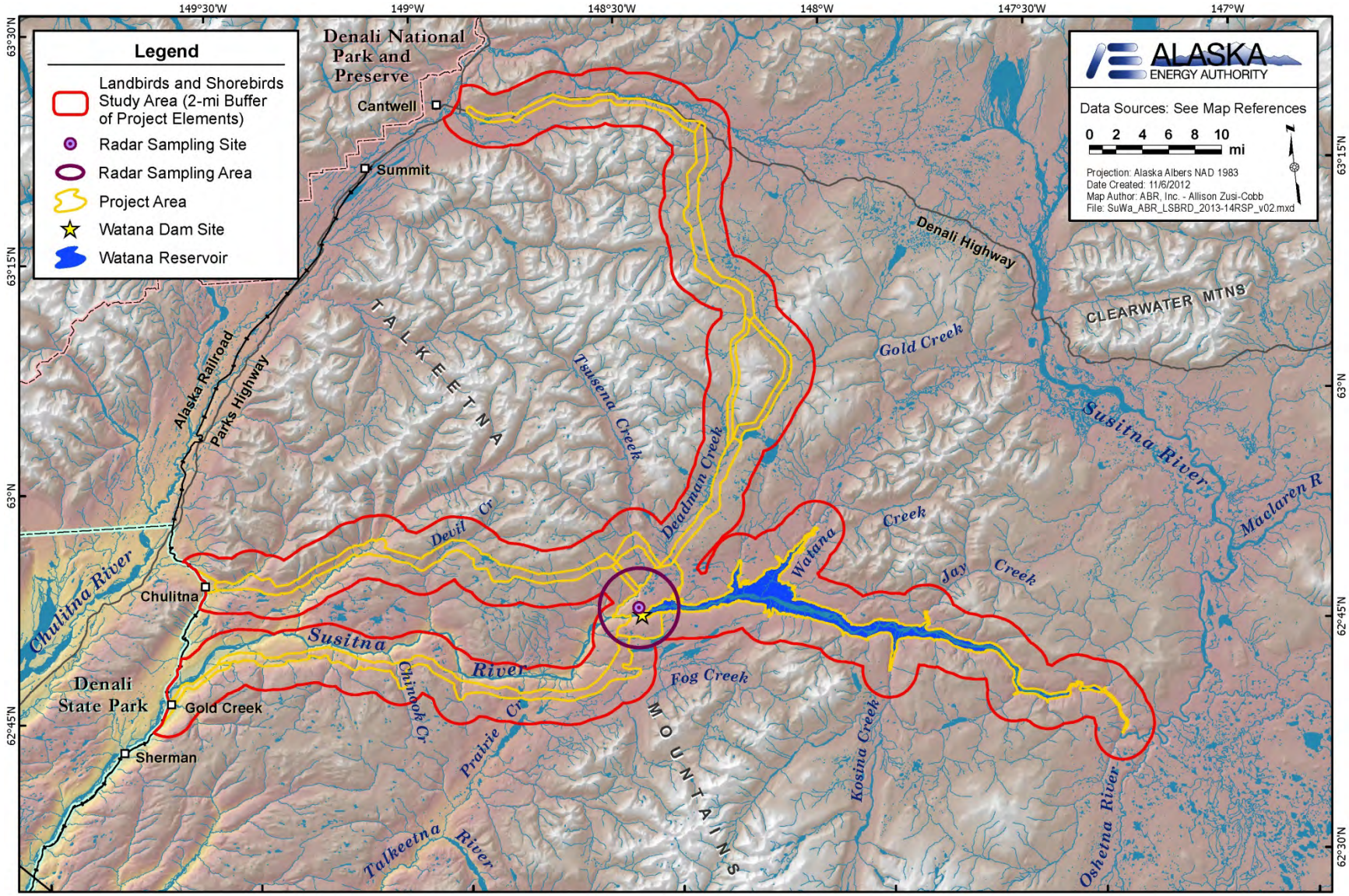

Figure 10.16-1. Landbird and shorebird study area.

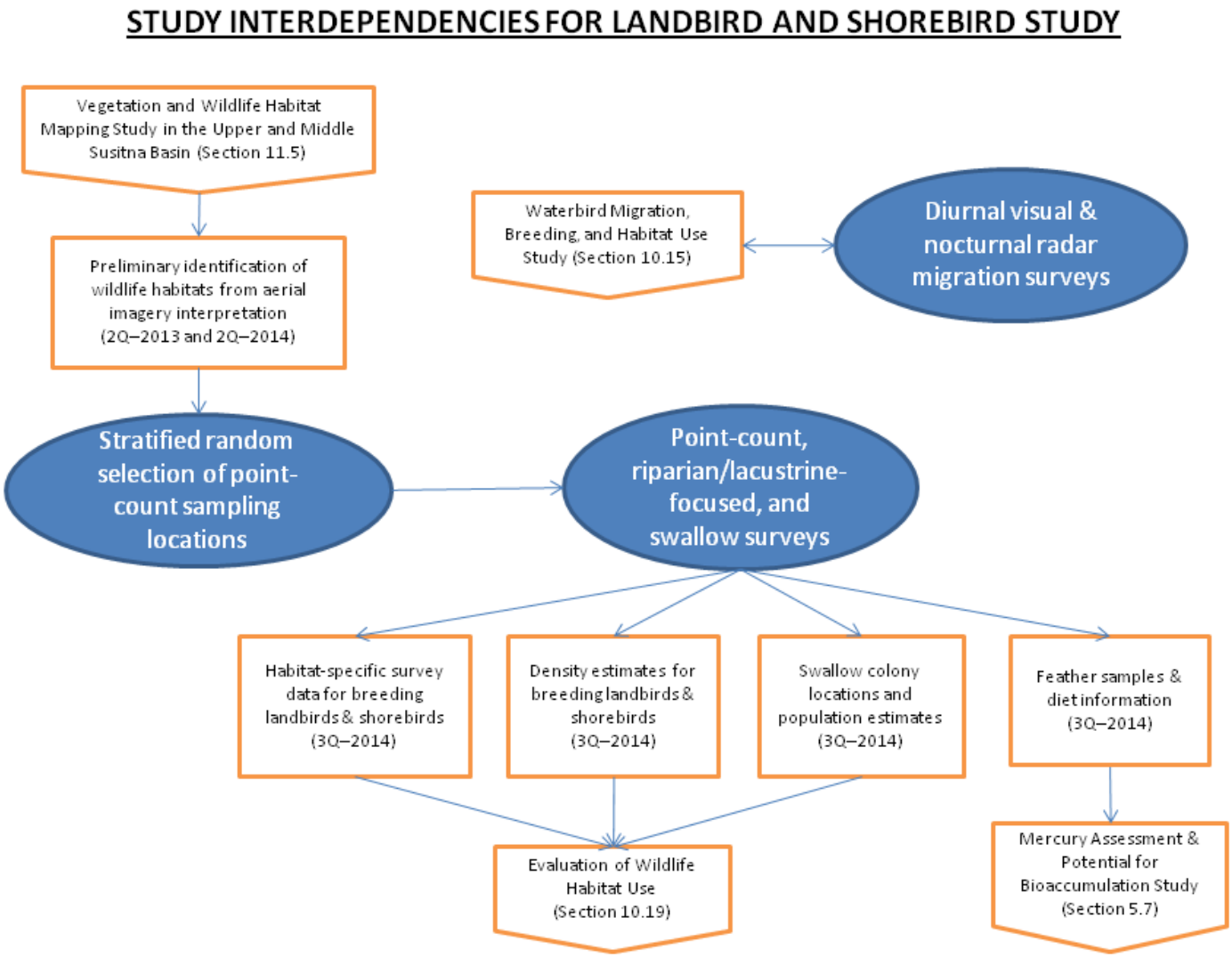

Figure 10.16-2. Study interdependencies for the landbird and shorebird study.

10.17. Population Ecology of Willow Ptarmigan in Game Management Unit 13

10.17.1. General Description of the Proposed Study

The Ptarmigan Study, which will be conducted by the Alaska Department of Fish and Game (ADF&G), will be a two-year investigation, beginning in spring 2013 and continuing through winter 2014 to inform the FERC licensing process. To take full advantage of the expected life span of the radio telemetry tags that will be deployed for the study, ADF&G may continue to track tagged birds further (into 2016), but the data obtained in 2013 and 2014 will be sufficient for the FERC licensing effort.

Study Goals and Objectives

The goal of this study is to provide the necessary data to evaluate the potential effects of the proposed Project on Willow Ptarmigan, the predominant species of upland game bird in the Project area and surrounding areas. The area of interest consists of Subunits 13A and 13E of Game Management Unit (GMU) 13 (Figure 10.17-1).

The study has four objectives:

- Determine the seasonal distribution of Willow Ptarmigan in the Project area.
- Determine the seasonal migratory patterns of Willow Ptarmigan that occur in the Project area.
- Estimate the abundance of ptarmigan in the Project area during the breeding season and during the fall.
- Estimate seasonal survival of Willow Ptarmigan.

The data gathered during the study will be integrated to determine potential effects of the Project on Willow Ptarmigan.

10.17.2. Existing Information and Need for Additional Information

The Willow Ptarmigan is the most common and widespread ptarmigan in Alaska, constituting an estimated 65–70 percent of all ptarmigan statewide, followed by Rock Ptarmigan at 25–30 percent, and White-tailed Ptarmigan at <10 percent (Taylor 1994). All three ptarmigan species occur in GMU 13 (Taylor 2000).

Ptarmigan hunting is a very popular activity in the fall and winter months in GMU 13 due to the accessibility of the unit from the state highway system. Since 1997, ADF&G has conducted ptarmigan surveys in spring along the Denali, Parks, and Richardson highways to quantify the relative abundance of territorial males. All survey efforts have centered on road-accessible areas within GMU 13. Those surveys suggest that Willow Ptarmigan along the road system portions of GMU 13 are declining in abundance or have remained at low abundance since 2000 (Bill Taylor, pers. comm.). Due to this continued low abundance, ADF&G recommended that the Alaska Board of Game reduce the bag limit of ptarmigan from 10 per day to 5 per day in Subunits 13A, 13B, and 13E between December 1 and March 31, and this recommendation took effect during the 2005–2006 regulatory year. Continued low abundance resulted in further harvest restrictions in Subunit 13B, and beginning in 2009, the ptarmigan season has been closed after November 30

each year. ADF&G has been unable to commit additional resources to better understand the life history of GMU 13 ptarmigan populations and there is little information on the habitat value of the Project area for ptarmigan.

Ptarmigan that winter in the Project area may be either resident or migratory birds. To better predict the potential effects of the proposed Project on Willow Ptarmigan, information needs to be collected to determine the annual ranges of ptarmigan that may use habitats in GMU 13. In particular, information is needed to evaluate the relative importance of the Project area to resident and migratory ptarmigan and the seasonal ranges of migratory birds need to be delineated.

10.17.3. Study Area

Willow Ptarmigan will be captured within a 15-mile buffer around the proposed dam site and reservoir and the access and transmission corridor alternatives (Figure 10.17-1). Capture locations will be in the headwaters of several major river drainages. The study area is composed of alpine habitats at higher elevations and subalpine spruce habitats at lower elevations. Areas in which Willow Ptarmigan will be captured are roadless, although periodic, but infrequent, all-terrain vehicle use can occur year-round.

The areas selected for capture have been identified previously as locations with relatively high breeding densities of Willow Ptarmigan. Initial capture efforts will focus on three areas, including upper Fog Creek (tributary to the upper Susitna River), upper Busch Creek (tributary to Goose Creek), and the pass between upper Jay and Coal creeks.

Radio-tagged Willow Ptarmigan are expected to remain within 50 miles of the original capture site, although movements may exceed that distance in some cases (Irving et al. 1967). Aerial surveys to locate birds with radios will be conducted in appropriate habitats within 50 miles of the original capture locations.

10.17.4. Study Methods

10.17.4.1. Capture and Radio-tagging of Ptarmigan

Beginning in April 2013, 50–100 Willow Ptarmigan will be captured annually at three sites within Subunits 13A and 13E (Figure 10.17-1) and fitted with radio-transmitter necklaces. All three sites are within 15 miles of either the proposed reservoir inundation zone or the access corridors. Alternative capture sites may be needed based on conditions each spring, depending on factors such as ptarmigan abundance, snow depth, and fixed-wing airplane access. Potential alternative capture sites (Figure 10.17-1) will be considered during field operations in the spring and summer of 2013.

Capture sites and future alternative sites have and will be identified based on several criteria:

- Willow Ptarmigan abundance
- Proximity to the future reservoir or access routes
- Ease of access using either fixed-wing or helicopter
- Observed springtime conditions (i.e., snow depth, and habitat availability during the capture time period)

During the breeding season in April and May of each year, several two-person teams will be deployed to various capture locations using wheel-ski equipped fixed-wing aircraft. Teams will attempt to capture 25–50 Willow Ptarmigan during the spring effort. Several teams will again be deployed in mid-August to September, using fixed-wing aircraft, in an effort to capture an additional 25–50 adult and fledged juveniles before brood dispersal occurs (Weeden and Watson 1967).

