Memorandum

DATE: July 20, 2011 Refer to File No.: Document1

TO: Elizabeth Sherlock, Environmental/Permitting Coordinator

FROM: Kirsten MacKenzie, M.Sc., R.P.Bio. (Fish Biologist)
Deborah Muggli, Ph.D., M.Sc., R.P.Bio. (Project Manager)

SUBJECT: Back River Airstrip Fish and Fish Habitat Assessment

1. Introduction

Sabina has proposed to construct an airstrip and associated access roads at the Goose Lake Camp. The airstrip will be located east of camp, and roads will be constructed to access the airstrip and borrow pits east of the airstrip. Drainages exist along the access roads and in the vicinity of the airstrip. A fish habitat and community assessment was conducted on these drainages to identify potential fish habitat and to recommend measures to protect fish resources.

2. Methodology

Fish habitat assessments at each stream site were based on the Fish Habitat Assessment Procedures (FHAP) (Johnston and Slaney 1996). The FHAP protocol is best suited to describe fish habitat at the habitat unit level and was conducted over 100 m-long stream sections roughly encompassing the proposed crossing locations. The FHAP procedure involves measuring individual habitat units and quantifying cover types, substrate, bank stability and riparian vegetation. It also aids in determining the availability of pools and other habitat types within stream reaches.

Fish sampling and community assessment was conducted by electrofishing. In addition to fish sampling, a barrier assessment was conducted to determine if the crossing sites were accessible to fish migrating upstream from Goose Lake.

3. Results and Observations

Four crossing sites were identified along the proposed access routes to the airstrip. Table 3.1 shows the UTM coordinates of each site. The weather at the time of the survey was rainy, and the water level in all water bodies was high.

Table 3.1 Locations of Stream Crossings along Proposed Airstrip Access Roads

Site	Zone	Easting	Northing	Comment
AS-1	13W	433824	7269795	Non Classified Drainage with no fish habitat
AS-2	13W	433377	7269435	Fish-bearing stream upstream of Gander Pond
AS-3	13W	432883	7269904	Fish-bearing stream downstream of Gander Pond
AS-4	13W	432964	7269946	Very small stream with marginal fish habitat

Site AS-1 is located just east of Goose Lake Camp. The area is characterized as a non-classified drainage (NCD) because it has no defined channel and no alluvial deposits. The area consists of ponded and pooled water in a low, wide drainage with no connectivity to surrounding water bodies (Plate 3.1). Several ponds up to 50 m^2 were observed, but no channels connected the ponds. The maximum depth of the ponds measured was 0.5 m, indicating that the area has no overwintering potential for fish. The lack of connectivity between water bodies, even at the high water levels observed, indicate that the area does not provide any suitable fish habitat.

Electrofishing was conducted for 257 s over a 100 m distance in several ponds and pools. No fish were captured or observed. This area is thus classified as non-fish-bearing, and a culvert crossing is suitable for the access road.

Plate 3.1 View looking west of AS-1 non-classified drainage

Site AS-2 is located approximately 100 m upstream of Gander Pond, east of the proposed airstrip. It is a stream with poorly defined banks and multiple channels (Plate 3.2). The bankfull width ranges from 1.5 m to 6.7 m, while the wetted width ranged from 1.6 m to 8.8 m (larger than bankfull because the

stream was in flood). The stream displays pool-riffle morphology; however, there were few deep pools. Most of the habitat units were glides or riffles. The substrate was dominated by boulder and cobble, while the cover was dominated by instream vegetation and boulders. Stream temperature was 6°C, conductivity was 4 µS/cm and pH was 8.0. The water was clear with no noticeable turbidity.

Site AS-2 was electrofished for 728 s over 100 m. One slimy sculpin (*Cottus cognatus*) was observed, but could not be captured because it retreated into the boulders along the bottom of the stream. No other fish were seen; however, the site has good connectivity to Gander Pond and has high habitat complexity due to the abundance of boulders and instream cover. The habitat in this area is suitable for rearing; however, no spawning habitat or overwintering habitat was seen.

