

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Rare Plant Study
Study Plan Section 11.8

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
ADNR	Alaska Department of Natural Resources
AEA	Alaska Energy Authority
AKNHP	Alaska Natural Heritage Program
CIRWG	Cook Inlet Regional Working Group
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
GPS	global positioning system
ILP	Integrated Licensing Process
ISR	Initial Study Report
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
RSP	Revised Study Plan
SPD	study plan determination
USFWS	DOI, Fish and Wildlife Service
USR	Updated Study Report

EXECUTIVE SUMMARY

Rare Plant Study 11.8	
Purpose	The primary goal of the Rare Plant Study is to locate populations of rare vascular plant species that may be affected by development activities associated with the proposed Project. The rare plant occurrence data collected in this study will be used to assess the potential direct, indirect, and cumulative impacts to rare plants from Project construction and operations activities. Additionally, the data will be used to develop protection, mitigation, and enhancement measures, as appropriate, to minimize Project impacts to rare plant populations.
Status	This study was designed so that the entire study area would be surveyed sequentially over 2 years. During July and August 2013, field surveys were conducted in the Watana Reservoir area, portions of the Watana Camp area, and in each of the three alternative Susitna-Watana access and transmission line corridors. A second year of fieldwork will be performed to fully survey the Gold Creek Corridor, some portions of the Chulitna and Denali Corridors, the southwestern portion of the proposed Watana Reservoir, and in the Watana Dam and Camp area. In the second study year, rare plant species found in other Project botanical studies will be collected to confirm identifications, and lists of species found in both study years (including rare species) will be reviewed for any range extensions.
Study Components	<p>The major study components include:</p> <p>Identify habitats in the Project area that may harbor rare vascular plant species previously found within a broad region surrounding the Project area;</p> <p>Locate populations of rare vascular plant species that may occur in those portions of the Project area that would be disturbed by Project construction and operations activities; and</p> <p>Estimate population sizes for any rare species found and map their locations.</p>
2013 Variances	There were no variances from the field survey methods (RSP Section 11.8.4.1) during the 2013 study season. While portions of the study area were not surveyed during 2013 due a lack of access to CIRWG lands, this is not considered a variance because the study was designed as a multi-year effort in which the study area would be sequentially surveyed. The study team will meet study objectives by surveying CIRWG lands in the next study season.
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.

Rare Plant Study 11.8	
Highlighted Results and Achievements	Two rare plant species were found in the portions of the study area surveyed in 2013, <i>Vicia americana</i> Muhl. ex Willd. (American vetch) and <i>Eriophorum viridicarinatum</i> (Engelm.) Fernald (thinleaf cottonsedge). <i>V. americana</i> is listed as S2, G5 (imperiled in Alaska, demonstrably secure globally); a population of several hundred plants was found growing with other successional forbs in disturbed clearings in the Gold Creek Camp area at the western end of the Gold Creek Corridor. <i>E. viridicarinatum</i> is listed as S2S3, G5 (rare or uncommon to imperiled in Alaska, demonstrably secure globally); several populations were found in wet sedge meadows below treeline, in the central portion of the proposed Watana Reservoir, on a terrace above the Susitna River west of Watana Creek.

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed its Revised Study Plan (RSP) for the Susitna-Watana Hydroelectric Project (FERC Project No. 14241) with the Federal Energy Regulatory Commission (FERC or Commission), which included 58 individual study plans (AEA 2012). Section 11.8 of the RSP described the Rare Plant Study. 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 11.8 was one of the 31 studies approved with no modifications.

In this study, the appropriate habitats for a set of rare vascular plant species likely to occur in the Project area were identified in 2013, and field surveys are being conducted to search for any populations of rare plants that may occur. The focus of the surveys is limited to those areas in which rare plant populations could be directly or indirectly affected by Project development activities in the Upper and Middle Susitna Basin. RSP Section 11.8 provided goals, objectives, and proposed methods for data collection regarding rare plants.

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 Rare Plant Study 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

The primary goal of the Rare Plant Study is to locate populations of rare vascular plant species that occur in the Upper and Middle Susitna River Basin (upstream of Gold Creek; see Section 3, Study Area, below) that may be affected by development activities associated with the proposed Project.

The specific objectives of the Rare Plant Study, as specified in Section 11.8.1 of the RSP, are to:

- Identify habitats in the Project area that may harbor rare vascular plant species previously found within a broad region surrounding the Project area.
- Locate populations of rare vascular plant species that may occur in those portions of the Project area that would be disturbed by Project construction and operations activities.
- Estimate population sizes for any rare species found and map their locations.

3. STUDY AREA

The study area for the Rare Plant Study is described in RSP Section 11.8.3. The study area includes the areas in and adjacent to those portions of the Project area in which habitat loss, alteration, and/or disturbance would occur (the Watana Reservoir, Watana Dam and Camp sites, and along the three proposed alternatives for the Susitna-Watana transmission lines and access corridor). Because rare plant species typically occur in specific habitats, the survey sites for rare plants were defined primarily by the locations of suitable habitats within the study area that could support rare plant species and could be affected by development activities (Figure 3-1).

4. METHODS AND VARIANCES IN 2013

The rare plant survey involved reviewing the list of rare plants that may occur in the Project area; identifying the habitats for rare species that may occur in the study area; and conducting field surveys in the study area to document the presence (and locations) of rare species and the habitats they may occupy. The rare plant species list used in preparing for the field surveys was provided on request by the Alaska Natural Heritage Program (AKNHP). The list was based on a query of the rare plant database maintained by the AKNHP using a rare plant search area based on subwatershed boundaries (see Section 4.1, Selection of Focal Species and Habitats below).

Based on the list provided, preliminary mapping of vegetation, wildlife habitats, and wetlands (see ISR Studies 11.5 and 11.7) and aerial photographs were reviewed to identify habitats that may support the list of possible rare species. Aerial photointerpretation was performed using high-resolution (0.3- to 1-ft pixels) aerial photography and satellite imagery for the Project area. To prioritize the field survey efforts, areas to be searched were categorized as having low, moderate, or high potential for supporting rare plants. Surveys for rare plants downstream of the Project dam site along the Susitna River are not planned because habitat loss, which could affect rare plant populations through the placement of fill and other construction activities, will not occur in those downstream riparian areas. Intensive vegetation surveys in riparian areas along the Susitna River, however, are being conducted in the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6), and rare vascular plant species were recorded during that work (see Section 5, Results below).

4.1. Selection of Focal Species and Habitats

The selection of focal species and habitats during the 2013 field season was completed in accordance with RSP Section 11.8.4.1 with no variances. In early 2013, the study team submitted a request to the AKNHP for a list of the rarer vascular plant taxa (S1, S1S2, S2, and S2S3; Table 4.1-1) that had been collected within a broad region surrounding the Project area. The search area used for the collection-records request (Figure 4.1-1) was designed to encompass, as much as possible, areas with landscape features and habitats similar to those occurring in the Project area. The search area was defined by watershed boundaries in a step-wise selection approach. First, the complete Susitna River drainage basin (hydrologic unit code 6 [HUC 6]) was selected, and added to that (intersected in a geographic information system [*ArcGIS*]) were the boundaries of five adjacent or partially included areas with similar terrain to that which occurs in the Project area: (1) Denali National Park and Preserve, (2) Nelchina Public Use Area (Alaska Department

of Natural Resources ([ADNR]), (3) Matanuska Valley Wildlife Area and State Range Area (ADNR), (4) areas surrounding the Denali Highway in the Nenana River drainage basin (contiguous with the Project's Denali Corridor), and (5) the study area for the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Study 11.5). All of the subwatersheds (HUC 12) that occurred wholly or partially within this intersected set of areas then were selected to yield a preliminary subwatershed search-area boundary. Lastly, a series of deletions of HUC-12 subwatersheds were made to further trim the search-area boundary to those areas with habitat features similar to those in the Project area, and in which rare plant surveys were likely to have been conducted in the past (e.g., along road systems). The HUC-12 subwatersheds that were deleted were those that occur (1) south of the Glenn Highway and west to the confluence of the Susitna and Yentna Rivers, (2) west of the Yentna River and north to the confluence of the east and west forks of the Yentna River (where they intersect the Denali National Park and Preserve boundary), (3) north of the Denali National Park and Preserve boundary up to the Teklanika River, and (4) west of the Teklanika River and north of the hills that occur north of Fish Creek.

Using the resulting search area based on subwatershed boundaries, AKNHP staff queried the BIOTICS geospatial database (AKNHP 2013) for rare vascular plant collection records in June 2013. The query results indicated that 14 plant taxa with rarity rankings of S2S3 or rarer had been recorded in the regional subwatershed search area during previous survey efforts. Those 14 taxa, along with 25 other taxa that were ranked as less rare (S3 or S3S4), or were unranked, are listed in Table 4.1-2. Using the habitat information from the BIOTICS database recorded for each collection of these rare taxa in the search area, the suitable habitats for each taxon were identified. For cases in which the habitat information from the collected specimen(s) was sparse, additional information on the suitable habitats for rare taxa was researched using Hultén (1968), Carlson et al. (2006), the Natural Resources Conservation Service's PLANTS database (NRCS 2013), and by examining specimens directly at the University of Alaska Museum of the North Herbarium. The generalized plant habitats determined for each taxon in this process and the 14 taxa with the rarer State rankings served as the primary focal points for the field survey efforts.

