

FINAL REPORT
8 January 1999

**LAND COVER MAP FOR THE PROPOSED
NORTHWEST EILEEN DEVELOPMENT AREA**



Prepared By
Lynn E. Noel

LGL ALASKA RESEARCH ASSOCIATES, INC.
4175 Tudor Centre Drive, Suite 202
Anchorage, Alaska 99508

For

BP EXPLORATION (ALASKA) INC.
P.O. Box 196612
Anchorage, Alaska 99519-6612

ABSTRACT

Proposed construction for the Northwest (NW) Eileen Development includes gravel placement at one or two drill site pads, an access road, and a processing facility pad. Vegetation within a minimum 1,300 foot buffer surrounding the proposed gravel placement sites was classified and mapped from aerial photographs in order to assist with placement of facilities and assess vegetation impacts from gravel placement. Land cover/vegetation in the NW Eileen area was classified using a hierarchical classification scheme designed specifically for the North Slope of Alaska. Vegetation type, soil moisture regime, and landform data collected from 70 sites between 24 July and 7 August 1998 were used to construct the map. Cover types were identified and delineated from 1:7,200-scale color infrared aerial photographs taken by Aeromap U.S., Inc. on 10 August 1995. Overlays were projected, scaled and fit to 1:6,000-scale basemaps. A total area of 3,867 acres was mapped. Gravel placement for all potential sites will cover 49.4 acres, of which 32% is moist sedge, dwarf shrub/wet graminoid tundra complex; 31% is moist sedge, dwarf shrub tundra; 10% is moist tussock sedge, dwarf shrub tundra; and 9% is wet sedge tundra.

Key Words: land cover map, hierarchical classification system, polygonal habitat map, tundra vegetation, arctic tundra, Prudhoe Bay, Alaska

INTRODUCTION

Proposed construction for the Northwest (NW) Eileen Development includes gravel placement at one or two drill site pads, NW Eileen No. 1 and/or NW Eileen No. 2 sites; an access road to the NW Eileen No. 1 drill pad; and a processing facility pad, either along the Spine Road or as an enlargement of Z Pad (Fig. 1). The NW Eileen No. 1 drill pad will not be developed at this time. Mapping and information obtained during this study at NW Eileen No. 1 is presented should NW Eileen No. 1 be developed at a later date. The vegetation within a minimum 1,300 foot buffer surrounding the proposed gravel placement sites was classified and mapped from aerial photographs in order to assist with facilities placement and assess vegetation impacts from gravel placement. Land cover/vegetation in the NW Eileen area was classified using a hierarchical classification scheme designed specifically for the North Slope of Alaska (Walker 1983). Ground-reference vegetation data collected between 24 July and 7 August 1998 was used to construct the map.

METHODS

Walker's (1983) vegetation and land cover classification scheme describes vegetation at four levels: Level A--for very small scale maps, Level B--for cover units that can be consistently classified from LANDSAT data, Level C--for photo-interpreted maps with ground truth data, and Level D--for individual plant communities as determined by ground surveys (Table 1). Sites are categorized with respect to site moisture regime and dominant plant growth forms (landform type is used when plant cover is sparse or non-existent). The site moisture terms (dry, moist, wet, or aquatic) are subjective categories based on soil moisture at the end of the growing season. Dominant plant growth forms are relatively straightforward and are dependent to a great degree on the site moisture regime and landform type. Many areas on the North Slope consist of complexes of landforms, which result in complexes of site moisture and vegetation types. In areas such as these the classification scheme calls for combining site moisture and plant growth form terms to more accurately describe the character of the area.

Vegetation for the NW Eileen Development area was mapped within a minimum 1,300 foot buffer zone surrounding the proposed gravel placement sites (Fig. 1 to Fig. 4). Vegetation types were identified and delineated from 1:7,200-scale color infrared aerial photographs taken by Aeromap U.S., Inc. on 10 August 1995. Natural-color 20 July 1997 1:18,000-scale aerial photography, also taken by Aeromap U.S., was used to assist with classification. Cover types were delineated on acetate overlays of the photos, then projected and scaled to basemaps using a Kargl Reflecting Projector (Keuffel & Esser Co.). Delineations were transferred to acetate overlays referenced to 1:6,000-scale basemaps. Polygons and line work for lakes, ponds and streams were copied from the digital basemaps, which were augmented or corrected where necessary. Cover types were then digitized, polygons and regions were constructed, and classifications were added to a Geographic Information System (GIS) database. Areas covered by developments were calculated with the GIS.

Ground-reference data were collected in the project area between 24 July and 7 August 1998. Ground-reference data included three cover estimates of dominant plant taxa within a 1 m² area circle (Mueller-Dombois and Ellenberg 1974), descriptions of site moisture regime, and landform description. Bryophyte and lichen taxa were identified to genus when possible (Vitt et al. 1988). Plant nomenclature follows Hultén (1968), except for *Salix planifolia* sp. *pulchra*. For continuity with Walker's classifications, *Dryas integrifolia* is considered a shrub, although it is more correctly categorized as a forb. All areas to be mapped were crossed and reference sites were positioned near the center of vegetation communities. Global positioning system (GPS) locations were recorded with a minimum objective of 300 locations. GPS locations were

differentially corrected by post-processing using base station data from either the Central, Alaska or Fairbanks, Alaska, Continuously Operating Reference Station (CORS), National Geodetic Survey, National Oceanic and Atmospheric Administration (NOAA).

Ground-reference data was compared to color infrared and natural color photographs to assist in photo-interpretation. Land cover categories were determined by fitting field descriptions of plant communities and landforms into the land cover/vegetation categories described for the North Slope as a whole by Walker (1983; 1985a,b) and Walker and Acevedo (1987). Land cover types were mapped and labeled at Level C (Table 1).

RESULTS

Seventeen Level C categories were identified and delineated (Fig. 2 to Fig. 4; Tables 1 and 2). Tussock tundra occurs within the map area, but was not consistently distinguishable on the color infrared, or natural color photography. Tussock tundra was delineated based on photo-interpretation combined with ground-reference data. A total area of 3,867 acres was mapped. The map includes three discontinuous areas; a 634 acre area around the proposed NW Eileen No. 2 pad site, a 2,325 acre area around the proposed NW Eileen No. 1 pad and the proposed access road (which includes the area around a proposed processing facility pad), and a 908 acre area around the existing Prudhoe Bay Unit Z Pad (an alternative processing facility site).