This site is considered to be fish-bearing and should be crossed with an open-bottom structure such as a bridge. The most suitable crossing location from a fish habitat standpoint is located approximately 100 m upstream of Gander Pond at 13W.433377.7269435. At this location, the stream is relatively confined between areas of raised tundra. Elsewhere, the stream is poorly confined and floodwaters extend far beyond the banks of the stream.

Plate 3.2 Site AS-2 looking downstream towards Gander Pond. Note the multiple channels and poorly defined banks.

Site AS-3 is located approximately 100 m downstream of Gander Pond near the existing hydrology station. The stream in this location is well-defined with stable banks and a deep channel (Plate 3.3). The morphology is riffle-pool; however, most of the channel was characterized by deep glides and riffles. The bankfull width ranged from 2.0 to 3.2 m, and the wetted width ranged from 2.0 to 6.2 m. Cover was dominated by instream vegetation and deep water, while the substrate was dominated by fine sediment and boulders. The habitat in this area has good potential for rearing, but no spawning habitat was observed. The channel is not likely deep enough to support overwintering.

Site AS-3 was electrofishing for 450 s over 100 m. No fish were captured or seen; however, electrofishing conditions were difficult due to the deep channel and swift flow. The stream was followed downstream to Goose Lake to look for potential barriers to fish migration. No permanent barriers to migration were observed; however, the stream becomes more poorly defined as it approaches Goose Lake and it flows through a wide swath of scrub birch and willow.

This reach should be considered fish-bearing due to the observation of a fish upstream at site AS-2. The confined channel and high banks near the hydrology station (UTM 13W.432870.7269944) make it suitable for a bridge crossing.

Plate 3.3 Site AS-3 looking upstream near the hydrology station. This area is suitable for a bridge crossing due to the confined channel and high banks.

Site AS-4 is a very small stream that also drains Gander Pond into Goose Lake. It has a defined channel approximately 0.3 m wide and 0.1 m deep (Plate 3.4). It is ephemeral and while it is accessible to fish at high flows, it does not provide any suitable habitat for any life stage. It is likely suitable for an arched culvert crossing due to the poor habitat quality. No sampling was conducted at this crossing.

The airstrip centreline was also surveyed for fish habitat. The airstrip is located on raised land, and no water was observed anywhere along its length.

Gander Pond (Pond 5) was also surveyed as part of the pond assessment. It is a small, very shallow pond with limited fish habitat potential. The maximum depth observed was approximately 0.5 m, and the substrate was dominated by fine sediment and boulders. Ten minnow traps were set overnight along the shoreline, but no fish were captured. This pond may provide rearing habitat during the summer months; however, the shallow depth makes it unsuitable for overwintering. The absence of

spawning habitat in the inflow and outflow streams makes it unlikely that anadromous fish (such as grayling or lake trout) enter this pond.

Plate 3.4 Site AS-4 looking downstream towards Goose Lake.

4. Conclusions and Recommendations

From a fish and fish habitat perspective, the airstrip and access roads are proposed for suitable locations. No fish habitat exists between the airstrip and camp; therefore a culvert crossing of the non-classified drainage (AS-1) is suitable. Bridge crossings should be considered for the sites upstream and downstream of Gander Pond (AS-2 and AS-3) due to the presence of fish and potentially high flows. Site AS-4 is likely suitable for a culvert crossing due to the poor fish habitat potential; however, installing an open-bottom crossing such as an arch culvert would avoid the uncertainty of requiring approval from DFO. No fish habitat was present along the airstrip centreline.

References

Johnston, N. T. and P. A. Slaney. 1996. Fish Habitat Assessment Procedures. *Watershed Technical Circular* No. 8.