4.1.1. Variances

There were no variances from the methods described in RSP Section 11.8 for the selection of focal species and habitats for the Rare Plant Study.

4.2. Field Surveys

In 2013, field surveys were conducted in accordance with RSP Section 11.8.4.1 with no variances. While these field surveys did not occur on Cook Inlet Regional Working Group (CIRWG) lands because land-access permits were not available, this was not considered a variance because this study was designed so that the entire study area would be surveyed and mapped sequentially over 2 years.

The field survey efforts were focused on surveying suitable habitats for the 14 taxa with the rarer State rankings (S1, S1S2, S2, and S2S3), which were found in the regional subwatershed search area for rare plant collection records. During the fieldwork, those taxa ranked as being less rare in the state (S3 through S3S4 rankings) also were recorded, but the focus of the survey work was

on the rarer taxa. When encountered, rare plants also were recorded during the 2013 field surveys for the Vegetation and Wildlife Habitat Mapping Study (Study 11.5), Riparian Study Vegetation Study (Study 11.6), and Wetland Mapping Study (Study 11.7).

Prior to the field surveys in 2013, the preliminary mapping of vegetation, wildlife habitats, and wetlands for the Project, which was conducted in 2012 and 2013 (see ISR Studies 11.5 and 11.7), as well as current, high-resolution (0.3- to 1-ft pixels) aerial imagery were reviewed to identify suitable habitats for the focal rare plant taxa within the study area.

The sampling methodology used by the AKNHP (Carlson et al. 2006; modified from Catling and Reznicek 2003) was employed in this study. With this methodology, to maximize the potential of encountering rare species, researchers identified survey areas based on site-specific criteria, including regional or locally unique geological features, suitable habitats for the species of concern (as described above in Section 4.1, Selection of Focal Species and Habitats), areas with high environmental gradients, and logistical feasibility. By combining these landscape characteristics, regions within the study area were categorized as having low, moderate, or high potential for supporting rare plants, and the field survey efforts were prioritized accordingly in those areas with high and moderate potential.

Forty-two survey transects were allocated for surveys of rare plants over the duration of the study (Figure 3-1). Seven of those transects were not surveyed in the first year of study (2013) because land access was not authorized, but will be surveyed in the next year of study. A total of 16 survey transects were sampled in the study area during two survey efforts in 2013 (July 1–8 and July 30–August 5). This included 14 of the preselected transects and two additional transects (one at Gold Creek Camp at the western end of the Gold Creek Corridor, and one outside the study area in the upper watershed of Devil Creek north of the Chulitna Corridor) that were selected in the field for sampling. The Devil Creek transect was sampled on a day when low clouds prohibited access to the scheduled transect for that day (which occurs at a similar elevation). Overall, in 2013, transects were sampled in the Watana Reservoir area, the Watana Dam and camp area, and in each of the three alternative corridors for the Susitna-Watana Transmission Line and the Susitna-Watana Road. The timing of the field surveys was designed to coincide with the approximate flowering periods of the focal plant species.

Transect length ranged from 1.1 to 6.2 km (0.6 to 4 mi), depending on the number of habitats of interest occurring on each transect. During the field surveys, each plant community encountered along the sampled transects was surveyed for rare taxa and described. Any unknown and/or unusual plants were collected and identified. For the two species found with rarity rankings of S2S3 or rarer (see Section 5, Results, below), the plants and plant community in which they were growing were photographed and global positioning system (GPS) locations were recorded. Detailed site characteristics and plant community data were documented, including a complete plant species list with cover estimates for all dominant species and plant life-forms present. The sizes of the rare plant populations found were estimated by either: (1) counting the total number of individuals and measuring the area of occurrence, or (2) for the locally common species, visually estimating the total percent cover of the species, and determining the extent of the habitat occupied. Because the field crew determined that collecting several plants would not significantly impact the populations, voucher specimens of each of the rare species were collected to confirm identifications. The identifications of rare plants were made initially using

the Flora of Alaska (Hultén 1968), the Alaska Rare Plant Field Guide (Lipkin and Murray 1997), and the Flora of North America North of Mexico (FNAEC, 1993–2012). Final nomenclature for the rare plant species found follows that used in the AKNHP BIOTICS database. Confirmation of the rare plant identifications was made by the University of Alaska Museum of the North Herbarium.

4.3. Variances In 2013

No variances from the field methods described in the Study Plan occurred during the 2013 study season. Because the study was designed to be conducted over two years, the lack of access to CIRWG lands is not considered a variance. The study team will meet the study objectives by completing the field work in the next study season.

5. RESULTS

Fourteen generalized plant habitats occurring on the 16 different survey transects in the study area were searched for rare plants (Table 5-1). Calcareous substrates occurred only in the northwest corner of the study area. Scree slopes were uncommon in the study area, and were generally confined to the lowest elevations in the study area, where the Susitna-Watana transmission line and/or access road would be located. During the field surveys, researchers sampled 43 different Level IV vegetation types (Viereck et al. 1992) in the search for rare plant taxa (Table 5-2). The most common vegetation types searched were Mesic Shrub Birch-Ericaceous Shrub and Subarctic Lowland Sedge Wet Meadow. The least common types were Sweetgale-Graminoid Bog, *Dryas*-Lichen Tundra, Dry Fescue, Subarctic Lowland Sedge-Moss Bog Meadow, and Ferns. A complete list of the vascular plant taxa recorded during the field surveys and a Project-specific (relative) rarity index for each taxon is provided in Appendix A.

Researchers found two rare plants: *Vicia americana* Muhl. ex Willd. (S2) and *Eriophorum viridicarinarum* (Engelm.) Fernald (S2S3) (Table 5-3). Site characteristics and plant community information for the collection localities for both species are listed in Appendix B. *V. americana* was found in the helicopter landing area of the Gold Creek Camp, the adjacent camp clearing, and the adjacent airstrip (Figure 5-1). The plant was only found in disturbed areas that had been recently cleared of trees or mowed to remove saplings. Hundreds of plants were found around the Gold Creek Camp area, comprising over 1 percent cover in the Mixed Herb Meadows vegetation type (Figure 5-2).

Eriophorum viridicarinarum was found growing in a Subarctic Lowland Sedge Wet Meadow wetland surrounded by Open White Spruce-Black Spruce Forest (Figure 5-3). The site, on a terrace above the Susitna River just upstream of the confluence of Watana Creek, supported approximately 100 individual flowering plants, in a narrow zone between the Open White Spruce-Black Spruce Forest surrounding the wetland and the wetter Subarctic Lowland Herb Bog Meadow in the center of the wetland (Figure 5-4). This species was also found in similar habitats by field crews working on other Project botanical studies outside of the rare plant study area, and those records will be reported in the Updated Study Report (USR).

Two additional rare vascular plant species were found outside of the rare plant study area, in riparian habitats along the Susitna River downstream of Gold Creek. These plants were found by field crews working on the Riparian Vegetation Study (Study 11.6). *Botrychium virginianum* (L.) Swartz, which is listed as S3, G5 (rare or uncommon in Alaska, demonstrably secure globally), was typically found in low abundance in large umbel meadows on inactive/abandoned floodplain surfaces. *Viola selkirkii*, which is listed as S3S4, G5? (rare or uncommon to apparently secure in Alaska, possibly secure globally), was found with cover estimates sometimes over one percent in the understory of Open Birch Forest and Mixed Spruce-Birch Forest habitats. The identifications of these two species were confirmed by the University of Alaska Museum of the North Herbarium.

Data generated in support of the ISR are available for download at <http://gis.suhydro.org/reports/isr>. The data files are as follows:

- Transect locations: ISR_11_8_RAPL_Data_ABR.gdb
- Table 5-1: ISR_11_8_RAPL_Table_5_1_Habitats.xlsx
- Table 5-2: ISR_11_8_RAPL_Table_5_2_Veg.xlsx
- Appendix A: ISR_11_8_RAPL_AppdxA_Vascular_Plant_List.xlsx
- Appendix B: ISR_11_8_RAPL_AppdxB_Rare_Plant_Hab_Char.xlsx

6. DISCUSSION

The 2013 survey effort was sufficient for achieving the goal of documenting the presence and size of rare vascular plant populations in the study area as described in the Study Plan. Researchers were able to sample a wide range of habitat types that could have harbored rare plants, and found two rare species. The use of long transects that covered several habitat types in a survey day was an effective way of searching for rare plants. Logistical support was excellent, giving researchers access to remote sites via helicopter, with sufficient time between drop-off and pick-up times to adequately survey the transects. Researchers were not able to sample large parts of the Gold Creek Corridor and the southwestern part of the proposed Watana Reservoir in 2013, due to landowner restrictions on access. Field surveys for rare plants will be conducted in those areas during the next study year if access to do so is granted.

