11.1. Vegetation and Wildlife Habitat Mapping Study

11.2. Riparian Study

11.3. Wetland Mapping Study in the Upper and Middle Susitna Basin

11.3.1. General Description of the Proposed Study

In the wetland mapping study, AEA will identify and map the extent of wetlands in the in the upper and middle Susitna basin. The mapping will encompass the inundation zone of the proposed reservoir, the dam site and associated infrastructure, and the three possible access route and transmission-line corridors. Wetlands in riparian areas along the Susitna River below the proposed dam will be mapped in a separate study, the riparian vegetation study (see Section 11.6). The mapping of wetlands in the upper and middle Susitna basin will be conducted using current, high-resolution aerial photography and remote-sensed imagery. The study will involve field surveys to collect ground-reference data to link the photosignatures in the study area (see Section 11.7.3 below) to known wetland types, and in the office, the boundaries for the identified wetland types will delineated by on-screen digitizing in GIS using the aerial photography and remote-sensed imagery for the study area as the base data layers. The wetland classification to be used in the study will be a hybrid classification specific to the wetlands in the study area, but it will be compatible with existing wetland classification systems used elsewhere in Alaska, especially the system used by the Matanuska-Susitna Borough. A wetland functional assessment also will be conducted in the study to determine the specific functions that the wetlands in the study area provide.

11.3.1.1. Study Goals and Objectives

The overall goal of the wetland mapping study is to prepare a baseline map of the existing wetland habitats in the upper and middle Susitna basin (upstream of Gold Creek). This mapping information will be used to assess impacts to wetland resources from the proposed Project, and to develop protection, mitigation, and enhancement (PM&E) measures to address any identified impacts.

The specific objectives of the wetland mapping study are to:

- Identify, delineate, and map wetlands in the upper and middle Susitna basin in GIS;
- Determine functional values for the mapped wetland types; and
- Quantify the potential direct, indirect, and cumulative impacts to wetlands and wetland functions from Project construction and operations activities, which will include any new wetlands that may be created by the proposed reservoir.

This multi-year study is being initiated in 2012 and will be continued in 2013 and 2014. Results from the first year of work in 2012 will be used to update future versions of this study plan, as needed, to (1) fine-tune the field investigations and mapping efforts for the existing conditions found in the study area, and (2) customize the mapping work (e.g., study area) to reflect further refinements in the design of the Project.

11.3.2. Existing Information and Need for Additional Information

Wetlands were mapped for the Alaska Power Authority's Susitna Hydroelectric Project (APA Project) in the 1980s through a cooperative agreement between U.S. Fish and Wildlife Service (USFWS) and the APA to produce a preliminary wetlands map for the APA Project area at a scale of 1:63,360. Those wetlands map data were based on the vegetation mapping completed by McKendrick et al. (1982), with some additional modification using stereoscopic photo-interpretation, and are now a part of the National Wetlands Inventory (NWI; USFWS 1984). The Alaska Vegetation Classification (AVC; Viereck and Dyrness 1980) vegetation classes that were mapped in the early 1980s were cross-referenced and converted into wetlands classes using the classification scheme of Cowardin et al. (1979).

Existing NWI data, which were developed in the 1980s (above) and cover the current study area, are expected to be available in digital format sometime in 2012. The NWI mapping data will help in understanding the types of wetlands that occur in the study area, but the mapping was not conducted at a scale sufficient for determining Project impacts on wetland resources. When mapping at the 1:63,360 scale, small drainages and other small wetland habitats are often overlooked. Additionally, ground verification of NWI wetlands maps typically is fairly limited. Because those NWI data are nearly 30 years old, and because vegetation, hydrology, and soil conditions likely have changed over that period (see below), an updated map of wetlands will be needed for the proposed Project. NWI maps from the 1980s will not reflect recent landscape changes due to fire, insect outbreaks, development, and climate change. In particular, reductions in forest cover from fires (Kasischke and Turetsky 2006, Kasischke et al. 2010), insect outbreaks (Werner et al. 2006), and permafrost degradation (Jorgensen et al. 2001) have been documented in recent decades in interior Alaska. These recent landscape changes will not be represented in wetlands mapping data from the 1980s.

11.3.3. Study Area

The proposed study area for wetlands mapping consists of a 2-mile buffer surrounding those areas that would be directly altered or disturbed by development of the Project (Figure 11.7-1). All direct and indirect effects of the proposed Project on wetlands are expected to be encompassed in a 2-mile buffer surrounding the Project infrastructure. The study area includes three possible alternatives for road and transmission lines, the proposed reservoir inundation area, and supporting facilities. The Chulitna Corridor includes east-west running transmission lines and a road north of the Susitna River connecting to the Alaska Intertie and the Alaska Railroad near the Chulitna station. Another east-west configuration would follow a corridor south of the Susitna River running to Gold Creek station. A third corridor, the Denali Corridor, runs north, and would connect the dam site to the Denali Highway by road over a distance of about 44 miles. If transmission lines are run north up the Denali corridor, they would need to also run west along the existing Denali Highway to connect to the Anchorage-Fairbanks Intertie Transmission lines near Cantwell.