Vegetation type, soil moisture regime, and landform data were collected from 70 sites within the mapped area between 24 July and 7 August 1998 (Fig. 1, Table A-1 to A-4). Ground-reference locations and the currently proposed development structures are shown in Figure 1. Descriptions of the land cover categories and dominant vascular plant taxa found in each category as mapped for the NW Eileen Development area are given below.

Ia. Water

The water category depicts all the water bodies that could be reasonably mapped at the 1:7,200 scale, including ponds, lakes, and streams. This category includes water of all depths, usually without emergent vegetation (see IIb below). Polygons designated as water cover on 1:6,000-scale digital basemaps were reviewed for completeness and classified as either Ia, IIa, IIb, or XIa as appropriate. A total of 909 acres or 24% of the mapped area is water (Table 2).

IIa. Shallow Water

This category includes small ponds, which may or may not dry entirely by the end of the growing season. These ponds probably contained water but were light colored indicating water was shallow. This classification usually does not contain emergent vegetation. A total of 4 acres or 0.1% of the mapped area is shallow water (Table 2).

IIb. Aquatic Graminoid Tundra

This category depicts areas of permanent fresh water where there is emergent vegetation. In deeper water these simple plant communities are dominated by *Arctophila fulva* (see 5A, Fig. 5), and in shallower water by *Carex aquatilis* with lesser amounts of *Eriophorum angustifolium* and *E. scheuchzeri*. This category grades continuously into wet sedge tundra vegetation (IIIa), but is distinguished by the presence of permanent water. Aquatic graminoid tundra is common in the shallow waters of ponds and lakes, and slow-moving streams, and it is especially common in lakes and ponds with complex, irregular shorelines. It also occurs in very wet low-centered polygon basins. On aerial photographs, aquatic graminoid tundra is often difficult to distinguish from both open water (when the density of plants is low), and from very wet, wet sedge tundra (at the edges of ponds and lakes). For this reason only the relatively obvious, ground-referenced, and large occurrences of this vegetation type were mapped. A total of 37 acres or 0.9% of the map area is aquatic graminoid tundra.

IIIa. Wet Sedge Tundra

This category depicts tundra areas which have poor drainage and retain standing water during the early part of the summer that drains or evaporates by the end of the season leaving saturated soils. Some standing water may persist throughout the growing season in abnormally wet summers. These areas are dominated by sedges such as *Carex aquatilis*, *Eriophorum angustifolium*, *E. russeolum* and *E. scheuchzeri* (see 5B, Fig. 5). Common forbs include *Pedicularis sudetica*, *Saxifraga hirculus*, and *S. cernua*. Wet sedge tundra commonly occurs on non-patterned ground, in low-centered polygon basins, and in troughs between strangmoor ridges. It is common at the edges of ponds and lakes, along streams, in drained lake basins, and on river terraces. As a mapped unit, wet sedge tundra was used only in areas where patterned ground was non-existent or poorly developed (i.e. where moist microsites were not prominent in the unit). A total of 272 acres or 7% of the map area is wet sedge tundra.

IIIc. Wet Sedge Tundra/Water Complex

This category depicts areas where ponds or lakes are interconnected to form a complex of water and intervening tundra. Water (Ia) and wet sedge tundra (IIIa) are the dominant land cover types. There may or may not be emergent vegetation (IIb). Intervening tundra is primarily wet, but moist sites also occur. Plant communities are similar to those listed in (IIIa), but lesser amounts of those listed in (Va) also occur. A total of 116 acres or 3% of the map area is wet sedge tundra/water complex.

IIIId. Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex

This category depicts areas dominated by wet sedge tundra (IIIa), but because of prominent patterned ground features such as low-centered polygons and strangmoor there are abundant moist microsites within the unit (see 5C, Fig. 5). The moist sites are well-drained polygons rims and strangmoor ridges, which are dominated by moist sedge, dwarf shrub tundra (Va). Poorly drained polygon centers and strangmoor troughs may contain small patches of aquatic graminoid tundra (IIb). This vegetation type is very common in drained lake basins and around pond margins. A total of 471 acres or 12% of the map area is wet sedge/moist sedge, dwarf shrub tundra complex.

IVa. Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex

This category depicts areas of significant ground patterning which are dominated by moist sedge, dwarf shrub tundra (Va), but abundant low lying areas dominated by wet sedge tundra (IIIa) are also present. In the NW Eileen area, this category describes areas of mixed high- and low-centered polygons often with extensively thermokarsted polygon troughs, and often occurring amidst numerous small ponds and lakes. As in category IIIId there are also occasionally small patches of aquatic graminoid tundra (IIb). A total of 642 acres or 17% of the map area is moist sedge, dwarf shrub/wet graminoid tundra complex.

Va. Moist Sedge, Dwarf Shrub Tundra

This category depicts areas of typical high-centered polygons with distinct polygon troughs, as well as areas of rather subtle high-centered and low-centered polygons with very little development of the polygon troughs (i.e. flat-topped polygons). There are often wet microsites in the polygon troughs, but overall drainage is good throughout the entire unit and the dominant landform is the moist polygon centers (see 5D, Fig. 5). In the NW Eileen area these sites are

dominated by the sedges *Eriophorum angustifolium*, *Carex misandra*, *C. aquatilis*, and *C. bigelowii*. The common dwarf shrubs are *Salix arctica*, *S. reticulata*, *S. rotundifolia*, and *Dryas integrifolia*. Common forbs include *Polygonum bistorta*, *Pedicularis sudetica*, *Papaver* sp., *Pyrola grandiflora*, *Saussurea angustifolia*, and *Saxifraga hirculus*. Moist sedge, dwarf shrub tundra typically occurs along ridges above the level of water bodies and drained lake basins. A total of 583 acres or 15% of the map area is moist sedge, dwarf shrub tundra.