Researchers from several other botanical studies compiled plant species lists for the Project and were given the list of potential rare plants developed for the Rare Plant Study. The field data from the Vegetation and Wildlife Habitat Mapping Study (Study 11.5), the Riparian Vegetation Study (Study 11.6), and the Wetland Mapping Study (Study 11.7) are undergoing QA/QC, and plant identifications are in the process of being verified. Any additional records of rare plant species will be reported in the USR, once the plant identifications have been verified.

Researchers for the Rare Plant Study are in the process of reviewing the 2013 species list for any range extensions or unusual plants that were found in the study area. Any information on range extensions and/or unusual plant collections will be included in the USR when data from the surveys in the two study seasons are available. Information on range extensions and additional

collections of rare species within their known ranges will provide useful information to the AKNHP to use in revising the rarity rankings for plant species in Alaska.

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.]

8. LITERATURE CITED

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9. TABLES

Table 4.1-1. State Conservation Rank Definitions.

Rank	Definition
S1	Critically imperiled within the state; at very high risk of extirpation because of extremely because of very few occurrences, declining populations, or extremely limited range and/or habitat.
S2	Imperiled within the state; at high risk of extirpation because of few occurrences, declining populations, limited range, and/or habitat.
S3	Rare within the state; at moderate risk of extirpation because of restricted range, narrow habitat specificity, recent population decline, small population sizes, a moderate number of occurrences.
S4	Apparently secure but uncommon within the state; may be a long-term conservation concern.
S5	Secure and widespread within the state; not at risk for extirpation because of widespread abundance.
G?	Inexact numeric rank reflecting inexact data (Global Conservation Rank).
S#S#	Status of species within a region is best described as a range between two ranks.
S#Q	Taxon is questionable or uncertain as currently defined but records assigned to that taxon are not questionable.
SP	Species is likely to occur in Alaska in a natural context based on its natural occurrence in adjacent territories near the Alaska border in habitat that is also present within Alaska.
SNA	Species cannot be considered rare because all reports were erroneous or based on material from a cultivated or introduced context (these ranks do not appear on the Rare Plant Tracking List but can be found on the Taxa Removed list).
SU	Species occurs in Alaska in a natural context and is likely rare but cannot be assigned an accurate conservation rank because of substantial uncertainty in the relevant data (i.e. records are incorrectly identified, records are ambiguous and indefinite, or records have not yet been redetermined after recent taxonomic changes).
SH	Possibly extirpated. Species is known only from records more than 50 years old (historical sources) that are either so vague that they cannot be relocated or that have been searched for unsuccessfully (although not thoroughly enough to presume that the species has been extirpated).

Table 4.1-2. Rare Vascular Plant Taxa Found in a Search of Collection Records within a Broad Region Surrounding the Susitna-Watana Hydroelectric Project Area.¹

Scientific Name	Common Name	State Rank ²	Global Rank ³	Habitat
<i>Blismopsis rufa</i> (Huds.) Link	red clubbrush	S1	unranked	Saline soils, coastal deltas
<i>Carex athrostachya</i> Olney	slender beak sedge	S1	G5	Seasonally moist meadows, marshes, pond and lake margins
<i>Artemisia dracunculus</i> L.	dragon wormwood	S1S2	G5	Exposed bluffs, rocky slopes, low elevation, sunny and dry
<i>Carex parryana</i> Dew.	Parry sedge	S2	G5	Mires, damp meadows, lowlands
<i>Erysimum asperum</i> var. <i>angustatum</i> (Rydb.) B. Boivin	wallflower	S2	G5T2	Dry, south-facing scree slopes, outcrops and dry grasslands
<i>Potamogeton robbinsii</i> Oakes	flat-leaf pondweed	S2	G5	Shallow to deep water of ponds, lakes, and slow-flowing rivers
<i>Schizachne purpurascens</i> (Torr.) Swallen	false melic	S2	G5	Low elevation, moist rocky slopes, alder thickets
<i>Vicia americana</i> Muhl. ex Willd.	American vetch	S2	G5	Low elevation thickets and meadows
<i>Arnica mollis</i> Hooker	hairy arnica	S2Q	G5	Moist meadows and conifer forests, stream banks, late snow-melt areas, montane to subalpine: 1000–4000 m
<i>Botrychium ascendens</i> W.H. Wagner	upward-lobed moonwort	S2S3	G3	Disturbed areas and fields
<i>Eriophorum viridicarinatum</i> (Engelm.) Fernald	green-keeled cottongrass	S2S3	G5	Marshes, meadows, bogs, fens, wet woods
<i>Chamaerhodos erecta</i> (L.) Bunge	Nuttall's ground-rose	S2S3	G5	Low elevation, dry, sandy substrates
<i>Saxifraga adscendens</i> ssp. <i>oregonensis</i> (Raf.) Bacig.	wedgeleaf saxifrage	S2S3	G5T4T5	Rock crevices, sandy places, alpine; 1200-4200 m
<i>Potentilla drummondii</i> Lehm.	Drummond cinquefoil	S2S3	G5	Low elevation, moist woods
<i>Botrychium alaskense</i> Wagner and Grant	Alaska moonwort	S3	G4	Disturbed meadows, roadsides, riverbars
<i>Botrychium virginianum</i> (L.) Swartz	Virginia moonwort	S3	G5	Low-elevation partially vegetated scree slopes
<i>Carex eburnea</i> Boott	bristle-leaf sedge	S3	G5	Conifer or mixed forests, occasionally fens, stable dunes and alvar, on neutral or calcareous substrates
<i>Carex heleonastes</i> Ehrh. ex L. f.	Hudson Bay sedge	S3	G4	Mires, damp meadows, lowlands
<i>Carex interior</i> L.H. Bailey	inland sedge	S3	G5	Wet meadows and prairies, fens, coniferous and deciduous swamps, river and lakeshores, usually on calcareous substrates
<i>Cicuta bulbifera</i> L.	bulb-bearing water hemlock	S3	G5	Marshes, bogs
<i>Glyceria striata</i> (Lam.) Hitchc.	fowl mannagrass	S3	G5	Moist ground, low elevation
<i>Juniperus horizontalis</i> Moench.	creeping juniper	S3	G5	Low elevation sand dunes, sandy and gravelly soils, prairies, slopes, rock outcrops, and stream banks

Scientific Name	Common Name	State Rank ²	Global Rank ³	Habitat
<i>Maianthemum stellatum</i> (L.) Link	starry solomon plume	S3	G5	Sand dunes, marginal woodlands, oak openings; 0–3200 m
<i>Polypodium sibiricum</i> Siplivinskij	Siberian polypody	S3	G5?	Rocks, tree trunks
<i>Potamogeton obtusifolius</i> Mert. & W.D.J. Koch	blunt-leaf pondweed	S3	G5	Medium- to low-alkaline waters of lakes and slow-flowing streams; 50–2000 m
<i>Puccinellia vahliana</i> (Liebm.) Scribn. & Merr.	Vahl's alkaligrass	S3	G4	Stony alpine tundra
<i>Carex lapponica</i> O. Lang	Lapland sedge	S3S4	G4G5Q	Sphagnum bogs, wet, nutrient-poor areas, mostly lowlands: 0–200 m
<i>Ceratophyllum demersum</i> L.	common hornwort	S3S4	G5	Quiet water
<i>Erigeron porsildii</i> G.L. Nesom & D.F. Murray	Porsild fleabane	S3S4	G3G4	Cliffs and talus (often calcareous) slopes, shaley gravel, grassy ravines, dry tundra 600–2100 m
<i>Minuartia dawsonensis</i> (Britt.) House	rock stitchwort	S3S4	G5	Moist, calcareous ledges and gravelly areas; 0–900 m
<i>Potamogeton subsibiricus</i>	Yenisei River pondweed	S3S4	G3G4	Shallow water of ponds and lakes; 0–915 m
<i>Viola selkirkii</i> Pursh ex Goldie	Selkirk's violet	S3S4	G5?	Understory of moist, low elevation woods
<i>Arnica ovata</i> Greene	sticky arnica	S3S4Q	G5	Moist meadows and conifer forests, stream banks, late snow-melt areas, montane to subalpine: 200–3600 m
<i>Mertensia paniculata</i> (Aiton) G. Don var. <i>alaskana</i> (B.)	Alaska tall bluebells	S3S4Q	G5TNR	Low elevation woods, riverbanks
<i>Oxytropis tananensis</i> Jurtz.	field locoweed	S3S4Q	GNR	Dry, sandy places
<i>Arnica lessingii</i> ssp. <i>norbergii</i>	Norberg arnica	unranked	G5	Alpine & subalpine meadows
<i>Eleocharis kamschatica</i> (C.A. Mey.) Kom.	Kamchatka spike-rush	unranked	G4	Brackish marshes, meadows, ponds, 0–30 m elevation
<i>Eritrichium splendens</i> Kearney ex W. Wight	showy alpine forget-me-not	unranked	G3G4	Alpine to 2000 m, rock crevices
<i>Phlox hoodii</i> Richardson	spiny phlox	unranked	G5	Alpine or well-drained river terraces

