Pebble Project
Environmental Baseline Document
2004 through 2008

CHAPTER 13.
VEGETATION
Bristol Bay Drainages

PREPARED BY:

THREE PARAMETERS PLUS, INC.
HDR ALASKA, INC.

TABLE OF CONTENTS

LIST OF TABLES (following Section 13.2.10)

LIST OF FIGURES (following tables)

LIST OF APPENDICES (following figures)

ACRONYMS AND ABBREVIATIONS

3PPI	Three Parameters Plus, Inc.
AKNHP	Alaska Natural Heritage Program
GIS	geographic information system
GPS	global positioning system
HDR	HDR Alaska, Inc.
LIDAR	light detection and ranging
PDA	personal data assistant
QC	quality control
RDI	Resource Data, Inc.
User's Guide	*User's Guide for Bristol Bay Land Cover Maps* (Wibbenmeyer et al., 1982)
USGS	U.S. Geological Survey

13. VEGETATION

13.1 Vegetation—Mine Study Area

13.1.1 Introduction

This section describes the dominant vegetation types (referred to herein as Project Vegetation Types), including typical plant-species composition and vegetation structure, in the mine mapping area in the mine study area for Pebble Project. In addition to descriptions of the Project Vegetation Types found at wetland determination study plots, this section describes the protocols used to produce a map of vegetation types in the mine mapping area. The Project Vegetation Types are based on standard vegetation-classification systems applicable to the Bristol Bay region of Alaska that have been modified to accommodate limitations to interpretation of available aerial imagery. Field crews collected data in the mine study area during the 2004 through 2008 field seasons. Similar studies were conducted in the transportation-corridor study area (Section 13.2) and in the Cook Inlet drainages study area (Chapter 38).

The vegetation studies overlap with and provide support for the chapters that address wetlands (Chapters 14 and 39) and terrestrial wildlife-habitat mapping (Chapters 16 and 41).

13.1.2 Study Objectives

The primary objective of the vegetation study was to describe the predominant vegetation types found in the mine study area. More specifically, the objectives of the vegetation study were as follows:

- Customize an existing vegetation-classification system to include Project Vegetation Types amenable to photo-interpretation (i.e., identification of vegetation types in photographs, particularly aerial photographs).
- Provide descriptions of Project Vegetation Types, including dominant and/or characteristic plant species composition and vegetation structure.
- Map Project Vegetation Types.
- Compile and document information on plant species observed at the study plots, including incidental observations of the following types of plant species:
  - Nonvascular plant species (e.g., moss and lichen).
  - Species considered rare according to the Alaska Natural Heritage Program (AKNHP).
  - Species that are considered weeds by the Alaska Committee for Noxious and Invasive Plants Management.

13.1.3 Study Area

The eastern edge of the Upper Talarik Creek watershed serves as the dividing line between the transportation-corridor study area (Section 13.2) and the mine study area. The mine study area (Figure 13.1-1a) encompasses the North Fork Koktuli watershed, the South Fork Koktuli River watershed, and the Upper Talarik Creek watershed. The study area also includes the headwaters areas of Kaskanak Creek and Lower Talarik Creek, and the Koktuli River watershed to approximately 4 miles downstream of the confluence of the north and south forks of the Koktuli River. The mine mapping area is a smaller area within the mine study area (Figure 13.1-1a) for which the data have been reviewed for quality and mapped.

Descriptions of the climate and physiography in the mine study area can be found in Chapters 2 and 4, respectively.

Several Native corporations and the State of Alaska own land within the mine study area. Land owners granted access for data collection.

13.1.4 Previous Studies

Prior to initiating field studies, existing documents that had relevance to vegetation mapping in the study area were identified.

The mine study area is located at the southern end of both the Yukon-Kuskokwim Highlands Major Land Resource Area (USDA NRCS, 2004) and the Lime Hills Ecoregion (Nowacki et al., 2001). The published descriptions of the vegetation in these areas are consistent with the predominant vegetation in the mine study area. Like the mine study area, the description of the Yukon-Kuskokwim Highlands includes alder and willow stands, low ericaceous shrubs, low shrub birch scrub, and various sedges and grasses including tussock-forming species. At higher elevations with shallow soils, lichen-dominated dwarf alpine scrub and bare ground are common (USDA NRCS, 2004). Similarly, the vegetation of the Lime Hills region is notable for the predominance of tall and low shrub communities consisting of birch, willow, and alder. Forests and woodlands generally are restricted to valley bottoms and toe slopes (Nowacki et al., 2001).

The *User's Guide for Bristol Bay Land Cover Maps* (referred to herein as the "User's Guide"; Wibbenmeyer et al., 1982) is a document that was deemed particularly relevant to the Pebble Project vegetation study. The User's Guide was initiated in 1981 as a cooperative data-collection and mapping effort between several government agencies and representatives of the Bristol Bay Borough and the Bristol Bay Coastal Resource Service Area to provide data for the Bristol Bay Cooperative Management Plan (ADNR, 1982). The land-cover mapping categories in the User's Guide were based on *The Revision of the Preliminary Classification System for the Vegetation of Alaska* (Viereck et al., 1981, as cited in ADNR, 1982). These categories were intended to describe land-cover classes that could be reliably recognized through the interpretation of Landsat data. Originally conceived to map land-cover classes within the Bristol Bay Coastal Zone, the project was subsequently expanded to include the entire Bristol Bay region.

13.1.5 Scope of Work

Researchers from two consulting firms, Three Parameters Plus, Inc. (3PPI), and HDR Alaska, Inc. (HDR), characterized the Project Vegetation Types as part of the wetland studies program described in Chapter 14. 3PPI collected data in the mine study area and in the transportation-corridor study area east of the Newhalen River. HDR collected data in the entire transportation-corridor study area and along the lower end of Upper Talarik Creek (in the mine study area). Although there was some overlap between the areas where the two companies collected data, all data for the mine study area are presented in this section prepared by 3PPI, and all data for the transportation-corridor study area are presented in Section 13.2 prepared by HDR, regardless of who collected the data.

The research and field work for this study were conducted from 2004 through 2008. Data analysis and mapping were started after the first field season concluded in 2004. The scope of work for the vegetation study includes the following elements:

- Review existing information on the study area and evaluate its usefulness for characterizing the study area vegetation.
- Collect vegetation data during wetland determinations at locations representing the diversity of vegetation, landforms, slope angles, and aspects found in the study area. Use methods that are typical for characterizing vegetation for the purpose of wetland determinations (Chapter 14).
- Correlate "signatures" on aerial photographs to vegetation observed on the ground and create a Project Vegetation Type photo signature guide (3PPI, 2006, 2007, 2008) for use during mapping.
- Enter field data, including site photographs and geographic coordinates of field plots, into the Pebble Project relational database and verify its accuracy.
- In the geographic information system (GIS) for Pebble Project, on an orthorectified aerial photograph base, draw boundaries between different vegetation types and create mapping polygons based on these differences.
- Using field data, the Project Vegetation Type photo signature guides, and other GIS layers as supporting information, assign attributes to each digitized polygon with the correct Project Vegetation Type to produce vegetation mapping. In addition, identify any areas with human-disturbed vegetation by coding the polygons representing those areas as "disturbed."
- Compile and document information on plant species observed at the study sites, including incidental observations of nonvascular plant species (e.g., moss and lichen), species considered rare by AKNHP, and species considered weeds by the Alaska Committee for Noxious and Invasive Plants Management.
- Prepare a document that describes the study and the Project Vegetation Types found in the vegetation mapping area (this report).

13.1.6 Methods

13.1.6.1 Literature Review

A literature search was conducted to identify reports and technical documents with relevant information about the mine study area and surrounding areas. Libraries, government agencies, and other data sources in the Anchorage area provided reference materials. In addition, information was obtained from online sources. The data sets that were identified are described below.

13.1.6.2 Compilation of Digital Data Sets

The review of existing data resulted in the creation of project-specific GIS layers for the mine study area. In addition, Pebble Partnership commissioned several captures of aerial imagery. The following data sets were compiled by Resource Data, Inc. (RDI), for digital presentation and review for this study:

- National Wetlands Inventory mapping (from the U.S. Fish and Wildlife Service, orthorectified and digitized from paper maps by RDI).
- U.S. Geological Survey (USGS) topographic mapping.
- Land-cover mapping from the Earth Resources Observation System and vegetation and land-cover types from the USGS associated with the *User's Guide for Bristol Bay Land Cover Maps* (Wibbenmeyer et al., 1982).
- Vegetation mapping and cover classes found on the National Park Service website for Lake Clark National Park and Preserve.
- Exploratory soil-survey data (from the U.S. Department of Agriculture, Natural Resources Conservation Service).
- Land-ownership information (from the Alaska Department of Natural Resources, with contributions from the Bureau of Land Management and the U.S. Census Bureau).
- Color infrared photographs from the National Aeronautics and Space Administration, orthorectified by Aero-Metric, Inc., at a scale of 1:60,000. The dates of the imagery are August 1978 and August 1982, depending on the location.
- Aerial photographs acquired by Aero-Metric, Inc., in October of 2004 and 2005 captured at a scale of 1:8,000 for the mine study area. These aerial photographs were orthorectified at a scale of 1.5-foot pixels and were used for analysis and interpretation in the GIS.
- Color aerial photographs acquired by Eagle Mapping at 1:20,000 for the mine study area. These aerial photographs were orthorectified at a scale of 1.5-foot pixels.
- Light detection and ranging (LIDAR) imagery acquired by Aero-Metric, Inc., in October 2004, October 2005, and August 2008 was used to produce a GIS layer of 4-foot contour lines for the study area. The Eagle Mapping data also included 2-foot-interval LIDAR imagery.
- Aerial photographs of the mine study area acquired in September 2008. The aerial photographs (1:20,000 scale) were orthorectified by Dudley Thompson Mapping Corporation Inc. at a scale of 1.0-foot pixels. A more detailed version (1:4,800 at a scale of 0.25-foot pixels) was also produced for the southern portion of the mine study area. This imagery was not used during quality control

(QC) review of field data forms or during delineation of vegetation mapping polygons, but was used to differentiate between alder and willow stands on the vegetation map during the map QC review.

A GIS spatial data set was constructed from the above sources. The 2004 and 2005 orthophotographs are the basemap for the vegetation and wetland studies.

13.1.6.3 Field Data Collection

Vegetation field data were collected as part of the field work for the wetland study. Data were collected following the procedures described in the study plan for wetlands (see Appendix E of this environmental baseline document).

Study Site Selection

Study sites were selected primarily to assist in the identification and mapping of wetlands. Additional goals in the selection of study sites were to ensure data collection from each aerial photo signature and in each Project Vegetation Type across the full range of landscape positions and soil types found in the study area. In later study years, priority was given to study sites in areas where vegetation signatures were unclear on photographic imagery or were underrepresented during the previous sampling, in areas with complex wetland and non-wetland boundaries, and in areas where multiple sample points could efficiently be accessed.

Types of Study Sites

At detailed-data collection plots, plant species composition and abundance were recorded within representative stands of vegetation. (Detailed-data collection plots are the study sites termed wetland determination plots and functional assessment plots for the wetlands study [Chapter 14].) Vegetation data collected at each 1/10th-acre plot generally included percent coverage of all observed vascular plant species and estimated tree height and diameter at breast height. Percent coverage for each vascular plant species was estimated visually, and species with less than 3 percent coverage were recorded as trace. In many plots, coverage estimates for mosses and lichens also were recorded, along with their names, if known. This information was used to refine Project Vegetation Types and to facilitate interpretation of photo signatures. Aerial photographs in the mine study area did not always provide the clarity needed to distinguish alders from willows or low canopies from tall canopies; therefore, in shrub communities, data were collected at shrub height plots to supplement the data collected at wetlands determination plots. The dominant types of shrubs were recorded at these shrub height plots, but data on the understory plants in the plot were not. At limited-data collection plots, the focus of sampling was to document the sites' vegetation type with photographs. (Limited-data collection plots are the study sites termed representative upland, representative wetland, waterbody, and stream crossing photo points or other supplemental plots [Chapter 14].) Data collection at limited-data collection plots was limited to taking photographs and collecting minimal physical site data (e.g., landscape position, macro- and microtopography, and very basic water chemistry). Limited-data collection plots also were used to document species being tracked by the AKNHP (see the section below on Tracked Species).

Field Technology

At each detailed data-collection site, scientists determined and recorded the global positioning system (GPS) coordinates for the site; took photographs of the dominant vegetation, soils, and/or landscape features; entered key site attributes into a digital recording device; marked the site location on a field map; and recorded other key information on hardcopy data forms. From 2004 through 2007, scientists used imaging systems equipped with digital cameras and GPS units (accuracy less than 50 feet) to record a subset of the field data, to watermark pictures with latitude and longitude, and to provide a direct interface to the GIS. In 2008, 3PPI researchers began using personal data assistant (PDAs) with a custom ArcPad script to capture the most critical data types needed at each plot type. The PDAs are technologically advanced units with GPS (accuracy less than 3 feet) and cameras and capable of full integration with GIS products via an ArcPad platform. RDI developed downloading procedures to efficiently process these data into the existing web-based database application.

Beginning in 2007, HDR scientists used an alternative system for capture of digital data in part of the study area (see Section 13.1.5). They used cameras equipped with a built-in GPS unit (accuracy 3 to 15 feet) for capture of photographs and later watermarking with location data. They collected site data in hand-held computers linked to GPS receivers by Bluetooth technology, providing accuracy within 6.5 to 16 feet. The hand-held computers were equipped with ArcPad 7.1 and linked with ArcGIS software for downloading to office computers.

Investigators from both firms used backup digital cameras, GPS units, and hand-recorded field notes if their primary systems failed.

Vegetation Characterization

Numerous taxonomic references and field guides, including those listed below, were used to identify trees, shrubs, forbs, and graminoids over the course of field surveys.

- *Alaska Trees and Shrubs* (Viereck and Little, 1972).
- *Flora of Alaska and Neighboring Territories: A Manual of Vascular Plants* (Hultén, 1968).
- *Plants of the Pacific Northwest Coast* (Pojar and MacKinnon, 1994).
- *Plants of the Western Boreal Forest and Aspen Parkland* (MacKinnon et al., 1995).
- *Willows of Southcentral Alaska* (Collet, 2002).
- *Willows of Interior Alaska* (Collet, 2004).
- *Wetland Sedges of Alaska* (Tande and Lipkin, 2003).
- *Flora of North America*, Volume 23: *Cyperaceae*, and Volumes 24 and 25: *Poaceae* Parts 1 and 2 (Flora of North America Editorial Committee, 2002, 2007, and 2003, respectively).

During the spring of 2006, scientists reviewed the vegetation field data collected to that time and developed Project Vegetation Types. The Project Vegetation Types were developed to ensure that vegetation mapping was consistent for all study areas and among all consultants. Vegetation types that could not be easily distinguished from each other on aerial photographs were combined in the Project Vegetation Types. Vegetation types that were common in the study areas but were not well described by

the *User's Guide for Bristol Bay Land Cover Maps* (Wibbenmeyer et al., 1982) or in *The Alaska Vegetation Classification* (Viereck et al., 1992) were refined and added to the list of Project Vegetation Types.

Before the 2006 field season, 3PPI produced the first draft vegetation type photo signature guide (3PPI, 2006). This photo signature guide included a cross-reference between Project Vegetation Types, vegetation classes from the User's Guide (Wibbenmeyer et al., 1982), and Viereck Level IV types (Viereck et al., 1992). In June 2007 and May 2008, the photo signature guide was updated to include new Project Vegetation Types/codes that had been characterized as the study areas expanded (3PPI, 2007, 2008). These new Project Vegetation Types/codes were developed in collaboration with HDR.

Project Vegetation Types frequently were named for the species that dominated the principal vegetation stratum in study plots for the Project Vegetation Type. For example, for the Project Vegetation Type Open White Spruce Forest, white spruce trees dominated the tree stratum. Project Vegetation Types that are not named for specific species (e.g., Closed Broadleaf Forest or Open Mixed Forest) may have more than one dominant species in the principal vegetation stratum. Dominant species are those species that are predominant in their stratum (tree, shrub, or herb) in a given study plot based on percent coverage (as determined by the 50/20/20 rule, which is described in detail in Chapter 14).

Tracked Species

Documentation of vascular plant species that are tracked by the AKNHP was not included in the scope of work for 2004 and 2005; however, some incidental observations of plants on the AKNHP vascular plant tracking list were noted in the Bristol Bay drainages (see AKNHP Sensitive Species Ranking in Appendix 13.1A).

The AKNHP vascular plant tracking list (AKNHP, 2008) includes more than 300 vascular plant species that AKNHP considers rare within Alaska. AKNHP ranks the species with a code that describes their population status on a global level (G-rank) and on a statewide level (S-rank). The status levels are ranked on a scale from one to five, where five is a common species with demonstrably secure populations, and one is a critically imperiled species whose populations are vulnerable to extirpation or extinction. If the level is uncertain, it is described with a range of two rankings (for example, S2S3) or with a ranking followed by a question mark (for example, G5?). Taxonomic uncertainty is indicated by the letter Q following the ranking (for example, G1Q).

As noted above, researchers occasionally encountered plant species on the AKNHP tracking list during vegetation sampling. These incidental observations often were supported by collecting a plant sample for species verification by an herbarium (voucher specimen), taking photographs of identifying traits, and collecting additional data to be used for reporting species of interest. However, scientists collected voucher specimens only if they deemed the species population large enough to support loss of a specimen without endangering the population.

Voucher specimens of putative rare species were forwarded to the University of Alaska, Fairbanks, herbarium for final taxonomic review and archiving. Final taxonomic review has not been completed for all collected specimens; thus the draft list of plant species observed in the mine mapping area (Appendix 13.1A) includes unverified reports of tracked species in the mapping area. In addition, if no voucher specimens or diagnostic photographs were obtained, plant identification cannot be officially confirmed.

13.1.6.4 Data Entry

Data from the PDA and digital-camera GPS systems, field forms, and field notebooks were uploaded or typed into a web-based relational database. All data were related to the associated plot's location in a GIS, which is managed by RDI. As plot locations were generated in the GIS upon uploading, some fields of the database were auto-populated with information drawn from geographic information already in the database, such as quadrangle names and section numbers. Upon completion of the data entry and applicable QC processes, data become available in the GIS for use in vegetation and wetland mapping and development of the list of observed plant species (Appendix 13.1A).

The vegetation data recorded on field forms were used to assign final Project Vegetation Types in the project database. Because field data collection was refined and standardized in minor ways through the years of field study, certain data were re-interpreted and modified in the office during QC reviews to maximize data consistency and usefulness. In particular, because the vegetation classification system was refined as data were collected, scientists reviewed vegetation types assigned in the field in early years and sometimes reassigned Project Vegetation Types according to the investigators' current shared understanding of those types (see the section on Vegetation Characterization above).

13.1.6.5 Digital Mapping

Aerial imagery was acquired several times during collection of baseline data (see Section 13.1.6.2). The 2004 and 2005 orthophotography with 4-foot contours, derived from the aerial photography and LIDAR imagery, became the basemap for the vegetation and wetland studies.

The vegetation map was drawn to a scale ranging between 1:1,200 and 1:1,500, and open water was drawn at 1:400 in ArcGIS.

Project vegetation codes listed in the draft project photo signature guides (3PPI, 2006, 2007, 2008) were assigned to the vegetation mapping polygons using available field data, including site photographs.

Field data were accessible in the relational database during mapping to assist in interpreting and assigning Project Vegetation Types to polygons. Scientists determined vegetation types on the photographs using the project photo signature guide, field data collected within a given polygon, and/or field data for nearby polygons with similar photo signatures and landscape positions. For individual study sites, the data collected in the field may appear not to match the final Project Vegetation Type assigned to that area. Such discrepancies may be the result of heterogeneity of vegetation that cannot always be reliably detected in or practically mapped from aerial photographs.

13.1.7 Results and Discussion

13.1.7.1 Project Vegetation Types

Researchers collected data at 16,947 limited-data collection sites, shrub heights, and detailed-data collection study sites in the mine study. Data on plant species composition and percent coverage were collected in more than 5,000 detailed-data collection plots in the mine study area (Figure 13.1-1b) and analyzed to develop a project vegetation classification system applicable to the Bristol Bay region of Alaska. This classification system developed for the Pebble Project was based on existing vegetation

classification systems and was modified to accommodate interpretation of available aerial imagery in the mine study area. Currently, 47 Project Vegetation Types have been defined for the mine study area and the transportation-corridor study area (three additional Project Vegetation Types have been defined for the Cook Inlet drainages study area [Chapter 38]). (The Project Vegetation Types include four types of land cover that are sparsely vegetated or unvegetated, i.e., Partially Vegetated, Barren, Open Water, and Snow.) Photographs and descriptions of typical vegetation characteristics for each Project Vegetation Type for the Bristol Bay drainages (mine and transportation-corridor study areas) are provided in Appendix 13.1B; however, the Closed Alder Low Shrub and Snow types were mapped but were not sampled or photographed and, therefore, are not included in Appendix 13.1B.

In the mine mapping area, 45 Project Vegetation Types were identified (Tables 13.1-1 through 13.1-3). Of these, 39 were fully sampled in conjunction with the wetland surveys. Three Project Vegetation Types—Barren, Open Water, Aquatic Herb—were identified in the mine mapping area only at limited-data collection plots, where no samples were collected. The other three Project Vegetation Types—Dwarf White Spruce Scrub, Mixed Forest Woodland, and Open Sweetgale Graminoid Bog—were uncommon in the mine mapping area and were not sampled there.

The descriptions of Project Vegetation Types provided in Tables 13.1-1 through 13.1-3 are based on data collected from 3,300 detailed-data collection plots in the smaller mine mapping area. When compiling these data, scientists included data that had undergone QC review and where species composition and abundance data for dominant and non-dominant species were collected. The plants found most frequently in the mine mapping area are listed in Appendix 13.1C.

Information on physical site characteristics (e.g., landscape position, macro- and microtopography) typically associated with each vegetation type generally is not presented in this section because this information has not been through QC review. Data on nonvascular plants were collected opportunistically and generally were not keyed to species; therefore, they are only occasionally included in the discussion below.

13.1.7.2 Vegetation Mapping

Forty-five vegetation types are represented in the 127,773.9 acres mapped in the mine mapping area (Table 13.1-4, Figure 13.1-2). These include forested types (the dominant growth form consists of trees at greater than ten percent cover), shrub types (the dominant growth form are multi-stemmed woody plants), herbaceous types (dominated by plants whose stem does not produce woody, persistent tissue and generally dies back at the end of each growing season), and unvegetated or sparsely vegetated areas ("land cover" types).

The forest types accounted for 0.33 percent of the mine mapping area. Of the nine forest types, two accounted for 71.2 percent of the forest cover: White Spruce Woodland (0.10 percent of the mine mapping area) and Open Broadleaf Forest (0.14 percent of the mine mapping area). The shrub types accounted for 81 percent of the mine mapping area (Table 13.1-4). Of the 25 shrub types, four accounted for more than 50 percent of the mine mapping area: Dwarf Ericaceous Shrub Tundra, 38.25 percent; Dwarf Ericaceous Shrub Lichen Tundra, 10.12 percent; Open Willow Low Shrub, 6.25 percent; and Closed Alder Tall Shrub, 4.05 percent. The herbaceous types accounted for 8.92 percent of the mine mapping area. Of the seven herbaceous types, Bluejoint Tall Grass (2.27 percent), Bluejoint Herb (2.28 percent), and Subarctic Sedge Moss Wet Meadow (3.37 percent) were most common. The land-cover

types accounted for almost 10 percent (9.72 percent) of the mine mapping area, with two of the four types accounting for 8.08 percent of the mine mapping area: Partially Vegetated (5.55 percent) and Open Water (2.53 percent).

For clearer display on maps, the 45 Project Vegetation Types were aggregated into 10 vegetation structure types. The groupings were based on the dominant growth form described above (forested, shrub, or herbaceous), vegetation density (open or closed canopy), and average height (dwarf, low, or tall; Table 13.1-5, Figure 13.1-3). The nine forested types shown in Table 13.1-4 were condensed into one grouped forested type: Open/Closed Forest. The 25 shrub types in the table were condensed into five grouped shrub types: Open Tall, Closed Tall, Open Low, Closed Low, and Dwarf Shrub. The seven herbaceous types were condensed into two grouped herbaceous types: Dry to Moist, and Wet Herbaceous. In addition, the four land cover types were grouped into two land cover types; Water and Other.

Upon examining the abundance of each of the 10 grouped vegetation types, it is evident that the dwarf shrub group accounted for 52.9 percent of the mine mapping area, while the open low shrub group and the closed tall shrub group accounted for 13.1 percent and 9.7 percent, respectively, of the mine mapping area (Table 13.1-5). The dry to moist herbaceous group covered 5.2 percent of the mine mapping area, while the wet herbaceous group covered 3.7 percent of the area. The forested group covered only 0.3 percent of the mine mapping area, mostly towards the eastern edge of the mapping area (Figure 13.1-3). Open water covered 2.5 percent of the mine mapping area.

13.1.7.3 Ecological Zone

The mine study area is within a continental climate characteristic of interior Alaska, from relatively gentle topography into steep mountain terrain. This summary is based on scientists' observations in the field and visual review of the mapping.

Low Scrub Shrub

The mine study area consists of one ecological zone and supports predominantly a dense low or dwarf (5 feet tall or less) shrub understory, with woodlands forming along the eastern boundary. The topography consists of large glaciated valleys, high mountains (Sharp, Groundhog, Kaskanak, and Koktuli Mountains), and riparian corridors along the major rivers. Water collects in ponds and lakes on a variety of landforms. In general, the vegetation of the low scrub shrub ecological zone is made up of dwarf ericaceous (heath family) shrubs, willows and alders (Project Vegetation Types: Dwarf Ericaceous Shrub Dwarf Ericaceous Shrub Lichen Tundra, Open Willow Low Shrub, and Closed Alder Tall Shrub).

Dwarf ericaceous shrubs and barren patches cover the mountain tops (Project Vegetation Types: Dwarf Ericaceous Shrub, Dwarf Ericaceous Shrub Lichen Tundra, Partially Vegetated, Bare, Snow). Mountain hillsides are covered with tall shrubs (Project Vegetation Types: Open and Closed Alder Tall Shrub, Open and Closed Alder Willow Tall Shrub, Open Willow Tall Shrub), interspersed with low willow stands and patches of bluejoint grass or wet sedge and shrub meadows (Project Vegetation Types: Open Willow Low Shrub, Open Willow Low Shrub Fens, Bluejoint Tall Grass, Bluejoint Tall Grass – Herb, Subarctic Sedge Moss Wet Meadow, Ericaceous Shrub Bog).

Dwarf ericaceous shrubs cover the dry, gravelly glacial terraces, while bluejoint grasses line numerous swales (Project Vegetation Types: Dwarf Ericaceous Shrub, Dwarf Ericaceous Shrub Lichen Tundra, Bluejoint Tall Grass, Bluejoint Tall Grass – Herb).

The North Fork and South Fork Koktuli Rivers and Upper Talarik Creek drain the mine study area. These riparian areas are often populated by low and tall willows and alder (Project Vegetation Types: Open and Closed Willow Tall Shrub, Open and Closed Alder Willow Tall Shrub, Open and Closed Low Willow). Marsh and wet meadow communities (Project Vegetation Types: Fresh Sedge Marsh, Subarctic Sedge Moss Wet Meadow, Ericaceous Shrub Bog) are often are found surrounding waterbodies and in large lowland expanses on the valley floor. Many kettle ponds and lakes (Project Vegetation Types: Open Water, Aquatic Herbaceous, Partially Vegetated, Bare) dot the lowland valleys, and are also found perched in undulating terrain at higher elevations.

13.1.7.4 Plant Species List

The draft list of plant species observed in the mine mapping area (Appendix 13.1A) includes species observed at 3,300 detailed-data collection plots that had undergone QC review. (The common plant species found most frequently in the mine mapping area are listed in Appendix 13.1C.)

There is only one federally listed plant species in Alaska, *Polystichum aleuticum*. It is a small fern endemic to the Aleutian Islands and is not expected in the mine study area. The AKNHP, part of the NatureServe program established by the Nature Conservancy, tracks population information on over 300 Alaskan plant species they consider rare. Populations of six of these species were recorded at 12 locations throughout the mine study area and are listed in Table 13.1-6.

Specimens of three species—*Primula tschuktschorum*, *Rumex beringensis, and Carex crawfordii*—have been reviewed and donated to the University of Alaska, Fairbanks, herbarium. *Primula tschuktschorum* and *R. beringensis,* are expected in this region; their preferred habitat is common and they have been previously recorded within 50 miles of the project area. In contrast, this sighting may represent a small range extension for *C. crawfordii;* according to the UAF Herbarium database *(*ARCTOS, University of Alaska Fairbanks 2011), this is the first recorded sighting southwest of the Cook Inlet Basin. The AKNHP (2008) has ranked *C. crawfordii* as demonstrably secure globally and uncommon or rare in Alaska (i.e., G5 S3). Three other records of tracked species in the mine study area *(Eriophorum viridicarinatum, Stellaria umbellata,* and *Carex bebbii)* should be considered unverified because neither voucher specimens nor diagnostic photographs were obtained. According to the UAF Herbarium database *(*ARCTOS) the only documented population of *Carex bebbii* in Alaska is near Anchorage; however, *S. umbellata* has been documented in a wide range of habitats. Specimens of *E. viridicarinatum* were collected nearby as part of the transportation corridor study and identification of those specimens has been confirmed (Table 13.2-6).

Some species observed in the mine mapping area have undergone taxonomic revision and may legitimately be referenced under more than one Latin name. For example, Northwest Territory sedge formerly was known as *Carex rhynchophysa* but is now known as *Carex utriculata*. Field personnel generally recorded the name referenced in the *National List of Plant Species that Occur in Wetlands: Alaska (Region A)* (Reed, 1988); however, field personnel occasionally used an updated name to refer to a species, and both names appear in the draft species list (species listed under more than one name are

noted in the draft species list). As a result, a count of the total number of taxa in the draft species list is a slight overestimate (<10) of the plant diversity observed in the mine mapping area.

13.1.8 Summary

Field staff collected information at 16,947 sites in the mine study area. Data on plant species composition and percent coverage in more than 3,300 detailed-data collection plots within the mine mapping area were analyzed. Because the vegetation study was conducted as part of the wetland studies (Chapter 14), field sampling targeted areas with unclear aerial photo signatures and/or areas along wetland boundaries. Researchers analyzed vegetation data collected in the field and aerial photo signatures to develop a list of Project Vegetation Types. They compared field data and site photographs to aerial photo signatures to produce a vegetation map.

Vegetation mapping has been completed for 127,773.9 acres in the mine mapping area. Forty-five Project Vegetation Types were identified. The vegetation mapping area was characterized by a predominance of shrub types of vegetation (81 percent coverage). Among the shrub types, the dwarf shrub group was most common and accounted for over half (approximately 53 percent) of the mine mapping area. Herbaceous types of vegetation accounted for approximately 9 percent of the mine mapping area, while forest types represented only about 0.3 percent. Approximately ten percent of the mine mapping area was unvegetated or sparsely vegetated.

13.1.9 References

Alaska Department of Natural Resources (ADNR).1982. Bristol Bay Cooperative Management Plan. Anchorage, AK.

Alaska Natural Heritage Program (AKNHP). 2008. Alaska Natural Heritage Program Rare Vascular Plant Tracking List. Anchorage, Alaska.

Collet, D.M. 2004. Willows of Interior Alaska. U.S. Fish and Wildlife Service, Anchorage, AK.

———. 2002. Willows of Southcentral Alaska. U.S. Fish and Wildlife Service, Anchorage, AK.

Flora of North America Editorial Committee. 2007. Flora of North America, Volume 24: *Poaceae* Part 1. New York, NY.

———. 2003. Flora of North America, Volume 25: *Poaceae* Part 2. New York, NY.

———. 2002. Flora of North America, Volume 23: *Cyperaceae*. New York, NY.

Hultén, E. 1968. Flora of Alaska and Neighboring Territories: A Manual of Vascular Plants. Stanford, CA: Stanford University Press.

MacKinnon, A., D. Johnson, J. Pojar, and L. Kershaw. 1995. Plants of the Western Boreal Forest and Aspen Parkland. Vancouver, BC, Canada: Lone Pine Press.

Nowacki, Gregory, Page Spencer, Michael Fleming, Terry Brock, and Torre Jorgenson. 2001. Ecoregions of Alaska. U.S. Geological Survey Open-File Report 02-297 (map).

Pojar, J., and A. MacKinnon. 1994. Plants of the Pacific Northwest Coast. Vancouver, BC, Canada: Lone Pine Press.

Reed, P.B., Jr. 1988. National List of Plant Species that Occur in Wetlands: Alaska (Region A). U.S. Department of Interior, Fish and Wildlife Service, National Wetlands Inventory Center, St. Petersburg, FL.

Tande, G., and R. Lipkin. 2003. Wetland Sedges of Alaska. U.S. Environmental Protection Agency, Kenai, AK.

Three Parameters Plus, Inc. (3PPI). 2008. Pebble Project Vegetation Type Photo Signature Guide, Draft Report. Version XVII. Palmer, AK. May.

———. 2007. Northern Dynasty Mines Inc. Pebble Project Draft Mine Site Photo Signature Guide. Version XIb. Palmer, AK. June.

———.2006. Northern Dynasty Mines Inc. Pebble Project Draft Mine Site Vegetation Type Photo Signature Guide. Version VII. Palmer, AK. April.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2004. Land Resource Regions and Major Land Resource Areas of Alaska. Palmer, Alaska

University of Alaska Fairbanks Herbarium 2011. ARCTOS database review. http://arctos.database.museum/SpecimenSearch.cfm (Accessed 8/9/2011).

Viereck, L.A., C.T. Dryness, and A.R. Batten, 1981. The Revision of the Preliminary Classification System for the Vegetation of Alaska. Mimeo report.

Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. The Alaska Vegetation Classification. General Technical Report PNW-GTR-286. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, Oregon.

Viereck, L.A., and E.L. Little Jr. 1972. Alaska Trees and Shrubs. University of Alaska Press, Anchorage, AK.

Wibbenmeyer, M., J. Grunblatt, and L. Shea. 1982. User's Guide for Bristol Bay Land Cover Maps. Bristol Bay Cooperative Management Plan. Alaska Department of Natural Resources and Alaska Department of Fish and Game, Anchorage, AK.

13.1.10 Glossary

Aerial photo signature—a unique texture, pattern, or color that vegetation has when captured in photographs taken from an airplane.

Ericaceous plants—plants in the heath family (Ericaceae), mostly plants that thrive in acidic soils; includes many plants from mostly temperate climates.

Forbs—herbaceous flowering plants that are not graminoids such as grasses, sedges, or rushes; a term frequently used in vegetation ecology to refer to broad-leaved herbs.

Graminoids—grasses and grass-like plants, including sedges and rushes.

Halophytic—adapted to living in a saline environment.

Herbaceous plants—plants that have leaves and stems that die to the soil level at the end of the growing season.

Hydrophytic vegetation—vegetation that is typically adapted for life in saturated soil conditions.

Landsat—refers to the Landsat Program, a series of satellite missions jointly managed by the National Aeronautics and Space Administration and the U.S. Geological Survey and which has collected information about Earth from space since 1972.

Mesic—type of habitat with a moderate or well-balanced supply of moisture; relates to an ecological habitat classified as “moderately moist."

Non-wetlands—uplands and lowland areas that are neither aquatic habitats, wetlands, nor other special aquatic sites. Non-wetlands are seldom or never inundated, or if frequently inundated, they have saturated soils for only brief periods during the growing season, and if vegetated, they normally support a prevalence of vegetation typically adapted for life only in aerobic soil conditions.

Orthophotography (orthophotographs)—digital imagery that has been orthorectified (see below); orthorectified photos have already been processed.

Orthorectify— to rectify digital imagery by removing distortion resulting from camera angle and topography, thus equalizing the distances represented on the image.

Photo signature—see aerial photo signature.

Signature—see aerial photo signature.

Stratum—a layer of vegetation in a plant community, usually of the same or similar height (plural is strata).

Tussock—the mound formed by any grass or sedge that grows in clumps or tufts, rather than forming sod or a mat.

Vegetation signature—see aerial photo signature.

Voucher specimen—any specimen that serves as a basis of study and is retained as a reference; it should be in a publicly accessible scientific reference collection. For purposes of this study, voucher specimens of AKNHP tracked species were collected and sent to the University of Alaska, Fairbanks, herbarium for species verification.

Wetlands—areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas.

13.2 Vegetation—Transportation-corridor Study Area

13.2.1 Introduction

This section summarizes the vegetation study for the Pebble Project transportation-corridor study area. The study objectives, scope of work, and methods used in the transportation-corridor study area were essentially identical to those used in the mine study area (Section 13.1), so readers are referred to Section 13.1 when pertinent. Where the study components differed between the study areas, the differences are described.

13.2.2 Study Objectives

The objectives of the vegetation study for the transportation-corridor study area are the same as those for the mine study area (Section 13.1.2). The primary objective of the vegetation study is to document and map the predominant vegetation types found in the transportation-corridor study area.

