Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin
Study Plan Section 11.5

Initial Study Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

ABR, Inc.—Environmental Research & Services

February 2014 Draft

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
AEA	Alaska Energy Authority
APA	Alaska Power Authority
ArcGIS	ESRI's geographic information system for mapping and analysis
AVC	Alaska Vegetation Classification
CIRWG	Cook Inlet Region Working Group
CFR	Code of Federal Regulations
ELS	Ecological Land Survey
ESRI	Environmental Systems Research, Incorporated
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
GPS	global positioning system
ILP	Integrated Licensing Process
ISR	Initial Study Report
ITU	Integrated Terrain Unit
LRR	land resource regions
MLRA	major land resource areas
NWI	National Wetlands Inventory
PM&E	protection, mitigation and enhancement
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
QA/QC	quality assurance/quality control
RSP	Revised Study Plan
SPD	study plan determination
USACE	U.S. Army Corps of Engineers
USR	Updated Study Report

EXECUTIVE SUMMARY

Vegetation and Wildlife Habitat Mapping Study 11.5	
Purpose	The primary objectives are to classify, delineate, and map existing vegetation and wildlife habitats in the Upper and Middle Susitna River Basin in those areas that would be directly altered or disturbed by Project construction and operations. The data will be used to facilitate the assessment of impacts to bird and mammal habitats associated with development of the proposed Project.
Status	The study was initiated with preliminary field and mapping work in 2012 and continued in 2013. This is an on-going study that will be completed after the next study season.
Study Components	(1) Field ground-reference surveys to collect data on the primary Integrated Terrain Unit (ITU) variables used to derive wildlife habitats (vegetation, physiography, surface forms, disturbances), and to collect complementary data on hydrology and soils; (2) digital mapping of physiography, surface form, vegetation type, and disturbance classes in *ArcGIS* based on high-resolution aerial imagery for the study area; and (3) derivation of wildlife habitats from the ITU field and mapping data.
2013 Variances	There were no variances from the field survey or mapping methods as described in the study.
Steps to Complete the Study	As explained in the cover letter to this draft ISR, AEA's plan for completing this study will be included in the final ISR filed with FERC on June 3, 2014.
Highlighted Results and Achievements	To date, a total of 1,271 field plots have been sampled in the study area. High-resolution imagery suitable for fine-scale mapping of vegetation and wildlife habitats was acquired during the summer of 2013 for the 55% of the study area for which current high-resolution imagery was lacking. The classification and mapping of ITU variables using the field data collected in 2012 and 2013 and aerial imagery for the study area is on-going. Based on the mapping completed as of the end of October 2013, a preliminary set of 46 wildlife habitat types was developed for this report using two primary ITU variables (physiography and vegetation type). Large portions of the study area are characterized by mountainous terrain in which six alpine habitats and 11 subalpine habitats have been defined. At lower elevations, 10 more well-drained upland habitats and 10 wetter lowland habitats were defined. Six riverine and three lacustrine habitats were defined. These preliminary habitat types will serve as a template for the final set of habitats to be developed for the USR. The study is on track to meet its objectives over the period of study.

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed its Revised Study Plan (RSP) with the Federal Energy Regulatory Commission (FERC or Commission) for the Susitna-Watana Hydroelectric Project No. 14241 (Project), which included 58 individual study plans (AEA 2012). Section 11.5 of the RSP described the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin. On February 1, 2013, FERC staff issued its study plan determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications. RSP Section 11.5 was one of the 31 studies approved with no modifications.

In this study, vegetation and wildlife habitats in the Upper and Middle Susitna River Basin (where the Watana Reservoir and Project infrastructure is proposed) are being identified in the field, classified, and mapped from aerial imagery. The mapping area encompasses the inundation zone of the proposed Watana Reservoir, the Watana Dam site and associated infrastructure, and the three possible corridors for the Susitna-Watana Transmission Line and the Susitna-Watana Road. RSP Section 11.5 provided goals, objectives, and proposed methods for data collection regarding vegetation and wildlife habitat mapping.

Following the first study season, FERC's regulations for the Integrated Licensing Process (ILP) require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule." (18 CFR 5.15(c)(1)) This Initial Study Report (ISR) on the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna River Basin has been prepared in accordance with FERC's ILP regulations and details AEA's status in implementing the study, as set forth in the FERC-approved RSP (referred to herein as the "Study Plan").

2. STUDY OBJECTIVES

As established in the Study Plan (RSP Section 11.5.1), the overall goals of the study are to classify and prepare maps of the existing vegetation and wildlife habitats in the Upper and Middle Susitna River Basin (upstream of Gold Creek; see Section 3, Study Area, below). This multi-year study was initiated in 2012 and will be continued through the next year of study. The mapping information from this study eventually will be used in AEA's License Application, to assess the potential impacts to both vegetation and wildlife habitat resources from development of the proposed Project, and to prepare any necessary protection, mitigation, and enhancement (PM&E) measures to minimize impacts to those resources. When completed, the wildlife habitat mapping will be used to evaluate habitat use by birds, mammals, and amphibians (Study 10.19, Evaluation of Wildlife Habitat Use), and to estimate quantitatively the impacts of habitat loss and alteration for birds, mammals, and amphibians during the FERC licensing process. The wildlife habitat mapping prepared in this study will be one of the primary pieces of information used to evaluate impacts to wildlife species from the proposed Project.

This study is being conducted in close coordination with the Wetland Mapping Study in the Upper and Middle Susitna Basin (Study 11.7). In the field, data are being collected for both studies at each sampling plot, and the mapping efforts for both studies are being performed concurrently (i.e., each map polygon is being coded with the attributes needed to map vegetation, wildlife habitats, and wetlands).

The specific objectives of the vegetation and wildlife habitat mapping study are to classify, delineate, and map vegetation and wildlife habitat types in the Upper and Middle Susitna River Basin based on current aerial imagery for the study area.

3. STUDY AREA

As established by RSP Section 11.5.3, the study area comprises a 4-mi buffer surrounding those areas that would be directly altered or disturbed by development of the proposed Project (Figure 3-1), including the three alternative corridors for the Susitna-Watana transmission lines and access road, Watana Dam and Watana Camp sites, and maximum normal pool elevation of the Watana Reservoir (2,050 ft). The Chulitna Corridor runs east-west north of the Susitna River connecting to the Alaska Intertie and the Alaska Railroad near Chulitna station at Chulitna Pass. Another east-west alternative, the Gold Creek Corridor, runs south of the Susitna River to the Alaska Intertie and the Alaska Railroad at Gold Creek station. A third alternative, the Denali Corridor, runs north-south, and would connect the Project dam site with the Denali Highway over a distance of about 44 miles and then would run west along the existing Denali Highway to connect to the Alaska Intertie near Cantwell.

In areas paralleling the Susitna River between the Project dam site and Gold Creek station (Figure 3-1), vegetation and wildlife habitats within the study area will be mapped up to the study area boundary of the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6). In the riparian vegetation study (Study 11.6), successional riparian vegetation and wildlife habitats will be mapped in areas downstream of the Project dam site along the Susitna River. Mapping methods in the vegetation and wildlife habitat mapping study and the riparian vegetation study (Study 11.6) are compatible, and seamless vegetation and wildlife habitat maps for the Project will be produced, which will include the areas above and below the Project dam site. The alteration of successional vegetation and wildlife habitats downstream of the Project dam site (due to changes in instream flow, groundwater/surface water interactions, ice processes, and fluvial geomorphic features in the Susitna River) will be addressed in the riparian vegetation study (Study 11.6).

4. METHODS AND VARIANCES IN 2013

In the mapping of vegetation in the study area, which is a multi-year effort to be completed in the next study season, the identification of vegetation types at the Level IV of Viereck et al. (1992) is being done by interpretation of aerial image-signatures on recent aerial. Detailed field ground-reference data collected over three field seasons will be used to link vegetation information and other landscape data to the image-signatures and facilitate the identification and delineation of vegetation and wildlife habitat types.

The mapping of wildlife habitats is being conducted using an integrated approach based on Integrated Terrain Unit (ITU) mapping methods developed for Ecological Land Surveys (ELS) studies, which have been conducted in tundra, boreal forest, and coastal regions in Alaska (see Jorgenson et al. 2003 for an example study in Southcentral Alaska). The ITU mapping approach involves mapping individual terrain units such as vegetation type, physiography, surface form, and disturbance type, and then combining them into composite units, which represent the range of landcover variation in the study area. When deriving wildlife habitats, the composite ITUs are then aggregated into a smaller set of ecologically important categories that represent the habitats used by wildlife in the study area (see Section 4.3, ITU Mapping and Derivation of Wildlife Habitats, below).