Notes:

1. Rare plant taxa with collection records in the BIOTICS database of rare species (AKNHP 2013), which were found in a regional subwatershed search area surrounding the Project area (see text and Figure 4.1-1); plant nomenclature and rarity rankings from the Rare Vascular Plant List (AKNHP 2012); habitat data from specimen records in the regional search area, from Hultén (1968), Carlson et al. (2006), NRCS (2013), and from review of specimens at the University of Alaska Museum of the North Herbarium.
2. State rarity rankings: S1 = critically imperiled, S2 = imperiled, S3 = rare, S4 = apparently secure, Q = uncertainty about taxonomic status may affect State rank
3. Global rarity rankings: G2 = imperiled, G3 = vulnerable, G4 = apparently secure, G5 = demonstrably secure, T = rank of subspecies or variety, Q = indicates uncertainty about taxonomic status which may affect global rank.

Table 5-1. Habitats Sampled for Rare Plants in the Susitna-Watana Hydroelectric Project Area, 2013.

Habitat	Focal Species: Rare Plant Taxa Found in Habitat in Other Studies	Survey Transect No.
Alpine meadow	<i>Arnica lessingii</i> ssp. <i>norbergii</i> , <i>Phlox hoodii</i> , <i>Puccinellia vahliana</i>	4, 10, 28, 37, 128,
Subalpine meadow	<i>Arnica lessingii</i> ssp. <i>norbergii</i> , <i>Arnica mollis</i> , <i>Arnica ovata</i>	4, 10, 17, 28, 30, 35, 37, 39, 40, 43, 128
Alpine rocky crevices	<i>Eritrichium splendens</i> , <i>Saxifraga adscendens</i> ssp. <i>oregonensis</i>	4, 10, 37, 128
Exposed bluff	<i>Artemesia dracunculus</i> , <i>Erigeron porsildii</i> , <i>Polypodium sibiricum</i>	4, 23, 25, 37
Scree slope	<i>Botrychium virginianum</i> , <i>Erigeron porsildii</i> , <i>Erysimum asperum</i> var. <i>angustatum</i> , <i>Polypodium sibiricum</i>	128
Alder thickets	<i>Schizachne purpurascens</i>	1, 4, 10, 17, 20, 23, 25, 37, 39, 40, 43
Disturbed meadow	<i>Botrychium alaskense</i> , <i>Botrychium ascendens</i> , <i>Vicia americana</i>	1, 37, 39, 40, 43, Gold Creek Camp
Moist forest	<i>Arnica mollis</i> , <i>Arnica ovata</i> , <i>Carex eburnea</i> , <i>Mertensia paniculata</i> var. <i>alaskana</i> , <i>Potentilla drummondii</i> , <i>Viola selkirkii</i>	1, 4, 10, 17, 20, 23, 25, 37, 39, 40, 43
Moist meadows	<i>Carex athrostachya</i> , <i>Carex heleonastes</i>	17, 20, 28, 30, 35, 37, 40, 43, 128
Wet meadows, fens, bogs	<i>Carex interior</i> , <i>Carex lapponica</i> , <i>Carex parryana</i> , <i>Cicuta bulbifera</i> , <i>Eriophorum viridicarinarum</i> , <i>Glyceria striata</i>	1, 17, 20, 28, 30, 35, 37, 40, 43
Standing water, ponds or lakes	<i>Ceratophyllum demersum</i> , <i>Potamogeton obtusifolius</i> , <i>Potamogeton robbinsii</i> , <i>Potamogeton subsibiricus</i>	1, 17, 20, 23, 25, 28, 30, 35, 37, 40, 43
River bar, terraces	<i>Botrychium alaskense</i> , <i>Phlox hoodii</i>	10, 20, 23, 25, 28
Calcareous substrates	<i>Carex interior</i> , <i>Erigeron porsildii</i> , <i>Minuartia dawsonensis</i>	43
Sand dunes and sandy substrates	<i>Chamaerhodos erecta</i> , <i>Juniperus horizontalis</i> , <i>Maianthemum stellatum</i> , <i>Oxytropis tananensis</i>	30, 35

Table 5-2.. Vegetation Types Sampled During the Survey for Rare Plants in the Susitna-Watana Hydroelectric Project Area, 2013.¹

Level I	Level II	Level III	Level IV	Survey Transect No.
I.Forest	A. Needleleaf Forest	(1) Closed Needleleaf Forest	J. White Spruce	1, 39
I.Forest	A. Needleleaf Forest	(2) Open Needleleaf Forest	E. White Spruce	1, 20, 23, 37, 39, 43
I.Forest	A. Needleleaf Forest	(2) Open Needleleaf Forest	F. Black Spruce	20, 23
I.Forest	A. Needleleaf Forest	(2) Open Needleleaf Forest	G. Black Spruce-White Spruce	20, 23, 25, 43
I.Forest	A. Needleleaf Forest	(3) Needleleaf Woodland	C. White Spruce	10, 20, 25, 39, 40
I.Forest	A. Needleleaf Forest	(3) Needleleaf Woodland	D. Black Spruce	1, 17 20, 25
I.Forest	B. Broadleaf Forest	(1) Closed Broadleaf Forest	D. Paper Birch	1, Gold Creek Camp
I.Forest	B. Broadleaf Forest	(2) Open Broadleaf Forest	A. Paper Birch	1, 20, Gold Creek Camp
I.Forest	B. Broadleaf Forest	(2) Open Broadleaf Forest	B. Quaking Aspen	10, 20
I.Forest	B. Broadleaf Forest	(2) Open Broadleaf Forest	C. Balsam Poplar	10, 17, 20, 35, Gold Creek Camp
I.Forest	C. Mixed Forest	(2) Open Mixed Forest	A. Spruce-Paper Birch	1, 23, 25, 35
II.Scrub	B. Tall Scrub	(1) Closed Tall Scrub	A. Willow	23, 25
II.Scrub	B. Tall Scrub	(1) Closed Tall Scrub	B. Alder	1, 4, 10, 17, 37, 43
II.Scrub	B. Tall Scrub	(2) Open Tall Scrub	B. Alder	39
II.Scrub	B. Tall Scrub	(2) Open Tall Scrub	C. Shrub Birch	4
II.Scrub	B. Tall Scrub	(2) Open Tall Scrub	D. Alder-Willow	1, 4, 10, 37, 43
II.Scrub	B. Tall Scrub	(2) Open Tall Scrub	E. Shrub-Birch Willow	17, 20, 30, 35
II.Scrub	C. Low Scrub	(2) Open Low Scrub	C. Mesic Shrub Birch-Ericaceous Shrub	17, 25, 28, 30, 35, 37, 39, 40, 43, 128
II.Scrub	C. Low Scrub	(2) Open Low Scrub	J. Sweetgale-Graminoid Bog	25
II.Scrub	D. Dwarf Scrub	(1) Dryas Dwarf Scrub	A. Dryas Tundra	4, 10, 28, 35, 39, 43
II.Scrub	D. Dwarf Scrub	(1) Dryas Dwarf Scrub	C. Dryas-Lichen Tundra	4
II.Scrub	D. Dwarf Scrub	(2) Ericaceous Dwarf Scrub	A. Bearberry Tundra	4, 37, 43
II.Scrub	D. Dwarf Scrub	(2) Ericaceous Dwarf Scrub	B. Vaccinium Tundra	4, 10, 28, 35, 37, 128
II.Scrub	D. Dwarf Scrub	(2) Ericaceous Dwarf Scrub	D. Cassiope Tundra	4, 10, 35, 128
II.Scrub	D. Dwarf Scrub	(3) Willow Dwarf Scrub	A. Willow Tundra	4, 128