The alteration of wetland habitats downstream of the dam (due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River) will be addressed in the riparian study (see Section 11.6). No placement of fill in wetlands is expected to occur downstream from the proposed dam; thus, a wetlands map will not be needed for the Clean Water Act Section 404 wetlands permit application for the Project (this has been confirmed by the U.S. Army Corps of

Engineers [USACE]; see Section 9.7 in AEA 2012). In the riparian study, successional vegetation, wetlands, and wildlife habitats will be mapped. Mapping and prediction of changes in riparian habitats from construction of the Project will be developed in collaboration with the AEA study teams for riverine physical processes, most notably instream flow, ice processes, and riverine geomorphology (see Section 11.6).

11.3.4. Study Methods

In general, the wetlands mapping for the study area will follow the protocols for preparing wetland maps that have been developed by the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) program (National Wetlands Inventory Center 1995, Dahl et al. 2009), but wetlands will be classified using the elements of three different wetland classification systems: Cowardin et al. (1979), hydrogeomorphic (HGM) (Brinson 1993), and Viereck et al. (1992) Level IV vegetation types. Wetland types will be defined based on a number of landscape, geomorphic, hydrological, and biological variables, including the wetland classification systems above. This integrated classification approach is similar to a regional classification system developed for lowlands in the Cook Inlet basin (Gracz 2011), and thus will allow cross-referencing between the two classifications where they identify similar wetlands. This approach was agreed to during meetings with resource management agencies regarding the wetland mapping study in spring 2012 (see Section 9.7 in AEA 2012).

In addition to the wetlands mapping needed for supporting a Clean Water Act Section 404 dredge and fill permit application, a wetland functional assessment for the mapped wetland types will be prepared to (1) evaluate the functional significance of wetland impacts that may occur as a result of the Project, and (2) for use in compensatory mitigation planning for unavoidable wetland losses. As agreed to with resource management agencies (see Attachment 9-1), the set of wetland functions to be assessed will be tailored to those expected to be of most importance in remote regions of Alaska in which landscape disturbances are few. The wetland functional assessment will be based on HGM principles. Although draft HGM guidebooks have been prepared for the Cook Inlet basin (Hall et al. 2003) and Interior Alaska (Alaska Department of Environmental Conservation and USACE 1999), the models are confined to a small set of HGM classes and are regionally specific; thus, they are not applicable to the Susitna basin, which lies in the transition zone between Interior Alaska and Cook Inlet and includes montane and riverine environments. As a result, the rapid assessment procedure developed by Magee (1998) is proposed to be used as the basis for assessing wetland functions, but the procedure (and parameters measured) will be modified as needed to evaluate wetland functions unique to the study area.

At a minimum, the wetland mapping study will include the following components:

- Initiate wetlands mapping using data collected during field surveys in summer 2012;
- Preselect 2013 and 2014 field sampling locations and conduct field wetland determination and functional assessment surveys;
- Revise preliminary wetlands map using field data collected in 2013 and 2014;
- Incorporate data from the vegetation and wildlife habitat mapping study and available data on natural fire patterns along the reservoir reach of the Susitna River into the mapping of wetland types; and

- Report on the 2013 study results (Initial Study Report) and 2014 study results (Updated Study Report).

11.3.4.1. Wetlands Classification and Mapping

Prior to the 2013 field season, a preliminary map of wetland and upland boundaries will be created in areas where high quality imagery is available. The map will be produced by digitizing polygons on-screen in ArcGIS 10.0, using ground-reference survey data collected in 2012. The goal of the preliminary mapping is to establish a reasonable set of characteristic wetland types that occur in the mapping study area, which will be used to guide field survey efforts in 2013 and 2014.

Classification and mapping of the study area will follow the protocols for preparing wetland maps that have been developed by the USFWS NWI program (National Wetlands Inventory Center 1995, Dahl et al. 2009). These protocols describe requirements for boundary delineation, polygon size, classification, and NWI annotation. The minimum mapping polygon size for most upland and wetland habitats will be 0.5 acres, with smaller polygons (0.1 acre) delineated for water bodies and other wetlands of ecological importance. Wetland and upland boundaries will be delineated based on color signature, plant canopy, and surface relief, along with hydrological indicators such as drainage patterns and surface water connections. As noted above, the classification of wetlands will incorporate elements of three different wetland classification systems: Cowardin et al. (1979), HGM (Brinson 1993), and Viereck et al. (1992) Level IV vegetation types. Wetland types will be defined based on a number of landscape, geomorphic, hydrological, and biological variables, including the wetland classification systems above, and the presence or absence of permafrost. This integrated approach is similar to a regional classification system developed for lowlands in the Cook Inlet basin (Gracz 2011), which improves upon Cowardin et al. (1979) by incorporating region-specific landscape, geomorphic, and wetland function features into the classification. The Cook Inlet system is specific to Cook Inlet lowlands, however, and many wetland types in the study area (which largely occurs at higher elevations) are unlikely to be represented in the Cook Inlet classification. Developing Project-specific wetland types will allow cross-referencing between the two classification systems and the identification of appropriate Cook Inlet classes for applicable lowland wetlands.