When capture efforts begin in April, male Willow Ptarmigan will be located visually or by using a playback recording of a territorial male Willow Ptarmigan (Taylor 1999; Peyton 1999; Savage et al. 2011). Playback recordings will be used effectively under low wind conditions (≤ 5 miles per hour) with no precipitation during early morning or late evening hours. Once ptarmigan are known to be in the vicinity, a styrofoam decoy and remotely powered caller will be placed within the defensive range (<100 meters [328 feet]) of a territorial male. A mist net will be deployed around the decoy and remotely powered caller in an attempt to capture the territorial male when he responds defensively to the call and decoy. Mist nets designed by Avinet (www.avinet.com) for capturing small hawks and large shorebirds will be used (Silvy and Robel 1968). These black nylon nets have a 100-millimeter (~4-inch) mesh and are 2.6 meters (8.5 feet) tall, with four shelves (Browers and Connelly 1986). When circumstances allow during spring capture efforts, a hand-held Coda net gun (www.codaenterprises.com) with a 12-square-foot net and 3-inch mesh will also be used opportunistically to capture territorial male birds on the ground, primarily as a backup to the mist net method. This method has been used from a helicopter to capture short-eared owls in northern Alaska and has proven to be safe and effective (T. Booms, ADF&G, pers. comm.). The use of decoys and calls is a novel adaptation to attempt to increase the number of captures typical of previous netting methods (>30 ptarmigan annually; Skinner et al. 1998; Kaler et al. 2010). No attempt to capture nesting or brood-rearing females will occur.

Post-breeding resident and migrant birds will be targeted for capture during a second annual capture effort in mid-August through September. Flocks of ptarmigan will be located visually, mist nets will be strategically placed around or in the vicinity, and ptarmigan of all age/sex classes will be flushed into the mist nets. Fall captures will be similarly outfitted with radio-transmitter necklaces.

At least two people will be present for any single capture event to remove birds from mist nets, handle, and release birds as quickly as possible. After capture, Willow Ptarmigan will be restrained in a capture bag or by holding their wings against their bodies. Birds will be instrumented with a necklace-mounted A3950 VHF radio transmitter with a 10-inch whip antenna (Raymond 1999; Paragi et al. 2012; Figure 10.17-2) from Advanced Telemetry Systems (ATS, www.atstrack.com). The entire radio and necklace package will weigh up to 10.7 grams (0.4 ounce) (1.7 percent of the body mass based on known weights of hunter-harvested Willow Ptarmigan; Hudson 1986; Thirgood et al. 1995). Radios will transmit in the frequency range of 148.000 Mhz. The transmitter is secured by a rubber-sheathed wire fitted over the bird's neck and crimped on either end to ensure its fit (Figure 10.17-2). The transmitter will be adjusted to compensate for crop expansion. No tissue samples will be collected from captured Willow Ptarmigan. Birds will be handled for 5–10 minutes and released at their point of capture.

Age and sex, based on plumage characteristics (Bergerud et al. 1963; Weeden and Watson 1967; Braun and Rogers 1971; Hudson 1986) will be recorded for each bird captured. Individually numbered leg bands will be placed on each radio-tagged bird. These tags will be useful for ground observations and to identify human-harvested birds or prey remains that may be found

during field efforts. A Global Positioning System (GPS) receiver will be used to record the location of capture. Date, time, and weather conditions also will be recorded. If a territorial male is captured, an attempt will be made to identify and record the location(s) of his territory post(s).

Radio tags will not be removed at the conclusion of the study, nor will tags drop off. There is little evidence to suggest that radio tags have a negative effect on the survival or breeding success of ptarmigan and other galliformes (Thirgood et al. 1995; Palmer and Wellendorf 2007; Terhune et al. 2007). Radio-tagged Willow Ptarmigan will be closely monitored within 24 hours of capture to document capture myopathy or other obvious handling-induced stresses. All potential capture and marking methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee (IACUC) certification. ADF&G will ensure compliance with all IACUC policies.

10.17.4.2. Relocation of Radio-tagged Ptarmigan

Radio-tagged ptarmigan will be relocated during aerial surveys conducted throughout the year to record habitat use, movements, and mortality. Birds will be tracked and relocated using a fixed-wing airplane equipped with wheel-skis, which will decrease search time and increase the area that can be covered. The first aerial survey will be performed within 10 days of capture to document survival rates of the birds recently radio-tagged. At least six additional aerial surveys will be performed annually: two in late summer (August–September), two in mid-winter (November–February), and two in early spring (late March to mid-April).

Range of radio tags will be tested before deployment. However, temperature may affect transmission range (T. Paragi and B. Taylor, ADF&G, pers. comm.). Therefore, to ensure a systematic search pattern, aerial surveys will be flown using a preselected 5-mile grid and flown at an altitude of 1,500–2,000 feet within Subunits 13A and 13E.

An ATS 4520 receiver will be used to locate radio-tagged birds. Two 4-element Yagi antennas will be mounted to each strut of the aircraft. A GPS receiver mounted at the windshield of the aircraft and connected to the ATS 4520 receiver will provide a location for each data record. Upon completion of each aerial survey, receivers will be downloaded to a field laptop or Local Area Network (LAN) at the ADF&G office in Palmer for future analysis and specific location determination of each tagged bird.

10.17.4.3. Aerial Transect Surveys

During September and March each year, aerial transect surveys will be flown to assess the abundance and density of ptarmigan using line-transect or repeat-count techniques (Royle and Dorazio 2008; Thomas et al. 2010). In addition to abundance, these surveys will provide data on the overall distribution of all ptarmigan (not just radio-tagged individuals) in Subunits 13A and 13E.

10.17.4.4. Analysis of Radio Telemetry Data

After the radio receivers have been downloaded, data will be transferred to a Microsoft Access database for analysis. Maps will be created using Geographic Information System (GIS) software (ArcMAP) for each aerial survey day, indicating the location of each relocated Willow Ptarmigan. These data will be catalogued and used for spatial analyses.

Movement and survival rates of tagged birds will be estimated using multistate models (Brownie et al. 1993). Occupancy models of aerial survey data will be used to estimate the probability that an area is used and to identify changes in the probability of use between fall and spring surveys (Nichols et al. 2008).

The combination of telemetry transmitters and large-scale aerial surveys will provide both specific information on individual movements and habitat use and general information on species distribution. These survey techniques are being developed and implemented for another study of ptarmigan north of the Brooks Range (K. Christie, pers. comm.).

10.17.5. Consistency with Generally Accepted Scientific Practice

Habitat availability and use analyses allow an ecosystem approach to impact assessment, and GIS-based analysis has become a standard and straightforward method of evaluating the impacts of habitat loss and alteration. Ptarmigan captures will be conducted by adapting fairly standard capture methods to the situation. With continuous improvements in technology, particularly in battery and transmitter weights, radio telemetry is an important and increasingly standard method of obtaining movement data even for small birds and mammals. All potential capture and marking methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee (IACUC) certification. ADF&G will ensure compliance with all IACUC policies. There is little evidence to suggest that radio tags have a negative effect on the survival or breeding success of ptarmigan and other galliformes (Thirgood et al. 1995; Palmer and Wellendorf 2007; Terhune et al. 2007). Radio-tagged Willow Ptarmigan will be closely monitored within 24 hours of capture for signs of capture myopathy or other obvious handling-induced stresses.

10.17.6. Schedule

As is summarized in Table 10.17-1, aerial transect surveys will begin in March 2013 and ptarmigan tagging and tracking will begin in April 2013 and will continue through the end of 2014. ADF&G may continue to track tagged ptarmigan through 2016, corresponding to the anticipated lifespan of the radio transmitters. Project milestones will follow the same monthly schedule each year, unless noted otherwise. Aerial transect surveys will be flown in March and September. Capture of ptarmigan and deployment of radio tags will be conducted in April, May, and August, and radio-tracking will be conducted from August 2013 through May 2014 and from August through December 2014. Updates on the study progress will be provided during Technical Workgroup meetings which will be held quarterly in 2013 and 2014. The Initial Study Report will be completed by February 2014, and the Updated Study Report will be completed by February 2015.

10.17.7. Relationship with Other Studies

As is depicted in Figure 10.17-3, the ptarmigan study will not require information inputs from other Project studies. The efforts conducted for this study will consist primarily of capture, tagging, and tracking of radio-tagged birds and aerial transect surveys of distribution and abundance. Radio-tracking data will be used to create a geodatabase of locations (with sex and season attributes), which will be used to evaluate regional occupancy and to conduct multistate modeling of seasonal range use, movements, and survival. Information on movements will be

used to delineate the seasonal ranges of ptarmigan using the study area. Data from aerial transect surveys will provide additional details on the distribution and abundance of ptarmigan in the study area in late winter and fall. Location data from both radio-tracking and transect surveys will identify high-value habitats for ptarmigan in the study area, which will be used to inform the Evaluation of Wildlife Habitat Use (Section 10.19). The aggregate data obtained on abundance, density, seasonal distribution, and movements will be used to assess the potential impacts of the Project and to develop PM&E measures, as appropriate.

The Ptarmigan Study is designed to provide relevant information for assessing potential direct, indirect, and cumulative effects of the Project, which may include the following:

- Permanent habitat loss caused by Project facilities, including the reservoir, powerhouse, and other permanent Project facilities.
- Temporary loss or alteration of habitats affected by clearing, dust fallout, gravel spray, persistent snow drifts, impoundments, thermokarst, contaminant spills, and other indirect effects of Project construction and operation.
- Behavioral disturbance of ptarmigan by Project construction and operation activities, including vehicle and heavy equipment traffic, geophysical investigations, and other human activities in the Project area.
- Indirect habitat loss through displacement of birds that avoid Project facilities or transportation routes.
- Increased predation on birds or their eggs that may result from attraction of predators to anthropogenic foods or artificial structures (such as perches on power poles or power lines, for example).
- Injury and mortality of birds from collisions with aircraft, vehicles, or structures (such as power lines, for example).
- Injury and mortality of birds due to contact with or ingestion of contaminants (including fuels), including potential indirect effects on forage plants.
- Increased harvest of ptarmigan resulting from improvements in access to humans.

During the impact assessment that will be conducted for the FERC License Application in 2015, data on the distribution, abundance, movements, productivity, and habitat use of Willow Ptarmigan in the study area will be used to assess Project impacts through geospatial analysis and evaluation of the responses of the species to other similar projects, as documented in the scientific literature. Using GIS software, species abundance data recorded among different habitat types will be combined with the spatially explicit wildlife habitat map of the Project area that will be developed under the botanical resources study plans to assess direct and indirect impacts of habitat loss and alteration and behavioral disturbance. The direct and indirect impacts of the Project will be evaluated by overlaying the Project features (including the reservoir impoundment, related infrastructure areas, and access road and power transmission corridors), and the seasonal ranges of ptarmigan on the Project habitat map. Seasonal ranges will be delineated with radio telemetry, using the recorded movements of a sample of birds to which radios have been attached. By plotting ptarmigan locations on the habitat map, high-value or high-density habitats can be identified. Indirect impacts will be estimated by applying various buffer distances on Project features, as determined from the available information on the anticipated effects of construction disturbance and habitat-related changes due to infrastructure and development, and identifying areas of high-value habitats that are affected. The GIS analysis will be combined with results from the telemetry study and transect surveys, as well as from the

scientific literature, to estimate the geographic extent, frequency, duration, and magnitude of Project effects on ptarmigan. Any necessary protection, mitigation, and enhancement (PM&E) measures will be developed, as appropriate, by examining the distribution and abundance of Willow Ptarmigan among habitats in relation to the geographic extent and seasonal timing of Project activities.

10.17.8. Level of Effort and Cost

This study is a multi-year effort that will be conducted by ADF&G. The estimated cost of the study over both years is $415,000.