Level I	Level II	Level III	Level IV	Survey Transect No.
III. Herbaceous	A. Graminoid Herbaceous	(1) Dry Graminoid Herbaceous	B. Dry Fescue	30
III. Herbaceous	A. Graminoid Herbaceous	(2) Mesic Graminoid Herbaceous	A. Bluejoint Meadow	1
III. Herbaceous	A. Graminoid Herbaceous	(2) Mesic Graminoid Herbaceous	B. Bluejoint-Herb	4, 30, 35, Gold Creek Camp
III. Herbaceous	A. Graminoid Herbaceous	(2) Mesic Graminoid Herbaceous	H. Sedge-Willow Tundra	30, 43
III. Herbaceous	A. Graminoid Herbaceous	(3) Wet Graminoid Herbaceous	C. Wet Sedge-Herb Meadow Tundra	17, 23, 30, 40, 43, 128
III. Herbaceous	A. Graminoid Herbaceous	(3) Wet Graminoid Herbaceous	E. Fresh Grass Marsh	1, 30, 40, 128
III. Herbaceous	A. Graminoid Herbaceous	(3) Wet Graminoid Herbaceous	F. Subarctic Lowland Sedge Wet Meadow	17, 20, 25, 28, 30, 35, 40, 43, 128
III. Herbaceous	A. Graminoid Herbaceous	(3) Wet Graminoid Herbaceous	K. Subarctic Lowland Sedge-Moss Bog Meadow	1
III. Herbaceous	B. Forb Herbaceous	(1) Dry Forb Herbaceous	A. Seral Herbs	4, 20, 23, 25, Gold Creek Camp
III. Herbaceous	B. Forb Herbaceous	(1) Dry Forb Herbaceous	C. Alpine Herbs	4, 25, 37, 128
III. Herbaceous	B. Forb Herbaceous	(2) Mesic Forb Herbaceous	A. Mixed Herbs	10, 20, 23, 25, 35, 39, 128
III. Herbaceous	B. Forb Herbaceous	(2) Mesic Forb Herbaceous	D. Ferns	Gold Creek Camp
III. Herbaceous	B. Forb Herbaceous	(3) Wet Forb Herbaceous	C. Subarctic Lowland Herb Bog Meadow	1, 40
III. Herbaceous	D. Aquatic Herbaceous	(1) Freshwater Aquatic Herbaceous	A. Pondlily	17, 20
III. Herbaceous	D. Aquatic Herbaceous	(1) Freshwater Aquatic Herbaceous	B. Common Maretail	28, 30, 35, 37, 43
III. Herbaceous	D. Aquatic Herbaceous	(1) Freshwater Aquatic Herbaceous	C. Aquatic Buttercup	30, 35, 40, 43, 128
III. Herbaceous	D. Aquatic Herbaceous	(1) Freshwater Aquatic Herbaceous	D. Burreed	30, 40, 128
III. Herbaceous	D. Aquatic Herbaceous	(1) Freshwater Aquatic Herbaceous	F. Fresh Pondweed	23, 28, 40, 43

Note:

1. Hierarchical vegetation types, Levels 1 through IV as defined in the *Alaska Vegetation Classification* (Viereck et al. 1992).

Table 5-3. Rare Vascular Plants Found During Field Surveys in the Susitna-Watana Hydroelectric Project Area, 2013.

Vascular Plant	Geographic Coordinates (Decimal Degrees, WGS 84)	Population Estimate
<i>Eriophorum viridicarinatum</i> (Engelm.) Fernald	62.8327 N 148.1971 W	Approximately 100 individual flowering plants
<i>Vicia americana</i> Muhl. ex Willd.	62.7648 N 149.6907 W	Hundreds of individual plants, with 1–5% cover in camp and airstrip clearings

10. FIGURES

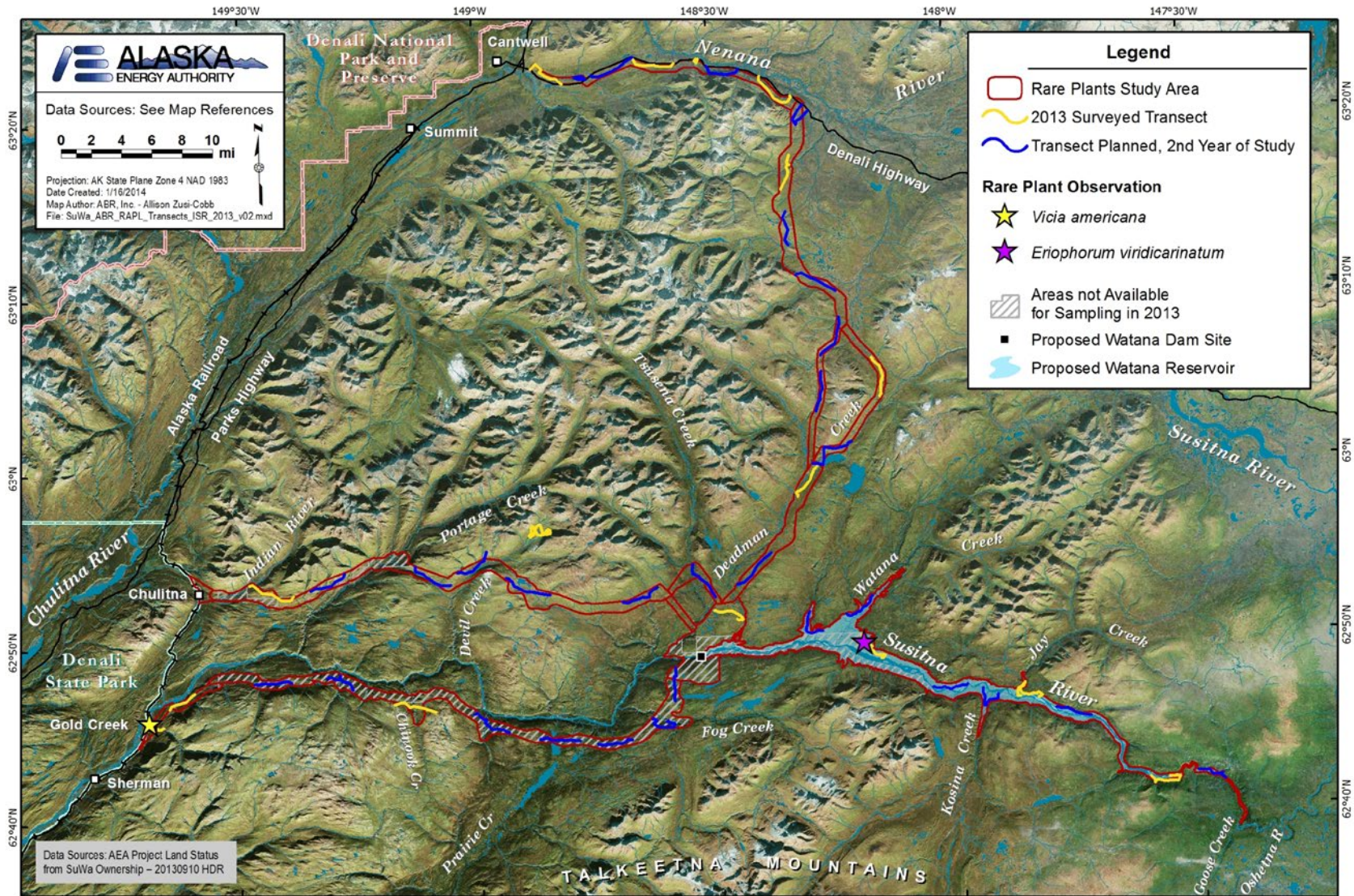


Figure 3-1. Rare Plant Study Area, Transects Allocated and Those Surveyed in 2013, and the Location of Two Rare Plants Found in 2013; VICAMA - *Vicia americana* Muhl. ex Willd. and ERIVIR - *Eriophorum viridicarinatum* (Engelm.) Fernald.

