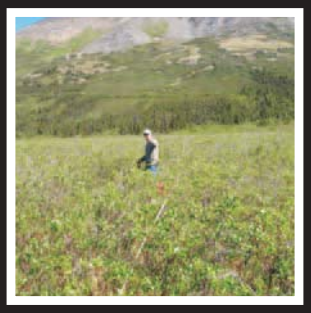
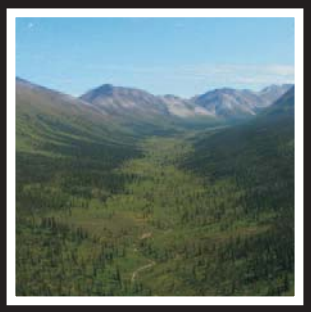
eba.ca





North American Tungsten Corporation Ltd.

ISSUED FOR USE

MACTUNG PROJECT
2008 ENVIRONMENTAL BASELINE STUDIES
VEGETATION AND ECOSYSTEM LAND CLASSIFICATION FOR PROPOSED ACCESS ROAD AND MACMILLAN PASS AERODROME EXPANSION

W23101021.017

November 2008

creating & delivering
better solutions

North American Tungsten Corporation Ltd.

ISSUED FOR USE

MACTUNG PROJECT
2008 ENVIRONMENTAL BASELINE STUDIES
VEGETATION AND ECOSYSTEM LAND CLASSIFICATION FOR PROPOSED ACCESS ROAD AND MACMILLAN PASS AERODROME EXPANSION

W23101021.017

November 2008

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

EXECUTIVE SUMMARY

North American Tungsten Corporation Ltd. retained EBA Consulting Engineers and Scientists Ltd. (EBA) to collect baseline vegetation information at the Mactung Project Property (Mactung) for a proposed 42 kilometre road. EBA conducted ecosystem land classification (ELC), a rare plant survey (RPS), and trace element concentration sampling from July 3 to July 8, 2008. The surveys were conducted in the area of the proposed footprint for the Mactung Project Road in the Yukon.

A total of 62 vegetation plots were sampled during the 2008 field season for a total of 109 for the RLSA including data collected in 2006 and 2007. The Wooded Taiga makes up the greatest area comprising 60.4% of the RLSA followed the Alpine with 26.6%, and the Shrub Taiga with 13%. A total of 15 distinct ecosystem units and 21 complex polygon associations were mapped based on sampling performed by EBA in 2006 to 2008. The ecosystem units with the greatest percent cover within the RLSA were: epilithic lichen (17.3%), heath-lichen (6.7%) and complexes such as fir-moss: spruce moss (12.5%) and fir-moss: willow slope (10.1%). Wetland and riparian areas totalled approximately 7.5% of the RLSA or 1,036 ha, with the willow-sedge (5.6%), sedge-*Sphagnum* (0.6), and willow-bluebell (0.6%) units representing the most area.

The Aerodrome expansion area consists of a 200 metre buffer around the entire proposed Aerodrome runway. The area is highly disturbed with 15.5% having been previously cleared as runway or exposed soil. The remainder of the area consists mainly of the riparian unit willow-sedge (31.6%), the wetland unit sedge-*Sphagnum* (20.0%) and the upland unit birch-lichen (17.6%).

The most abundant structural stage is mature forest (30.2%) associated with the Road and low shrub (29.5%) observed in the subalpine and riparian areas. Old growth forest was not observed in the RLSA.

A total of 21 rare plant species were identified as having a potential to occur within the Mactung Project area. In 2006, dwarf nagoonberry (*Rubus arcticus* ssp. *acaulis*), was observed in the RLSA, but not in areas that have been considered for the proposed footprint of the mine or Road. In 2007, no rare species were observed in areas proposed for development. In 2008 one species, heart-leaved twayblade (*Listera cordata*), considered rare by Douglas *et al.* (1981), was observed in the area of the proposed Road. NatureServe Yukon indicated this species is considered secure within the Yukon (Bruce Bennett pers. comm.) Based on this information, there were no rare plants observed in the proposed footprint for the Mine or the Road.

A baseline assessment of trace element concentrations (TEC) in plant tissue was performed within the RLSA. A total of 14 vegetation samples were collected with two samples collected at each of seven sample locations. Results of TEC analyses of vegetation samples collected in the Yukon were generally within one standard error of the mean and less than CCME soil standards except for cadmium concentrations in horsetail at locations MTEC 10, 11, and 12; selenium concentrations in horsetail at locations MTEC 05 and 06; and zinc concentrations in all willow samples.

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

TABLES

FIGURES

TABLE OF CONTENTS

PHOTOGRAPHS

APPENDICES

1.0 INTRODUCTION

North American Tungsten Corporation Ltd. (NATCL) is proposing the development of a world-class tungsten deposit located near Macmillan Pass in the Yukon (Figure 1). The Mactung mine site ("the Mine") is located in the Selwyn Mountains at an elevation of 1,725-1,800 metres above sea level (m a.s.l.). The Mine is connected to the southern Yukon during summer months by the North Canol Road via the Northwest Territories, and is 650 km (400 km by air) northeast of Whitehorse. In addition to the development of the Mine, NATCL has proposed an access road ("the Road") through the Yukon that will connect the Mine to the North Canol Road allowing access to Whitehorse and an aerodrome at MacMillan Pass. The development is to also include expansion of the existing MacMillan Pass Aerodrome ("the Aerodrome").

2.0 OBJECTIVES

The objectives of this report are to update and further supplement historic baseline vegetation information collected in the area of the Road and the Aerodrome in support of future regulatory submissions leading to approvals and implementation of the Project (the Mine, the Road, and the Aerodrome). NATCL retained EBA Engineering Consultants Ltd. (EBA) to:

- Provide information on land cover types (ecosystem land classification) and forest cover;
- Document and map ecosystem units to the species level on the sites that may be disturbed as a result of development;
- Describe vegetation including protected areas and any identified rare, sensitive, and/or endangered species;
- Identify any wetlands in the project area; and
- Collect and present baseline information relating to trace element concentrations in vegetation in and around the footprint of the mine.

3.0 ENVIRONMENTAL SETTING

3.1 STUDY AREA

3.1.1 Road Local Study Area and Aerodrome Expansion

The Road Local Study Area (RLSA) is presented in Figure 2 and includes a 1.5 km buffer around the Road totalling 13,834 ha (Photo 1). The size of the RLSA considered the objectives of both the vegetation and wildlife components, including requirements for the future assessment of Project effects. The 1.5 km buffer would normally extend slightly into the Northwest Territories (NWT), however, only the area up to the Yukon-NWT border was included in this study. An additional 74 ha was studied for the expansion of the

Aerodrome and included a 200 m buffer around all Aerodrome facilities following expansion. The Aerodrome is not included in the area calculations of the RLSA.and will be examined separately (Photo 2).

The Mactung RLSA lies within the Selwyn Mountain Ecoregion of the Taiga Cordillera Ecozone of Canada (Smith *et al.* 2004). Ecodistricts for the RLSA have not been formally defined. However, for the purposes of this report, a Selwyn-Yukon Ecodistrict (YN) has been designated. The Selwyn Mountain Ecoregion is characterized by high elevation mountain ranges that contain alpine glaciers such as those located on nearby Keele Peak (2,970 m a.s.l.). Elevations range from 745 m a.s.l. to 2,970 m a.s.l. The Selwyn Mountains give rise to the highest levels of annual precipitation (600-700 mm) in Yukon outside the Coast Mountains (Smith et al. 2004). Mean annual temperatures for the region are -5°C to – 8°C, ranging from an average of -20°C in January to 8°C in July. The region lies in the discontinuous permafrost zone; however, the RLSA around the Mine is likely within the continuous permafrost zone due to its high elevation of between 1,300 m a.s.l. to 2,200 m a.s.l. Approximate land cover in the Selwyn Mountain Ecoregion is 65% boreal/subalpine coniferous forest, 20% alpine tundra, and 15% rockland (Smith *et al.* 2004).

Vegetation is highly variable in the RLSA due to elevation, aspect, microtopography, and soil conditions. Valley bottoms tend to be vegetated by willow and scrub-birch thickets, wetlands, and sedge-forb meadows. Black and white spruce communities are rare in the Hess Tributary. Subalpine fir dominates the Wooded Taiga (WTA) from 1,200 m a.s.l. to 1,550 m a.s.l. At higher elevations in the Alpine, the canopy becomes sparse and is typically replaced by krummholz Alpine-fir and dwarf shrub communities. At elevations above 1,800 m a.s.l., vascular plants become rare and bare rock and epilithic lichen communities dominate.

3.1.2 Fire History

The importance of fire to the structure and vegetation dynamics of forest ecosystems has long been recognized. Typical fire frequencies in the boreal forest are approximately every 100 years in areas dominated by white spruce, 75 years for black spruce and 50 years for trembling aspen (Larson 1997). The fire interval was found to increase at northern latitudes in the Yukon from 133 years to 234 years (Theberge 1972). Due to the moist and cold climate in the area of the Mactung RLSA, the latter value is likely more accurate. Historical records indicate no major fire disturbance in the area of the proposed mine (Figure 3). This infers that late successional and/or mature communities are likely to be present in the RLSA.

3.2 ECOSYSTEM LAND CLASSIFICATION IN THE YUKON

3.2.1 Background

Ecosystem land classification (ELC) is an ecological mapping process which integrates site, soil, and vegetation characteristics in order to identify ecological units that are repeatable and can be mapped for environmental land use planning and resource management. Currently, ELC exists for many parts of Canada and provinces such as British Columbia. An ELC framework for the Yukon is currently under development, with a draft framework already developed by Francis and Steffen (2003). This framework describes a hierarchical system incorporating Ecoregional classification (Ecozone, Ecoregion and Ecodistrict) and ecosystems (Bioclimate Zones and Ecosystem Units).

Ecozone and Ecoregion mapping exists for the entire Yukon Territory. Ecodistrict mapping has been completed for many Ecoregions. EBA (2003) completed the Ecodistrict mapping for the Pelly Mountains and Yukon Southern Lakes Ecoregions. Bioclimate Zone mapping has been completed for a number of the Yukon Ecoregions. EBA (2003) also completed an ELC for the Pelly Mountains and Yukon Southern Lakes Ecoregions.

Biophysical mapping was completed for the Watson Lake area by Lipovsky and McKenna (2005) using a new site classification system. Zoladeski *et al.* (1996) assembled a site classification guide for southeast Yukon. Ecosystem mapping at a scale of 1:20,000 was carried out for the Wolverine Mine Project (YZC and AXYS 2005) and Mactung Mine Project (EBA 2007a; 2007b). These studies described and developed new ELC units and cross-referenced these units to those described by Zoladeski et al. (1996).

Ecological land classification and mapping presented in this report is based upon EBA (2003), Francis and Steffen (2003), Kershaw and Kershaw (1983), and Zoladeski et al. (1996). Table 1 shows the ecosystem land classification hierarchy for the MacTung RLSA. As stated in the objectives, Levels 1-3 (Figure 1), Level 4 (Figure 4), and Level 6/7 (Figures 5.a. through 5.i) were all defined (Table 2) and mapped.

TABLE 1: ECOSYSTEM LAND CLASSIFICATION HIERARCHY FOR THE MACTUNG RLSA

Classification Level		Unit Name		Unit Code
1	**Ecozone**	Taiga Cordillera		TC
2	**Ecoregion**	Selwyn Mountains		SM
3	**Ecodistrict**	Selwyn-Yukon		YN
4	**Bioclimate**	Icefield		ICF
		Alpine		ALP
		Shrub Taiga		STA
		Wooded Taiga		WTA
5	**Landscape**	Upland	Unclassified	-Uu
			Terrace	-Ut
			Depressional	-Ud

TABLE 1: ECOSYSTEM LAND CLASSIFICATION HIERARCHY FOR THE MACTUNG RLSA				
Classification Level		**Unit Name**		**Unit Code**
		Lowland	Unclassified	-Lu
			Terrace	-Lt
			Riparian	-Lr
			Depressional	-Ld
			Braided	-Lb
6/7	**Vegetation/ Ecosystem**	Epilithic Lichen (Bare rock-crustose lichen)		EL
		Fescue-Sedge (*Festuca-Carex*)		FC
		Fescue –Willow (*Festuca-Salix*)		FS
		Heath-Lichen (*Cassiope-Cladina*)		CC
		Birch-Lichen (*Betula-Cladina*)		BC
		Birch-Moss (*Betula*-Moss)		BM
		Sedge –Bluebell (*Carex-Mertensia*)		CM
		Willow –Bluebell (*Salix-Mertensia*)		SM
		Willow (low/tall)-Slope (Salix-Slope)		WS
		Fir-Lichen (*Abies-Cladina*)		AC
		Fir-Moss (*Abies*-Moss)		AM
		Spruce-Moss (*Picea*-Moss)		PM
		Sedge –Sphagnum (*Carex- Sphagnum*)		CS
		Willow – Sedge (*Salix-Carex*)		SC
		Wetland		WD

3.2.2 Bioclimate Zones

There are four Bioclimate Zones in the Selwyn Mountains Ecoregion, but only three are present within the RLSA. Icefields (ICF) do not occur within the RLSA, although this zone does occur immediately to the north at Keele Peak. All four Bioclimate Zones for the Taiga Cordillera are described here to help distinguish the characteristics of each Bioclimate Zone (Francis and Steffen 2003).