In 2012, the accuracy of the vegetation data from the vegetation map prepared in the 1980s by Kreig and Associates (1987) for the Alaska Power Authority's Susitna Hydroelectric Project (APA Project) was assessed by the study team (ABR 2013). When evaluated in relation to current aerial imagery, the 1987 vegetation map was not highly accurate at the Level IV of *The Alaska Vegetation Classification* (AVC) (Viereck et al. 1992); accuracy improved when evaluating the map polygons at a coarser scale roughly equivalent to the Level III in the AVC. Because of these reasons, the mapping of Kreig and Associates (1987) is being used primarily to determine vegetation structure (a Level III attribute) and not dominant species plus vegetation structure (Level IV attributes). The 1987 vegetation map data are being used to help in mapping when determining where Level III vegetation types occur, and in field survey preparations in the allocation of field sampling plots by vegetation type.

4.1. Develop Mapping Materials from Historical and Current Data

The methods for developing mapping materials for this study in 2013 were implemented as described in RSP Section 11.5.4.1 with no variances.

All available historical and current data layers that can be used to facilitate the mapping of vegetation and wildlife habitats have been compiled and are being managed in an *ArcGIS* geodatabase. These data include current, high-resolution (0.3- to 1-ft pixels) aerial photography and satellite imagery for the study area, National Wetlands Inventory (NWI) mapping, and existing, historical vegetation mapping for the study area (Kreig and Associates 1987). The historical vegetation map layer (Kreig and Associates 1987) has been updated to *ArcGIS 10.1* format for use in this study. Additional high-resolution imagery, for those portions of the study area where only moderate-resolution (5-m [16-ft] pixels) imagery was available previously, was acquired by AeroMetric (now Quantum Spatial) in July and August 2013. This new digital imagery was prepared in both natural color and infrared formats and, as of late fall 2013, was being used for this study.

4.1.1. Variances

In 2013, there were no variances from the methods described in RSP Section 11.5.4.1 to compile and develop historical and current mapping materials.

4.2. ITU Mapping and Derivation of Wildlife Habitats

The ITU mapping methods and the derivation of wildlife habitat types for this study in 2013 were implemented as described in RSP Section 11.5.4.2 with no variances.

The mapping of ITU variables and the derivation of wildlife habitats is an on-going multi-year study that will be completed after the next study season. In 2013, the mapping of vegetation types and other ITU variables was done by digitizing polygons on-screen using *ArcGIS* software. Map polygon boundaries were determined by interpretation of high-resolution (0.3- to 1-ft pixels) aerial image-signatures supported by ground-reference survey data collected in 2012 and 2013. Each map polygon was attributed for a Level IV vegetation type (Viereck et al. 1992), physiography class, surface form class, and disturbance type. The Level IV vegetation classes of Viereck et al. (1992), with additions by the study team for undescribed types and nonvegetated land cover types, are defined by vegetation structure and dominant plant species (e.g., Open White Spruce Forest, Closed Tall Alder Shrub, Subarctic Lowland Sedge Wet Meadow). Physiography types represent broad, landscape-scale geomorphic features and landscape position (e.g., riverine, lacustrine, lowland, upland, subalpine, and alpine). Surface forms are finer scale geomorphic features, in this case in boreal forest environments (e.g., ridge crest, toe slope, kettle basin, point bar); the surface-form classes being used were modified from Washburn (1973) and Jorgenson et al. (2003). The disturbance types being used were modified from a list defined by the study team for previous ELS studies in both remote and developed areas in Alaska (see Jorgenson et al. 2003 for an example).

In 2013, vegetation and the other ITU variables in the study area were mapped at a scale of 1:2,000. The minimum mapping polygon size for vegetated habitats is 1.0 acre and 0.25 acres for water bodies. The Wetland Mapping Study in the Upper and Middle Susitna Basin (Study 11.7) covers the same areas mapped for wildlife habitats but uses smaller minimum mapping sizes (0.5 acres for vegetated wetlands and 0.1 acre for water bodies); the smaller minimum mapping sizes in Study 11.7 are used because of specific wetland permitting requirements for that study.

Because fine-scale mapping of ITU boundaries is possible only with the use of high-resolution imagery, the detailed mapping of ITU variables prior to the 2013 field season was limited to two areas with high-resolution imagery: (1) a corridor around the Upper Susitna River, which covers the southwestern portion of the Watana Reservoir, and portions of the Gold Creek Corridor; and (2) in the vicinity of Cantwell and adjacent portions of the Parks and Denali highways in the Denali Corridor. For those areas lacking high-resolution imagery prior to the 2013 field season, moderate-resolution RapidEye imagery (5-m [16-ft] pixels), in a false natural-color format, was used to determine preliminary vegetation and wildlife habitat classes and select field sampling transects for survey work in 2013. Additional high-resolution imagery for the study area was acquired in July and August 2013, as is noted above (see Section 4.1, Develop Mapping Materials from Historical and Current Data).

A preliminary map of ITU boundaries was completed for a portion of the areas where high-resolution imagery was available prior to the 2013 field season and was used to define a set of characteristic vegetation types that occur in the mapped areas. This information was used to guide the field survey efforts in 2013. In particular, the preliminary mapping and the available aerial imagery was used to focus the field surveys on (1) those vegetation and other ITU types, as determined from aerial image-signatures elsewhere in the study area, that are less well represented in the preliminary mapping completed prior to the 2013 field season; (2) those vegetation and ITU types that had been more challenging to identify from aerial image-signatures during the preliminary mapping efforts; and (3) those vegetation and ITU types for which less field ground-truth information was available to confirm the range in variation in image-signature types. In addition, results from the 2012 field surveys (ABR 2013) were used to identify vegetation types and other ITU types that had been under-sampled in the field so that those types could be targeted for additional sampling in the 2013 field survey.

For this report, a preliminary set of vegetation and wildlife habitat types for the study area was prepared from the mapping that was completed as of end of October 2013. To derive the preliminary set of wildlife habitat types, two of the four ITU attributes assigned to each map polygon (vegetation type and physiography) were combined to produce a large number of multivariate habitat types. These initial habitat types then were aggregated into a smaller set of derived habitat types that share similar characteristics considered important to the wildlife species that occur in the study area. In the derivation of the preliminary wildlife habitats, vegetation structure, dominant plant species, and physiographic position were the primary factors used to represent wildlife habitat quality. In the last year of study, during the development of the final set of wildlife habitat types for this study, information on surface forms, disturbance type, and soil drainage will be added, as needed to refine the set of wildlife habitat types. The development of wildlife habitats is an iterative process tailored to the specific set of wildlife species to be evaluated for impacts from the proposed Project (see Study 10.19, Evaluation of Wildlife Habitat Use), and the final set of wildlife habitat types will be developed with input from the wildlife researchers working on the Project so that the habitats will be representative of those known to be used by birds, mammals, and amphibians in the study area. In this process, researchers will rely on the Project-specific observations of wildlife habitat use and, as needed, the literature describing wildlife-habitat associations in Alaska.

When the ITU mapping is completed, a rigorous QA/QC review process will be performed using tools developed by the study team and the Wetlands Data Verification Toolset developed by the NWI program to identify digitizing anomalies (e.g., incorrect attribute codes, unattributed polygons, adjacent polygons with the same coding, and digital slivers [null polygons < 0.01 acre in size]). The NWI toolset was created using the Environmental Systems Research, Incorporated (ESRI) Model Builder (http://www.fws.gov/wetlands/Data/Tools-Forms.html).

4.2.1. Variances

In 2013, there were no variances from the methods described in RSP Section 11.5.4.2 for the mapping of ITU variables and the derivation of wildlife habitats.

4.3. Field Surveys

The field survey methods for this study in 2013 were implemented as described in RSP Section 11.5.4.3 with no variances.

Field ground-reference data to link to aerial-image signatures were collected during summer 2013. In 2013, eight scientists (four teams of two each) collected vegetation, wildlife habitat, and wetlands ground-reference data in two separate field survey efforts: July 1–11 and July 30 – August 8. The field surveys were organized so as to collect data for as many habitat types as possible in a way that maximizes efficiency (numerous different habitat types were sampled in a day) and safety (topographic hazards such as traversing steep bluffs and creek crossings were avoided).

The preliminary ITU mapping completed prior to the 2013 field survey (described below; see Section 4.3, ITU Mapping and Derivation of Wildlife Habitats), along with both the high- and moderate-resolution imagery available for those portions of the study area where no preliminary mapping had yet been completed, was used to select sampling transects for the 2013 field surveys (Figure 3-1).The field sampling transects (1.5–3.0 km [0.93–1.86 mi]) long were focused on vegetation and other ITU types that were less well represented in the preliminary mapping, more challenging to identify from aerial image-signatures, for which less field data were available to confirm the range in aerial image-signatures, and/or were under-sampled during the first year of field surveys in 2012. The sampling transects were designed to cross a number of different habitats during each survey day. On each transect, 6–10 full ground-reference plots, which included a formal wetland determination (see Study 11.7, Wetland Mapping Study in the Upper and Middle Susitna Basin), were sampled depending on the length of the transect and/or the number of distinct habitat types encountered. Field plots were sampled along transects located within the major physiographic types in the study area, including riverine, lacustrine, lowland, upland, subalpine, and alpine areas. When transitional habitats or areas not readily discernible from image-signature features alone were encountered in the field, additional plots were surveyed.