Vb. Moist Tussock Sedge, Dwarf Shrub Tundra

This category depicts areas with better drainage, between lake basins and on the sides of pingos, with the tussock forming *Eriophorum vaginatum* (see 5E, Fig. 5). Tussock tundra was not consistently distinguishable from non-tussock tundra on either color infrared or natural color photographs. Delineations are based on a combination of photo-interpretation and ground-reference data. Tussocks were generally 10 inches or less in diameter. In areas where the ice road, which followed the proposed gravel access road corridor, to the NW Eileen No. 1 site crossed tussock tundra, some tussocks were flattened or pushed over. Common sedges include *E. vaginatum*, *E. angustifolium*, *C. bigelowii*, and *C. misandra*. Common shrubs include *Dryas integrifolia*, *Salix reticulata*, *S. planifolia* sp. *pulchra*; and forbs include *Cassiope tetragona*, and *Polygonum viviparum*. A total of 385 acres or 10% of the map area is moist tussock sedge, dwarf shrub tundra.

Vc. Dry Dwarf Shrub, Crustose Lichen Tundra

This category depicts areas of very good drainage which are often blown free of snow during the winter. This vegetation type occurs along creek terraces, ridges between thaw lake basins, and near the tops of some pingos. Vegetation is forms a conspicuous mat of *Dryas integrifolia*, with other dominants such as *Salix rotundifolia*, *S. reticulata*, *Carex misandra*, and *Papaver* sp. (see 5F, Fig. 5). There are many other common forbs and graminoids giving this vegetation type high species diversity. There is also typically a large portion of exposed mineral soil covered with crustose lichens. A total of 69 acres or 2% of the map area is dry dwarf shrub, crustose lichen tundra.

Ve. Moist Graminoid, Dwarf Shrub Tundra/Barren Complex

This category depicts areas of typical moist sedge, dwarf shrub tundra (Va) in which there is a preponderance of frost boils or frost scars (see 5G, Fig. 5). Plant taxa are similar to those in category (Va), but within the frost boils there are either completely barren areas or partially

vegetated communities dominated by species such as *Eriophorum angustifolium*, *Saxifraga oppositifolia*, *Dryas integrifolia*, *Salix arctica*, *S. reticulata*, and *Dupontia fischeri*. A total of 242 acres or 6% of the map area is moist graminoid, dwarf shrub tundra/barren complex.

IXb. Dry Barren/Dwarf Shrub, Forb Grass Complex

This category depicts dry or moist disturbed areas next to gravel roads and pads within the map area. Some gravel and accumulations of road dust are common. Dominant plant taxa include *Carex misandra*, *Dryas integrifolia*, *Salix reticulata*, and *Festuca vivipara*. A total of 7 acres or 0.2% of the map area is dry barren/dwarf shrub, forb grass complex.

IXg. Dry Barren/Low Shrub Complex

This category depicts the sand dune area to the east of the proposed processing facility pad (Fig. 1 and Fig. 3). This dune area grades into the side of a pingo. Dominant plant taxa are *Dryas integrifolia*, *Salix arctica*, *Papaver* sp., *Polygonum bistorta*, and *Festuca vivipara* (see 5H, Fig. 5). A total of 5 acres or 0.1% of the map area is dry barren/low shrub complex.

Xb. Sand Dunes

This category depicts the lake margin east of the proposed processing facility pad (see 5I, Fig. 5; Fig. 1 and Fig. 3). This area is covered by moist sand with small dune deposits which are essentially devoid of vegetation. A total of 13 acres or 0.3% of the map area is sand dunes.

Xc. Barren Gravel Outcrops

This category depicts gravel spill areas likely to have some vegetation, but ground cover is less than 30%. Class Xc includes areas with abandoned road beds, washout areas next to the airstrip and Z Pad, and reserve pits at Z Pad (Fig. 2 to Fig. 4). A total of 21 acres or 0.6% of the map area is barren gravel outcrops.

Xe. Gravel Roads and Pads

This category refers to the Milne Point Road, Spine Road, various exploratory and production pads and the abandoned airstrip along the proposed road corridor (Fig. 2 to Fig. 4). These areas are generally devoid of vegetation. A total of 41 acres or 1% of the map area is gravel roads and pads.

XIa. Wet Mud

This category depicts drained lakes and ponds. In some areas the mud surface is actually dry. These areas are usually unvegetated but there can be scattered individuals of species such as *Deschampsia caespitosa* and *Senecio congestus*. A total of 49 acres or 1% of the map area is wet mud.

Gravel placement for all the proposed facilities will cover 49.4 acres of tundra (Table 3). The access road to the NW Eileen No. 1 pad covers 17.8 acres, 69% of which is moist or dry tundra (Class V; Table 3). This class accounts for 757 acres or 33% of the NW Eileen No. 1 map area (Table 2). The NW Eileen No. 1 pad covers 9.1 acres, 68% of this area is moist or dry tundra (Class V). The processing facility site along the Spine Road covers 14.3 acres, 71% of which is moist sedge/wet sedge complex (IVa). This category covers 405 acres or 17% of the NW Eileen No. 1 map area. The NW Eileen No. 2 pad covers 8.2 acres, 49% of which is wet tundra (Class II and III), which is 184 acres or 29% of the NW Eileen No. 2 map area.

DISCUSSION

The NW Eileen Development area (Fig. 1) is part of the Arctic coastal thaw-lake plain. It is within what has been termed a gently rolling thaw-lake plain landscape (Walker and Acevedo, 1987) with oriented thaw lakes and ponds, irregular pond complexes, and large drained lake basins alternating with broad, slightly elevated areas giving the region a gently rolling aspect. Soils do not receive loess fallout from the Sagavanirktok River and, therefore, are probably more acidic than those at Prudhoe Bay. This is indicated by the presence of acidophilic taxa, specifically *Pyrola gandiflora* and *Vaccinium vitis-idaea* (both uncommon species at Prudhoe Bay). Terrain is characterized by moist, well-drained elevated areas dominated by high-centered polygons and tussock tundra, and lower wet areas dominated by drained lake basins with low-centered polygons, strangmoor, frost boils, and non-patterned ground.