13.2.3 Study Area

The transportation-corridor study area extends from the mine study area to the boundary between the Bristol Bay drainages and the Cook Inlet drainages and it generally paralleling the north shore of Iliamna Lake. (see overview map in Figure Series 13.2-1). Data have been collected throughout the study area, but mapping has been completed only for an approximately 2,000-foot-wide corridor within the study area, referred to as the "transportation-corridor mapping area" (see overview map in Figure Series 13.2-1). Scientists consider the information gathered outside the mapping area to be useful for characterizing the environment surrounding the mapping area, and so data collected from all sites are discussed here and presented in data tables. The vegetation study area is identical to the wetland study area described in Chapter 14.

Several Alaska Native corporations and the State of Alaska own land within the vegetation study area. Access was granted for data collection on all properties, with the exception of Alaska Native allotments (parcels of land owned by individual Alaska Natives for which the Bureau of Indian Affairs has a trust responsibility).

13.2.4 Previous Studies

Previous studies are as described in Section 13.1.4, with the following exception. Whereas the mine study area fell within the Yukon Kuskokwin Highlands ecoregion and the Lime Hills ecoregion, the transportation-corridor study is outside of the Yukon Kuskowkin Highland ecoregion, falls within the same Lime Hills ecoregion, and extends into two additional ecoregions, the Alaska Range, and the Alaska Peninsula ecoregions (Nowacki et al., 2001). The vegetation of the Lime Hills region is notable for the predominance of tall and low shrub communities consisting of birch, willow, and alder. Forests and woodlands generally are restricted to valley bottoms and toe slopes. The vegetation of the Alaska Range is notable for shrub communities of willow, birch, and alder that occupy lower slopes and valley bottoms. Forests are rare and are usually limited to low-elevation drainages. The dominant vegetation of the Alaska Peninsula is low shrublands of willow, birch, and alder interspersed with ericaceous heath and lichen communities. Alpine tundra and glaciers are on mountaintops.

13.2.5 Scope of Work

The scope of work for the transportation-corridor study area is the same as that for the mine study area (Section 13.1.5). The field work in the transportation-corridor study area was carried out by two firms: Three Parameters Plus, Inc. (3PPI), and HDR Alaska, Inc. (HDR). 3PPI conducted field studies in the corridor west of the Newhalen River, between the Newhalen River and the mine study area (overview map for Figure Series 13.2-1). HDR conducted field studies in the corridor from the Newhalen River eastward to the boundary between Bristol Bay and Cook Inlet drainages. Field work for the transportation-corridor study area was conducted primarily in 2004 and 2005, with additional work on the area west of the Newhalen River completed in 2006 through 2008. All results for the transportation-corridor study area are presented in this section.

13.2.6 Methods

Scientists used essentially the same study methods in the transportation-corridor study area as in the mine study area (Section 13.1.6). Scientists combined the aerial photography, field observations, and data collections to characterize vegetation, assign Project Vegetation Types, and document vascular plant species that are tracked by the AKNHP. Differences between the methods used in the two study areas are identified in the following sections.

13.2.6.1 Literature Review

The literature review is described in Section 13.1.6.1. Resource maps (USDA NRCS, 2004) and the *User's Guide for Bristol Bay Land Cover Maps* (referred to herein as the "User's Guide"; Wibbenmeyer et al., 1982) are the primary resources cited and discussed in that section.

13.2.6.2 Compilation of Digital Data Sets

The compiled digital data set described in Section 13.1.6.2 was used throughout the transportation-corridor study area except for some of the aerial imagery. The imagery for the west end of the transportation-corridor study area—generally the segment west of the Newhalen River—was the same as that used for the mine study area. That imagery extended only a short distance east of the Newhalen

River however; therefore the following additional data were generated for study of the transportation-corridor study area:

- Color aerial photographs were captured in October 2004, and supplemented in October 2005 and September 2008, at a scale of 1:8,000. Together, this photography covered the transportation-corridor mapping area and some additional outlying areas within the study area. These aerial photographs were orthorectified at a scale of 1.5-foot pixels and were used for interpretation and mapping in the geographic information system (GIS). (Orthorectification is removing photographic distortion that results from the camera angle and/or topography.)
- Light detection and ranging (LIDAR) imagery was acquired in October 2004 and was used to produce a layer of 4-foot contour lines for the transportation-corridor mapping area and some additional outlying areas within the study area.
- IKONOS (GeoEye) satellite imagery was captured in July 2004 of most of the transportation-corridor study area east of the Newhalen River. The imagery covered the northern part of the study area from Iliamna Lake to the Bristol Bay drainages/Cook Inlet drainages boundary, where field investigations occurred. It did not cover the part of the mapping area between Iliamna River and the Bristol Bay/Cook Inlet drainages boundary. Field investigators used this imagery for some basemaps in 2004 and 2005.

13.2.6.3 Field Data Collection

The methods for the field work in the transportation-corridor study area were similar to the mine study area (Section 13.1.6.3). The digital technology used for field data collection differed among investigators, as described in Section 13.1.6.3. The types of study sites in the transportation-corridor study area were the same as those in the mine study area, although data collection from shrub height plots was limited to west of the Newhalen River.

13.2.6.4 Data Entry

Data entry to the project database was the same for the transportation-corridor study area and the mine study area. Details are described in Section 13.1.6.4. The vegetation data recorded on field forms and in site photos were used to assign final Project Vegetation Types in the project database.

13.2.6.5 Digital Mapping

Scientists mapped vegetation in the transportation-corridor mapping area using 2004 and 2005 aerial photographs as the basemap, as described for the mine study area in Section 13.1.6.5. Any later photography was used as a supplemental resource. The mapping methods used in the two study areas were the same.

13.2.7 Results and Discussion

13.2.7.1 Project Vegetation Types

Field crews documented detailed vegetation data at 597 locations in the transportation-corridor study area. In addition to collecting data at these detailed-data collection plots, field scientists classified the site

vegetation and collected an abbreviated suite of data at three shrub height plots and 526 limited-data collection plots. (Data from limited-data collection plots and shrub height plots were not used in developing descriptions of the Project Vegetation Types, but were used as reference for mapping.) Figure Series 13.2-1 shows the locations of all study sites.

Investigators identified 45 Project Vegetation Types (including three sparsely vegetated or unvegetated cover types) in the transportation-corridor study area. These types are listed in Tables 13.2-1 through 13.2-3. For 39 of the Project Vegetation Types, the tables present narrative descriptions based on detailed vegetation data. Five of the types were documented only with photographs, without detailed-data collection in this study area, and one type was identified only on aerial imagery and was not sampled in the field. Appendix 13.1B shows representative photographs and more detailed descriptions of all Project Vegetation Types for both the mine and transportation-corridor study areas, except the single type identified only on aerial photographs (Closed White Spruce Forest).

13.2.7.2 Vegetation Mapping

Mappers delineated Project Vegetation Types in the 19,917-acre transportation-corridor mapping area. This mapping, shown on Figure Series 13.2-2, shows 45 Project Vegetation Types (including three sparsely vegetated or unvegetated cover types). Table 13.2-4 lists the area occupied by each Project Vegetation Type in the transportation-corridor mapping area, along with the percentage of the mapping area that each comprises. As noted in Section 13.2.7.1, six Project Vegetation Types mapped in transportation-corridor mapping area were not sampled in detailed-data collection plots. Three of these types (Partially Vegetated, Barren, and Open Water) are unvegetated land covers, and the other three (Closed Alder Willow Low Shrub and Dwarf Ericaceous Shrub Lichen Tundra, each of which was identified only at limited-data collection plots, and Closed White Spruce Forest, which was identified only on aerial photographs) each comprised less than 1 percent of the transportation-corridor mapping area. Vegetation types included forested types (the dominant growth form consists of trees at greater than ten percent cover), shrub types (the dominant growth form are multi-stemmed woody plants), herbaceous types (dominated by plants whose stem does not produce woody, persistent tissue and generally dies back at the end of each season), and unvegetated or sparsely vegetated areas ("land cover" types).

Unlike the mine study area where shrub vegetation comprised the majority of the area, in the transportation corridor, particularly to the east of Canyon Creek, forested vegetation types comprised over two-thirds (68 percent) of the mapping area. Of the forested types, Open Mixed Forest was by far the most common type (31 percent of the mapping area), followed by White Spruce Woodland (10 percent) and Open Broadleaf Forest, Open White Spruce Forest, Mixed Forest Woodland, and Closed Mixed Forest (each between 5 and 7 percent). Shrub-dominated vegetation types occupied approximately one-quarter (24 percent) of the mapping area, with Dwarf Ericaceous Shrub Tundra (6 percent) and Closed Alder Tall Shrub (5 percent) being the most common shrub vegetation types. Herbaceous vegetation types and unvegetated cover types each occupied approximately 4 percent of the mapping area. (Definitions of canopy closure terms [closed, open, woodland] and height categories [tall, low, dwarf] are shown in Tables 13.2-1 and 13.2-2.)

For clearer display on maps, the 45 Project Vegetation Types were aggregated into 10 vegetation structure types. The groupings were based on the dominant growth form described above (forested, shrub, or herbaceous), vegetation density (open or closed canopy), and average height (dwarf, low, or tall; Table 13.2-5, Figure Series 13.2-3). The 12 forested types shown in Table 13.2-4 were condensed into one

grouped forested type: Open/Closed Forest. The 23 shrub types in the table were condensed into four grouped shrub types: Open Tall, Closed Tall, Open Low, and Dwarf Shrub. The seven herbaceous types were condensed into two grouped herbaceous types: Dry to Moist, and Wet Herbaceous. In addition, the three land cover types were grouped into two land cover types; Open Water and Other.

Upon examining the abundance of each of the 10 grouped vegetation types, it is evident that the open/closed forest group accounted for 68.4 percent of the transportation-corridor mapping area, while the open low shrub group, the dwarf shrub group, the closed tall shrub, and the open tall shrub group accounted for 7.6 percent, 7.1 percent, 5.9 percent, and 3.2 percent, respectively, of the transportation-corridor mapping area (Table 13.2-5). The wet herbaceous group covered 2.6 percent of the mine mapping area, while the dry to moist herbaceous group covered 1.3 percent of the area. The closed low shrub group covered only 0.3 percent of the transportation-corridor mapping area. Open water covered 3.0 percent of the transportation-corridor mapping area.

13.2.7.3 Ecological Zones

The transportation-corridor study area extends approximately 60 miles from west of the Newhalen River to the Bristol Bay/Cook Inlet drainages boundary, from an area with a continental climate characteristic of interior Alaska to a maritime climate, and from relatively gentle topography into steep mountain terrain. Because of these differences in climate and topography, the vegetation typical of the west end of the corridor is distinct from that typical of the east-central part and the far eastern end. The differences in vegetation among the three ecological zones of the transportation-corridor study area are summarized below. This summary is based on scientists' observations in the field and visual review of the mapping.

Woodland

The ecological zone between the western end of the transportation-corridor study area and Canyon Creek (Tiles 1 through 5 of Figure Series 13.2-2 and 13.2-3) supports predominantly a sparse tree cover or woodland that provides little canopy cover over a dense low or dwarf (5 feet tall or less) shrub understory. The topography is generally rolling, but the transportation-corridor study area also includes steep hillsides near the mine study area and on Roadhouse Mountain. The woodland ecological zone is drained by the Newhalen River and many smaller creeks. Water also collects in ponds on a variety of landforms. In general, the vegetation of the woodland ecological zone is made up of open forests and woodlands (Project Vegetation Types: Mixed Forest Woodland, Open Mixed Forest, White Spruce Woodland) interspersed with tundra dominated by ericaceous (heath family) and dwarf shrubs (Project Vegetation Types: Dwarf Ericaceous Shrub Tundra, Dwarf Ericaceous Shrub Tundra–Hummocks, Open Dwarf Birch Shrub). Larger streams are often bordered by tall willows and alder (Project Vegetation Types: Closed Willow Tall Shrub, Closed Alder Willow Tall Shrub, Open Willow Tall Shrub, Open Alder Willow Tall Shrub). Marsh and wet meadow communities (Project Vegetation Types: Fresh Sedge Marsh, Subarctic Sedge Moss Wet Meadow) are limited in extent and often are found surrounding small waterbodies. Within this ecological zone, the moraine area between the Newhalen River and Roadhouse Mountain (Tile 2 of Figure Series 13.2-2 and 13.2-3) is distinguished by its topographic complexity and lack of trees. Higher exposed areas support expanses of well-drained low and dwarf shrub tundra (Project Vegetation Types: Low Ericaceous Shrub Tundra, Dwarf Ericaceous Shrub Tundra, Dwarf Ericaceous Shrub Tundra–Hummocks), while less exposed swales and kettles support ponds, wet meadows, and wet shrub communities.

Forest

The ecological zone extending from Canyon Creek to the mouth of Chinkelyes Creek (Tiles 5 through 9 of Figure Series 13.2-2 and 13.2-3) is forested. The landscape is mountainous, so the transportation-corridor study area traverses steep hillsides and the valley bottoms of large streams that drain into Iliamna Lake. The vegetation of this ecological zone consists of forests (Project Vegetation Types: Open Mixed Forest, Open White Spruce Forest, Open Broadleaf Forest, Closed Mixed Forest) of Kenai birch or mixed birch and white spruce. White spruce were once co-dominant in these forests, but a recent state-wide infestation of spruce bark beetles killed a large proportion of those trees. Steeper slopes may support dense stands of tall alder or mixed willow and alder shrubs (Project Vegetation Types: Closed Alder Tall Shrub, Closed Alder Willow Tall Shrub). The floodplains of the Pile and Illiamna Rivers (Tiles 8 and 9, Figure Series 13.2-2 and 13.2-3) are complex mosaics of vegetation in flood channels, bars, and abandoned channels, dominated by willows (Project Vegetation Type: Open Willow Tall Shrub), open forests (Project Vegetation Types: Open Mixed Forest, Open Broadleaf Forest), and marsh (Project Vegetation Type: Subarctic Sedge Moss Wet Meadow).

Mountainous Shrubland

The ecological zone extending from the mouth of Chinkelyes Creek to the boundary between the Bristol Bay and Cook Inlet drainages (Tiles 9 and 10 of Figure Series 13.2-2 and 13.2-3) is mountainous shrubland. In this region, the study area encompasses steep slopes and relatively flat valley bottoms. Alders (Project Vegetation Types: Closed Alder Tall Shrub, Open Alder Tall Shrub) dominate the slopes and in some areas form a mosaic with meadows (Project Vegetation Type: Bluejoint Herb). In valley bottoms, willows (Project Vegetation Types: Closed Willow Low Shrub, Open Willow Low Shrub), other low and dwarf shrub types (Project Vegetation Types: Open Dwarf Birch Ericaceous Shrub Bog, Dwarf Ericaceous Shrub Tundra), and wet meadows (Project Vegetation Type: Subarctic Sedge Moss Wet Meadow) are common along riparian corridors.

13.2.7.4 Plant Species List

The draft plant species list (Appendix 13.2A) is a list of the vascular plant species observed at the detailed-data collection plots in the transportation-corridor study area. Some plant species are listed in this draft list under more than one valid Latin name (as a result of taxonomic revisions—see Section 13.1.6.3); however, in the final list, each species will be listed under only one Latin name. Investigators observed more than 300 vascular plant species in the study area. The plant species most frequently found in the transportation-corridor study area are listed in Appendix 13.2B.

The AKNHP, part of the NatureServe program established by the Nature Conservancy, tracks population information on over 300 Alaskan plant species they consider rare (AKNHP, 2008). During 2004 and 2005, populations of three of these species were recorded at 11 locations throughout the transportation-corridor study area and are listed in Table 13.2-6. Scientists collected voucher specimens of some of the plants believed to be tracked species, and the identities of some of those plants have been confirmed by a botanist at the University of Alaska Fairbanks herbarium. For most of these incidental observations, population information was recorded in the Pebble Project database.

These three species were ranked by AKNHP based on factors contributing to rarity, including population number and size, trends, and threats. *Eleocharis quinqueflora*, ranked as G5 S1, is secure (common; widespread and abundant) throughout its entire global range, but within the State of Alaska, it is critically

imperiled (because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation). *Eriophorum viridicarinatum*, ranked as G5 S2, is secure (common; widespread and abundant) throughout its entire global range, but within the State of Alaska, it is imperiled (because of rarity due to very restricted range, very few populations, steep declines, or other factors making them very vulnerable to extirpation). *Malaxis paludosa*, ranked as G4 S3 means that the species is apparently secure (uncommon but not rare; some cause for long-term concern due to declines or other factors) throughout its entire global range, but within the State of Alaska, it is vulnerable (due to restricted range, relatively few populations, recent and widespread declines, or other factors making it vulnerable to extirpation).

13.2.8 Summary

Scientists characterized vegetation in the transportation-corridor study area with methods similar to the methods used in the mine study area. The transportation-corridor study area extends from the mine study area to the boundary between the Bristol Bay and Cook Inlet drainages.

In 2004 through 2008, field crews collected detailed vegetation data at approximately 597 locations in the transportation-corridor study area and documented vegetation types with photographs at approximately 529 other sites. Scientists mapped vegetation based on interpretation of aerial photographs and using information gained during field investigation for reference. The transportation-corridor study area, which encompasses almost 20,000 acres, supports 45 Project Vegetation Types.

The rolling western segment of the study area, termed the woodland ecological zone, is characterized by a sparse canopy of white spruce over a dense layer of shrubs such as dwarf birch and members of the heath family. The central (forest) ecological zone in the mountains along the northeast side of Iliamna Lake supports a forest of birch trees, in some places mixed with live or standing, dead white spruce. Much of the spruce has been killed by a recent state-wide bark beetle infestation. Shrub thickets occupy higher mountain slopes, and the floodplains of the large streams that drain through this zone support a mosaic of vegetation types. The eastern end of the transportation-corridor study area, the mountainous shrublands zone, is mountainous and supports primarily tall shrub thickets and herb meadows on the mountain slopes and shrub thickets along the valley-bottom streams.

More than 300 species of vascular plants were observed during the course of field investigations in the transportation-corridor study area, including three herb species that are on the AKNHP's list of tracked plant species (AKNHP, 2008).

13.2.9 References

Alaska Natural Heritage Program (AKNHP). 2008. Alaska Natural Heritage Program Vascular Plant Tracking List. Alaska Natural Heritage Program. Anchorage, Alaska. http://www.uaa.alaska.edu/enri/aknhp_web/index.html (accessed November 11, 2008).

Nowacki, G., P. Spencer, M. Fleming, T. Brock, and T. Jorgenson. 2001. Ecoregions of Alaska. U.S. Geological Survey Open-File Report 02-297.

13.2.10 Glossary

Ericaceous plants—plants in the heath family (Ericaceae), mostly plants that thrive in acid soils. Includes numerous plant species from mostly temperate climates: cranberry, blueberry, heather, huckleberry, azalea, and rhododendron are well-known examples.

Graminoids—grasses and grass-like plants, including sedges and rushes.

Herbaceous plants—a plant that has leaves and stems that die to the soil level at the end of the growing season.

Mesic—type of habitat with a moderate or well-balanced supply of moisture; relates to an ecological habitat classified as “moderately moist."

Tussock—the mound formed by any grass or sedge that grows in clumps or tufts, rather than forming sod or a mat.

Voucher specimen— any specimen that serves as a basis of study and is retained as a reference; it should be in a publicly accessible scientific reference collection. For purposes of this study, voucher specimens of AKNHP tracked species were collected and sent to the University of Alaska, Fairbanks, herbarium for species verification..

Wetlands—areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas.

TABLES

TABLE 13.1-1
Project Vegetation Types in Which the Tree Stratum Is Dominant (≥10% coverage), Mine Mapping Area, 2004-2008

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Open White Spruce Forest (OWSF) *n* = 3	Open forests dominated by white spruce	The average height and diameter of *Picea glauca* was 22 feet and 5 inches, respectively. *Spiraea beauverdiana*, *Vaccinium vitis-idaea*, and *Epilobium angustifolium* were present in the understory.
White Spruce Woodlands (WSW) *n* = 4	Woodlands dominated by white spruce	The average height and diameter of *Picea glauca* was 30 feet and 5 inches, respectively. *P. glauca* saplings, *Empetrum nigrum*, and shrub willows (*Salix pulchra* or *S. glauca)* were present in all plots.
Closed Broadleaf Forest (CBF) *n* = 5	Closed forests dominated by broadleaf tree species	The tree stratum was dominated by *Populus balsamifera, Salix alaxensis,* or *Betula kenaica*. The shrub layer was variable, with the exception of *Viburnum edule* (average cover 13%). In the herb stratum, *Calamagrostis canadensis*, *Equisetum* spp., *Dryopteris dilatata* ssp*. americana* and *Angelica lucida* often were present.
Open Broadleaf Forest (OBF) *n* = 20	Open forests dominated by broadleaf tree species	The tree stratum was generally dominated by *Populus balsamifera*, although *Salix alaxensis* may have been dominant along riparian corridors. Shrub willows (*Salix* spp.), *Calamagrostis canadensis*, *Equisetum* spp*., Epilobium angustifolium,* and *Gymnocarpium dryopteris* were common in the understory. The average height and diameter of *P. balsamifera* exceeded 35 feet and 7 inches, respectively.
Broadleaf Woodland (BW) *n* = 3	Woodland dominated by broadleaf trees	Three broadleaf tree species were recorded: *Populus balsamifera*, *Betula kenaica*, and *Salix alaxensis*. No shrub genus was observed in all plots, but *Angelica* spp. and *Calamagrostis canadensis* were consistently present.
Open Mixed Forest (OMF) *n* = 2	Open forests co-dominated by needleleaf and broadleaf tree species	*Picea glauca* and *Betula papyrifera* were co-dominant in the tree stratum, while *Salix pulchra, Equisetum arvense,* and *Calamagrostis canadensis* were common in the understory.
Mixed Forest Woodland (MFW) *n* = 0	Woodlands co-dominated by needleleaf and broadleaf trees	This uncommon (<0.01% of mine mapping area) vegetation type was documented only at limited-data collection plots in the mine study area. A detailed description of this vegetation type is provided in Appendix 13.1B.
Dwarf Black Spruce Scrub (DBSS) *n* = 1	Needleleaf forest (tree species canopy coverage 10-60%) dominated by dwarf (<10 feet tall) black spruce	*Picea mariana* was assessed at 60% coverage. No herbs were reported, but *Sphagnum* spp. covered 35% of the area, and several shrubs (*e.g., Ledum decumbens*, *Vaccinium vitis-idaea*, *Empetrum nigrum*) were well represented.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Dwarf White Spruce Scrub (DWSS) *n* = 0	Needleleaf forest (tree species canopy coverage 10-60 percent) dominated by dwarf (<10 feet tall) white spruce	This uncommon (<0.01% of mine mapping area) vegetation type was documented only at limited-data collection plots in the mine study area. A detailed description of this vegetation type is provided in Appendix 13.1B.

a. Number of plots (*n*) includes plots where field investigators collected full vegetation data. It does not include shrub height plots or limited-data collection plots.

b. Forest density classes (closed, open, woodland) are differentiated based on tree canopy coverage (>60%, 25-59%, 10-24%, respectively).

c. See Appendix 13.1B for photos and further detail, including the common names associated with the Latin names given in this column and an explanation of dominant species.

TABLE 13.1-2
Project Vegetation Types in Which the Shrub Stratum is Dominant (>25% shrub coverage), Mine Mapping Area, 2004-2008

Tree coverage is < 10%.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Closed Willow Tall Shrub (CWTS) *n* = 234	Thickets of tall willows	The dominant species in these thickets generally was *Salix pulcha*, followed by *S. barclayi*. Stands dominated by *S. alaxensis* sometimes occurred near streams and rivers. The understory was diverse; common herbs included *Calamagrostis canadensis*, *Epilobium angustifolium*, *Sanguisorba* spp., and *Equisetum* spp.
Closed Alder Tall Shrub (CATS) *n* = 140	Thickets of tall alder	*Alnus sinuata* was the most commonly observed alder species. Typical components of the understory included *Ribes glandulosum, Calamagrostis canadensis*, and *Dryopteris dilatata* ssp. *americana*.
Closed Alder Willow Tall Shrub (CAWTS) *n* = 51	Mixed species thickets of tall alders and willows	*Alnus sinuata* and *Salix pulchra* were the most commonly observed shrub species. *Calamagrostis canadensis*, *Dryopteris dilatata* ssp. *americana*, *Equisetum* spp., and *Spiraea beauverdiana* were often observed in the understory.
Open Willow Tall Shrub (OWTS) *n* = 133	Open stands of tall willow	*Salix pulchra* was the typical dominant species in tall willow thickets, although *S. alaxensis* was often dominant along riparian corridors. Other commonly observed species included *Angelica lucida*, *Calamagrostis canadensis*, *Epilobium angustifolium*, *Sanguisorba* spp., and *Equisetum* spp.
Open Alder Tall Shrub (OATS) *n* = 25	Open stands of tall alder	*Alnus sinuata* dominated these stands, with *Spiraea beauverdiana* and *Vaccinium uliginosum* often found in the understory. *Calamagrostis canadensis*, *Dryopteris dilatata* ssp. *americana*, and *Trientalis europaea* were typically present.
Open Alder Willow Tall Shrub (OAWTS) *n* = 16	Tall, open shrub stands co-dominated by alder and willow	*Alnus sinuata* and *Salix pulchra* were commonly the dominant species in the shrub overstory. *Spiraea beauverdiana*, *Calamagrostis canadensis*, *Dryopteris dilatata* ssp. *americana*, *Epilobium angustifolium,* and *Equisetum* spp. were typical components of the herb stratum.
Closed Willow Low Shrub (CWLS) *n* = 113	Thickets of low willow	The most abundant low thicket species was *Salix pulchra*, although *S. barclayi* was also frequently observed. *Calamagrostis canadensis*, *Equisetum* spp., *Epilobium angustifolium*, and *Sanguisorba* spp. were typical components of the understory. *Potentilla palustris* was frequently observed in wetter plots.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Closed Alder Low Shrub (CALS) *n* = 0	Thickets of low alder	This uncommon vegetation type (0.03% of mine mapping area) was not documented in the field, but was mapped based on aerial photographs.
Closed Alder Willow Low Shrub (CAWLS) *n* = 2	Mixed-species thickets of low alders and willows	*Alnus sinuata and Salix pulchra* were abundant. *Calamagrostis canadensis* was common in the herb stratum.
Open Mixed Shrub Sedge Tussock (OMSST) *n* = 45	Tussock tundra co-dominated by low shrubs and tussock-forming graminoids	*Eriophorum vaginatum* was the most common tussock-forming species, although tussocks dominated by *Carex bigelowii* also were observed. Other common herbs were *C. aquatilis, Eriophorum* spp., and *Rubus chamaemorus.* Many dwarf shrubs co-dominated these communities, including *Andromeda polifolia, Betula nana, Salix* spp., *Vaccinium* spp., and *Ledum decumbens. Sphagnum* spp. were a common groundcover.
Open Dwarf Birch Shrub (ODBS) *n* = 88	Open stands of dwarf birch and/or shrub birch (>8 inches tall)	*Betula nana*, rather than *Betula glandulosa*, was frequently dominant. *Salix* spp., *Empetrum nigrum*, and ericaceous shrubs also were typical in the shrub stratum. Common scattered herbs included *Calamagrostis canadensis*, *Rubus chamaemorus*, and *Carex* spp.
Low Ericaceous Shrub Tundra (LEST) *n* = 67	Shrublands dominated by low ericaceous shrubs	Typical shrub species included *Betula nana*, *Empetrum nigrum*, *Ledum decumbens*, *Spiraea beauverdiana*, *Vaccinium uliginosum*, *V. vitis-idaea*, and/or dwarf *Salix* spp. Scattered *Salix pulchra* was often observed. In the herb stratum, *Calamagrostis canadensis*, *Rubus chamaemorus*, and *Carex* spp. were common.
Open Dwarf Birch Ericaceous Shrub Bog (ODBESB) *n* = 145	Bogs with abundant mosses, ericaceous shrubs, and dwarf birch	*Betula nana* often exceeded 20% coverage. Other common shrubs were *Empetrum nigrum, Vaccinium* spp., *Ledum decumbens*, *Andromeda polifolia, Salix fuscescens, a*nd *S. pulchra*. In the herbaceous stratum, *Carex* spp. (particularly *Carex aquatilis)*, *Calamagrostis canadensis, Eriophorum* spp., *Equisetum* spp., and *Rubus chamaemorus* were common. *Sphagnum* moss was often abundant.
Ericaceous Shrub Bog (ESB) *n* = 111	Bogs with abundant mosses and ericaceous shrubs, but only sparse dwarf birch	Common shrubs included *Empetrum nigrum, Ledum decumbens*, *Salix fuscescens*, and *Vaccinium* spp. Scattered *Betula nana, S. pulchra,* and/or *Andromeda polifolia* was often present. In the herbaceous stratum, typical species were *Carex aquatilis*, *Eriophorum* spp., *Carex* spp., *Equisetum* spp., *Potentilla palustris,* and *Rubus chamaemorus*. *Sphagnum* moss was often abundant.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Shrub Birch Willow (SBW) *n* = 40	Open or dense shrub stands co-dominated by willows and birch	*Betula nana* along with *Salix pulchra, S. barclayi,* and *S. glauca* co-dominated these stands. These species were often accompanied by ericaceous shrubs, *Empetrum nigrum*, and dwarf *Salix* spp. Common herbs included *Calamagrostis canadensis*, *Carex* spp., and *Equisetum* spp.
Open Willow Low Shrub (OWLS) *n* = 325	Open stands of low willow	*Salix pulchra* and *S. barclayi* were common constituents of the shrub stratum. Other shrubs common to this diverse vegetation type were *Spiraea beauverdiana*, *Vaccinium uliginosum*, *Empetrum nigrum,* and dwarf *Salix* spp. *Calamagrostis canadensis* was generally abundant. Other common herbs were *Equisetum* spp., dwarf *Rubus* spp., *Sanguisorba* spp., and *Epilobium angustifolium*.
Open Willow Low Shrub Fen (OWLSF) *n* = 80	Fens characterized by open stands of low willows	*Salix pulchra* and *S. barclayi* dominated the shrub layer. Other common shrubs included ericaceous species, *Betula nana, S. reticulata*, and *S. fuscescens*. Typical herbs were *Calamagrostis canadensis* and *Equisetum* spp. In wetter microsites, *Carex aquatilis*, *Eriophorum* spp., *Potentilla palustris*, and *Sphagnum* spp. were often abundant.
Open Sweetgale Graminoid Bog (OSGB) *n* = 0	Bogs characterized by an abundance of sweetgale (>25% coverage)	This uncommon (<0.01% of mine mapping area) vegetation type was documented only at limited-data collection plots in the mine study area. A detailed description of this vegetation type is provided in Appendix 13.1B.
Open Alder Willow Low Shrub (OAWLS) *n* = 5	Low, open shrub stands co-dominated by alder and willow	*Alnus sinuata* and *Salix pulchra* were often the dominant shrub species. Other common species included *Spiraea beauverdiana, Empetrum nigrum, Vaccinium uliginosum*), and *Calamagrostis canadensis*.
Open Alder Low Shrub (OALS) *n* = 4	Open stands of low alder	Both *Alnus sinuata* and *Alnus crispa* were observed. *Calamagrostis canadensis* and *Trientalis europaea*, and *Betula* spp. also were often present.
Dwarf Ericaceous Shrub Lichen Tundra (DESLT) *n* = 38	Dwarf ericaceous shrublands on lichen-dominated (>60% coverage) ground	Foliose and fruticose lichens, including *Cladonia* spp. and *Cladina stellaris,* were frequently observed. Typical vascular species were ericaceous shrubs, *Empetrum nigrum*, *Betula nana*, *Carex* spp., *Calamagrostis canadensis,* and dwarf *Salix* spp.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Dwarf Ericaceous Shrub Tundra (DEST) *n* = 388	Dwarf ericaceous shrublands that do not satisfy the requirements of other Project Vegetation Types	The shrub stratum in this common vegetation type was often composed primarily of *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, *Ledum decumbens*, *Empetrum nigrum*, *Betula nana,* and low/dwarf *Salix* spp. *Spiraea beauverdiana* was a commonly observed, but minor, shrub. The herb layer was usually sparse, often including low amounts of *Calamagrostis canadensis*, scattered *Carex* spp*. (e.g., C. microchaeta s.l.),* and/or dwarf *Rubus* spp.
Dwarf Ericaceous Shrub Tundra—Hummocks (DEST-H) *n* = 162	Dwarf ericaceous shrublands growing on moderate to large hummocks (>6 inches tall)	The shrub layer often consisted primarily of *Vaccinium* spp., *Ledum decumbens*, *Empetrum nigrum*, *Salix* spp., and *Betula nana*, with interspersed *Spiraea beauverdiana*. Scattered herbs were frequently reported; typical species included *Calamagrostis canadensis*, *Carex nesophila, C. bigelowii,* and dwarf *Rubus* spp. Average combined coverage for moss and lichens exceeded 20%. [d]
Dwarf Ericaceous Shrub Tundra—*Carex* (DEST-C) *n* = 61	Dwarf ericaceous shrublands with abundant sedges (>25 percent coverage)	The abundance of *Carex* spp. distinguishes this vegetation type from other DEST communities. Several species of *Carex* were observed, but the most common species were *C. bigelowii* and *C. stylosa*. In wetter sites, *C. aquatilis* often was present. Common associates included *Betula nana*, *Salix pulchra*, *Ledum decumbens*, *Vaccinium* spp., *Empetrum nigrum*, dwarf *Rubus* spp., and *Calamagrostis canadensis*
Dwarf Ericaceous Shrub Tundra—*Equisetum* (DEST-EQ) *n* = 20	Dwarf ericaceous shrublands with abundant horsetails (>25 percent coverage)	The abundance of *Equisetum* spp. distinguishes this vegetation type from other DEST or ESB communities. *E. sylvaticum* and *E. arvense* were particularly common. Typical associates included ericaceous species, *Betula nana*, *Empetrum nigrum*, *Rubus chamaemorus,* scattered sedges *(e.g., Carex microchaeta s.l.),* and *Calamagrostis canadensis*.

a. The number of plots (*n*) includes plots where field investigators collected full vegetation data. It does not include shrub height plots or limited-data collection plots.

b. Shrub density classes (closed thickets and open) are differentiated based on shrub canopy coverage (>75% and 25-75%, respectively). Shrub height classes (tall, low, and dwarf) are differentiated based on average shrub height (>5 feet tall, between 5 feet and 8 inches tall, and <8 inches tall, respectively).

c. See Appendix 13.1B for photos and further detail, including the common names associated with the Latin names given in this column and an explanation of dominant species.

d. Average percent coverage was calculated using data only from plots in which the species occurred.

TABLE 13.1-3
Project Vegetation Types in Which the Herb Stratum Is Dominant or Which Lack Vegetation, Mine Mapping Area, 2004-2008

Trees provide less than 10% coverage and shrubs either contribute less than 25% coverage or are not apparent on photographs because of a dense, tall, herbaceous stratum.

Project Vegetation Type and Number of Study Plots [a]	Definition	Typical Vegetative Composition Based on Sample Plots [b]
Bluejoint Tall Grass (BTG) *n* = 142	Abundant bluejoint reedgrass; other herbs and grasses may be present but are not co-dominant	*Calamagrostis canadensis* was abundant, often exceeding 80% coverage. A diverse array of other herbs often was scattered among the *C. canadensis*; more than 170 unique taxa were identified in 142 sample plots. Common taxa were *Salix pulchra*, *Epilobium angustifolium*, *Sanguisorba* spp., *Angelica lucida*, dwarf *Rubus* spp., and *Equisetum* spp.
Bluejoint Herb (BH) *n* = 205	Abundant bluejoint reedgrass interspersed with other low-growing species	*Calamagrostis canadensis* was abundant and sometimes overtopped a diverse community of shrubs and herbs (more than 215 unique taxa were recorded). Several shrub species, including *Salix pulchra* and *Spiraea beauverdiana,* were often present in small amounts. Typical herbs included dwarf *Rubus* spp., *Equisetum* spp., *Epilobium angustifolium*, and *Angelica lucida*.
Subarctic Sedge Moss Wet Meadow (SSMWM) *n* = 489	Graminoid-dominated communities, found on wet soils, that do not satisfy the requirements of other Project Vegetation Types	*Carex* spp. (particularly *C. aquatilis*), *Eriophorum* spp., *Potentilla palustris*, and *Calamagrostis canadensis* were often abundant in the herb stratum. Scattered *Equisetum* spp. and shrubs were typical; ericaceous species, *Salix fuscescens,* and *Betula nana* were often observed. *Sphagnum* moss formed a common groundcover.
Fresh Sedge Marsh (FSM) *n* = 32	Dominated by members of the sedge family (*e.g.,* sedges, cottongrass), rooted in standing water, and often near open water	*Eriophorum* spp., particularly *E. angustifolium*, and *Carex aquatilis* are often abundant. Other common herbs are *Potentilla palustris* and *Calamagrostis canadensis*. Scattered shrub species, particularly *Betula nana* and *Salix fuscescens* may colonize drier microsites.
Mesic Herb (MH) *n* = 77	Herb-dominated communities that occur on mesic sites and do not satisfy the requirements of other Project Vegetation Types	Many herbaceous species colonize mesic herb sites; over 120 herb species were identified in sample plots. Common herb species included *Calamagrostis canadensis, Sanguisorba* spp., *Rubus arcticus* s.l., *Carex* spp., *Angelica lucida*, and *Epilobium angustifolium*. Although this vegetation type was dominated by herbs, scattered shrubs, such as *Salix* spp., *Empetrum nigrum*, *Vaccinium* spp., and *Spiraea beauverdiana,* were often observed.