Memorandum

DATE:	October 4, 2011
TO:	Elisabeth Sherlock, Environmental/Permitting Coordinator
FROM:	Greg Sharam (Manager, Terrestrial Group); Deborah Muggli (Project Advisor)
CC:	Stephen Monninger (Project Manager), Tara Wight (Project Coordinator)
SUBJECT:	Ecosystem Overview at Proposed Goose Camp Airstrip

Introduction

Sabina Gold and Silver Ltd. (Sabina) contracted Rescan Environmental Services Ltd. (Rescan) to map and describe the ecosystems at a potential location for an airstrip, borrow pits and roads, west of the existing Goose Lake Camp, Nunavut.

Methods

Ecosystem mapping was conducted using ecological features such as terrain, soil, and vegetation to delineate ecosystem units on a map. Mapping used a georeferenced orthophoto complied by SRK from black and white aerial photos at a scale of approximately 1:5 000 taken on September 2, 2000. Ecosystem classification was conducted using stereo pairs of hard copy 2003 1:30 000 scale black and white air photos obtained from the National Air Photo Library to produce shapefile polygons for each ecosystem unit. The ecosystems present in each polygon were then recorded as a decile on a scale from one to ten, which represents it's proportional area within the polygon (e.g., 70% Wet Meadow, 20% Emergent Marsh and 10% Betula-Moss) using a system developed in British Columbia (RIC 1998) and adapted for the tundra environment. There are a maximum of three deciles per polygon. Decile 1 contains the most dominant ecosystem unit. Decile 2 and 3 contain the second and third most dominant ecosystem units, respectively.

Ground truthing for ecosystem mapping, ecosystem classification and a vegetation inventory were performed at Back River/Goose Lake Camp July 14 to 18, 2011. A total of 24 sample plots and 134 visual assessments were performed in the field. Sample plots included detailed assessments of the site conditions (slope, landscape position, drainage, etc.), basic soil plots (surficial material, soil moisture and nutrients, depth to permafrost, etc.), and vegetation surveys (species, percent cover by layer, etc.). Plot data were used to develop a preliminary ecosystem unit classification, based on established systems in Nunavut. Data collection methodology was adapted from the Describing Ecosystems in the Field (BC MoE 1998) and ecosystem classification and mapping were adapted from BC Government Guideline for Terrestrial Ecosystem Mapping (BC MoE 1998). Vegetation samples that could not be identified in the field were collected and pressed on site for further evaluation.

Results and Discussion

The Back River/Goose Lake study area is comprised of typical Arctic tundra ecosystems. The study area is relatively flat, with elevation changes of less than 50 m from lake shores to height of land. Small

rocky ridges are common, but rarely extensive. The ridges contain sparse vegetation on the windswept crests, while sheltered edges often contain microsites that sustain a higher vegetation diversity and more vigorous growth (shelter from wind enables many species to grow taller). Downslope from the ridges, on moderate to gently sloped blankets of glacial till (typically with abundant frost boils), vegetation communities are dominated by prostrate dwarf shrubs. Appendix A contains a description of all of the mapped and sampled ecosystem units in the proposed airstrip area. Appendix B contains a list of identified vegetation species.

In depressions at valley bottoms, a variety of communities exist. Soil texture is generally finer, and organic layers deeper, resulting in richer growing conditions. These areas are generally water-receiving sites where water deficits are rare. Palsa mounds, and small tussocks are common, as are small marshes along the edge of ponds and shallow open water communities. Vegetation communities in the low water receiving areas are diverse and largely dependent on small microsite changes (i.e. wet communities occurring beside dry communities on raised hummocks/palsa mounds).

Less common community types that occur in a variety of slope positions include riparian birch that can reach heights of 0.5 m along small streams, gravel beaches and floodplains along lake foreshores, and block fields with occasional 'floating' mats of organic material that support a variety of shrub and herb growth. No eskers were observed in the area. No rare or uncommon species were identified.

A total of 13 ecosystem units and 6 non vegetated units were described for the study area. Figure 1 and Table 1 contain a summary of the ecosystem units mapped in the study area, and the area (hectares) that will be disturbed by the proposed airstrip, access road, and quarries.