10.17.9. Literature Cited

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10.17.10. Tables

Table 10.17-1. Schedule for implementation of the Willow Ptarmigan Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
First field season: capture and tag birds		—	—						
Aerial radio-tracking surveys			—	—	—	—	—	—	
Aerial transect surveys		—		—		—		—	
Initial Study Report				—	Δ				
Second field season: capture and tag birds						—	—		
Telemetry analyses (occupancy modeling, multistate models)					—	—	—		
Updated Study Report								—	▲

Legend:

— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.17.11. Figures

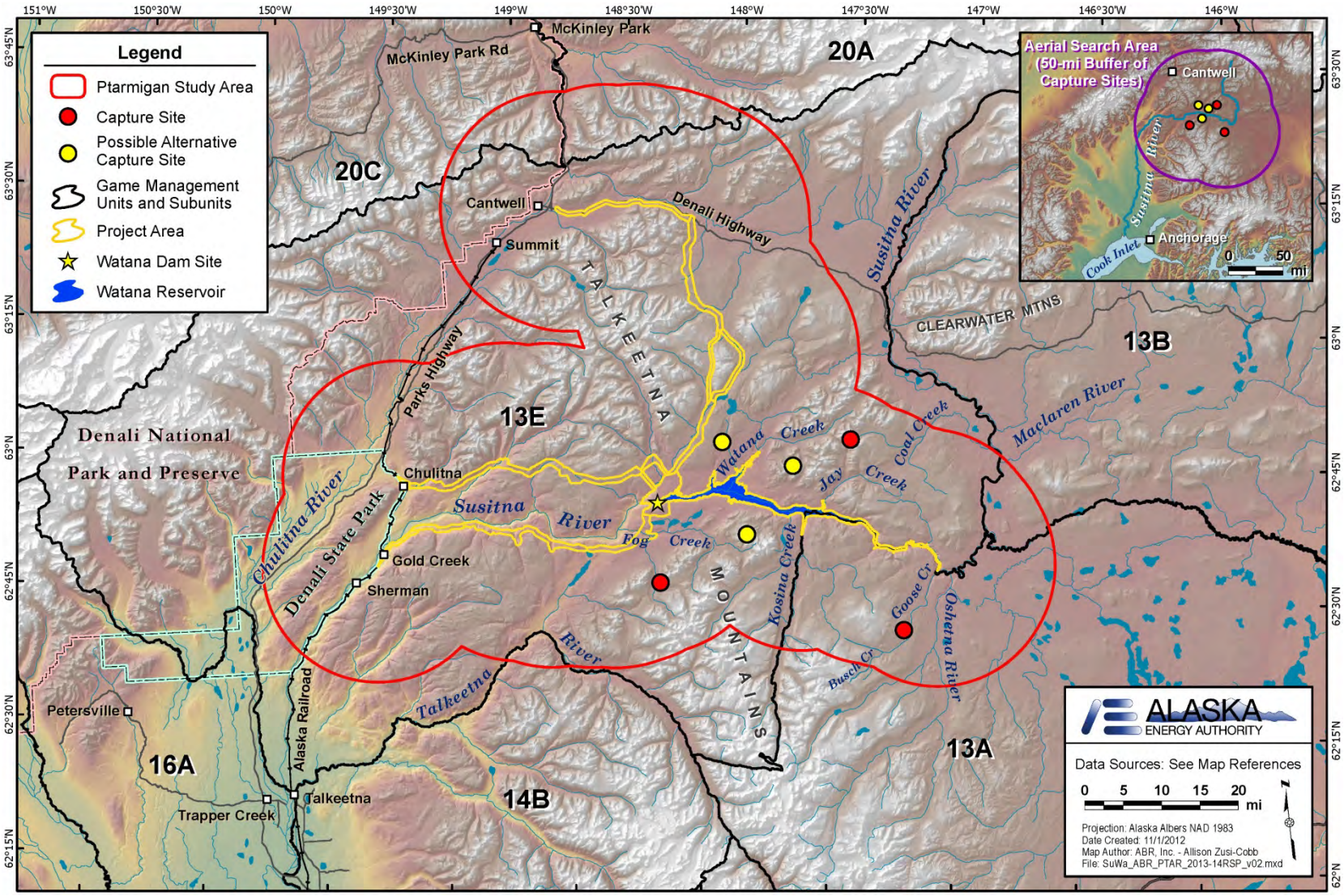

Figure 10.17-1. Willow Ptarmigan study area.

Figure 10.17-2. A Sharp-tailed Grouse equipped with an ATS 3950 radio tag identical to the model that will be used for Willow Ptarmigan. [Photo by Scott Brainerd, ADF&G, 2012.]

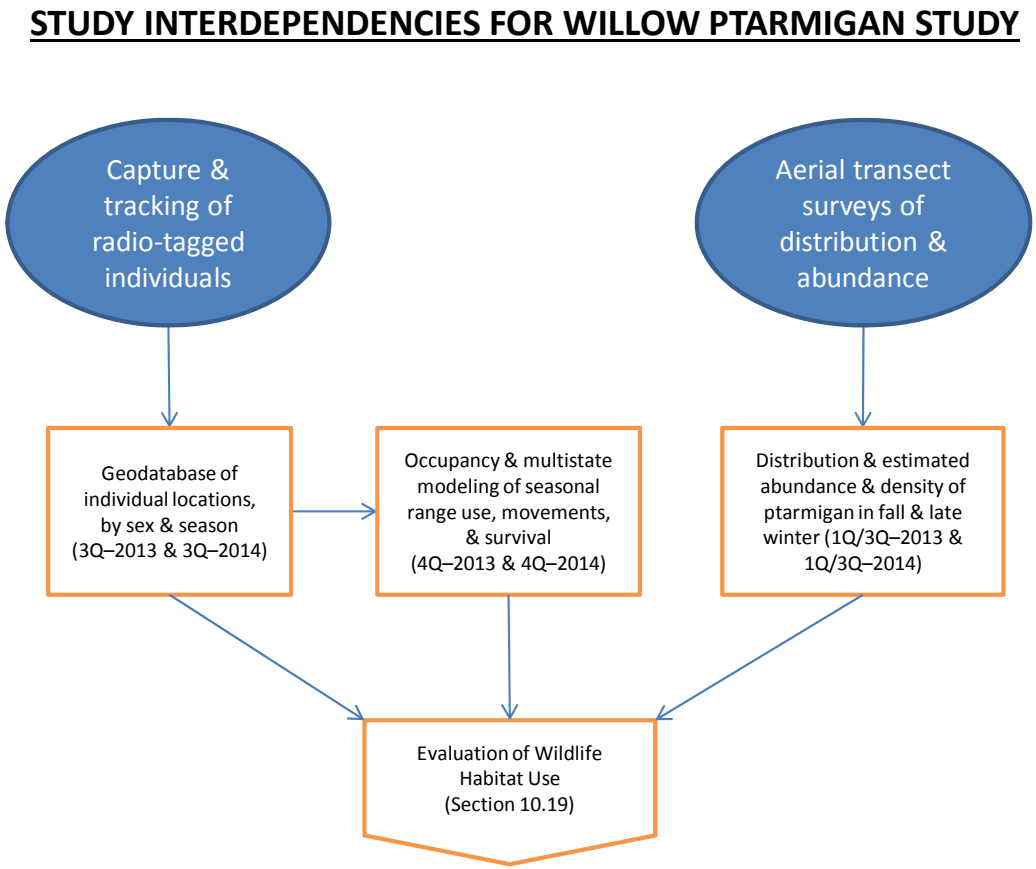

Figure 10.17-3. Study interdependencies for the Willow Ptarmigan study.

10.18. Wood Frog Occupancy and Habitat Use

10.18.1. General Description of the Proposed Study

The Wood Frog Occupancy and Habitat Use study (Wood Frog Study) will be conducted over two years (2013 and 2014), with fieldwork scheduled in May each year. The study will focus on evaluating the distribution of breeding wood frogs in those portions of the Project area in the upper and middle Susitna basin where breeding frogs could be directly or indirectly affected by Project development activities. The study will involve both field surveys and habitat occupancy modeling. In addition, AEA is proposing to opportunistically capture and sample frogs (non-lethally) to assay for the presence of the chytrid fungus that has been linked to amphibian declines worldwide (see Section 10.18.2 below).

Study Goal and Objectives

The goal of the Wood Frog Study is to characterize the use of the Project area by breeding wood frogs to facilitate an assessment of potential impacts on wood frogs from development of the proposed Project.

The study has four objectives:

- Review existing data on habitat use and distribution of breeding wood frogs in a broad region surrounding the Project area.
- Estimate the current occupancy rate for breeding wood frogs in suitable habitats in the study area through a combination of field surveys and habitat-occupancy modeling.
- Use information on current habitat occupancy and habitat use to estimate the habitat loss and alteration expected to occur from development of the Project.
- Sample frogs opportunistically for the presence of the chytrid fungus that has been linked to amphibian population declines. (At the request of state and federal management agencies, EA has agreed to sample for the chytrid fungus, to opportunistically take advantage of planned fieldwork by providing some baseline information on the occurrence of the fungus in the Project area pre-development.)

The Wood Frog Study is planned as a two-year study. Results from the first year of work in 2013 will be presented in the Initial Study Report and will be used to update the study plan for 2014, as needed, and to adjust the field survey methods and survey areas, if necessary, based on comments on the Initial Study Report by FERC, resource agencies, and other licensing participants.

10.18.2. Existing Information and Need for Additional Information

Because amphibians were not included in the original Alaska Power Authority (APA) Susitna Hydroelectric Project environmental program studies in the 1980s, data on the occurrence of wood frogs in the upper Susitna drainage is lacking. It is likely that wood frogs occur in the Project area because they occur in suitable habitats throughout southern Alaska and in the interior north to the southern slopes of the Brooks Range; they have also been documented in Denali National Park and Preserve, near Healy, and in the lower Susitna drainage (Cook and MacDonald 2003; Anderson 2004; Gotthardt 2004, 2005; Hokit and Brown 2006; MacDonald 2010). Amphibian populations appear to have been declining worldwide for several decades (Blaustein and Wake 1990; McCallum 2007) and, although populations may be healthy in

Alaska (Gotthardt 2004, 2005), concern has been expressed about the conservation status of wood frogs in Alaska (ADF&G 2006). Because of this and because their status in the Project area is unknown, field surveys for wood frogs will be conducted in areas likely to be affected by Project facilities and activities.

Batrachochytrium dendrobatidis (Bd) is a chytrid fungus that causes the disease chytridiomycosis in amphibians. Since it was first discovered in amphibians in 1998, it has devastated amphibian populations around the world, including in North America. Bd is sometimes a non-lethal parasite and some amphibian species and some populations of susceptible species are known to survive infection. The fungus is widespread and ranges from lowland forests to cold mountain tops, and is typically associated with host mortality in high altitude environments and during winter, with greater pathogenicity at lower temperatures. Wood frogs have been identified as a frog species susceptible to infection by Bd, and Bd was first detected in a dead wood frog in Kenai National Wildlife Refuge in 2002 (Reeves 2008). The only other positive detection of Bd was near Dyea in Southeast Alaska in 2006 and was associated with the apparent die-off of western toads in Southeast Alaska (Sunday, May 21, 2006, *Juneau Empire*). No sampling for Bd has occurred in the Project area. Bd is believed to spread mainly through contact between infected frogs or with infected water. In its comments on study requests for the Project, the Alaska Department of Fish and Game (ADF&G) requested that water or frogs at survey locations be tested for the presence of Bd (see Section 8.4 in AEA 2012).

10.18.3. Study Area

The study area includes those water bodies and suitable wetland habitats in the proposed Project area in which habitat loss, habitat alteration, and disturbance are expected to occur. The proposed study area encompasses the reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access roads, and material sites (Figure 10.18-1).

10.18.4. Study Methods

10.18.4.1. Field Surveys and Occupancy Modeling

Because the study area is large and the calling period of breeding male frogs is short, this study will not involve a comprehensive survey of all potential frog breeding habitat present in the study area. Instead, observers will survey for frogs in smaller sampling regions containing suitable habitats. Up to 10 sampling regions will be selected to survey for wood frogs in the study area (two in each of the three access road corridors and four in the reservoir zone and dam and camp facilities area of the proposed reservoir). Using a Geographic Information System (GIS), the sampling regions will be selected randomly from available areas of suitable water body and wetland habitats for frogs by overlaying a grid onto the full study area (Figure 10.18-1), removing all grid cells that contain no suitable habitat (or very little habitat), and then randomly selecting from the remaining cells for sampling. The random cell-selection process will be stratified so that sampling regions are selected in each of the transmission line/access road corridors and in the inundation/dam infrastructure zone, as noted above. One exception to this random cell-selection process will be made to ensure that the water bodies and wetlands in

the dam and camp facilities area near the proposed dam are included as one of the sampling regions.

Within the study area boundary, potential water bodies and wetland habitats (with permanent standing water) to be surveyed will be identified from interpretation of aerial photos or remote-sensed imagery and from the preliminary mapping of vegetation, wildlife habitats, and wetlands (see Sections 11.5 and 11.7). From this set of water bodies and wetlands, habitats will be categorized as having a higher or lower probability of supporting breeding frogs. The random sampling of water bodies and wetlands in each sampling region then will be stratified so that a greater effort is made to survey habitats that have a higher probability of being used by frogs. Habitats more likely to be used by breeding frogs will be identified using GIS as those that (1) are not known to support fish (if available, data from the fish distribution and abundance studies [see Section 9] will be used to document fish occurrence, recognizing that those data may not be complete in 2013); (2) are not connected to stream systems supporting fish; and (3) have at least some emergent vegetation. Fish are efficient predators of frogs, and in studies in south-central Alaska, including portions of the lower Susitna basin (Gotthardt 2004), frogs have been recorded in lower numbers in water bodies that support fish. Emergent and aquatic vegetation in water bodies provides a substrate for frog egg-masses and escape cover from aquatic predators, as well as helping to increase dissolved oxygen in the water (France 1997; Babbitt and Tanner 1998).