Project Vegetation Type and Number of Study Plots [a]	Definition	Typical Vegetative Composition Based on Sample Plots [b]
Fresh Herb Marsh (FHM) *n* = 12	Dominated by emergents in persistent standing water	Commonly observed herb species included *Calamagrostis canadensis*, *Carex* spp. (particularly *C. aquatilis*), *Potentilla palustris,* and *Equisetum* spp. *Arctophila fulva* was reported in almost half of the sample plots. *Salix pulchra* sometimes colonized drier microsites.
Aquatic Herbaceous (AH) *n* = 0	Dominated by submerged plants or plants with floating leaves	This uncommon (0.02% of mine mapping area) vegetation type was documented only at limited-data collection plots in the mine study area. A detailed description of this vegetation type is provided in Appendix 13.1B.
Barren (BARE) *n* = 0	Very sparse (<10 percent) cover of vascular plants	This uncommon (<2% of mine mapping area) land-cover type was documented only at limited-data collection plots in the mine study area. A representative photo is provided in Appendix 13.1B.
Partially Vegetated (PV) *n* = 12	Sparse (10-25 percent) cover of vascular plants	Dwarf ericaceous shrubs, low/dwarf *Salix* spp., and scattered short herbs, particularly *Calamagrostis canadensis,* were typical.
Open Water (OW) *n* = 0	Unvegetated to very sparsely vegetated open water, including streams, rivers, lakes, and ponds	This land-cover type is unvegetated or very sparsely vegetated and was documented only at limited-data collection plots in the mine study area. A representative photo is provided in Appendix 13.1B.
Snow (SNOW) *n* = 0	Persistent snowfields	This land-cover type is unvegetated and was not documented in the field, but was mapped based on aerial photographs.

a. The number of plots (*n*) includes plots where field investigators collected full vegetation data. It does not include shrub height plots or limited-data collection plots.

b. See Appendix 13.1B for photos and further detail, including the common names associated with the Latin names given in this column and an explanation of dominant species.

TABLE 13.1-4
Project Vegetation Type Acreages, Mine Mapping Area, 2004-2008

Project Vegetation Mapping Code	Project Vegetation Type	Number of Acres [a]	Percentage of Mapping Area [a]
Forested Types			
OWSF	Open White Spruce Forest	49.4	0.04
WSW	White Spruce Woodland	127.3	0.10
CBF	Closed Broadleaf Forest	18.5	0.01
OBF	Open Broadleaf Forest	185.1	0.14
BW	Broadleaf Woodland	16.8	0.01
OMF	Open Mixed Forest	36.6	0.03
MFW	Mixed Forest Woodland	4.9	<0.01
DBSS	Dwarf Black Spruce Scrub	0.1	<0.01
DWSS	Dwarf White Spruce Scrub	0.2	<0.01
Forested Types Totals		**438.9**	**0.33**
Shrub Types			
CWTS	Closed Willow Tall Shrub	2,837.2	2.22
CATS	Closed Alder Tall Shrub	5,177.6	4.05
CAWTS	Closed Alder Willow Tall Shrub	4,401.3	3.44
OWTS	Open Willow Tall Shrub	2,979.3	2.33
OATS	Open Alder Tall Shrub	1,088.7	0.85
OAWTS	Open Alder Willow Tall Shrub	1,075.9	0.84
CWLS	Closed Willow Low Shrub	1,433.7	1.12
CALS	Closed Alder Low Shrub	43.9	0.03
CAWLS	Closed Alder Willow Low Shrub	134.6	0.11
OMSST	Open Mixed Shrub Sedge Tussock	548.7	0.43
ODBS	Open Dwarf Birch Shrub	1,116.1	0.87
LEST	Low Ericaceous Shrub Tundra	1,065.7	0.83
ODBESB	Open Dwarf Birch Ericaceous Shrub Bog	1,500.2	1.17
ESB	Ericaceous Shrub Bog	1,567.9	1.23
SBW	Shrub Birch Willow	1,607.6	1.25
OWLS	Open Willow Low Shrub	7,980.5	6.25
OWLSF	Open Willow Low Shrub Fen	999.2	0.78
OSGB	Open Sweetgale Graminoid Bog	5.1	<0.01
OAWLS	Open Alder Willow Low Shrub	240.9	0.19
OALS	Open Alder Low Shrub	126.7	0.10
DESLT	Dwarf Ericaceous Shrub Lichen Tundra	12,931.5	10.12
DEST	Dwarf Ericaceous Shrub Tundra	48,873.9	38.25
DEST-H	Dwarf Ericaceous Shrub Tundra—Hummocks	4,219.1	3.30
DEST-C	Dwarf Ericaceous Shrub Tundra—*Carex*	1,259.3	0.99

Project Vegetation Mapping Code	Project Vegetation Type	Number of Acres [a]	Percentage of Mapping Area [a]
DEST-EQ	Dwarf Ericaceous Shrub Tundra—*Equisetum*	295.6	0.23
Shrub Types Totals		**103,510.2**	**81.0**
Herbaceous Types			
BTG	Bluejoint Tall Grass	2,897.9	2.27
BH	Bluejoint Tall Grass Herb	2,912.1	2.28
SSMWM	Subarctic Sedge Moss Wet Meadow	4,309.8	3.37
FSM	Fresh Sedge Marsh	321.1	0.25
MH	Mesic Herb	896.7	0.70
FHM	Fresh Herb Marsh	37.7	0.03
AH	Aquatic Herbaceous	26.5	0.02
Herbaceous Types Totals		**11,401.8**	**8.92**
Land-cover Types			
BARE	Barren	2,002.9	1.57
PV	Partially Vegetated	7,093.9	5.55
OW	Open Water	3,234.4	2.53
SNOW	Snow	91.9	0.07
Land-cover Types Totals		**12,423.1**	**9.72**
TOTAL MAPPING AREA		**127,773.9**	**100**

Note:

a. All numbers are rounded. Apparent inconsistencies in sums are the result of rounding.

TABLE 13.1-5
Grouped Vegetation Types and Associated Acreage, Mine Mapping Area, 2004-2008

Grouped Vegetation Type [a]	Project Vegetation Mapping Code [b]	Number of Acres [c]	Percentage of Mapping Area [c]
Open/Closed Forest	CBF, OWSF, OBF, OMF, WSW, DBSS, DWSS, BW, MFW	438.9	0.3
Open Tall Shrub	OATS, OAWTS, OWTS	5,143.9	4.0
Closed Tall Shrub	CATS, CAWTS, CWTS	12,416.1	9.7
Open Low Shrub	OALS, OWLS, OAWLS, OSGB,OMSST, SBW, OWLSF, LEST, ESB, ODBESB, ODBS	16,758.6	13.1
Closed Low Shrub	CAWLS, CWLS, CALS	1,612.2	1.3
Dwarf Shrub	DESLT, DEST, DEST-H, DEST-C, DEST-EQ,	67,579.4	52.9
Dry to Moist Herbaceous	BTG, BH, MH	6,706.7	5.2
Wet Herbaceous	AH, FHM, FSM, SSMWM	4,695.1	3.7
Open Water	OW	3,234.4	2.5
Other	BARE, SNOW, PV	9,188.7	7.2
Total Mapping Area		**127,773.9**	**100.0**

Note:

a. The 45 Project Vegetation Types for the mine study area were aggregated into vegetation type groups based on the dominant growth form (tree, shrub, or herb), vegetation density (open or closed canopy), and average height (tall, low, or dwarf).

b. Project Vegetation Mapping Codes are defined in Table 13.1-4.

c. All numbers are rounded. Apparent inconsistencies in sums are the result of rounding.

TABLE 13.1-6
AKNHP Tracked Vascular Plant Species Observed in the Mine Mapping Area, 2004-2008

Latin Name	Common Name	AKNHP Ranks (Global and State) [a]	Project Vegetation Type	Plot Number, Approximate Location	Plant Identification Verification Status (Voucher Specimen Number)
Carex bebbi	Bebb's sedge	G5S1	Bluejoint Herb	3PP3845 North of Kaskanak Mt.	Identity not positively confirmed (no voucher specimen)
Carex crawfordii	Crawford's sedge	G5S3	Bluejoint Herb	3PP13707 Two miles SE of Crazy Lady Lake	Confirmed [b] Voucher transferred to UAF Herbarium.
Eriophorum viridicarinatum	Green-keel cotton grass	G5S2	Subarctic Sedge Moss Wet Meadow	3PP16383 NE of Sharp Mt	Identity not positively confirmed (no voucher specimen)
Primula tschuktschorum	Chukchi primrose	G2G3 S2S3	Subarctic Sedge Moss Wet Meadow	3PP9789 Three miles North of Kaskanak Mt.	Confirmed [b] Voucher transferred to UAF Herbarium
			Bluejoint Herb	3PP20066a -20067 1.5 miles east of Cone (Black) Mt.	Identity not positively confirmed (no voucher specimen)
			Subarctic Sedge Moss Wet Meadow	3PP09557 One mile North of Cone (Black) Mt.	Identity not positively confirmed (voucher specimen collected)
Rumex beringensis	Bering Sea Dock	G3S3	Mesic Herb (shoreline)	3PP16329 Between Newhalen and Upper Talarik River	Confirmed [b] Voucher transferred to UAF Herbarium.
			Partially Vegetated (shoreline)	3PP2147 Six miles SE of Koktuli River Confluence	Confirmed [b] Voucher transferred to UAF Herbarium.

Latin Name	Common Name	AKNHP Ranks (Global and State) [a]	Project Vegetation Type	Plot Number, Approximate Location	Plant Identification Verification Status (Voucher Specimen Number)
			Mesic Herb	3PP10506 Between Newhalen and Upper Talarik River	Confirmed [b] Voucher transferred to UAF Herbarium
			Partially Vegetated (shoreline)	3PP7947 Between Newhalen and Upper Talarik River	Confirmed [b] Voucher transferred to UAF Herbarium.
			Dwarf Ericaceous Shrub Tundra	3PP5207 Between Newhalen and Upper Talarik River	Identity not positively confirmed (voucher specimen collected)
Stellaria umbellata	Umbellate starwort	G5 S2S3	Open Willow Low Shrub	3PP8369	Identity not positively confirmed (no voucher specimen)

Notes:

a. The Alaska Natural Heritage Program (AKNHP) ranks plants with a code that describes their population status on a global (Gx) and on a statewide (Sx) level, where "x" represents a rank from 1 to 5, where 5 is a common plant with demonstrably secure populations, and 1 is a critically imperiled plant whose populations are vulnerable to extirpation or extinction. If the rank is uncertain, it is described as a range between two numbers (for example, S2S3) or with a question mark (for example, G5?). Tracked species are those with a state rank of S1 through S4.

b. Identity of a voucher specimen was confirmed by C. Parker of the University of Alaska Fairbanks herbarium.

TABLE 13.2-1
Project Vegetation Types in Which the Tree Stratum Is Dominant (≥10% tree cover), Transportation-corridor Study Area

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Closed White Spruce Forest (CWSF) *n* = 0	Closed forests dominated by white spruce	This Project Vegetation Type was identified only on aerial photographs and vegetation data were not collected in any study area; therefore, species data are not available for this Project Vegetation Type.
Open White Spruce Forest (OWSF) *n* = 4	Open forests dominated by white spruce	*Picea glauca* trees formed the principal vegetation stratum. *Vaccinium uliginosum, V. vitis-idaea,* and *Empetrum nigrum* were frequently observed in the understory.
Black Spruce Woodland (BSW) *n* = 4	Woodlands dominated by black spruce	*Picea mariana* trees formed the principal vegetation stratum. Common shrubs in these plots included *Ledum decumbens* and *Empetrum nigrum.* Typical herbs were *Equisetum sylvaticum* and sedges (*Carex* spp.).
White Spruce Woodland (WSW) *n* = 42	Woodlands dominated by white spruce	*Picea glauca* trees formed the prinicpal vegetation stratum. Frequently observed shrubs included *Betula nana*, *Empetrum nigrum*, *Ledum decumbens*, *Vaccinium uliginosum*, and *V. vitis-idaea.* Typical herbs were *Calamagrostis canadensis* and *Equisetum arevense*.
Closed Broadleaf Forest (CBF) *n* = 6	Closed forests dominated by broadleaf tree species	*Betula kenaica* and *Populus balsamifera* trees formed the principal vegetation stratum. *Viburnum edule* was a typical shrub. Typical herbs included *Calamagrostis canadensis, Dryopteris dilatata, Equisetum arvense,* and *Gymnocarpium dryopteris*.
Open Broadleaf Forest (OBF) *n* = 34	Open forests dominated by broadleaf tree species	*Betula papyrifera, B. kenaica,* and *Populus balsamifera* trees formed the principal vegetation stratum. *Spiraea beauverdiana, Vaccinium vitis-idaea, Viburnum edule, Calamagrostis canadensis, Epilobium angustifolium,* and *Gymnocarpium dryopteris* were common in the understory.
Broadleaf Woodland (BW) *n* = 2	Woodlands dominated by broadleaf tree species	*Betula kenaica* and *Populus balsamifera* trees formed the principal vegetation stratum. In these plots, shrubs were present but no one genus appeared in both plots. *Calamagrostis canadensis, Sanguisorba stipulata*, and *Equisetum arvense* were commonly present in the herb stratum.
Closed Mixed Forest (CMF) *n* = 10	Closed forests co-dominated by needleleaf and broadleaf tree species	*Picea glauca*, *Betula kenaica*, and *Populus balsamifera* trees formed the principal vegetation stratum. *Alnus sinuata, Vaccinium vitis-idaea,* and *Calamagrostis canadensis* was common in the understory.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Open Mixed Forest (OMF) *n* = 60	Open forests co-dominated by needleleaf and broadleaf tree species	*Picea glauca*, *Betula papyrifera,* and *Populus balsamifera* trees formed the principal vegetation stratum. *Spiraea beauverdiana, Vaccinium vitis-idaea, Calamagrostis canadensis,* and *Gymnocarpium dryopteris* were common in the understory
Mixed Forest Woodland (MFW) *n* = 28	Woodlands co-dominated by needleleaf and broadleaf tree species	*Picea glauca* and *Betula papyrifera* trees formed the principal vegetation stratum. *Empetrum nigrum, Ledum decumbens, Vaccinium uliginosum,* and *Calamagrostis canadensis* were common in the understory.
Dwarf Black Spruce Scrub (DBSS) *n* = 3	Open forests and woodlands dominated by dwarf black spruce (<10 feet tall)	Dwarf *Picea mariana* trees formed the principal vegetation stratum. Frequently observed shrubs in these plots included *Betula nana*, *Ledum decumbens, Vaccinium uliginosum,* and *V. vitis-idaea.* Typical herbs included *Carex bigelowii* and *Rubus chamaemorus.*
Dwarf White Spruce Scrub (DWSS) *n* = 4	Open forests and woodlands dominated by dwarf white spruce (<10 feet tall)	Dwarf *Picea glauca* trees formed the principal vegetation stratum. Frequently observed shrubs in these plots included *Betula nana* and *Empetrum nigrum.* Typical herbs included *Carex bigelowii, C. canescens,* and *Equisetum arvense.*

Notes:

a. Number of plots (*n*) includes plots where field investigators collected detailed vegetation data. It does not include shrub height plots or limited-data collection plots.

b. Forest density classes (closed, open, woodland) are differentiated based on tree canopy cover (>60%, 25-59%, 10-24%, respectively).

c. See Appendix 13.1B for photos and further detail, including the common names associated with the Latin names given in this column. These descriptions are not necessarily based on statistical dominance but are based on a combination of frequency, cover, and professional experience to list species that create a typical picture of the site.

TABLE 13.2-2
Project Vegetation Types in Which the Shrub Stratum Is Dominant (shrub cover is >25%), Transportation-corridor Study Area

Tree coverage is <10%.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Closed Willow Tall Shrub (CWTS) *n* = 6	Thickets of tall willows	Characteristic species in these willow thickets were S*alix barclayi* and *S. pulchra.* In the understory, C*alamagrostis canadensis*, *Epilobium angustifolium, Equisetum arvense*, and *Sanguisorba canadensis* were frequently observed. .
Closed Alder Tall Shrub (CATS) *n* = 13	Thickets of tall alder	*Alnus sinuata* shrubs formed the principal vegetation stratum. Other frequently occuring species in the understory included *Calamagrostis canadensis, Dryopteris dilatata, Oplopanax horridus,* and *Rubus spectabilis.*
Closed Alder Willow Tall Shrub (CAWTS) *n* = 2	Mixed-species thickets of tall alders and willows	*Alnus sinuata* and *Salix alaxensis* shrubs formed the principal vegetation stratum in these two plots. *Calamagrostis canadensis* was the most frequently occuring herb.
Open Willow Tall Shrub (OWTS) *n* = 6	Open stands of tall willow	Willow shrubs, including *Salix barclayi, S. glauca,* and *S. pulchra,* formed the principal vegetation stratum in these thickets. Frequently occuring species in the understory included *Vaccinium uliginosum, Calamagrostis canadensis,* and *Equisetum arvense.*
Open Alder Tall Shrub (OATS) *n* = 2	Open stands of tall alder	Alder shrubs, mainly *Alnus sinuata*, formed the principal vegetation stratum in these plots. *Rubus spectabilis* and *Calamagrostis canadensis* were common in the understory.
Open Alder Willow Tall Shrub (OAWTS) *n* = 1	Tall, open shrub stands co-dominated by alder and willow	Alder and willow shrubs, *Alnus sinuata* and *Salix barclayi,* formed the principal vegetation stratum in this plot. *Calamagrostis canadensis* and *Dryopteris dilatata* were frequently observed in the understory.
Closed Willow Low Shrub (CWLS) *n* = 4	Thickets of low willow	The characteristic species in these plots were *Salix barclayi* and *S. pulchra.* The understory was most commonly composed of *Calamagrostis canadensis* and *Equisetum arvense.*
Closed Alder Willow Low Shrub (CAWLS) *n* = 0	Mixed-species thickets of low alders and willows	This Project Vegetation Type was documented in the transportation-corridor study area only at a limited-data collection plot; therefore, species data are not available for this Project Vegetation Type in the transportation-corridor study area. See Appendix 13.1B.

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Open Mixed Shrub Sedge Tussock (OMSST) *n* = 6	Tussock tundra co-dominated by low shrubs and tussock-forming sedges	*Eriophorum angustifolium* was the most common tussock-forming species. Many dwarf shrubs co-dominated these communities, including *Andromeda polifolia, Betula nana,* and *Vaccinium* spp. Other common herbs are *Carex aquatilis* and *Rubus chamaemorus.*
Open Dwarf Birch Shrub (ODBS) *n* = 42	Open stands of dwarf birch or shrub birch (>8 inches tall)	*Betula nana* shrubs formed the principal vegetation stratum. Other frequently occuring shrubs included *Empetrum nigrum, Ledum decumbens, Vaccinium uliginosum,* and *V. vitis-idaea. Carex bigelowii* and *Rubus chamaemorus* were common scattered herbs.
Low Ericaceous Shrub Tundra (LEST) *n* = 13	Open to dense stands of low ericaceous shrubs	Ericaceous shrubs such as *Ledum decumbens, Vaccinium uliginosum,* and *V. vitis-idaea,* and *Empetrum nigrum* and *Betula nana* formed the principal vegetation stratum. Frequently occuring herbs included scattered sedges (*Carex* spp.) and *Rubus chamaemorus.* A moss layer also was present.
Open Dwarf Birch Ericaceous Shrub Bog (ODBESB) *n* = 41	Bogs and fens with abundant mosses, ericaceous shrubs, and dwarf birch. Drainage is poor and soils generally are composed of peat >8 inches thick.	*Betula nana* was the most frequently observed shrub species with percent cover often exceeding 20%. Other common shrubs included *Andromeda polifolia, Empetrum nigrum, Ledum decumbens, Vaccinium uliginosum,* and *V. vitis-idaea.* Common herbs included *Carex bigelowii, Equisetum arvense*, *Eriophorum angustifolium,* and *Rubus chamaemorus. Sphagnum* spp. was abundant (30% or greater cover).
Ericaceous Shrub Bog (ESB) *n* = 17	Bogs and fens with abundant mosses and ericaceous shrubs, but only sparse dwarf birch. Drainage is poor and soils generally are composed of peat >8 inches thick.	Characteristic shrubs included *Betula nana* (cover less than 20%)*, Empetrum nigrum, Ledum decumbens,* and *Vaccinium uliginosum.* Common herbs in the understory included *Carex bigelowii, Eriophorum angustifolium,* and *Rubus chamaemorus.*A dense moss layer with greater than 50% cover by *Sphagnum* spp.was often present.
Shrub Birch Willow (SBW) *n* = 8	Open or dense shrub stands co-dominated by willows and birch shrubs	*Betula nana* along with *Salix barclayi* formed the principal vegetation stratum. These species were commonly found with ericaceous shrubs and *Empetrum nigrum.* Common herbs included *Calamagrostis canadensis* and *Equisetum arvense.*
Open Willow Low Shrub (OWLS) *n* = 17	Open stands of low willow	*Salix barclayi* and *S. pulchra* formed the principal vegetation stratum. Other common shrubs included *Betula nana, Empetrum nigrum,* and *Vaccinium uliginosum.* The understory contained a variety of herbs—*Calamagrostis canadensis* was the most frequent.
Open Willow Low Shrub Fen (OWLSF) *n* = 1	Fens and other wet areas characterized by open stands of low willows	Willow shrubs, mainly *Salix pulchra,* and herbs characterized this vegetation type. Herbs varied and mainly included sedges (*Carex* spp.), cottongrass (*Eriophorum* spp.), and *Calamagrostis canadensis.*

Project Vegetation Type and Number of Study Plots [a]	Definition [b]	Typical Vegetative Composition Based on Sample Plots [c]
Open Sweetgale Graminoid Bog (OSGB) *n* = 23	Bogs and fens dominated by sweetgale (>25% cover)	*Myrica gale* shrubs characterized the primary vegetation stratum. Other common shrubs included *Andromeda polifolia, Betula nana,* and *Potentilla fruticosa*. Herbs included mainly sedges, with *Carex aquatilis* being the most frequenlty occuring herb.
Open Alder Willow Low Shrub (OAWLS) *n* = 1	Low, open shrub stands co-dominated by alder and willow	*Alnus sinuata* and *Salix barclayi* characterized the shrub stratum. Herbs were scarce or absent, and bare ground was prominent.
Open Alder Low Shrub (OALS) *n* = 1	Open stands of low alder	*Alnus sinuata* formed the primary vegetation stratum. Common herbs in this plot included *Calamagrostis canadensis* and *Dryopteris dilatata.*
Dwarf Ericaceous Shrub Lichen Tundra (DESLT) *n* = 0	Open stands of dwarf ericaceous shrubs on lichen-dominated (>60% cover) ground	This Project Vegetation Type was documented in the transportation-corridor study area only by limited-data collection plots; therefore, species data are not available for this Project Vegetation Type in the transportation-corridor study area. See Appendix 13.1B.
Dwarf Ericaceous Shrub Tundra (DEST) *n* = 34	Open to closed stands of dwarf ericaceous shrubs that do not satisfy the requirements of other Project Vegetation Types	The shrub stratum was characterized by dwarf shrubs, including *Betula nana, Empetrum nigrum, Vaccinium uliginosum,* and *V. vitis-idaea.* Although herbs were present, no single species was found frequently or in abundance. Lichen cover was less than 60%.
Dwarf Ericaceous Shrub Tundra—Hummocks (DEST-H) *n* = 6	Open to closed stands of dwarf ericaceous shrubs growing on hummocks >6 inches tall	The shrub stratum was characterized by dwarf shrubs, including *Betula nana, Empetrum nigrum, Vaccinium uliginosum,* and *V. vitis-idaea. Carex biglowii* was a common herb that often grew on the tops of hummocks.
Dwarf Ericaceous Shrub Tundra—*Carex* (DEST-C) *n* = 4	Open to closed stands of dwarf ericaceous shrubs with >25% *Carex* cover	The shrub stratum was characterized by dwarf shrubs, including *Empetrum nigrum, Ledum decumbens*, and *Vaccinium uliginosum. Calamagrostis canadensis* and *Carex bigelowii* were common.

Notes:

a. Number of plots (*n*) includes plots where field investigators collected detailed vegetation data. It does not include shrub height plots or limited-data collection plots,

b. Shrub density classes (closed thickets, open) are differentiated based on shrub canopy cover (>75%, 25-75%, respectively). Shrub height classes (tall, low, dwarf) are differentiated based on average shrub height (>5 feet tall, between 5 feet and 8 inches tall, <8 inches tall, respectively).

c. See Appendix 13.1B for photos and further detail, including the common names associated with the Latin names given in this column. These descriptions are not necessarily based on statistical dominance but are based ona combination of frequency, cover, and professional experience to list species that create a typical picture of the site.

TABLE 13.2-3
Project Vegetation Types in Which the Herb Stratum Is Dominant or Which Lack Vegetation, Transportation-corridor Study Area

Trees provide <10% coverage and shrubs either contribute <25% coverage or are not apparent on photographs because of a dense, tall, herbaceous stratum.

Project Vegetation Type and Number of Study Plots [a]	Definition	Typical Vegetative Composition Based on Sample Plots [b]
Bluejoint Tall Grass (BTG) *n* = 9	Dominated by bluejoint reedgrass; other herbs may be present but are not co-dominant	*Calamagrostis canadensis* formed the primary vegetaion statum. *Equisetum arvense* was the other most common herb. Other herbs were often scattered among the *C. canadensis* culms. Shrubs were less common—*Salix pulchra* occurred most frequently in plots.
Bluejoint Herb (BH) *n* = 11	Co-dominated by bluejoint reedgrass and other herbs	*Calamagrostis canadensis* was abundant and often overtopped a diverse community of shrubs and herbs. *Spirea beauverdiana* was the most common shrub species found scattered throughout plots. Common herbs included *Angelica lucida, Epilobium angustifolium,* and *Geranium erianthum.*
Subarctic Sedge Moss Wet Meadow (SSMWM) *n* = 111	Sedge-dominated communities found on wet sites and that do not satisfy the requirements of other Project Vegetation Types. Moss cover ranges from sparse to nearly complete.	*Carex, Eriophorum,* and *Scirpus* species were abundant in the herb stratum. Common shrubs were often dwarf or low growing and included *Andromeda polifolia, Betula nana,* and *Empetrum nigrum.*
Fresh Sedge Marsh (FSM) *n* = 10	Standing water 6 to14 inches deep dominated by members of the sedge family (*e.g., Carex* spp., *Eriophorum* spp.). Often near open water.	*Carex* and *Eriophorum* species, including *Carex aquatilis, C. rhynchophysa,* and *Eriophorum angustifolium*, formed the primary vegetation stratum. Common shrubs, including *Betula nana* and *Salix fuscescens,* were often dwarf or low growing.
Mesic Herb (MH) *n* = 8	Herb-dominated communities, without a strong component of bluejoint, that occur on mesic sites and that do not satisfy the requirements of other Project Vegetation Types	Herbs formed the primary vegetation stratum. Common herbs included *Calamagrostis canadensis, Dryopteris dilatata, Epilobium angustifolium,* and *Gymnocarpium dryopteris.* Shrubs including *Rubus arcticus* and *Spiraea beauverdiana* were somewhat frequently observed.
Fresh Herb Marsh (FHM) *n* = 2	Persistently flooded areas dominated by non-graminoid herbs that extend above the water surface (i.e., emergents). Water is >6 inches deep.	Emergent herbs rooted in standing water formed the primary vegetation stratum. Common herbs included *Equisetum fluviatile, Menyanthes trifoliata,* and *Potentilla palustris.*

Project Vegetation Type and Number of Study Plots [a]	Definition	Typical Vegetative Composition Based on Sample Plots [b]
Aquatic Herbaceous (AH) *n* = 1	Standing water dominated by submerged plants or plants with floating leaves	Floating-leaved and submerged aquatic herbs formed the primary vegetation stratum. Characteristic species included *Arctophila fulva, Ranunculus flammula,* and *R. trichophyllus.*
Barren (BARE) *n* = 0	Sites with <10% cover of vascular plants	This Project Vegetation Type was documented in the transportation-corridor study area only by a limited-data collection plot; therefore, species data are not available for this cover type in the transportation-corridor study area. See Appendix 13.1B.
Partially Vegetated (PV) *n* = 0	Sites with 10-24% cover of vascular plants	This Project Vegetation Type was documented in the transportation-corridor study area only by limited-data collection plots; therefore, species data are not available for this Project Vegetation Type in the transportation-corridor study area. See Appendix 13.1B.
Open Water (OW) *n* = 0	Standing or flowing water with <25% cover of vascular plants	This Project Vegetation Type was documented in the transportation-corridor study area only by limited-data collection plots; therefore, species data are not available for this Project Vegetation Type in the transportation-corridor study area. See Appendix 13.1B.

Notes:

a. Number of plots (*n*) includes plots where field investigators collected detailed vegetation data. It does not includeshrub height plots or limited-data collection plots.

b. See Appendix 13.1B for photos and further detail, including the common names associated with the Latin names given in this column. These descriptions are not necessarily based on statistical dominance but are based ona combination of frequency, cover, and professional experience to list species that create a typical picture of the site.

TABLE 13.2-4
Project Vegetation Types and Associated Acreages, Transportation-corridor Mapping Area

Project Vegetation Mapping Code	Project Vegetation Type	Number of Acres [a]	Percentage of Mapping Area [a]
Forest Types			
CWSF	Closed White Spruce Forest	6.3	0.0
OWSF	Open White Spruce Forest	1,115.4	5.6
BSW	Black Spruce Woodland	35.5	0.2
WSW	White Spruce Woodland	1,966.3	9.9
CBF	Closed Broadleaf Forest	554.7	2.8
OBF	Open Broadleaf Forest	1,315.0	6.6
BW	Broadleaf Woodland	129.3	0.6
CMF	Closed Mixed Forest	1,009.3	5.1
OMF	Open Mixed Forest	6,147.6	30.9
MFW	Mixed Forest Woodland	1,086.2	5.5
DBSS	Dwarf Black Spruce Scrub	71.8	0.4
DWSS	Dwarf White Spruce Scrub	189.5	1.0
Forest Types Totals		**13,627.0**	**68.4**
Shrub Types			
CWTS	Closed Willow Tall Shrub	46.8	0.2
CATS	Closed Alder Tall Shrub	991.7	5.0
CAWTS	Closed Alder Willow Tall Shrub	136.5	0.7
OWTS	Open Willow Tall Shrub	70.4	0.4
OATS	Open Alder Tall Shrub	442.7	2.2
OAWTS	Open Alder Willow Tall Shrub	115.1	0.6
CWLS	Closed Willow Low Shrub	44.2	0.2
CAWLS	Closed Alder Willow Low Shrub	17.7	0.1
OMSST	Open Mixed Shrub Sedge Tussock	17.5	0.1
ODBS	Open Dwarf Birch Shrub	466.0	2.3
LEST	Low Ericaceous Shrub Tundra	56.1	0.3
ODBESB	Open Dwarf Birch Ericaceous Shrub Bog	311.5	1.6
ESB	Ericaceous Shrub Bog	26.9	0.1
SBW	Shrub Birch Willow	159.7	0.8
OWLS	Open Willow Low Shrub	185.4	0.9
OWLSF	Open Willow Low Shrub Fen	20.5	0.1
OSGB	Open Sweetgale Graminoid Bog	115.1	0.6
OAWLS	Open Alder Willow Low Shrub	27.1	0.1
OALS	Open Alder Low Shrub	120.0	0.6

Project Vegetation Mapping Code	Project Vegetation Type	Number of Acres [a]	Percentage of Mapping Area [a]
DESLT	Dwarf Ericaceous Shrub Lichen Tundra	118.0	0.6
DEST	Dwarf Ericaceous Shrub Tundra	1,176.4	5.9
DEST-H	Dwarf Ericaceous Shrub Tundra—Hummocks	108.0	0.5
DEST-C	Dwarf Ericaceous Shrub Tundra—*Carex*	5.0	0.0
Shrub Types Totals		**4,778.0**	**24.0**
Herbaceous Types			
BTG	Bluejoint Tall Grass	31.3	0.2
BH	Bluejoint Herb	213.4	1.1
SSMWM	Subarctic Sedge Moss Wet Meadow	481.4	2.4
FSM	Fresh Sedge Marsh	39.1	0.2
MH	Mesic Herb	13.6	0.1
FHM	Fresh Herb Marsh	0.9	0.0
AH	Aquatic Herbaceous	2.4	0.0
Herbaceous Types Totals		**782.2**	**3.9**
Land-cover Types			
BARE	Barren	69.1	0.3
PV	Partially Vegetated	60.7	0.3
OW	Open Water	600.1	3.0
Land-cover Types Totals		**730.0**	**3.7**
TOTAL MAPPING AREA		**19,917.1**	**100.0**

Note:

a. All numbers are rounded. Apparent inconsistencies in sums are the result of rounding.

TABLE 13.2-5
Grouped Vegetation Types and Associated Acreages, Transportation-corridor Mapping Area

Grouped Vegetation Type [a]	Project Vegetation Mapping Code [b]	Acres [c]	Percentage of Mapping Area [c]
Open/Closed Forest	BSW, BW, CBF, CMF, CWSF, DBSS, DWSS, MFW, OBF, OMF, OWSF, WSW	13,627.0	68.4
Open Tall Shrub	OATS, OAWTS, OWTS	628.2	3.2
Closed Tall Shrub	CATS, CAWTS, CWTS	1,174.9	5.9
Open Low Shrub	OALS, OWLS, OAWLS, OSGB,OMSST, SBW, OWLSF, LEST, ESB, ODBESB, ODBS	1,505.6	7.6
Closed Low Shrub	CAWLS, CWLS	61.8	0.3
Dwarf Shrub	DESLT, DEST, DEST-H, DEST-C	1,407.5	7.1
Dry to Moist Herbaceous	BTG, BH, MH	258.4	1.3
Wet Herbaceous	AH, FHM, FSM, SSMWM	523.8	2.6
Open Water	OW	600.1	3.0
Other	BARE, PV	129.8	0.7
TOTAL MAPPING AREA		**19,917.1**	**100.0**

Notes:

a. Project Vegetation Types were aggregated into vegetation type groups based on the dominant growth form (tree, shrub, or herb), vegetation density (open or closed canopy), and average height (low, dwarf, or tall).

b. Project Vegetation Mapping Codes are defined in Table 13.2-4.

c. All numbers are rounded. Apparent inconsistencies in sums are the result of rounding.

TABLE 13.2-6
AKNHP Tracked Vascular Plant Species Observed in the Transportation-corridor Study Area

Latin Name	Common Name	AKNHP Ranks (Global and State) [a]	Project Vegetation Type	Plot Number, Approximate Location	Plant Identification Verification Status (Voucher Specimen Number)
Eleocharis quinqueflora	Few-flower spikerush	G5 S1	Subarctic Sedge Moss Wet Meadow	HDR1738 Between Roadhouse and Knutson mountains	Confirmed [b] (MD05-393)
Eriophorum viridicarinatum	Green-keel cottongrass	G5 S2	Subarctic Sedge Moss Wet Meadow	HDR1627 Between Roadhouse and Knutson mountains	Confirmed [b] (ASL07003)
			Open Sweetgale Bog	HDR1189 SE of Roadhouse Mountain	Confirmed [b] (ASL07004)
			Subarctic Sedge Moss Wet Meadow	HDR1026 SE of Roadhouse Mountain	Confirmed [b] (ASL07005)
			Subarctic Sedge Moss Wet Meadow	HDR1738 Between Roadhouse and Knutson mountains	Confirmed [b] (MD05-390, ASL07002)
			Subarctic Sedge Moss Wet Meadow	HDR1172 SE of Roadhouse Mountain	Confirmed [b] (ASL07007)
			Subarctic Sedge Moss Wet Meadow	HDR1181 SE of Roadhouse Mountain	Confirmed [b] (ASL07006)
			Subarctic Sedge Moss Wet Meadow	HDR1182 SE of Roadhouse Mountain	Identity not positively confirmed (no voucher specimen collected)

Latin Name	Common Name	AKNHP Ranks (Global and State) [a]	Project Vegetation Type	Plot Number, Approximate Location	Plant Identification Verification Status (Voucher Specimen Number)
			Open Dwarf Birch Ericaceous Shrub Bog	HDR1622 Between Roadhouse and Knutson mountains	Confirmed [b] (ASL07008)
			Subarctic Sedge Moss Wet Meadow	HDR1636 Between Roadhouse and Knutson mountains	Identity not positively confirmed (no voucher specimen collected)
Malaxis paludosa	Bog adder's mouth	G4 S3	Subarctic Sedge Moss Wet Meadow	HDR1210 SW of Roadhouse Mountain	Identity not yet confirmed by University of Alaska herbarium (diagnostic photos)
			Subarctic Sedge Moss Wet Meadow	HDR1738 Between Roadhouse and Knutson mountains	Confirmed [b] (ASL07001)
			Subarctic Sedge Moss Wet Meadow	HDR1770 Between Newhalen River and Roadhouse Mountain	Confirmed [b] (MD05-398)

Notes:

a. The Alaska Natural Heritage Program (AKNHP) ranks plants with a code that describes their population status on a global (Gx) and on a statewide (Sx) level, where "x" represents a rank from 1 to 5, where 5 is a common plant with demonstrably secure populations, and 1 is a critically imperiled plant whose populations are vulnerable to extirpation or extinction. If the rank is uncertain, it is described as a range between two numbers (for example, S2S3) or with a question mark (for example, G5?). Tracked species are those with a state rank of S1 through S4. AKNHP rank is based on factors contributing to rarity, including population number and size, trends, and threats. An AKNHP rank of G5 S1 means that the species is secure (common; widespread and abundant) throughout its entire global range, but within the State of Alaska, it is critically imperiled (because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation). An AKNHP rank of G5 S2 means that the species is secure (common; widespread and abundant) throughout its entire global range, but within the State of Alaska, it is imperiled (because of rarity due to very restricted range, very few populations, steep declines, or other factors making it very vulnerable to extirpation). An AKNHP rank of G4 S3 means that the species is apparently secure (Uncommon but not rare; some cause for long-term concern due to declines or other factors.) throughout its entire global range, but within the State of Alaska, it is vulnerable (due to restricted range, relatively few populations, recent and widespread declines, or other factors making it vulnerable to extirpation).

b. Identity of a voucher specimen was confirmed by C. Parker of the University of Alaska Fairbanks herbarium.