To maximize efficiency in data collection, at each ground-reference plot, data were collected for vegetation and wildlife habitat mapping as well as wetlands mapping. At each plot, a standard U.S. Army Corps of Engineers (USACE) wetland determination and data form was completed (Environmental Laboratory 1987, USACE 2007; see the Wetland Mapping Study in the Upper and Middle Susitna Basin [Study 11.7]). Data elements recorded included visual cover estimates of all vascular plant species present (generally within a 10-m [33-ft] radius plot of relatively homogeneous vegetation), soil profile descriptions, and hydrologic observations. The size and shape of the ground-reference plots were modified as needed, however, depending on the extent of the plant community being sampled (e.g., narrower plots were used in riparian fringe habitats). The plant data recorded for the wetland determination are sufficient to accurately classify a site at the Level IV of the AVC (Viereck et al. 1992). A mobile *Trimble® Nomad*™ series GIS unit was used to record the wetland-determination field data (using the *WetForm* database), and to record global positioning system (GPS) coordinates for each plot. *WetForm* is a commercially available (Ecotone Corp.) relational database used to record wetlands site data in the field, and it facilitates the preparation of electronic copies of the 2007 *Regional Supplement* dataform (USACE 2007) for each wetland determination plot.

Additional vegetation and wildlife habitat data elements were recorded digitally in the field on an *Android* tablet computer using a customized data entry program which links directly to a relational database (*Microsoft Access*). Additional vegetation information recorded included the Level IV vegetation class (Viereck et al. 1992) and the percent areal cover data for structural classes of vascular and nonvascular plants (trees, saplings, tall shrubs, low shrubs, dwarf shrubs, tall herbs, low herbs, floating aquatics, aquatic plants, mosses, and lichens); these data were recorded to assist in defining vegetation and wildlife habitat types and evaluating the use of wildlife habitats by birds, mammals, and amphibians. The site characteristics recorded at each plot included physiography, surface form, and any disturbances, as described by Jorgenson et al. (2003) and Schick and Davis (2008), as well as slope and aspect (in degrees), digital photos (of the site, vegetation, and soils), and GPS coordinates. Observations of recreational use, subsistence use, and wildlife use (e.g., nests, dens, scat, tracks) and other site characteristics that reflect habitat quality also were recorded at each plot.

In addition to the full ground-reference plots, rapid map-verification plots were sampled to help facilitate the vegetation and wildlife habitat mapping efforts. Map-verification plots were sampled in habitats which had been previously well documented with full ground-reference plots at other sites; the map-verification plots were used to improve map accuracy by increasing the number of documented habitat types tagged to particular aerial image-signatures. At these plots, a limited set of data was recorded, including cover estimates for the dominant vascular plant species, Level IV vegetation class (Viereck et al. 1992), physiography class, site photos, and GPS coordinates. No soils information was recorded at map-verification plots.

To support the survey efforts of other botanical and wildlife studies being conducted for the Project, the locations of incidental observations of rare plants, invasive plants, wildlife species, or significant wildlife habitat features (e.g., raptor nests) were documented when encountered.

4.3.1. Variances

In 2013, there were no variances from the field sampling methods described in the RSP Section 11.5.4.3.

5. RESULTS

5.1. ITU Mapping and Derivation of Wildlife Habitat Types

Data developed in support of this study are available for download in the following files at http://gis.suhydro.org/reports/isr:

- ISR_11_5_VEG_Data_ABR.gdb
- ISR_11_5_VEG_Plot_and_Classif.accdb

Although the ITU mapping is not yet complete for the study area, a preliminary set of 46 wildlife habitat types was developed for review in this report (Table 5.2-1; Figure 5.2-1 through Figure 5.2-3). As the field survey data collected in 2013 continues to be reviewed, additional field data are collected in the next study season, and as the mapping of ITU variables continues in next study season, the set of wildlife habitat types to be mapped in the study area is expected to change. The preliminary wildlife habitat types presented in this report represent the integration of two primary ITU variables (physiography and vegetation type). The habitat types were derived by combining physiography and vegetation type and then aggregating into a smaller set of habitats based primarily on shared vegetation structure and physiography, although in some cases the dominant species occurrence information from the Level IV AVC vegetation types was preserved (e.g., Lowland Low and Tall Birch-Ericaceous Scrub vs. Lowland Low and Tall Willow Scrub). As the mapping of the study area continues in next study season, and as specific wildlife habitat-use requirements become evident (through collaboration with the wildlife researchers working on the Project), a final set of wildlife habitat types will be developed. Two other ITU variables (surface form and disturbance type) and soil drainage as well also are expected to be integrated, as needed, into the final classification of wildlife habitat types.

5.2. Field Surveys

Data developed in support of this study are available for download in the following file at http://gis.suhydro.org/reports/isr:

- ISR_11_5_VEG_Plot_and_Classif.accdb

During the two survey periods in 2013, 619 full ground-reference plots and 297 map-verification plots were sampled along 77 transects. On the ground-reference plots, the full range of physiographic types present in the study area was sampled (Table 5.1-1). Subalpine, lowland, and upland physiographic classes were the most commonly sampled (n = 193, 142, and 141, respectively). Alpine and riverine classes were the next most commonly sampled (n = 64 and 59, respectively), and the Lacustrine physiographic class was the least commonly sampled in 2013 (n = 20).

In the north-south trending portion of the Denali Corridor, the ground-reference plots sampled were primarily in subalpine physiographic areas, while in the east-west trending portion of the Denali Corridor (along the Denali Highway), a mix of upland and lowland physiographic types were most commonly sampled. The physiographic types sampled at ground-reference plots in the Chulitna Corridor were predominantly alpine or subalpine, while the ground-reference plots sampled in the Gold Creek Corridor were predominated by a mix of upland and subalpine physiographic types. The ground-reference plots sampled in the vicinity of the Watana Dam site and Watana Reservoir were predominated by a mix of subalpine, upland, and lowland physiographic types. Riverine and lacustrine physiographic types generally were sampled throughout the study area, although ground-reference plots in riverine physiographic classes were most commonly sampled in the east-west trending portion of the Denali Corridor.

At the ground-reference plots sampled in 2013, 67 Level IV AVC vegetation classes were recorded (Table 5.1-2). Combined with the data from the 2012 field work for this study (ABR 2013), a total of 73 vegetation classes were sampled in the two field seasons. The data from 2013 include 13 vegetation classes not sampled in 2012: Spruce-Aspen Woodland, Spruce-Paper Birch Woodland, Black Spruce-White Spruce Woodland, Mixed Conifer Woodland, Wet Bryophyte, Subarctic Lowland Sedge Mesic Meadow, Open Dwarf Dry Shrub Birch-Ericaceous Shrub, Dwarf White Spruce Woodland, Closed Low Shrub Birch, Open Low Shrub Birch, Open Low Shrub Birch-Ericaceous Shrub Bog, and Open Low Ericaceous Shrub.

In 2013, forest vegetation classes were most commonly sampled at ground-reference plots at lower elevations in the vicinity of the Watana Dam site and Watana Reservoir and in the east-west trending portion of the Denali Corridor, while shrub and herbaceous vegetation classes were sampled throughout the study area. Ground-reference plots characterized by forest and low-shrub vegetation classes predominated in the east-west trending portion of the Denali Corridor, and low shrub and wet graminoid-herbaceous vegetation classes were most common in the north-south trending portion of the Denali Corridor. Ground-reference plots sampled in both the Gold Creek and Chulitna corridors were predominated by a mix of dwarf-, low-, and tall-shrub vegetation classes. Ground-reference plots sampled in the vicinity of the Watana Dam site and Watana Reservoir were predominated by forest and low-shrub vegetation classes.

6. DISCUSSION

The field data collection efforts and the mapping prepared in 2013 were conducted as planned and described in the study plan. Field data collection and mapping efforts in 2013 were performed with no variances (see Section 4, Methods and Variances, above), and all indications are that the data are of sufficient quality to meet the study objectives. The vegetation and wildlife habitat mapping study is on-going, with field data QA/QC, aerial image interpretation, and ITU mapping currently occurring. From the work completed as of the end of October 2013, the ITU field and mapping data were used to develop a set of preliminary habitat types. This preliminary set of habitat types will serve as the template for the development of the final set of wildlife habitat types to be prepared for the USR. The progress of the study to date is sufficient to meet the study objectives with an additional year of field data collection and ITU mapping.