Table 1. Ecosystem Units Identified through Mapping and Field-truthing at Airstrip Site, Goose Lake Camp

Code	Ecosystem Unit	Area (ha)				% Disturbed
		Total	Road/Runway	Quarries	Total Lost	
BE	Beach	0.1				
BF	Blockfield	2.6				
BL	Betula-Ledum-Lichen	83.0	0.8	2.6	3.4	4.1
BM	Betula-Moss	6.7	0.1		0.1	1.5
BS	Birch Seep/Shrub	6.8				
BT	Birch-Ledum Tussock	2.1				
DH	Dryas Herb Mat	18.1		1.9	1.9	10.5
EM	Emergent Marsh	8.0	0.1		0.1	1.3
FP	Low Bench Floodplain	2.7				
MI	Mine	7.8	0.1		0.1	1.3
MZ	Rubbly Mine Spoils	3.8				
OW	Open Water	1.6				
PD	Pond	6.8				
RB	Riparian Birch	2.5				
RI	River	1.7				
RO	Rock Outcrop	8.2		1.4	1.4	17.1
SB	Snowbank Community	8.7		4.3	4.3	49.4
SH	Dwarf Shrub Heath	97.5	5.5	5.3	10.8	11.1
WM	Wet Meadow	37.4	0.1	0.8	0.9	2.4
	Total	**306.1**	**6.7**	**16.4**	**23.1**	**7.5**

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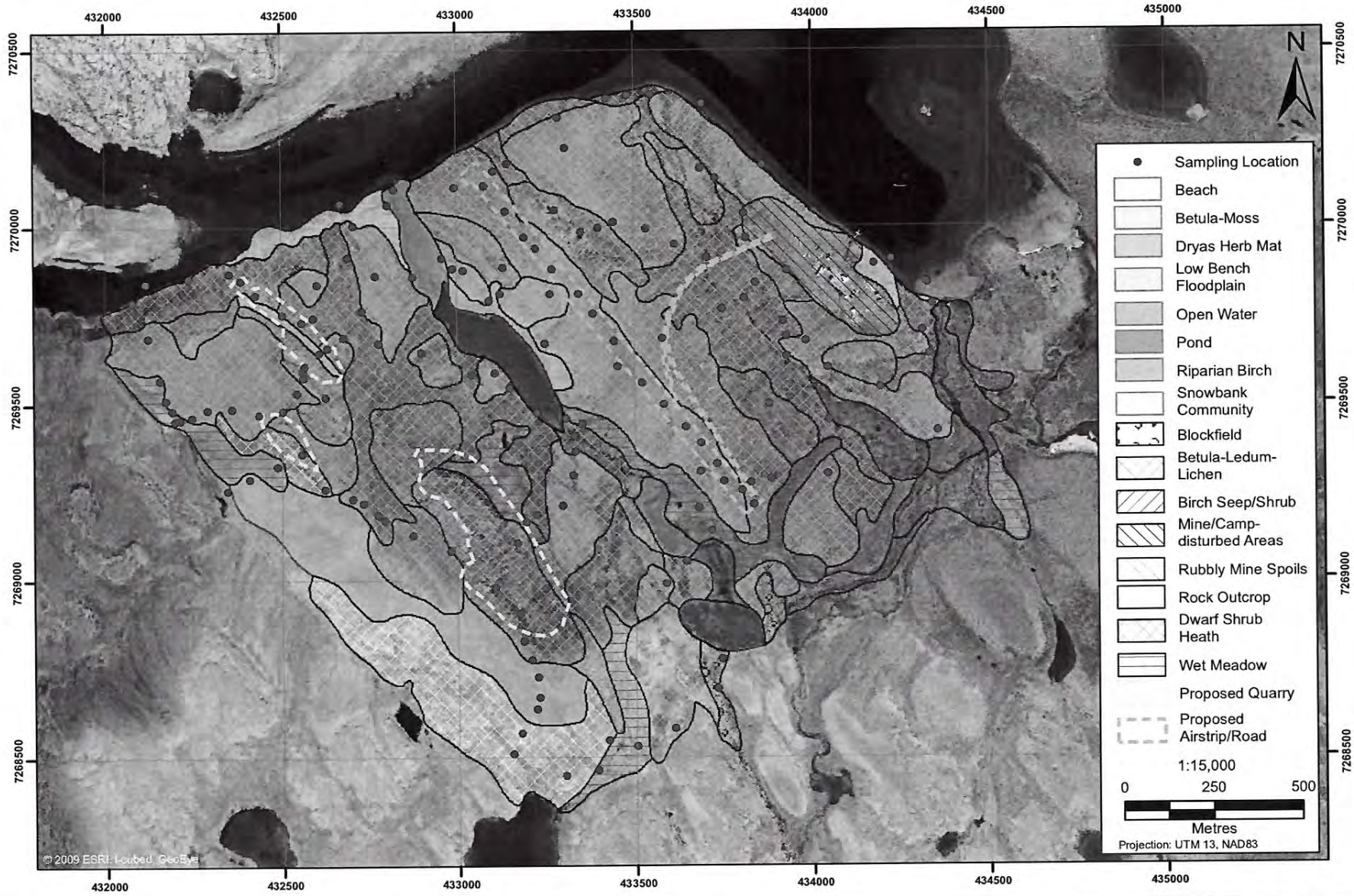