The NW Eileen Development land cover map is based on photo-interpretation supported by ground-reference data. Tussock tundra was not consistently distinguishable from moist sedge, dwarf shrub tundra on aerial photography. Occurrences of this map unit were determined primarily by ground-reference data. The accuracy of this vegetation map has not been assessed, all ground-reference data was used to construct and correct the current map. Independent ground-reference data are required to assess map accuracy. In a few cases (five sites), a combination of narrow polygon delineations and inaccurate GPS positions (suspected reflectance

interference in one case) led to discrepancies between the ground-reference site and the map classification. These sites were repositioned.

ACKNOWLEDGEMENTS

This study was funded by BP Exploration (Alaska) Inc. (BPXA). I thank Ray Jakubczak and Dave Trudgen for their support. Dale Funk and Kristen Brown helped collect ground-reference data (often in adverse weather) and Dale reviewed delineations and provided comments on the draft report. Craig Perham compiled and prepared photo-documentation for presentation in the final report. Thanks to all.

LITERATURE CITED

- Hultén, E. 1968. Flora of Alaska and neighboring territories. A manual of the vascular plants. Stanford University Press, Stanford, CA.
- Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and methods of vegetation ecology. New York, Wiley. 547 pp.
- Vitt, D.H., J.E. Marsh, and R.B. Bovey. 1988. Mosses Lichens and Ferns of Northwest North America. Lone Pine Publishing, Redmond, WA.
- Walker, D.A. 1983. A hierarchical tundra vegetation classification especially designed for mapping in northern Alaska. Pp. 1332–1337 *in* Proceedings of the Fourth International Conference on Permafrost, July 17–22, 1983, Fairbanks, AK. National Academy Press, Washington, D.C.
- Walker, D.A. 1985a. Vegetation and environmental gradients of the Prudhoe Bay region, Alaska. CRREL Report 85-14, U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, NH.
- Walker, D.A. 1985b. Illustrated surface-form and vegetation legend for geobotanical mapping of the arctic coastal plain of northern Alaska (Preliminary Draft). Special Studies, U.S. Fish and Wildlife Service/Institute of Arctic and Alpine Research, Boulder, CO.
- Walker, D.A., and W. Acevedo. 1987. Vegetation and a Landsat-derived land cover map of the Beechey Point Quadrangle, Arctic Coastal Plain, Alaska. CRREL Report 87-5, U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, NH.

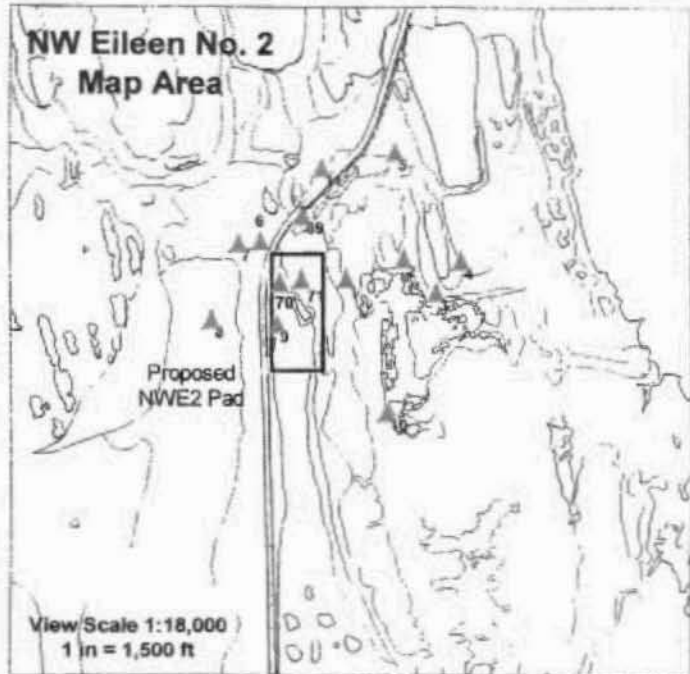
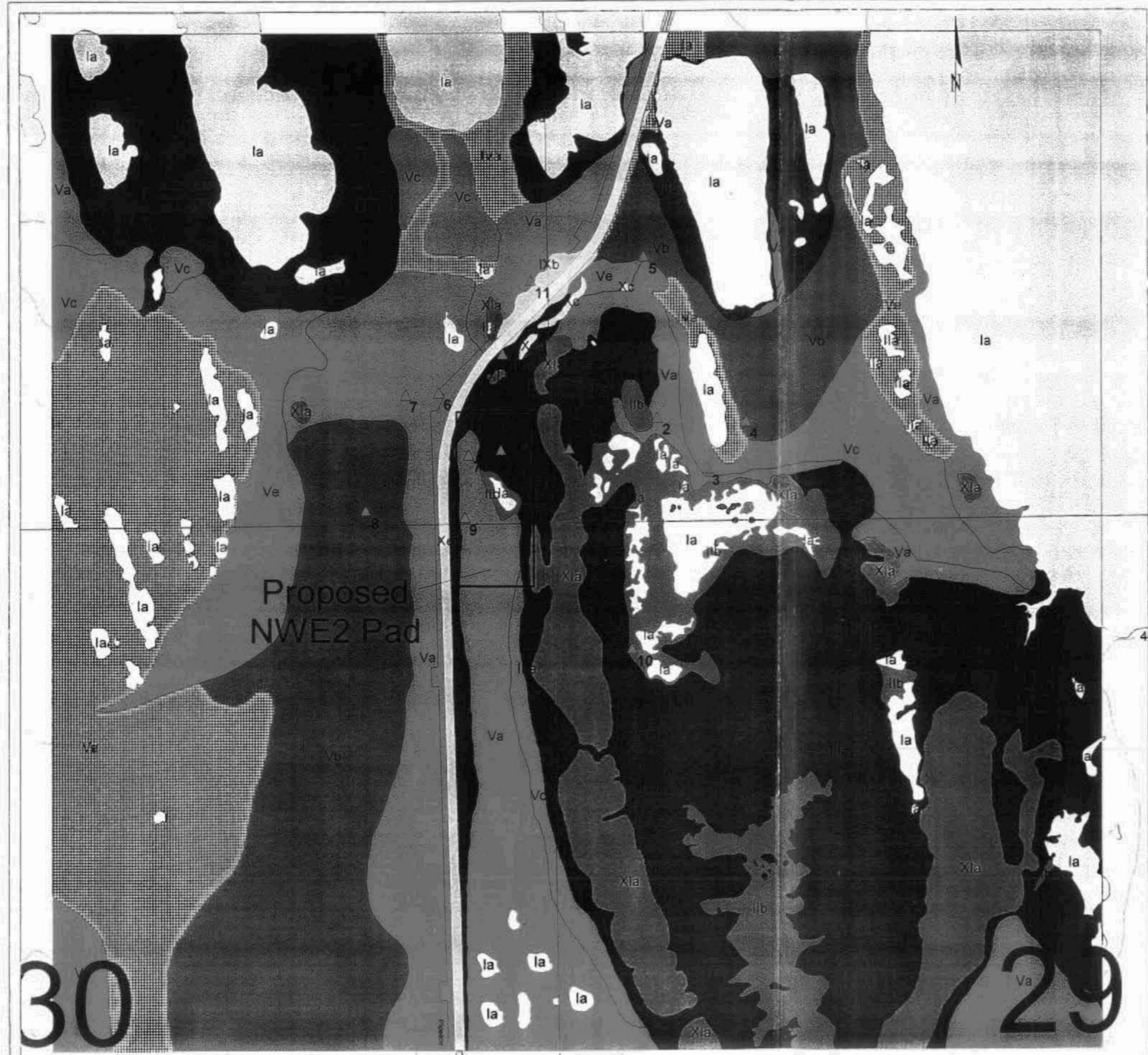