Icefield **(ICF):** Highest elevations of mountain regions with extensive icefields. Most areas are covered by ice and bare rock; vegetated areas are limited. Due to regional precipitation regimes, the icefield bio-climate zone in Yukon is limited to the Kluane Region of southwest Yukon and isolated areas within major mountain ranges (Mackenzie and Selwyn Mountains).

Alpine **(ALP):** High elevation mountain regions vegetated by dwarf shrubs, herb/cryptograms, and low-growing and scattered krummholtz trees are the dominant vegetation condition. At upper elevation ranges, large areas may include bare rock, colluvium or ice/snow.

Shrub Taiga **(STA):** High elevation Shrub Taiga replaces the term "Subalpine" in the northern Yukon. These areas are dominated by tall or low shrub vegetation or may have sparse or sporadic tree cover. These areas are generally influenced by arctic weather systems (i.e., the east side of the Richardson Mountains).

Wooded Taiga **(WTA):** Primarily coniferous forested areas with an open canopy. Wooded Taiga generally occurs in valley bottoms and lower slopes of mountain valleys or on plateaus and plains. The distribution and depth of permafrost is a major influence of vegetation distribution and dynamics. In steep terrain, slope processes help determine forested areas.

3.2.3 Landscape Units

Landscape units (Level 5) of the Yukon framework are used to incorporate terrain/ landscape features into the mapping and classification framework. The first major division at the landscape level of the framework is defining Upland and Lowland areas. Upland is defined as *"any landform that is not influenced by the fluvial processes…"* (Francis and Steffen 2003) and includes depressional (d), terraced (t), and unclassified subtypes (u). Lowland is defined as *"any major lowland landform that is or has been influenced by active fluvial processes…"* (Francis and Steffen 2003) and includes braided (b), depressional (d), riparian (r), terraced (t), and unclassified subtypes (u). Landscape units were mapped, but are not presented in this report. Detailed landscape, terrain, and soil mapping was completed and will be included in additional reporting.

3.2.4 Vegetation and Ecosystem Units

Vegetation (Level 6) and ecosystem units (Level 7) are the most detailed levels of classification according to the Francis and Steffen (2003). For the purposes of this report, only ecosystem units will be referred to and will encompass map units and vegetation units interchangeably. Ecosystem units are more detailed than vegetation units and incorporate details of stand composition, aspect, and soil drainage. Data on ecosystem units were collected for the Mactung RLSA and the Aerodrome expansion area with units mapped and presented in Figure 3. A summary of the current ecosystem unit classification is presented in Table 1, with full descriptions presented below (Table 2).

TABLE 2: DESCRIPTION OF ECOSYSTEM UNITS WITHIN THE RLSA AND AERODROME

Ecosystem Unit	Map Code	Description
Alpine		
Epilithic Lichen	EL	These areas are mainly exposed bare rock, talus or boulderfields covered with crustose lichen communities that occur above 1,650 m a.s.l. At lower elevations, dwarf shrub species and graminoid species may be observed sporadically.
Fescue-Sedge	FC	These areas are dry alpine meadows observed in the alpine between 1,870 m a.s.l. and 1,515 m a.s.l. in Yukon. The vegetation unit is dominated by *Festuca altaica* and *Cladina* species, although, *Carex* and *Poa* species may occur in high abundance on moister soils. These sites are generally on exposed, well drained soils, convex micro-topography and/or warm aspects.
Fescue –Willow	FS	These areas are moist alpine meadows observed in the alpine between 1,780 and 1,590 m a.s.l. in Yukon. The vegetation unit is dominated by fescue (*Festuca altaica*) and moss species, although, sedge (*Carex*), hairgrass (*Deschampsia*), and rush (*Luzula*) species may occur in high abundance. These sites are characterized by the occurrence of dwarf shrub species such as *Salix arctica, Salix reticulata, and Salix barrattianna.* Fescue-Salix vegetation units are generally less exposed than Fescue-Sedge and occur on well drained soils, concave micro-topography and cool aspects.
Heath-Lichen	CC	These areas are dwarf shrub communities observed in the alpine of the Yukon. The vegetation unit is dominated by dwarf shrub species mountain heather (*Cassiope tetragona, Phyllodoce* species), crowberry (*Empetrum nigrum*), Lingonberry (*Vaccinium vitis idea*), and lichen species. Few plants grow taller than 20 cm high. These sites are generally on exposed and well drained soils (Photo 3).
Shrub Taiga		
Birch-Lichen	BC	These areas were observed in the Shrub Taiga of the Yukon between 1,530 m a.s.l. and 1,350 m a.s.l. and in the Wooded Taiga mainly on upland terraces in the Yukon between 1,406 and 1,175 m a.s.l. The vegetation unit is dominated by scrub birch (Betula nana) and lichen

TABLE 2: DESCRIPTION OF ECOSYSTEM UNITS WITHIN THE RLSA AND AERODROME		
Ecosystem Unit	**Map Code**	**Description**
		species (*Cladina, Cetraria, and Cladonia*). On upland terraces in the Yukon *Ledum decumbens* occurred with high abundance. These sites are generally on exposed well drained soils, convex micro-topography and/or warm aspects (Photo 4).
Birch-Moss	BM	These areas were observed in the Shrub Taiga of the Yukon between 1,420 m a.s.l. and 1,385 m a.s.l. The vegetation unit is dominated by scrub birch (*Betula nana*) and a moss understory (*Hylocomnium splendens* and *Polytrichum commune*). Birch-Moss is generally favoured on sheltered, moist, well drained soils, concave micro-topography and/or cool aspects.
Sedge–Bluebell	CM	These areas were observed in the lower Alpine and Shrub Taiga of the Yukon between 1,620 m a.s.l. and 1,370 m a.s.l. The vegetation unit is dominated by *Carex podocarpa* and a diverse mix of forbs including *Mertensia paniculata, Senecio triangularis, Artemesia arctica, and Polemonium acutiflorum*. On valley sub-mesic valley benches the ecosystems may occur with *Festuca altaica* as a co-dominant. Sedge-bluebell sites are generally gentle sloping, with moderately drained submesic to mesic soils, in sheltered valleys. This unit is similar to Willow-Mertensia and may occur at higher elevations with submesic soils. These units are may indicate seepage areas.
Willow –Bluebell	SM	The Willow-Bluebell unit occurs adjacent to streams and seepage areas. These areas were observed in the lower Alpine and Shrub Taiga of the Yukon between 1,525 m a.s.l. and 1,455 m a.s.l. and in the Wooded Taiga at 1,400 m a.s.l.. The dense canopy is dominated by medium to tall willow species *Salix planifolia, Salix glauca, Salix alaxensis, and Salix barrattianna*. The understory is a diverse mix of forbs including *Mertensia paniculata, Senecio triangularis, Artemesia arctica, and Polemonium acutiflorum*. These sites are generally gentle sloping, moderately drained, with moist to wet soils, in sheltered valleys.
Willow (med/tall)-Slope	WS	These areas were observed on steep slopes such as avalanche chutes in the Wooded Taiga of the Yukon between 1,450 m a.s.l. and 1,250 m a.s.l. The dense canopy is dominated by medium to tall willow species *Salix planifolia, Salix alaxensis, and Salix glauca*. An overstory of alpine fir was observed along the Road at lower elevations. The herbaceous (c) layer is characterized by sedge species (*Carex aquatilis and C. podocarpa*), *Salix reticulata*, and/ or a mix of forbs. These sites are steep slopes, with well drained, with submesic to xeric soils.
Wooded Taiga		
Fir-Lichen	AC	These areas were observed in the Wooded Taiga of the Yukon between 1,445 m a.s.l. and 1,200 m a.s.l. The vegetation unit is dominated by alpine fir (*Abies lasiocarpa*) and lichen species. The canopy is usually open and may a have Scrub birch B2 layer. These sites are generally on exposed, well drained soils, convex micro-topography and/or warm aspects.

TABLE 2: DESCRIPTION OF ECOSYSTEM UNITS WITHIN THE RLSA AND AERODROME		
Ecosystem Unit	**Map Code**	**Description**
Fir-Moss	AM	These areas were observed in the Wooded Taiga of the Yukon between 1,450 m a.s.l. and 1,200 m a.s.l. The vegetation unit is dominated by alpine fir (*Abies lasiocarpa*) and a moss understory (*Hylocomnium splendens and Polytrichum commune*). Percent canopy cover is higher than in the Fir-Lichen vegetation unit. Fir-Moss is generally favoured on sheltered, moist, well drained soils, concave micro-topography and/or cool aspects. This community also occurs adjacent to seeps streams (Photo 5).
Spruce-Moss	PM	These areas were observed in the Wooded Taiga of the Yukon below 1,400 m a.s.l. The vegetation unit is dominated by white spruce (*Picea glauca*) and a moss understory (*Hylocomnium splendens and Polytrichum commune*). White spruce is usually a co-dominant species with subalpine fir along the Road. Black spruce (*Picea mariana*) may also occur in valley bottoms and intermixed with white spruce on lower slopes. Spruce-moss is replaced by fir-moss/ fir-lichen at elevations above approximately 1400 m a.s.l.
Wetland and Riparian		
Sedge –Sphagnum	CS	This area was observed in low-lying depressions along the access road and generally occurs as a continuous "fen" wetland system. The vegetation unit is dominated by *Carex aquatilis* with a minor component of *Carex podocarpa* and *Potentilla palustris*. These sites are generally depressional to flat areas with poorly drained, subhygric soils in valleys bottoms. The groundcover was dominated by *Sphagnum* species such *Sphagnum fuscum* and moss species including glow moss (*Aulacomnium palustre*) and golden fuzzy moss (*Tomenthypnum nitens*) (Photo 6).
Willow – Sedge	SC	The Willow-Sedge unit occurs adjacent to streams and rivers in floodplains. These areas were observed in the Shrub Taiga between 1,500 m a.s.l. and 1,450 m a.s.l. and the Wooded Taiga between 1,300 and 1,150 m a.s.l. The dense canopy is dominated by medium to tall willow *species Salix alaxensis, Salix planifolia, and Salix glauca.* The understory is characterized by sedge species (*Carex aquatilis and C. podocarpa*), *Equisetum* species, and moss species. These sites are generally flat, moderately to well drained, with submesic to mesic soils (Photo 7).
Wetland	WD	In the southeast LSA along the North Canol Road graminoid and shrubby fens were observed in the Wooded Taiga along the Macmillan River at elevations of 1,300 m a.s.l.. These fens were observed to be dominated by willow and *Sphagnum* species. Other wetland areas include low-lying depressions along the Hess River where poor drained soils support shrubby fens and intermixed with black spruce
Other		
Pond	PD	Small body of water greater than 2 m deep and less than 50 ha in area.
No Data	ND	No data includes areas which were unmappable due to cloud cover and shadow effects.

3.2.5 Structural Stages

Structural stages describe the existing dominant stand appearance or physiognomy for an ecosystem unit. This parameter emphasises structural habitat characteristics and can be used to help describe the seral variation within an ecosystem type. Structural stage classes as defined by RIC (1998a) were adopted for this project (Table 3).