FIGURES

155°52'0"W 155°44'0"W 155°36'0"W 155°28'0"W 155°20'0"W 155°12'0"W 155°4'0"W

60°0'0"N

59°52'0"N

59°44'0"N

North Fork Koktuli River

South Fork Koktuli River

Upper Talarik Creek

Koktuli River

Kaskanak Creek

Lower Talarik Creek

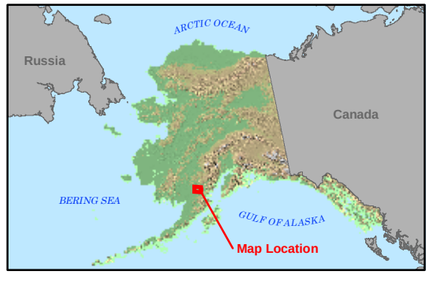
Iliamna Lake

THE pebble PARTNERSHIP

Figure 13.1-1a
Mine Study Area for Vegetation, 2004-2008

Legend

- Mine Mapping Area
- Mine Study Area
- Watershed Boundary
- General Deposit Location



0 2 4 6 Miles

0 2 4 6 8 Kilometers

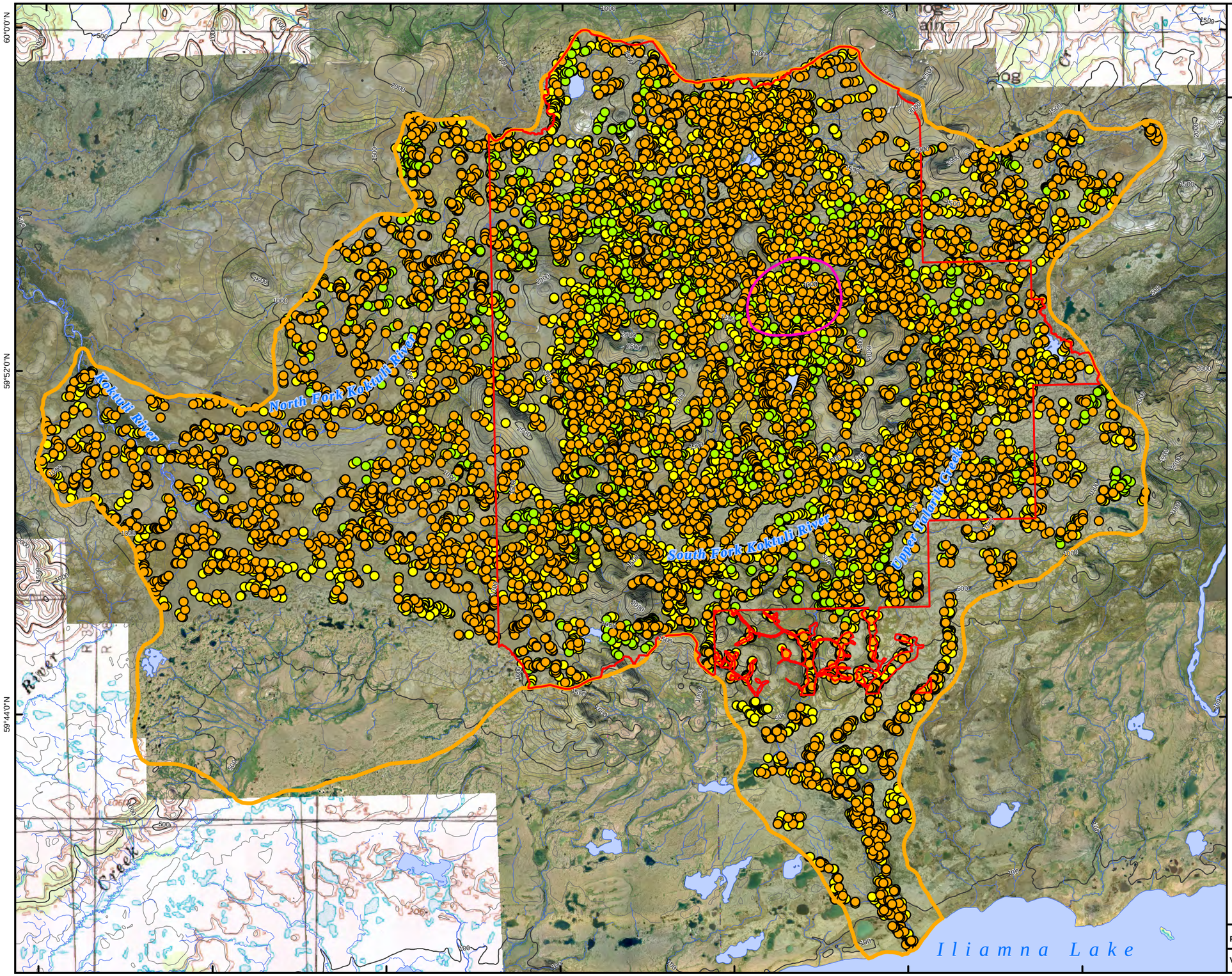
Contour Interval 100 ft

Scale 1:165,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

N

File: RDI_3PP_EBD_Veg_13-1-1a_11X17L_1of1_D07.mxd	Date: July 20, 2011
Version: 7	Author: RDI- LS

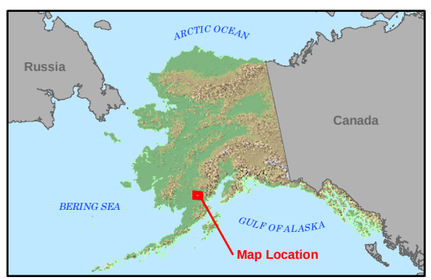


THE pebble PARTNERSHIP

Figure 13.1-1b
Vegetation Study Sites
Mine Study Area,
2004-2008

Legend

- Mine Mapping Area
- Mine Study Area
- General Deposit Location
- Detailed-Data Collection Plots
- Shrub Height Plots
- Limited-Data Collection Plots



0 2 4 6 Miles

0 2 4 6 8 Kilometers

Contour Interval 100 ft

Scale 1:165,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

N

File: RDI_3PP_EBD_Veg_13-1-1b_11X17L_1of1_D07.mxd	Date: July 19, 2011
Version: 7	Author: RDI- LS

155°28'0"W 155°20'0"W 155°12'0"W 155°4'0"W 154°56'0"W

59°60'0"N

59°52'0"N

59°44'0"N

PROJECT VEGETATION TYPE (ACRES)

Forested Types
- Open White Spruce Forest (49.4)
- White Spruce Woodland (127.3)
- Closed Broadleaf Forest (18.5)
- Open Broadleaf Forest (185.1)
- Broadleaf Woodland (16.8)
- Open Mixed Forest (36.6)
- Mixed Forest Woodland (4.9)
- Dwarf Black Spruce Scrub (0.1)
- Dwarf White Spruce Scrub (0.2)

Shrub Types
- Closed Willow Tall Shrub (2,837.2)
- Closed Alder Tall Shrub (5,177.6)
- Closed Alder Willow Tall Shrub (4,401.3)
- Open Willow Tall Shrub (2,979.3)
- Open Alder Tall Shrub (1,088.7)
- Open Alder Willow Tall Shrub (1,075.9)
- Closed Willow Low Shrub (1,433.7)
- Closed Alder Low Shrub (43.9)
- Closed Alder Willow Low Shrub (134.6)
- Open Mixed Shrub Sedge Tussock (548.7)
- Open Dwarf Birch Shrub (1,116.1)
- Low Ericaceous Shrub Tundra (1,065.7)
- Open Dwarf Birch-Ericaceous Shrub Bog (1,500.2)
- Ericaceous Shrub Bog (1,567.9)
- Shrub Birch Willow (1,607.6)
- Open Willow Low Shrub (7,980.5)
- Open Willow Low Shrub Fen (999.2)
- Open Sweetgale Graminoid Bog (5.1)
- Open Alder Willow Low Shrub (240.9)
- Open Alder Low Shrub (126.7)
- Dwarf Ericaceous Shrub Lichen Tundra (12,931.5)
- Dwarf Ericaceous Shrub Tundra (48,873.9)
- Dwarf Ericaceous Shrub Tundra-Hummocks (4,219.1)
- Dwarf Ericaceous Shrub Tundra-Carex (1,259.3)
- Dwarf Ericaceous Shrub Tundra-Equisetum (295.6)

Herbaceous Types
- Bluejoint Tall Grass (2,897.9)
- Bluejoint Tall Grass Herb (2,912.1)
- Subarctic Sedge Moss Wet Meadow (4,309.8)
- Fresh Sedge Marsh (321.1)
- Mesic Herb (896.7)
- Fresh Herb Marsh (37.7)
- Aquatic herbaceous (26.5)

Land Cover Types
- Bareground/Barren (2,002.9)
- Partially Vegetated (7,093.9)
- Open Water (3,234.4)
- Snow (91.9)

THE pebble PARTNERSHIP

Figure 13.1-2
Vegetation Mapping in the Mine Study Area, 2004-2008

Legend
- Mine Mapping Area
- Mine Study Area
- General Deposit Location

Miles 0 1 2 3 4 5

Kilometers 0 1 2 3 4 5 6

N

Scale 1:125,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_3PP_EBD_Veg_13-1-3_11X17L_1of1_D03.mxd	Date: June 27, 2011
Version: 3	Author: RDI- LS

155°36'0"W 155°28'0"W 155°20'0"W 155°12'0"W 155°4'0"W

59°60'0"N

59°52'0"N

59°44'0"N

THE pebble PARTNERSHIP

Figure 13.1-3
Grouped Vegetation Mapping in the Mine Mapping Area, 2004-2008

Legend

- Mine Mapping Area
- Mine Study Area
- General Deposit Location

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Bare, Snow, etc.)

0 1 2 3 4 5 Miles

0 1 2 3 4 5 6 Kilometers

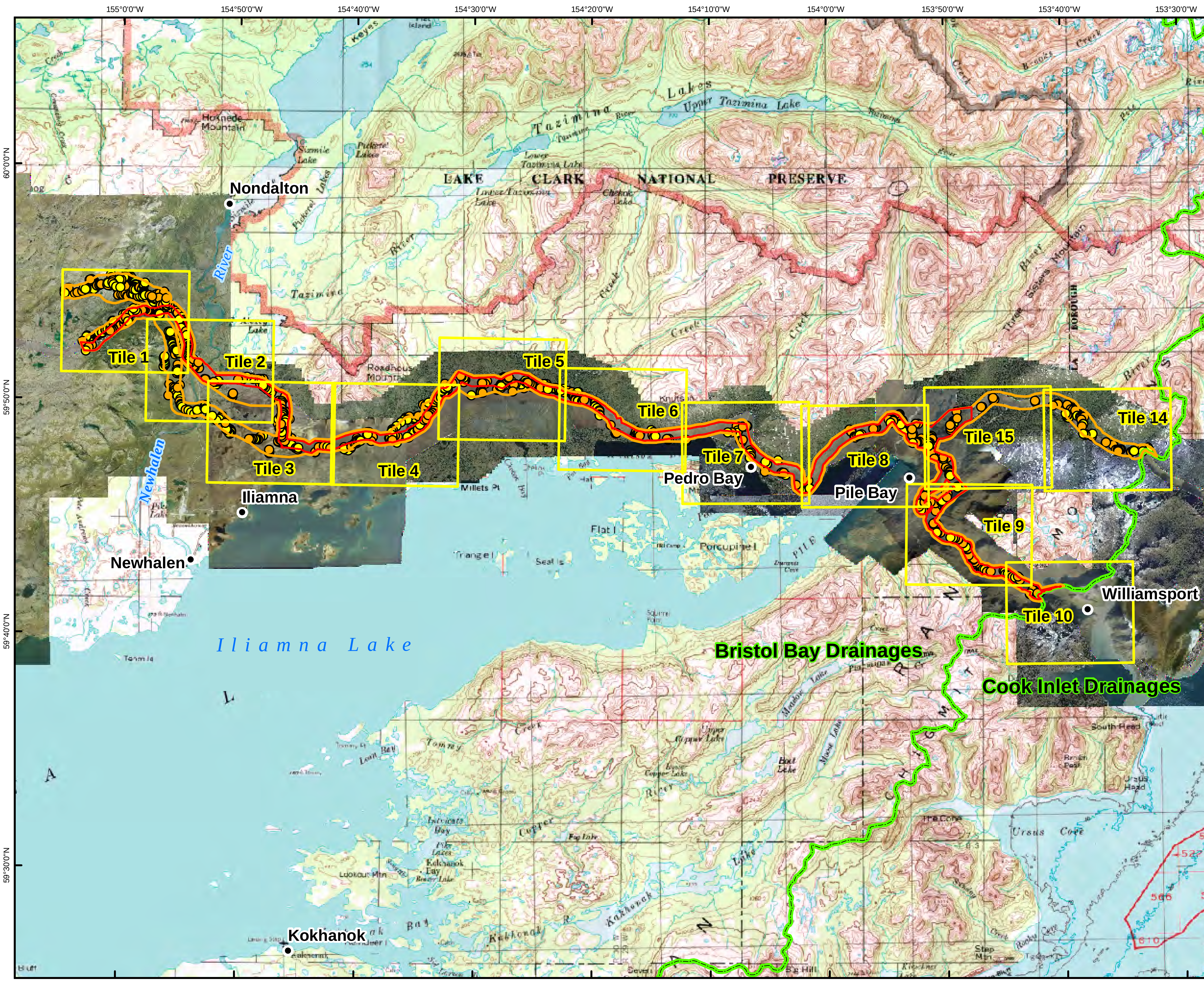
N

Scale 1:125,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_3PP_EBD_Veg_13-1-3_11X17L_1of1_D04.mxd	Date: July 11, 2011
Version: 4	Author: RDI- LS

155°36'0"W 155°28'0"W 155°20'0"W 155°12'0"W 155°4'0"W



THE pebble PARTNERSHIP

Figure 13.2-1 Overview Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Grid for Detailed Mapping Tiles
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots

Note: For detailed mapping see the individual tiles in this figure series.
Tiles 11-13 are presented in the mapping for the Cook Inlet Study Area (EBD Chapter 38).

Miles: 0 2 4 6 8 10
Kilometers: 0 5 10 15
Scale 1:300,000
N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Overview_11X17L_1of1_D03.mxd	Date: August 9, 2011
Version: 3	Author: RDI- LS

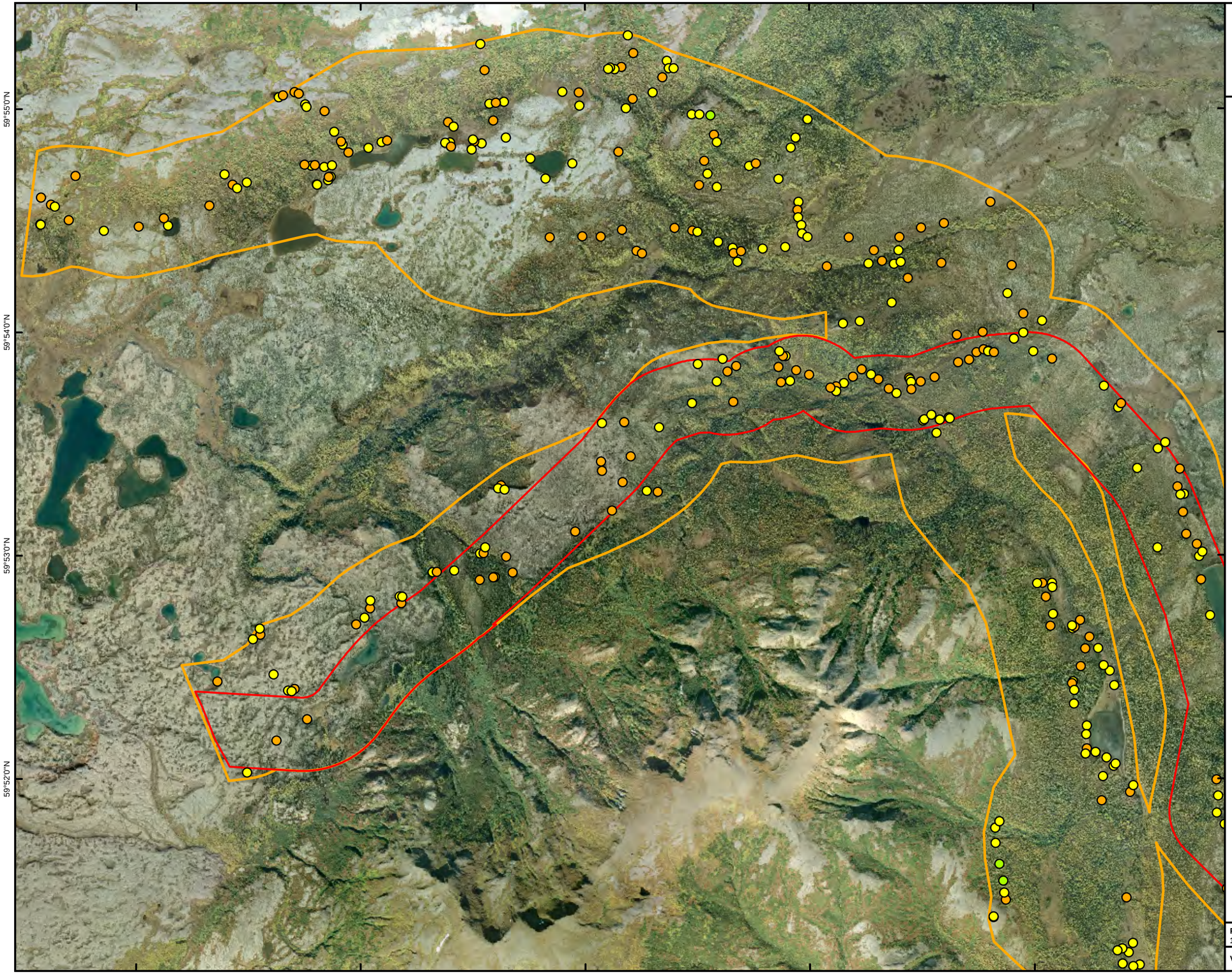
155°4'0"W 155°2'0"W 155°0'0"W 154°58'0"W 154°56'0"W

59°55'0"N

59°54'0"N

59°53'0"N

59°52'0"N

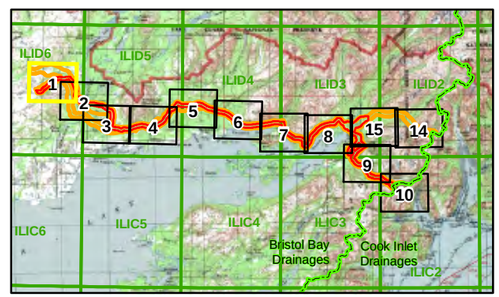


THE pebble PARTNERSHIP

Figure 13.2-1
Tile 1
Vegetation Study Sites,
Transportation-corridor Study Area,
2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_ 11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

154°56'0"W 154°54'0"W 154°52'0"W 154°50'0"W 154°48'0"W

59°53'0"N

59°52'0"N

59°51'0"N

59°50'0"N

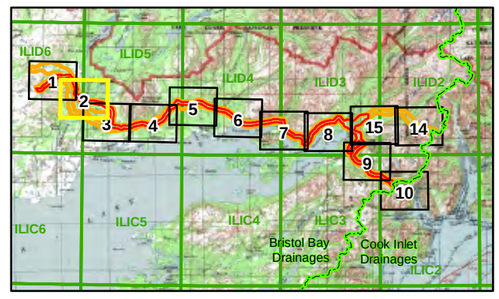
Newhalen River

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 2
Vegetation Study Sites,
Transportation-corridor Study Area,
2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_ 11X17L_1of12_D02.mxd	**Date: July 14, 2011**
Version: 3	**Author: RDI- LS**

154°52'0"W 154°50'0"W 154°48'0"W 154°46'0"W 154°44'0"W 154°42'0"W

59°50'0"N

59°49'0"N

59°48'0"N

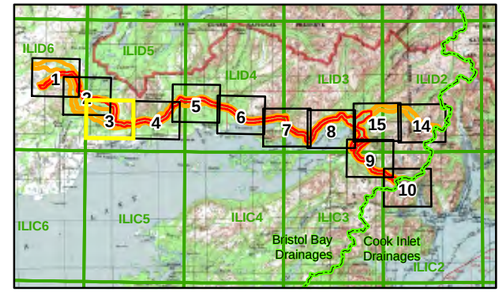
59°47'0"N

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 3
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

154°42'0"W 154°40'0"W 154°38'0"W 154°36'0"W 154°34'0"W 154°32'0"W

59°50'0"N

59°49'0"N

59°48'0"N

59°47'0"N

Roadhouse Mountain

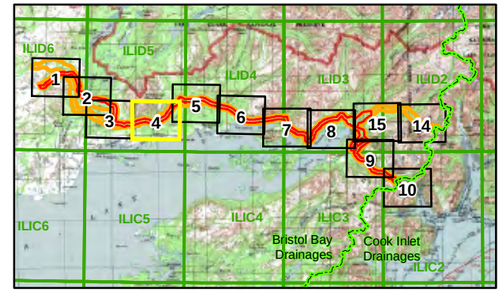
Stonehouse

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 4
Vegetation Study Sites,
Transportation-corridor Study Area,
2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_ 11X17L_1of12_D02.mxd	**Date: July 14, 2011**
Version: 3	**Author: RDI- LS**

154°32'0"W 154°30'0"W 154°28'0"W 154°26'0"W 154°24'0"W

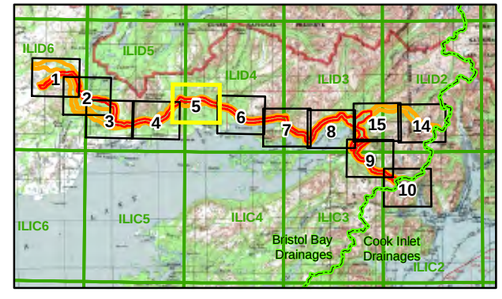
59°52'0"N 59°51'0"N 59°50'0"N 59°49'0"N

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 5
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

154°22'0"W 154°20'0"W 154°18'0"W 154°16'0"W 154°14'0"W

59°51'0"N
59°50'0"N
59°49'0"N
59°48'0"N

Canyon Creek

Knutson Bay

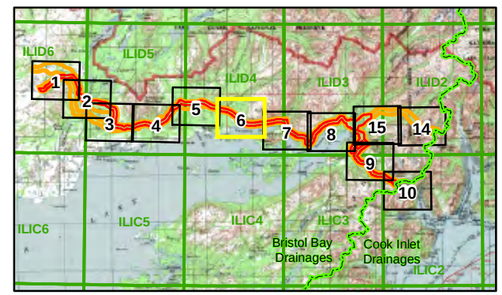
Fox Bay

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 6
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

154°22'0"W 154°20'0"W 154°18'0"W 154°16'0"W 154°14'0"W

154°12'0"W 154°10'0"W 154°8'0"W 154°6'0"W 154°4'0"W 154°2'0"W

59°49'0"N
59°48'0"N
59°47'0"N
59°46'0"N

Knutson Mountain

Knutson Creek

Knutson Bay

Pedro Bay

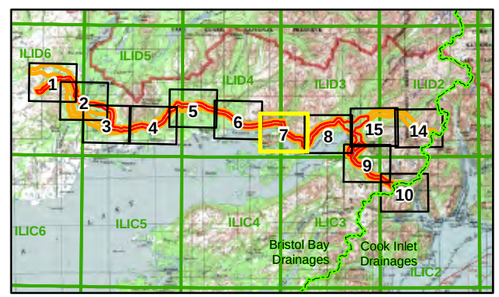
Pedro Bay

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 7
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_ 11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

154°2'0"W 154°0'0"W 153°58'0"W 153°56'0"W 153°54'0"W 153°52'0"W

59°49'0"N 59°48'0"N 59°47'0"N 59°46'0"N

Pile River

Lonesome Bay

Pile Bay

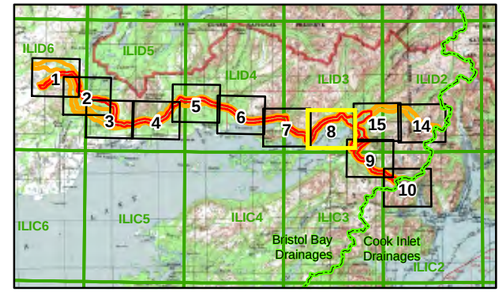
Pile Bay

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 8
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

153°52'0"W 153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W

59°46'0"N 59°45'0"N 59°44'0"N 59°43'0"N

Iliamna River

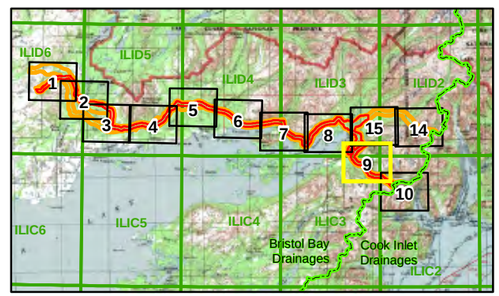
Chinkelyes Creek

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 9
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

153°44'0"W 153°42'0"W 153°40'0"W 153°38'0"W 153°36'0"W

59°43'0"N 59°42'0"N 59°41'0"N 59°40'0"N 59°39'0"N

Williamsport

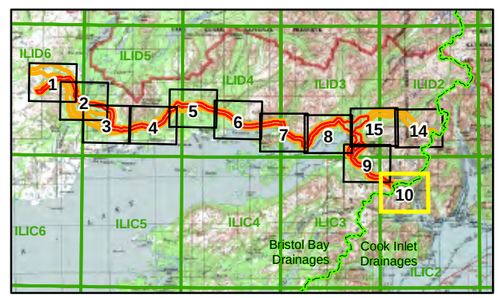
Iliamna Bay

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 10
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

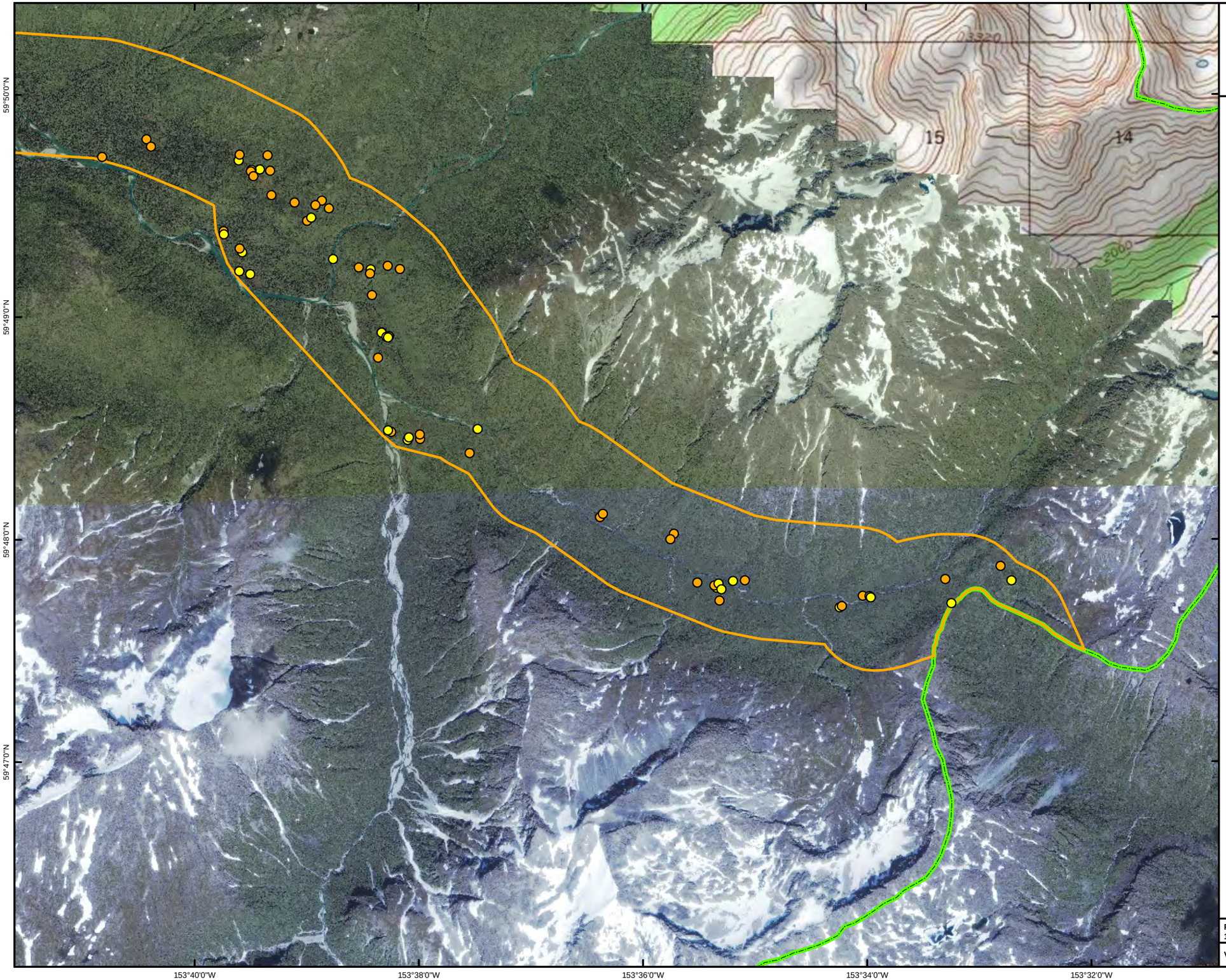
Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

153°40'0"W 153°38'0"W 153°36'0"W 153°34'0"W 153°32'0"W

59°50'0"N 59°49'0"N 59°48'0"N 59°47'0"N

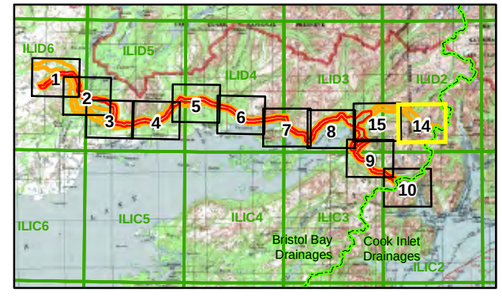


THE pebble PARTNERSHIP

Figure 13.2-1
Tile 14
Vegetation Study Sites,
Transportation-corridor Study Area,
2004-2008

Legend

- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_ 11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W 153°42'0"W

59°50'0"N

59°49'0"N

59°48'0"N

59°47'0"N

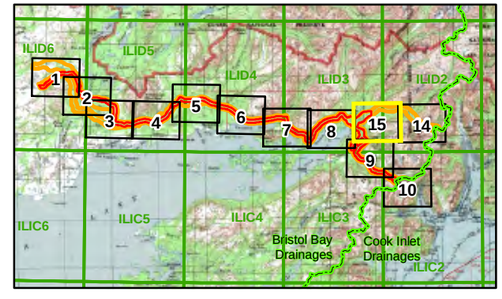
Iliamna River

THE pebble PARTNERSHIP

Figure 13.2-1
Tile 15
Vegetation Study Sites, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities
- Detailed-data Collection Plots
- Shrub Height Plots
- Limited-data Collection Plots



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-1_Veg_Fldplots_Tiled_11X17L_1of12_D02.mxd	Date: July 14, 2011
Version: 3	Author: RDI- LS

155°0'0"W 154°50'0"W 154°40'0"W 154°30'0"W 154°20'0"W 154°10'0"W 154°0'0"W 153°50'0"W 153°40'0"W 153°30'0"W

60°0'0"N

59°50'0"N

59°40'0"N

59°30'0"N

Nondalton
Iliamna
Newhalen
Pedro Bay
Pile Bay
Williamsport
Lake Clark National Preserve
Iliamna Lake
Bristol Bay Drainages
Cook Inlet Drainages
Tile 1
Tile 2
Tile 3
Tile 4
Tile 5
Tile 6
Tile 7
Tile 8
Tile 9
Tile 10
Tile 15

Project Vegetation Type (Acres in Transportation-corridor Mapping Area)

Forested Types

- Closed White Spruce Forest (6)
- Open White Spruce Forest (1,115)
- Black Spruce Woodland (36)
- White Spruce Woodland (1,966)
- Closed Broadleaf Forest (555)
- Open Broadleaf Forest (1,315)
- Broadleaf Woodland (129)
- Closed Mixed Forest (1,009)
- Open Mixed Forest (6,148)
- Mixed Forest Woodland (1,086)
- Dwarf Black Spruce Scrub (72)
- Dwarf White Spruce Scrub (190)

Shrub Types

- Closed Willow Tall Shrub (47)
- Closed Alder Tall Shrub (992)
- Closed Alder Willow Tall Shrub (137)
- Open Willow Tall Shrub (70)
- Open Alder Tall Shrub (443)
- Open Alder Willow Tall Shrub (115)
- Closed Willow Low Shrub (44)
- Closed Alder Willow Low Shrub (18)
- Open Mixed Shrub Sedge Tussock (18)
- Open Dwarf Birch Shrub (466)
- Low Ericaceous Shrub Tundra (56)
- Open Dwarf Birch-Ericaceous Shrub Bog (312)
- Ericaceous Shrub Bog (27)
- Shrub Birch Willow (160)
- Open Willow Low Shrub (185)
- Open Willow Low Shrub Fen (21)
- Open Sweetgale Graminoid Bog (115)
- Open Alder Willow Low Shrub (27)
- Open Alder Low Shrub (120)
- Dwarf Ericaceous Shrub Lichen Tundra (118)
- Dwarf Ericaceous Shrub Tundra (1,176)
- Dwarf Ericaceous Shrub Tundra-Hummocks (108)
- Dwarf Ericaceous Shrub Tundra-Carex (5)

Herbaceous Types

- Bluejoint Tall Grass (31)
- Bluejoint Herb (213)
- Subarctic Sedge Moss Wet Meadow (481)
- Fresh Sedge Marsh (39)
- Mesic Herb (14)
- Fresh Herb Marsh (1)
- Aquatic Herbaceous (2)

Land Cover Types

- Barren (69)
- Partially Vegetated (61)
- Open Water (600)

THE pebble PARTNERSHIP

Figure 13.2-2
Overview
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Grid for Detailed Mapping Tiles
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Note: For detailed mapping see the individual tiles in this figure series.
Tile 11 is presented in the mapping for the Cook Inlet Study Area (EBD Chapter 38).
Tiles 12-14 are not presented because mapping did not extend into those areas.