The wetlands map will be revised in 2013 and 2014 following completion of the field surveys and the acquisition of additional imagery. The mapping will undergo a rigorous QA/QC review using tools developed by ABR and the Wetlands Data Verification Toolset developed by the NWI program to identify incorrect codes, digital anomalies, unattributed (null) polygons, adjacent polygons with the same coding, and digital slivers (< 0.01 acre). The NWI toolset was created using Environmental Systems Research, Incorporated's (ESRI) ModelBuilder (http://www.fws.gov/wetlands/Data/Tools-Forms.html).

Suitable high-resolution imagery is not yet available for the entire study area; additional imagery acquisition is anticipated during the 2013 field season. Thus, the detailed mapping of wetland types in 2013 will be limited to those areas with high-resolution imagery: a corridor around the upper Susitna River, which covers the southern part of the reservoir inundation zone, and in the vicinity of Cantwell along the Denali corridor. Lower-resolution imagery may be used for creating preliminary NWI and HGM classes and selecting field sample plots for the 2013 field season, but fine-scale mapping is only possible through the use of high-resolution imagery.

11.3.4.2. Field Surveys

The wetland field surveys will be organized to collect data from as many wetland types as possible in a way that maximizes safety and efficiency. The preliminary mapping effort described above will be used to preselect sampling transects and wetland-determination plots, although additional plots may be established in the field to describe transitional habitats or areas not discernible using photosignature features alone. Field plots will be sampled along transects located within major physiographic types, including riverine, lacustrine, lowland, and upland areas.

Wetland determinations will be made using the standard three-parameter approach described in the 1987 Corps of Engineers Wetlands Delineation Manual (Environment Laboratory 1987) and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0) (USACE 2007). Field surveys will be conducted between June 15 and September 15, which is well within the median dates of the onset of vegetation green-up in spring and vegetation senescence in fall for south-central Alaska, as specified in the 2007 Regional Supplement. To be classified as a wetland, a site must be dominated by hydrophytic plants, have hydric soils, and show evidence of a wetland hydrologic regime. At each wetland determination plot, percent areal cover of plant species within each stratum (herb, shrub, and tree) will be visually estimated, generally within a 10-m (33-ft) radius of relatively homogeneous vegetation as specified in the 1987 Manual. The size and dimensions of the plots may be modified, however, depending on the site characteristics of the plant community (e.g., narrower plots in riparian fringe habitats). Additional documentation at each plot will include observations of wildlife use (stick nests, dens) and other site characteristics that reflect habitat quality and wetland function. Additional vegetation structure information for both vascular and nonvascular plants will be recorded to assist in evaluating use of the wetland types by birds and mammals.

In addition to wetland determination plots, ground-verification plots will be established for improving the accuracy of the overall mapping effort. At these plots, the dominant vascular plant species, Cowardin et al. (1979) wetland class, and Viereck Level IV vegetation class (Viereck et al. 1992) will be assigned. These verification assessments will be performed in areas where the wetland or upland status has been well documented in determination plots elsewhere, and will be used to improve map accuracy by increasing the number of documented wetland types tagged to particular aerial photosignatures.

A mobile Trimble® Nomad™ series GIS unit will be used to record the field wetlands data (using the WetForm database), record GPS location, and provide field access to aerial imagery and the preliminary mapping performed prior to the field survey. WetForm is a proprietary relational database used to enter wetlands site data in the field, and it facilitates the preparation of electronic copies of the USACE 2007 Regional Supplement dataform for each wetland determination plot. Additional data to support the wetland classification and functional assessment efforts will be collected electronically at each plot using an Android tablet computer.