TABLE 3: DESCRIPTION OF STRUCTURAL STAGES WITHIN THE RLSA AND AERODROME

Code	Structural Stage	Definition
Sparse / Bryoid		Initial stages of primary and secondary succession; bryophytes and lichens often dominant; time since disturbance may be prolonged where there is little or no soil development (bedrock, boulderfields, etc.).
1a	Sparse	Less than 10% vegetation cover.
1b	Bryoid	Bryophyte and lichen-dominated community (>50% of total vegetative cover).
Herb		Early successional stage or herb communities maintained by environmental conditions or disturbance; dominated by herbs; some invading or residual shrubs and trees may be present; many non-wooded communities are perpetually maintained in this stage.
2a	Forb-dominated	Includes non-graminoid herbs and ferns.
2b	Graminoid-dominated	Includes grasses, sedges, reeds, and rushes.
2c	Aquatic	Floating or submerged; does not include sedges growing in marshes with standing water (classed as 2b).
2d	Dwarf shrub-dominated	Dominated by dwarf woody species such as crowberry, mountain cranberry, twinflower, cloudberry, etc.
Shrub / Woodland		Early successional stage or shrub communities maintained by environmental conditions or disturbance; dominated by shrubby vegetation; seedlings and advance regeneration may be abundant.
3a	Low shrub	Dominated by shrubby vegetation < 2 m tall; seedlings and advance regeneration may be abundant; may be perpetuated indefinitely by environmental conditions or disturbance.
3b	Tall shrub / Woodland	Dominated by shrubs or trees that are 2-10 m tall; often the near-climax structural stage for woodlands in the LSA.
4	Pole / Sapling	Trees > 10 m tall; typically densely stocked, have overtopped shrub and herb layers; self-thinning and vertical structure not yet evident in the canopy. (This stage was not mapped in the study area but is included here for completeness.)
5	Young Forest	Trees > 10 m tall; self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers (dominant, main canopy, and overtopped).
6	Mature Forest	Trees > 10 m tall; trees established after the last disturbance has matured; understories become well developed as the canopy opens up; time since disturbance generally 125-250 years.
7	Old Forest	Trees > 10 m tall; old, structurally complex stands comprised mainly of shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition and patchy understories typical; time since disturbance generally > 250 years. (This stage was not mapped in the LSA, but is included here for completeness.)

3.3 SUMMARY OF VEGETATION ENVIRONMENTAL BASELINE STUDIES MACTUNG

3.3.1 2006 Environmental Baseline Studies-Vegetation and Ecosystem Land Classification

The following is a summary of the Vegetation and Ecosystem Land Classification conducted for the 2006 Environmental Baseline Studies for the Mactung Project (EBA 2007a).

- The Mactung Project Local Study Area is located in the Selwyn Mountain Range where the Canol Road crosses the Yukon Northwest Territories boundary. Mapping of bioclimate zones for the LSA show that the Alpine represents 65.5%, the Shrub Taiga represents 13.6% and the Wooded Taiga represents 21.0% of the LSA.
- A total of 51 ground inspection forms (GIF) plots and 26 visual plots were completed for a total of 77 sample plots. The 77 plots sampled within 324 polygons (including 24 no data polygons) represent a sampling intensity of 23.8%. Average polygon size was determined to be 69.3 hectares.
- Thirteen distinct vegetation units/ map units and ten complex polygon associations were mapped at a scale of 1:20,000 based on sampling performed by EBA in 2006. The map units with the greatest percent cover of the LSA are: epilithic lichen (41.7%), heath-lichen (13.7%), fir-lichen: fir-moss (6.7%), birch-lichen (5.8%), fescue-willow (3.4%), and fescue-sedge (3.3%).
- A total of 123 different plants were recorded within the 51 ground inspection plots. Of these, 29 plants were identified only to genus and are assumed to be different than those identified to species.
- Initial reconnaissance indicates there is a potential for 26 rare plant species to occur in the LSA. Two rare species (*Rubus arcticus* and *Carex albo-nigra*) were observed in the LSA, but not in areas that historically have been considered for the proposed footprint of the mine. A list of rare plant communities does not currently exist for the Mactung Project LSA.
- There are no national parks, territorial parks, habitat protection or wildlife management zones in the area of the Mactung Project LSA.
- Various wetlands and riparian areas have been identified in the LSA. Two areas may be potentially affected by the proposed Project footprint area of the mine, and include the wetlands in the Upper Dale Valley, NWT and a small marsh and riparian area in the upper valley in the Yukon Territory.

3.3.2 2007 Environmental Baseline Studies Rare Plant Survey and Ecosystem Land Classification Update

The following is a summary of the Vegetation and Ecosystem Land Classification conducted for the 2007 Environmental Baseline Studies for the Mactung Project (EBA 2007b).

- EBA conducted a rare plant survey (RPS), trace element concentration (TEC) sampling, and ecosystem land classification (ELC) survey from August 13 to August 15, 2007. The surveys were conducted in the area of the proposed footprint for the MacTung Project in both Yukon and Northwest Territories. Vegetation samples for (TEC) analysis in plant tissue was conducted within and downgradient of the Mactung Project footprint from August 13 to 16, 2007.
- There are no national parks, territorial parks, habitat protection or wildlife management zones in the area of the Mactung Project LSA.
- A list of rare plant communities does not currently exist for the Mactung LSA. In general, wetlands and arctic/alpine communities are considered sensitive communities.
- A three day RPS was conducted from August 13 to August 15, 2007 in the proposed disturbance footprint for the Mactung Project. One day of effort was conducted in the NWT and two days of effort were conducted in the Yukon. A total of 31 plants species were identified as having a potential to occur within the LSA, 13 of these in the Yukon and 18 in the NWT. In 2007, no rare species were observed in areas proposed for development.
- An assessment of TEC in plant tissue was performed within the LSA. A total of 14 vegetation samples were collected with two samples collected at each of seven sample locations. Baseline concentrations or standards are currently not available in the Yukon or NWT for metal concentrations in plant tissue. Determination of mean and standard error indicated that sampling stations MTEC00 (NWT downstream) and MTEC01 (NWT footprint) had relatively high values compared to other sampling stations for most metals in horsetail, while sampling station MTEC01 had relatively high values for most metals in willow composite samples.
- A total of 15 distinct ecosystem units/ map units and 12 complex polygon associations were mapped based on sampling performed by EBA in 2006. One new ecosystem unit, spruce-moss, was observed in 2007 at lower elevations (below 1,200 m a.s.l.) in the Hess River basin. Three new complex associations were mapped including: birch-moss: heath-lichen, birch lichen: spruce-moss, and willow-sedge: wetland. Birch- lichen: fir-moss was replaced in 2007 with birch-lichen: spruce-moss. The map units with the greatest percent cover within the LSA are: epilithic lichen (41.7%), heath-lichen (13.7%), birch-lichen (6.0%), fescue-willow (3.4%), fir-lichen: fir-moss (4.0%), and spruce-moss (3.1%).

- In order to perform in-field quality control of the ELC map, EBA conducted 36 visual inspections to determine if mapping conducted by remote sensing techniques were comparable with field data. The overall correlation between the sites inspected in 2007 and ELC mapping from 2006 was 61%. Correlation between field inspections and map units was 72% in the NWT and 50% in the Yukon. During the field program it was observed that in the Yukon, white spruce replaced subalpine fir below approximately 1,200 m a.s.l. This accounted for five of the nine errors in mapping in the Yukon. The map of ecosystem units in the LSA has been revised and updated to include all new observations. EBA is confident that the updated map accurately reflects the distribution of ecosystem units in the Mactung LSA.

4.0 METHODS

Mr. Jamie Slogan (M.Sc., R.P.Bio.) and Mr. David McQuinn (B.Sc., RPF) conducted an ecosystem land classification (ELC) survey, a rare plant reconnaissance, and trace element concentration sampling from July 3 to July 8, 2008. The surveys were conducted in the area of the proposed route for the Road plus a 1,500 metre buffer on each side of the route. Vegetation samples for trace element concentrations (TEC) analysis in plant tissue were collected within the Mactung Project footprint from July 3 to July 8, 2008. Ecosystem land classification (ELC) was also performed for the Macmillan Pass Aerodrome expansion area (Photo 2)

4.1 ECOSYSTEM LAND CLASSIFICATION AND VEGETATION INVENTORY

The general process for ELC consists of project planning and initial classification, field sampling, imagery preparation, mapping, and quality control. The methods and approaches for each phase are discussed below.

4.1.1 Preliminary Classification and Sampling Plan

Project planning and initial review included defining the objectives and the purpose of the work, conducting a detailed literature review of the prior vegetation and ecosystem classification for the RLSA (AMAX 1982; EBA 2007a; EBA 2007b; Kershaw and Kershaw 1983), and determining a sampling plan and survey intensity. The RLSA was estimated to be 13,834 ha with approximately 17 plant communities present (EBA 2007a).

The size of the RLSA and the Project objectives suggests a survey intensity level (SIL) of 4 (RIC 1998) in the buffer and an SIL 2 survey within the Road footprint. As the Road is estimated to be less than 20 m wide and the final route has not been determined or surveyed, an SIL 4 was conducted throughout the RLSA. A SIL 4 involves the inspection of 15% to 25% of mapped polygons (1:20,000 scale) at a ratio of 5 full plots, 20 ground inspections (GIF) and 75 visual inspections. A review of reports and maps for the area indicated that polygon size would be medium to large, therefore, EBA estimated that there would be approximately 230 polygons in the buffer with an average size of 60 ha. The typical range of polygon sizes for the selected scale of mapping is 60-80 ha. Based on

this information, EBA estimated that 59 plots would be required at a sampling intensity of 25% in the buffer. This extrapolates into 3 full plots, 12 GIF, and 44 visual plots for a total of 59 sample plots.

4.1.2 Field Sampling

EBA conducted field vegetation sampling between July 3 and 8, 2008. Sampling of vegetation was completed using full forms (FS 882) and ground inspection forms (GIF's) (FS212-2), produced by the RIC. Visual inspections followed the methods outlined in the *Field Manual for Describing Terrestrial Ecosystems* (BC MELP and BC MOF 1998) using site description forms from the Yukon Ministry of Environment. Mapping of vegetation adhered to the *Standard for Terrestrial Ecosystem Mapping in British Columbia* (RIC 1998). All plot locations were recorded in UTM using a Garmin 60Cx Global Positioning System with accuracy of between 5-8 m.

In each full plot, EBA collected the following site information: plot number, date, UTM coordinate, elevation, exposure, aspect, slope, macro- and meso-site position, relative soil moisture, drainage, relative nutrient regime, ecosystem unit name, and surface substrate (bedrock, rocks, mineral soil, organic matter and water). Notes describing the plot-in-context and variability within the polygon were also recorded. Photographs were taken at each plot.

Ground inspection plots involved recording UTM coordinates, vegetation data, and surface substrate. Visual plots involved recording brief point or area characteristics made from the ground, and were used to note the basic ecosystem unit, vegetation, or other key features. The primary function of visual plots is to aid in the delineation of polygon units and to confirm polygon boundaries during the air photo interpretation and mapping phases. Visual plots were recorded during the vegetation survey as well as during the breeding bird surveys (EBA 2008).

Guidelines and nomenclature for ELC are presented in Section 3.2. Initial assessment and ecosystem unit nomenclature are based on plant communities identified by Zoladeski et al. (1996). Nomenclature for plant species are based upon Cody (1996) and Cody et al. (1998; 2000; 2001).

4.1.3 Mapping and Imagery

Mapping of vegetation adhered to the *Standard for Terrestrial Ecosystem Mapping in British Columbia* (RIC 1998). Guidelines and nomenclature for ELC are from EBA (2007a), which was further based upon Kershaw and Kershaw (1983) and Zoladeski et al. (1996). Ecosystem units were mapped at a scale of 1:20,000. Both simple (e.g., containing a single ecosystem unit) and complex polygons were identified. Complex polygons were delineated when distinct ecosystem units were not mappable with confidence at the 1:20,000 scale. Complex polygons were limited to two map units and were assumed to occur as 50% Map Unit 1: 50% Map Unit 2.

The imagery used for ELC mapping included two ortho-rectified Quickbird satellite images which covered the majority of the RLSA. The imagery was acquired August 21, 2006 and September 29, 2007. The Quickbird satellite collects panchromatic imagery at 60-70 cm resolution and multi-spectral imagery at 2.4-2.8 m resolution. Additional digital aerial photography was utilized to fill minor gaps in the satellite image coverage. The aerial photography consisted of two photographs (A122343-241 and 242) from the Energy, Mines, and Resources Library in Whitehorse. Aerial photography used to supplement gaps in coverage in the Aerodrome buffer and footprint consisted of one photograph (A24961-40, also from the Energy, Mines and Resources Library in Whitehorse.

A quality assurance/quality control (QA/QC) review of the mapping was performed by comparing all ground data locations with mapped polygons. Each polygon was also checked after mapping to ensure all attributes met the conditions of the classification hierarchy. In order to minimize data entry errors, the attribute table was also audited for all non-values. Final ELC documentation included tabulated ecosystem summaries, analysis of area extent of ecosystem units within the LSA, and an ecosystem unit map of the LSA.