Miles
0 2 4 6 8 10
Kilometers
0 5 10 15
Scale 1:300,000

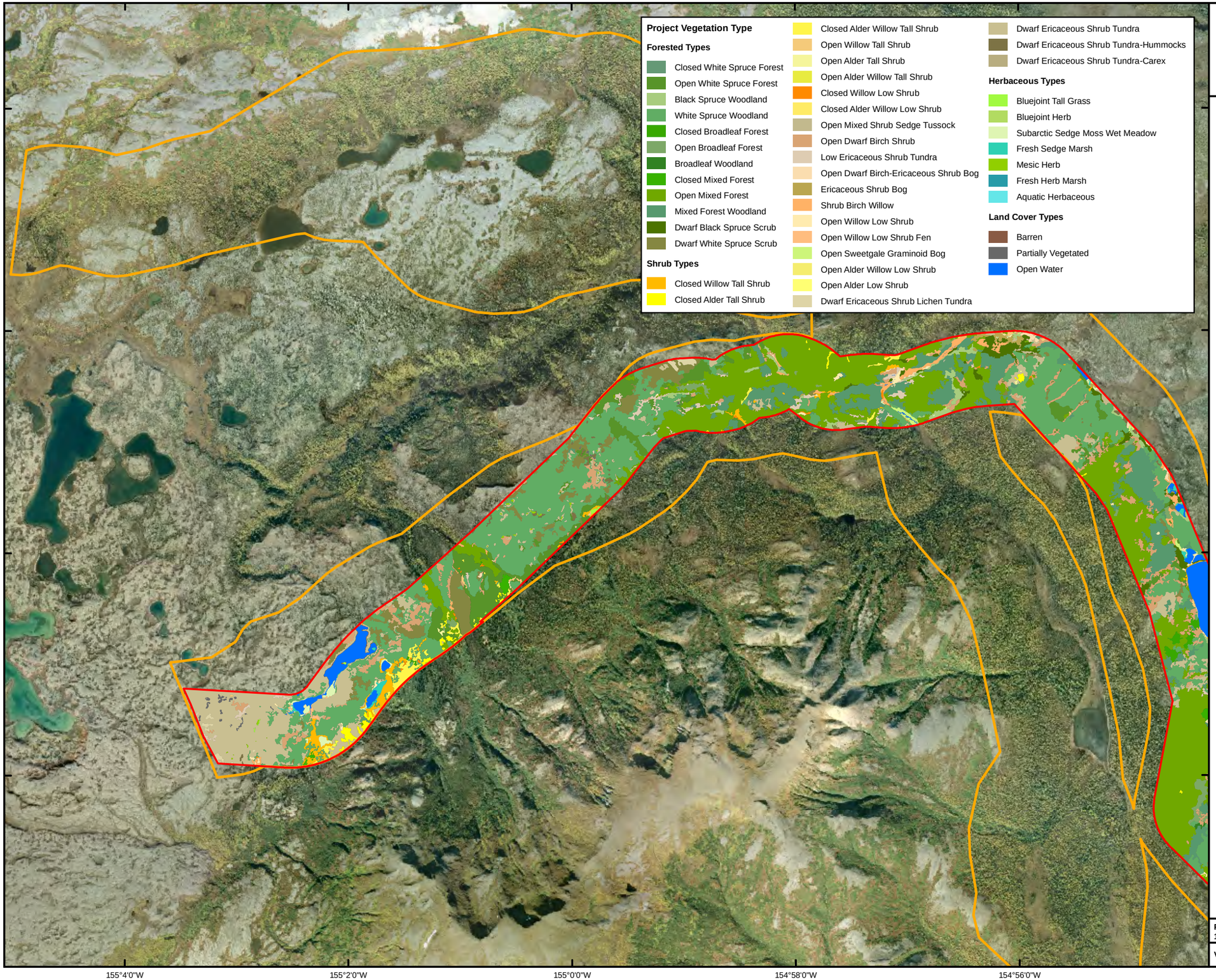
Alaska State Plane Zone 5 (units feet)
1983 North American Datum

N

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Overview_11X17L_1of1_D03.mxd	Date: August 9, 2011
Version: 3	Author: RDI- LS

155°4'0"W 155°2'0"W 155°0'0"W 154°58'0"W 154°56'0"W

59°55'0"N 59°54'0"N 59°53'0"N 59°52'0"N

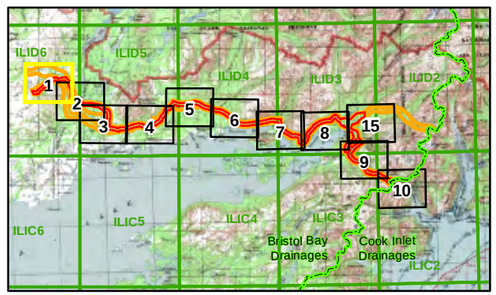


THE pebble PARTNERSHIP

Figure 13.2-2
Tile 1
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	**Date: August 8, 2011**
Version: 4	**Author: RDI- LS**

154°56'0"W 154°54'0"W 154°52'0"W 154°50'0"W 154°48'0"W

59°53'0"N 59°52'0"N 59°51'0"N 59°50'0"N

Newhalen River

Project Vegetation Type

Forested Types
- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types
- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

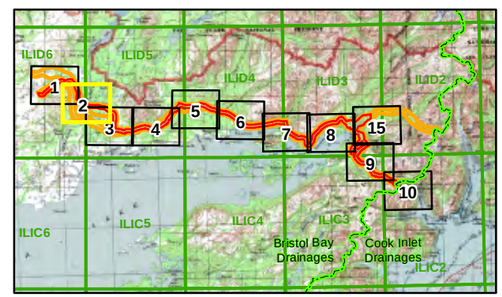
Herbaceous Types
- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 2
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend
- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_ 11X17L_1of11_D04.mxd	**Date: August 8, 2011**
Version: 4	**Author: RDI- LS**

154°52'0"W 154°50'0"W 154°48'0"W 154°46'0"W 154°44'0"W 154°42'0"W

59°50'0"N
59°49'0"N
59°48'0"N
59°47'0"N

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 3
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

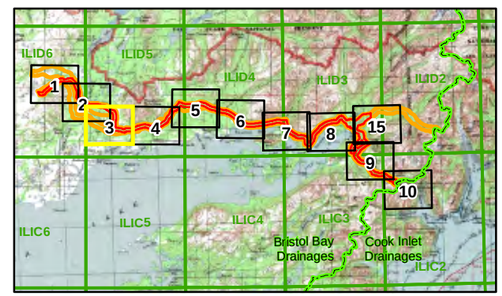
- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

- Barren
- Partially Vegetated
- Open Water



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	Date: August 8, 2011
Version: 4	Author: RDI- LS

154°42'0"W 154°40'0"W 154°38'0"W 154°36'0"W 154°34'0"W 154°32'0"W

59°50'0"N

59°49'0"N

59°48'0"N

59°47'0"N

Roadhouse Mountain

Stonehouse

Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

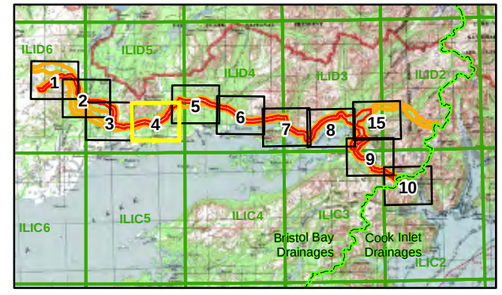
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 4
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	Date: August 8, 2011
Version: 4	Author: RDI- LS

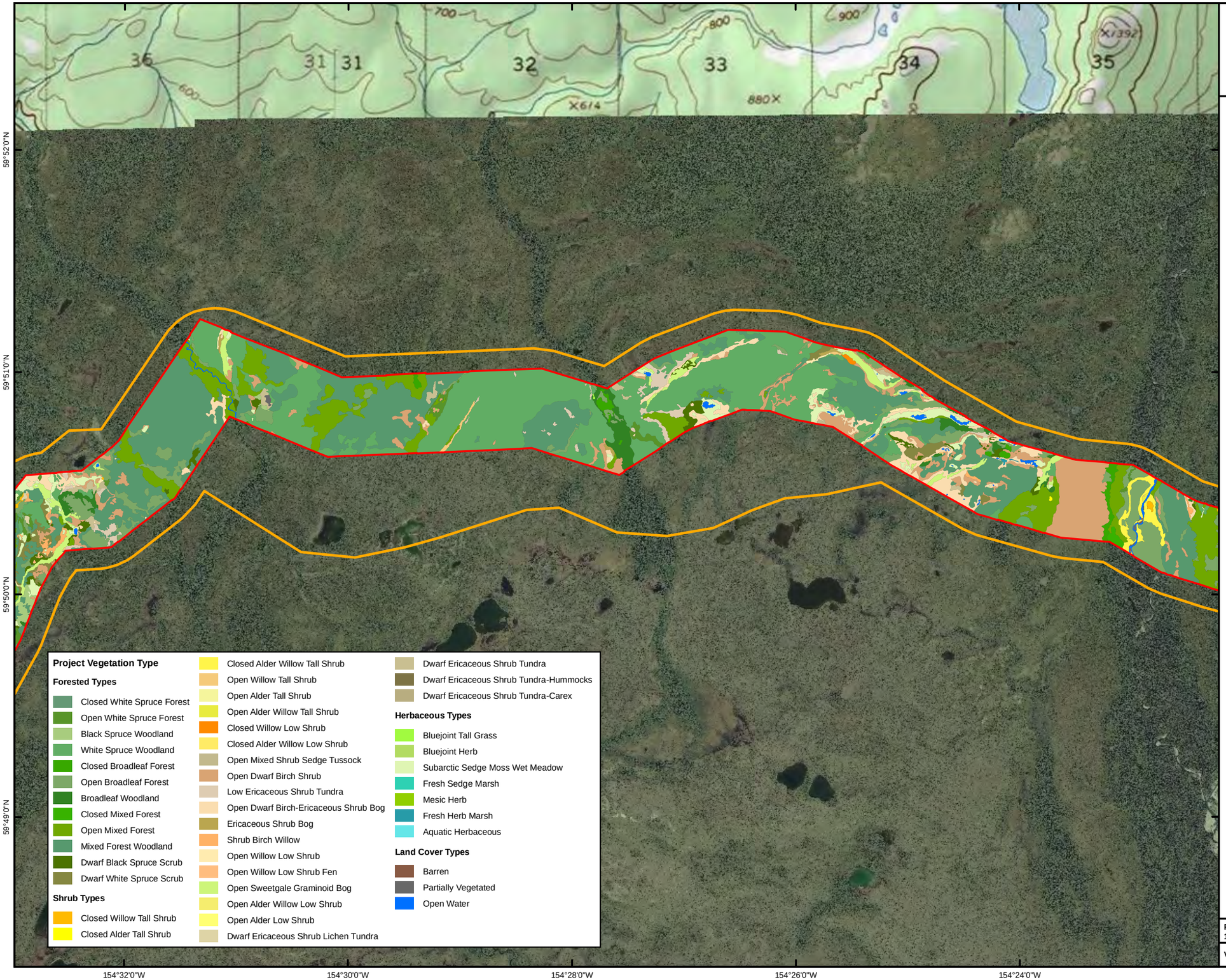
154°32'0"W 154°30'0"W 154°28'0"W 154°26'0"W 154°24'0"W

59°52'0"N

59°51'0"N

59°50'0"N

59°49'0"N



Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

- Barren
- Partially Vegetated
- Open Water

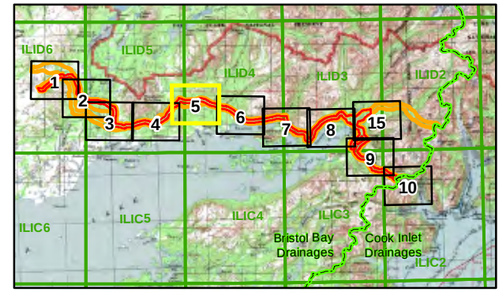
154°32'0"W 154°30'0"W 154°28'0"W 154°26'0"W 154°24'0"W

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 5
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_ 11X17L_1of11_D04.mxd	Date: August 8, 2011
Version: 4	Author: RDI- LS

154°22'0"W 154°20'0"W 154°18'0"W 154°16'0"W 154°14'0"W

59°51'0"N 59°50'0"N 59°49'0"N 59°48'0"N

Canyon Creek

Knutson Bay

Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

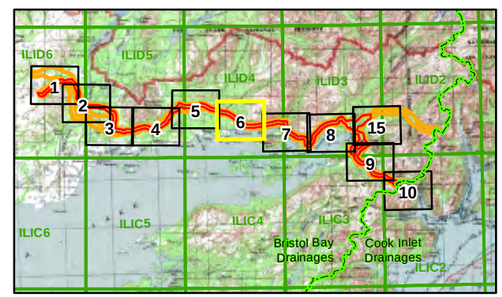
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 6
Vegetation Mapping,
Transportation-corridor Mapping Area,
2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_ 11X17L_1of11_D04.mxd	**Date: August 8, 2011**
Version: 4	**Author: RDI- LS**

154°12'0"W 154°10'0"W 154°8'0"W 154°6'0"W 154°4'0"W 154°2'0"W

59°49'0"N 59°48'0"N 59°47'0"N 59°46'0"N

Knutson Mountain

Knutson Creek

Knutson Bay

Pedro Bay

Pedro Bay

Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

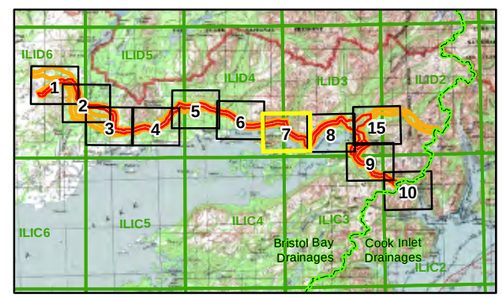
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 7
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	**Date: August 8, 2011**
Version: 4	**Author: RDI- LS**

154°2'0"W 154°0'0"W 153°58'0"W 153°56'0"W 153°54'0"W 153°52'0"W

59°49'0"N
59°48'0"N
59°47'0"N
59°46'0"N

Pile River
Lonesome Bay
Pile Bay
Pile Bay

Project Vegetation Type

Forested Types
- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types
- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

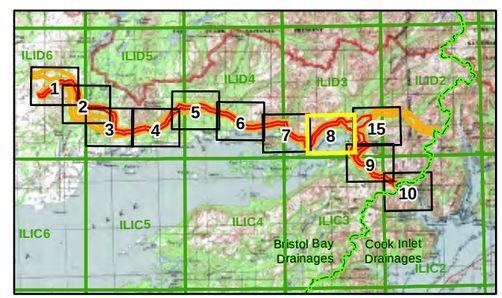
Herbaceous Types
- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 8
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend
- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles
0 0.5 1 1.5 Kilometers
N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	Date: August 8, 2011
Version: 4	Author: RDI- LS

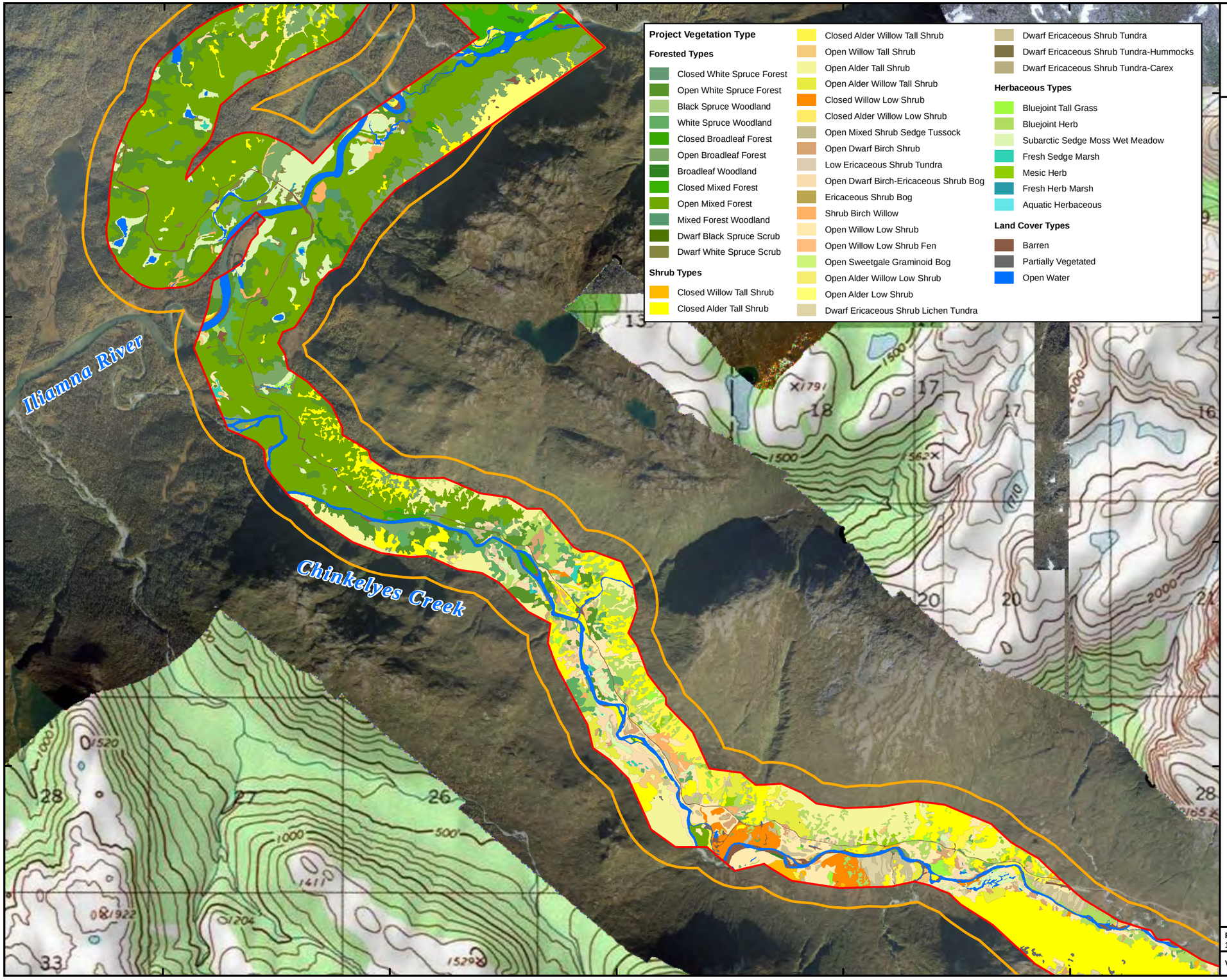
153°52'0"W 153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W

59°46'0"N

59°45'0"N

59°44'0"N

59°43'0"N



Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

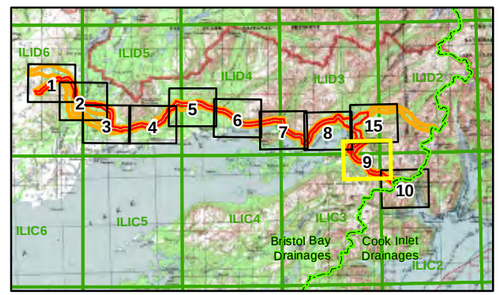
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 9
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_ 11X17L_1of11_D04.mxd	Date: August 8, 2011
Version: 4	Author: RDI- LS

153°44'0"W 153°42'0"W 153°40'0"W 153°38'0"W 153°36'0"W

59°43'0"N 59°42'0"N 59°41'0"N 59°40'0"N 59°39'0"N

Williamsport

Iliamna Bay

Project Vegetation Type

Forested Types

- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types

- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types

- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

Land Cover Types

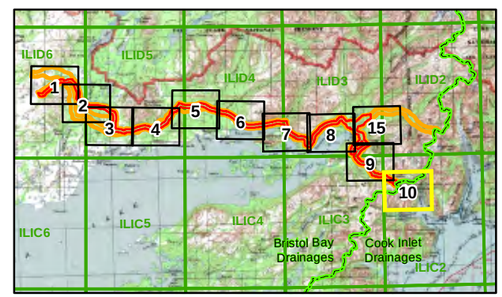
- Barren
- Partially Vegetated
- Open Water

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 10
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	Date: August 8, 2011
Version: 4	Author: RDI- LS

153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W 153°42'0"W

59°50'0"N
59°49'0"N
59°48'0"N
59°47'0"N

Illiamna River

Project Vegetation Type

Forested Types
- Closed White Spruce Forest
- Open White Spruce Forest
- Black Spruce Woodland
- White Spruce Woodland
- Closed Broadleaf Forest
- Open Broadleaf Forest
- Broadleaf Woodland
- Closed Mixed Forest
- Open Mixed Forest
- Mixed Forest Woodland
- Dwarf Black Spruce Scrub
- Dwarf White Spruce Scrub

Shrub Types
- Closed Willow Tall Shrub
- Closed Alder Tall Shrub
- Closed Alder Willow Tall Shrub
- Open Willow Tall Shrub
- Open Alder Tall Shrub
- Open Alder Willow Tall Shrub
- Closed Willow Low Shrub
- Closed Alder Willow Low Shrub
- Open Mixed Shrub Sedge Tussock
- Open Dwarf Birch Shrub
- Low Ericaceous Shrub Tundra
- Open Dwarf Birch-Ericaceous Shrub Bog
- Ericaceous Shrub Bog
- Shrub Birch Willow
- Open Willow Low Shrub
- Open Willow Low Shrub Fen
- Open Sweetgale Graminoid Bog
- Open Alder Willow Low Shrub
- Open Alder Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Dwarf Ericaceous Shrub Tundra-Hummocks
- Dwarf Ericaceous Shrub Tundra-Carex

Herbaceous Types
- Bluejoint Tall Grass
- Bluejoint Herb
- Subarctic Sedge Moss Wet Meadow
- Fresh Sedge Marsh
- Mesic Herb
- Fresh Herb Marsh
- Aquatic Herbaceous

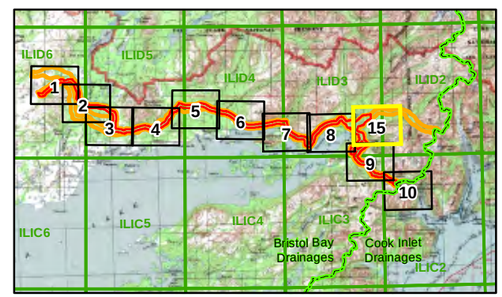
Land Cover Types
- Barren
- Partially Vegetated
- Open Water

153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W 153°42'0"W

THE pebble PARTNERSHIP

Figure 13.2-2
Tile 15
Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend
- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-2_Veg_Detail_Tiled_11X17L_1of11_D04.mxd	**Date: August 8, 2011**
Version: 4	**Author: RDI- LS**

155°0'0"W 154°50'0"W 154°40'0"W 154°30'0"W 154°20'0"W 154°10'0"W 154°0'0"W 153°50'0"W 153°40'0"W 153°30'0"W

60°0'0"N

59°50'0"N

59°40'0"N

59°30'0"N

Nondalton
Iliamna
Newhalen
Pedro Bay
Pile Bay
Williamsport
Kokhanok
Iliamna Lake
Bristol Bay Drainages
Cook Inlet Drainages
Lake Clark National Preserve
Tile 1
Tile 2
Tile 3
Tile 4
Tile 5
Tile 6
Tile 7
Tile 8
Tile 9
Tile 10
Tile 15

THE pebble PARTNERSHIP

Figure 13.2-3
Overview
Grouped Vegetation Mapping, Transportation-corridor Mapping Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Grid for Detailed Mapping Tiles
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)

Note: For detailed mapping see the individual tiles in this figure series.
Tile 11 is presented in the mapping for the Cook Inlet Study Area (EBD Chapter 38).
Tiles 12-14 are not presented because mapping did not extend nto those areas.

0 2 4 6 8 10 Miles
0 5 10 15 Kilometers

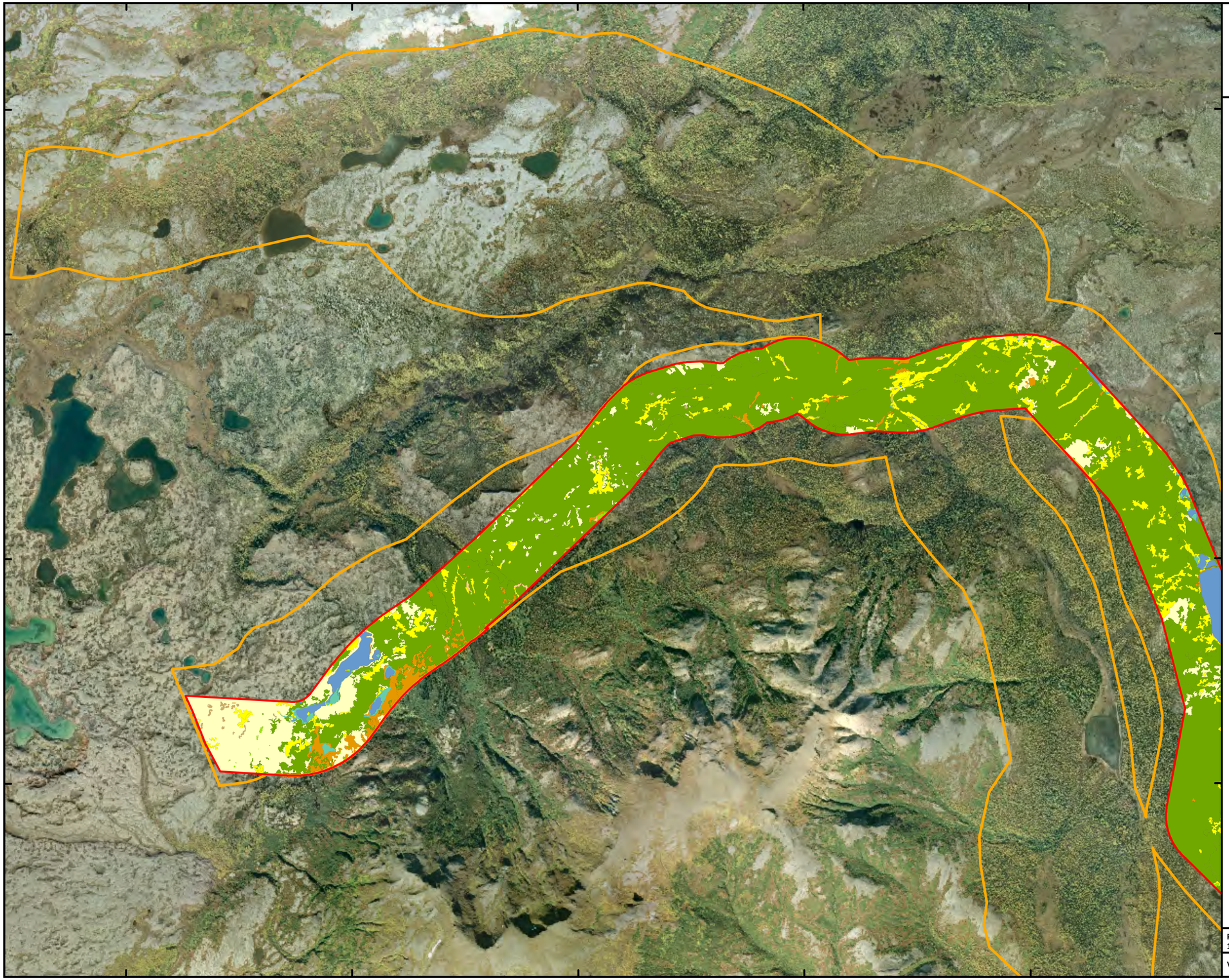
Scale 1:300,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Overview_11X17L_1of1_D03.mxd	Date: August 9, 2011
Version: 2	Author: RDI- LS

155°4'0"W 155°2'0"W 155°0'0"W 154°58'0"W 154°56'0"W

59°55'0"N 59°54'0"N 59°53'0"N 59°52'0"N



THE pebble PARTNERSHIP

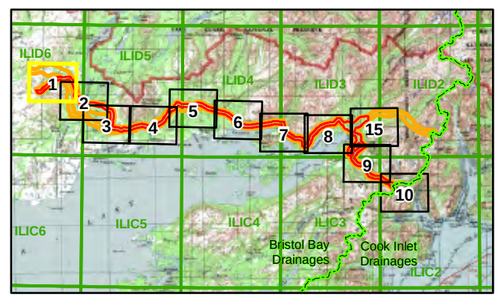
Figure 13.2-3
Tile 1
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

154°56'0"W 154°54'0"W 154°52'0"W 154°50'0"W 154°48'0"W

59°53'0"N 59°52'0"N 59°51'0"N 59°50'0"N

Newhalen River

THE pebble PARTNERSHIP

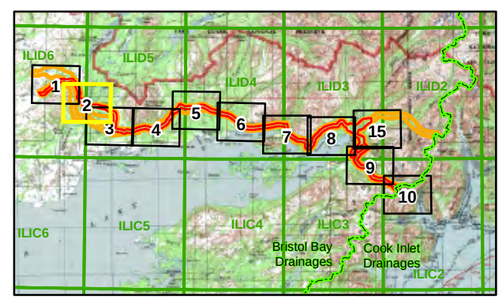
Figure 13.2-3
Tile 2
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	**Date: July 15, 2011**
Version: 3	**Author: RDI- LS**

154°52'0"W 154°50'0"W 154°48'0"W 154°46'0"W 154°44'0"W 154°42'0"W

59°50'0"N

59°49'0"N

59°48'0"N

59°47'0"N

THE pebble PARTNERSHIP

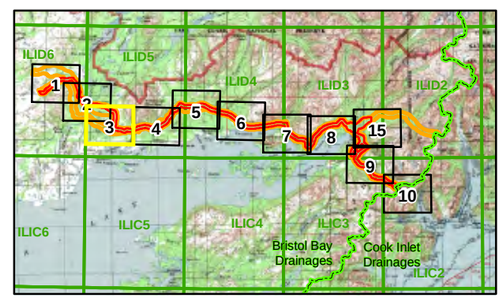
Figure 13.2-3
Tile 3
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

154°42'0"W 154°40'0"W 154°38'0"W 154°36'0"W 154°34'0"W 154°32'0"W

59°50'0"N

59°49'0"N

59°48'0"N

59°47'0"N

Roadhouse Mountain

Stonehouse

THE pebble PARTNERSHIP

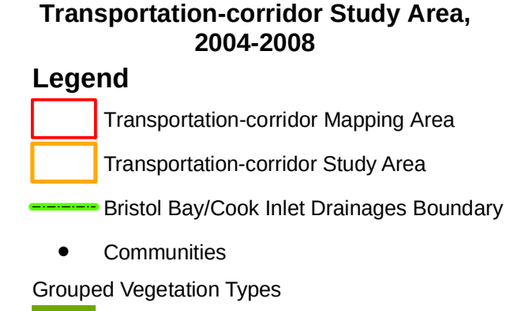
Figure 13.2-3
Tile 4
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

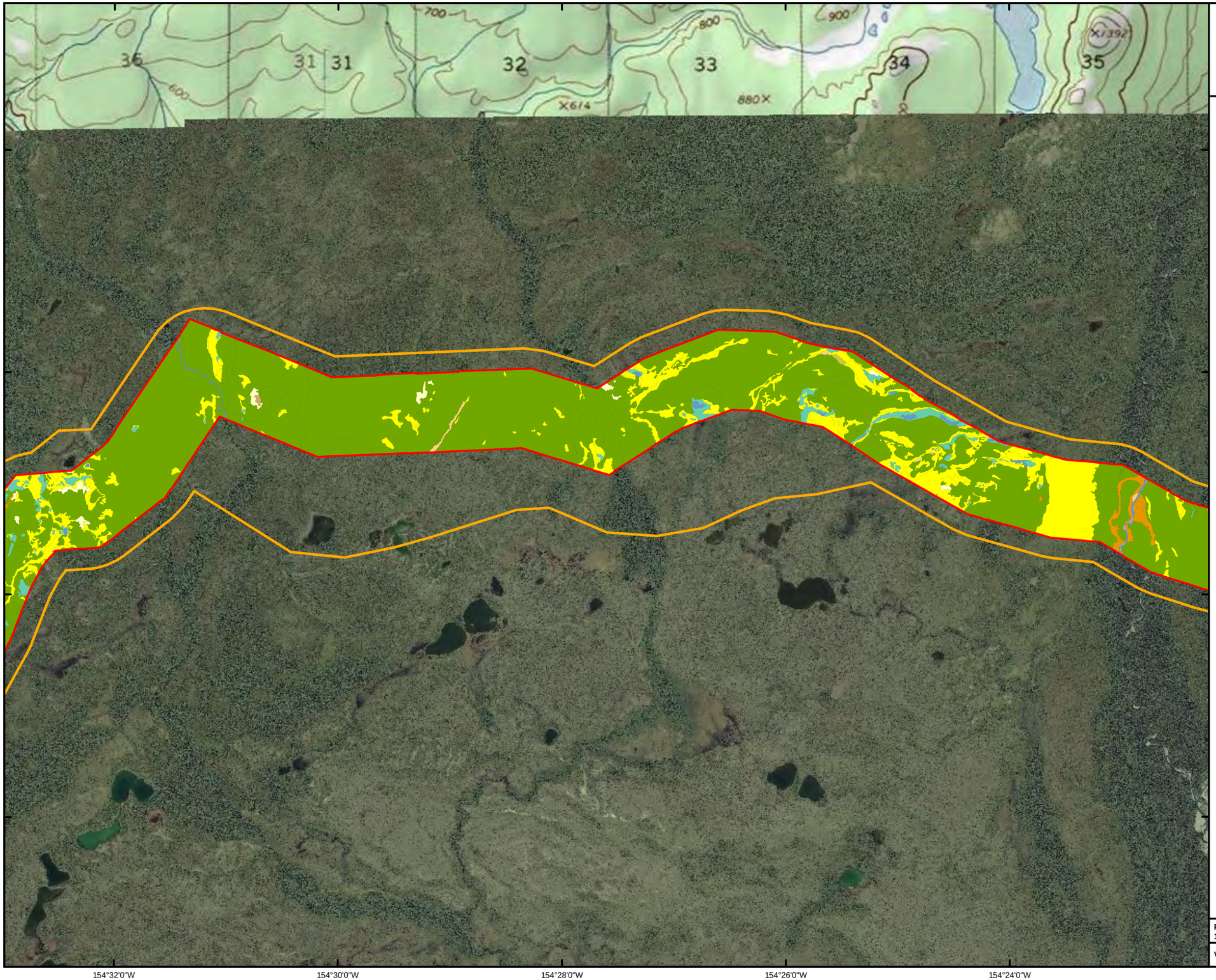
Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_ 11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

154°32'0"W 154°30'0"W 154°28'0"W 154°26'0"W 154°24'0"W

59°52'0"N
59°51'0"N
59°50'0"N
59°49'0"N



THE pebble PARTNERSHIP

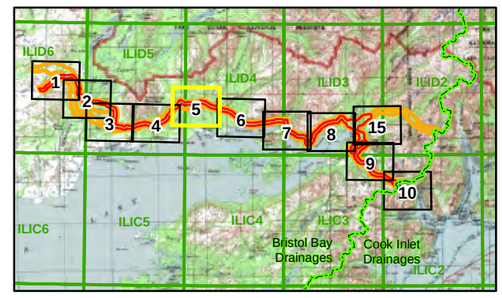
Figure 13.2-3
Tile 5
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

154°22'0"W 154°20'0"W 154°18'0"W 154°16'0"W 154°14'0"W

59°51'0"N
59°50'0"N
59°49'0"N
59°48'0"N

Canyon Creek

Knutson Bay

Fox Bay

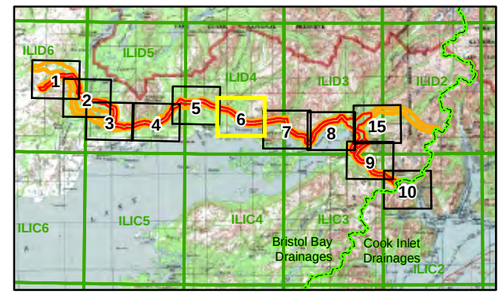
Figure 13.2-3
Tile 6
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

154°12'0"W 154°10'0"W 154°8'0"W 154°6'0"W 154°4'0"W 154°2'0"W

59°49'0"N
59°48'0"N
59°47'0"N
59°46'0"N

Knutson Mountain
Knutson Creek
Knutson Bay
Pedro Bay
Pedro Bay

THE pebble PARTNERSHIP

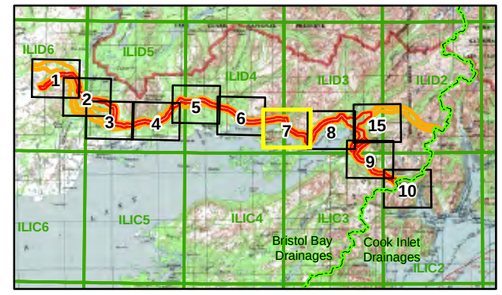
Figure 13.2-3
Tile 7
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

154°2'0"W 154°0'0"W 153°58'0"W 153°56'0"W 153°54'0"W 153°52'0"W

59°49'0"N
59°48'0"N
59°47'0"N
59°46'0"N

Pile River
Lonesome Bay
Pile Bay
Pile Bay

THE pebble PARTNERSHIP

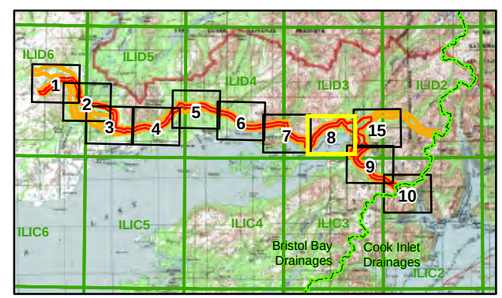
Figure 13.2-3
Tile 8
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