Figure 1. Northwest Eileen Development land cover map area and ground-reference data locations collected between 24 July and 7 August 1998, Alaska.

▲ 14
Ground-Reference site location and number (See Tables A-1 to A-4)

Map Projection: U.S. State Plane, Alaska Zone 4
Datum: NAD 1927
View Scale: Varies by Map
Mapping Scale: 1"=6,000
Date: 5 January 1999
Prepared by LGL Alaska Research Associates, Inc.
File: NWE1Fig1.WOR

Figure 2. NW Eileen No. 2 Area Land Cover Map.



Land Cover Types ¹	
Level B Land Cover Units	Level C Photo-interpreted Map Units
I. Water	Ia. Water (ponds, lakes, rivers, streams, saltwater)
	Ila. Water (shallow ponds)
II. Very Wet Tundra	Ilb. Aquatic Graminoid Tundra (emergent vegetation)
	Illa. Wet Sedge Tundra
	Illc. Wet Sedge Tundra/Water Complex (inter-connected ponds with no emergent vegetation)
III. Wet Tundra	Illd. Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex (wet patterned-ground complex)
	Iva. Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex (moist patterned-ground complex)
	Ivb. Moist Tussock Sedge, Dwarf Shrub Tundra
IV. Moist/Wet Tundra	Ivc. Dry Dwarf Shrub, Crustose Lichen Tundra (Dryas tundra, pingos)
	Ive. Moist Graminoid, Dwarf Shrub Tundra/Barren Complex (frost-scar tundra)
	IXb. Dry Barren/Dwarf Shrub, Forb, Grass Complex (forb rich river bars)
	IXg. Dry Barren/Low Shrub Complex
V. Moist or Dry Tundra	Xb. Sand Dunes
	Xc. Barren Gravel Outcrops
	Xe. Gravel Roads and Pads
IX. Partially Vegetated	Xia. Wet Mud
X. Light Colored Barrens (<30% cover)	
X. Dark Colored Barrens (<30% cover)	

¹ Adapted from: Walker, D.A. 1983. A hierarchical tundra vegetation classification especially designed for mapping in northern Alaska. Pages 1332-1337 in Proceedings of the Fourth International Conference on Permafrost. July 17-22, 1983, Fairbanks, AK.

▲ Ground-Reference Site 14 Location and Number (See Tables A-1 to A-4)

Map Projection: U.S. State Plane, Alaska Zone 4
 Datum: NAD 1927
 View Scale: 1:19,200
 Mapping Scale: 1:6,000
 Date: 5 January 1999
 Prepared by: I.G.L Alaska Research Associates
 File: NWEIVegFinal.WOR