11.3.4.3. Wetland Functional Assessment

Based on discussions with resource management agencies while planning the 2012 wetland mapping study (see Section 9.7 in AEA 2012), wetland functions in the study area will be assessed using HGM principles (Smith et al. 1995). Similar to formal HGM methodologies, HGM classes as defined by Brinson (1993) (e.g., depressional, slope, lacustrine fringe) will be used. The functional capacity of each wetland type will be assessed following Magee's (1998) rapid-assessment procedure, which involves incorporating field data into HGM-specific models. The Magee (1998) rapid-assessment procedure provides a means for collecting field data relevant to HGM assessments within a time frame compatible with the schedule for the Project. The procedure also has several key elements that make it suitable for use in this Project:

- It provides the flexibility needed for developing HGM models that are relevant to the Susitna basin;
- The rule-based, qualitative approach to assessing wetland function is important because due to its remoteness, virtually no multi-year, quantitative data on wetland ecosystem parameters are available for the Susitna basin;
- Incorporates landscape, hydrologic, soil, and vegetation variables into the model;
- The method has a high degree of repeatability, which helps ensure consistency in recording field observations by multiple observers; and
- New functional assessment parameters can be added as needed.

In addition to the rapid-assessment procedure, for some wetland functions (described below), Project-specific data will be incorporated into the functional assessment and wetland function will be assigned to specific wetlands in the study area depending on their geographic location.

As agreed to with resource management agencies (see Section 11.4 and Attachment 11.1), the following set of 10 wetland functions will be evaluated using a combination of field data from this and other Project studies (see Figure 11.7-2), and will include GIS analyses of the spatial occurrence of the wetland types identified in the study area:

- Modification of groundwater discharge;
- Modification of groundwater recharge;
- Storm and flood-water storage;
- Modification of stream flow;
- Modification of water quality, including sediment retention and nutrient and toxicant removal;
- Export of detritus;
- Contribution to abundance and diversity of wetland vegetation;
- Fish and wildlife habitat;
- Consumptive uses; and
- Uniqueness.

In the field, at each wetland determination plot, data reflecting wetland functional capacity will be collected for hydrologic variables (e.g., surface water pH, wetland water regime, presence of seeps or springs), soil (organic or mineral soils), and vegetation variables (e.g., dominant wetland type, vegetation interspersion) following Magee (1998). These data will be run through HGM-class-specific models (Magee 1998) to determine a base level of functional capacity for each mapped wetland type for 7 of the 10 functions (all except fish and wildlife habitat, consumptive uses, and uniqueness).

The modification of groundwater discharge and modification of groundwater recharge functions, as determined with field data from this study, will be augmented by incorporating Project-specific data on groundwater and surface-water interaction locations from the groundwater-related aquatic habitat study (see Section 7.5). The presence of seeps or springs is a direct indicator of groundwater discharge, and is incompatible with groundwater recharge (Magee 1998). In locations with documented seeps and springs, individual polygons will be given the highest possible score for groundwater discharge and the lowest possible score for groundwater recharge. In wetlands without seeps and springs, groundwater recharge is assumed to occur, and in those areas field data will be used to determine the level of function.

The fish and wildlife and habitat functions will be assessed by incorporating Project-specific fish and wildlife occurrence data to derive spatially-explicit functional capacity indices indicating which specific wetlands in the study area provide those habitat functions and to what degree. Fish-occurrence data for the study area from the fish distribution and abundance studies (see Section 9) will be used to attribute individual wetland (waterbody) polygons known to support fish, which will then be given higher rankings for the fish habitat function; rankings will be determined based on the number of fish species present so that waterbodies supporting more species and a greater number of life-history stages will be ranked higher. Data from the evaluation of wildlife habitat use study (Section 10.19) will be used to identify habitat features important for wildlife and specific regions in the study area that are heavily used by wildlife. This information then will be used to evaluate the use of the mapped wetland types by a set of wildlife species of concern; essentially this will entail conducting habitat-use evaluations for wetland types instead of wildlife habitat types (see Section 10.19). Wetlands known or expected to support wildlife will then be given a higher functional capacity index for wildlife habitat. As with the fish habitat function, those wetlands that support a greater number of wildlife species and more life-history stages will be ranked higher.

Magee (1998) does not include models for consumptive uses or uniqueness. If possible, the evaluation of the consumptive uses function will be spatially explicit, using Project-specific recreational- and subsistence-use data (see Sections 12 and 14, respectively) to indicate which general regions in the study area are used currently (actual use for recreation and subsistence activities such as hunting, trapping, fishing, berry picking). The coarse spatial resolution of the recreational- and subsistence-use data, however, likely will preclude a determination of which specific wetland types are being used, so a likelihood of actual use will be assigned based on the vegetation structure and plant species composition in each wetland type and proximity to access points. The potential for additional consumptive use in other parts of the study area after Project construction will be assessed in GIS by identifying those wetland types that are likely to be used now, as described above, and then determining the locations of those types where they occur adjacent to the proposed access road. Those wetland areas that could be more easily accessed via the new road will be categorized with a potential consumptive use value specific to the possible future use(s).

The specific definition of wetland uniqueness will be determined after the mapping of wetland types in the study area is complete. The uniqueness function will be used to identify those wetland types and their specific occurrences in the study area that are regionally scarce relative to other more common wetland types.