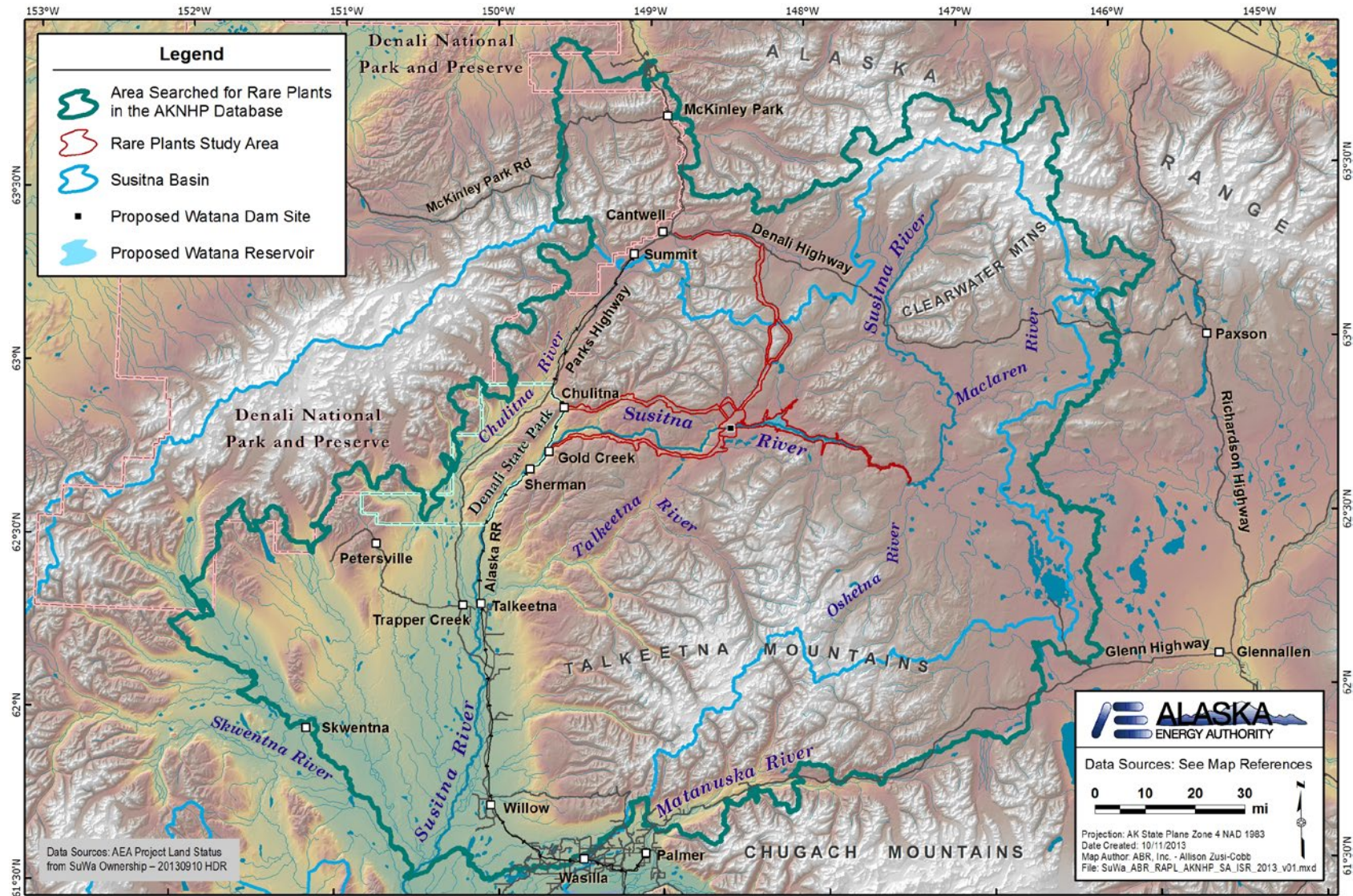


Figure 4.1-1. Regional Subwatershed Area Searched for Rare Vascular Plant Records in the Alaska Natural Heritage Program Biotics Database, 2013.

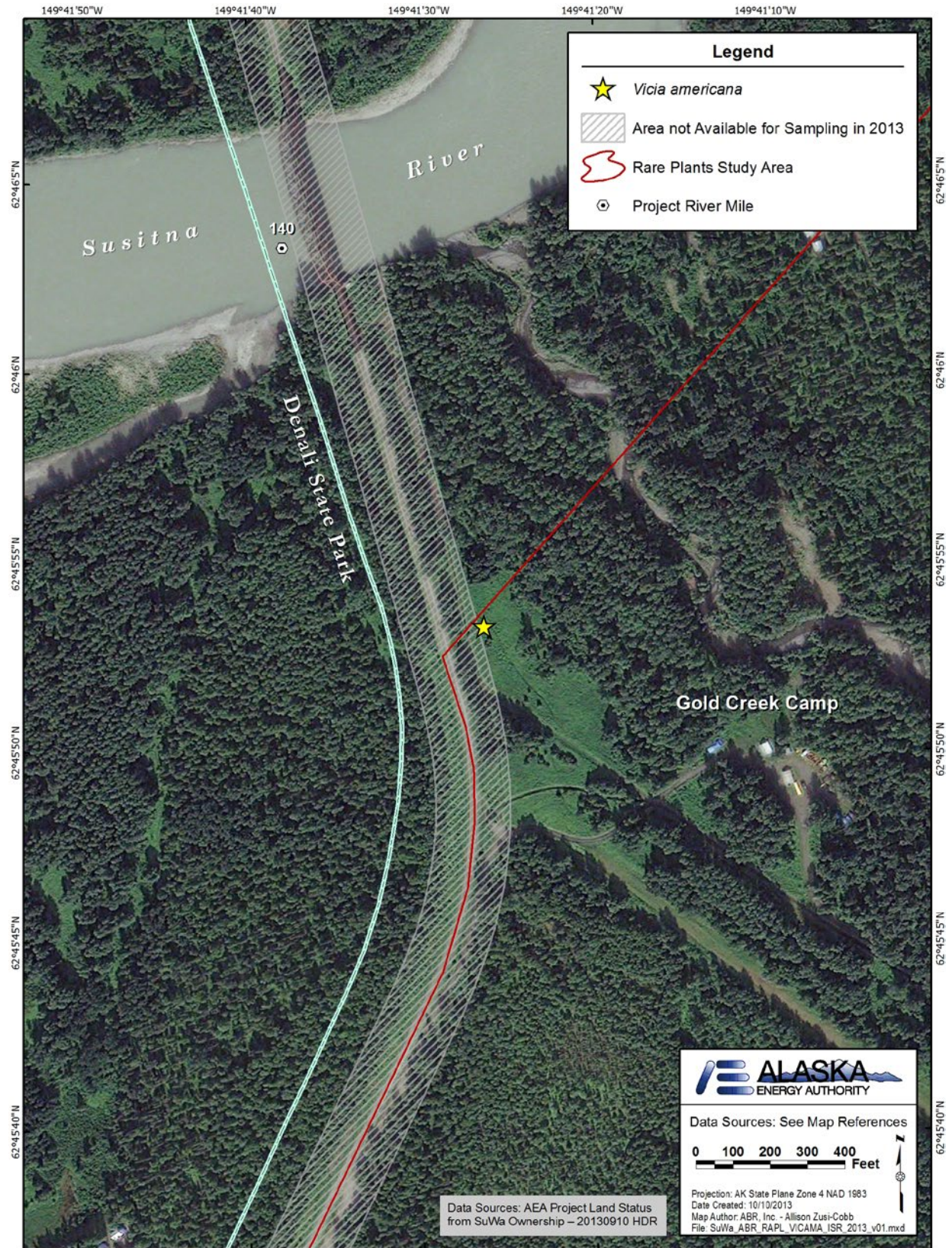


Figure 5-1. Location of *Vicia americana* Muhl. ex Willd. Population, 2013.



(A)



(B)

Figure 5-2. *Vicia americana* Muhl. ex Willd.: (A) Close-up of Plant, (B) Forb Meadow Community Where it was Found, 2013.



Figure 5-3. Location of *Eriophorum viridicarinatum* (Engelm.) Fernald Population, 2013.



(A)



(B)

Figure 5-4. *Eriophorum viridicarinatum* (Engelm.) Fernald: (A) Close-up of Plant, (B) Wet Sedge Meadow Community Where it was Found, 2013.

APPENDIX A: LIST OF ALL VASCULAR PLANT SPECIES FOUND AND FREQUENCY OF OCCURRENCE (NUMBER OF DAYS DETECTED) DURING THE 2013 RARE PLANT SURVEYS; NOMENCLATURE ACCORDING TO NRCS (2013).

Vascular Plant Species	Number of Occurrences	Vascular Plant Species	Number of Occurrences
<i>Achillea millefolium</i>	9	<i>Cardamine pratensis</i>	8
<i>Aconitum delphiniifolium</i>	11	<i>Cardamine purpurea</i>	1
<i>Actaea rubra</i>	1	<i>Carex aquatilis</i>	13
<i>Agrostis scabra</i>	7	<i>Carex atrofusca</i>	1
<i>Alnus viridis</i> ssp. <i>fruticosa</i>	12	<i>Carex aurea</i>	4
<i>Andromeda polifolia</i>	15	<i>Carex bigelowii</i>	14
<i>Androsace chamaejasme</i>	1	<i>Carex canescens</i>	10
<i>Anemone narcissiflora</i>	7	<i>Carex capillaris</i>	2
<i>Anemone parviflora</i>	5	<i>Carex chordorrhiza</i>	3
<i>Anemone richardsonii</i>	13	<i>Carex garberi</i>	1
<i>Angelica lucida</i>	9	<i>Carex glacialis</i>	3
<i>Antennaria alpina</i>	1	<i>Carex lachenalii</i>	3
<i>Antennaria friesiana</i>	6	<i>Carex leptalea</i>	1
<i>Antennaria monocephala</i>	4	<i>Carex limosa</i>	3
<i>Anthoxanthum hirtum</i>	2	<i>Carex livida</i>	2
<i>Anthoxanthum monticola</i> ssp. <i>alpinum</i>	10	<i>Carex maritima</i>	1
<i>Arabis holboellii</i>	2	<i>Carex membranacea</i>	9
<i>Arabis lyrata</i>	1	<i>Carex mertensii</i>	2
<i>Arctagrostis latifolia</i>	7	<i>Carex microchaeta</i>	7
<i>Arctophila fulva</i>	3	<i>Carex microchaeta</i> spp. <i>nesophila</i>	1
<i>Arctostaphylos alpina</i>	12	<i>Carex microglochin</i>	1
<i>Arctostaphylos rubra</i>	8	<i>Carex norvegica</i>	3
<i>Arnica alpina</i>	3	<i>Carex pauciflora</i>	1
<i>Arnica latifolia</i>	2	<i>Carex podocarpa</i>	8
<i>Arnica lessingii</i>	5	<i>Carex rariflora</i>	5
<i>Artemisia arctica</i>	9	<i>Carex rostrata</i>	5
<i>Artemisia frigida</i>	6	<i>Carex rotundata</i>	4
<i>Artemisia tilesii</i>	12	<i>Carex saxatilis</i>	2
<i>Aster alpinus</i> var. <i>vierhapperi</i>	1	<i>Carex scirpoidea</i>	5
<i>Astragalus alpinus</i>	7	<i>Carex spectabilis</i>	1
<i>Astragalus bodinii</i>	3	<i>Carex stipata</i>	3
<i>Astragalus umbellatus</i>	4	<i>Carex stylosa</i>	1
<i>Betula glandulosa</i>	10	<i>Carex tenuiflora</i>	4
<i>Betula nana</i>	12	<i>Carex utriculata</i>	1
<i>Betula neoalaskana</i>	8	<i>Cassiope tetragona</i>	7
<i>Boschniakia rossica</i>	6	<i>Castilleja caudata</i>	3
<i>Boykinia richardsonii</i>	8	<i>Chamaedaphne calyculata</i>	2