With a set of water bodies and wetlands identified throughout the study area that have the potential to support breeding frogs, a subset of those sites in each of the 10 sampling regions in the study area will be selected to survey for breeding frogs. Within each sampling region, a minimum of 12 potential water body and/or wetland sites will be selected for sampling using a stratified random selection process in GIS, as noted above, so that more effort is expended on sampling sites likely to be of higher value to breeding frogs. With 12 sites sampled in each of 10 sampling regions, at least 120 sites are expected to be surveyed across the full study area in each year. In practice, more than 120 sites may be surveyed because some sites will not need to be visited twice (i.e., when frogs are detected on the first visit, see below). A minimum distance of 250 meters (820 feet) between sample sites will be maintained to avoid duplicate detections of frogs.

Ground-based auditory surveys of the randomly selected water bodies and wetlands in the study area will be conducted during the breeding season for frogs (mid- to late May). (In addition to these surveys, it is expected that incidental detections of wood frogs will also be documented during data collection efforts for other resources [e.g., fisheries, vegetation and wetlands, and ground-based bird surveys], and this information may provide additional information on the occurrence of frogs in the study area.) Survey sites will be accessed by helicopter and on foot by navigating to predetermined sample sites using hand-held global positioning system (GPS) receivers. The field surveys will involve auditory detections of calling frogs to ascertain the presence or absence of wood frogs at each sampling site. Observations along the margins of each water body or wetland will be made at locations where observers can readily hear calling frogs. For small water bodies and wetlands, a single observation point will suffice to detect the presence of frogs, but for large water bodies and wetlands, multiple observation points may be needed to determine the presence of frogs. For large water bodies and wetlands, up to four observation points will be located and sampled, with distances of up to 500 meters between each point to achieve adequate survey coverage. Up to two independent, replicate surveys will be made by trained observers to each water body during the peak calling period (approximately

1200 to 2200 hours) of male wood frogs in southern Alaska (Gotthardt 2004; PLP 2011). Due to variability in the calling frequency of male wood frogs even during the peak of the breeding season (see PLP 2011), two visits may be needed to detect frogs at some water bodies; these replicate survey data will also be used to calculate the detectability of calling frogs, which is a critical component of this study. The second survey at each site will be conducted by a different observer with no knowledge of the survey results from the first survey. However, because this study involves the use of a "removal design" to estimate occupancy, if detected on the first survey, a second survey will not be needed (i.e., that site will be "removed" from further sampling; see Mackenzie and Royle [2005] for more information). Surveys will be conducted only under favorable weather conditions (e.g., light rain or no rain, air temperature higher than 4° C [39° F], and wind speeds less than or equal to 25 kilometers per hour [15 miles per hour]). Observers will spend a minimum of 5 minutes at each survey location listening for calling frogs, but will terminate the survey early if frogs are detected.

To increase accuracy in the calculation of detectability of calling frogs, a small number of acoustic monitoring devices will be deployed at a subset of water bodies known to be occupied by frogs. Data from automated acoustic monitoring devices, which record calls throughout the day, will allow calculations of the probability of frogs calling on a given date, or at a specific time period and/or temperature range during the day, and will provide a direct estimate of the detectability of calling frogs.

Habitat and environmental characteristics (e.g., size and depth of water body, substrate, presence and type of emergent aquatic vegetation, distance to human disturbance, water quality [pH level, dissolved oxygen], ice cover, elevation, aspect, surrounding terrestrial vegetation, water and air temperature, precipitation, cloud cover, wind speed, time of day, beaver activity) will be recorded during the field surveys to facilitate the development of a Project-specific occupancy estimation model based on the habitat characteristics of the occupied water bodies. In addition, data from the vegetation and habitat mapping, wetland mapping, and wetland functional assessment studies (see Sections 11.5 and 11.7), and the literature (e.g., Stevens et al. 2006; AKNHP 2008) will be evaluated as potential model variables to characterize wood frog habitat.

With estimates of the detectability of wood frogs calculated from the field data collected for this study, the observed ("naïve") occupancy rate of frogs in water bodies and wetlands will be corrected (to account for those frogs present but not detected) to produce a corrected occupancy rate for the water bodies and wetlands in each of the sampling regions.

10.18.4.2. Bioassays for Batrachochytrium dendrobatidis (Bd)

The specific assay and sampling methods for Bd will be determined through consultation with commercial or research laboratories. Currently available information indicates that no standard methods for bioassay of Bd have been proffered or certified by the U.S. Environmental Protection Agency (EPA) or other regulatory or standards agencies. The currently proposed strategy is to assess the presence/absence of Bd from swabs of frog skin, which would then be analyzed using a Polymerase Chain Reaction (PCR) technique to test for chytrid fungus.

Further consultation with the ADF&G and the U.S. Fish and Wildlife Service (USFWS) in early 2013 will be conducted to finalize the sampling protocol described here, but provisionally, frogs will be collected opportunistically during the field surveys with long-handled nets. The skin of the abdomen and/or foot webbing of each captured frog will be swabbed 25 times with a sterile

cotton swab, after which the frog will be released unharmed. The samples will then be sealed and refrigerated and analyzed later in the laboratory for the presence of chytrid DNA.

10.18.4.3. Reporting and Data Deliverables

The reports and data deliverables for this study include the following:

- **Electronic copies of field data.** A geospatially-referenced relational database of field data collected during the 2013 and 2014 field seasons, including representative photographs of water body habitats occupied by wood frogs, will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The Wood Frog Study results will be presented in the Initial and Updated Study reports, according the schedule indicated in Table 10.18-1. The reports will include descriptions of the field methods, a map of the water bodies and wetlands surveyed, results of the occupancy surveys, and descriptions of the potential impacts to wood frogs from development of the Project.

10.18.5. Consistency with Generally Accepted Scientific Practice

The Wood Frog Study will involve occupancy surveys of randomly selected water bodies and suitable wetland habitats, and will be conducted following currently accepted practices for the monitoring of amphibians, with field surveys designed to estimate detectability (USGS 2012). A similar occupancy survey of wood frogs in randomly selected water bodies was successfully conducted by ABR in 2007 on another large-scale project in southwest Alaska (see PLP 2011).

10.18.6. Schedule

The Wood Frog Study is planned to be conducted over two years. The activities for each year are described in Table 10.18-1. Finalization of the sampling protocol for Bd will occur in February and March of 2013. Review of aerial imagery and selection of sampling regions and habitat areas to be surveyed will be conducted in March and April each year. Field surveys by a crew of two biologists will be conducted during the second and third weeks of May each year, with specific survey timing and duration to be determined annually, depending on snowmelt and lake-thaw information obtained from personnel working on other studies in the Project area each spring. Data analyses will be conducted during September–December each year. The Initial Study Report will be completed by February 2014 and the Updated Study Report will be completed by February 2015.

Technical Workgroup meetings will be planned on a quarterly basis in 2013 and 2014 to review study progress. Licensing participants will have the opportunity to review and comment on the Initial Study Report and Updated Study Report when they are completed.

10.18.7. Relationship with Other Studies

As depicted in Figure 10.18-2, the Wood Frog Study will use information from the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5), the Wetland Mapping Study in the Upper and Middle Susitna Basin (Section 11.7), and the fish distribution and abundance studies in the Upper, Middle, and Lower Susitna River (Sections 9.5

and 9.6) to identify habitats potentially occupied by wood frogs. Potential habitats will be identified from air-photo interpretation during the mapping studies and, where available, from fish presence data in individual water bodies (those without fish being of higher value for frogs). Random sampling will be used to first select sampling regions for acoustic surveys of frogs from among all areas of suitable habitat in the study area, and then to select specific areas of habitat to be surveyed. Acoustical survey data from multiple visits will be used to estimate detectability of calling male frogs and to develop occupancy estimates for the areas of habitat surveyed. When completed, data from this study will be used in the Evaluation of Wildlife Habitat Use study (Section 10.19) to determine habitat values for wood frogs for each of the wildlife habitat types mapped for the Project.

The distribution information and habitat occupancy estimates for wood frogs determined in this study will be used to assess the potential impacts of the Project and to develop PM&E measures, as appropriate, during preparation of the FERC License Application in 2015.

Wood frogs potentially could be affected primarily by direct mortality during construction and by the loss of water bodies and wetlands suitable for breeding from the placement of fill and from inundation in the reservoir impoundment zone. Additional impacts could occur from the alteration of habitats due to erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Aquatic habitats created by the impoundment may not be suitable for wood frogs due to their preference for smaller water bodies.

The impact assessment for wood frogs will be conducted by ascertaining which water bodies and wetland types are suitable for breeding using habitat characteristics that can be identified from aerial imagery interpretation, wildlife habitat and wetlands mapping, and fish survey data, as described above in Section 10.18.4.1. This information will allow the calculation of the amount of suitable habitat available before development. Using the corrected occupancy estimates from this study, the amount of the available habitat will be reduced to that amount most likely to be actually occupied (e.g., if the occupancy rate is estimated at 50 percent, then, on average, only 50 percent of the available habitat will be occupied). However, because all suitable habitat in the study area cannot be sampled, there will not be spatially explicit information for all sites to indicate which sites are actually occupied and which are not. With this available habitat and occupancy information, the Project footprint will be overlain, in GIS, on the map polygons representing suitable water body and wetland types to estimate the acreages of water bodies and wetlands that would be lost directly to fill or inundation. This acreage figure will then be reduced to account for the calculated occupancy rate, as noted above. The estimation of acreages of frog breeding habitats that could be affected by habitat alteration will be conducted similarly by overlaying habitat alteration buffers (surrounding the proposed Project infrastructure) to identify which habitats are likely to be affected by ancillary impacts associated with Project construction and operations. The size and number of habitat alteration buffer(s) to be used will be determined based upon the final specifications for Project construction and operations activities, which will be provided in the Project description.

Sampling for Bd in frogs in 2013 and 2014 will establish a baseline for comparison of the occurrence of Bd in frogs in the Project area after construction of the proposed Project.

Cumulative effects on wood frogs in the region of the proposed Project will be assessed in the FERC License Application document (to be prepared in 2015) and the details of that analysis (e.g., the spatial scale and temporal extent for cumulative effects) will be defined at that time.

10.18.8. Level of Effort and Cost

The Wood Frog Study is planned to be conducted over two years (2013–2014). A single field survey effort will be conducted each year in late spring (May) by a crew of two biologists. Based on previous occupancy surveys (PLP 2011), it is estimated that roughly 25 sites can be surveyed in a day. Occupancy surveys will be conducted for approximately 10 days each year. Helicopter support will be required for this study with multiple drop-offs and pick-ups in the afternoon and evening hours each day in the field (i.e., a dedicated helicopter may be required). The bulk of the costs associated with this study are for the field sampling, data analysis, and reporting. The projected cost for this study in each year is on the order of $80,000, for an approximate estimated total of $160,000 for both years.