4.2 RARE PLANT RECONNAISANCE

A reconnaissance for rare plants was conducted in limited areas of the RLSA (Figure 6). This work was completed between July 3 and July 8, 2008 in conjunction with the ELC field sampling. A rare plant reconnaissance was also conducted in areas where vegetation plots were sampled within the area of the proposed footprint during the 2006 and 2007 season. Approximately 15 minutes of effort were taken at the end of sampling each plot to look specifically for rare plant species, and a two day targeted rare plant survey was also conducted from August 13 to August 15, 2007 in the proposed disturbance footprint for the Mine which overlaps with the RLSA. Field surveys were conducted by walking in a meandering fashion through the areas of interest. More informal surveys were also conducted while traversing between sampling locations. Data collected in July 2006 and 2007 was used to supplement the 2008 rare plant reconnaissance.

Prior to conducting the rare plant reconnaissance, several sources were reviewed to compile a list of rare plant species for the Yukon that could potentially be present in the RLSA including Douglas et al. (1981), Kershaw and Kershaw (1983) and communication with NatureServe Yukon.

It is important to note that the specific development areas had not been finalized at the time of this study; however plots were aligned with potential development areas as they were known at the time. The purpose of this reconnaissance was to supplement future rare plant surveys and determine potential for rare plants in the RLSA

4.3 TRACE ELEMENT CONCENTRATIONS IN PLANT TISSUES

A baseline assessment of trace element concentrations (TEC) in plant tissue was performed within the RLSA. A total of six vegetation samples were collected in 2008 with two samples collected at each of three sample locations (Photo 8). Three sample locations were

established in the Yukon (MTEC 10, 11, 12) and were combined with samples previously collected for the Mine (MTEC 03, 04, 05, and 06), for a total of seven in the entire RLSA. The purpose of the assessment was to collect information on metal concentrations in plant tissue in areas potentially affected by future activity from the proposed road and in undisturbed areas downgradient from the proposed Mine. Sample locations were established primarily in riparian areas. Locations of samples are shown in Figure 7 with species and rationale for sample locations explained in Table 4.

TABLE 4. SUMMARY OF TRACE ELEMENT CONCENTRATION SAMPLING PROGRAM FOR MACTUNG RLSA

Sample Location	Species Sampled	Date Collected	Rationale for Location
MTEC 10	Horsetail Willow Composite	July 8, 2008	Adjacent to proposed road and upstream from proposed crossing and confluence
MTEC 11	Horsetail Willow Composite	July 8, 2008	Downstream from current and proposed bridge crossing of the Macmillan River.
MTEC 12	Horsetail Willow Composite	July 8, 2008	Near old camp site-Adjacent to proposed road and downstream from historic and proposed crossing point of stream
MTEC 03	Horsetail Sedge Composite	August 15, 2007	In proposed borrow pit.
MTEC 04	Horsetail Sedge Composite	August 16, 2007	In proposed tailings area.
MTEC 05	Horsetail Willow Composite	August 16, 2007	Immediately downstream of proposed tailings area-Yukon.
MTEC 06	Horsetail Willow Composite	August 16, 2007	Downstream of confluence of tributaries draining the Project area.

Plant species chosen for the TEC assessment include sedge composites (*Carex* species) at two locations, willow composites (*Salix* species) at five locations, and horsetail (*Equisetum arvense*) at all seven locations. Sedges and willows are major components of the diet of ungulates including caribou and moose (BC MELP 2000) and horsetails are believed to accumulate metals (Pojar and MacKinnon 1994). All TEC samples were collected at ELC sample locations so that a general plant species list and soil characteristics from each site were recorded. Current year's foliage was collected from above-ground tissues with a focus on newest growth. Some stem tissue was also included in willow samples. Vegetation samples were collected into paper bags for drying, and then shipped to Cantest Ltd. in Burnaby, BC for analysis. All metals, except mercury, were analysed using Inductively Coupled Argon Plasma Spectroscopy (ICP) or ICP Mass Spectroscopy (ICP-MS). Mercury was analyzed using Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry.

5.0 RESULTS

5.1 ELC FIELD SAMPLING

A total of 62 vegetation plots were sampled during the 2008 field season, resulting in a grand total of 109 plots for the RLSA with the inclusion of data collected in 2006 and 2007. Altogether, 2 full plots, 44 GIF plots, and 63 visual plots were sampled overall. The 109 vegetation plots sampled within the 13,834 ha RLSA represents a sampling intensity of one plot per 127 ha.

A total of 257 polygons were mapped. The average polygon size was determined to be 54 ha. In total, 57 different polygons were inspected with some the larger polygons inspected multiple times. The 51 polygons inspected represent a total a sampling intensity of 28% which slightly exceeds the goal of between 15 and 25% inspection rate based on the RIC (1998).

5.2 ELC MAPPING

5.2.1 Bioclimate Zones

There are four bioclimate zones present in the Selwyn Mountain Ecoregion, but there are only three present in the RLSA. Icefield does not occur within the Road LSA, but is present near the northern portion of the access road at Keele Peak (2,970 m a.s.l.). The distribution of Bioclimate Zones within the RLSA is shown in Figure 4 and Table 5. The Wooded Taiga (WTA) makes up the greatest area comprising 60.4% of the RLSA, followed by the Alpine (ALP) with 26.6%, and the Shrub Taiga (STA) with 13%. These values reflect the decision to place the road in the lower valleys on birch-lichen terraces and though spruce and alpine fir forests. The Alpine generally only occurs at the end of the Road to the Mine. The Aerodrome occurs entirely within the Wooded Taiga.

TABLE 5. SUMMARY OF BIOCLIMATE ZONES WITHIN THE MACTUNG ROAD RLSA

Zone	Area(ha)	Percent of Total Area
ALP	3,676.1	26.6
STA	1,801.3	13.0
WTA	8,356.1	60.4
Total	**13,833.6**	**100**

5.2.2 Ecosystem Units

Ecosystem units are the most detailed level of classification according to the YCEMF (2003). A description of the ecosystem units is presented in Table 2. Complex polygons are not described in Table 2 as they are formed as a result of small-scale changes in microtopography, aspect, soil conditions, and slope which create a patchwork of the ecosystem units currently described. A summary of the results obtained from mapping ecosystem units at a 1:20,000 scale are presented in Table 6 and Figure 5a-5i.

A total of 16 distinct ecosystem units/ map units and 21 complex polygon associations were mapped based on sampling performed by EBA in 2006 to 2008 (excluding water and no data polygons). The map units with the greatest percent cover within the RLSA are: epilithic lichen (17.3%), heath-lichen (6.7%) and complexes such as fir-moss: spruce moss (12.5%) and fir-moss: willow slope (10.1%). Wetland and riparian areas totalled approximately 7.5% of the RLSA or 1,036 ha, with the willow-sedge (5.6%), sedge-*Sphagnum* (0.6), and willow-bluebell (0.6%) units representing the most area.

TABLE 6: SUMMARY OF ECOSYSTEM UNITS WITHIN THE MACTUNG RLSA

Map Unit	Ecosystem Unit	Area (Ha)	Percent Cover
Alpine			
EL	Epilithic Lichen	2397.8	17.3
CC	Heath-Lichen	925.4	6.7
FC	Fescue-Sedge	183.1	1.3
FS	Fescue-Willow	123.9	0.9
CC:FC	Heath-Lichen: Fescue-Sedge	210.1	1.5
Shrub Taiga			
BC	Birch-Lichen	664.3	4.8
BM	Birch-Moss	90.0	0.7
CM	Sedge-Bluebell	26.8	0.2
WS	Willow-Slope	341.7	2.5
BC:CC	Birch-Lichen: Heath-Lichen	318.5	2.3
WS:FC	Willow-Slope: Fescue-Sedge	295.8	2.1
WS:FS	Willow-Slope: Fescue-Willow	118.5	0.9
BC:FC	Birch-Lichen: Fescue-Sedge	38.6	0.3
BC:BM	Birch-Lichen: Birch-Moss	14.2	0.1
Wooded Taiga			
PM	Spruce Moss	703.8	5.1
AC	Fir-Lichen	556.5	4.0
AM	Fir-Moss	130.6	0.9
AM:PM	Fir-Moss: Spruce-Moss	1726.5	12.5
AM:WS	Fir-Moss: Willow Slope	1396.8	10.1
AC:BC	Fir-Lichen: Birch-Lichen	804.2	5.8
AM:BM	Fir-Moss: Birch-Moss	656.6	4.7
AC:AM	Fir-Lichen: Fir-Moss	292.2	2.1
PM:BC	Spruce Moss: Birch-Lichen	253.8	1.8
PM:SC	Spruce Moss: Willow-Sedge	154.3	1.1
AM:BC	Fir-Moss: Birch-Lichen	143.8	1.0

TABLE 6: SUMMARY OF ECOSYSTEM UNITS WITHIN THE MACTUNG RLSA			
Map Unit	**Ecosystem Unit**	**Area (Ha)**	**Percent Cover**
PM:BM	Spruce Moss: Birch-Moss	74.0	0.5
Wetland and Riparian Areas			
SC	Willow-Sedge	774.5	5.6
CS	Sedge-Sphagnum	81.5	0.6
SM	Willow-Bluebell	67.9	0.5
WD	Marsh/Fen	1.9	<0.1
SC:BC	Willow-Sedge: Birch-Lichen	64.0	0.5
FS:CS	Fescue-Willow: Sedge-Sphagnum	14.3	0.1
SC:FC	Willow-Sedge: Fescue Sedge	12.4	0.1
SC:CS	Willow-Sedge: Carex-Sphagnum	9.9	0.1
BC:CS	Birch-Lichen: Sedge-Sphagnum	6.0	<0.1
SC:WD	Willow-Sedge: Marsh/Fen	3.6	<0.1
Other			
ND	No Data	149.51	1.1
OW	Open Water	4.2	<0.1
GB	Gravel Bar	1.4	<0.1
PD	Pond	1.1	<0.1

The Aerodrome expansion area consists of a 200 metre buffer around the entire proposed Aerodrome footprint. The area is highly disturbed with 15.5% having been previously cleared as runway and exposed soil (Table 7). The remainder of the area consists mainly of the riparian willow-sedge unit (31.6%), the wetland sedge-*Sphagnum* unit (20.0%), and the upland unit birch-lichen (17.6%).

TABLE 7: SUMMARY OF ECOSYSTEM UNITS WITHIN THE AERODROME EXPANSION STUDY AREA			
Airstrip			
Map Unit	**Ecosystem Unit**	**Area (Ha)**	**Percent of Aerodrome Expansion Area**
SC	Willow-Sedge	23.4	31.6
CS	Sedge-Sphagnum	14.8	20.0
BC	Birch-Lichen	13.0	17.6
ES	Exposed soil	9.1	12.3
PM	Spruce-Moss	7.5	10.1
RI	River	3.9	5.3
AP	Airstrip	2.4	3.2

5.2.2.1 Structural Stage

Distribution of structural stages within the RLSA is provided in Table 8 and Figure 8. The most abundant structural stage is mature forest (30.2%) associated with the Road and low shrub (29.5%) observed in subalpine and riparian areas. Dwarf shrub-dominated ecosystem units such as heath-lichen were also common in the RLSA (10.0%) There were no pole sapling structural stages observed, which are typically characteristic of forests 20-50 years old that are regenerating following a disturbance such as logging or fire. Old growth forest was also not observed in the RLSA. For this study, old growth forests were based loosely on fire return cycles, with trees greater than 250 years of age being representative of this structural stage (Wong *et al.* 2003).

TABLE 8: STRUCTURAL STAGES WITHIN THE MACTUNG RLSA

Structural Stage (code)	Total Area (ha)	Percent Total Area
Sparse Bryoid (1)	1.4	<0.1
Sparse (1a)	2,141.6	15.5
Bryoid (1b)	256.2	1.9
Forb-dominated (2a)	94.7	0.7
Graminoid-dominated (2b)	565.1	4.1
Dwarf shrub-dominated (2d)	1,386.2	10.0
Low Shrub (3a)	4,082.5	29.5
Tall Shrub (3b)	387.6	2.8
Pole Sapling (4)	0.0	0.0
Young Forest (5)	582.0	4.2
Mature Forest (6)	4,181.6	30.2
Old Growth Forest (7)	0.0	0.0
Other (1)	154.7	1.1
Total	**13,833.6**	**100.0**

The distribution of structural stages within the Aerodrome is provided in Table 9 and Figure 8. The most common structural stage is low shrub (49.2%), followed by exposed soil (classified as sparse bryoid [12.3%]), and mature forest (10.1%). The river and existing runway were classified as other/ not applicable (these features are generally not assigned a structural stage class according to RIC [1998]).