As specified in RSP Section 11.5.7, no data from other Project studies are required as inputs to complete the mapping of vegetation and wildlife habitats in this study. The mapping of vegetation types and other ITU variables along with the wetland classes for the Wetland Mapping Study in the Upper and Middle Susitna Basin (Study 11.7), however, will be conducted concurrently so that the classification of the ITU map polygons for this study will benefit from the concurrent review of the field data for this study and Study 11.7. The vegetation and wildlife mapping study team also will work closely with the wildlife researchers on the Project (Studies 10.5 through 10.18) in the development of the final set of wildlife habitat types. In this process, review comments on the preliminary wildlife habitat types from the wildlife researchers will be taken into account so that the final mapped habitat types are representative of the habitats used by wildlife species in the study area. Similarly, the study team will work with researchers from the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6) in developing a set of wildlife habitat types for riparian areas downstream of the Watana Dam site.

6.1. Ecoregions in the Study Area

Land resource regions (LRRs) and major land resource areas (MLRAs) in Alaska were defined by the USDA-NRCS (2004) using climatic, physiographic, biological, and ecological features, properties, and relationships. LRRs represent broad regions of the state that share similar climatic conditions, patterns, and processes, and MLRAs represent subregional areas with shared physiographic and geomorphic patterns and processes. The vegetation and wildlife habitat mapping study area spans two LRRs (Southern Alaska and Interior Alaska) and three MLRAs (the Cook Inlet Mountains subregion in Southern Alaska, and the Interior Alaska Mountains and Copper River Basin subregions in Interior Alaska; USDA-NRCS 2004). The Cook Inlet Mountains subregion encompasses the vast majority of both the Chulitna and Gold Creek corridors. The easternmost extent of the Watana Reservoir extends into the Copper River Basin subregion, while the remainder of the study area (the Denali Corridor, the easternmost portions of the Chulitna and Gold Creek corridors, and the majority of the Watana Dam site and Watana Reservoir) is located within the Interior Alaska Mountains subregion.

The Cook Inlet Mountains subregion includes portions of the Talkeetna, Kenai, and Chugach mountains that drain into the Cook Inlet Lowlands MLRA and Cook Inlet, as well as portions of the Alaska and Aleutian ranges (USDA-NRCS 2004). Portions of Denali National Park and Preserve, Lake Clark National Park and Preserve, Kenai National Wildlife Refuge, and Chugach National Forest are located within the Cook Inlet Mountains subregion. Rugged mountains, deeply incised with narrow to broad, high-gradient valleys dominate the terrain in this subregion. The climate is characterized by short summers with moderate to cold winters, with an average frost-free period of 60–80 days. During the 2013 field surveys, 15 transects were sampled in the Cook Inlet Mountains subregion, within the Chulitna and Gold Creek corridors. These transects were dominated by alpine and subalpine physiography, and dwarf to low-shrub vegetation classes typical of the mountains within this subregion.

The Copper River Basin subregion includes portions of the Talkeetna, Chugach, and Wrangell Mountains, and the Copper River Plateau (USDA-NRCS 2004). Glenallen is the largest community within the Copper River Basin MLRA, and portions of the Wrangell-St. Elias National Park and Preserve are located within this subregion. Undulating plains and rolling hills dominate the terrain, with lakes and interconnecting wetlands in shallow basins. Most of this subregion drains into the Copper River. The subarctic continental climate of this subregion is characterized by brief, warm summers and long, cold winters, with an average frost-free period of 35–90 days. The Copper River Basin MLRA is located within the discontinuous permafrost zone, and near-surface permafrost is common in fine-textured sediments on plains, stream terraces, and gentle slopes. Two survey transects were sampled in the Copper River Basin subregion in 2013, and they were predominantly in lowland physiographic areas. Vegetation classes sampled within the Copper River Basin subregion ranged from forested to wet herbaceous vegetation classes, which is typical for this subregion.

The Interior Alaska Mountains subregion includes the high mountain slopes and glaciated hills and plains in the Alaska Range and in the Talkeetna, Chugach, and Wrangell mountains, the northern portions of the Aleutian Range that drain into the upper Tanana and Kuskokwim rivers, and the Copper River Plateau (USDA-NRCS 2004). This subregion is primarily undeveloped and includes portions of Denali National Park and Preserve, Wrangell St-Elias National Park and Preserve, and Tetlin National Wildlife Refuge. High rugged mountains, low rounded hills, and extended footslopes along the base of mountains dominate the terrain, with narrow to broad high-gradient valleys dissecting the mountains. This subregion drains to the Tanana River, Kuskokwim River, Copper River Basin, the Cook Inlet Lowlands, and Cook Inlet. The subarctic continental climate of this subregion is characterized by brief, warm summers and long, cold winters, with an average frost-free period of 50–80 days. The Interior Alaska Mountains MLRA is located within the discontinuous permafrost zone, with near-surface permafrost generally restricted to fine-textured sediments on stream terraces and swales on hills and footslopes. The majority (60) of the 77 survey transects sampled in 2013 were in the Interior Alaska Mountains subregion; these transects were located within the Denali Corridor, in the study area just to the north of the Watana Dam site, and in the study area surrounding the proposed Watana Reservoir.

The north-south and east-west trending portions of the Denali Corridor exhibit different aspects of the Interior Alaska Mountains subregion: high-gradient valleys in the mountains and extended footslopes, respectively. The north-south trending portion of the Denali Corridor is dominated by subalpine physiography and dwarf to low shrubs typical of the broad, high-gradient valleys in this subregion. In contrast, the east-west trending portion of the Denali Corridor is dominated by a mix of upland and lowland physiography, with forested and low-shrub vegetation classes typical of extended footslopes in this subregion.

The physiographic and vegetation classes sampled in the three MLRAs in the study area in 2013 should not be interpreted as the expected distribution of classes in the final ITU mapping. In particular, land-access restrictions precluded sampling at lower elevations in most of the Gold Creek Corridor, in much of the study area surrounding the Watana Dam site, and in the western portion of the Watana Reservoir (Figure 3-1). Extensive lower elevation forests are visible in the aerial imagery for these areas, but few of those forest vegetation classes were sampled in the field. Similarly, alpine physiography dominates the north-south trending portion of the Denali Corridor in the aerial imagery, but the field survey efforts were focused on the more difficult-to-distinguish subalpine physiographic vegetation classes.

6.2. Occurrence and Distribution of Wildlife Habitats

Lacustrine habitats within the study area are limited to open water bodies over 20 acres in size and the associated habitats directly influenced by lacustrine processes (Table 5.1-1). Large water bodies that meet the criteria for lacustrine physiography occur sparsely throughout the study area, and are concentrated near the south side of Deadman Mountain in the Denali Corridor and in the Fog Lakes area south of the Susitna River. Lacustrine Graminoid Marsh and Lacustrine Wet Graminoid Meadow are examples of herbaceous-dominated wildlife habitats that occur adjacent to water bodies and that differ in hydrologic characteristics (Table 5.2-1).

Riverine wildlife habitats in the study area are often characterized by low- and tall-shrub vegetation on well-drained seasonally flooded substrates (Table 5.2-1, Figure 5.2-2). To date, a small number of Riverine Needleleaf Forests have been sampled in the study area, and similarly, very little data are available for Riverine Moist Mixed Forests, and no data are available for Riverine Broadleaf Forests. This is due to a combination of limited occurrence and limited access for surveys: the areas most likely to support mixed and broadleaf riverine forests are in the Gold Creek Corridor where access currently is limited. Rivers and streams in the study area include both upper and lower perennial rivers and streams, including the Susitna River (upstream of the Project dam site), the Nenana River, and their clear water tributaries. The preliminary wildlife habitat mapping shown in Figure 5.2-2 illustrates how ITU combinations of physiography and vegetation type are aggregated to derive both Riverine and Upland wildlife habitat types.

Lowland physiography, for the purposes of this study, is identified at a local scale (Table 5.1-1), and as such, is not synonymous with a broad region of lowlands occurring below mountain ranges, such as the Cook Inlet or Kenai lowlands. The local-scale lowland physiography used in this study is intended to portray water-gathering, and generally concave landscape features capable of supporting wetland complexes. Examples include broad glacial-scour features that form linear troughs on upland hillsides, concave toeslopes, and abandoned floodplain features.

Lowland physiographic features support a range of habitats from small open-water ponds and wet meadows to low-lying and poorly drained forest habitats dominated by needleleaf species (Table 5.2-1). A typical lowland wetland complex within the study area is characterized by a core of poorly drained habitats (e.g., Lowland Wet Graminoid Meadow, Lowland Ponds) with a fringe of drier shrub and forest types (e.g., Lowland Spruce Forest, Lowland Low and Tall Willow Scrub) (Figure 5.2-1).