Vascular Plant Species	Number of Occurrences	Vascular Plant Species	Number of Occurrences
<i>Calamagrostis canadensis</i>	15	<i>Chamerion angustifolium</i>	14
<i>Calamagrostis stricta</i> ssp. <i>inexpansa</i>	5	<i>Chamerion latifolium</i>	11
<i>Caltha palustris</i>	3	<i>Chrysosplenium tetrandrum</i>	6
<i>Campanula lasiocarpa</i>	7	<i>Cicuta mackenziana</i>	1
<i>Cardamine bellidifolia</i>	2	<i>Claytonia sarmentosa</i>	5
<i>Comarum palustre</i>	12	<i>Eurybia sibirica</i>	7
<i>Cornus canadensis</i>	1	<i>Festuca altaica</i>	12
<i>Cornus suecica</i>	14	<i>Festuca brachyphylla</i>	2
<i>Corydalis pauciflora</i>	1	<i>Festuca rubra</i>	5
<i>Crepis nana</i>	1	<i>Fritillaria camschatcensis</i>	1
<i>Crepis tectorum</i>	1	<i>Galeopsis bifida</i>	3
<i>Cryptogramma sitchensis</i>	1	<i>Galium boreale</i>	6
<i>Dasiphora fruticosa</i>	15	<i>Galium trifidum</i>	6
<i>Delphinium glaucum</i>	5	<i>Galium triflorum</i>	1
<i>Deschampsia cespitosa</i>	3	<i>Gentiana douglasiana</i>	1
<i>Descurainia incana</i>	1	<i>Gentiana glauca</i>	5
<i>Diapensia lapponica</i>	8	<i>Gentiana propinqua</i>	3
<i>Diphasiastrum alpinum</i>	5	<i>Geocaulon lividum</i>	3
<i>Dodecatheon frigidum</i>	13	<i>Geranium erianthum</i>	10
<i>Draba alpina</i>	1	<i>Geum macrophyllum</i>	2
<i>Draba glabella</i>	1	<i>Geum rossii</i>	1
<i>Drosera anglica</i>	2	<i>Glyceria maxima</i>	1
<i>Drosera rotundifolia</i>	2	<i>Glyceria pulchella</i>	4
<i>Dryas octopetala</i>	8	<i>Gymnocarpium dryopteris</i>	6
<i>Dryopteris expansa</i>	9	<i>Harrimanella stelleriana</i>	3
<i>Eleocharis quinqueflora</i>	1	<i>Hedysarum alpinum</i>	7
<i>Elymus alaskanus</i>	4	<i>Heracleum maximum</i>	7
<i>Empetrum nigrum</i>	15	<i>Heuchera glabra</i>	1
<i>Epilobium anagallidifolium</i>	1	<i>Hieracium triste</i>	1
<i>Epilobium palustre</i>	7	<i>Hippuris vulgaris</i>	7
<i>Equisetum arvense</i>	15	<i>Honckenya peploides</i>	1
<i>Equisetum fluviatile</i>	9	<i>Hordeum jubatum</i>	1
<i>Equisetum palustre</i>	4	<i>Huperzia selago</i> var. <i>selago</i>	5
<i>Equisetum pratense</i>	1	<i>Juncus alpinoarticulatus</i> ssp.	2
<i>Equisetum scirpoides</i>	3	<i>Juncus arcticus</i>	2
<i>Equisetum sylvaticum</i>	12	<i>Juncus arcticus</i> ssp. <i>alaskanus</i>	2
<i>Equisetum variegatum</i>	3	<i>Juncus arcticus</i> ssp. <i>littoralis</i>	2

Vascular Plant Species	Number of Occurrences	Vascular Plant Species	Number of Occurrences
<i>Erigeron acris</i>	4	<i>Juncus biglumis</i>	8
<i>Erigeron humilus</i>	3	<i>Juncus castaneus</i>	8
<i>Erigeron peregrinus</i>	2	<i>Juncus castaneus</i> ssp. <i>castaneus</i>	2
<i>Eriophorum angustifolium</i>	14	<i>Juncus castaneus</i> ssp. <i>leucochlamys</i>	2
<i>Eriophorum brachyantherum</i>	1	<i>Juncus filiformis</i>	1
<i>Eriophorum russeolum</i>	10	<i>Juncus stygius</i>	1
<i>Eriophorum scheuchzeri</i>	1	<i>Juncus triglumis</i>	4
<i>Eriophorum vaginatum</i>	4	<i>Juniperus communis</i>	7
<i>Eriophorum viridicarinatum</i>	1	<i>Ledum groenlandicum</i>	7
<i>Euphrasia disjuncta</i>	1	<i>Ledum palustre</i> spp. <i>decumbens</i>	12
<i>Linnaea borealis</i>	13	<i>Pinguicula villosa</i>	4
<i>Lloydia serotina</i>	1	<i>Plantago major</i>	4
<i>Loiseleuria procumbens</i>	11	<i>Platanthera dilata</i>	1
<i>Luetkea pectinata</i>	4	<i>Platanthera hyperborea</i>	4
<i>Lupinus arcticus</i>	2	<i>Poa alpina</i>	5
<i>Lupinus nootkatensis</i>	6	<i>Poa arctica</i>	10
<i>Luzula arcuata</i>	4	<i>Poa glauca</i>	3
<i>Luzula confusa</i>	6	<i>Poa paucispicula</i>	1
<i>Luzula multiflora</i>	7	<i>Poa vivipara</i>	1
<i>Luzula wahlenbergii</i>	4	<i>Polemonium acutiflorum</i>	15
<i>Lycopodium annotinum</i>	7	<i>Polygonum alpinum</i>	4
<i>Lycopodium clavatum</i>	6	<i>Polygonum aviculare</i>	2
<i>Matricaria matricarioides</i>	1	<i>Polygonum bistorta</i>	12
<i>Matteuccia struthiopteris</i>	1	<i>Polygonum viviparum</i>	10
<i>Menyanthes trifoliata</i>	5	<i>Populus balsamifera</i>	11
<i>Mertensia paniculata</i>	14	<i>Populus tremuloides</i>	4
<i>Moehringia lateriflora</i>	2	<i>Potamogeton alpinus</i>	1
<i>Moneses uniflora</i>	6	<i>Potamogeton filiformis</i>	1
<i>Myrica gale</i>	2	<i>Potamogeton foliolosus</i>	1
<i>Myriophyllum sibiricum</i>	1	<i>Potamogeton richardsonii</i>	2
<i>Nuphar lutea</i> ssp. <i>polysepala</i>	1	<i>Potamogeton zosterifolius</i>	2
<i>Oplopanax horridus</i>	2	<i>Potentilla anserina</i> ssp. <i>egedii</i>	4
<i>Orthilia secunda</i>	2	<i>Potentilla biflora</i>	2
<i>Oxyria digyna</i>	4	<i>Potentilla bimundorum</i>	1
<i>Oxytropis maydelliana</i>	1	<i>Potentilla diversifolia</i>	1
<i>Oxytropis nigrescens</i> var. <i>nigrescens</i>	2	<i>Potentilla norvegica</i>	2
<i>Packera cymbalaria</i>	1	<i>Potentilla uniflora</i>	1