TABLE 9: STRUCTURAL STAGES WITHIN THE AERODROME EXPANSION AREA		
Structural Stage (code)	**Total Area (ha)**	**Percent Total Area**
Sparse Bryoid (1)	9.1	12.3
Sparse (1a)	0.0	0.0
Bryoid (1b)	0.0	0.0
Forb-dominated (2a)	0.0	0.0
Graminoid-dominated (2b)	14.8	20.0
Dwarf shrub-dominated (2d)	0.0	0.0
Low Shrub (3a)	36.4	49.2
Tall Shrub (3b)	0.0	0.0
Pole Sapling (4)	0.0	0.0
Young Forest (5)	0.0	0.0
Mature Forest (6)	7.5	10.1
Old Growth Forest (7)	0.0	0.0
Other/ Not applicable	6.3	8.5
Total	**74.0**	**100**

5.2.2.2 Plant Species

Species observed during the 2008 field season are listed in Appendix A with nomenclature according to Cody (1996). A summary of all vegetation data recorded is presented in Appendix B. One hundred twenty seven different plants were recorded within the 62 inspection plots. Twenty-six of these recorded plants were identified only to genus and are assumed to be different than those identified to species. These results are similar to the 2006 baseline program.

5.3 RARE PLANT RECONNAISANCE

A literature search for protected areas and rare, sensitive, and/or endangered plant communities was conducted for the Project area. There are no national parks, territorial parks, habitat protection or wildlife management zones in the area. A list of rare plant communities does not currently exist for the area encompassing the Mactung Project. In general, wetlands and arctic/alpine communities are considered sensitive communities. Wetlands and riparian areas have a higher potential for rare plants, high wildlife habitat value, are sensitive to potential contamination drainage, are very sensitive to disturbance, and may take a long time to reclaim. Alpine plant communities also have a higher potential to support rare plants, are very sensitive to disturbance, and may also take longer to recover from disturbances. Wetland and riparian areas in the Project area should be considered as sensitive plant communities.

EBA consulted the *Species at Risk Act* (SARA) database, *The Rare and Vascular Plants of the Yukon* (Douglas et al. 1981), and NatureServe Yukon in order to determine potential rare vascular plants at Mactung. A list of potential rare plant species with species observed is presented in Table 10. A total of 21 plants species were identified as having a potential to occur within the Project area.

TABLE 10: LIST OF POTENTIAL AND OBSERVED RARE PLANT SPECIES FOR THE MACTUNG RLSA AND AERODROME EXPANSION STUDY AREA

Yukon			
Species	**Habitat**	**Location[1]**	**Observed**
Angelica lucida	sub-alpine meadow	YT	
Arnica parryi	alpine, steep ravines, ledges	YT	
Carex albo nigra	dry alpine tundra	YT	
Carex arcta	woodland bogs, marshes	YT	
Draba ogilviensis	Montane/alpine meadows	YT	
Draba porsildii	Montane/alpine meadows/scree	YT	
Eritrichium slendons	arctic-alpine scree slopes ledges	YT	
Koeleria astiatica	Shale scree/dry tundra	YT	
Listera cordata	Coniferous forest	YT	✓
Phegopteris connectilis	alpine cliff ledges/rocky slopes	YT	
Phylodoce glanduliflora	alpine/sub-alpine slopes-moist	YT	
Poa porsildii	alpine/sub-alpine slopes-moist	YT	
Podisteva macounii	ridgetops/rock	YT	
Polystichum lonchitis	limestone cliffs, rocky/talus slopes	YT	
Ranunculus turneri	sub-alpine meadows	YT	
Rubus arcticus spp. acaulis	alpine and sub-alpine meadows	YT	✓
Rumex acetosa	Arctic-alpine moist meadows	YT	
Salix arctophila	wet/dry mossy tundra	YT	
Saxifraga aizoides	Moist calcareous. and gravel	YT	
Viola selkirkii	alpine tundra	YT	
Woodsia ilvensis	dry cliffs/talus slopes	YT	

Notes: [1] from Douglas *et. al.* 1981.

In 2006, one rare plant, dwarf nagoonberry (*Rubus arcticus* ssp. *acaulis*), was observed in the RLSA, but not in areas that have been considered for the proposed footprint of the Mine. In 2007, no rare species were observed in areas proposed for development. In 2008 one species, heart-leaved twayblade (*Listera cordata*), considered rare by Douglas *et al.* (1981), was observed in the area of the proposed Road. After further communication of the result with NatureServe Yukon (Bruce Bennett pers. comm.), it was determined that heart-leaved

twayblade is "…not particularly rare, just poorly reported" and is "considered secure in Yukon in the 2005 General Status report." Based on this information, heart-leaved twayblade is not considered as rare and therefore, there were no rare plants observed in the proposed footprint for the Mine or the Road Footprint. Although a survey of this type cannot confirm the absence of rare plants at the site, reasonable sampling effort was put forward to investigate areas with a high potential to support rare plants and areas where construction of the Mine may have a significant impact on rare plants.

5.4 TRACE ELEMENT CONCENTRATIONS IN PLANT TISSUES

A baseline assessment of trace element concentrations (TEC) in plant tissue was performed within the RLSA. A total of 14 vegetation samples were collected with two samples collected at each of seven sample locations (Figure 7; Photo 8). Results from TEC sampling are presented in Appendix C. Data was collected to establish baseline values for TEC in plants in and around the Project area. Baseline concentrations or standards are currently unavailable for metal concentrations in plants, however, results were compared to the within group sample mean and to the Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME) for parkland to give some comparison values.

Results of TEC analyses of vegetation samples collected in the Yukon were generally within one standard error of the mean and less than CCME soil standards (see table in Appendix F-3). The few exceptions to this include cadmium concentrations in horsetail at locations MTEC 10, 11, and 12; selenium concentrations in horsetail at locations MTEC 05 and 06; and zinc concentrations in all willow samples. In addition, arsenic was elevated compared to other sites, but just less than the CCME for arsenic in soil.

6.0 SUMMARY

The following is a summary of the ELC and vegetation baseline study proposed Mactung access road and Macmillan Aerodrome expansion, Yukon Territory in 2008.

- The Mactung RLSA lies within the Selwyn Mountain Ecoregion of the Taiga Cordillera Ecozone of Canada. Ecodistricts for the RLSA have not been formally defined. The Selwyn Mountain Ecoregion is characterized by high elevation mountain ranges that contain alpine glaciers such as those located on nearby Keele Peak (2,970 m a.s.l.). Elevations range from 745 m a.s.l. to 2,970 m a.s.l. The Selwyn Mountains give rise to the highest levels of annual precipitation (600-700 mm) in the Yukon outside the Coast Mountains (Smith et al. 2004). Mean annual temperatures for the region are -5°C to -8°C, ranging from an average of -20°C in January to 8°C in July. The region lies in the discontinuous permafrost zone; however, the area around the Mine is likely within the continuous permafrost zone due to its high elevation of between 1,300 m a.s.l. to 2,200 m a.s.l. Approximate land cover in the Selwyn Mountain Ecoregion is 65% boreal/subalpine coniferous forest, 20% alpine tundra, and 15% rockland (Smith et al. 2004).

- Historical records indicate no major fire disturbance in the study area of the Road or Aerodrome.
- A total of 62 vegetation plots were sampled during the 2008 field season for a total of 109 for the RLSA including data collected in 2006 and 2007. Overall, 2 full plots, 44 GIF plots, and 63 visual plots were sampled for a total of 109 vegetation plots within the RLSA. The 109 vegetation plots sampled within a 13,834 ha RLSA represents a sampling intensity of one plot per 127 ha. A total of 257 polygons were mapped. Average polygon size was determined to be 54 ha. Assuming each plot was in a separate polygon, 42% of the 257 mapped polygons were visited.
- There are four Bioclimate Zones present in the Selwyn Mountain Ecoregion, but there are only three present in the RLSA. The Wooded Taiga makes up the greatest area comprising 60.4% of the RLSA followed the Alpine with 26.6%, and the Shrub Taiga with 13%. These values reflect planning to propose the road in the lower valleys on the birch-lichen terraces and though the spruce and alpine-fir forests. The alpine generally only occurs at the end of the Road to the Mine. The Aerodrome occurs entirely within the Wooded Taiga.
- A total of 15 distinct ecosystem units/ map units and 21 complex polygon associations were mapped based on sampling performed by EBA in 2006 to 2008 (excluding water and no data polygons). The map units with the greatest percent cover within the RLSA are: epilithic lichen (17.3%), heath-lichen (6.7%) and complexes such as fir-moss: spruce moss (12.5%) and fir-moss: willow slope (10.1%). Wetland and riparian areas totalled approximately 7.5% of the RLSA or 1,036 ha, with the willow-sedge (5.6%), sedge-*Sphagnum* (0.6), and willow-bluebell (0.6%) units representing the most area.
- The Aerodrome expansion area consists of a 200 metre buffer around the entire proposed Aerodrome runway. The area is highly disturbed with 15.5% having been previously cleared as runway or exposed soil. The remainder of the area consists mainly of the riparian unit willow-sedge (31.6%), the wetland unit sedge-*Sphagnum* (20.0%) and the upland unit birch-lichen (17.6%).
- The most abundant structural stage is mature forest (30.2%) associated with the Road and low shrub (29.5%) observed in the subalpine and riparian areas. Dwarf shrub dominated ecosystem units such as heath-lichen were also common in the RLSA (10.0%) There were no pole sapling structural stages observed which are typically characteristic of regenerating forests 20-50 years old after a disturbance such as logging or fire. Old growth forest was also not observed in the RLSA.
- One hundred twenty seven different plants were recorded within the 62 inspection plots. Twenty-six of these recorded plants were identified only to genus and are assumed to be different than those identified to species. These results are similar to the 2006 baseline program.

- A total of 21 rare plant species were identified as having a potential to occur within the Mactung Project area. In 2006, one rare plant, dwarf nagoonberry (*Rubus arcticus* ssp. *acaulis*), was observed in the RLSA, but not in areas that historically have been considered for the proposed footprint of the mine. In 2007, no rare species were observed in areas proposed for development. In 2008 one species, heart-leaved twayblade (*Listera cordata*), considered rare by Douglas et al. (1981), was observed in the area of the proposed Road. NatureServe Yukon indicated this species is considered secure within the Yukon (Bruce Bennett pers. comm.). Based on this information, heart-leaved twayblade is not considered as rare and therefore, there were no rare plants observed in the proposed footprint for the Mine or the Road.
- Currently, no government national parks, territorial parks, habitat protection or wildlife management areas exist in the area of the Mactung Project area.
- A baseline assessment of trace element concentrations (TEC) in plant tissue was performed within the RLSA. A total of 14 vegetation samples were collected with two samples collected at each of seven sample locations. Results of TEC analyses of vegetation samples collected in the Yukon were generally within one standard error of the mean and less than CCME soil standards (see table in Appendix F-3). The few exceptions to this include cadmium concentrations in horsetail at locations MTEC 10, 11, and 12; selenium concentrations in horsetail at locations MTEC 05 and 06; and zinc concentrations in all willow samples. In addition, arsenic was elevated compared to other sites, but just less than the CCME for arsenic in soil.

7.0 CLOSURE

EBA is pleased to present the North American Tungsten Corporation Ltd. with this 2008 Environmental Baseline Study of Vegetation and Ecosystem Land Classification for the Proposed Access Road and Macmillan Aerodrome Expansion. The survey objective was to conduct ecological land classification, inventory vegetation and plant communities, provide baseline information on trace element concentrations in plant tissue, assess the potential for rare plants and identify any wetlands within the Local Study Area. We are pleased to provide information in support of regulatory activities associated with project approvals and production.

Respectfully submitted,
EBA Engineering Consultants Ltd.

Prepared by:

Jamie Slogan, M.Sc., R.P.Bio.
Vegetation Ecologist

Reviewed by:

Tania Perzoff, M.Sc., R.P.Bio.
Senior Biologist

REFERENCES

AMAX Northwest Mining Company Limited. 1982. Initial Environmental Evaluation of the MacTung Project Yukon and Northwest Territories.

BC Ministry of Environment, Land, and Parks (BC MELP). 2000. Moose in British Columbia-Ecology, Conservation and Management. Habitat Conservation Trust Fund. Pp. 6.