The study area lies within zones of discontinuous and sporadic permafrost (Brown et al. 2001), and permafrost is known to affect the functional capacity of wetlands (e.g., by slowing biogeochemical reaction rates due to low temperatures and reducing groundwater recharge). The presence or absence of permafrost will be included in the classification of wetland types (see Section 11.7.4.1 above), thus allowing distinctions between the functional capacities of permafrost and non-permafrost wetland types.

11.3.4.4. Wetland Impact Assessment

Direct impacts to wetlands and water bodies are expected to occur in the form of habitat loss from the placement of fill and the conversion of palustrine wetlands to lacustrine habitats in the proposed reservoir. Direct habitat alteration would occur in those wetlands adjacent to areas of fill through construction activities (e.g., storage and laydown yards, vehicular traffic). Indirect habitat alteration could occur in wetlands adjacent to areas of fill due to erosion, fugitive dust accumulation, permafrost degradation, landslides, and off-road vehicle use. Additional indirect impacts in wetlands adjacent to the proposed reservoir could occur through changes in local climatic conditions. Indirect impacts to riparian habitats (including wetlands) are also anticipated to occur downstream of the proposed dam due to changes in instream flow, ice processes, and fluvial geomorphology in the Susitna River (hydrology, plant species diversity, and vegetation composition have the potential to be altered). These downstream effects will be addressed in the riparian study (see Section 11.6).

The wetland impact assessment will be conducted in GIS. Direct effects to wetlands will be determined by overlaying the Project footprint on the final wetland map polygons. Indirect effects to wetlands will be similarly determined by overlaying disturbance buffers (surrounding the proposed Project infrastructure) to identify areas likely to be affected by ancillary impacts associated with Project construction, operations, and maintenance. The size and number of disturbance buffer(s) will be based upon the final specifications for Project construction, operations, and maintenance activities, which will be provided in the Project description.

The wetlands impact assessment will quantify direct and indirect effects to wetlands (acreage per wetland type), and direct and indirect effects to wetland functions (acreage per wetland function) per development alternative. The assessment will also identify which wetland types are particularly sensitive to disturbance, with assistance from Project study teams for permafrost and hydrology.

Cumulative effects on wetlands in the region of the proposed Project will be assessed in the 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.

11.3.4.5. Reporting and Data Deliverables

The reports and data deliverables for this study include:

- **Electronic copies of field data.** A geospatially-referenced relational database of historic (APA Project) data and data collected during the 2012–2014 field seasons, including representative photographs of wetland types will be prepared. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Wetland map in ArcGIS and PDF formats.** The preliminary and final wetland maps will be developed and delivered according to the schedule indicated below. Naming conventions of files and data fields, spatial resolution, map projections, and metadata descriptions will meet the data standards to be established for the Project.
- **Initial Study Report and Updated Study Report.** The wetland mapping study results will be presented in the Initial and Updated study reports, according the schedule indicated below. The reports will include descriptions of the wetland types identified; a

summary table (acreages) of the wetland types and upland areas represented in the wetlands mapping effort; a description of the vegetation, hydrology, and soils of the wetland types identified; the models used for the functional assessment; and descriptions of the potential impacts to wetland types from development of the Project. The Initial Study Report will include recommendations for the 2014 field survey effort. Both reports also will include field wetland dataforms for each plot surveyed, and field plot photos including site, ground, and soil photographs.

11.3.5. Consistency with Generally Accepted Scientific Practice

Wetlands in the study area will be identified using standard and accepted methods for the determination of wetlands in Alaska (Environment Laboratory 1987, USACE 2007). Similarly, wetland mapping will follow standard procedures for mapping wetlands across broad areas through onscreen digitizing in GIS over digital aerial imagery (National Wetlands Inventory Center 1995, Dahl et al. 2009). The mapping will be based on intensive ground-reference data, which is being collected in the vicinity of the proposed Project footprint, where most impacts will occur. The classification of wetlands in the study area will be done using a customized procedure based on several different wetland classification systems. The procedure to be used has been agreed to by licensing participants interested in wetlands mapping for the Project, and will provide data compatible with the mapping of wetlands in other areas surrounding the Project area.

11.3.6. Schedule and Study Interdependencies

See Table 11.7-1 for schedule information for the wetlands mapping study and Figure 11.7-2 for information on the relationships between the wetlands mapping study and other Project studies.