Scale: 1 in = 550 ft
 1 in = 168 m

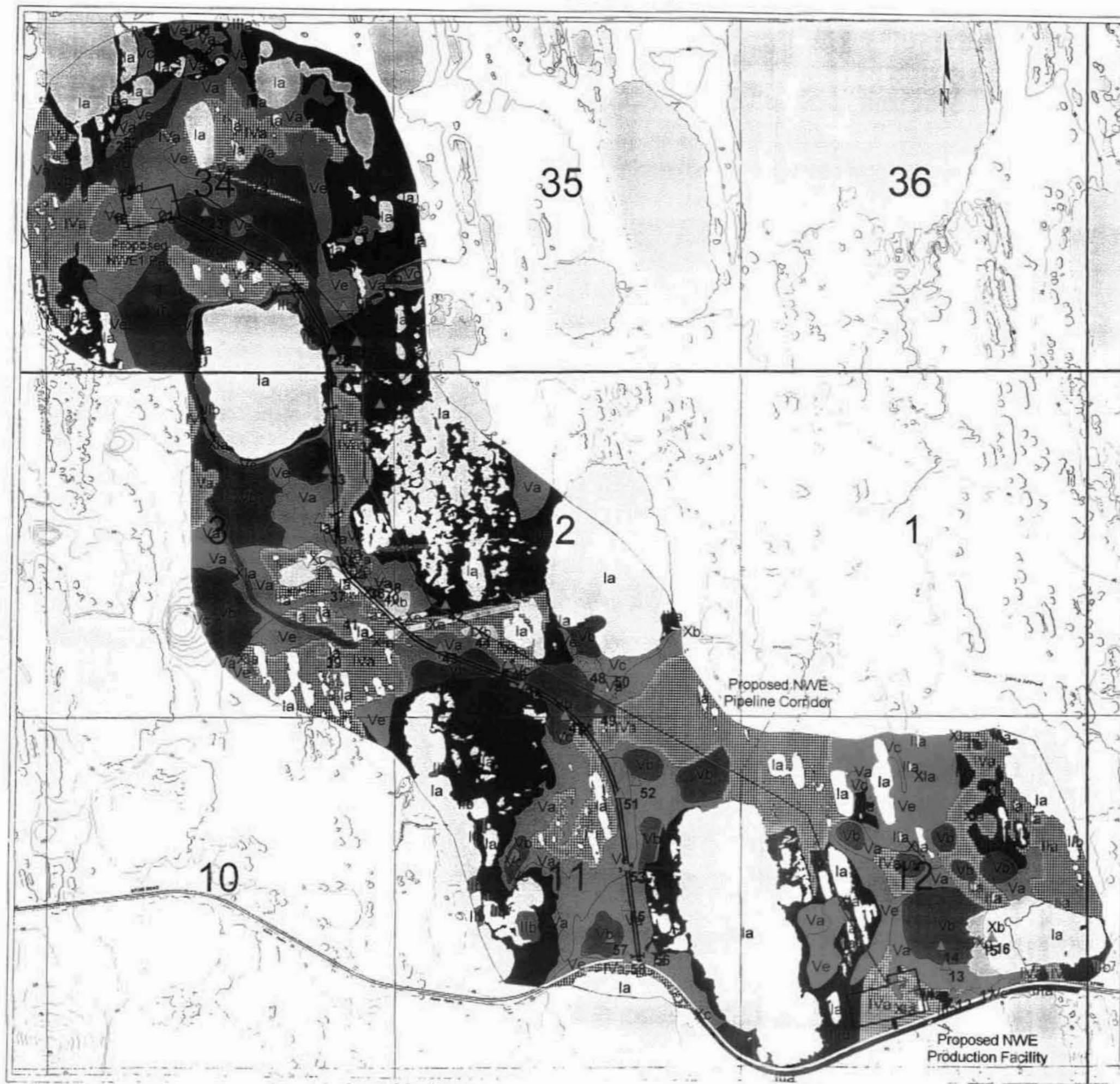


Figure 3. NW Eileen No. 1 Area Land Cover Map.

Level B Land Cover Units	Land Cover Types ¹ Level C Photo-interpreted Map Units
I. Water	Ia. Water (ponds, lakes, rivers, streams, saltwater) Ila. Water (shallow ponds)
II. Very Wet Tundra	Ilib. Aquatic Graminoid Tundra (emergent vegetation)
III. Wet Tundra	Ilii. Wet Sedge Tundra Iliid. Wet Sedge Tundra/Water Complex (inter-connected ponds with no emergent vegetation) Iliid. Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex (wet patterned-ground complex)
IV. Moist/Wet Tundra	Iva. Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex (moist patterned-ground complex)
V. Moist or Dry Tundra	Va. Moist Sedge, Dwarf Shrub Tundra Vb. Moist Tussock Sedge, Dwarf Shrub Tundra Vc. Dry Dwarf Shrub, Crustose Lichen Tundra (Dryas tundra, pingos) Ve. Moist Graminoid, Dwarf Shrub Tundra/Barren Complex (frost-scar tundra)
IX. Partially Vegetated	IXb. Dry Barren/Dwarf Shrub, Forb, Grass Complex (forb rich river bars) IXg. Dry Barren/Low Shrub Complex
X. Light Colored Barrens (<30% cover)	Xb. Sand Dunes Xc. Barren Gravel Outcrops Xe. Gravel Roads and Pads
X. Dark Colored Barrens (<30% cover)	Xla. Wet Mud

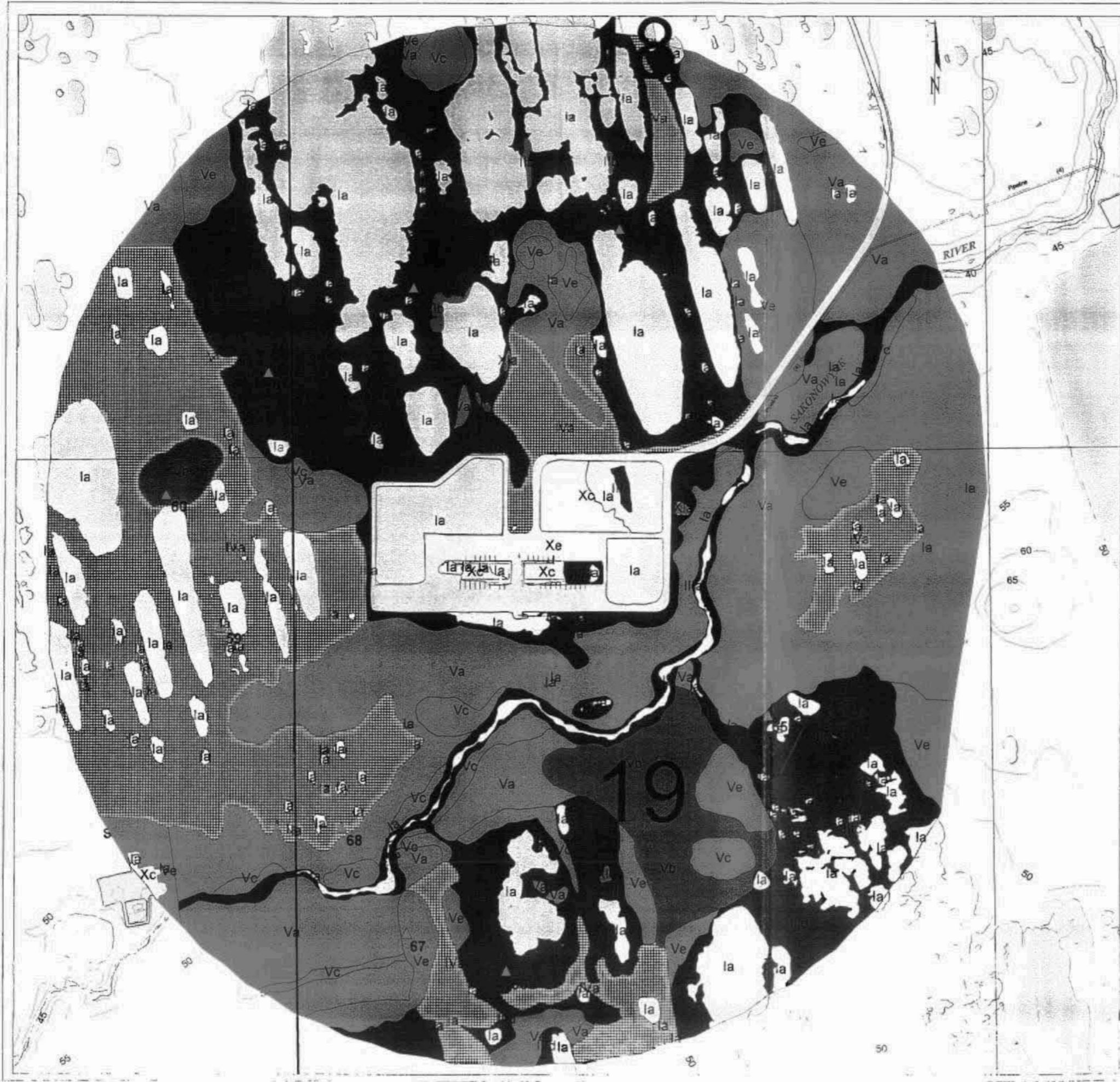
¹ Adapted from: Walker, D.A. 1983. A hierarchical tundra vegetation classification especially designed for mapping in northern Alaska. Pages 1332-1337 in Proceedings of the Fourth International Conference on Permafrost. July 17-22, 1983, Fairbanks, AK.