Many of the mature forest types in the study area occur in areas of Upland physiography (Table 5.2-1). Upland Moist Mixed Forest primarily is found at lower elevations in the Gold Creek Corridor. Upland Spruce Forests are more prevalent in the east-west trending portion of the Denali Corridor along the Denali Highway, and in the far eastern portion of the proposed Watana Reservoir within the Copper River Basin MLRA (in which spruce forests typical of Interior Alaska are dominant). One upland habitat type (Upland Spruce Woodland with Tall Shrub Understory) was developed specifically to address breeding landbird habitat-use patterns observed during the field surveys for the Landbird and Shorebird Migration, Breeding, and Habitat Use Study (Study 10.16). Large areas of upland physiography in the study area support low- and tall-shrub habitats, including the common Upland Moist Birch-Ericaceous Scrub. Upland Moist Birch-Ericaceous Scrub is dominated by shrub birch and occurs primarily on low to mid-slope areas to the north and east of Devils Canyon.

Areas of subalpine physiography (Table 5.1-1) in the study area span a wide elevational gradient from treeline to the upper limit of low-shrub growth. The transition to extremely well-drained, rocky alpine physiography typically occurs on middle to upper slopes at approximately 3,500 ft above sea level. Much of the study area falls within the subalpine zone, including the high, upper slopes of the Gold Creek Corridor; many of the broad, high, glacial valleys traversed by the Chulitna Corridor; and the north-south trending portion of the Denali Corridor. Subalpine wildlife habitat types range from wet, permanently flooded types to dry dwarf-shrub and barren types (Table 5.2-1, Figure 5.2-3).

Alpine physiography (Table 5.1-1) is found at high elevations, typically above 3,500 ft in those portions of the Talkeetna Mountains and the Alaska Range that intersect with the study area. Steep, rugged, well-drained, and largely unvegetated terrain dominates the alpine zone. Vegetated habitats including Alpine Moist Dwarf Scrub, Alpine Moist Graminoid-Forb Meadow, Alpine Wet Sedge Meadow, and Alpine Wet Sedge-Shrub Meadow occur on a limited basis in shallow terrain breaks, protected snowbed sites, and in the headwaters of streams (Table 5.2-1).

7. COMPLETING THE STUDY

[As explained in the cover letter to this draft ISR, AEA’s plan for completing this study will be included in the final ISR filed with FERC on June 3, 2014.]

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9. TABLES

Table 5.1-1. Description of Physiographic Types Identified in the Vegetation and Wildlife Habitat Mapping Study Area, Susitna-Watana Hydroelectric Project, 2013.

Physiography	Elevation	Characteristics	Typical Wildlife Habitats	Example Photograph
Alpine (A)	Above tree line and above low-shrub zone; mostly > 3500' asl	Defined by elevation and corresponding lack of trees or tall and low shrubs; dwarf shrubs and wet meadows may be present; most extensive along ridgelines, on saddles, and north-facing slopes.	Barren to partially barren ridgelines, dwarf ericaceous shrub-lichen communities on ridge crests and shoulders, and moist dwarf scrub in nivation hollows.	
Subalpine (S)	Above tree line, within tall- and low-shrub zone; mostly ~2500–3500' asl	Defined by elevation and corresponding lack of trees; tall shrubs may be present; often steeply sloping.	Low open birch, birch-willow, or ericaceous-birch scrub on hillsides; tall alder scrub in drainages; and wet herbaceous meadows.	
Upland (U)	Below tree line	Water-shedding terrain; typically well-drained, dry to moist mineral soils; often located on slopes.	Moist forests; low open birch, birch-willow, or ericaceous-birch scrub on hillsides; and moist to dry herbaceous meadows.	
Lowland (L)	Below tree line	Water-gathering terrain; typically moist to wet with organic soils; located in valley bottoms, lower slopes, toeslopes, and benches with concave or level topography and wet habitats.	Wet sedge meadows, marshes (permanently flooded), and shrub bogs/swamps.	

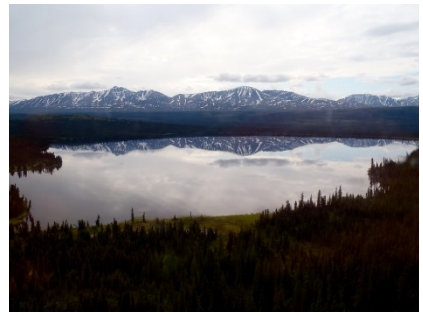
Physiography	Elevation	Characteristics	Typical Wildlife Habitats	Example Photograph
Lacustrine (P)	Any	Driven by lacustrine processes in which the water body is the dominant feature; includes the water body, shallow water zones, and adjacent wetlands where water levels are controlled by the lake.	Open water, emergent wet sedge marshes in lacustrine margins, shrub swamps, and floating bog mats.	
Riverine (R)	Any	More than just a proximal relationship with rivers and streams; riverine communities show evidence of influence by riverine processes, particularly hydrology.	Seasonally flooded riverine scrub (willow, alder, and/or balsam poplar); dry riverbanks where the presence of a river or stream and well-drained soils drops the water table to create a dry micro-habitat.	

Table 5.1-2. Vegetation Classes Sampled in the Vegetation and Wildlife Habitat Mapping Study Area, Susitna-Watana Hydroelectric Project, 2013.

Level IV Vegetation Class[1]	Code	*n* (2012)[2]	*n* (2013)[2]
Barren	Bbg	1	4
Partially Vegetated	Bpv	4	4
Closed Quaking Aspen-Balsam Poplar Forest	Fbcap	1	
Open Quaking Aspen Forest	Fboa	1	1
Open Paper Birch Forest	Fbob	2	2
Open Paper Birch-Balsam Poplar Forest	Fbobp	1	
Open Balsam Poplar Forest	Fbop	2	1
Open Paper Birch-Balsam Poplar-Spruce	Fmobps	1	
Open Spruce-Paper Birch	Fmosb	9	5
Open Spruce-Balsam Poplar Forest	Fmosp	1	1
Spruce-Quaking Aspen Woodland	Fmwsa		1
Spruce-Paper Birch Woodland	Fmwsb		2
Open Black Spruce Forest	Fnobs	9	11
Open White Spruce Forest	Fnows	2	16
Black Spruce Woodland	Fnwbs	16	12
Black Spruce-White Spruce Woodland	Fnwbw		1
Mixed Conifer Woodland	Fnwmc		3
White Spruce Woodland	Fnwws	14	53
Wet Bryophyte	Hbbw		1
Midgrass-Herb	Hgdgh	1	5
Midgrass-Shrub	Hgdgs		3
Bluejoint Meadow	Hgmb	2	11
Bluejoint-Shrub	Hgmbs	3	4
Moist Seral Grass-Herb Meadow	Hgmgh	3	3
Moist Grass-Herb Meadow Tundra	Hgmght	1	5
Subarctic Lowland Sedge Mesic Meadow	Hgmsl		1
Moist Sedge-Shrub Tundra	Hgmss	2	10
Moist Sedge-Willow Tundra	Hgmswt	3	1
Fresh Sedge Marsh	Hgwfs	7	16
Subarctic Lowland Graminoid-Herb Wet Meadow	Hgwgh	1	3
Subarctic Lowland Sedge Bog Meadow	Hgwsb	11	11
Subarctic Lowland Sedge Wet Meadow	Hgwsl	16	23
Subarctic Lowland Sedge-Moss Bog Meadow	Hgwsmb	8	3
Subarctic Lowland Sedge-Shrub Wet Meadow	Hgwss	8	8
Wet Sedge Meadow Tundra	Hgwst	2	18
Wet Sedge-Willow Tundra	Hgwswt	2	2
Dryas-Sedge Dwarf Shrub Tundra	Sdds	1	2
Dryas Dwarf Shrub Tundra	Sddt	4	1
Bearberry Dwarf Shrub Tundra	Sdeb	1	2
Cassiope Dwarf Shrub Tundra	Sdec	1	9

Level IV Vegetation Class[1]	Code	*n* (2012)[2]	*n* (2013)[2]
Crowberry Dwarf Shrub Tundra	Sdee	2	11
Ericaceous-Lichen Dwarf Shrub Tundra	Sdel	4	13
Ericaceous Dwarf Shrub Tundra	Sdet	4	17
Vaccinium Dwarf Shrub Tundra	Sdev	3	10
Open Dwarf Dry Shrub Birch-Ericaceous Shrub	Sdobe		9
Willow Dwarf Shrub Tundra	Sdwt	1	6
Open Dwarf Black Spruce	Sfobs	2	8
Open Dwarf White Spruce	Sfows	1	2
Dwarf Black Spruce Woodland	Sfwbs	1	9
Dwarf White Spruce Woodland	Sfwws		2
Closed Low Shrub Birch Shrub	Slcb		1
Closed Low Shrub Birch-Ericaceous Shrub	Slcbe	6	12
Closed Low Shrub Birch-Willow Shrub	Slcbw	1	2
Closed Low Sweetgale Meadow	Slcm	1	2
Closed Low Willow	Slcw	1	11
Open Low Shrub Birch	Slob		7
Open Low Shrub Birch-Ericaceous Shrub Bog	Slobb		5
Open Low Mesic Shrub Birch-Ericaceous Shrub	Slobe	32	40
Open Low Shrub Birch-Willow	Slobw	1	19
Open Low Sweetgale-Graminoid Bog	Slocg	2	3
Open Low Ericaceous Shrub	Sloe		7
Open Low Ericaceous Shrub Bog	Sloeb	7	2
Open Low Willow	Slow	7	38
Open Low Willow-Graminoid Shrub Bog	Slowg	1	5
Closed Tall Alder	Stca	14	14
Closed Tall Alder-Willow Shrub	Stcaw	4	
Closed Tall Willow Shrub	Stcw	9	17
Open Tall Alder	Stoa	12	3
Open Tall Alder-Willow	Stoaw	2	
Open Tall Shrub Birch	Stob	7	9
Open Tall Scrub, post burn or disturbance	Stod	1	
Open Tall Willow	Stow	8	17
Water	W	1	59
Total		**276**	**619**

Notes:

1 Following Viereck et al. 1992, with additions by ABR for undescribed vegetation classes and non-vegetated land-cover types.