Figure 1

Sabina

Ecosystem Types in the Goose Camp Airstrip Area

Figure 1

Rescan™ Engineers & Scientists

References

BC Ministry of Environment, Lands and Parks and Ministry of Forests. 1998. Field Manual for Describing Terrestrial Ecosystems. BC Ministry of Environment, Lands & Parks and Ministry of Forests, Victoria, BC.

RIC. 1998. Standard for Terrestrial Ecosystem Mapping in British Columbia. Victoria, BC: Terrestrial Ecosystems Taskforce, Ecosystems Working Group, Resources Inventory Committee.

Appendix A. Back River / Goose Lake, Nunavut, Ecosystem Units, July 2011

Table A.1. Ecosystem Units and their Corresponding Mapping Codes

Code	Ecosystem Unit	Code	Ecosystem Unit
BE	Beach	MZ	Rubbly Mine Spoils
BF	Blockfield	OW	Open Water
BL	Betula-Ledum-Lichen	PD	Pond
BM	Betula-Moss	RB	Riparian Birch
BS	Birch Seep/Shrub	RI	River
BT	Birch-Ledum Tussock	RO	Rock Outcrop
DH	Dryas Herb Mat	SB	Snowbank Community
EM	Emergent Marsh	SH	Dwarf Shrub Heath
FP	Low Bench Floodplain	WM	Wet Meadow
MI	Mine/Camp-disturbed areas		

Description of Ecosystem Units at Goose Lake Airstrip Site

Beach (BE)

Gravel beach with sparse vegetation. Limited in extent and rare in study area. No soil development. See Plate 1.

Plate 1. Example of Beach in the airfield study area.

Blockfield (BF)

Areas dominated by shattered bedrock or till boulders. Vegetation and soil largely absent, or represented by 'floating' mats of organics (organic mat on large boulders with no mineral soil) with diverse herb, shrub and lichen communities (Lichen-Rock Community). Occurs in a variety of locations and slope positions. See Plate 2.

Plate 2. Example of Blockfield in the airfield study area.

Betula-Ledum-Lichen (BL)

Hummocky areas dominated by prostrate to low shrub dwarf birch, northern Labrador tea, cottongrass and diverse assemblage of dry (on palsa mounds) and wet (depressions between mounds) species. Occurs on thin fibric organic layers over slightly finer (relative to dry communities such as SH) textures till blankets. Flat to gently sloping. Common, but rarely extensive and typically mixed with WM, BM or SH. Occasionally occurring in small patches in depressions at the base of rock outcrops. Soil moisture ranges from submesic to mesic (subhygric in depressions), soil nutrients are poor to medium. See Plate 3.