153°52'0"W 153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W

59°46'0"N 59°45'0"N 59°44'0"N 59°43'0"N

Iliamna River

Chinkelyes Creek

THE pebble PARTNERSHIP

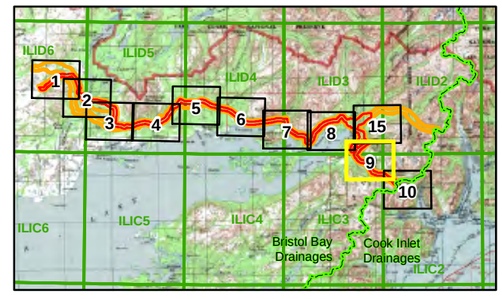
Figure 13.2-3
Tile 9
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

153°44'0"W 153°42'0"W 153°40'0"W 153°38'0"W 153°36'0"W

59°43'0"N 59°42'0"N 59°41'0"N 59°40'0"N 59°39'0"N

Williamsport

Iliamna Bay

THE pebble PARTNERSHIP

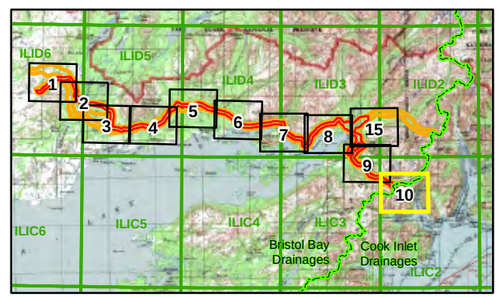
Figure 13.2-3
Tile 10
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



Miles
0 0.25 0.5 0.75 1 1.25

Kilometers
0 0.5 1 1.5

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	Date: July 15, 2011
Version: 3	Author: RDI- LS

153°50'0"W 153°48'0"W 153°46'0"W 153°44'0"W 153°42'0"W

59°50'0"N 59°49'0"N 59°48'0"N 59°47'0"N

Illiamna River

THE pebble PARTNERSHIP

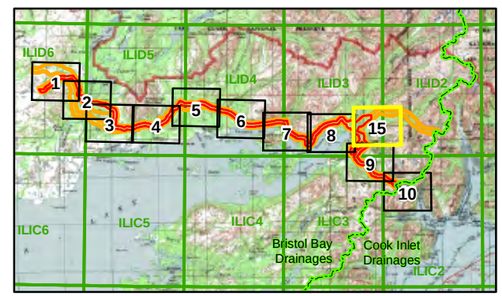
Figure 13.2-3
Tile 15
Grouped Vegetation Mapping, Transportation-corridor Study Area, 2004-2008

Legend

- Transportation-corridor Mapping Area
- Transportation-corridor Study Area
- Bristol Bay/Cook Inlet Drainages Boundary
- Communities

Grouped Vegetation Types

- Open/Closed Forest
- Open Tall Shrub
- Closed Tall Shrub
- Open Low Shrub
- Closed Low Shrub
- Dwarf Shrub
- Dry to Moist Herbaceous
- Wet Herbaceous
- Open Water
- Other (Barren, Partially Vegetated)



0 0.25 0.5 0.75 1 1.25 Miles

0 0.5 1 1.5 Kilometers

N

Scale 1:31,680

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_HDR_EBD_Fig13.2-3_Veg_Group_Tiled_11X17L_1of11_D03.mxd	**Date: July 15, 2011**
Version: 3	**Author: RDI- LS**

APPENDICES

APPENDIX 13.1A

Draft Plant List Report: Mine Mapping Area, January 2011

Trees:

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Alnus sinuata (tree)	ALSI-T	Sitka alder	
Betula kenaica (trees)	BEKA-T	Kenai birch	
Betula papyrifera s.l. (trees)	BEPA-T	Paper birch	
Picea glauca (snags)	PIGL-SN	White spruce	
Picea glauca (trees)	PIGL-T	White spruce	
Picea mariana (snags)	PIMA-SN	Black spruce	
Picea mariana (trees)	PIMA-T	Black spruce	
Populus balsamifera (trees)	POBA-T	Cottonwood	
Salix alaxensis (trees)	SAAL-T	Feltleaf willow	
Salix arbusculoides (tree)	SAAR-T	Little tree willow	
Betula papyrifera s.l. (saplings)	BEPA-SAP	Paper birch	
Betula papyrifera s.l. (seedlings)	BEPA-SE	Paper birch	
Picea glauca (saplings)	PIGL-SAP	White spruce	
Picea mariana (sapling/stunted)	PIMA-SAP	Black spruce	
Picea sitchensis (sapling or dwarf)	PISI-SAP	Sitka spruce	
Populus balsamifera (saplings)	POBA-SAP	Cottonwood	
Populus tremuloides (saplings)	POTR-SAP	Quaking aspen	

Shrubs:

Alnus crispa s.l.	ALCR	Green alder	
Alnus sp.	ALNU-SP	Unspecified alder	
Alnus sinuata	ALSI	Sitka alder	
Alnus viridis (*Alnus* sp.)	ALVI	Green alder or sitka alder, unspecified	
Andromeda polifolia	ANPO	Bog rosemary	
Arctostaphylos alpina	ARAL2	Alpine bearberry	
Arctostaphylos alpina var *rubra*	ARALR	Red fruit bearberry	
Arctostaphylos uva-ursi	ARUV	Kinnikinnick	
Artemisia frigida	ARFR4	Prairie sagewort	
Artemisia tilesii	ARTI	Sagebrush	
Betula glandulosa	BEGL	Shrub birch	
Betula hybrid	BENAX	Birch hybrid	
Betula kenaica (shrub)	BEKA-SH	Kenai birch	
Betula nana ssp. *exilis*	BENA	Dwarf birch	
Cassiope lycopodioides	CALY2	Clubmoss mountain heather	
Cassiope tetragona	CATE1	Arctic bell-heather	
Diapensia lapponica	DILA	Pincushion plant	
Dryas drummondii	DRDR	Yellow mountain-avens	
Dryas integrifolia	DRIN	Entire-leaf mountain-avens	
Dryas octopetala	DROC		
Dryas sp.	DRYA-SP	Unspecified mountain-avens	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Empetrum nigrum	EMNI	Black crowberry	
Harrimanella stelleriana	HAST	Alaska moss heath	
Juniperus communis	JUCO	Juniper	
Ledum decumbens	LEDE	Narrow-leaf Labrador tea	
Ledum groenlandicum	LEGR	Greenland Labrador tea	
Linnaea borealis	LIBO3	Twinflower	
Loiseleuria procumbens	LOPR	Alpine azalea	
Menziesia ferruginea	MEFE	Mock-azalea	
Myrica gale	MYGA	Sweetgale	
Oplopanax horridus	OPHO	Devil's club	
Potentilla fruticosa	POFR1	Shrubby cinquefoil	
Ribes bracteosum	RIBR	California black currant	
Ribes glandulosum	RIGL	Skunk currant	
Ribes hudsonianum	RIHU	Hudson Bay currant	
Ribes lacustre	RILA	Prickly currant	
Ribes laxiflorum	RILA1	Trailing black currant	
Ribes sp.	RIBE-SP	Unspecified currant	
Ribes triste	RITR	Swamp red currant	
Rosa acicularis	ROAC	Prickly rose	
Rubus sp.	RUBU-SP	Unspecified rubus	
Rubus spectabilis	RUSP1	Salmonberry	
Salix alaxensis (shrubs)	SAAL-S	Feltleaf willow	
Salix arbusculoides	SAAR	Little-tree willow	
Salix arctica	SAAR1	Arctic willow	
Salix barclayi	SABA	Barclay's willow	
Salix bebbiana	SABE	Bebb willow	
Salix fuscescens	SAFU	Alaska bog willow	
Salix glauca	SAGL	Grayleaf willow	
Salix hastata	SAHA	Halberd willow	
Salix myrtillifolia	SAMY	Blueberry willow	
Salix ovalifolia	SAOV	Oval-leaf willow	
Salix phlebophylla	SAPH	Skeleton-leaf willow	
Salix planifolia s.l.	SAPL	Diamondleaf willow	
Salix polaris	SAPO	Polar willow	
Salix pseudomyrsinites	SAPS	Tall blueberry willow	
Salix pulchra	SAPL1	Diamondleaf willow	
Salix reticulata	SARE	Netleaf willow	
Salix richardsonii	SARI	Richardson's willow	
Salix rotundifolia	SARO	Least willow	
Salix scouleriana	SASC-S	Scouler's willow	
Salix sitchensis	SASI	Sitka willow	
Salix sp.	SALI-SP	Unspecified willow	
Sambucus racemosa	SARA2	European red elder	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Sibbaldia procumbens	SIPR	Creeping sibbaldia	
Sorbus scopulina	SOSC	Greene's mountain ash	
Spiraea beauverdiana	SPBE	Beauverd spirea	
Vaccinium microcarpus [b]	VAMI	Blueberry	
Vaccinium ovalifolium	VAOV	Early blueberry	
Vaccinium oxycoccos [b]	VAOX	Small cranberry	
Vaccinium uliginosum	VAUL	Bog blueberry	
Vaccinium vitis-idaea ssp. *minus*	VAVI	Mountain cranberry	
Viburnum edule	VIED	Squashberry	

Herbs:

Achillea borealis	ACBO	Yarrow	
Achillea millefolium s.l.	ACMI	Common yarrow	
Achillea sp.	ACHI-SP	Unspecified yarrow	
Aconitum delphiniifolium	ACDE	Monkshood (larkspur-leaf)	
Actaea rubra	ACRU	Baneberry	
Adiantum pedatum	ADPE	Northern maiden-hair fern	
Agrostis borealis	AGBO	Northern bentgrass	
Agrostis gigantea	AGGI2	Black bentgrass	
Agrostis scabra	AGSC	Rough bentgrass	
Agrostis sp.	AGRO-SP	Unspecified agrostis	
Alopecurus aequalis	ALAE	Short-awn foxtail	
Alopecurus alpinus	ALAL	Mountain foxtail	
Anemone multifida	ANMU	Cut-leaf anemone	
Anemone narcissiflora	ANNA	Narcissus-flowered anemone	
Anemone richardsonii	ANRI	Yellow thimble-weed	
Anemone sp.	ANEM-SP	Unspecified anemone	
Angelica genuflexa	ANGE	Kneeling angelica	
Angelica lucida	ANLU	Seawatch angelica	
Angelica sp.	ANGE-SP	Unspecified angelica	
Antennaria monocephala	ANMO	One-headed everlasting	
Antennaria rosea s.l.	ANRO	Pussy-toes	
Antennaria sp.	ANTE-SP		
Arabis divaricarpa	ARDI	Limestone rockcress	
Arctagrostis latifolia sl	ARCLAT	Arctic-bentgrass,broad-leaf	
Arctophila fulva	ARFU	Pendent grass	
Arnica chamissonis	ARCH	Leafy arnica	
Arnica frigida	ARFR	Frigid arnica	
Arnica latifolia	ARLA1	Mountain arnica	
Arnica lessingii [b]	ARLE2	Nodding arnica	
Arnica lessingii ssp. *lessingii* [b]	ARLEL	Nodding arnica	
Arnica sp.	ARNI-SP	Unspecified arnica	
Artemisia arctica	ARAR	Mountain sagewort	
Artemisia sp	ARTE-SP	Unspecified artemisia	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Aster s.l. sp	ASTE-SP	Unspecified aster	
Aster sibiricus	ASSI	Siberian aster	
Astragalus sp	ASTR-SP	Unspecified milkvetch	
Astragalus umbellatus	ASUM	Hairy arctic milkvetch	
Athyrium filix-femina ssp. *cyclosorum*	ATFI	Subarctic lady fern	
Boschniakia rossica	BORO	Northern groundcone	
Botrychium lanceolatum	BOLA	Triangle moonwort	
Botrychium lunaria	BOLU	Moonwort	
Botrychium minganense	BOMI	Mingan Moonwort	
Botrychium multifidum	BOMU	Leathery grapefern	
Botrychium sp.	BOTR-SP		
Bromus ciliatus	BRCI	Fringed brome	
Calamagrostis canadensis	CACA	Blue-joint reedgrass	
Calamagrostis deschampsioides	CADE	Circumpolar small-reedgrass	
Calamagrostis lapponica	CALA	Lapland small-reedgrass	
Calamagrostis neglecta	CANE	Slimstem reedgrass	
Calamagrostis sp.	CALA-SP	Unspecified reedgrass	
Calamagrostis stricta ssp. *inexpansa*	CAST13	Northern reedgrass	
Callitriche anceps	CAAN	Two-edge water-starwort	
Caltha leptosepala	CALE	Slender-sepal marsh-marigold	
Caltha palustris	CAPA1	Common marsh-marigold	
Caltha sp.	CALT-SP	Marsh-marigold	
Campanula lasiocarpa	CALA1	Common Alaska bellflower	
Campanula rotundifolia	CARO	Scotch bellflower	
Cardamine bellidifolia	CABE	Alpine bitter-cress	
Cardamine pratensis	CAPR	Meadow bitter-cress	
Cardamine purpurea	CAPU	Purple bitter-cress	
Cardamine sp.	CARD-SP	Unspecified bitter-cress	
Cardamine umbellata	CAUM	Umbel-flower bitter-cress	
Carex anthoxanthea	CAAN2	Grassy-slope arctic sedge	
Carex aquatilis	CAAQ	Water sedge	
Carex arcta	CAAR	Northern clustered sedge	
Carex bebbii	CABE1	Bebb's sedge	G5 S1
Carex bicolor	CABI	Two-color sedge	
Carex bigelowii s.l.	CABI1	Bigelows sedge	
Carex bipartita s.l.	CABI2	Arctic hare's-foot sedge	
Carex brunnescens s.l.	CABR1	Brownish sedge	
Carex buxbaumii	CABU2	Brown bog sedge	
Carex canescens	CACA1	Hoary sedge	
Carex capitata	CACA3	Capitate sedge	
Carex chordorrhiza	CACH	Creeping sedge	
Carex circinnata	CACI	Coiled sedge	
Carex crawfordii	CACR1	Crawford's sedge	G5S3
Carex disperma	CADI2	Soft-leaf sedge	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Carex garberi	CAGA	Elk sedge	
Carex gynocrates	CAGY	Northern bog sedge	
Carex kelloggii	CAKE	Kellogg's sedge	
Carex laeviculmis	CALA2	Smooth-stem sedge	
Carex lenticularis s.l.	CALE1	Shore sedge	
Carex leptalea	CALE2	Bristly-stalk sedge	
Carex limosa	CALI	Mud sedge	
Carex livida	CALI1	Livid sedge	
Carex lugens	CALU	Spruce-muskeg sedge	
Carex lyngbyei	CALY	Lyngbye's sedge	
Carex mackenziei	CAMA	Mackenzie's sedge	
Carex macloviana	CAMA1	Falkland island sedge	
Carex macrocephala	CAMA2	Big-head sedge	
Carex macrochaeta	CAMA3	Alaska long-awn sedge	
Carex magellanica ssp. *irrigua*	CAMA6	Boreal bog sedge	
Carex maritima	CAMA5	Seaside sedge	
Carex media	CAME	Intermediate sedge	
Carex membranacea	CAME1	Fragile-seed sedge	
Carex mertensii	CAME2	Merten's sedge	
Carex microchaeta s.l.	CAMI1	Smallawned sedge	
Carex micropoda	CAMI3	Pyrenean sedge	
Carex nesophila	CANE1	Bering Sea sedge	
Carex nigricans	CANI	Black alpine sedge	
Carex pachystachya	CAPA2	Thick-head sedge	
Carex paupercula	CAPA5	Poor sedge	
Carex pluriflora	CAPL1	Several flowered sedge	
Carex podocarpa	CAPO	Short-stalk sedge	
Carex ramenskii	CARA	Ramensk's sedge	
Carex rariflora	CARA1	Loose flowered sedge	
Carex rhynchophysa s.l.[b]	CARH	Northwest Territory sedge	
Carex rostrata	CARO1	Beaked sedge	
Carex rotundata	CARO2	Round-fruit sedge	
Carex saxatilis s.l.	CASA1	Russet sedge	
Carex scirpoidea	CASC1	Canadian single-spike sedge	
Carex sitchensis	CASI	Sitka sedge	
Carex sp.	CAREX	Unspecified sedge	
Carex spectabilis	CASP3	Showy sedge	
Carex stylosa	CAST	Long-style sedge	
Carex tenuiflora	CATE	Sparse-flower sedge	
Carex ursina	CAUR	Bear sedge	
Carex utriculata[b]	CAUT	Beaked sedge	
Carex vaginata	CAVA	Sheathed sedge	
Carex williamsii	CAWI	William's sedge	
Castilleja elegans	CAEL1	Paintbrush	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Cerastium arvense	CEAR4	Mouse-ear chickweed	
Cerastium beeringianum	CEBE	Bering Sea cerastium	
Cerastium sp.	CERA-SP	Unspecified chickweed	
Chrysosplenium tetrandrum	CHTE	Northern golden-saxifrage	
Cicuta mackenzieana	CIMA	Mackenzie's water hemlock	
Cirsium arvense	CIAR	Creeping thistle	
Claytonia sarmentosa	CLSA	Alaska springbeauty	
Claytonia sibirica	CLSI	Siberian springbeauty	
Composite sp.	COMP-SP	Unspecified composite	
Coptis trifolia	COTR	Alaska goldthread	
Cornus canadensis	COCA	Canada bunchberry	
Cornus suecica	COSU	Swedish dwarf dogwood	
Corydalis pauciflora	COPA	Few flowered corydalis	
Cystopteris montana	CYMO1	Mountain bladder fern	
Danthonia intermedia	DAIN	Vasey oatgrass	
Delphinium glaucum	DEGL	Tower larkspur	
Delphinium sp.	DELP-SP	Larkspur	
Deschampsia beringensis	DEBE	Bering hairgrass	
Deschampsia cespitosa s.l.	DECE	Tufted hairgrass	
Deschampsia pumila	DEPU	Little hairgrass	
Deschampsia sp.	DESC-SP	Unspecified deschampsia	
Draba aurea	DRAU	Golden whitlow-grass	
Dracocephalum parviflorum	DRPA	American dragon-head	
Drosera anglica	DRAN	English sundew	
Drosera rotundifolia	DRRO	Round-leaf sundew	
Dryopteris dilatata ssp. *americana*	DRDI	Mountain woodfern	
Eleocharis acicularis	ELAC	Least spikerush	
Eleocharis palustris	ELPA	Creeping spikerush	
Eleocharis sp.	ELEO-SP	Spikerush	
Epilobium adenocaulon	EPAD		
Epilobium anagallidifolium	EPAN	Pimpernel willowherb	
Epilobium angustifolium	EPAN1	Fireweed	
Epilobium ciliatum	EPCI	Hairy willowherb	
Epilobium hornemannii	EPHO	Hornemann's willowherb	
Epilobium lactiflorum	EPLA	White-flower willowherb	
Epilobium latifolium	EPLA1	River beauty	
Epilobium leptocarpum	EPLE	Slender-fruited willow-herb	
Epilobium palustre	EPPA	Marsh willow-herb	
Epilobium sp. s.l.	EPIL-SP	Epilobium, unspecified	
Equisetum arvense	EQAR	Field horsetail	
Equisetum fluviatile	EQFL	Water horsetail	
Equisetum hyemale	EQHY	Rough horsetail	
Equisetum palustre	EQPA	Marsh horsetail	
Equisetum pratense	EQPR	Meadow horsetail	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Equisetum scirpoides	EQSC	Dwarf scouring-rush	
Equisetum sp.	EQUI-SP	Unspecified horsetail	
Equisetum sylvaticum	EQSY	Woodland horsetail	
Equisetum variegatum	EQVA	Variegated horsetail	
Erigeron acris	ERAC	Bitter fleabane	
Erigeron peregrinus	ERPE	Wandering fleabane	
Erigeron sp.	ERIG-SP	Unspecified erigeron	
Eriophorum alpinum	ERAL	Alpine cottongrass	
Eriophorum angustifolium	ERAN	Narrow-leaf cottongrass	
Eriophorum brachyantherum	ERBR	Short-anther cottongrass	
Eriophorum chamissonis s.l.	ERCH	Russet cottongrass	
Eriophorum russeolum s.l.	ERRU	Russets cottongrass	
Eriophorum scheuchzeri	ERSC	Scheuchzer's cottongrass	
Eriophorum sp	ERIO-SP	Unspecified cottongrass	
Eriophorum vaginatum	ERVA	Tussock cottongrass	
Eriophorum viridicarinatum	ERVI	Green-keel cottongrass	G5 S2
Euphrasia disjuncta	EUPDIS		
Fern	FERN	Unspecified Fern	
Festuca altaica	FEAL	Rough fescue	
Festuca rubra	FERU	Red fescue	
Festuca sp.	FEST-SP	Unspecified fescue	
Forb	FORB	Unspecified forb	
Fritillaria camschatcensis	FRCA	Kamchatka mission-bells/chocolate lily	
Galium boreale	GABO	Northern bedstraw	
Galium sp.	GALI-SP	Unspecified galium	
Galium trifidum	GATR	Small bedstraw	
Galium triflorum	GATR1	Sweet-scent bedstraw	
Gentiana algida	GEAL	Whitish gentian	
Gentiana glauca	GEGL	Glaucous gentian	
Gentiana sp.	GENT-SP	Unspecified gentian	
Geranium erianthum	GEER	Woolly geranium	
Geranium sp.	GERA-SP	Unspecified geranium	
Geum macrophyllum	GEMA	Large-leaf avens	
Geum sp.	GEUM-SP	Unspecified avens	
Glecoma hederacea	GLHE	Ground ivy	
Grass sp.	GRAS-SP	Unspecified grass	
Gymnocarpium dryopteris	GYDR	Oak fern	
Hedysarum hedysaroides	HEHE		
Hedysarum mackenzii	HEMA	Sweetvetch	
Heracleum lanatum	HELA	Cow-parsnip	
Hieracium triste	HIETRI		
Hierochloe alpina	HIAL	Alpine sweetgrass	
Hierochloe hirta	HIHI	Vanilla grass	
Hierochloe odorata	HIOD	Holy grass	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Hierochloe sp.	HIER-SP	Sweetgrass	
Hippuris montana	HIMO	Mountain mare's-tail	
Hippuris vulgaris	HIVU	Common mare's-tail	
Iris setosa	IRSE	Beach-head iris	
Iris sp.	IRIS-SP	Unspecified iris	
Juncus alpinus s.l.	JUAL1	Richardson's rush	
Juncus arcticus s.l.	JUAR	Arctic rush	
Juncus biglumis	JUBI	Two-flower rush	
Juncus bufonius	JUBU	Toad rush	
Juncus castaneus	JUCA	Chestnut rush	
Juncus drummondii	JUDR	Drummond's rush	
Juncus filiformis	JUFI	Thread rush	
Juncus mertensianus	JUME	Merten's rush	
Juncus sp.	JUNC-SP	Rush	
Juncus triglumis	JUTR	Three-flower rush	
Kobresia myosuroides	KOMY	Pacific kobresia	
Koenigia islandica	KOIS	Island koenigia	
Lagotis glauca s.l.	LAGL	Weaselsnout	
Lathyrus palustris	LAPA	Vetchling peavine	
Leptarrhena pyrolifolia	LEPY	Leather-leaf saxifrage	
Ligusticum scoticum	LISC	Scotch lovage	
Listera borealis	LIBO1	Northern twayblade	
Listera cordata	LICO1	Heart-leaf twayblade	
Lloydia serotina	LLSE	Common alpine lily	
Luetkea pectinata	LUPE	Partridge-foot	
Lupinus arcticus	LUAR	Arctic lupine	
Lupinus nootkatensis	LUNO	Nootka lupine	
Lupinus sp.	LUPI-SP	Unspecified lupine	
Luzula arcuata	LUAR1	Curved woodrush	
Luzula multiflora	LUMU	Common woodrush	
Luzula parviflora	LUPA	Small-flower woodrush	
Luzula rufescens	LURU	Hairy woodrush	
Luzula sp.	LUZU-SP	Unspecified woodrush	
Luzula spicata	LUSP	Spiked woodrush	
Luzula wahlenbergii s.l.	LUWA	Wahlenberg's woodrush	
Lycopodium alpinum	LYAL	Alpine clubmoss	
Lycopodium annotinum s.l.	LYAN	Stiff clubmoss	
Lycopodium clavatum s.l.	LYCL	Running pine	
Lycopodium complanatum	LYCO	Trailing clubmoss	
Lycopodium s.l. sp.	LYCO-SP	Unspecified clubmoss	
Lycopodium selago s.l.	LYSE	Fir clubmoss	
Mertensia paniculata	MEPA	Tall bluebells	
Mimulus guttatus	MIGU	Common large monkey-flower	
Minuartia arctica	MIAR	Arctic stitchwort	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Minuartia macrocarpa	MIMA4	Longpod stitchwort	
Minuartia obtusiloba	MIOB	Alpine stitchwort	
Moehringia lateriflora	MOLA6	Grove sandwort	
Moneses uniflora	MOUN	Shy maiden	
Montia chamissoi	MOCH	Water miners lettuce	
Myosotis alpestris	MYAL	Alpine forget-me-not	
Oxyria digyna	OXDI	Alpine mountain-sorrel	
Oxytropis maydelliana	OXMA2	Maydell's oxytrope	
Oxytropis mertensiana	OXME2	Merten's oxytrope	
Oxytropis nigrescens	OXNI	Blackish oxytrope	
Oxytropis sp.	OXYT-SP	Oxytrope	
Parnassia kotzebuei	PAKO	Kotzebue's grass-of-parnassus	
Parnassia palustris	PAPA	Northern grass-of-parnassus	
Parnassia sp.	PARN-SP	Unspecified grass-of-parnassus	
Pedicularis capitata	PECA	Capitate lousewort	
Pedicularis labradorica	PELA	Labrador lousewort	
Pedicularis lanata	PELA1	Woolly lousewort	
Pedicularis langsdorffii ssp. *arctica*	PELAA2	Arctic lousewort	
Pedicularis langsdorfii	PELA2	Langsdorf's lousewort	
Pedicularis oederi	PEOD	Oeder's lousewort	
Pedicularis parviflora	PEPA	Small-flower lousewort	
Pedicularis sp.	PEDI-SP	Unspecified lousewort	
Pedicularis sudetica	PESU	Sudetic lousewort	
Pedicularis verticillata	PEVE	Whorled lousewort	
Petasites frigidus s.l.	PEFR	Arctic sweet coltsfoot	
Petasites hyperboreus	PEHY	Arctic sweet coltsfoot	
Petasites sagittatus	PESA	Arrow-leaf sweet coltsfoot	
Phleum alpinum	PHAL2	Alpine timothy	
Phleum commutatum	PHCO		
Pinguicula macroceras	PIMA1	California butterwort	
Pinguicula sp.	PING-SP		
Pinguicula villosa	PIVI	Hairy butterwort	
Pinguicula vulgaris s.l.	PIVU	Common butterwort	
Platanthera dilatata	PLDI	Leafy white orchid	
Platanthera hyperborea	PLHY	Northern green orchid	
Platanthera obtusata	PLOB	Small northern bog orchid	
Platanthera sp.	PLAT-SP	Unspecified orchid	
Poa alpigena	POAL	Low bluegrass	
Poa alpina	POAL1	Alpine bluegrass	
Poa arctica	POAR	Arctic bluegrass	
Poa palustris	POPA	Fowl bluegrass	
Poa pratensis s.l.	POPR	Kentucky bluegrass	
Poa sp.	POA-SP	Unspecified bluegrass	
Poa stenantha	POST	Northern bluegrass	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Polemonium acutiflorum	POAC	Sticky tall Jacob's-ladder	
Polemonium sp.	POLE-SP	Unspecified Jacob's-ladder	
Polygonum bistorta ssp. *plumosum*	POBI	Meadow bisort	
Polygonum pennsylvanicum	POPE	Pennsylvania smartweed	
Polygonum sp. s.l.	POLY-SP	Unspecified knotweed	
Polygonum viviparum	POVI	Viviparous knotweed	
Potamogeton alpinus	POAL4	Alpine pondweed	
Potamogeton filiformis	POFI	Fine-leaf pondweed	
Potamogeton friesii	POFR	Fries's pondweed	
Potamogeton sp. s.l.	POTA-SP	Unspecified pondweed	
Potentilla hyparctica	POHY2	Arctic cinquefoil	
Potentilla palustris	POPA1	Marsh cinquefoil	
Potentilla virgulata	POVI1	Twiggy cinquefoil	
Primula cuneifolia	PRCU	Wedge-leaf primrose	
Primula eximia	PREX2	Arctic primrose	
Primula sp.	PRIM-SP		
Primula tschuktschorum	PRTS	Chukchi primrose	G2G3 S2S3
Pyrola asarifolia	PYAS	Pink wintergreen	
Pyrola grandiflora	PYGR	Arctic wintergreen	
Pyrola minor	PYMI	Lesser wintergreen	
Pyrola rotundifolia	PYRO	Round-leaf wintergreen	
Pyrola secunda	PYSE	One-sided wintergreen	
Pyrola sp. s.l.	PYRO-SP	Unspecified wintergreen	
Ranunculus eschscholtzii	RAES	Eschscholtz buttercup	
Ranunculus flammula	RAFL	Spearwort buttercup	
Ranunculus hyperboreus	RAHY	Arctic buttercup	
Ranunculus lapponicus	RALA	Lapland buttercup	
Ranunculus occidentalis	RAOC	Western buttercup	
Ranunculus repens	RARE	Creeping buttercup	
Ranunculus sp.	RANU-SP	Unspecified buttercup	
Ranunculus trichophyllus	RATR	White water-crowfoot	
Ranunculus uncinatus	RAUN	Hooked buttercup	
Rhinanthus arcticus	RHAR	Arctic yellow rattle	
Rhinanthus minor	RHMI	Little yellow rattle	
Rorippa palustris	ROPA	Bog yellow-cress	
Rorippa sp.	RORIP		
Rubus acaulis	RUAC	Dwarf raspberry	
Rubus arcticus s.l.	RUAR	Arctic raspberry	
Rubus arcticus stellatus	RUBSTE	Arctic raspberry	
Rubus chamaemorus	RUCH	Cloudberry	
Rubus pedatus	RUPE	Strawberry-leaf raspberry	
Rubus stellatus	RUST	Nagoonberry	
Rumex acetosa ssp. *alpestris*	RUAC1	Garden sorrel	
Rumex arcticus	RUAR1	Arctic dock	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Rumex beringensis	RUBE	Bering Sea dock	G3S3
Rumex crispus	RUCR	Curly dock	
Rumex occidentalis	RUOC	Western dock	
Rumex sp.	RUME-SP	Unspecified rumex	
Sanguisorba canadensis [b]	SACA1	Canada burnet	
Sanguisorba menziesii	SAME	Menzies' burnet	
Sanguisorba officinalis	SAOF	Great burnet	
Sanguisorba sp.	SANG-SP	Burnet	
Sanguisorba stipulata [b]	SAST		
Saussurea angustifolia	SAAN	Narrow-leaf saw-wort	
Saxifraga foliolosa	SAFO	Leafy saxifrage	
Saxifraga hieracifolia	SAHI	Stiff-stem saxifrage	
Saxifraga hirculus	SAHI1	Yellow marsh saxifrage	
Saxifraga lyallii	SALY	Red-stem saxifrage	
Saxifraga mertensiana	SAME1	Merten's saxifrage	
Saxifraga nivalis	SANI6	Alpine saxifrage	
Saxifraga punctata s.l.	SAPU	Dotted saxifrage	
Saxifraga sp.	SAXI-SP	Unspecified saxifrage	
Scirpus cespitosus [b]	SCCE	Tufted bulrush	
Scirpus validus	SCVA	Soft-stem bulrush	
Sedum rosea ssp. *integrifolium*	SERO	Roseroot stonecrop	
Senecio congestus	SECO	Marsh groundsel	
Senecio cymbalaria	SECY	Dwarf arctic groundsel	
Senecio lugens	SELU	Black-tip groundsel	
Senecio pauciflorus	SEPA	Few-flower groundsel	
Senecio sp.	SENE-SP		
Senecio streptanthifolius	SEST	Cleft-leaf groundsel	
Senecio triangularis	SETR	Arrow-leaf groundsel	
Solidago canadensis s.l.	SOCA	Canada goldenrod	
Solidago lepida	SOLE1	Canada goldenrod	
Solidago multiradiata	SOMU	Mountain goldenrod	
Solidago sp.	SOLI-SP	Unspecified goldenrod	
Sparganium hyperboreum	SPHY	Northern bur reed	
Sparganium minimum	SPMI	Small bur reed	
Sparganium sp.	SPAR-SP		
Spiranthes romanzoffiana	SPRO	Hooded ladies' tresses	
Stellaria calycantha	STCA	Northern starwort	
Stellaria crassifolia	STCR	Fleshy starwort	
Stellaria humifusa	STHU	Low starwort	
Stellaria laeta	STLA	Long-stalk starwort	
Stellaria longifolia	STLO	Long-leaf starwort	
Stellaria longipes ssp. *longipes*	STLOL	Long-stalk starwort	
Stellaria media	STME	Common chickweed	
Stellaria sitchana	STSI	Sitka starwort	

Latin Name	Abbreviation	Common Name	AKNHP Sensitive Species Ranking[a]
Stellaria sp.	STEL-SP	Unspecified starwort	
Stellaria umbellata	STUM	Umbellate starwort	G5 S2S3
Streptopus amplexifolius	STAM	Clasp-leaf twisted-stalk	
Taraxacum sp.	TARA-SP		
Thalictrum alpinum	THAL	Alpine meadow-rue	
Thalictrum sp.	THAL-SP	Unspecified meadow-rue	
Thalictrum sparsiflorum	THSP	Few-flower meadow-rue	
Thelypteris phegopteris	THPH	Narrow beech fern	
Tiarella trifoliata	TITR	Three-leaf foamflower	
Tiarella trifoliata var *unifoliata*	TITRU	Three-leaf foamflower	
Tofieldia coccinea	TOCO	Northern false-asphodel	
Tofieldia pusilla	TOPU	Scotch false-asphodel	
Tofieldia sp.	TOFI-SP		
Trichophorum caespitosum [b]	TRCA	Tufted bulrush	
Trientalis europaea s.l.	TREU	European starflower	
Triglochin palustris	TRPA	Marsh arrow-grass	
Trisetum spicatum	TRSP1	Spiked false-oats	
Urtica gracilis	URGR		
Urtica sp.	URTI-SP	Nettle	
Vahlodea atropurpurea	VAAT	Mountain hairgrass	
Valeriana capitata	VACA	Clustered valerian	
Valeriana sitchensis	VASI	Sitka valerian	
Veratrum viride var. *eschscholzianum*	VEVI	American false-hellebore	
Veronica serpyllifolia	VESE	Thyme-leaf speedwell	
Veronica wormskjoldii	VEWO	American alpine speedwell	
Viola adunca	VIAD	Hooked-spur violet	
Viola biflora	VIBI	Twin-flower violet	
Viola epipsila ssp. *repens*	VIEP	Dwarf marsh violet	
Viola langsdorffii	VILA	Alaska violet	
Viola sp.	VIOL-SP	Unspecified violet	

a. The Alaska Natural Heritage Program (AKNHP) ranks the species with a code that describes their population status on a global level (G-rank) and on a statewide level (S-rank). The status levels are ranked on a scale from one to five, where five is a common species with demonstrably secure populations, and one is a critically imperiled species whose populations are vulnerable to extirpation or extinction. If the level is uncertain, it is described with a range of two rankings (for example, S2S3) or with a ranking followed by a question mark (for example, G5?). Species that are not tracked by the AKNHP do not have a ranking, and therefore the space is left blank.

b. Taxonomic revisions have occurred for this plant and is referenced by more than one Latin name on this list.