2 Sample sizes (number of ground-reference plots surveyed) in 2012 and 2013.

Table 5.2- 1. Preliminary Descriptions of Wildlife Habitat Types Expected to be Mapped in the Vegetation and Wildlife Habitat Mapping Study Area, Susitna-Watana Hydroelectric Project, 2013.

Physiography	Wildlife Habitat Type	Description[1]
Lacustrine	Lacustrine Graminoid Marsh	Permanently flooded communities with low plant diversity; dominated by wetland-obligate, tall, coarse sedges; primarily limited to lake margins.
	Lacustrine Wet Graminoid Meadow	Wet graminoid meadows occupying lacustrine fringe environments.
	Lake	Permanently flooded water bodies greater than 20 acres in size.
Riverine	Riverine Barrens	Barren to partially vegetated (< 30% cover) point bars; substrates are well-drained sands and gravels.
	Riverine Low Willow Scrub	Low willow-dominated communities usually occupying point bars along active river channels.
	Riverine Moist Mixed Forest	Mature forest stands composed of paper birch and white spruce; typically occupying upland banks of the Susitna or Nenana Rivers.
	Riverine Needleleaf Forest	Mature forest stands composed primarily of white spruce; typically occupying upland banks of the Susitna or Nenana Rivers, but may be found along banks of smaller tributaries.
	Riverine Tall Alder or Willow Scrub	Found along banks of small tributaries and larger rivers; mixed tall alder and willow stands, either open (25 to 75% cover) or closed (> 75% cover).
	Rivers and Streams	Permanently flooded upper and lower perennial rivers and streams found throughout the study area.
Lowland	Lowland Pond	Permanently flooded water bodies less than 20 acres in size; often a component of a larger sloping wetland system.
	Lowland Disturbed Graminoid Meadow	Wet meadows dominated by bluejoint grass; commonly occurring around abandoned beaver dams.
	Lowland Ericaceous Scrub Bog	Wet meadows dominated by ericaceous shrubs; soils are saturated histosols; typically located on margins of sloping lowland wetland complexes.
	Lowland Low and Tall Birch-Ericaceous Scrub	Low-to tall-shrub communities dominated by shrub birch, often with a dwarf ericaceous shrub understory.
	Lowland Low and Tall Willow Scrub	Low- to tall-shrub communities dominated by willow species.
	Lowland Moist Sedge-Shrub Meadow	Herbaceous plant communities co-dominated by wetland sedges and low deciduous shrubs (often willows).
	Lowland Wet Graminoid Meadow	Plant communities primarily dominated by wetland-obligate sedge species; forbs and/or deciduous shrubs can be co-dominant.
	Lowland Spruce Forest	Needleleaf forests with open (25 to 60% cover) to woodland (< 25% cover) canopies; primarily occurs at the margins of larger wetland complexes or abandoned floodplains.
	Lowland Graminoid Marsh	Permanently flooded communities with low plant diversity; dominated by wetland-obligate, tall, coarse sedges; limited in extent (primarily in the margins of surface-water impoundments within larger wetland complexes).
	Lowland Low Myrica Scrub	Low-shrub communities dominated by *Myrica gale*; generally found in transition areas between larger wetland complexes and adjacent forests.

Physiography	Wildlife Habitat Type	Description[1]
Upland	Upland Dry Dwarf Birch-Ericaceous Scrub	Dwarf-shrub communities dominated by shrub birch and ericaceous shrubs; typically occupies convex, well-drained, and exposed surfaces below treeline.
	Upland Moist Birch-Ericaceous Scrub	Commonly occurring type throughout the study area; primarily low shrub birch-dominated communities on well-drained surfaces below treeline.
	Upland Moist Broadleaf Forest	Mature, open (25 to 60% cover) aspen- or birch-dominated forests, generally occurring on steep south-facing lower slopes.
	Upland Moist Graminoid Meadow	Rarely occurring type; moist graminoid-dominated plant communities occurring below treeline, often with an herbaceous component.
	Upland Moist Low Willow Scrub	Low willow communities, both closed (> 75% cover) and open (25 to 75% cover), occurring on a variety of surfaces below treeline; typically associated with drainage features or in the margins of wetland complexes.
	Upland Moist Mixed Forest	Mature mixed forests with open (25 to 60% cover) to woodland (< 25% cover) canopies; found predominantly at low elevations within the Gold Creek Corridor.
	Upland Moist Tall Alder Scrub	Tall alder communities, both closed (> 75% cover) and open (25 to 75% cover) canopies; typically occurs on upland terrain below treeline.
	Upland Moist Tall Willow Scrub	Tall willow communities, both closed (> 75% cover) and open (25 to 75% cover) canopies; typically occurs on upland terrain below treeline.
	Upland Spruce Forest	Needleleaf forests with open (25 to 60% cover) to woodland (< 25% cover) canopies; occurs in well-drained upland areas.
	Upland Spruce Woodland with Tall Shrub Understory	Needleleaf woodlands (< 25% cover) with a prominent tall-shrub understory, often dominated by alder; typically occurs below and adjacent to Subalpine Tall Alder Scrub.
Subalpine	Alpine and Subalpine Tarn	Permanently flooded water bodies in the subalpine zone; depressional features with very little lacustrine fringe development.
	Subalpine Dry Barrens	Well-drained barren areas found on mid-slopes or on convex features in exposed subalpine areas (2500–3500 ft asl).
	Subalpine Moist Birch-Ericaceous Scrub	Low-shrub communities dominated by shrub birch and ericaceous shrubs; occurs on mid-slopes near the subalpine/upland boundary as forest grades into tundra.
	Subalpine Moist Dwarf Shrub Scrub	Dwarf-shrub communities occurring on well-drained convex surfaces between 2500 and 3500 ft asl; composed of a variety of prostrate, deciduous and evergreen ericaceous shrubs; lichens are common.
	Subalpine Moist Graminoid-Shrub Meadow	Dwarf shrubs and graminoids co-dominate this subalpine plant community, which is typically found on sheltered mid-slopes.
	Subalpine Moist Herb Meadow	Forb-dominated moist communities found within the subalpine zone.
	Subalpine Tall Alder Scrub	Generally closed (> 75% cover) canopy tall alder communities found near treeline.
	Subalpine Tall Willow Scrub	Closed (> 75% cover) and open (25 to 75% cover) canopy willow communities occur near treeline.
	Subalpine Wet Sedge-Shrub Meadow	Wet sedge communities dominated by wetland-obligate sedges; found in low lying areas in broad subalpine valleys or in small patches at the margins of subalpine tarns.

Physiography	Wildlife Habitat Type	Description[1]
	Subalpine Low Willow Scrub	Closed (> 75% cover) and open (25 to 75% cover) canopy low willow communities occupying extensive lower slope terrain within broad subalpine valleys; often poorly drained with surface water present.
	Subalpine Sedge Marsh	Permanently flooded sedge-dominated communities; limited to small concavities and margins of subalpine tarns.
Alpine	Alpine Dry Barrens	Barren rock and scree generally above 3500 ft asl.
	Alpine Moist Dwarf Shrub Scrub	Dry dwarf-shrub communities dominated by prostrate alpine dwarf shrubs; forbs are co-dominant and there is often significant lichen cover.
	Alpine Moist Graminoid-Forb Meadow	Graminoid- and forb-dominated communities in protected sites in the alpine zone.
	Alpine Wet Sedge Meadow	Wet meadows dominated by wetland-obligate sedge species; small patches form in concave depressions in alpine areas.
	Alpine Wet Sedge-Shrub Meadow	Wet communities co-dominated by wetland-obligate sedges and dwarf deciduous shrubs; surface water typically present; occurs in drainage features and terrain concavities.
	Alpine and Subalpine Tarn	Permanently flooded water bodies in the alpine zone; depressional features with very little lacustrine fringe development.