Betula-Moss (BM)

The Betula Moss (BM) ecosystem unit occurs on level to slightly sloped till blankets, often on slightly elevated microsites. Always occurs near WM or standing water. Soil moisture and nutrients are generally mesic and medium. It is characterized by a think cover of dwarf birch, and a low diversity and cover of other shrubs and herbs. A thick cover of moss is always present. See Plate 4.

Plate 3. Example of Betula-Ledum-Lichen in the airfield study area.

Plate 4. Example of Betula-Moss in the airfield study area.

Birch Seep/Shrub (BS)

Common in study area, but unsure if it should be a distinct ecosystem unit. Occurs on flat till areas that are generally water receiving. Sites are dominated by dwarf birch, along with a diverse (but sparse) cover of other dwarf shrubs and herbs. Moss and lichens noticeably absent (distinguishes BS from BL). Soil nutrients medium, and moisture subhygric. Often occurs with small depressions with thick sedges. See Plate 5.

Plate 5. Example of Birch Seep/Shrub in the airfield study area.

Birch-Ledum Tussock (BT)

Small tussocks of cottongrass with a significant cover of northern Labrador tea, and a generally low cover of other dwarf shrubs. Limited extent and uncommon in area. Typically mixed with other wet communities such as WM, EM and BL. Occurs on firbic organic veneers (17 cm deep) over fine textured (silty) till (maybe lacustrine) material with no coarse fragments. Underlain by permafrost (uncommon at shallow depths in study area) at the transition from organic to mineral soil. Soil nutrients rich and moisture subhygric. See Plate 6.

Dryas Herb Mat (DH)

Drya Herb Mats are restricted to windswept rocky crests and bedrock outcrops. Soils are thin and coarse; typically thin layers over bedrock. Soil moisture is xeric and nutrients very poor to poor. Vegetation is sparse. Shrubs are lacking. Dwarf shrubs are common and dominant. Mountain avens are common, but species assemblages are diverse in response to microsites. Lichens are common, but not extensive while mosses are generally absent. Exposed mineral soils frost boils, solifluction and rock outcrops are common. See Plate 7.

Plate 6. Example of Birch-Ledum Tussock in the airfield study area.

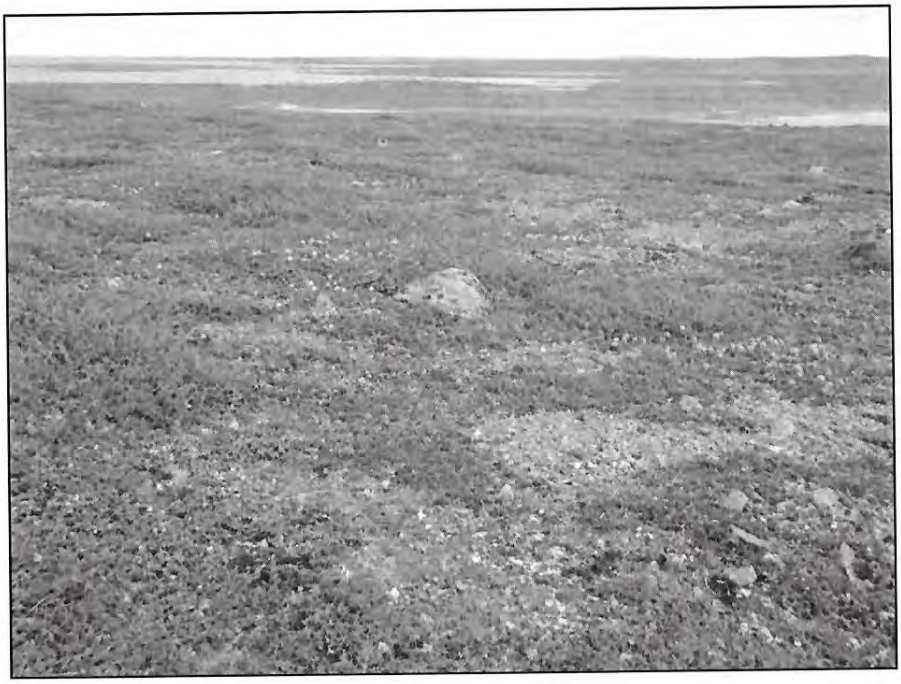

Plate 7. Example of Dryas Herb Mat in the airfield study area.