10.18.9. Literature Cited

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10.18.10. Tables

Table 10.18-1. Schedule for implementation of the Wood Frog Study.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1Q
Finalize sampling protocol for Bd	—								
Review aerial imagery to select aquatic habitats to survey	——	—			——	—			
Field survey; survey timing and duration may be modified, depending on snowmelt and lake-thaw information obtained from other Project studies		—				—			
Data analysis			——	——			——	——	
Initial Study Report					Δ				
Updated Study Report									▲

Legend:

—— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.18.11. Figures

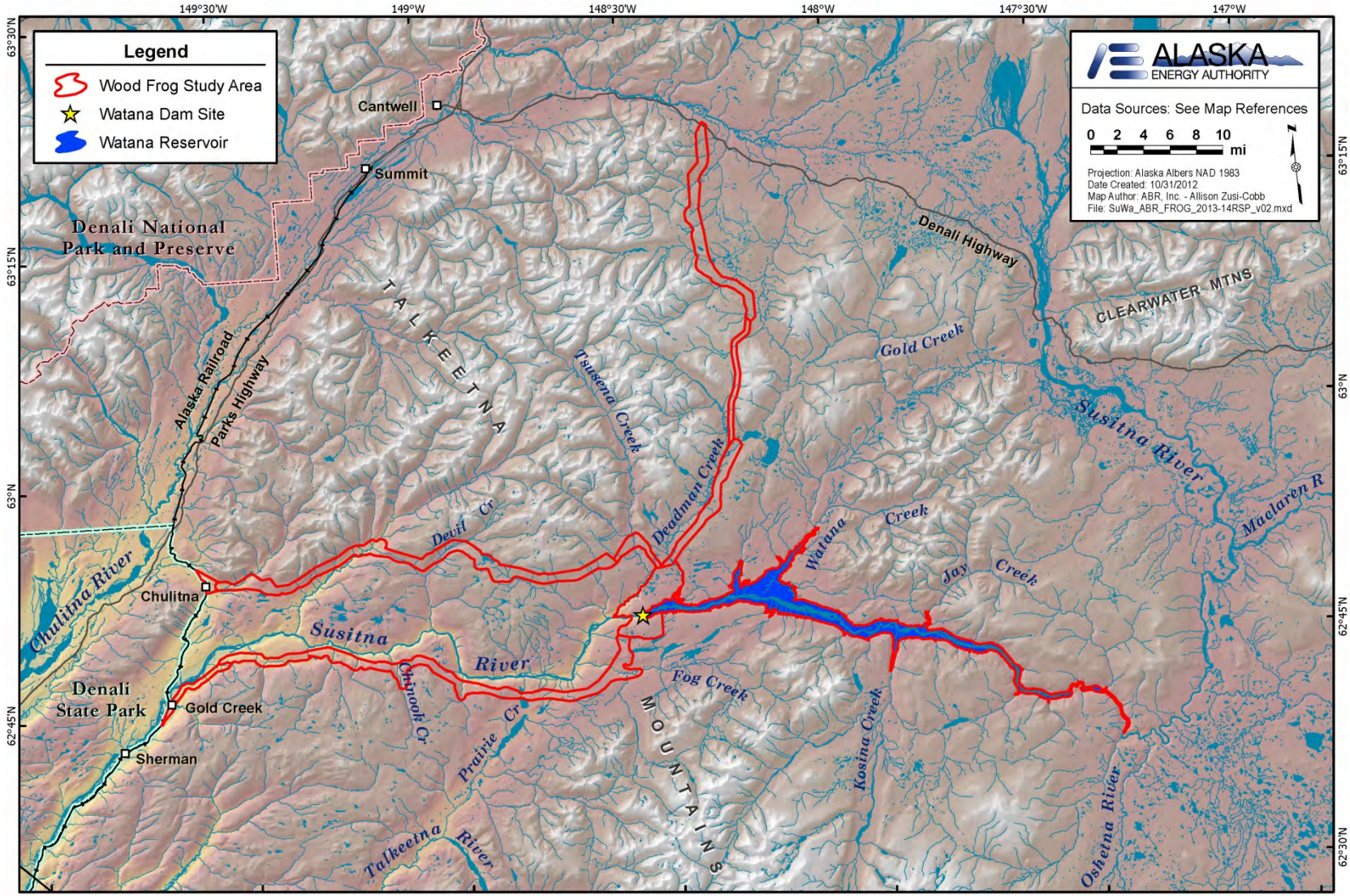

Figure 10.18-1. Wood frog study area.

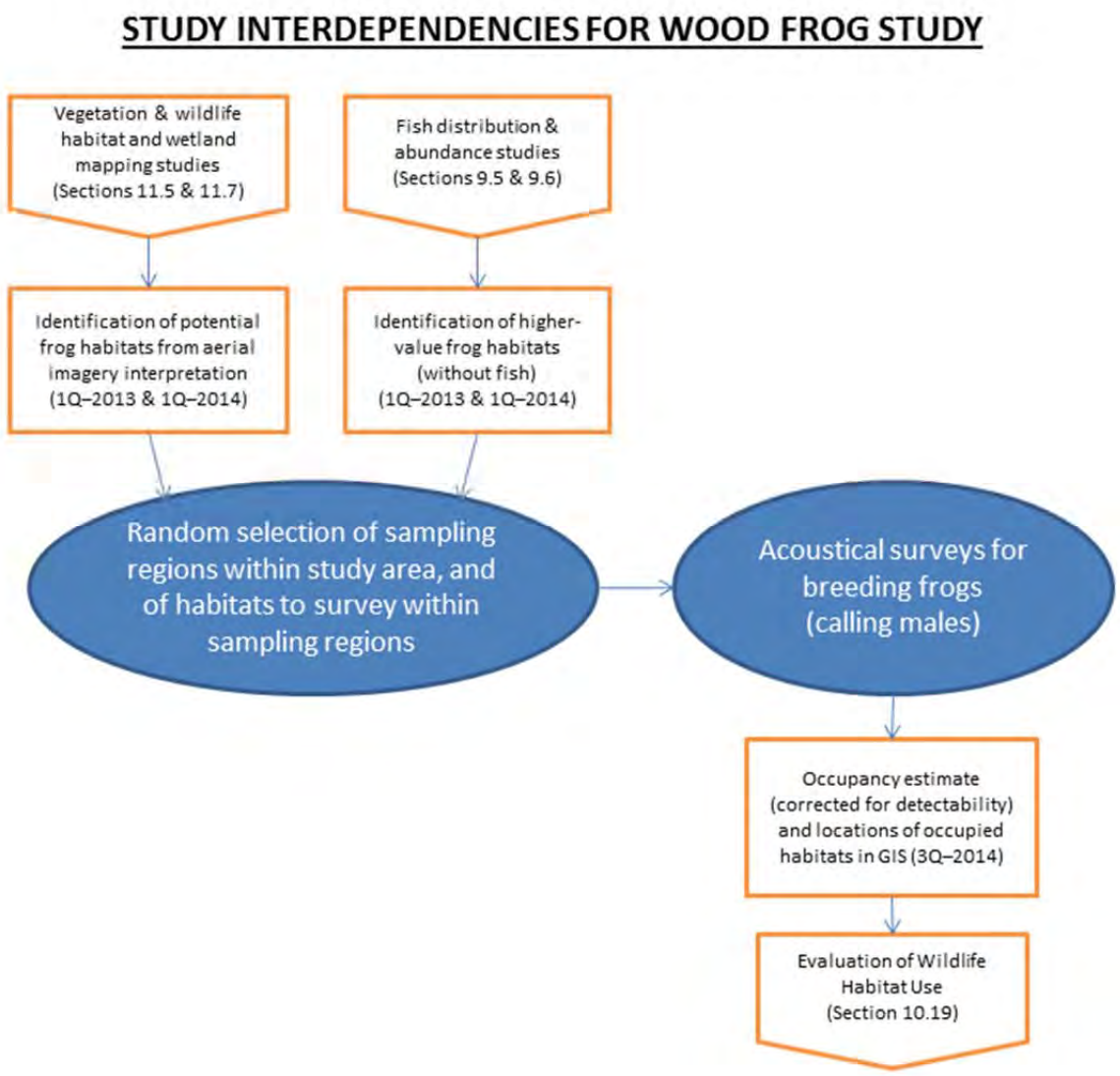

Figure 10.18-2. Interdependencies for Wood Frog Study.

10.19. Evaluation of Wildlife Habitat Use

10.19.1. General Description of the Proposed Study

The Evaluation of Wildlife Habitat Use Study will be an analysis of both existing information on wildlife habitat use in Alaska (e.g., from the scientific literature) and new, Project-specific information on wildlife habitat use derived from survey data to be collected for the Project (see Sections 10.5 to 10.18). This habitat-use information will be used to systematically evaluate the use of the specific wildlife habitat types being mapped for the Project (see Section 11.5). In this study, categorical habitat values will be determined for each mapped habitat type and each wildlife species of concern to be assessed for impacts during the FERC licensing process.

Study Goal and Objectives

The goal of the study is to provide Project-specific habitat evaluation information for birds, mammals, and amphibians to facilitate quantitative assessments of the impacts on wildlife habitats from development of the proposed Project.

The wildlife habitat evaluation has two fundamental objectives:

- Use Project-specific survey data and the scientific literature to determine local habitat associations for those wildlife species occurring in the Project area that are of conservation, management, cultural, or ecological concern and that are specific to the wildlife habitat types to be mapped in the Project area.
- Categorically rank habitat values for each wildlife species of concern for each of the wildlife habitat types that will be mapped in the Project area.

The habitat-association data to be developed in this study, together with the wildlife habitats that will be mapped digitally in the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin and the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (see Sections 11.5 and 11.6, respectively), will be used in spatially-explicit analyses with a Geographic Information System (GIS) to derive quantitative estimates of habitat loss, habitat alteration, and disturbance effects for birds, mammals, and amphibians (see Section 10.19.7 below). This impact assessment work, which is not part of this study but is dependent on the results of this study, will be conducted during preparation of the FERC License Application for the Project.

10.19.2. Existing Information and Need for Additional Information

Wildlife habitat evaluations for the Susitna basin were conducted in several studies in the early 1980s for the Alaska Power Authority (APA) Susitna Hydroelectric Project and for another study effort in the lower portions of the drainage (AEA 2011). Those habitat evaluations were based on vegetative cover types that were mapped within 16 kilometers (10 miles) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). That vegetation mapping and the subsequent habitat evaluations were conducted three decades ago.

Both the vegetation mapping and the habitat evaluations should be updated for the current Project for three primary reasons. First, the wildlife habitat evaluations completed in the early 1980s were based solely on vegetation types, not wildlife habitat types. Wildlife habitat maps provide land-cover classifications that are better suited to evaluations of habitat use by birds,

mammals, and amphibians than is a vegetation map alone, primarily through the incorporation of physiography, landform, and vegetation structure information (see Section 11.5). Second, populations of wildlife species undoubtedly have fluctuated in size since the early 1980s, and it is known that habitat use by birds and mammals can be influenced by density (a greater diversity of habitats often is used when densities are high). Third, vegetation cover, structure, and even landforms are likely to have changed to some degree within the Project area because of landslides, erosion, thermokarst, fire, forest succession, expansion/contraction/decadence of birch and aspen clones, and increases in woody shrub cover associated with increased summer temperatures. To provide accurate information to use in evaluating the impacts of habitat loss and alteration for wildlife species during the FERC licensing process, it is imperative that wildlife habitat evaluations be updated for the currently proposed Project, and that those habitat evaluations are based on a recently prepared wildlife habitat map for the Susitna basin.

10.19.3. Study Area

The wildlife habitat evaluation study area will be identical to the area mapped for wildlife habitats in the upper and middle Susitna basin (Section 11.5), plus the area downstream of the proposed dam mapped to be mapped for riparian wildlife habitats (Section 11.6). These two areas overlap between the dam site and Gold Creek (Figure 10.19-1), but wildlife habitats in that section of the Susitna River floodplain will be mapped only in the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Section 11.6). The wildlife habitat evaluation study area (Figure 10.19-1) includes a 4-mile buffer surrounding those areas in the upper and middle Susitna basin that could be directly affected by Project construction and operations (the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission line corridors, and materials sites). The portion of the study area along the Susitna River downstream of Gold Creek includes the width of the active floodplain, as represented by the extent of riverine physiography (see Section 11.6). The downstream extent and width of the riparian zone to be evaluated in the Evaluation of Wildlife Habitat Use Study will match the final study area boundaries developed for the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam, which will be determined in the first quarter of 2013 (see Section 11.6).

10.19.4. Study Methods

10.19.4.1. Habitat Evaluation Procedures

The proposed methods for the Evaluation of Wildlife Habitat Use Study involve the use of current and Project-specific survey data for birds, mammals, and amphibians in coordination and conjunction with the preparation of a current wildlife habitat map for the Project area. This study will be an office-based effort, performed after the wildlife habitat mapping for the Project area is completed. The methods to be used will follow those outlined in ABR (2008) and Schick and Davis (2008).

The first task in the Evaluation of Wildlife Habitat Use Study is selection of a set of wildlife species of concern for which Project-related habitat impacts will be evaluated. The selection criteria to be used to determine which animals are included will be finalized with input from the federal and state resource management agencies and other interested licensing participants in Q1 2013 as part of the planned Technical Workgroup (TWG) meetings, which will be scheduled

quarterly in 2013 (see Section 10.19.6 below). Specific criteria will be established for the species-selection process. It is proposed that a species be selected if it meets one or more of the following criteria:

- A federally- or state-protected species.
- A bird species of conservation and management concern, determined from lists maintained by various management agencies, agency working groups, and non-governmental conservation organizations (as outlined in the FERC–USFWS Memorandum of Understanding [MOU] on migratory birds; FERC and USFWS [2011]).
- A bird or mammal species of management concern for federal and/or state management agencies (primarily game and furbearer species).
- A species that is an important subsistence resource or is culturally significant for Alaska Natives.
- An ecologically important species with demonstrable ecosystem effects, such as ecosystem engineers (e.g., beaver), and species that occupy prominent positions in the trophic structure as predators or prey.

As agreed to during meetings with resource management agencies (see Appendices 3 and 4), the preliminary list of bird species of concern for the Project area (Table 10.19-1) comprises those species listed in Table 2 of the wildlife data-gap report for the Project (ABR 2011) and in Table 4.8-2 of the Project Pre-Application Document (PAD; AEA 2011), plus two additional shorebird species (Short-billed Dowitcher and Hudsonian Godwit) requested by the U.S. Fish and Wildlife Service (USFWS). The list of mammal species of concern will include big game, furbearers, and selected species of smaller mammals, including the little brown bat and Alaska tiny shrew. The list of wildlife species of concern, which is likely to include birds, mammals, and amphibians, will be refined further with input from resource management agencies.