Notes:

1 In the AVC (Viereck et al. 1992), tall shrubs are defined as > 1.5 m (4.9 ft) in height, low shrubs are < 1.5m (4.9 ft) in height, and dwarf shrubs are < 20cm (8 in) in height.

10. FIGURES

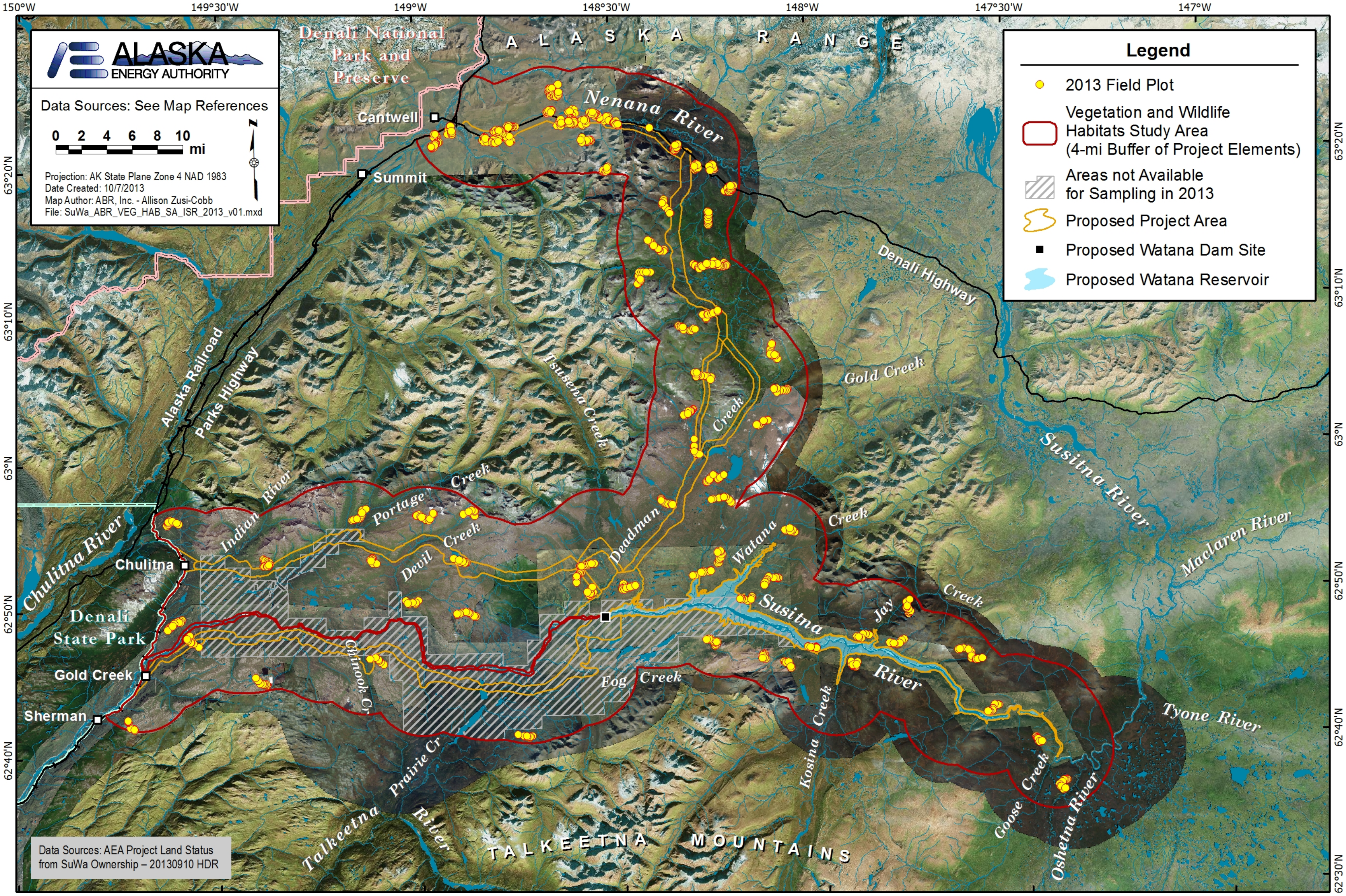


Figure 3-1. Vegetation and Wildlife Habitat Mapping Study Area and Ground-reference Plots Sampled in 2013, Susitna-Watana Hydroelectric Project.

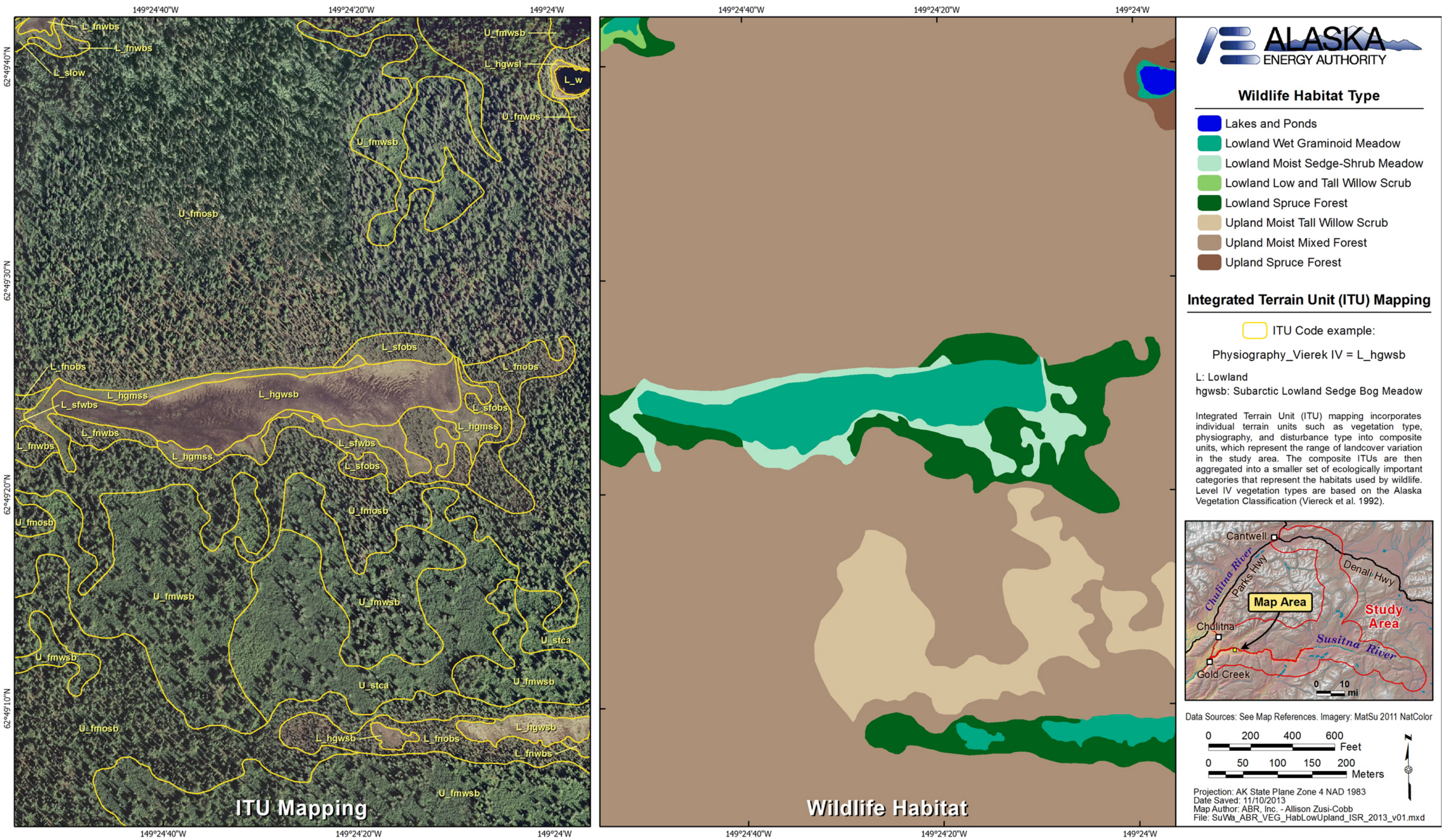


Figure 5.2-1. Preliminary Wildlife Habitat Mapping in Upland and Lowland Physiographic Units in the Vegetation and Wildlife Habitat Mapping Study Area.