BC Ministry of Environment, Lands, and Parks and BC Ministry of Forests (BC MELP and BC MOF). 1998. Field Manual for Describing Terrestrial Ecosystems. Land Management Handbook 25. Province of BC.

Cody, W.J. 1996. Flora of the Yukon Territory. NRC Research Press, Ottawa, Ontario, Canada.

Cody, W.J., C.E. Kennedy, and B. Bennett. 1998. New records of vascular plants in the Yukon Territory. Canadian Field-Naturalist 112(2): 289-328.

Cody, W.J., C.E. Kennedy, and B. Bennett. 2000. New records of vascular plants in the Yukon Territory II. Canadian Field-Naturalist 114(3): 417-443.

Cody, W.J., C.E. Kennedy, and B. Bennett. 2001. New records of vascular plants in the Yukon Territory III. Canadian Field-Naturalist 115(2): 301-322.

Douglas, G.W., G.W. Argus, H.L. Dickson, and D.F. Brunton. 1981. The Rare Vascular Plants of the Yukon. SyllogeusNo. 28. National Museum of Natural Sciences, Ottawa.

EBA Engineering Consultants Ltd. 2003. Regional Ecosystem Land Classification & Mapping for the Yukon Southern Lakes & Pelly Mountain Ecoregions. Submitted to: Government of Yukon. November 2003. Whitehorse, YN.

EBA Engineering Consultants Ltd. 2007a. MacTung Project 2006 Environmental Baseline Studies: Vegetation and Ecosystem Land Classification. Prepared for North American Tungsten Corporation Ltd. April 2007. Vancouver, BC.

EBA Engineering Consultants Ltd. 2007b. MacTung Project 2007 Environmental Baseline Studies: Rare Plant Survey and Ecosystem Land Classification Update. Prepared for North American Tungsten Corporation Ltd. December 2007. Vancouver, BC.

Francis, S.R. and N. Steffen. 2003. Concepts, Rationale and Suggested Standards for the Yukon Ecosystem Classification and Mapping Framework-First Approximation. Draft, ver.1.3. Report prepared by Applied Ecosystem Management Ltd. fir DIAND Environment Directorate and DIAND Lands Branch, Whitehorse, Yukon. January, 2003.

Kershaw, G.P. and L.J. Kershaw. 1983. Geomorphology and Vegetation of the MacTung Study Area Yukon/N.W.T. Prepared for Amax Northwest Mining Company Limited. Department of Geography, University of Alberta, Edmonton, Alberta.

Larsen, C.P.S. 1997. Spatial and Temporal Variations in Boreal Forest Fire Frequency in Northern Alberta. Journal of Biogeography, 24(5): 663-673.

Lipovsky, P.S. and K.M. McKenna. 2005. Local-scale biophysical mapping for integrated resource management, Watson Lake area (NTS 105A/2), Yukon. Yukon Geological Survey, Open file 2005-6 report and CD ROM, 73 p.

Pojar J., and A. MacKinnon. 1994. Plants of Coastal British Columbia including Washington, Oregon and Alaska. BC Ministry of Forests and Lone Pine Publishing.

Resources Inventory Committee (RIC). 1998. Standard for Terrestrial Ecosystem Mapping in British Columbia. Terrestrial Ecosystems Task Force, Ecosystem Working Group, Province of British Columbia, Publication #315.

Smith, C.A.S., J.C. Meikle, and C.F. Roots (editors). 2004. Ecoregions of the Yukon Territory: Biophysical properties of Yukon landscapes. Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia, 313 p.

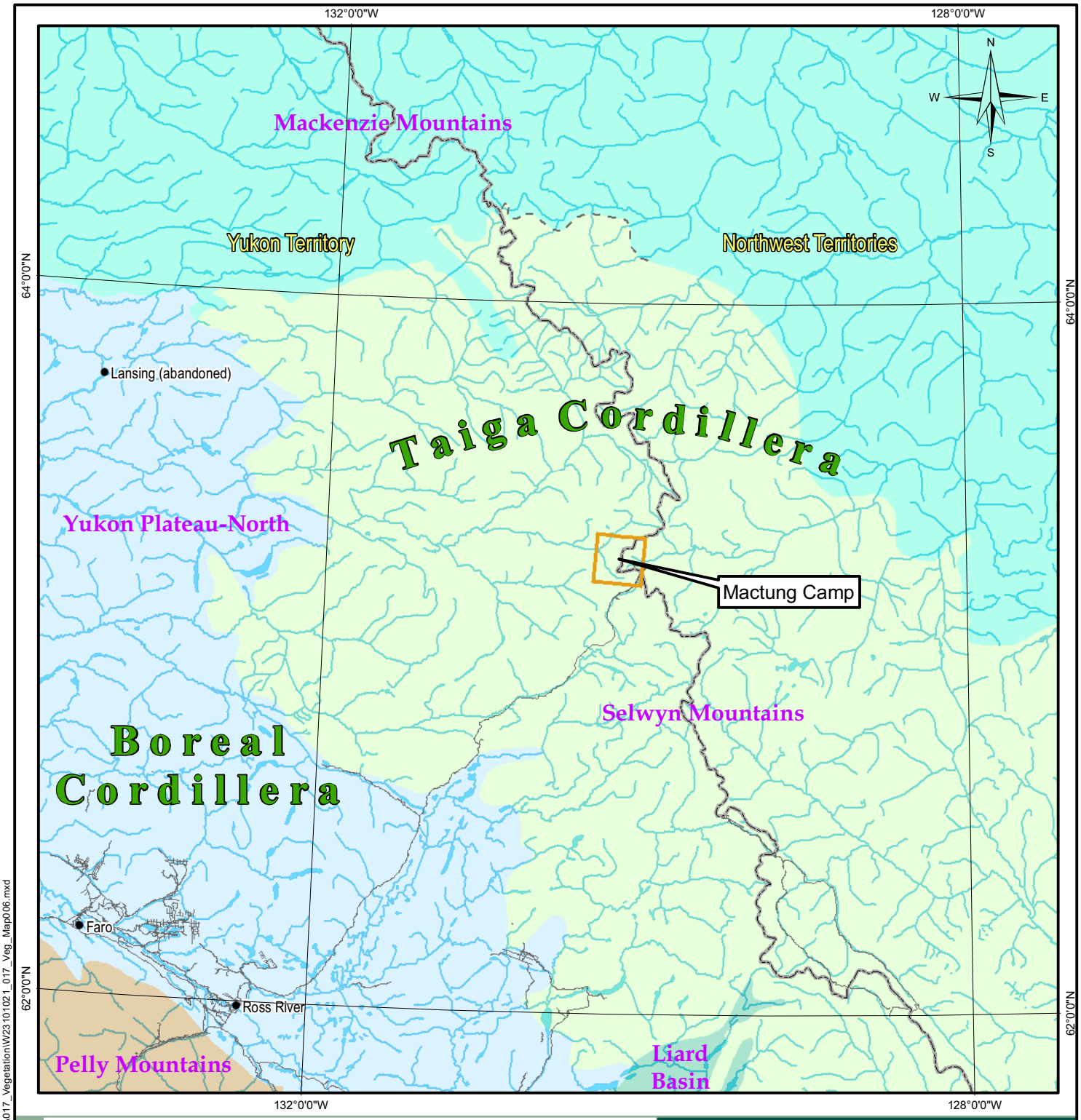
Theberge, J.B. 1972. Considerations for fire management in Kluane National Park. Contract report submitted to Canadian Wildlife Service, Western Region, Edmonton, Alberta. 23p.

Wong, C., H. Sandmann, and B. Dorner. 2003. Historical Variability of Natural Disturbances in British Columbia: A literature review. FORREX – Forest Research Extension Partnership. Kamloops, B.C. FORREX Series 12. Retrieved from http://www.forrex.org/publications/forrexseries/fs12.pdf.

Yukon Zinc Corporation (YZC) and AXYS Environmental. 2005. Wolverine Project Yukon Territory Environmental Assessment Report Volume 1 Environmental Assessment Report Text.

Zoladeski, C.A., D.W. Cowell, and Ecosystem Classification Advisory Committee. 1996. Ecosystem classification for the southeast Yukon: field guide, first approximation. Yukon Renewable Resources, Canadian Forest Service, Department of Indian Affairs and Northern Development, Whitehorse, Yukon.

FIGURES



LEGEND

- Local Study Area
- MacTung_NWTBorder
- Roads
- Place Names
- Ecozones
- Watercourse
- Waterbody
- Extrapolated Ecoregion Boundary

Ecoregions

- Selwyn Mountains
- Mackenzie Mountains
- Pelly Mountains
- Liard Basin
- Yukon Plateau-North

NOTES

Base data source:
Yukon, Northwest Territories Governments, NTS

ISSUED FOR USE

MACTUNG

Site Location

PROJECTION	DATUM
UTM Zone 9	NAD83

Scale: 1:1,725,000

20 10 0 20 40

Kilometres

EBA Engineering Consultants Ltd.

FILE NO.
W23101021_017_Veg_Map006.mxd

PROJECT NO.	DWN	CKD	REV
W23101021.017	MEZ	JS	0

OFFICE	DATE
EBA-VANC	December 3, 2008

Figure 1

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_Map006.mxd

420000 425000 430000 435000 440000 445000 450000

7020000 7015000 7010000 7005000 7000000

N W E S

North Canol Road

LEGEND

- North Canol Road
- Proposed Access Road
- NWT-Yukon Territory Border
- Proposed Mine Site Infrastructure
- Proposed Aerodrome Expansion Footprint
- Vegetation Local Study Area
- Aerodrome 200m Buffer

ISSUED FOR USE

NOTES

Base data source: Site Plan Drawing adapted from original provided by Wardrop

MACTUNG

Local Study Area

PROJECTION	DATUM
UTM Zone 9	NAD83

Scale: 1:100,000

2 1 0 2

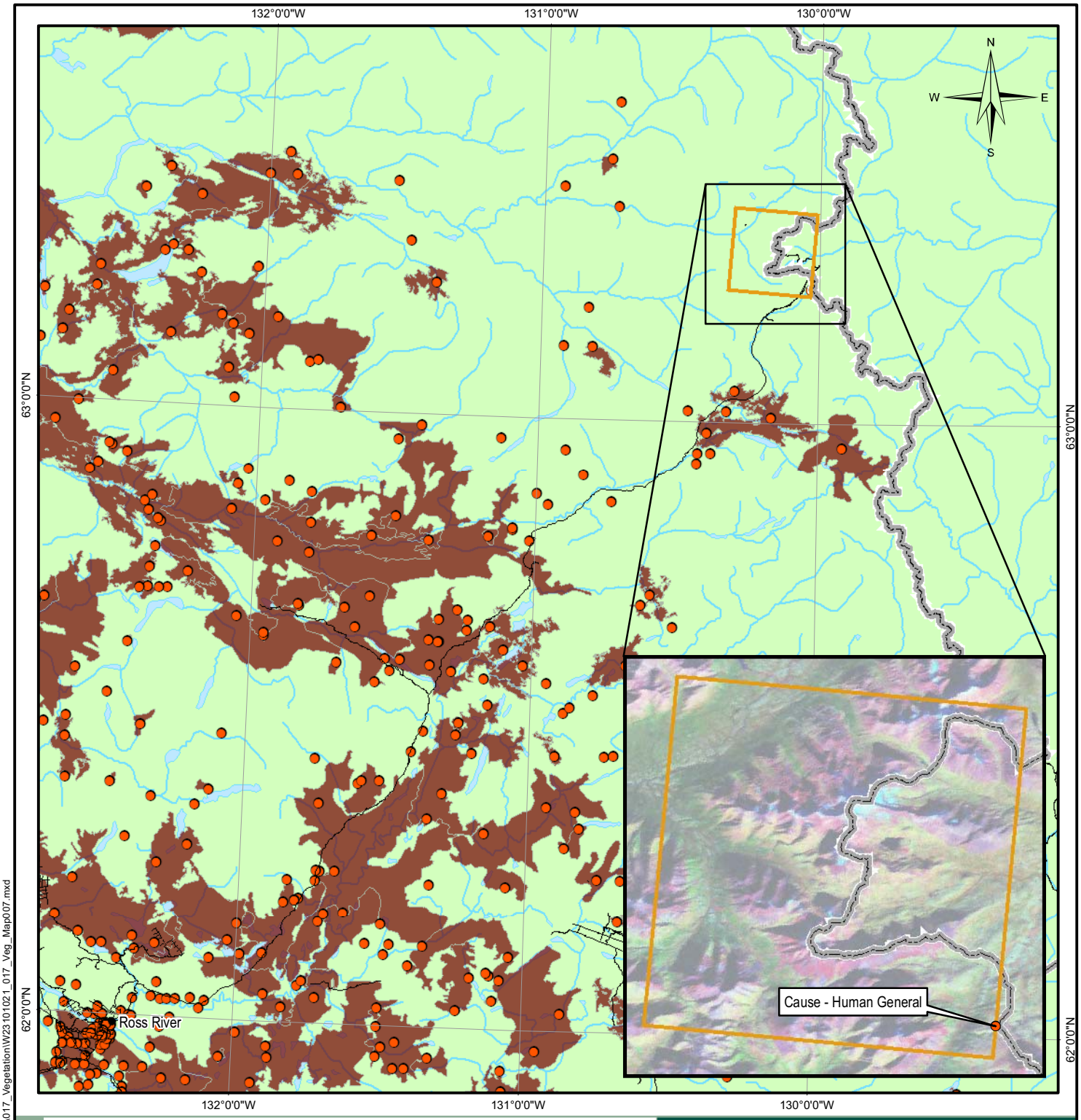
Kilometers

EBA Engineering Consultants Ltd.