A matrix will be constructed listing each species of concern and each wildlife habitat type mapped in the Project area, and a habitat-value ranking will be assigned to each cell in the matrix. As with the species selection process, the ranking procedure will be developed further with input from federal and state resource management agencies and other interested licensing participants, but it is likely that a habitat-value categorization system will be used (e.g., negligible, low, moderate, and high value). The habitat-value rankings will be derived in different ways among species, depending on the level of Project-specific data that are available to assess habitat use in each of the mapped wildlife habitat types. Observations of wildlife species will be tagged to mapped habitats using global positioning system (GPS) coordinates and a GIS, and the data quality will be assessed for each species and mapped habitat type (e.g., adequately sampled, under-sampled, or not sampled). Data-supported quantitative evaluations of habitat use will be employed whenever possible in the habitat-value rankings. However, in cases in which the habitats in question were under-sampled or not sampled, or for which sufficient Project-specific data are not available, then habitat-use information from the scientific literature and from field experience with the species elsewhere in Alaska will be used to derive habitat-value rankings.

Habitats will be ranked for the various life history stages of each of the species of concern addressed (e.g., breeding/calving, post-calving, spring and fall migration, overwintering) to encompass the complete seasonal range of habitat use. Additionally, specific habitat-use maps can be prepared for high-value game animals such as caribou, moose, and bears to illustrate

specific areas and seasons of use, in addition to identifying habitat types that are important to those species.

10.19.4.2. Reporting and Deliverables

Because the Evaluation of Wildlife Habitat Use Study cannot be completed until after the wildlife habitat mapping for the Project area is completed in October 2014, a brief Initial Study Report will be completed in February 2014, but the final habitat evaluations will not be available until the Updated Study Report is completed in February 2015 (see Section 10.19.6 below). The Updated Study Report will include descriptions of the methods used, including summaries of habitat use for each species assessed, and tables indicating habitat-values by species and habitat type. As agreed to with the resource management agencies (see Appendices 3 and 4), individual sections for each species assessed will be prepared in which the available habitat-use information will be linked to the specific habitat values derived (to illustrate the logic used in determining habitat values for each species).

10.19.5. Consistency with Generally Accepted Scientific Practice

The study methods discussed above have been successfully used for recent wildlife habitat evaluations on several projects in Alaska (e.g., ABR 2008; Schick and Davis 2008; PLP 2011). The methods have been favorably received by agency reviewers.

10.19.6. Schedule

The schedule for implementation of the Evaluation of Wildlife Habitat Use Study is summarized below (Table 10.19-2). The wildlife habitat evaluation can be completed only after the wildlife habitat mapping for the Project area is available in October 2014. Preliminary information to be used in the habitat-use rankings can be obtained through literature review in 2013 and earlier in 2014, however. The initial selection of species for analysis and accompanying literature review to support the habitat evaluations will be conducted during February–April 2013. A preliminary report of progress to date will be prepared for the Initial Study Report in February 2014 and the initial habitat-value rankings will be prepared during February–April 2014, using the preliminary results of wildlife field studies that are available by that time. The final selection of species for the final evaluation matrix will be completed by September 2014 and the final data analyses and habitat-value rankings will be conducted during September–December 2014, for presentation in the Updated Study Report in February 2015.

TWG meetings will be planned on a quarterly basis in 2013 and 2014 to review study progress. Licensing participants will have the opportunity to review and comment on the Initial Study Report and Updated Study Report.

10.19.7. Relationship with Other Studies

The relationships between the wildlife habitat-use evaluation and other Project studies are summarized here and illustrated below (Figure 10.19-2). Primary sources of information for the wildlife habitat-use evaluation include the wildlife habitat map polygons for the upper and middle Susitna basin from the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Section 11.5), and the wildlife habitat map polygons for riparian areas downstream of the proposed dam from the Riparian Vegetation Mapping Study (Section 11.6).

As was described above, these mapped wildlife habitats will be evaluated for wildlife use and will be ranked categorically in terms of habitat value for a selected set of wildlife species of concern. Project-specific habitat-use information for mammals, birds, and amphibians will be obtained from each of the wildlife studies (Sections 10.5–10.18). These Project-specific data will be provided in GIS so that they can be directly associated with the mapped habitat types. From each of the wildlife studies, information on the locations of observations, the species and numbers recorded, seasonality, and behaviors observed, when available, will be used to evaluate the use of the wildlife habitats mapped for the Project.

The information on wildlife habitat values derived in this study will be used in the FERC License Application to assess the expected impacts of the proposed Project on the habitats known to be used by each wildlife species of concern in the study area. In addition, the wildlife habitat values will be used in the License Application to develop protection, mitigation, and enhancement (PM&E) measures, as appropriate.

Data from the Evaluation of Wildlife Habitat Use Study will be used in quantitative assessments of habitat loss and habitat alteration for each of the wildlife species of concern. With habitat-value rankings for each bird, mammal, and amphibian species of concern for each mapped habitat type, the areas within the Project footprint that are important for each species of concern can be identified, and the total areas of each to be directly affected (e.g., habitat loss and habitat alteration) by development of the Project can be determined quantitatively in GIS. Similarly, the indirect effects of disturbance will be assessed by applying species-specific disturbance buffers to the Project footprint and determining quantitatively the total areas of important habitats for each species of concern that could be influenced indirectly by disturbance effects during Project construction and operations. Data from the Evaluation of Wildlife Habitat Use Study will also be used to help address the potential for fragmentation of habitat patches for species of concern because of Project development.

Also in the FERC License Application, for areas downstream of the proposed dam, the habitat-value rankings from this study will be used to help predict how wildlife species will respond to the changes in riparian wildlife habitats in the Susitna River floodplain that are expected to occur with construction and operation of the proposed dam.

As agreed to during meetings with resource management agencies (see Appendices 3 and 4), the finer-scale habitat types mapped in the Project area (see Section 11.5) will be "crosswalked" with the coarser-scale habitats (30-meter pixel resolution) mapped in the Alaska Gap Analysis Project (GAP). The habitat-value rankings for each wildlife species of concern in each mapped habitat type in the Project area will also be "crosswalked" to the coarser-scale GAP habitats, and averaged, when multiple values need to be combined, to derive appropriately-scaled habitat rankings. With the habitat-value rankings upgraded to the GAP habitat types, the habitat loss and habitat alteration effects from the proposed Project can be placed in a broader regional context (e.g., habitat impacts can be assessed at the eco-regional scale).

10.19.8. Level of Effort and Cost

The wildlife habitat evaluation will be an office-based effort and is expected to be completed relatively quickly once the wildlife habitat mapping tasks are completed. The Evaluation of Wildlife Habitat Use Study can be completed in several months. The habitat evaluation will be conducted by up to two vegetation ecologists and four wildlife biologists (with specific expertise

with various vertebrate species groups). The total cost of this study over both years is estimated to be approximately $200,000.

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10.19.10. Tables

Table 10.19-1. Bird species of conservation/management concern that are known or likely to occur in the Susitna River basin, Alaska.

English Name	USFWS BCC [1]	USFWS BMC [2]	ADFG [3]	BLM [4]	NAWCP [5]	NAWMP [6]	ASG (USSCP) [7]	BPIF (PIF) [8]
Greater White-fronted Goose (Tule)		■				■		
Snow Goose		■						
Brant		■				■		
Canada Goose		■				■		
Trumpeter Swan		■		■				
Tundra Swan		■						
Gadwall		■						
American Wigeon		■				■		
Mallard		■				■		
Blue-winged Teal		■				■		
Northern Shoveler		■						
Northern Pintail		■				■		
Green-winged Teal		■						
Canvasback		■				■		
Redhead		■				■		
Ring-necked Duck		■						
Greater Scaup		■						
Lesser Scaup		■				■		
Harlequin Duck		■						
Surf Scoter		■	■			■		
White-winged Scoter		■	■			■		
Black Scoter		■				■		
Long-tailed Duck		■				■		
Common Goldeneye		■				■		
Rock Ptarmigan			■					

Table 10.19-1. Continued.

English Name	USFWS BCC [1]	USFWS BMC [2]	ADFG [3]	BLM [4]	NAWCP [5]	NAWMP [6]	ASG (USSCP) [7]	BPIF (PIF) [8]
White-tailed Ptarmigan								■
Red-throated Loon	■		■	■*	■			
Pacific Loon			■					
Common Loon			■					
Horned Grebe	■		■		■			
Red-necked Grebe			■					
Osprey			■					
Bald Eagle			■					
Northern Harrier			■					
Sharp-shinned Hawk			■					
Northern Goshawk			■					
Red-tailed Hawk			■					
Golden Eagle			■	■				
Merlin			■					
Gyrfalcon			■					■
Peregrine Falcon [9]	■		■					
American Golden-Plover							■	
Solitary Sandpiper	■	■	■				■	
Lesser Yellowlegs	■	■	■				■	
Upland Sandpiper	■	■					■	
Whimbrel	■	■					■	
Hudsonian Godwit	■	■					■	
Ruddy Turnstone [10]							■	
Black Turnstone [10]							■	
Short-billed Dowitcher	■	■					■	
Surfbird							■	
Sanderling							■	

Table 10.19-1. Continued.

English Name	USFWS BCC [1]	USFWS BMC [2]	ADFG [3]	BLM [4]	NAWCP [5]	NAWMP [6]	ASG (USSCP) [7]	BPIF (PIF) [8]
Wilson's Snipe		■						
Black-legged Kittiwake			■					
Arctic Tern			■					
Great Horned Owl			■					
Snowy Owl			■					
Northern Hawk Owl			■					
Short-eared Owl	■		■	■				■
Boreal Owl			■					■
Belted Kingfisher			■					
Hairy Woodpecker			■					
American Three-toed Woodpecker			■					
Black-backed Woodpecker			■					■
Northern Flicker			■					
Olive-sided Flycatcher	■		■	■				■
Western Wood-Pewee								■
Northern Shrike								■
Violet-green Swallow			■					
Bank Swallow			■					
Cliff Swallow			■					
Boreal Chickadee			■					
Brown Creeper			■					
American Dipper								■
Golden-crowned Kinglet			■					
Gray-cheeked Thrush				■*				■
Hermit Thrush			■					
Varied Thrush			■					■
Bohemian Waxwing								■

Table 10.19-1. Continued.

English Name	USFWS BCC [1]	USFWS BMC [2]	ADFG [3]	BLM [4]	NAWCP [5]	NAWMP [6]	ASG (USSCP) [7]	BPIF (PIF) [8]
Smith's Longspur	■		■					■
Blackpoll Warbler			■	■				■
Townsend's Warbler			■	■*				■
Wilson's Warbler			■					
White-crowned Sparrow			■					
Golden-crowned Sparrow								■
Dark-eyed Junco			■					
Rusty Blackbird	■		■	■				■
Gray-crowned Rosy Finch			■					
Pine Grosbeak			■					
White-winged Crossbill			■					■
Pine Siskin			■					

Species list derived from Kessel et al. (1982) and APA (1985: Appendices E5.3 and E6.3), plus Townsend's Warbler, Hudsonian Godwit, and Short-billed Dowitcher.

[1] USFWS (2008) Birds of Conservation Concern.
[2] USFWS (2009) Birds of Management Concern.
[3] ADF&G (2006) Featured Species.
[4] BLM (2010a) Sensitive Species; asterisk denotes Watch List Species (BLM 2010b).
[5] North American Waterbird Conservation Plan (Kushlan et al. 2002, 2006).
[6] North American Waterfowl Management Plan Committee (2004).
[7] Alaska Shorebird Group (2008).
[8] Boreal Partners in Flight Working Group (1999).
[9] Previously listed as threatened under the Endangered Species Act (ESA), the American Peregrine Falcon (*Falco peregrinus anatum*) was delisted in August 1999.
[10] Species identity (Ruddy Turnstone, Black Turnstone) of sole record in the Susitna basin was unconfirmed (Kessel et al. 1982), but both are on the ASG list.

Table 10.19-2. Schedule for implementation of the wildlife habitat-use evaluation.