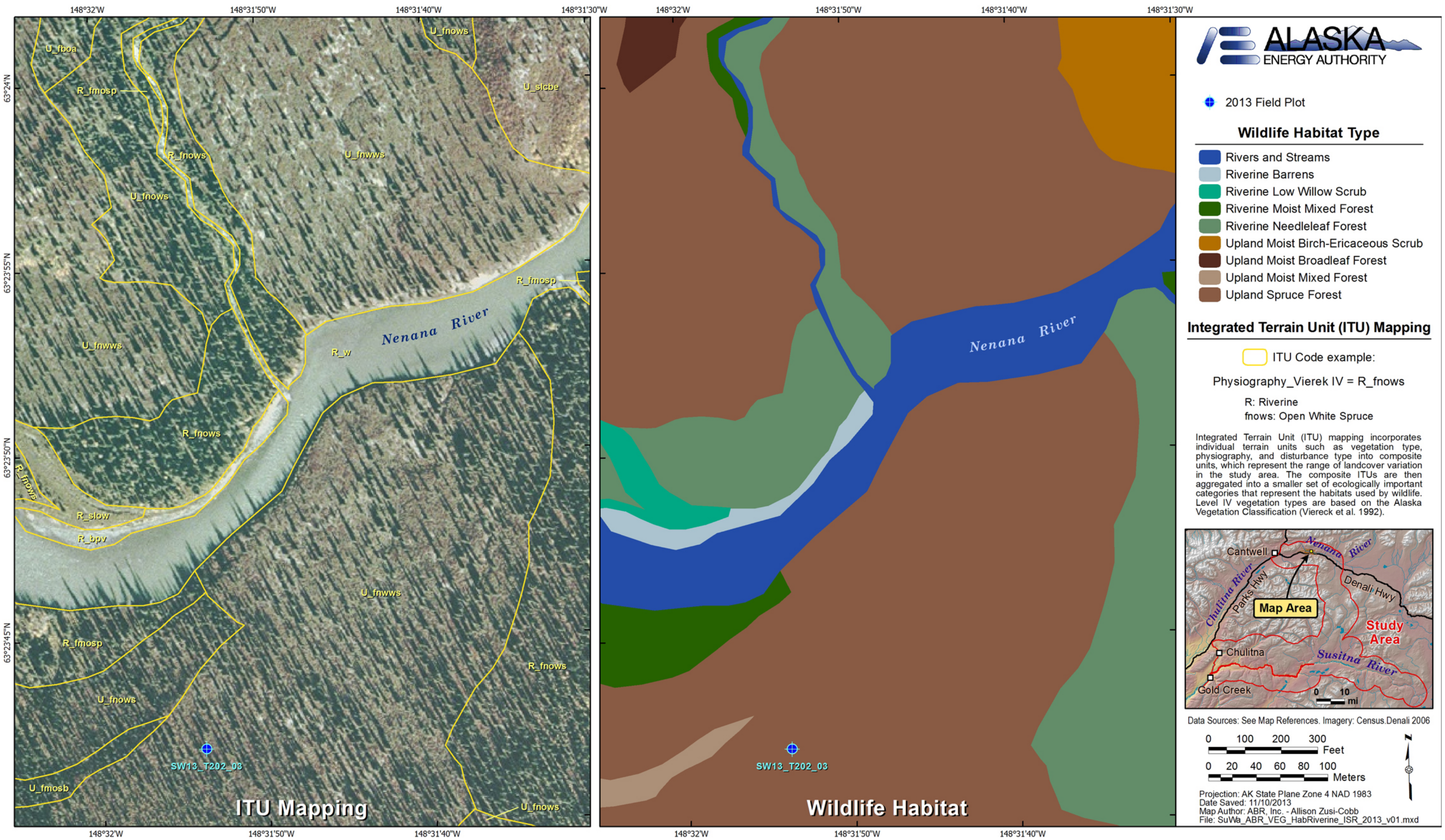


Figure 5.2-2. Preliminary Wildlife Habitat Mapping in Riverine and Upland Physiographic Units in the Vegetation and Wildlife Habitat Mapping Study Area.

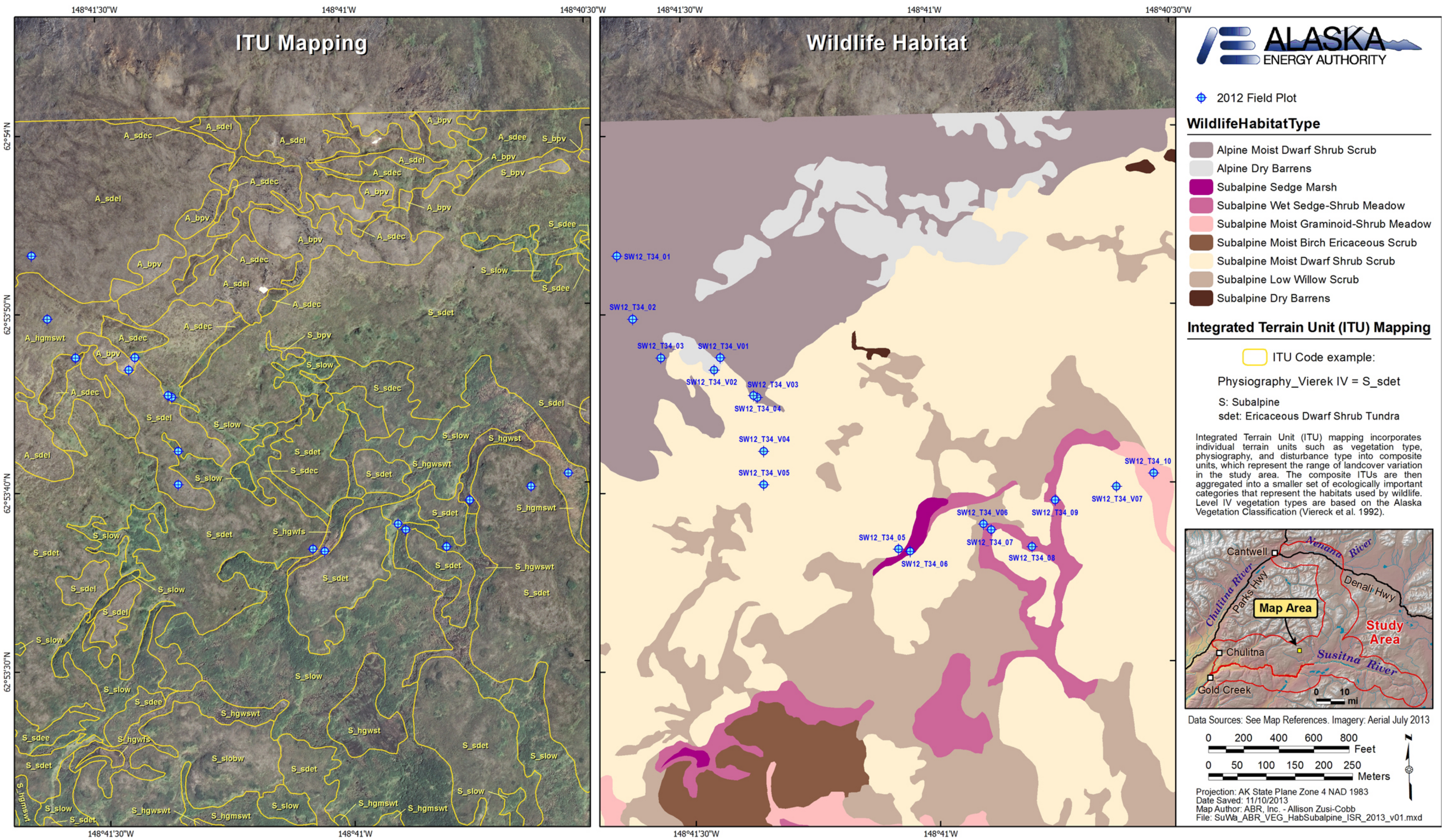


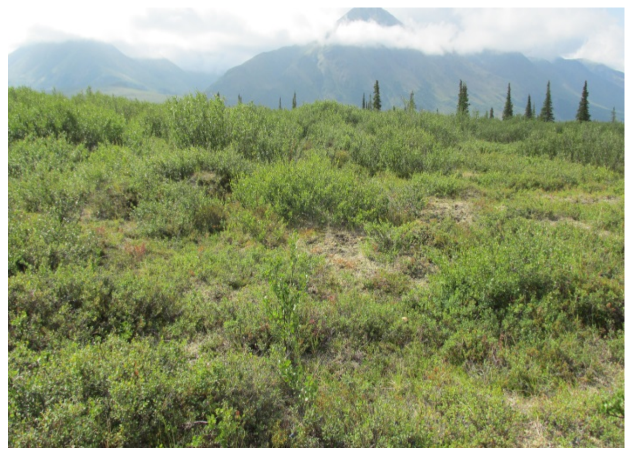
Figure 5.2-3. Preliminary Wildlife Habitat Mapping in Subalpine and Alpine Physiographic Units in the Vegetation and Wildlife Habitat Mapping Study Area.

APPENDIX A: COMMONLY SAMPLED WILDLIFE HABITAT TYPES


Alpine Moist Dwarf Shrub Scrub


Subalpine Low Willow Scrub


Upland Spruce Forest


Upland Moist Birch-Ericaceous Scrub


Lowland Wet Graminoid Meadow


Riverine Low Willow Scrub