FILE NO.			
W23101021_017_Veg_Map008.mxd			
PROJECT NO.	DWN	CKD	REV
W23101110.001	MEZ	JS	0
OFFICE	DATE		
EBA-VANC	December 3, 2008		

Figure 2

G:\Vancouver\GIS\ENVIRONMENTAL\W23\W23101021_MacTung\Maps\017_Vegetation\W23101021-017_Veg_Map008.mxd



LEGEND

- Local Study Area
- NWT - Yukon Border
- Place Names
- Roads
- Fire Incident
- Fire Extent
- Watercourse
- Waterbody

NOTES

Base data source:
Yukon Government, NTS, Landsat

ISSUED FOR USE

MACTUNG

Regional Fire History

PROJECTION	DATUM
UTM Zone 9	NAD83

Scale: 1:1,000,000

10 5 0 10 20 30

Kilometres

FILE NO.
W23101021_017_Veg_Map007.mxd

PROJECT NO.	DWN	CKD	REV
W23101021.017	MEZ	JS	0

OFFICE	DATE
EBA-VANC	December 3, 2008

EBA Engineering Consultants Ltd.

Figure 3

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_Map007.mxd

420000 425000 430000 435000 440000 445000 450000

7020000 7015000 7010000 7005000 7000000

N W E S

North Canol Road

LEGEND

- North Canol Road
- Proposed Access Road
- Proposed Mine Site Infrastructure
- NWT-Yukon Territory Border
- Vegetation Local Study Area
- Aerodrome 200m Buffer

Bioclimate

- ALP
- STA
- WTA

ISSUED FOR USE

NOTES

Base data source: Site Plan Drawing adapted from original provided by Wardrop

MACTUNG

Bioclimate Zones

PROJECTION	DATUM
UTM Zone 9	NAD83

Scale: 1:100,000

2 1 0 2

Kilometers

EBA Engineering Consultants Ltd.

FILE NO.			
W23101021_017_Veg_Map001.mxd			
PROJECT NO.	**DWN**	**CKD**	**REV**
W23101021.017	MEZ	JS	0
OFFICE	**DATE**		
EBA-VANC	December 3, 2008		

Figure 4

Q:\Vancouver\GIS\ENVIRONMENTAL\W23\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_Map001.mxd

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_ELCSeries.mxd

7003000 7004000 7005000 7006000 7007000

436000 437000 438000 439000 440000 441000 442000

CS AM:BM BC AC BC CC EL AC:BC CC AC PM:SC PM BC BC BC SC SC AC:BC BC:CC EL

SC SC RI ES BC ES AP ES SC SC CS BC SC PM CS SC

i h f g e d c b a

LEGEND

- North Canol Road
- Proposed Access Road
- Contours (20m)
- NWT-Yukon Territory Border
- Vegetation Road Local Study Area
- Aerodrome 200m Buffer
- Proposed Mine Site Infrastructure
- Ecological Land Classification

NOTES

Base data source: QuickBird, Landsat, NTS 1:50,000

ISSUED FOR USE

MACTUNG

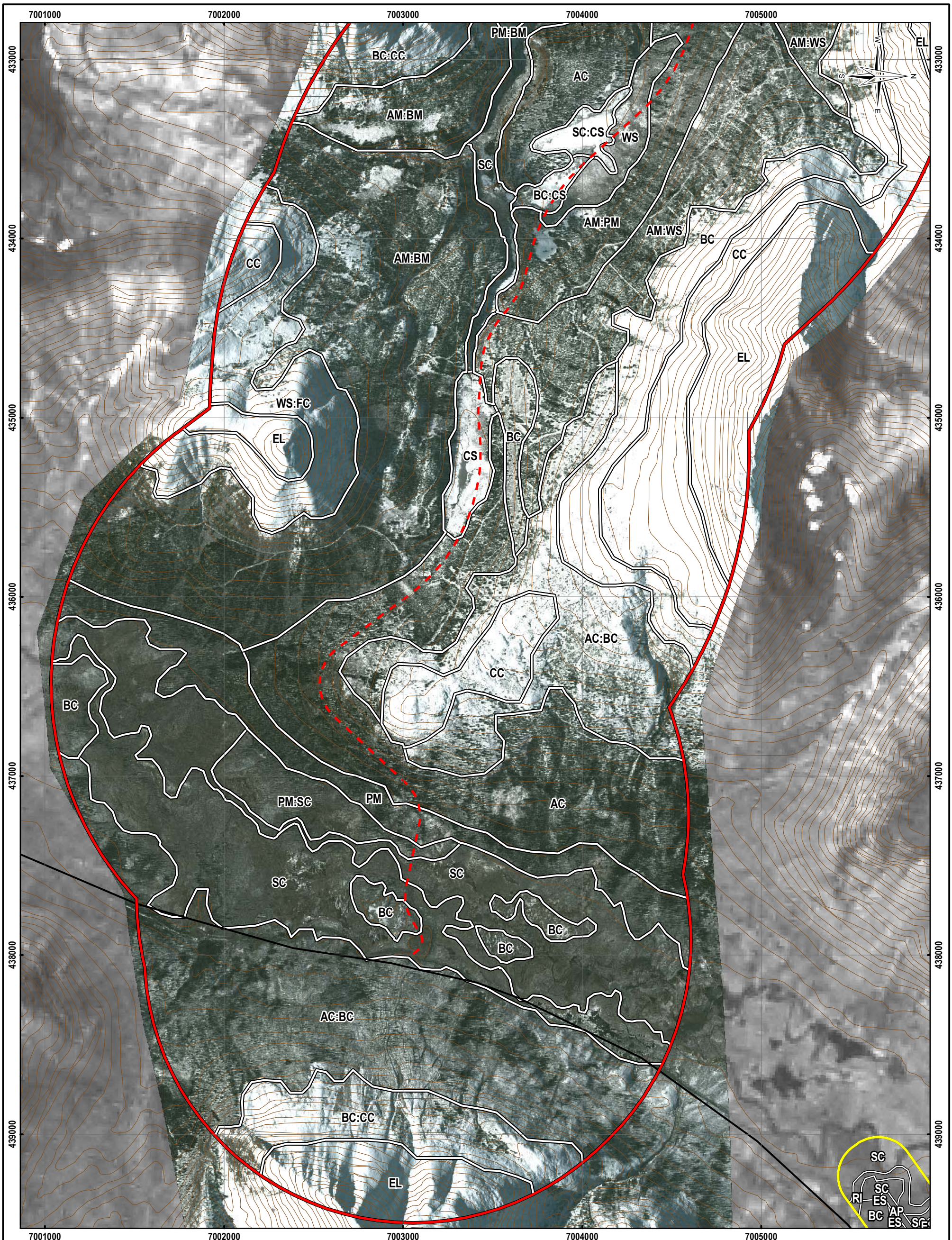
Ecosystem Units

PROJECTION: UTM Zone 9	DATUM: NAD83		
Scale: 1:20,000 (400 200 0 400 Meters)			
FILE NO.: W23101021_017_Veg_ELCSeries.mxd			
PROJECT NO.: W23101021.017	DWN: MEZ	CKD: JS	REV: 0
OFFICE: EBA-VANC	DATE: December 3, 2008		

EBA Engineering Consultants Ltd.

Figure 5a

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_ELCSeries.mxd



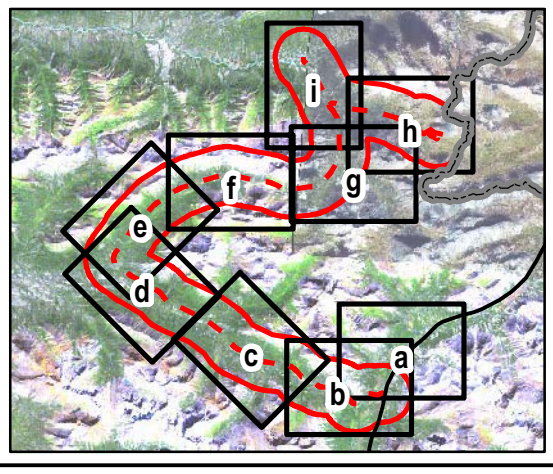
LEGEND

- North Canol Road
- Proposed Access Road
- Contours (20m)
- NWT-Yukon Territory Border
- Vegetation Road Local Study Area
- Aerodrome 200m Buffer
- Proposed Mine Site Infrastructure
- Ecological Land Classification

NOTES

Base data source: QuickBird, Landsat, NTS 1:50,000

ISSUED FOR USE



MACTUNG

Ecosystem Units

PROJECTION: UTM Zone 9		DATUM: NAD83	
Scale: 1:20,000 (400 200 0 400 Meters)			
FILE NO.: W23101021_017_Veg_ELCSeries.mxd			
PROJECT NO.: W23101021.017	DWN: MEZ	CKD: JS	REV: 0
OFFICE: EBA-VANC	DATE: December 3, 2008		

EBA Engineering Consultants Ltd.

Figure 5b

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_ELCSeries.mxd

427000 7007000 428000 7008000 429000 7009000 430000

7006000 427000 7005000 428000 7004000 429000 7003000 430000 7002000 431000

431000 432000 433000 434000 435000

AM:PM
AM:BC
BC
CS
WS
AM:PM
AM:WS
SC
AM:BM
BC:CC
AM:BM
BC:FC
EL
SC
SC
PD
BC
CC
EL
PM:BM
AM:PM
AM:WS
AC
WS
SC:CS
BC:CC
AM:BM
BC:CS
AM:BM
EL

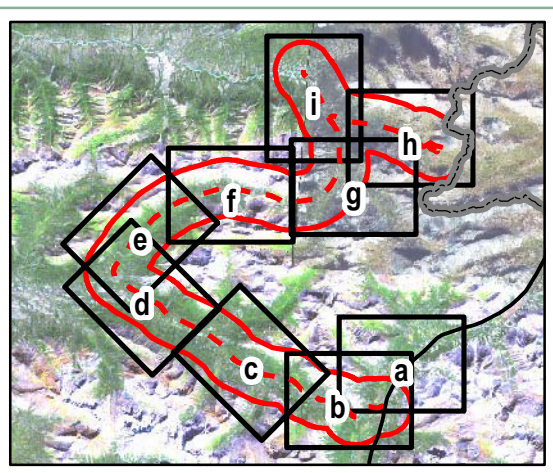
432000 7002000 433000 7003000 434000 7004000 435000

LEGEND

- North Canol Road
- Proposed Access Road
- Contours (20m)
- NWT-Yukon Territory Border
- Vegetation Road Local Study Area
- Aerodrome 200m Buffer
- Proposed Mine Site Infrastructure
- Ecological Land Classification