Lichens, Fungi and Bryophytes:[1]

Latin Name	Abbreviation	Common Name
Alectoria nigricans	ALNI	Fruticose lichen
Alectoria ochroleuca	ALOC60	Fruticose lichen
Alectoria sp.	ALEC-SP	
Aulacomnium palustre	AUPA	Ribbed bog moss
Bryum sp.	BRYU-SP	Unspecified bryum moss
Calliergon sp.	CALL-SP	
Calliergon stramineum	CAST70	Calliergon moss
Calypogeia sphagnicola	CASP24	Hepatic
Campylium sp.	CAMPY	
Cetraria cucullata	CECU	Lichen
Cetraria sp.	CETR-SP	Unspecified cetraria lichen
Cladina rangiferina	CLRA	Lichen
Cladina sp.	CLADI-SP	Lichen
Cladina stellaris	CLST	Lichen
Cladonia sp.	CLADO-SP	Lichen
Climacium dendroides	CLDE	Tree climacium moss
Dicranum sp.	DICR-SP	Unspecified dicranum moss
Drepanocladus sp.	DREP-SP	Unspecified drepanocladus moss
Feather moss	FEATHER	Unspecified feather moss
Foliose lichen	FOLIOSE	Unspecified foliose lichen
Fruticose lichen	FRUTICO	Unspecified fruticose lichen
Fungus	FUNGI	
Hornwort	HORNW	Unspecified hornworts
Hylocomium splendens	HYSP	Splendid feather moss
Lichen sp.	LICHEN-SP	Unspecified lichen
Liverwort sp.	LIVER-SP	Unspecified liverwort
Lobaria sp.	LOBA-SP	Lung lichen
Meesia triquetra	METR70	
Mnium sp.	MNIU-SP	
Moss sp.	MOSS-SP	Unspecified moss
Nephroma arcticum	NEAR	Arctic kidney lichen
Nephroma sp.	NEPH-SP	Unspecified kidney lichen
Paludella squarrosa	PASQ70	Bedspring moss
Peltigera aphthosa	PEAP60	Felt lichen
Peltigera malacea	PEMA	Lichen
Peltigera sp.	PELT-SP	Unspecified felt lichen
Pleurozium schreberi	PLSC1	Schreber's big red stem moss
Pohlia sp.	POHL-SP	Pohlia moss
Polytrichum commune	POCO2	Moss
Polytrichum sp.	POLY1-SP	Unspecified polytrichum moss
Polytrichum strictum	POST1	Moss
Ptilidium ciliare	PTCI	Moss

Latin Name	Abbreviation	Common Name
Ptilium crista-castrensis	PTCR	Knights plume moss
Racomitrium lanuginosum	RACLAN	
Racomitrium sp.	RACO-SP	Moss
Rhizomnium sp.	RHIZ-SP	
Sphagnum angustifolium	SPAN11	Sphagnum
Sphagnum fuscum	SPFU70	Sphagnum
Sphagnum papillosum	SPPA71	Moss
Sphagnum sp.	SPHA-SP	Unspecified sphagnum moss
Sphagnum squarrosum	SPSQ70	Sphagnum
Sphagnum warnstorfii	SPWA	Warnstorf's sphagnum
Stereocaulon sp.	STER-SP	Lichen
Thamnolia sp.	THAM-SP	Unspecified whiteworm lichen
Tomentypnum nitens	TONI	Tomentypnum moss

[1] These records were not intended as a comprehensive list of lichens, fungi, and bryophytes. Identification of lichens, fungi, and bryophytes at study sites was optional or incidental, not intended to be of the same quality as the vascular plant data.

Other:

Latin Name	Abbreviation	Common Name
Bare ground	BARE	Bare ground
Rock	ROCK	Rock or talus
Water	WATER	Water

APPENDIX 13.1B

Photographs and Descriptions of Project Vegetation Types

Photographs and Descriptions of Project Vegetation Types Bristol Bay Drainages Study Areas

This document shows photographs and descriptions of the Project Vegetation Types identified during vegetation and wetland studies in the Bristol Bay drainages study areas (mine study area and transportation-corridor study area) for Pebble Project. Project Vegetation Types frequently are named for the species that dominated the principal vegetation stratum in study plots with that Project Vegetation Type. For example, for the Project Vegetation Type Open White Spruce Forest, white spruce trees dominated the tree stratum. Project Vegetation Types that are not named for specific species (e.g., Closed Broadleaf Forest or Open Mixed Forest) may have more than one dominant species in the principal vegetation stratum. Dominant species are those species that are predominant in their stratum (tree, shrub, or herb) in a given study plot based on percent coverage (as determined by the 50/20/20 rule, which is described in detail in Chapter 14 of the *Pebble Project Environmental Baseline Document*).

Plant species listed in the descriptions of the Project Vegetation Types are categorized as either characteristic or frequently observed. In species-specific Project Vegetation Types, the characteristic species is always the eponymous dominant species. In the broader Project Vegetation Types, the characteristic species are those that were most frequently dominant in the study plots for the specified Project Vegetation Type. For instance, the dominant tree species in any given study plot for Open Broadleaf Forest may be cottonwood, Kenai birch, or paper birch, or some mix thereof. The characteristic species for that Project Vegetation Type overall is cottonwood, because that species was the dominant species in greatest number of study plots characterized as Open Broadleaf Forest. Frequently observed species are not necessarily dominant species. Frequently observed species are those found in a majority of plots for the particular Project Vegetation Type, but although they were widespread throughout the Project Vegetation Type, they may have occurred in small numbers (a few plants in each of many plots).

In the descriptions below, the characteristic species and frequently observed species specific to the mine study area are noted as MS, and those specific to the transportation-corridor study area are noted as TC. Species not so designated are representative of both study areas.

If detailed vegetation data were collected or the Project Vegetation Type was mapped in only one of the study areas, this information is noted below the name of the Project Vegetation Type.

Representative photograph: OWSF, Open White Spruce Forest from plot #3PP02910, July 2006.

Open White Spruce Forest (OWSF)

Vegetation Type Requirements:	Open forest (tree canopy cover 25–60 percent) dominated by white spruce
Characteristic Species:	White spruce (*Picea glauca*)
Other Frequently Observed Species:	Bog blueberry (*Vaccinium uliginosum*) MS: Beauverd spirea (*Spiraea beauverdiana*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), and fireweed (*Epilobium angustifolium*) TC: Dwarf birch (*Betula nana* ssp*. exilis*), black crowberry (*Empetrum nigrum*) and narrow-leaf Labrador tea (*Ledum decumbens*)

Representative photograph: BSW, Black Spruce Woodland from plot #HDR1171, August 2004.

Black Spruce Woodland (BSW)

Detailed vegetation data collected and Project Vegetation Type mapped only in the transportation-corridor study area

Vegetation Type Requirements:	Woodland forest (tree canopy cover 10–24 percent) dominated by black spruce
Characteristic Species:	Black spruce (*Picea mariana*)
Other Frequently Observed Species:	Narrow-leaf Labrador tea (*Ledum decumbens),* black crowberry *(Empetrum nigrum)*, Bigelow's sedge (*Carex bigelowii*), mud sedge *(C. limosa), russet sedge (C. saxatilis),* woodland horsetail *(Equisetum sylvaticum),* narrow-leaf cottongrass *(Eriophorum angustifolium),* and arctic rush (*Juncus arcticus)*
General distribution, if notable:	Very poorly drained soils in valley bottoms, foot slopes, and toe slopes

Representative photograph: WSW, White Spruce Woodland from plot #3PP02913, July 2006.

White Spruce Woodlands (WSW)

Vegetation Type Requirements:	Woodland forest (tree canopy cover 10–24 percent) dominated by white spruce
Characteristic Species:	White spruce (*Picea glauca*)
Other Frequently Observed Species:	Willows (*Salix* spp.), black crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum*), dwarf birch (*Betula nana* ssp. *exilis*) TC: Narrow-leaf Labrador tea (*Ledum decumbens*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), bluejoint reedgrass (*Calamagrostis canadensis*), horsetails (*Equisetum* spp.)

Representative photograph: CBF, Closed Broadleaf Forest from plot #3PP08940, July 2007.

Closed Broadleaf Forest (CBF)

Vegetation Type Requirements:	Closed forest (tree canopy cover > 60 percent) dominated by broadleaf trees
Characteristic Species:	Kenai birch (*B. kenaica*) and cottonwood (*Populus balsamifera)*
Other Frequently Observed Species:	Squashberry (*Viburnum edule*), bluejoint reedgrass (*Calamagrostis canadensis*), horsetails (*Equisetum* spp.), and/or mountain woodfern (*Dryopteris dilatata* ssp*. americana*) MS: Felt leaf willow (*Salix alaxensis*) TC: Paper birch (*Betula papyrifera),* oak fern (*Gymnocarpium dryopteris*) and fireweed (*Epilobium angustifolium*)
General distribution, if notable:	Hillsides and along floodplains and riparian corridors

Representative photograph: OBF, Open Broadleaf Forest from plot #3PP6525, July 2007.

Open Broadleaf Forest (OBF)

Vegetation Type Requirements:	Open forest (tree canopy cover 25–60 percent) dominated by broadleaf tree species
Characteristic Species:	Cottonwoods (*Populus balsamifera*) TC: Paper birch (*Betula papyrifera*) and Kenai birch (*Betula kenaica*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*), horsetails (*Equisetum* spp.), oak fern (*Gymnocarpium dryopteris*), and fireweed (*Epilobium angustifolium*) MS: Willows (*Salix* spp.) TC: Squashberry (*Viburnum edule*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), beauverd spirea (*Spiraea beauverdiana*), European starflower (*Trientalis europea s.l.*) and mountain woodfern (*Dryopteris dilatata* ssp*. americana*)

Photo 13.1-11. Representative photograph: BW, Broadleaf Woodland from plot #3PP06090, June 2006.

,

Broadleaf Woodland Forest (BW)

Vegetation Type Requirements:	Woodland forest (tree canopy cover 10–24 percent) dominated by broadleaf species
Characteristic Species:	Cottonwood (*Populus balsamifera)*, Kenai birch (*Betula kenaica*) MS: Felt-leaf willow (*Salix alaxensis*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*) MS: Angelica (*Angelica* spp.) TC: Willows (*Salix* spp.), beauverd spirea (*Spiraea beauverdiana*), squashberry (*Viburnum edule*), Sitka alder (*Alnus sinuata*), burnet (*Sanguisorba stipulata)* and field horsetail (*Equisetum arvense*)

Representative photograph: CMF, Closed Mixed Forest from plot #HDR2023, July 2004.

Closed Mixed Forest (CMF)

Detailed vegetation data collected and Project Vegetation Type mapped only in the transportation-corridor study area

Vegetation Type Requirements:	Closed forest (tree cover > 60 percent) co-dominated by needleleaf and broadleaf trees
Characteristic Species:	White spruce (*Picea glauca)*, birch (*Betula papyrifera* and *B. kenaica*), and balsam poplar (*Populus balsamifera*)
Other Frequently Observed Species:	Sitka alder (*Alnus sinuate),* dwarf birch *(Betula nana* ssp*. exilis),* crowberry *(Empetrum nigrum),* narrow-leaf Labrador tea *(Ledum decumbens),* mock azalea *(Menziesia ferruginea),* beauverd spirea *(Spiraea beauverdiana),* bog blueberry *(Vaccinium uliginosum),* mountain cranberry *(V. vitis-idaea* ssp. *minus),* and squashberry *(Viburnum edule),* rough bentgrass *(Agrostis scabra),* bluejoint reedgrass *(Calamagrostis canadensis),* Canada bunchberry *(Cornus canadensis*), mountain woodfern *(Dryopteris dilatata* ssp*. americana),* fireweed *(Epilobium angustifolium),* horsetails *(Equisetum* spp.), oak fern (*Gymnocarpium dryopteris),* pink wintergreen *(Pyrola asarifolia),* cloudberry *(Rubus chamaemorus),* and strawberry leaf raspberry (*R. pedatus)*
General distribution, if notable:	Along hillsides and valley bottom with flat terrain

Representative photograph: OMF, Open Mixed Forest from plot #3PP00362, August 2004.

Open Mixed Forest (OMF)

Vegetation Type Requirements:	Open forest (tree cover 25–60 percent) co-dominated by needleleaf and broadleaf trees
Characteristic Species:	White spruce (*Picea glauca*) and paper birch (*Betula papyrifera*) TC: Kenai birch (*Betula kenaica*) and balsam poplar (*Populus balsamifera)*
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*) MS: Field horsetail (*Equisetum arvense*) and diamondleaf willow (*Salix pulchra*) TC: Beauverd spirea (*Spiraea beauverdiana*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), oak fern (*Gynocarpium dryopteris*), and mountain woodfern (*Dryopteris dilatata* ssp*. americana*)

Representative photograph: MFW, Mixed Forest Woodland from plot #3PP00843, August 2004.

Mixed Forest Woodland (MFW)

Detailed vegetation data collected only in the transportation-corridor study area

Vegetation Type Requirements:	Woodland forest (tree cover 10–24 percent) co-dominated by needleleaf and broadleaf trees
Characteristic Species:	White spruce (*Picea glauca*), paper birch (*Betula papyrifera*), and Kenai birch (*Betula kenaica*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis),* willows (*Salix* spp.), narrow-leaf Labrador tea (*Ledum decumbens*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), black crowberry (*Empetrum nigrum*), dwarf birch (*Betula nana* ssp. *exilis*), bog blueberry (*Vaccinium uliginosum*), and fireweed (*Epilobium angustifolium*)

Photo 13.1-9. Representative photograph: DBSS, Dwarf Black Spruce Scrub from plot #HDR5030, July 2007.

Dwarf Black Spruce Scrub (DBSS)

Vegetation Type Requirements:	Needleleaf forest (tree species canopy cover 10-60 percent) dominated by dwarf black spruce (< 10 feet tall)
Characteristic Species:	Small black spruce trees (*Picea mariana*)
Other Frequently Observed Species:	Narrow-leaf Labrador tea (*Ledum decumbens*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), black crowberry (*Empetrum nigrum*), and *Sphagnum* spp. TC: Dwarf birch (*Betula nana* ssp*. exilis*), bog blueberry (*Vaccinium uliginosum*), Bigelow's sedge (*Care bigelowii*) and cloudberry (*Rubus chamaemorus*)

Photo 13.1-10. Representative photograph: DWSS, Dwarf White Spruce Scrub from plot #HDR2145, August 2004.

Dwarf White Spruce Scrub (DWSS)

Detailed vegetation data collected only in the transportation-corridor study area

Vegetation Type Requirements:	Needleleaf forest (tree species canopy cover 10-60 percent) dominated by dwarf white spruce (< 10 feet tall)
Characteristic Species:	White spruce (*Picea glauca*)
Other Frequently Observed Species:	Dwarf birch *(Betula nana* ssp*. exilis),* black crowberry *(Empetrum nigrum),* shrubby cinquefoil (*Potentilla fruticosa),* Bigelow's sedge *(Carex bigelowii),* hoary sedge *(C. canescens),* Northwest territory sedge *(C. rhynchophysa)*, and field horsetail *(Equisetum arvense)*
General distribution, if notable:	Poorly drained soils in a variety of landscape positions throughout the transportation-corridor study area

Representative photograph: CWTS, Closed Willow Tall Shrub from plot #3PP00325, July 2004.

Closed Willow Tall Shrub (CWTS)

Vegetation Type Requirements:	Closed stands (> 75 percent cover) of tall willow (> 5 feet tall)
Characteristic Species:	Diamondleaf willow (*Salix pulchra*), Barclay's willow (*Salix barclayi*) MS: Felt-leaf willow (*S. alaxensis*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*) MS: Burnet (*Sanguisorba* spp.), horsetails (*Equisetum* spp.), fireweed (*Epilobium angustifolium*), and violets (*Viola* spp.) TS: Sedges (*Carex* spp.)
General distribution, if notable:	Riparian corridors

Representative photograph: CATS, Closed Alder Tall Shrub from plot #3PP00998, September 2004.

Closed Alder Tall Shrub (CATS)

Vegetation Type Requirements:	Closed stands (> 75 percent cover) of tall alder (> 5 feet tall)
Characteristic Species:	Sitka alder (*Alnus sinuata)*
Other Frequently Observed Species:	Mountain woodfern (*Dryopteris dilatata* ssp. *americana)*, bluejoint reedgrass (*Calamagrostis canadensis)* MS: Skunk currant (*Ribes glandulosum*) TC: Devil's club (*Oplopanax horridus*), subarctic lady fern (*Athyrium filix-femina* ssp. *cyclosorum*), oak fern (*Gymnocarpium dryopteris*), narrow beech fern (*Thelypteris phegopteris*), and salmonberry (*Rubus spectabilis*)
General distribution, if notable:	Drier microsites on slopes and mountainsides

Representative photograph: CAWTS, Closed Alder Willow Tall Shrub from plot #3PP00510, August 2004.

Closed Alder Willow Tall Shrub (CAWTS)

Vegetation Type Requirements:	Closed shrub stands (>75% cover) co-dominated by tall alder and willow (> 5 feet tall)
Characteristic Species:	Sitka alder (*Alnus sinuata*)
	MS: Diamondleaf willow (*Salix pulchra*)
	TC: Felt leaf willow (*Salix alaxensis*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*)
	MS: Beauverd spirea (*Spiraea beauverdiana*), horsetails (*Equisetum* spp.), and mountain woodfern (*Dryopteris dilatata* ssp. *americana*)

Representative photograph: OWTS, Open Willow Tall Shrub from plot #3PP00290, July 2004.

Open Willow Tall Shrub (OWTS)

Vegetation Type Requirements:	Open stands (25–75 percent cover) of tall willow (> 5 feet tall)
Characteristic Species:	Diamondleaf willow (*Salix pulchra*)
	MS: Felt-leaf willow (*Salix alaxensis*)
	TC: Gray-leaf willow (*Salix glauca*) and Barclay's willow (*Salix barclayi*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*) and horsetails (*Equisetum* spp.)
	MS: Fireweed (*Epilobium angustifolium*), burnet *(Sanguisorba* spp.), angelica (*Angelica* spp.)
	TC: Bog blueberry (*Vaccinium uliginosum*)
General distribution, if notable:	Riparian corridors

Representative photograph: OATS, Open Alder Tall Shrub from plot #3PP11008, July 2007.

Open Alder Tall Shrub (OATS)

Vegetation Type Requirements:	Open stands (25–75 percent cover) of tall alder (> 5 feet tall)
Characteristic Species:	Sitka alder (*Alnus sinuata*)
Other Frequently Observed Species:	Mountain woodfern (*Dryopteris dilatata* ssp. *americana*), bluejoint reedgrass (*Calamagrostis canadensis*) MS: Beauverd spirea (*Spiraea beauverdiana*), and bog blueberry (*Vaccinium uliginosum*), and European starflower (*Trientalis europaea s.l.*) TC: Devil's club (Oplopanax horridus), salmonberry (Rubus spectabilis)
General distribution, if notable:	Drier microsites on slopes and mountainsides, including dry swales and benches

Representative photograph: OAWTS, Open Alder Willow Tall Shrub from plot #3PP01689, August 2005.

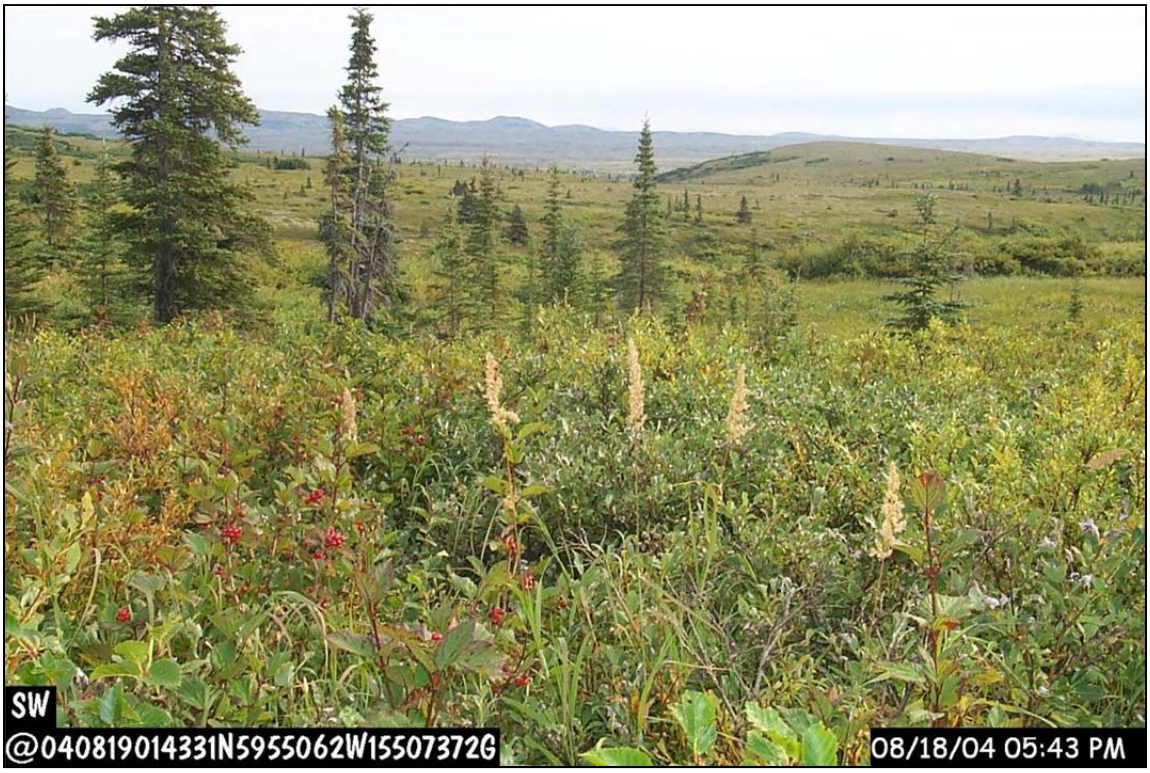
Open Alder Willow Tall Shrub (OAWTS)

Vegetation Type Requirements:	Open shrub stands co-dominated by alder and willow (> 5 feet tall). The combined cover of alder and willow is 25–75 percent.
Characteristic Species:	Sitka alder (*Alnus sinuata*)
	MS: Diamondleaf willow (*Salix pulchra*)
	TC: Barclay's willow (*Salix barclayi*)
Other Frequently Observed Species:	Mountain woodfern (*Dryopteris dilatata* ssp. *americana*), and bluejoint reedgrass (*Calamagrostis canadensis*).
	MS: Beauverd spirea (*Spiraea beauverdiana*), fireweed *(Epilobium angustifolium),* horsetails (*Equisetum* spp.),

Representative photograph: CWLS, Closed Willow Low Shrub from plot #3PP00076, July 2004.

Closed Willow Low Shrub (CWLS)

Vegetation Type Requirements:	Closed stands (> 75 percent cover) of low willow (< 5 feet tall)
Characteristic Species:	Diamondleaf willow (*Salix pulchra*)
	MS: Barclay's willow (*Salix barclayi*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*) and horsetails (*Equisetum* spp.)
	MS: Fireweed *(Epilobium angustifolium)*, burnet (*Sanguisorba* spp.), and, in wetter microsites, marsh cinquefoil *(Potentilla palustris)*



Representative photograph: CAWLS, Closed Alder Willow Low Shrub from plot #3PP00466, August 2004.

Closed Alder Willow Low Shrub (CAWLS)

Detailed vegetation data collected only in the mine study area

Vegetation Type Requirements:	Closed shrub stands (>75% cover) co-dominated by low alder and willow (< 5 feet tall)
Characteristic Species:	Diamondleaf willow (*Salix pulchra*) and Sitka alder (*Alnus sinuata*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*)

Representative photograph: OMSST, Open Mixed Shrub Sedge Tussocks from plot #3PP10640, August 2007.

Open Mixed Shrub Sedge Tussock (OMSST)

Vegetation Type Requirements:	Tussock tundra co-dominated by low shrubs (<5 feet tall) and tussock-forming graminoids
Characteristic Species:	Low and dwarf shrubs and members of the sedge family (Cyperaceae), including cottongrass (*Eriophorum* spp.).
Other Frequently Observed Species:	Dwarf birch (*Betula nana* ssp. *exilis*), narrow-leaf Labrador tea (*Ledum decumbens*), blueberries and cranberries (*Vaccinium* spp.), water sedge (*Carex aquatilis*), sphagnum moss (*Sphagnum* spp.) MS: Willows (*Salix* spp.), bog rosemary (*Andromeda polifolia*), tussock cottongrass (*Eriophorum vaginatum*), and cloudberry (*Rubus chamaemorus*) TC: Narrow-leaf cottongrass (*Eriophorum angustifolium*)

Representative photograph: ODBS, Open Dwarf Birch Shrub from plot #3PP00320, August 2004.

Open Dwarf Birch Shrub (ODBS)

Vegetation Type Requirements:	Open stands (25–75 percent cover) of dwarf birch and/or shrub birch
Characteristic Species:	Dwarf birch (*Betula nana* ssp. *exilis)*
Other Frequently Observed Species:	Willows (*Salix* spp.), bog blueberry (*Vaccinium uliginosum*), mountain cranberry (*V. vitis-idaea* ssp. *minus*), black crowberry (*Empetrum nigrum*), narrow-leaf Labrador tea (*Ledum decumbens*), bluejoint reedgrass (*Calamagrostis canadensis*), cloudberry (*Rubus chamaemorus*), and sedges (*Carex* spp.)

Representative photograph: LEST, Low Ericaceous Shrub Tundra from plot #3PP02435, August 2005.

Low Ericaceous Shrub Tundra (LEST)

Vegetation Type Requirements:	Tundra dominated by low ericaceous shrubs (>8 inches)
Characteristic Species:	Black crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum*) TC: Narrow-leaf Labrador tea (*Ledum decumbens*) MS: Dwarf birch (*Betula nana* ssp. *exilis)*
Other Frequently Observed Species:	Mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), beauverd spirea (*Spiraea beauverdiana*), bluejoint reedgrass (*Calamagrostis canadensis*), cloudberry (*Rubus chamaemorus*), and scattered willows (*Salix* spp.) MS: Narrow-leaf Labrador tea (*Ledum decumbens*), scattered sedges *(e.g., Carex microchaeta s.l.),* TC: Dwarf birch (*Betula nana* ssp. *exilis*), sphagnum moss (*Sphagnum* spp.) and other mosses

Representative photograph: ODBESB, Open Dwarf Birch Ericaceous Shrub Bog from plot #3PP02348, June 2005.

Open Dwarf Birch Ericaceous Shrub Bog (ODBESB)

Vegetation Type Requirements:	Bogs with abundant ericaceous shrubs and dwarf birch
Characteristic Species:	Dwarf birch (*B. nana* ssp. *exilis*), bog blueberry (*Vaccinium uliginosum*), narrow-leaf Labrador tea (*Ledum decumbens*), black crowberry (*Empetrum nigrum*) MS: Alaska bog willow (*Salix fuscescens*) TC: Shrub birch (*Betula glandulosa)*
Other Frequently Observed Species:	Mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), bog rosemary (*Andromeda polifolia*), cottongrass (*Eriophorum* spp.), horsetails (*Equisetum* spp.), cloudberry (*Rubus chamaemorus*), sedges (*Carex* spp.), and sphagnum mosses (*Sphagnum* spp.) MS: Small cranberry (*Vaccinium oxycoccus*), bluejoint reedgrass (*Calamagrostis canadensis*), diamondleaf willow (*S. pulchra*), and water sedge (*Carex aquatilis*)

Representative photograph: ESB, Ericaceous Shrub Bog from plot #3PP02685, August 2005.

Ericaceous Shrub Bog (ESB)

Vegetation Type Requirements:	Bogs with abundant mosses and ericaceous shrubs, but only sparse dwarf birch
Characteristic Species:	Bog blueberry (*Vaccinium uliginosum*), narrow-leaf Labrador tea (*Ledum decumbens*), black crowberry (*Empetrum nigrum*), scattered dwarf birch (*Betula nana* ssp. *exilis*) TC: Bog rosemary (*Andromeda polifolia*)
Other Frequently Observed Species:	Cottongrass (*Eriophorum* spp.), sedges (*Carex* spp.), cloudberry (*Rubus chamaemorus*), *Sphagnum* spp. MS: Willows (*e.g.,* diamondleaf willow [*Salix pulchra*] and Alaska bog willow [*Salix fuscescens]*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), bog rosemary (*Andromeda polifolia*), sedges (e.g., water sedge and loose-lowered sedge *[C. rariflora]*), horsetails (*Equisetum* spp.), bluejoint reedgrass (*Calamagrostis canadensis*). and cloudberry (*Rubus chamaemorus*)

Representative photograph: SBW, Shrub Birch Willow from plot #3PP00026, July 2004.

Shrub Birch Willow (SBW)

Vegetation Type Requirements:	Open or dense shrub stands (percent cover > 25 percent) co-dominated by willows and birch
Characteristic Species:	Shrub birch (*Betula glandulosa*) and/or dwarf birch (*B. nana* ssp. *exilis*) and willow species (*Salix* spp.)
Other Frequently Observed Species:	Diamondleaf willow (*S. pulchra*), dwarf willows (*e.g., S. reticulata* and/or *Salix fuscescens*), ericaceous shrubs, black crowberry (*Empetrum nigrum*), bluejoint reedgrass (*Calamagrostis canadensis*), and horsetails (*Equisetum* spp.) TC: Barclay's willow (*Salix barclayi*), sedges (*Carex* spp.)

Representative photograph: OWLS, Open Willow Low Shrub from plot #3PP02314, June 2005.

Open Willow Low Shrub (OWLS)

Vegetation Type Requirements:	Open stands (25–75 percent cover) of low willow (< 5 feet tall)
Characteristic Species:	Diamondleaf willow (*Salix pulchra*), Barclay's willow (*S. barclayi*) MS: Dwarf willows (*e.g., S. fuscescens, S. reticulata*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*), fireweed (*Epilobium angustifolium*), burnet (*Sanguisorba* spp.), black crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum*), MS: Beauverd spirea *(Spiraea beauverdiana),* horsetails (*Equisetum* spp.), dwarf berries (*Rubus arcticus, R. chamaemorus*) TC: Woolly geranium (*Geranium erianthum*)

Representative photograph: OWLSF, Open Willow Low Shrub Fen from plot #3PP02623, August 2005.

Open Willow Low Shrub Fen (OWLSF)

Vegetation Type Requirements:	Fens characterized by open stands (25–75 percent cover) of low willows (<5 feet tall)
Characteristic Species:	Diamondleaf willow (*Salix pulchra*) and Barclay's willow (*S. barclayi*)
Other Frequently Observed Species:	Dwarf willows (Alaska bog willow *[S. fuscescens],* and netleaf willow, *[S. reticulata])*, dwarf birch (*B. nana* ssp. *exilis*), blueberries and cranberries (*Vaccinium spp.*), horsetails (*Equisetum* spp.), bluejoint reedgrass (*Calamagrostis canadensis*), marsh cinquefoil (*Potentilla palustris*), water sedge (*Carex aquatilis*), cottongrass (*Eriophorum spp.),* and Sphagnum moss *(Sphagnum spp.)*
General distribution, if notable:	Wet sites, including seeps and springs

Representative photograph: OSGB, Open Sweet Gale Bog from plot #HDR4024, July 2007.

Open Sweetgale Graminoid Bog (OSGB)

Detailed vegetation data collected only in the transportation-corridor study area

Vegetation Type Requirements:	Bogs characterized by an abundance of sweetgale (> 25 percent cover)
Characteristic Species:	Sweetgale (*Myrica gale*)
Other Frequently Observed Species:	Dwarf birch (*Betula nana* ssp. *exilis*), bog rosemary (*Andromeda polifolia*), shrubby cinquefoil (*Potentilla fruticosa*), cottongrass (*Eriophorum* spp.), and sedges (*Carex* spp.), particularly water sedge (*Carex aquatilis*)
General distribution, if notable:	Saturated soils

Representative photograph: OAWLS, Open Alder Willow Low Shrub from plot #3PP01002, July 2004.

Open Alder Willow Low Shrub (OAWLS)

Vegetation Type Requirements:	Open shrub stands co-dominated by alder and willow (< 5 feet tall). The combined cover of alder and willow is 25–75 percent
Characteristic Species:	Sitka alder (*Alnus sinuata*)
	MS: Diamondleaf willow (*Salix pulchra*)
	TC: Barclay's willow (*Salix barclayi*)
Other Frequently Observed Species:	MS: Beauverd spirea (*Spiraea beauverdiana*), crowberry (*Empetrum nigrum),* bog blueberry *(Vaccinium uliginosum),* and bluejoint reedgrass (*Calamagrostis canadensis).*

Representative photograph: OALS, Open Alder Low Shrub from plot #3PP10172, August 2007.

Open Alder Low Shrub (OALS)

Vegetation Type Requirements:	Open stands (25–75 percent cover) of low alder (< 5 feet tall)
Characteristic Species:	Sitka alder (*Alnus sinuata)*
Other Frequently Observed Species:	Shrub birches (*Betula nana* ssp*. exilis, B. glandulosa*), bluejoint reedgrass (*Calamagrostis canadensis*) MS: European starflower (*Trientalis europaea s.l.*) TC: Black crowberry (*Empetrum nigrum*), narrow-leaf Labrador tea (*Ledum decumbens*), salmonberry (*Rubus spectabilis*), mountain woodfern (*Dryopteris dilatata*) and oak fern (*Gymnocarpium dryopteris*)

Representative photograph: DESLT, Dwarf Ericaceous Shrub Lichen Tundra from plot #3PP00749, September 2004.

Dwarf Ericaceous Shrub Lichen Tundra (DESLT)

Detailed vegetation data collected only in the mine study area

Vegetation Type Requirements:	Lichen-dominated ground (>60 percent cover) with > 25 percent cover of dwarf ericaceous shrubs (<8 inches tall)
Characteristic Species:	Reindeer lichens (*Cladonia* spp., *Cladina* spp.), black crowberry (*Empetrum nigrum*), narrow-leaf Labrador tea (*Ledum decumbens*), dwarf birch (*Betula nana* ssp. *exilis*), and bog blueberry (*Vaccinium uliginosum*)
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*), scattered sedges (*e.g.,* Bigelow's sedge [*Carex bigelowii s.l. and* smallawned sedge [*Carex microchaeta s.l.*]), and dwarf willows (*e.g., Salix arctica, S. phlebophylla)*

Representative photograph: DEST, Dwarf Ericaceous Shrub Tundra from plot #3PP00994, September 2004.

Dwarf Ericaceous Shrub Tundra (DEST)

Vegetation Type Requirements:	Tundra that does not satisfy the requirements of other Project Vegetation Types and is dominated by dwarf ericaceous shrubs (<8 inches tall)
Characteristic Species:	Black crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), narrow-leaf Labrador tea (*Ledum decumbens*), dwarf birch (*Betula nana* ssp. *exilis*)
Other Frequently Observed Species:	MS: Willows *(Salix* spp.), beauverd spirea *(Spiraea beauverdiana),* bluejoint reedgrass (*Calamagrostis canadensis*), sedges (*e.g.,* smallawned sedge, *Carex microchaeta s.l.*), and cloudberry (*Rubus chamaemorus*) TC: Although herbs are present, no single species is found frequently or in abundance
General distribution, if notable:	Very common vegetation type throughout the mine study area.

Representative photograph: DEST-H, Dwarf Ericaceous Shrub Tundra- Hummocks from plot #3PP03280, June 2006.

Dwarf Ericaceous Shrub Tundra—Hummocks (DEST-H)

Vegetation Type Requirements:	Tundra characterized by dwarf ericaceous shrubs (>25 percent cover) growing on moderate to large hummocks (> 6 inches tall)
Characteristic Species:	Narrow-leaf Labrador tea (*Ledum decumbens*), dwarf birch (*Betula nana* ssp. *exilis*), black crowberry (*Empetrum nigrum*), bog blueberry (*Vaccinium uliginosum)*, and mountain cranberry (*V. vitis-idaea* ssp. *minus*) TC: Alpine bearberry (*Arctostaphylos alpina*)
Other Frequently Observed Species:	Sedges (*e.g.,* Bigelow's sedge [*Carex bigelowii s.l.*]), lichens MS: Beauverd spirea (*Spiraea beauverdiana*), Alaska bog willow (*Salix fuscescens*), diamondleaf willow (*S. pulchra*), bluejoint reedgrass (*Calamagrostis canadensis*), arctic raspberry (*Rubus arcticus*), and cloudberry (*Rubus chamaemorus*).

Representative photograph: DEST-C, Dwarf Ericaceous Shrub Tundra- Carex from plot #3PP06150, July 2006.

Dwarf Ericaceous Shrub Tundra—*Carex* (DEST-C)

Vegetation Type Requirements:	Tundra co-dominated by sedges (>25 percent cover) and dwarf ericaceous shrubs
Characteristic Species:	Black crowberry (*Empetrum nigrum*), willows (*Salix* spp.), dwarf birch (*Betula nana* ssp. *exilis*), narrow-leaf Labrador tea (*Ledum decumbens*), dwarf raspberry and cloudberry (*Rubus* spp.), bog blueberry (*Vaccinium uliginosum*), mountain cranberry (*Vaccinium vitis-idaea* ssp. *minus*), bluejoint reedgrass (*Calamagrostis canadensis*), Bigelow's sedge (*Carex bigelowii*), sphagnum moss (*Sphagnum* spp.) and other mosses MS: Bering Sea sedge (*Carex nesophila*), long-style sedge (*Carex stylosa*), and, in wet sites, water sedge (Carex *aquatilis)*

Representative photograph: DEST-EQ, Dwarf Ericaceous Shrub Tundra-Equisetum from plot #3PP03362, July 2006.

Dwarf Ericaceous Shrub Tundra—*Equisetum* (DEST-EQ)
Detailed vegetation data collected and Project Vegetation Type mapped only in the mine study area

Vegetation Type Requirements:	Tundra co-dominated by horsetails (>25 percent cover) and dwarf ericaceous shrubs
Characteristic Species:	Field horsetail (*E. arvense*) and woodland horsetail (*E. sylvaticum),* bog blueberry (*Vaccinium uliginosum*), black crowberry (*Empetrum nigrum*), narrow-leaf Labrador tea (*Ledum decumbens*), and dwarf birch (*Betula nana* ssp. *exilis.*
Other Frequently Observed Species:	Bluejoint reedgrass (*Calamagrostis canadensis*), scattered sedges *(e.g., Carex microchaeta s.l.),* and cloudberry (*Rubus chamaemorus*).

Representative photograph: BTG, Bluejoint Tall Grass from plot #3PP02696, August 2005.