Vascular Plant Species	Number of Occurrences	Vascular Plant Species	Number of Occurrences
<i>Packera pauciflora</i>	1	<i>Primula borealis</i>	1
<i>Parnassia kotzebuei</i>	5	<i>Primula egalikensis</i>	2
<i>Parnassia palustris</i>	9	<i>Pyrola asarifolia</i>	7
<i>Parrya nudicaulis</i>	1	<i>Pyrola minor</i>	9
<i>Pedicularis capitata</i>	6	<i>Ranunculus eschscholtzii</i>	2
<i>Pedicularis labradorica</i>	13	<i>Ranunculus gmelinii</i>	5
<i>Pedicularis lanata</i>	3	<i>Ranunculus hyperboreus</i>	5
<i>Pedicularis langsdorffii</i>	3	<i>Ranunculus lapponicus</i>	2
<i>Pedicularis lapponica</i>	2	<i>Ranunculus nivalis</i>	2
<i>Pedicularis verticillata</i>	1	<i>Ranunculus sceleratus</i>	1
<i>Petasites frigidus</i>	12	<i>Ranunculus trichophyllus</i> var.	3
<i>Phleum alpinus</i>	1	<i>Ranunculus uncinatus</i>	2
<i>Phleum pratense</i>	2	<i>Rhodiola rosea</i>	9
<i>Picea glauca</i>	13	<i>Rhododendron lapponicum</i>	2
<i>Picea mariana</i>	6	<i>Ribes glandulosum</i>	1
<i>Ribes hudsonianum</i>	1	<i>Sibbaldia procumbens</i>	4
<i>Ribes laxiflorum</i>	1	<i>Smelowskia borealis</i>	1
<i>Ribes</i> sp.	4	<i>Solidago multiradiata</i>	11
<i>Ribes triste</i>	7	<i>Sorbus scopulina</i>	2
<i>Rorippa islandica</i>	2	<i>Sparganium angustifolium</i>	1
<i>Rosa acicularis</i>	13	<i>Sparganium hyperboreum</i>	2
<i>Rubus arcticus</i>	13	<i>Sparganium natans</i>	2
<i>Rubus chamaemorus</i>	14	<i>Spiraea stevenii</i>	15
<i>Rubus idaeus</i>	5	<i>Spiranthes romanzoffiana</i>	3
<i>Rumex acetosa</i>	2	<i>Stellaria crassifolia</i>	7
<i>Rumex arcticus</i>	12	<i>Stellaria longipes</i>	8
<i>Salix alaxensis</i>	10	<i>Stellaria media</i>	1
<i>Salix arbusculooides</i>	4	<i>Streptopus amplexifolius</i>	4
<i>Salix arctica</i>	7	<i>Swertia perennis</i>	11
<i>Salix barclayi</i>	5	<i>Taraxacum officinale</i>	4
<i>Salix barrattiana</i>	1	<i>Taraxacum officinale</i> ssp.	2
<i>Salix bebbiana</i>	3	<i>Taraxacum phymatocarpum</i>	2
<i>Salix fuscescens</i>	9	<i>Tephrosia atropurpurea</i>	4
<i>Salix glauca</i>	7	<i>Thalictrum alpinum</i>	4
<i>Salix hastata</i>	9	<i>Thalictrum sparsiflorum</i>	7
<i>Salix ovalifolia</i>	1	<i>Tofieldia coccinea</i>	2
<i>Salix pulchra</i>	13	<i>Tofieldia pusilla</i>	9

Vascular Plant Species	Number of Occurrences	Vascular Plant Species	Number of Occurrences
<i>Salix reticulata</i>	9	<i>Trichophorum alpinum</i>	1
<i>Salix richardsonii</i>	7	<i>Trichophorum cespitosum</i>	6
<i>Salix rotundifolia</i>	1	<i>Trientalis europaea</i>	9
<i>Salix stolonifera</i>	1	<i>Trifolium repens</i>	1
<i>Sambucus racemosa</i>	2	<i>Triglochin palustris</i>	4
<i>Sanguisorba canadensis</i>	12	<i>Trisetum spicatum</i>	8
<i>Sanguisorba officinalis</i>	1	<i>Urtica dioica</i> spp. <i>gracilis</i>	2
<i>Saussurea angustifolia</i>	9	<i>Utricularia intermedia</i>	2
<i>Saxifraga bronchialis</i>	2	<i>Utricularia macrorhiza</i>	1
<i>Saxifraga hieraciifolia</i>	2	<i>Vaccinium ovalifolium</i>	2
<i>Saxifraga hirculus</i>	1	<i>Vaccinium oxycoccos</i>	5
<i>Saxifraga nelsoniana</i> ssp. <i>pacifica</i>	7	<i>Vaccinium uliginosum</i>	15
<i>Saxifraga reflexa</i>	1	<i>Vaccinium vitis-idaea</i>	13
<i>Saxifraga serpyllifolia</i>	1	<i>Valeriana capitata</i>	13
<i>Saxifraga tricuspidata</i>	6	<i>Veratrum viride</i>	4
<i>Scheuchzeria palustris</i>	1	<i>Veronica wormskjoldii</i>	4
<i>Senecio congestus</i>	1	<i>Viburnum edule</i>	4
<i>Senecio lugens</i>	6	<i>Vicia americana</i>	1
<i>Senecio triangularis</i>	1	<i>Viola biflora</i>	1
<i>Shepherdia canadensis</i>	9	<i>Viola epipsila</i>	7
Vascular Plant Species	Number of Occurrences		
<i>Viola</i> sp.	9		
<i>Woodsia glabella</i>	2		
<i>Woodsia ilvensis</i>	3		
<i>Zigadenus elegans</i>	3		

APPENDIX B: HABITAT CHARACTERISTICS FOR THE TWO RARE PLANT SPECIES FOUND IN THE RARE PLANT STUDY AREA IN 2013.

Plant Life-form/Ground Cover	Percent Areal Cover	
	<i>Eriophorum viridicarinatum</i> Habitat	<i>Vicia Americana</i> Habitat
Low shrubs	1	0
Erect dwarf shrubs	+	0
Prostrate dwarf shrubs	1	0
Evergreen shrubs	+	0
Deciduous shrubs	1	0
Erect forbs	0	95
Non-tussock graminoids	50	1
Fruticose lichen	+	0
<i>Pleurocarpus</i> bryophytes	25	5
<i>Acrocarpus</i> bryophytes/Liverworts	0	0
Horsetails	0	+
Rocks	0	0
Bare soil/Salt crust	0	0
Water	15	0
Total dead vegetation	30	5
Canopy/Relief	Height (cm)	
Vegetation canopy	25	60
Microrelief	10	0

Site Characteristic	<i>Eriophorum viridicarinatum</i> Habitat	<i>Vicia Americana</i> Habitat
Landform	residual plain	abandoned alluvial plain
Surficial geology/parent material	lacustrine organic deposits	stabilized alluvium
Surficial geomorphology	small wetland hummocks	featureless
Site moisture	subhygric	mesic
Soil moisture	very saturated	moist to wet
Glacial geology	bedrock with subsequent deposition	reworked alluvial till
Topographic position	flat	flat
Estimated snow duration	snow free immediately after melt-out	snow free immediately after melt-out
Disturbance degree	none	disturbed more than once/year
Disturbance type	none	human activities including clearing, vehicle traffic and walking
Stability	stable	stable
Exposure	moderate exposure to wind	protected from winds

Plant Species	Areal Cover Category (r = rare, + = common, 1 = 1–5%, 2 = 6–25%, 3 = 26–50%)	
	<i>Eriophorum viridicarinatum</i> Habitat	<i>Vicia Americana</i> Habitat
<i>Picea glauca</i>	1	
<i>Vaccinium uliginosum</i>	1	
<i>Andromeda polifolia</i>	1	
<i>Salix fuscescens</i>	1	
<i>Ledum groenlandicum</i>	+	
<i>Carex lividum</i>	3	
<i>Eriophorum viridicarinatum</i>	1	
<i>Carex aquatilis</i>	1	
<i>Carex limosa</i>	+	
<i>Eriophorum angustifolium</i>	+	
<i>Eriophorum russeolum</i>	+	
<i>Triglochin palustre</i>	+	
Unknown green and black wetland moss	2	
<i>Drepanocladus</i> spp.	+	
<i>Cladonia pocillum</i>	+	
<i>Heracleum maximum</i>		3
<i>Chamerion angustifolium</i>		3
<i>Vicia americana</i>		1
<i>Ranunculus bongardi</i>		1
<i>Angelica lucida</i>		+
<i>Taraxacum officinale</i>		+
<i>Dryopteris expansa</i>		+
<i>Urtica lyallii</i>		+
<i>Mertensia paniculata</i>		+
<i>Equisetum arvense</i>		+
<i>Geranium erianthum</i>		+
<i>Galeopsis bifida</i>		+
<i>Viola epipsela</i>		+
<i>Delphinium glauca</i>		+
<i>Carex stipata</i>		+
Unknown <i>Pleurocarpus</i> moss		1