Emergent Marsh (EM)

Not sampled. Emergent marsh is the wettest ecosystem unit in the study area, with standing water always present. It is uncommon and never extensive. It is dominated by a thick, continuous cover of sedges, with small occurrences of cottongrass. Other species may occur, but they never have a significant cover. Always occurs in depressions, generally in complexes of WM and on the edge of standing water. See Plate 8.

Plate 8. Example of Emergent Marsh in the airfield study area.

Low Bench Floodplain (FP)

Low bench floodplains occur on the edges of large waterbodies that seasonally flood. Vegetation is diverse, likely in response to parent material and duration of inundation, and forms a continuous cover. It is never extensive and typically occurs in narrow linear strips on small flat toes. Think organic soils may be present. Mineral soils are strongly mottled and gleyed. See Plate 9.

Mine (MI) & Rubbly Mine Spoils (MZ)

Not sampled. Camp, sludge pit, old drill pads. Various types of permanent or temporary disturbance from exploration activities. Generally exposed soils with remnant vegetation and profusion of grasses. See Plate 10.

Open Water / Pond (OW/PD)

Not sampled. Shallow open water and pond with no aquatic vegetation and sparse emergent vegetation. Substrates range from fines/organics to cobble/boulder. See Plate 11.

Plate 9. Example of Low Bench Floodplain in the airfield study area.

Plate 10. Example of Mine & Rubbly Mine Spoils in the airfield study area.

Plate 11. Example of Open Water / Pond in the airfield study area.

Riparian Birch (RB)

Thick, tall (over 0.5m) birch with minor occurrences of willow. Herbaceous and dwarf shrubs generally lacking. Occurs on sandy, water washed (active flooding) till along small creeks and streams. On slopes and depressions shrub growth is 0.5m or greater, while on flatter, exposed areas shrubs are stunted allowing for more substantial herbaceous and dwarf shrub cover. Soil nutrients poor to medium, moisture hygric to subhydric. See Plate 12.

Snowbank Community (SB)

Unsure if this should be a distinct community. Uncommon and not extensive. Sheltered sites on banks of rock outcrops where snowpack is deeper, or persists, and wind exposure is limited relative to open sites. Vegetation is diverse as soil development is inconsistent, ranging from dwarf shrub dominated sites on floating organic layers (organic mats over rock), and sheltered areas with thick willow growth. See Plate 13.

Dwarf Shrub Heath (SH)

This typical tundra plant community typically occurs on flat to moderately slopping veneers and blankets of glacial till, often with a shallow fibric organic layer. Permafrost is generally deep, but frost boils and solifluction lobes are common. It is dominated by stunted dwarf shrubs such as northern birch, northern Labrador tea, bog and dwarf blueberry, alpine azalea, reindeer lichen, as a variety of herbaceous species. The SH community is the most common and extensive in the study area. See Plate 14.

Plate 12. Example of Riparian Birch in the airfield study area.

Plate 13. Example of Snowbank Community in the airfield study area.

Plate 14. Example of Dwarf Shrub Heath in the airfield study area.

Wet Meadow (WM)

Wet community type that occurs in small depressions, often complexed with other vegetation types. Small palsa mounds are common. Vegetation is dominated by sedges and cottongrass, with small dry elevation mounds common. Lichens are absent (with the exception of elevated dry sites where vegetation is quite random; can include dwarf shrubs, lichens, herbs and mosses). Standing water is present much of the year, but unlike EM, sites can be muddy or dry. Higher cover of cottongrass than EM, and typically does not occur in similar landscape positions as EM (adjacent to waterbodies). Soil moisture hygric to subhydric; nutrients medium to rich. Relatively thick fibric organic layers common over strongly gleyed till. See Plate 15.