11.3.7. Level of Effort and Cost

The wetland mapping study is planned as a three-year effort; work began in 2012 and will continue in 2013 and 2014. Field sampling will be conducted each year during the growing season by four to eight observers (working in crews of two). Surveys will be conducted for approximately 20 days in each year. The level of effort for 2013 is expected to be considerably greater than in 2012, because the 2012 effort is focused only on those portions of the study area that have aerial photography coverage of sufficient resolution for preliminary mapping and field sampling. In 2013, high-resolution imagery should be available for the entire study area by early fall 2013, so the number of person-days dedicated to the field effort will be increased to support the expected increase in mapping effort when the high resolution imagery becomes available. Field surveys will be conducted in conjunction with the vegetation and wildlife habitat mapping study to maximize efficiency and reduce costs. A less extensive field survey and mapping effort is anticipated in 2014, as the study will be more focused on the final QA/QC of maps, wetlands map production, preparation of wetlands summary data tables, and the wetland functional assessment.

Total costs in 2013 are estimated at $500,000. A more limited field survey will be conducted in 2014 focusing on problem areas or areas where the field survey coverage to date is insufficient. Additional field data needed to support the wetland functional analysis will also be collected in 2014. Total costs in 2014 are estimated at $300,000.

11.3.8. Literature Cited

Alaska Department of Environmental Conservation/U. S. Army Corps of Engineers Waterways Experiment Station Technical Report Number: WRP-DE-____1999. Operational draft guidebook for reference based assessment of the functions of precipitation-driven wetlands on discontinuous permafrost in Interior Alaska. Anchorage, AK.

Alaska Energy Authority (AEA). 2011. Pre-Application Document: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2011. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska.

Alaska Energy Authority (AEA). 2012. Proposed Study Plan: Susitna-Watana Hydroelectric Project FERC Project No. 14241. July 2012. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska.

Brinson, M.M. 1993. A hydrogeomorphic classification for wetlands. Technical Report WRP–DE–4, U.S. Corps of Engineers, Army Engineer Waterways Experiment Station, Vicksburg, MS.

Brown, J., O.J. Ferrians, Jr., J.A. Heginbottom, and E.S. Melnikov. 1998, revised February 2001. Circum-arctic map of permafrost and ground ice conditions. Boulder, CO: National Snow and Ice Data Center. Digital media.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Northern Prairie Publication 0421, U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. 131 pp.

Dahl, T. E., J. Dick, J. Swords, and B. O. Wilen. 2009. Data collection requirements and procedures for mapping wetland, deepwater and related habitats of the united states. Division of Habitat and Resource Conservation, National Standards and Support Team, Madison, WI. 85 p. (http://www.fws.gov/wetlands/_documents/gNSDI/DataCollectionRequirementsProcedures.pdf)

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station. (http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf)

Gracz, M. 2011. Cook Inlet Lowland Wetlands. Available from http://cookinletwetlands.info/ Accessed September 2012.

Hall, J. V., J. E. Powell, S. Carrack, T. Rockwell, G. Hollands, T. Walter, and J. White. 2003. Wetland functional assessment guidebook, operational draft guidebook for assessing the functions of slope/flat wetland complexes in the Cook Inlet Basin Ecoregion Alaska, using the HGM approach. ADEC and/ USACE Waterways Experiment Station Technical Report: WRP-DE-__. 160 pp.

Jorgenson, M. T., C. H. Racine, J. C. Walters, and T. E. Osterkamp. 2001. Permafrost degradation and ecological changes associated with a warming climate in central Alaska. Climatic Change 48:551–579.

Kasischke, E., and M. Turetsky. 2006. Recent changes in the fire regime across the North American boreal region: Spatial and temporal patterns of burning across Canada and Alaska. Geophysical Research Letters 33:L09703.

Kasischke, E. S., D. Verbyla, T. S. Rupp, A. D. McGuire, K. A. Murphy, J. L. Allen, E. E. Hoy, R. Jandt, P. Duffy, M. Calef, and M. R. Turetsky. 2010. Alaska's changing fire regime—Implications for the vulnerability of its boreal forests. Canadian Journal of Forest Research 40:1313–1324.

National Wetlands Inventory Center. 1995. Photointerpretation conventions for the National Wetlands Inventory, USFWS. St. Petersburg, FL. 60 pp.

Magee, D. W. 1998. A rapid procedure for assessing wetland functional capacity based on hydrogeomorphic (HGM) classification. Bedford, NH.

McKendrick, J. D., W. Collins, D. Helm, J. McMullen, and J. Koranda. 1982. Susitna Hydroelectric Project environmental studies, Phase I final report, Subtask 7.12—Plant ecology studies. Report prepared by University of Alaska, Agricultural Experiment Station, Palmer, for Alaska Power Authority, Anchorage. 124 pp. + appendix. [APA Doc. No. 1321]

Smith, R. D., A. Ammann, C. Bartoldus, and M. M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP–DE–9, U.S. Corps of Engineers, Army Engineer Waterways Experiment Station, Vicksburg, MS.

USACE (U.S. Army Corps of Engineers). 2007. Regional supplement to the corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0). ERDC/EL TR-07-24. September 2007. Wetlands Regulatory Assistance Program. U.S. Army Engineer Research and Development Center, Vicksburg, MS. 130 pp.