▲ Ground-Reference Site
14 Location and Number
 (See Tables A-1 to A-4)

Map Projection: U.S. State Plane, Alaska Zone 4
 Datum: NAD 1927
 View Scale: 1:19,200
 Mapping Scale: 1:6,000
 Date: 5 January 1999
 Prepared by: LGL Alaska Research Associates
 File: NWEIVegFinal WOR

Scale: 1 in = 1,600 ft
 1 in = 488 m

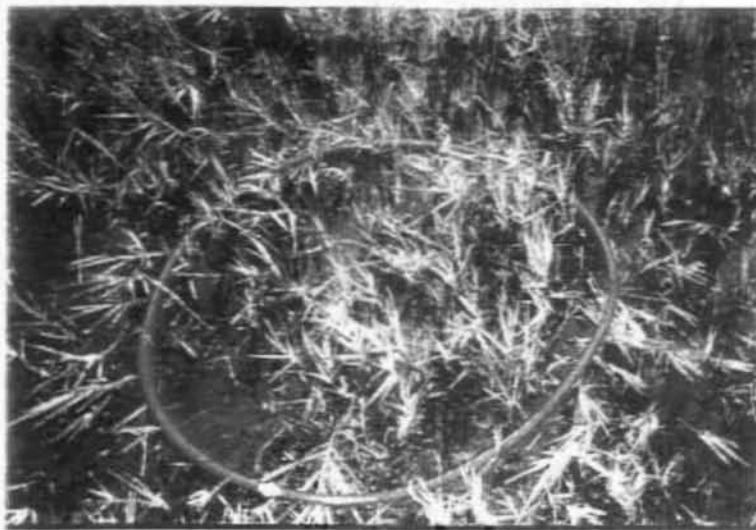
Figure 4. NW Eileen Area Z Pad Processing Facilities Land Cover Map.



Land Cover Types ¹	
Level B Land Cover Units	Level C Photo-interpreted Map Units
I. Water	Ia. Water (ponds, lakes, rivers, streams, saltwater)
	Ila. Water (shallow ponds)
II. Very Wet Tundra	Ilb. Aquatic Graminoid Tundra (emergent vegetation)
III. Wet Tundra	Illa. Wet Sedge Tundra
	Illc. Wet Sedge Tundra/Water Complex (inter-connected ponds with no emergent vegetation)
	Illd. Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex (wet patterned-ground complex)
IV. Moist/Wet Tundra	Iva. Moist Sedge, Dwarf Shrub/ Wet Graminoid Tundra Complex (moist patterned-ground complex)
V. Moist or Dry Tundra	Va. Moist Sedge, Dwarf Shrub Tundra
	Vb. Moist Tussock Sedge, Dwarf Shrub Tundra
	Vc. Dry Dwarf Shrub, Crustose Lichen Tundra (Dryas tundra, pingos)
	Ve. Moist Graminoid, Dwarf Shrub Tundra/ Barren Complex (frost-scar tundra)
IX. Partially Vegetated	IXb. Dry Barren/Dwarf Shrub, Forb, Grass Complex (forb rich river bars)
	IXg. Dry Barren/Low Shrub Complex
X. Light Colored Barrens (<30% cover)	Xb. Sand Dunes
	Xc. Barren Gravel Outcrops
	Xe. Gravel Roads and Pads
X. Dark Colored Barrens (<30% cover)	Xla. Wet Mud

¹ Adapted from: Walker, D.A. 1983. A hierarchical tundra vegetation classification especially designed for mapping in northern Alaska. Pages 1332-1337 in Proceedings of the Fourth International Conference on Permafrost. July 17-22, 1983, Fairbanks, AK.

Ground-Reference Site 14 Location and Number (See Tables A-1 to A-4)
 Map Projection: U.S. State Plane, Alaska Zone 4
 Datum: NAD 1927
 View Scale: 1:19,200
 Mapping Scale: 1:6,000
 Date: 5 January 1999
 Prepared by: LGL Alaska Research Associates
 File: NWEIVegFinal.WOR
 Scale: 1 in = 1,600 ft
 1 in = 488 m



5A.

Class IIb. Aquatic Graminoid Tundra (*Arctophilla fulva*).



5B.