Plate 15. Example of Wet Meadow in the airfield study area.

Appendix B. Vegetation Species Identified During Ground-Truthing

Scientific Name	Common Name
Allium schoenoprasum	wild chives
Andromeda polifolia	bog rosemary
Antennaria spp.	
Arctostaphylos spp.	bearberry
Armeria scabra	arctic thrift
Arnica angustifolia	alpine arnica
Aulacomnium palustre	glow moss
Betula glandulosa	dwarf birch
Cardamine bellidifolia	alpine bitter-cress
Carex aquatalis var. *stans*	water sedge
Carex fuliginosa	short-leafed sedge
Carex membranacea	fragile sedge
Carex rotundata	round sedge
Carex rupestris	curley sedge
Carex spp.	
Cassiope tetragona	four-angled mountain-heather
Castilleja elegans	Paintbrush
Castilleja sp.	
Cerastium arvense	field chickweed
Cerastium sp.	
Cladina rangiferina	gray reindeer lichen
Cladina sp.	
Cladonia sp.	
Comarum palustre	marsh cinquefoil
Dactylina arctica	butterfingers
Diapensia lapponica	diapensia
Dicranium sp.	
Drabba sp.	
Dryas integrifolia	mountain-avens
Dryopteris fragans	fragrent shield fern
Empetrum nigrum	crowberry
Epilobium latifolium	broad-leaved willowherb
Equisetum arvense	common horsetail
Eriophorum angustifolium	narrow-leaved cotton-grass
Eriophorum vaginatum	sheathed cotton-grass
Festuca brachyphylla	alpine fescue
Hedysarum mackenzeii	northern sweet vetch
Hierochloe alpina	holly grass
Hylocomium splendens	step moss
Juncus biglumis	two-flowered rush

Scientific Name	Common Name
Juncus sp.	
Ledum palustre ssp. decumbens	northern Labrador tea
Loiseleuria procumbens	alpine azalea
Luzula confusa	confused woodrush
Luzula wahlenbergii	Piper's wood-rush
Lycopodium sp.	
Masonhalea righardsonii	
Oxytropis arctobia	
Oxytropis maydelliana	yellow oxytripe
Pedicularis capitata	capitate lousewort
Pedicularis labradorica	Labrador lousewort
Pedicularis lanata	wooly lousewort
Pedicularis lapponica	Lapland lousewort
Pedicularis sudetica	Sudetan lousewort
Peltigera aphthosa	silver-edge pelt
Peltigera sp.	
Persicaria vivpara	bistwort
Pinguicula villosa	bladderwort
Pinguicula vulgaris	bladderwort
Pleurozium schreberi	red-stemmed feathermoss
Potentilla sp.	
Pyrola grandiflora	largeflowered wintergreen
Pyrola seconda	one-sided wintergreen
Ranunaculus sp.	buttercup
Rhizocarponsp.	map lichen
Rhododendron lapponicum	Lapland rosebay
Rubus chamaemorus	cloudberry
Salix arctica	arctic willow
Salix arctophila	northern willow
Salix herbacea	snow-bed willow
Salix reticulata	net-veined willow
Salix spp.	
Salix stolonifera	creeping willow
Saxifraga cernua	noding saxifrage
Saxifraga tricuspidata	three-toothed saxifrage
Silene acaulis	moss campion
Sphagnum fuscum	common brown peat-moss
Sphagnum sp.	
Stellaria subvestita	

Scientific Name	Common Name
Stereocaulon sp.	
Thamnolia subuliformis	
Tofildia coccinea	false asphodel
Tofildia pusilla	false asphodel
Trisetum spicatum	spiked trisetum
Umbilicaria sp.	rock tripe
Vaccinium uliginosum	bog blueberry
Vaccinium vitis-idaea	lingonberry