USFWS (U.S. Fish and Wildlife Service). 1984. Wetlands mapping [no title page]. Report section prepared for Harza–Ebasco Susitna Joint Venture, Anchorage. 29 pp. [APA Doc. No. 2376].

U. S. Geological Survey in cooperation with the U.S. Environmental Protection Agency. 1999. National Hydrography Dataset—Medium resolution. Reston, Virginia. U.S. Geological Survey. Online Linkage: http://nhd.usgs.gov. Accessed 15 June 2006.

Viereck, L. A., and C. T. Dyrness. 1980. A preliminary classification for the vegetation of Alaska. General Technical Report PNW-106, Portland, OR. U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, 38 pp.

Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 pp.

Werner, R. A., E. H. Holsten, S. M. Matsuoka, and R. E. Burnside. 2006. Spruce beetles and forest ecosystems in south-central Alaska: A review of 30 years of research. Forest Ecology and Management 227:195–206.

11.3.9. Tables

Table 11.7-1. Schedule for implementation of the wetland mapping study.

Activity	2012				2013				2014				2015
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q
Wetland mapping and field plot selection					—	—							
Field surveys						—	—						
Wetland map revisions							—	—					
Initial Study Report								—	Δ				
Delivery of field data and preliminary wetland map								—					
Wetland mapping and field plot selection for remaining unmapped areas									—	—			
Field surveys										—	—		
Final wetland map revisions											—	—	
Wetland functional analysis											—	—	
Updated Study Report												—	▲
Delivery of final field data and final wetland map												—	

Legend:

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

11.3.10. Figures

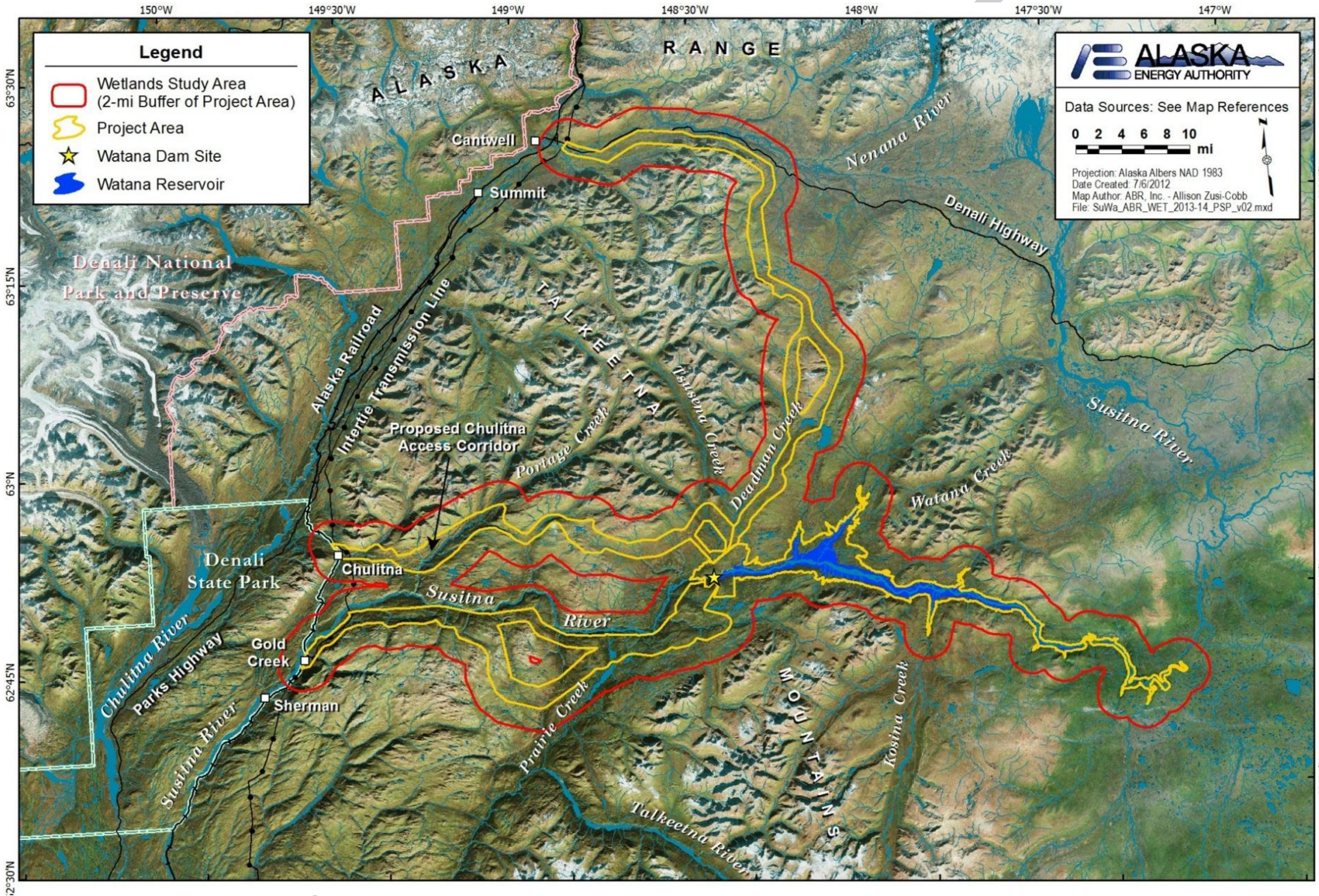

Figure 11.7-1. Study area for wetlands mapping in 2013 and 2014 in the Susitna-Watana Hydroelectric Project area.

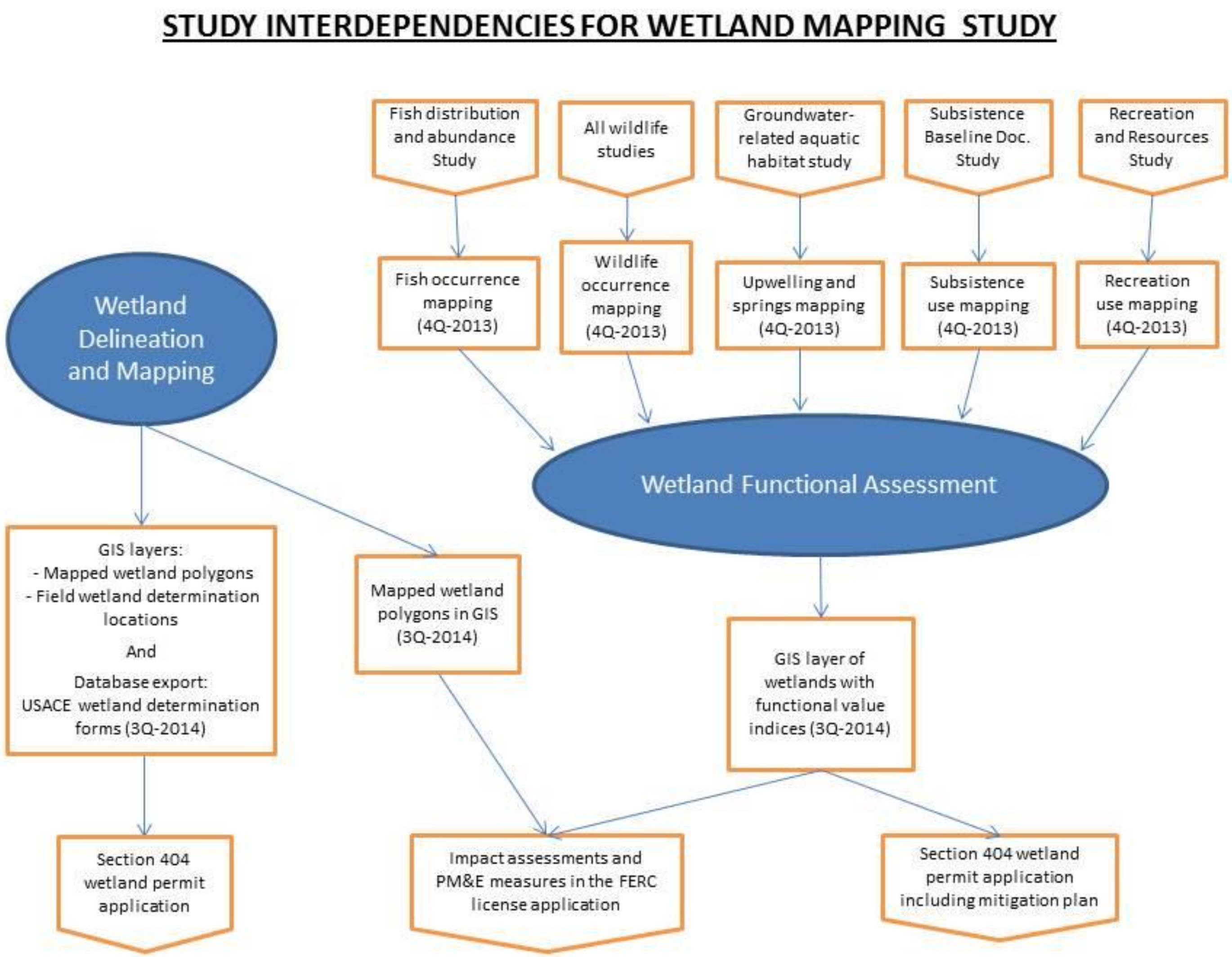

Figure 11.7-2. Study interdependencies for the wetland mapping study.