Bluejoint Tall Grass (BTG)

Vegetation Type Requirements:	Abundant bluejoint reedgrass; other herbs and grasses may be present but are not co-dominant
Characteristic Species:	Bluejoint reedgrass (*Calamagrostis canadensis*)
Other Frequently Observed Species:	Horsetails (*e.g.,* field horsetail [*Equisetum arvense])* and diamondleaf willow (*Salix pulchra)* MS: Fireweed *(Epilobium angustifolium),* seawatch angelica *(Angelica lucida),* European starflower *(Trientalis europaea s.l.),* burnet *(Sanguisorba* spp*.),* arctic raspberry and/or cloudberry (*Rubus arcticus, R. chamaemorus*) TC: Beauverd spirea (*Spiraea beauverdiana*)
General distribution, if notable:	Floodplains and hillsides

Representative photograph: BH, Bluejoint Tall Grass Herb from plot #3PP02825, September 2005.

,

Bluejoint Herb (BH)

Vegetation Type Requirements:	Abundant bluejoint reedgrass interspersed with other herbs
Characteristic Species:	Bluejoint reedgrass (*Calamagrostis canadensis)*, fireweed (*Epilobium angustifolium),* burnet (*e.g., Sanguisorba stipulata*) MS: Arctic raspberry and/or cloudberry (*Rubus arcticus, R. chamaemorus*), horsetails (e.g., *Equisetum arvense, E. pratense*), seawatch angelica (*Angelica lucida*) TC: Oak fern *(Gymnocarpium dryopteris)*
Other Frequently Observed Species:	Wooly geranium (*Geranium erianthum*), European starflower (*Trientalis europaea s.l.*) MS: Scattered willows (e.g., diamondleaf willow *[Salix pulchra]),* ericaceous shrubs, and violets (*Viola* spp.), TC: Seawatch angelica (*Angelica lucida*), beauverd spirea (*Spiraea beauverdiana*), yarrow (*Achillea borealis*)

Representative photograph: SSMWM, Subarctic Sedge Moss Wet Meadow from plot #3PP02795, September 2005.

Subarctic Sedge Moss Wet Meadow (SSMWM)

Vegetation Type Requirements:	Graminoid-dominated communities found on wet soils and that do not satisfy the requirements of other Project Vegetation Types
Characteristic Species:	Sedges (*e.g.,* water sedge [*Carex aquatilis]*) and sphagnum mosses (*Sphagnum* spp.), cottongrasses (*e.g.,* narrow-leaf cottongrass *[Eriophorum angustifolium*])
	MS: Marsh cinquefoil (*Potentilla palustris*), Alaska bog willow (*Salix fuscescens*), horsetails (*Equisetum* spp.)
	TC: tufted bulrush (*Scirpus cespitosus*)
Other Frequently Observed Species:	Bog rosemary (*Andromeda polifolia*), dwarf birch (*Betula nana* ssp. *exilis*), bog blueberry (*Vaccinium uliginosum*), bluejoint reedgrass (*Calamagrostis canadensis*), black crowberry *(Empetrum nigrum*)
	MS: Diamondleaf willow (*S. pulchra*)
	TC: Marsh cinquefoil (*Potentilla palustris*), horsetails (particularly *Equisetum arvense*)

Representative photograph: FSM, Fresh Sedge Marsh from plot #3PP02781, September 2005.

Fresh Sedge Marsh (FSM)

Vegetation Type Requirements:	Dominated by members of the sedge family (*e.g.,* sedges [*Carex* spp.], cottongrass [*Eriophorum* spp.]) rooted in standing water
Characteristic Species:	Water sedge (*Carex aquatilis*) TC: Lyngbye's sedge (*Carex lyngbyei*), Northwest territory sedge (*Carex rhynchosphysa s.l.*)
Other Frequently Observed Species:	Marsh cinquefoil (*Potentilla palustris*) and bluejoint reedgrass (*Calamagrostis canadensis*), narrow-leaf cottongrass (*Eriophorum angustifolium*) MS: Russet cottongrass (*Eriophorum russeolum s.l.*); Alaska bog willow (*Salix fuscescens*) and dwarf birch (*Betula nana* ssp. *exilis)* are often observed in drier microsites
General distribution, if notable:	Shallow standing water

Representative photograph: MH, Mesic Herb from plot #3PP00018b, July 2004.

Mesic Herb (MH)

Vegetation Type Requirements:	Herb-dominated communities that occur on mesic sites and do not satisfy the requirements of other Project Vegetation Types
Characteristic Species:	Bluejoint reedgrass (*Calamagrostis canadensis*), arctic raspberry (*Rubus arcticus)*, seawatch angelica (*Angelica lucida)*, and fireweed (*Epilobium angustifolium)* MS: Burnet *(Sanguisorba* spp.), sedges *(e.g., Carex canescens)* TC: Mountain woodfern (*Dryopteris dilatata* ssp. *americana*) and oak fern (*Gymnocarpium dryopteris*)
Other Frequently Observed Species:	Beauverd spirea (*Spiraea beauverdiana*) MS: Willows (*e.g.,* diamondleaf willow *[Salix pulchra])*, black crowberry (*Empetrum nigrum)*, blueberries and cranberries (*Vaccinium* spp.*)*

Representative photograph: FHM, Fresh Herb Marsh from plot #3PP01680, June 2005..

Fresh Herb Marsh (FHM)

Vegetation Type Requirements:	Dominated by emergent herbaceous plants rooted in standing water
Characteristic Species:	Horsetails (*e.g., Equisetum fluviatile, E. hyemale*) TC: Marsh cinquefoil (*Potentilla palustris*) MS: Bluejoint reedgrass (*Calamagrostis canadensis*), water sedge (*Carex aquatilis)*
Other Frequently Observed Species:	Sedges (*Carex* spp.) MS: Pendent grass (*Arctophila fulva*) and marsh cinquefoil (*Potentilla palustris*) TC: Buckbean (*Menyanthes trifoliata*)
General distribution, if notable:	Shallow standing water

Representative photograph: AH, Aquatic Herb from plot #HDR1744, August 2005.

Aquatic Herbaceous (AH)

Detailed vegetation data collected only in the transportation-corridor study area

Vegetation Type Requirements:	Dominated by submerged plants or plants with floating leaves
Characteristic Species:	Pendent grass (*Arctophila fulva*), common mare's tail (*Hippuris vulgaris*), spearwort buttercup (*Ranunculus flammula*), white water-crowfoot (*Ranunculus trichophyllus*)
General distribution, if notable:	Shallow ponds, oxbows ponds, and other slow moving or still water

Representative photograph: BARE, Barren from plot #3PP00950, August 2004.

Barren (BARE)

Vegetation Type Requirements:	Very sparse (<10 percent cover) of vascular plants
Characteristic Species:	N/A
Other Frequently Observed Species:	N/A
General distribution, if notable:	Seasonally flooded gravel bars and ponds, and exposed areas along hillsides and ridge tops

Representative photograph: PV, Partially Vegetated from plot #3PP00762, July 2004.

Partially Vegetated (PV)
Detailed vegetation data collected only in the mine study area

Vegetation Type Requirements:	Sparse (10–25 percent) cover of vascular plants
Characteristic Species:	Scattered short herbs, particularly bluejoint reedgrass *(Calamagrostis canadensis)*
Other Frequently Observed Species:	Dwarf ericaceous shrubs, low or dwarf willows (*Salix* spp.)
General distribution, if notable:	Seasonally flooded gravel bars or ponds and in exposed areas along hillsides and ridge tops

Representative photograph: OW, Open Water from plot #3PP00101, July 2004.

Open Water (OW)

Vegetation Type Requirements:	Unvegetated to very sparsely vegetated
Characteristic Species:	N/A
Other Frequently Observed Species:	N/A
General distribution, if notable:	Streambeds, river channels, lakes, and ponds

APPENDIX 13.1C

Draft List of the Most Common Plant Taxa Found in the Mine Mapping Area

Draft List of the Most Common[a] Plant Taxa Found in the Mine Mapping Area

The most frequently reported (>10) plant taxa per stratum.

Latin Name	Acronym	Common Name
Trees/Saplings		
Betula papyrifera s.l. (trees)	BEPA-T	Paper birch
Picea glauca (saplings)	PIGL-SAP	White spruce
Picea glauca (trees)	PIGL-T	White spruce
Picea mariana (trees)	PIMA-T	Black spruce
Populus balsamifera (saplings)	POBA-SAP	Cottonwood
Populus balsamifera (trees)	POBA-T	Cottonwood
Salix alaxensis (trees)	SAAL-T	Feltleaf willow
Shrubs		
Alnus sinuata	ALSI	Sitka alder
Andromeda polifolia	ANPO	Bog rosemary
Arctostaphylos alpina	ARAL2	Alpine bearberry
Betula nana ssp. exilis	BENA	Dwarf birch
Empetrum nigrum	EMNI	Black crowberry
Ledum decumbens	LEDE	Narrow-leaf Labrador tea
Loiseleuria procumbens	LOPR	Alpine azalea
Potentilla fruticosa	POFR1	Shrubby cinquefoil
Ribes glandulosum	RIGL	Skunk currant
Salix alaxensis (shrubs)	SAAL-S	Feltleaf willow
Salix arbusculoides	SAAR	Little-tree willow
Salix arctica	SAAR1	Arctic willow
Salix barclayi	SABA	Barclay willow
Salix fuscescens	SAFU	Alaska bog willow
Salix glauca	SAGL	Grayleaf willow
Salix planifolia s.l.	SAPL	Diamondleaf willow
Salix pulchra	SAPL1	Diamondleaf willow
Salix reticulata	SARE	Netleaf willow
Salix richardsonii	SARI	Richardson;s willow
Spiraea beauverdiana	SPBE	Beauverd spirea
Vaccinium oxycoccos	VAOX	Small cranberry
Vaccinium uliginosum	VAUL	Bog blueberry
Vaccinium vitis-idaea ssp. minus	VAVI	Mountain cranberry
Viburnum edule	VIED	Squashberry
Herbs		
Achillea borealis	ACBO	Yarrow
Aconitum delphiniifolium	ACDE	Monkshood (larkspur-leaf)
Angelica lucida	ANLU	Seawatch angelica

Latin Name	Acronym	Common Name
Artemisia arctica	ARAR	Mountain sagewort
Athyrium filix-femina ssp. cyclosorum	ATFI	Subarctic lady fern
Calamagrostis canadensis	CACA	Bluejoint reedgrass
Carex aquatilis	CAAQ	Water sedge
Carex bigelowii s.l.	CABI1	Bigelow's sedge
Carex microchaeta s.l.	CAMI1	Smallawned sedge
Carex nesophila	CANE1	Bering Sea sedge
Carex sp.	CAREX	Unspecified sedge
Carex stylosa	CAST	Long-style sedge
Cornus suecica	COSU	Swedish dwarf dogwood
Dryopteris dilatata ssp. americana	DRDI	Mountain woodfern
Epilobium angustifolium	EPAN1	Fireweed
Epilobium palustre	EPPA	Marsh willow-herb
Equisetum arvense	EQAR	Field horsetail
Equisetum fluviatile	EQFL	Water horsetail
Equisetum pratense	EQPR	Meadow horsetail
Equisetum sylvaticum	EQSY	Woodland horsetail
Eriophorum angustifolium	ERAN	Narrow-leaf cottongrass
Eriophorum scheuchzeri	ERSC	Scheuchzer's cottongrass
Eriophorum vaginatum	ERVA	Tussock cottongrass
Festuca altaica	FEAL	Rough fescue
Galium boreale	GABO	Northern bedstraw
Geranium erianthum	GEER	Woolly geranium
Gymnocarpium dryopteris	GYDR	Oak fern
Heracleum lanatum	HELA	Cow parsnip
Lycopodium annotinum s.l.	LYAN	Stiff clubmoss
Moehringia lateriflora	MOLA6	Grove sandwort
Petasites frigidus s.l.	PEFR	Arctic sweet coltsfoot
Poa palustris	POPA	Fowl bluegrass
Polemonium acutiflorum	POAC	Sticky tall Jacob's-ladder
Potentilla palustris	POPA1	Marsh cinquefoil
Pyrola asarifolia	PYAS	Pink wintergreen
Rubus arcticus s.l.	RUAR	Arctic raspberry
Rubus chamaemorus	RUCH	Cloudberry
Rumex arcticus	RUAR1	Arctic dock
Sanguisorba canadensis	SACA1	Canada burnet
Sanguisorba stipulata	SAST	
Solidago multiradiata	SOMU	Mountain goldenrod
Stellaria sp.	STEL-SP	Unspecified starwort

Latin Name	Acronym	Common Name
Streptopus amplexifolius	STAM	Clasp-leaf twisted-stalk
Trientalis europaea s.l.	TREU	European starflower
Valeriana capitata	VACA	Clustered valerian
Viola epipsila ssp. repens	VIEP	Dwarf marsh violet
Viola sp.	VIOL-SP	Unspecified violet
Mosses and Lichens		
Cladina rangiferina	CLRA	Lichen
Cladina sp.	CLADI-SP	Lichen
Cladina stellaris	CLST	Lichen
Cladonia sp.	CLADO-SP	Lichen
Feather moss	FEATHER	Unspecified feather moss
Hylocomium splendens	HYSP	Splendid feather moss
Lichen sp.	LICHEN-SP	Unspecified lichen
Moss sp.	MOSS-SP	Unspecified moss
Pleurozium schreberi	PLSC1	Schreber's big red stem moss
Polytrichum sp.	POLY1-SP	Unspecified polytrichum moss
Sphagnum sp.	SPHA-SP	Unspecified sphagnum moss
Stereocaulon sp.	STER-SP	Lichen
Thamnolia sp.	THAM-SP	Unspecified whiteworm lichen

a. The most common plant taxa are species that are the most frequently observed species in the Project Vegetation Types of the mine study area; they are found in a majority of plots. They may or may not dominate their particular stratum at a sampling site.

APPENDIX 13.2A

Draft List of Plant Species Observed in the Transportation-corridor Study Area, 2004-2008

Draft List of Plant Species Observed in the Transportation-corridor Study Area, 2004-2008

Latin Name	Common Name
Trees	
Alnus sinuata (tree)	Sitka alder
Betula kenaica (tree)	Kenai birch
Betula occidentalis (tree)	Spring birch
Betula papyrifera s.l. (tree)	Paper birch
Picea glauca (snag)	White spruce
Picea glauca (tree)	White spruce
Picea mariana (tree)	Black spruce
Picea sitchensis	Sitka spruce
Populus balsamifera (tree)	Cottonwood
Populus tremuloides (tree)	Quaking aspen
Salix alaxensis (tree)	Felt-leaf willow
Salix barclayi (tree)	Barclay willow
Salix pulchra (tree)	Diamondleaf willow
Salix scouleriana (tree)	Scouler willow
Betula papyrifera s.l. (sapling)	Paper birch
Picea glauca (sapling)	White spuce
Picea mariana (sapling/stunted)	Black spruce
Populus balsamifera (sapling)	Cottonwood
Populus tremuloides (sapling)	Quaking aspen
Shrubs	
Alnus crispa s.l.	Green alder
Alnus sinuata	Sitka alder
Andromeda polifolia	Bog rosemary
Arctostaphylos alpina	Alpine bearberry
Arctostaphylos alpina var. *rubra*	Red fruit bearberry
Arctostaphylos uva-ursi	Kinnikinnick
Artemisia tilesii	Sagebrush
Betula glandulosa	Shrub birch
Betula hybrid	Birch hybrid
Betula kenaica (shrub)	Kenai birch
Betula nana ssp. *exilis*	Dwarf birch
Diapensia lapponica	Pincushion plant
Dryas integrifolia	Entire-leaf mountain-avens
Dryas octopetala	
Empetrum nigrum	Black crowberry
Harrimanella stelleriana	Alaska moss heath
Juniperus communis	Juniper
Ledum decumbens	Narrow-leaf Labrador tea
Linnaea borealis	Twinflower

Latin Name	Common Name
Loiseleuria procumbens	Alpine azalea
Menziesia ferruginea	Mock-azalea
Myrica gale	Sweetgale
Oplopanax horridus	Devil's club
Phyllodoce aleutica	Aleutian mountain heather
Potentilla fruticosa	Shrubby cinquefoil
Ribes bracteosum	California black currant
Ribes glandulosum	Skunk currant
Ribes lacustre	Prickly currant
Ribes laxiflorum	Trailing black currant
Ribes sp.	Unspecified currant
Ribes triste	Swamp red currant
Rosa acicularis	Prickly rose
Rubus idaeus	Common red raspberry
Rubus spectabilis	Salmonberry
Salix alaxensis (shrub)	Felt-leaf willow
Salix arbusculoides	Little-tree willow
Salix arctica	Arctic willow
Salix barclayi	Barclay's willow
Salix bebbiana	Bebb willow
Salix fuscescens	Alaska bog willow
Salix glauca	Gray-leaf willow
Salix lasiandra	Pacific willow
Salix ovalifolia	Oval-leaf willow
Salix planifolia s.l.	Diamondleaf willow
Salix pseudomyrsinites	Tall blueberry willow
Salix pulchra	Diamondleaf willow
Salix reticulata	Netleaf willow
Salix richardsonii	Richardson's willow
Salix scouleriana (shrub)	Scouler's willow
Salix sitchensis	Sitka willow
Salix sp.	Unspecified willow
Sambucus racemosa	European red elder
Sibbaldia procumbens	Creeping sibbaldia
Sorbus scopulina	Greene's mountain ash
Sorbus sitchensis	Mountain ash
Spiraea beauverdiana	Beauverd spirea
Vaccinium alaskaense	Alaska blueberry
Vaccinium microcarpus	Blueberry
Vaccinium ovalifolium	Early blueberry
Vaccinium oxycoccos	Small cranberry

Latin Name	Common Name
Vaccinium uliginosum	Bog blueberry
Vaccinium vitis-idaea ssp. *minus*	Mountain cranberry
Viburnum edule	Squashberry
Herbs	
Achillea borealis	Yarrow
Achillea millefolium s.l.	Common yarrow
Achillea sp.	Unspecified yarrow
Aconitum delphiniifolium	Monkshood (larkspur-leaf)
Actaea rubra	Baneberry
Agropyron s.l. sp.	Unspecified agropyron
Agrostis alaskana	Alaska bentgrass
Agrostis borealis	Northern bentgrass
Agrostis scabra	Rough bentgrass
Agrostis sp.	Unspecified agrostis
Anemone parviflora	Small-flower thimble-weed
Anemone richardsonii	Yellow thimble-weed
Angelica genuflexa	Kneeling angelica
Angelica lucida	Seawatch angelica
Angelica sp.	Unspecified angelica
Antennaria monocephala	One-headed everlasting
Arctagrostis latifolia	Arctic-bentgrass, broad-leaf
Arctophila fulva	Pendent grass
Arnica chamissonis	Leafy arnica
Artemisia arctica	Mountain sagewort
Artemisia sp.	Unspecified artemisia
Aster s.l. sp.	Unspecified aster
Athyrium filix-femina ssp. *cyclosorum*	Subarctic lady fern
Boschniakia rossica	Northern groundcone
Botrychium lunaria	Moonwort
Calamagrostis canadensis	Bluejoint reedgrass
Calamagrostis neglecta	Slimstem reedgrass
Calamagrostis sp.	Unspecified reedgrass
Callitriche anceps	Two-edge water-starwort
Caltha leptosepala	Slender-sepal marsh-marigold
Caltha sp.	Marsh-marigold
Campanula lasiocarpa	Common Alaska bellflower
Cardamine sp.	Unspecified bitter-cress
Cardamine umbellata	Umbel-flower bitter-cress
Carex anthoxanthea	Grassy-slope arctic sedge
Carex aquatilis	Water sedge
Carex aurea	Golden-fruit sedge

Latin Name	Common Name
Carex bicolor	Two-color sedge
Carex bigelowii s.l.	Bigelow's sedge
Carex brunnescens s.l.	Brownish sedge
Carex buxbaumii	Brown bog sedge
Carex canescens	Hoary sedge
Carex capillaris	Hair-like sedge
Carex chordorrhiza	Creeping sedge
Carex garberi	Elk sedge
Carex gynocrates	Northern bog sedge
Carex kelloggii	Kellogg's sedge
Carex laeviculmis	Smooth-stem sedge
Carex lenticularis s.l.	Shore sedge
Carex leptalea	Bristly-stalk sedge
Carex limosa	Mud sedge
Carex livida	Livid sedge
Carex loliacea	Rye-grass sedge
Carex lyngbyei	Lyngbye's sedge
Carex macrochaeta	Alaska long-awn sedge
Carex magellanica ssp. *irrigua*	Boreal bog sedge
Carex media	Intermediate sedge
Carex membranacea	Fragile-seed sedge
Carex microchaeta s.l.	Smallawned sedge
Carex nesophila	Bering Sea sedge
Carex pauciflora	Few-flower sedge
Carex paupercula	Poor sedge
Carex phyllomanica	Coastal stellate sedge
Carex pluriflora	Several flowered sedge
Carex podocarpa	Short-stalk sedge
Carex rariflora	Loose flowered sedge
Carex rhynchophysa s.l.	Northwest Territory sedge
Carex rostrata	Beaked sedge
Carex rotundata	Round-fruit sedge
Carex saxatilis s.l.	Russet sedge
Carex scirpoidea	Canadian single-spike sedge
Carex sitchensis	Sitka sedge
Carex sp.	Unspecified sedge
Carex spectabilis	Showy sedge
Carex stylosa	Long-style sedge
Carex tenuiflora	Sparse-flower sedge
Carex utriculata	Beaked sedge
Carex vaginata	Sheathed sedge

Latin Name	Common Name
Carex williamsii	William's sedge
Castilleja elegans	Paintbrush
Chrysosplenium tetrandrum	Northern golden-saxifrage
Cicuta mackenzieana	Mackenzie's water-hemlock
Circaea alpina	Small enchanter's nightshade
Conioselinum gmelinii	Western hemlock-parsley
Coptis aspleniifolia	Spleenwort-leaf goldthread
Coptis trifolia	Alaska goldthread
Cornus canadensis	Canada bunchberry
Cornus suecica	Swedish dwarf dogwood
Cystopteris montana	Mountain bladder fern
Deschampsia beringensis	Bering hairgrass
Deschampsia cespitosa s.l.	Tufted hairgrass
Deschampsia sp.	Unspecified deschampsia
Drosera anglica	English sundew
Drosera rotundifolia	Round-leaf sundew
Dryopteris dilatata ssp. *americana*	Mountain woodfern
Eleocharis acicularis	Least spikerush
Eleocharis palustris	Creeping spikerush
Eleocharis pauciflora	Few-flower spikerush
Epilobium angustifolium	Fireweed
Epilobium ciliatum	Hairy willowherb
Epilobium latifolium	River beauty
Epilobium palustre	Marsh willowherb
Epilobium s.l. sp.	Unspecified epilobium
Equisetum arvense	Field horsetail
Equisetum fluviatile	Water horsetail
Equisetum hyemale	Rough horsetail
Equisetum palustre	Marsh horsetail
Equisetum pratense	Meadow horsetail
Equisetum scirpoides	Dwarf scouring-rush
Equisetum sp.	Unspecified horsetail
Equisetum sylvaticum	Woodland horsetail
Equisetum variegatum	Variegated horsetail
Erigeron peregrinus	Wandering fleabane
Erigeron sp.	Unspecified erigeron
Eriophorum alpinum	Alpine cottongrass
Eriophorum angustifolium	Narrow-leaf cottongrass
Eriophorum brachyantherum	Short-anther cottongrass
Eriophorum chamissonis s.l.	Russet cottongrass
Eriophorum russeolum s.l.	Russet cottongrass

Latin Name	Common Name
Eriophorum scheuchzeri	Scheuchzer's cottongrass
Eriophorum sp.	Unspecified cottongrass
Eriophorum vaginatum	Tussock cottongrass
Eriophorum viridicarinatum	Green-keel cottongrass
Festuca altaica	Rough fescue
Fritillaria camschatcensis	Kamchatka mission-bells/chocolate lily
Galium boreale	Northern bedstraw
Galium sp.	Unspecified galium
Galium trifidum	Small bedstraw
Galium triflorum	Sweet-scent bedstraw
Gentiana algida	Whitish gentian
Gentiana glauca	Glaucous gentian
Gentiana platypetala	Broad-petal gentian
Geranium erianthum	Woolly geranium
Geum macrophyllum	Large-leaf avens
Goodyera oblongifolia	Giant rattlesnake-plantain
Goodyera repens	Dwarf rattlesnake-plantain
Grass sp.	Unspecified grass
Gymnocarpium dryopteris	Oak fern
Heracleum lanatum	Cow parsnip
Heuchera glabra	Alpine heuchera
Hieracium triste	Hawkweed
Hierochloe alpina	Alpine sweetgrass
Hippuris vulgaris	Common mare's tail
Iris setosa	Beach-head iris
Isoetes sp.	Unspecified quillwort
Juncus alpinus s.l.	Richardson's rush
Juncus arcticus s.l.	Arctic rush
Juncus biglumis	Two-flower rush
Juncus bufonius	Toad rush
Juncus castaneus	Chestnut rush
Juncus filiformis	Thread rush
Juncus mertensianus	Mertens' rush
Juncus sp.	Unspecified juncus
Juncus stygius	Moor rush
Juncus supiniformis	Hairy-leaf rush
Juncus triglumis	Three-flower rush
Lagotis glauca s.l.	Weaselsnout
Lathyrus palustris	Vetchling peavine
Listera cordata	Heart-leaf twayblade
Luetkea pectinata	Partridge-foot

Latin Name	Common Name
Lupinus arcticus	Arctic lupine
Lupinus nootkatensis	Nootka lupine
Lupinus sp.	Unspecified lupine
Luzula multiflora	Common woodrush
Luzula parviflora	Small-flower woodrush
Luzula sp.	Unspecified woodrush
Luzula wahlenbergii s.l.	Wahlenberg's woodrush
Lycopodium alpinum	Alpine clubmoss
Lycopodium annotinum s.l.	Stiff clubmoss
Lycopodium complanatum	Trailing clubmoss
Lycopodium s.l. sp.	Unspecified clubmoss
Lycopodium selago s.l.	Fir clubmoss
Lysimachia thyrsiflora	Tufted loosestrife
Malaxis paludosa	Bog adder's mouth
Menyanthes trifoliata	Buckbean
Mimulus guttatus	Common large monkey-flower
Minuartia arctica	Arctic stitchwort
Moehringia lateriflora	Grove sandwort
Nuphar polysepalum	Rocky mountain pond-lily
Oxytropis nigrescens	Blackish oxytrope
Parnassia fimbriata	Fringed grass-of-parnassus
Parnassia palustris	Northern grass-of-parnassus
Parnassia sp.	Unspecified grass-of-parnassus
Pedicularis labradorica	Labrador lousewort
Pedicularis lanata	Woolly lousewort
Pedicularis parviflora	Small-flower lousewort
Pedicularis sp.	Unspecified lousewort
Pedicularis verticillata	Whorled lousewort
Petasites frigidus s.l.	Arctic sweet coltsfoot
Petasites hyperboreus	Arctic sweet coltsfoot
Pinguicula villosa	Hairy butterwort
Pinguicula vulgaris s.l.	Common butterwort
Platanthera obtusata	Small northern bog orchid
Poa alpigena	Low bluegrass
Poa arctica	Arctic bluegrass
Poa palustris	Fowl bluegrass
Poa sp.	Unspecified bluegrass
Polemonium acutiflorum	Sticky tall Jacob's-ladder
Polemonium sp.	Unspecified Jacob's-ladder
Polygonum bistorta ssp. *plumosum*	Meadow bistort
Polygonum pennsylvanicum	Pennsylvania smartweed

Latin Name	Common Name
Polygonum s.l. sp.	Unspecified knotweed
Polygonum viviparum	Viviparous knotweed
Potamogeton epihydrus	Ribbon-leaf pondweed
Potamogeton gramineus	Grassy pondweed
Potamogeton praelongus	White-stem pondweed
Potamogeton pusillus	Small pondweed
Potamogeton s.l. sp.	Unspecified pondweed
Potentilla palustris	Marsh cinquefoil
Pyrola asarifolia	Pink wintergreen
Pyrola grandiflora	Arctic wintergreen
Pyrola minor	Lesser wintergreen
Pyrola secunda	One-sided wintergreen
Pyrola s.l. sp.	Unspecified wintergreen
Ranunculus hyperboreus	Arctic buttercup
Ranunculus macounii	Macoun"s buttercup
Ranunculus sp.	Unspecified buttercup
Ranunculus trichophyllus	White water-crowfoot
Rhinanthus arcticus	Arctic yellow rattle
Rhinanthus minor	Little yellow rattle
Rubus arcticus s.l.	Arctic raspberry
Rubus chamaemorus	Cloudberry
Rubus pedatus	Strawberry-leaf raspberry
Rubus stellatus	Nagoonberry
Rumex arcticus	Arctic dock
Rumex sp.	Unspecified rumex
Sanguisorba canadensis	Canada burnet
Sanguisorba menziesii	Menzies' burnet
Sanguisorba stipulata	
Saussurea angustifolia	Narrow-leaf saw-wort
Saxifraga hieracifolia	Stiff-stem saxifrage
Saxifraga hirculus	Yellow marsh saxifrage
Saxifraga punctata s.l.	Dotted saxifrage
Saxifraga sp.	Unspecified saxifrage
Scirpus cespitosus	Tufted bulrush
Sedum rosea ssp. *integrifolium*	Roseroot stonecrop
Selaginella selaginoides	Club spike-moss
Senecio lugens	Black-tip groundsel
Senecio resedifolius	Dwarf arctic ragwort
Senecio sp.	
Senecio triangularis	Arrow-leaf groundsel
Solidago canadensis s.l.	Canada goldenrod

Latin Name	Common Name
Solidago multiradiata	Mountain goldenrod
Solidago sp.	Unspecified goldenrod
Sparganium angustifolium	Narrowleaf bur-reed
Sparganium hyperboreum	Northern bur-reed
Sparganium minimum	Small bur-reed
Spiranthes romanzoffiana	Hooded ladies' tresses
Stellaria calycantha	Northern starwort
Stellaria sitchana	Sitka starwort
Stellaria sp.	Unspecified starwort
Streptopus amplexifolius	Clasp-leaf twisted-stalk
Swertia perennis	Felwort
Thalictrum alpinum	Alpine meadow-rue
Thalictrum sparsiflorum	Few-flower meadow-rue
Thelypteris phegopteris	Narrow beech fern
Tiarella trifoliata var. *unifoliata*	Three-leaf foamflower
Tofieldia pusilla	Scotch false-asphodel
Tofieldia sp.	
Trichophorum alpinum	Alpine bulrush
Trichophorum caespitosum	Tufted bulrush
Trientalis europaea s.l.	European starflower
Triglochin palustris	Marsh arrow-grass
Triglochin sp.	Unspecified arrow-grass
Trisetum spicatum	Spiked false-oats
Utricularia intermedia	Flat-leaf bladderwort
Utricularia minor	Lesser bladderwort
Utricularia sp.	Unspecified bladderwort
Vahlodea atropurpurea	Mountain hairgrass
Valeriana capitata	Clustered valerian
Valeriana sitchensis	Sitka valerian
Veratrum viride var. *eschscholzianum*	American false-hellebore
Viola epipsila ssp. *repens*	Dwarf marsh violet
Viola langsdorffii	Alaska violet
Viola sp.	Unspecified violet
Lichens, Fungi, and Bryophytes [b]	
Cetraria sp.	Unspecified cetraria lichen
Cladina rangiferina	Lichen
Cladina sp.	Lichen
Cladina stellaris	Lichen
Cladonia sp.	Lichen
Feather moss	Unspecified feather moss
Foliose lichen	Unspecified foliose lichen

Latin Name	Common Name
Fruticose lichen	Unspecified fruticose lichen
Hylocomium splendens	Splendid feather moss
Lichen sp.	Unspecified lichen
Moss sp.	Unspecified moss
Peltigera sp.	Unspecified felt lichen
Pleurozium schreberi	Schreber's big red stem moss
Polytrichum sp.	Unspecified polytrichum moss
Ptilium crista-castrensis	Knight's plume moss
Sphagnum sp.	Unspecified sphagnum moss
Stereocaulon sp.	Lichen
Thamnolia sp.	Unspecified whiteworm lichen

Notes:

a. These records were not intended as a comprehensive list of lichens, fungi, and bryophytes. Identification of lichens, fungi, and bryophytes at study sites was optional or incidental, not intended to be of the same quality as the vascular plant data.

APPENDIX 13.2B

Draft List of the Most Common Plant Species Observed in the Transportation-corridor Study Area, 2004-2008

Draft List of the Most Common Plant Species Observed in the Transportation-corridor Study Area, 2004-2008

Latin Name	Common Name
Trees	
Betula kenaica	Kenai birch
Betula papyrifera s.l.	Paper birch
Picea glauca	White spruce
Picea mariana	Black spruce
Populus balsamifera	Cottonwood
Shrubs	
Alnus sinuata	Sitka alder
Andromeda polifolia	Bog rosemary
Arctostaphylos alpina	Alpine bearberry
Betula kenaica	Kenai birch
Betula nana ssp. *exilis*	Dwarf birch
Empetrum nigrum	Black crowberry
Ledum decumbens	Narrow-leaf Labrador tea
Myrica gale	Sweetgale
Potentilla fruticosa	Shrubby cinquefoil
Salix barclayi	Barclay's willow
Salix fuscescens	Alaska bog willow
Salix glauca	Gray-leaf willow
Salix pulchra	Diamondleaf willow
Salix sp.	Unspecified willow
Spiraea beauverdiana	Beauverd spirea
Vaccinium microcarpus	Blueberry
Vaccinium oxycoccos	Small cranberry
Vaccinium uliginosum	Bog blueberry
Vaccinium vitis-idaea ssp. *minus*	Mountain cranberry
Viburnum edule	Squashberry
Herbs	
Achillea borealis	Yarrow
Aconitum delphiniifolium	Monkshood (larkspur-leaf)
Angelica lucida	Seawatch angelica
Athyrium filix-femina ssp. *cyclosorum*	Subarctic lady fern
Calamagrostis canadensis	Bluejoint reedgrass
Carex aquatilis	Water sedge
Carex bigelowii s.l.	Bigelow's sedge
Carex canescens	Hoary sedge
Carex limosa	Mud sedge
Carex livida	Livid sedge
Carex macrochaeta	Alaska long-awn sedge

Latin Name	Common Name
Carex pauciflora	Few-flower sedge
Carex rhynchophysa s.l.	Northwest Territory sedge
Carex saxatilis s.l.	Russet sedge
Carex sp.	Unspecified sedge
Cornus suecica	Swedish dwarf dogwood
Drosera rotundifolia	Round-leaf sundew
Dryopteris dilatata ssp. *americana*	Mountain woodfern
Epilobium angustifolium	Fireweed
Equisetum arvense	Field horsetail
Equisetum pratense	Meadow horsetail
Equisetum sylvaticum	Woodland horsetail
Eriophorum angustifolium	Narrow-leaf cottongrass
Eriophorum russeolum s.l.	Russets cottongrass
Eriophorum scheuchzeri	Scheuchzer's cottongrass
Festuca altaica	Rough fescue
Geranium erianthum	Woolly geranium
Grass sp.	Unspecified grass
Gymnocarpium dryopteris	Oak fern
Heracleum lanatum	Cow parsnip
Iris setosa	Beach-head iris
Lycopodium annotinum s.l.	Stiff clubmoss
Menyanthes trifoliata	Buckbean
Parnassia palustris	Northern grass-of-parnassus
Pedicularis sp.	Unspecified lousewort
Polemonium acutiflorum	Sticky tall Jacob's-ladder
Potentilla palustris	Marsh cinquefoil
Pyrola asarifolia	Pink wintergreen
Pyrola secunda	One-sided wintergreen
Rubus arcticus s.l.	Arctic raspberry
Rubus chamaemorus	Cloudberry
Rubus pedatus	Strawberry-leaf raspberry
Rubus stellatus	Nagoonberry
Rumex arcticus	Arctic dock
Sanguisorba canadensis	Canada burnet
Sanguisorba stipulata	
Scirpus cespitosus	Tufted bulrush
Spiranthes romanzoffiana	Hooded ladies'tresses
Streptopus amplexifolius	Clasp-leaf twisted-stalk
Thelypteris phegopteris	Narrow beech fern
Trichophorum caespitosum	Tufted bulrush
Trientalis europaea s.l.	European starflower

Latin Name	Common Name
Veratrum viride var. *eschscholzianum*	American false-hellebore
Viola sp.	Unspecified violet
Lichens, Fungi, and Bryophytes [b]	
Cladina sp.	Lichen
Feather moss	Unspecified feather moss
Foliose lichen	Unspecified foliose lichen
Fruticose lichen	Unspecified fruticose lichen
Hylocomium splendens	Splendid feather moss
Lichen sp.	Unspecified lichen
Moss sp.	Unspecified moss
Polytrichum sp.	Unspecified polytrichum moss
Sphagnum sp.	Unspecified sphagnum moss

Notes:

a. These records were not intended as a comprehensive list of lichens, fungi, and bryophytes. Identification of lichens, fungi, and bryophytes at study sites was optional or incidental, not intended to be of the same quality as the vascular plant data.