Activity	2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Initial selection of species for analysis	—								
Literature review of habitat-use information	—	—							
Initial Study Report					Δ				
Initial habitat-value ranking					—	—			
Final selection of species for analysis							—		
Data analysis and habitat-value ranking							—	—	
Updated Study Report									▲

Legend:

—— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.19.11. Figures

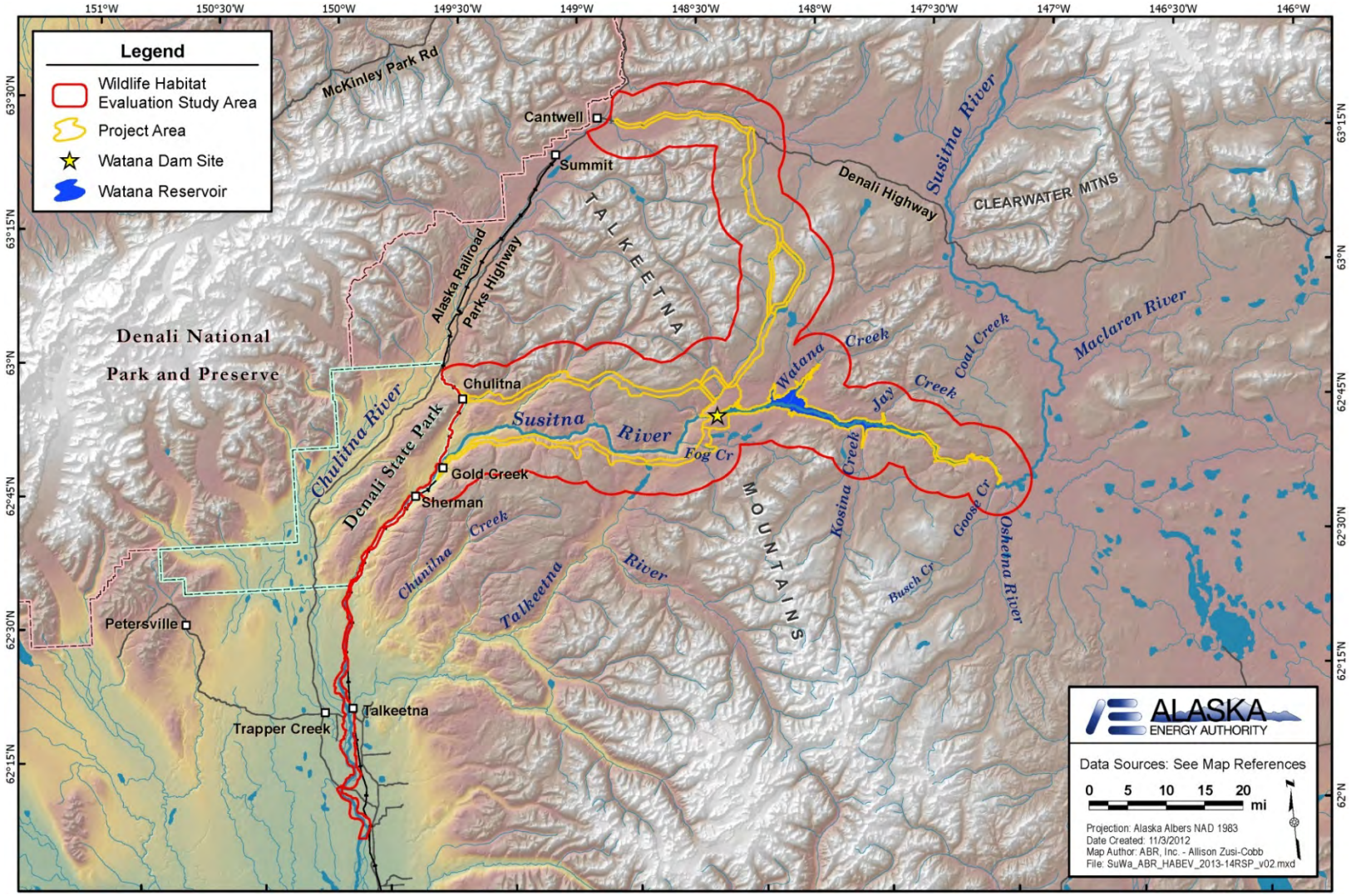

Figure 10.19-1. Study area for evaluation of wildlife habitat use. The study area is a combination of the wildlife habitat mapping areas from the Vegetation and Habitat Mapping Study (Section 11.5) and the Riparian Vegetation Study (Section 11.6).

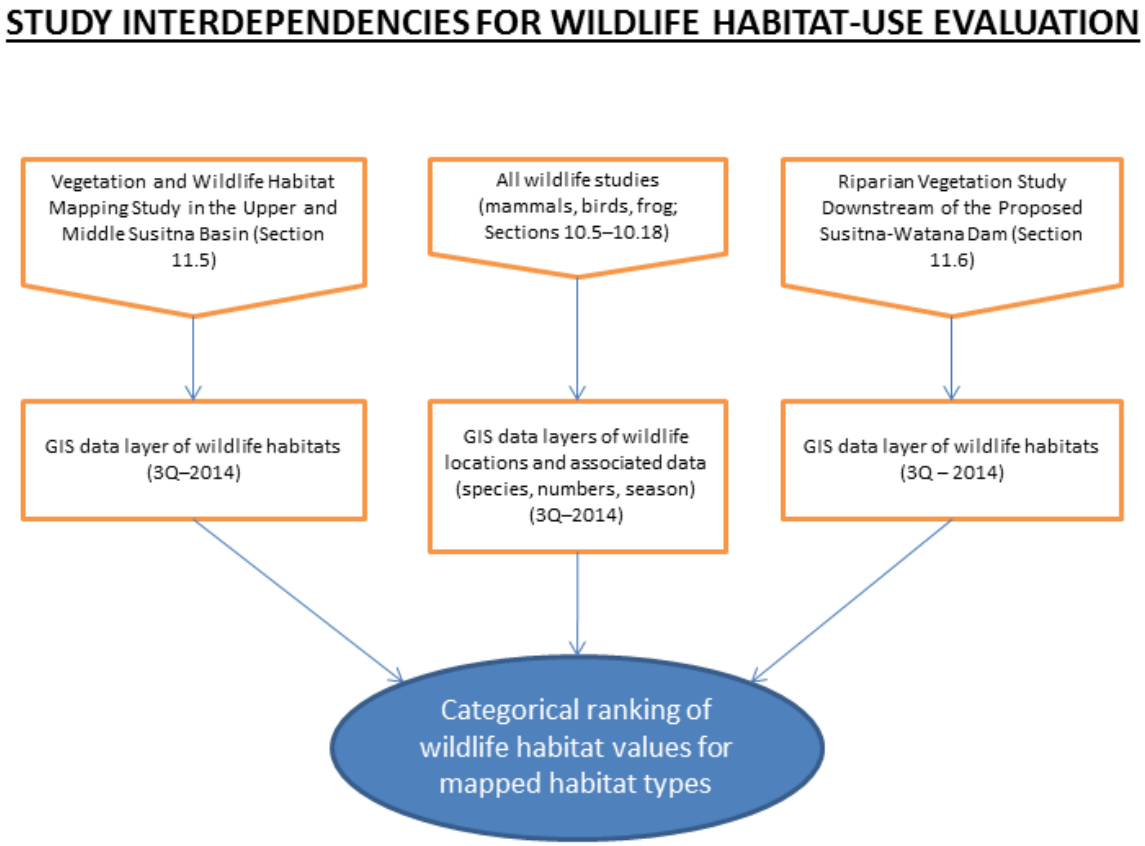

Figure 10.19-2. Study interdependencies for the wildlife habitat-use evaluation.

10.20. Wildlife Harvest Analysis

10.20.1. General Description of the Proposed Study

The wildlife harvest analysis study is an office-based study of Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife (USFWS) harvest records for large mammals and furbearers, as well as for smaller mammals and upland gamebirds (if data are available). In this study, AEA will characterize past and current hunter effort and harvest levels in the region of the proposed Project by summarizing and analyzing data from the ADF&G harvest database for Alaska, which also includes some harvest data from subsistence users reported to USFWS.

Study Goal and Objectives

Construction and operation of the Project will alter human access to the region through construction of the access road and power transmission corridors, and through the creation of the reservoir. Much of Alaska Game Management Unit (GMU) 13, which encompasses the Project area, is readily accessible by road and provides hunting opportunities for many Alaskans. Creating access points to the Project site from the Denali Highway to the north or from the rail corridor to the west may result in increased motorized vehicle access for hunters and recreational users to portions of GMU 13 that are currently remote. The potential for increased human access and activity within GMU Subunits 13A and 13E without additional understanding of the implications for game populations has been identified as a resource management concern by ADF&G.

The goal of this study is to compile and analyze information on the distribution of big game, furbearers, and small game (including both small mammals and upland gamebirds, assuming data are available) and to understand patterns of hunting effort and harvest in the study area. These data will provide information on identification of past and current trends in hunter access modes, hunting locations, and harvest locations, and identify potential Project-induced changes that are likely to alter hunter access or harvest patterns. These findings will help predict the impacts of those changes on wildlife harvests. This study is a multi-year effort that began in 2012 (AEA 2012).

Specifically, this study has three primary objectives:

- Identify past and current harvest effort for large and small game including furbearers, harvest locations, access modes and routes.
- Compare current harvest locations of large and small game, including furbearers, with data on the seasonal distribution, abundance, and movements of harvested species, using the results of other, concurrent Project studies on big game and furbearers (Sections 10.5–10.11).
- Provide harvest data for use in the analyses to be conducted for the recreation and subsistence resource studies (Sections 12.5 and 14.5, respectively).

The information developed in this study will be used to help develop any necessary measures to address Project impacts on hunting opportunities, hunter distribution, and impacts to game species abundance.

10.20.2. Existing Information and Need for Additional Information

The wildlife data-gap analysis conducted for the Project (ABR 2011) identified the need for an updated drainage-specific compilation of subsistence, sport hunter, and trapper harvest data for big game and furbearers. Hunter access to this region has changed since the 1980s, but potential changes in patterns of harvest at this scale have not been evaluated or compared with distribution of harvested species. Compilation of historic data may be useful for identifying trends in human access and harvest locations over the past decades and will provide information that may inform ADF&G's management goals for big game and furbearers in the Project area.

ADF&G documents legal sport hunting and trapping in Alaska through the collection of harvest reports and sealing records of hides for certain furbearers. Harvest reports are required to be submitted by hunters for some big game species. Hunting effort and harvest success are summarized from harvest reports and sealing records by GMU, subunit, and, when possible, by smaller Uniform Coding Units (UCU) that are delineated based on watersheds at a sub-basin level. These data are compiled and stored by ADF&G in a statewide harvest database. In addition, a trapper questionnaire is issued annually to compile trappers' views of various wildlife species in their areas (Schumacher 2010) and some subsistence hunting activity is summarized based on household surveys. Information on harvest as a part of federal subsistence hunts on federal land is maintained by USFWS and will need to be obtained through a separate data sharing agreement.

This information from ADF&G is available to be summarized and analyzed to elucidate spatial and temporal patterns of hunting effort and harvest success. It also provides some information on access types, use of guides, and residency of hunters. These data can be compared with data on the distribution of game mammals and the analyses can be used to help predict the impact of the Project on hunting opportunities and hunter distribution, and impacts on game mammals. Subsistence surveys will be conducted by ADF&G to gather current information for communities near the Project area. Additional information on subsistence harvests will also be available from other studies.

The following issues identified in the Pre-Application Document (PAD) (AEA 2011) will be addressed in this study:

- W4: Potential impact of changes in predator and prey abundance and distribution related to increased human activities and habitat changes resulting from Project development.
- W5: Potential impacts to wildlife from changes in hunting, vehicular use, noise, and other disturbances due to increased human presence resulting from Project development.

10.20.3. Study Area

The study area (Figure 10.20-1) includes GMU Subunits 13A, 13B, 13E, 14B, 16A, and portions of 20A. These GMUs were selected because hunting and trapping activities in portions of each of these GMUs may be influenced directly or indirectly by Project construction and operations, including the reservoir inundation zone, associated facility sites, laydown/storage areas, and access road and power transmission corridors. The study area is based on GMUs conforming with the harvest data available (which is recorded by GMU) and because hunting and trapping in the region of the Project is managed by GMU.

10.20.4. Study Methods

In this study, AEA will use existing data, as well as new data to be collected during concurrent studies, to assess the spatial and temporal patterns and success of hunting and trapping efforts and to examine relationships between effort, harvest, and the distribution of wildlife, as indicated by telemetry studies and other surveys. Existing data from harvest reports will be compiled and reviewed to assess their adequacy to address Project-related changes in human access. These data will be shared with researchers conducting the recreation and subsistence resource studies (Sections 12.5 and 14.5). The methods used in this study will include the following tasks:

- Compilation and analysis of ADF&G harvest database records
- Review of ADF&G management reports
- Review of ADF&G trapper questionnaires
- Review of ADF&G small game outlook and harvest surveys
- Review of ADF&G and USFWS subsistence surveys and harvest reports
- Interviews with regional biologists
- Comparison of harvest patterns with development plans and the distribution of game mammals and birds

Initial efforts will focus on compilation and analysis of hunter effort and harvest success within harvest report units contained within the ADF&G harvest-record database. The spatial resolution, adequacy, and completeness of the harvest data record for detecting potential changes in use of wildlife resources in the Project area will be evaluated.

The study will build on results of the wildlife harvest data analysis begun in 2012 and will incorporate new harvest data as they become available, as well as the results of the ADF&G moose, caribou, and ptarmigan telemetry studies begun in 2012. Harvest patterns will be compared with seasonal distribution and movements revealed by the telemetry data on moose, caribou, and ptarmigan.