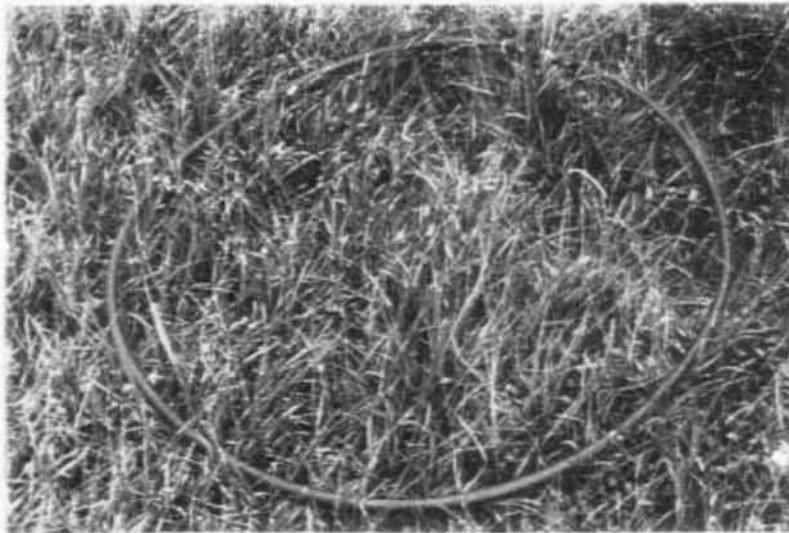
Class IIIa. Wet Sedge Tundra



5C.

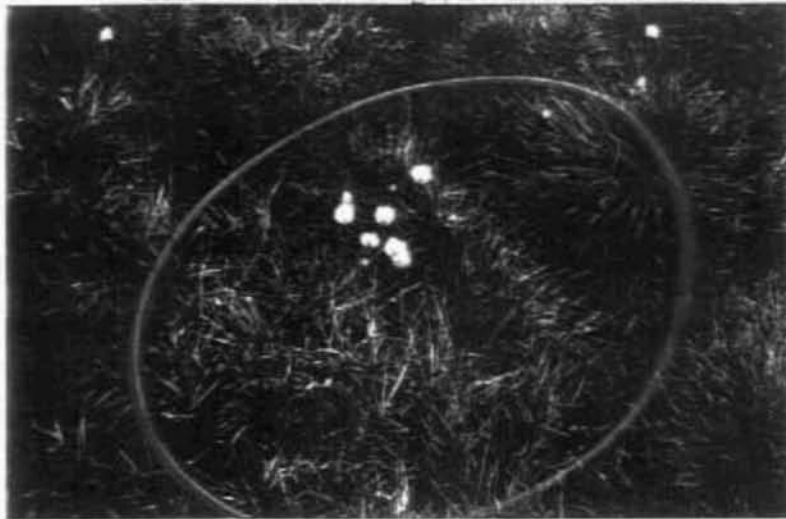
Class IIIId. Wet Sedge/Moist Sedge Dwarf Shrub Tundra Complex (strangmoor)

Figure 5. Examples of vegetation within Level C land cover classes (Table 1, Walker 1983) for the Northwest Eileen Development area, Prudhoe Bay, Alaska.



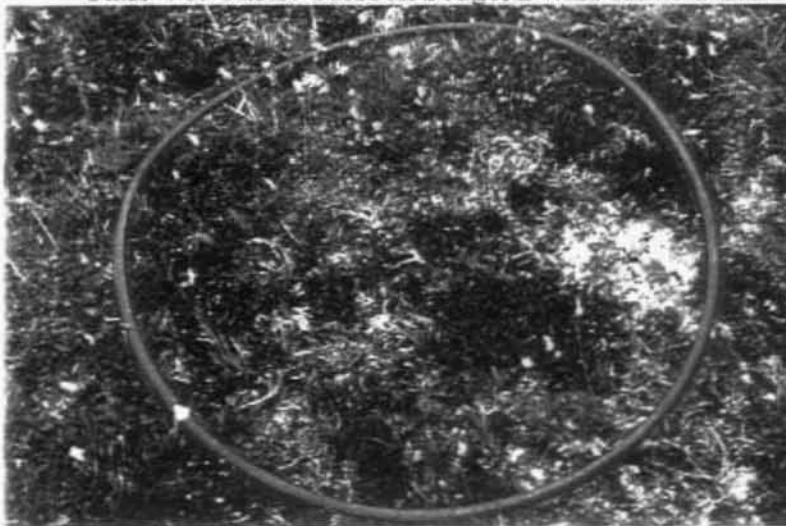
5D.

Class Va. Moist Sedge, Dwarf Shrub Tundra



5E.

Class Vb. Moist Tussock Sedge, Dwarf Shrub Tundra



5F.

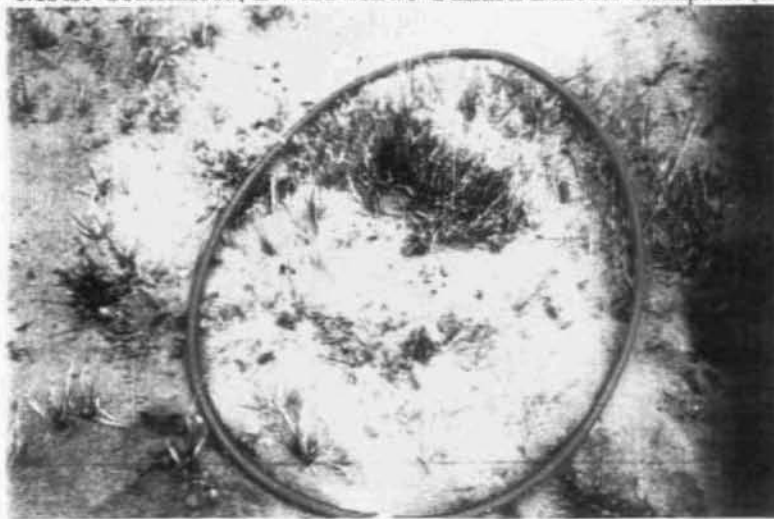
Class Vc. Dry Dwarf Shrub, Crustose Lichen Tundra (*Dryas* Tundra)

Figure 5. Continued.



5G.

Class Ve. Moist Graminoid, Dwarf Shrub Tundra/Barren Complex (frost-scar tundra)



5H.

Class IXg. Dry Barren/Low Shrub Complex



5I.

Class Xb. Sand Dunes

Figure 5. Continued.