A relational database of harvest and effort data used in the analysis will be prepared. Naming conventions of files, data fields, and metadata descriptions will meet the Alaska Department of Natural Resources (ADNR) standards established for the Project. Harvest effort and success will be calculated at the highest spatial resolution possible given the quality of the data (GMUs, Subunits, or UCUs) and compared with the best available estimates of game populations, hunting regulations, and access. Hunter effort and harvest success maps showing big game and furbearer species will be developed based on the relational database developed from the ADF&G harvest database. All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and North American Datum of 1983 (NAD 83) horizontal datum, consistent with ADNR standards.

10.20.5. Consistency with Generally Accepted Scientific Practices

Harvest data will be analyzed according to commonly accepted statistical techniques. Spatial statistics will be conducted with commonly accepted techniques such as fixed-kernel density estimation with least-squares cross validation or plug-in bandwidth selection (Seaman and Powell 1996; Gitzen et al. 2006).

10.20.6. Schedule

This study is a multi-year effort that began in 2012 with data transfers from ADF&G and USFWS for dates from 2011 and earlier (AEA 2012). The schedule planned for 2013–2014 activities is depicted in Table 10.20-1. Transfer of 2012 harvest and subsistence data from ADF&G and USFWS is planned for July 2013 and 2014, depending on the availability of summarized data from their geodatabases (data transfer may occur somewhat later in the third quarter [3Q]). The data received from those agencies will be compiled into the Project-specific geodatabase for summary and analysis in the fourth quarter [4Q] each year, which will be used in the Initial Study Report to be completed by February 2014, and in the Updated Study Report to be completed by February 2015. Updates on the study progress will be provided during Technical Workgroup meetings which will be held quarterly in 2013 and 2014.

10.20.7. Relationship with Other Studies

As depicted in Figure 10.20-2, data inputs for the wildlife harvest analysis will be required annually from the harvest databases maintained by state (ADF&G) and federal (USFWS) agencies. Those data will be compiled into a Project-specific geodatabase of harvest data, organized by species, date, method, and location (reporting area), which will be used to prepare spatially-explicit summaries of harvests in various portions of the study area to as fine a level of spatial resolution as is supported by the data. The data outputs from these analyses will be provided to the Subsistence Resource Study (Section 14.5) and the Recreation Resource Study (Section 12.5) so that subsistence and sport harvests, respectively, can be evaluated and compared with other human uses of the Project area.

During the impact assessment that will be conducted for the FERC License Application in 2015, the results of the wildlife harvest analysis will be used both directly and indirectly (through the other studies mentioned in the preceding paragraph) in the assessment of impacts and in the identification of any appropriate protection, mitigation, and enhancement (PM&E) measures. Data on the recent and current distribution of harvest effort and harvest success in the study area will be used to assess potential Project impacts on hunting and trapping effort and harvest success. The assessment of impacts on hunting and trapping effort and harvest success will be coordinated with the Recreational Resources Study and the Subsistence Resources Study (Sections 12.5 and 14.5,. respectively) to assess how the expected changes in land use and access in the Project area may affect patterns of hunting and trapping. The direct and indirect impacts of the Project on game animal populations will be assessed in other wildlife studies (Sections 10.5–10.11 and 10.17) by conducting geospatial analyses using information on the responses of the species to other development projects, as documented in the scientific literature. Those geospatial analyses will overlay the Project footprint and species-specific habitat alteration and disturbance buffers on the known locations of use by the species of interest, as determined from Project-specific survey data and the Evaluation of Wildlife Habitat Use (Section 10.19). Similarly, Geographic Information System (GIS) analyses of potential impacts on hunting and trapping effort and harvest success will be conducted for this study by overlaying the Project footprint and species-specific habitat alteration and disturbance buffers on the known locations of harvest data obtained in this study.

10.20.8. Level of Effort and Cost

This study will focus on analyzing existing harvest data and new data collected for other wildlife, subsistence, and recreational studies to maximize the information gained from these data. Thus, basic questions associated with human harvest of game animals in and near the Project area can be analyzed in a cost-effective manner. The estimated total cost of the study is less than $100,000 over both years.

10.20.9. Literature Cited

ABR. 2011. Wildlife data-gap analysis for the proposed Susitna–Watana Hydroelectric Project. Draft report, August 16, 2011. Report for the Alaska Energy Authority by ABR, Inc.—Environmental Research and Services, Fairbanks, Alaska. 114 pp.

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Gitzen, R. A., J. J. Millspaugh, and B. J. Kernohan. 2006. Bandwidth selection for fixed-kernel analysis of animal utilization distributions. *Journal of Wildlife Management* 70: 1334–1344.

Schumacher, T. 2010. Trapper questionnaire: Statewide annual report, 1 July 2008–30 June 2009. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau.

Seaman, D. E., and R. A. Powell. 1996. An evaluation of the accuracy of kernel density estimators for home range analysis. *Ecology* 77: 2075–2085.

10.20.10. Tables

Table 10.20-1. Schedule for implementation of the Wildlife Harvest Analysis.

Activity	2012				2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Transfer of 2012 harvest data							—						
Analysis of 2012 harvest data and preparation of Initial Study Report, to be completed in February 2014								—	Δ				
Transfer of 2013 harvest data											—		
Analysis of 2013 harvest data and preparation of Updated Study Report, to be completed in February 2015												—	▲

Legend:

— Planned Activity
Δ Initial Study Report
▲ Updated Study Report

10.20.11. Figures

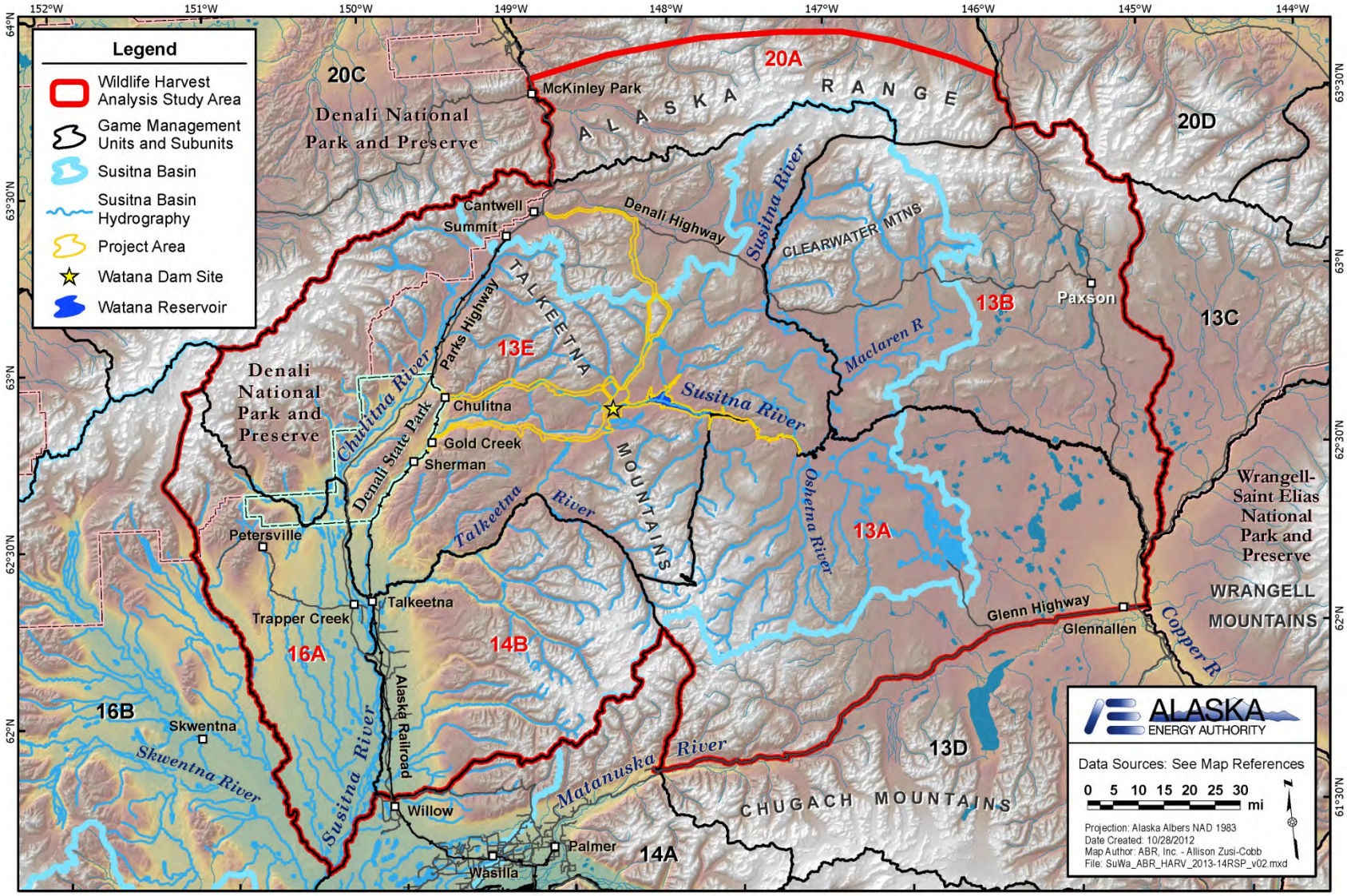

Figure 10.20-1. Study area for the Wildlife Harvest Analysis.

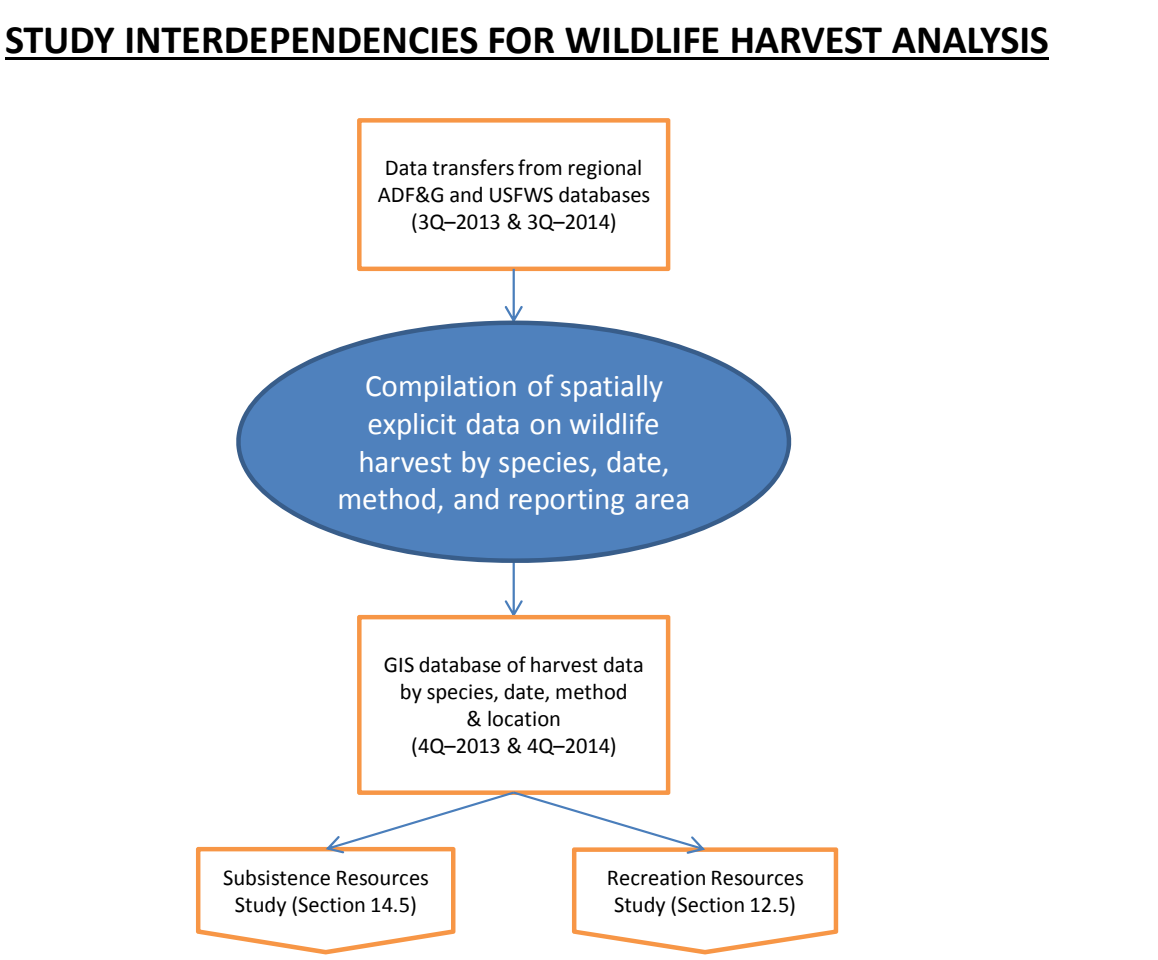

Figure 10.20-2. Study interdependencies for the Wildlife Harvest Analysis.