NOTES

Base data source: QuickBird, Landsat, NTS 1:50,000



MACTUNG

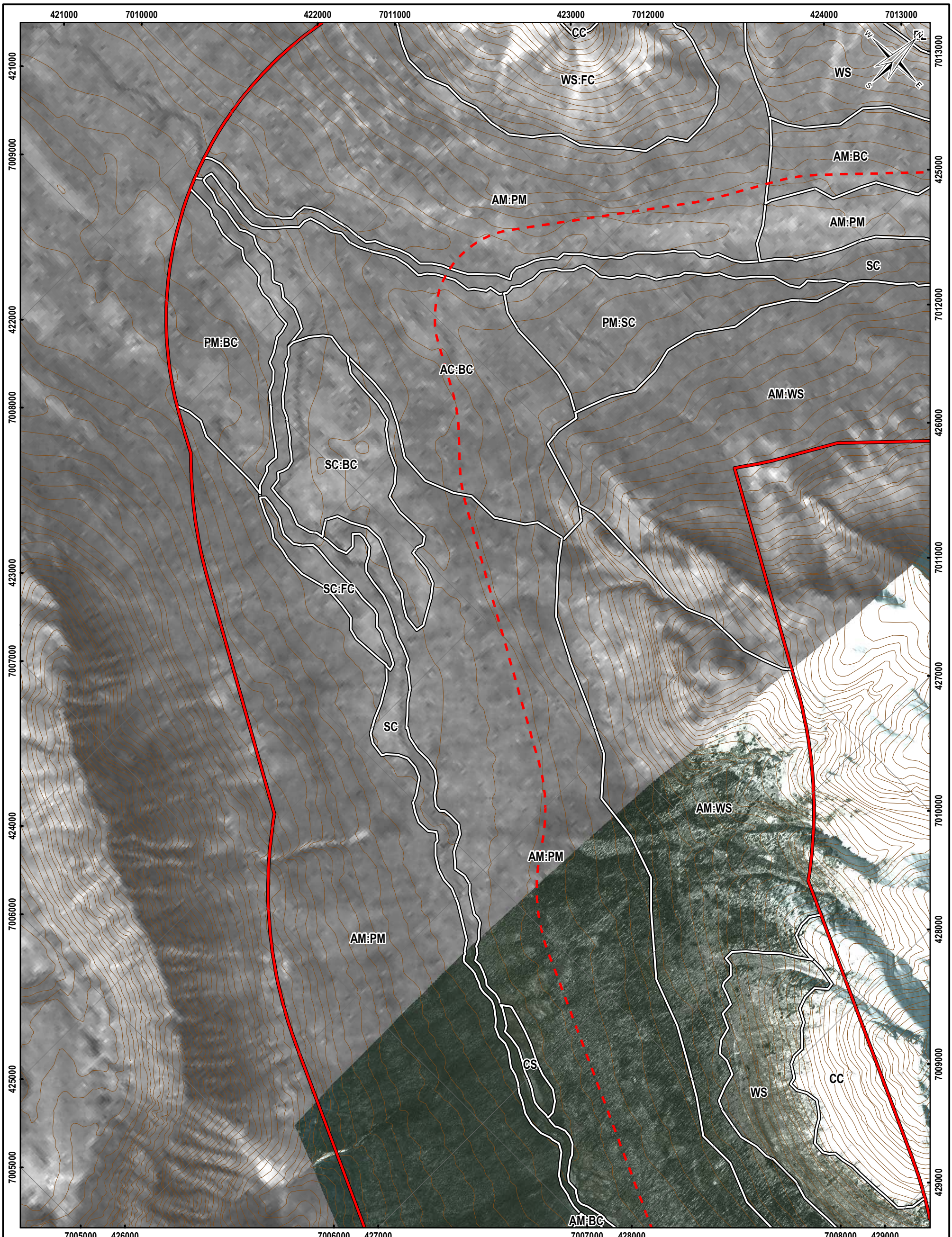
Ecosystem Units

PROJECTION: UTM Zone 9	DATUM: NAD83		
Scale: 1:20,000 (400 200 0 400 Meters)			
FILE NO.: W23101021_017_Veg_ELCSeries.mxd			
PROJECT NO.: W23101021.017	DWN: MEZ	CKD: JS	REV: 0
OFFICE: EBA-VANC	DATE: December 3, 2008		

EBA Engineering Consultants Ltd.

Figure 5c

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101021_MacTung\Maps\017_Vegetation\W23101021_017_Veg_ELCSeries.mxd



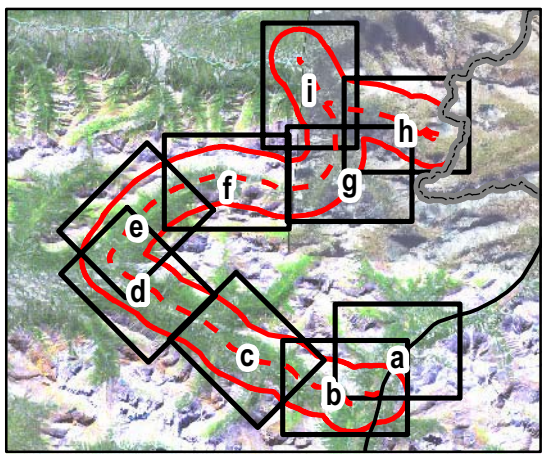
LEGEND

- North Canol Road
- Proposed Access Road
- Contours (20m)
- NWT-Yukon Territory Border
- Vegetation Road Local Study Area
- Aerodrome 200m Buffer
- Proposed Mine Site Infrastructure
- Ecological Land Classification

NOTES

Base data source: QuickBird, Landsat, NTS 1:50,000

ISSUED FOR USE



MACTUNG

Ecosystem Units

PROJECTION: UTM Zone 9	DATUM: NAD83		
Scale: 1:20,000 (400 200 0 400 Meters)			
FILE NO.: W23101021_017_Veg_ELCSeries.mxd			
PROJECT NO.: W23101021.017	DWN: MEZ	CKD: JS	REV: 0
OFFICE: EBA-VANC	DATE: December 3, 2008		

EBA Engineering Consultants Ltd.

Figure 5d

PHOTOGRAPHS

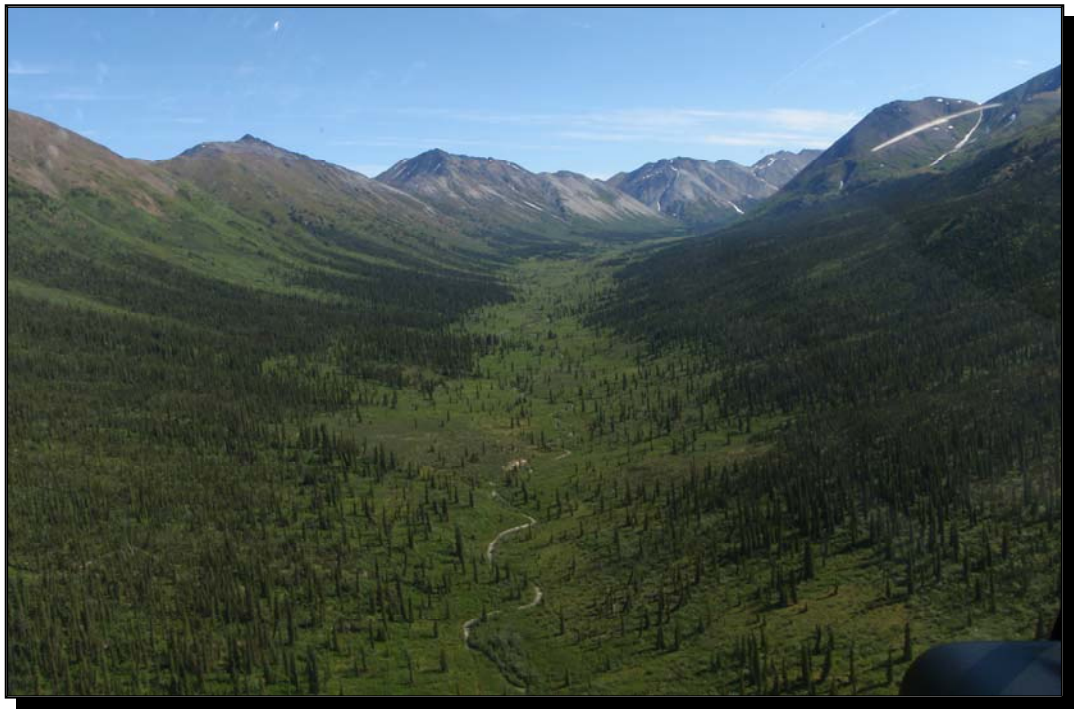


Photo 1
Looking west at the valley corridor near the North Canol Road for proposed access road

Photo 2
Looking south at current Aerodrome

Photo 3
Heath-lichen ecosystem in Subalpine

Photo 4
Birch-lichen ecosystem in Subalpine

Photo 5
Fir-moss ecosystem

Photo 6
Sedge-sphagnum fen wetland

Photo 7
Willow-sedge riparian ecosystem

Photo 8
Collecting vegetation (TEC) samples at MTEC011

APPENDIX A

APPENDIX A 2008 PLANT SPECIES LIST

Latin Name	Common Name
Abies lasiocarpa	subalpine fir
Agrostis sp.	bentgrass
Andromeda polifolia	bog-rosemary
Anemone narcissiflora	narcissus anemone
Anemone sp.	anemone
Artemisia norvegica	mountain sagewort
Aster sp.	aster
Aulacomnium palustre	glow moss
Barbilophozia lycopodioides	common leafy liverwort
Betula nana	scrub birch
Brachythecium sp	ragged moss
Calamagrostis sp.	reedgrass
Calliergon sp.	water-moss
Carex aquatilis	water sedge
Carex media	Scandinavian sedge
Carex microchaeta	small-awned sedge
Carex nigricans	black alpine sedge
Carex podocarpa	graceful mountain sedge
Carex rossii	Ross' sedge
Carex sp.	sedge
Cassiope tetragona	four-angled mountain-heather
Cetraria sp.	icelandmoss lichens
Cladonia bellidiflora	toy soldiers
Cladonia cornuta	horn cladonia
Cladonia crispata	shrub fennel lichen
Cladina mitis	lesser green reindeer
Cladonia pyxidata	pebbled pixie-cup
Cladina rangiferina	grey reindeer
Cladina stellaris	star-tipped reindeer
Comarum palustre	marsh cinquefoil
Cornus canadensis	bunchberry
Dactylina sp.	finger lichens
Delphinium glaucum	tall larkspur
Dicranum sp.	heron's-bill moss
Drepanocladus aduncus	common hook-moss
Dryas sp.	mountain avens
Eleocharis sp.	cotton grass
Empetrum nigrum	crowberry
Epilobium angustifolium	fireweed
Epilobium latifolium	broad-leaved willowherb
Equisetum arvense	common horsetail
Equisetum scirpoides	dwarf scouring-rush
Erigeron humulis	Arctic daisy
Eriophorum angustifolium	narrow-leaved cotton-grass
Eriophorum chamissonis	Chamisso's cotton-grass
Festuca altaica	Altai fescue
Gentianella amarella	northern gentian
Gentiana glauca	glaucous gentian
Hedysarum alpinum	alpine hedysarum
Hylocomium splendens	step moss

Icmadophila ericetorum	spraypaint
Latin Name	Common Name
Kalmia sp.	kalmia
Ledum palustre	northern Labrador tea
Ledum palustre ssp. decumbens	northern Labrador tea
Listera cordata	heart-leaved twayblade
Lupinus arcticus	arctic lupine
Luzula parviflora	small-flowered wood-rush
Lycopodium annotinum	stiff club-moss
Lycopodium clavatum	running club-moss
Mertensia paniculata	tall bluebells
Myosotis asiatica	mountain forget-me-not
Nephroma arcticum	green light
Nephroma sp.	paw lichens
Orthilia secunda	one-sided wintergreen
Oryzopsis sp.	rice grass
Parnassia palustris	northern grass-of-Parnassus
Pedicularis labradorica	Labrador lousewort
Pedicularis sudetica	Sudeten lousewort
Peltigera sp.	pelt lichens
Peltigera scabrosa	toad pelt
Petasites frigidus	sweet coltsfoot
Petasites frigidus var. frigidus	sweet coltsfoot
Phyllodoce empetriformis	pink mountain-heather
Picea glauca	white spruce
Plagiomnium sp.	leafy moss
Pleurozium schreberi	red-stemmed feathermoss
Poa sp.	bluegrass
Poa alpina	alpine bluegrass
Polemonium acutiflorum	tall Jacob's-ladder
Polytrichum juniperinum	juniper haircap moss
Polytrichum sp.	haircap moss
Polygonum viviparum	alpine bistort
Potentilla fruticosa	shrubby cinquefoil
Potentilla palustris	marsh cinquefoil
Pseudephebe pubescens	fine rockwool
Ptilidium ciliare	northern naugahyde liverwort
Pyrola sp.	wintergreen
Racomitrium lanuginosum	hoary rock-moss
Ranunculus acris	meadow buttercup
Ribes sp.	currant or gooseberry
Rosa acicularis	prickly rose
Rubus arcticus ssp. Arcticus	nagoonberry
Rubus arcticus ssp. Acaulis	nagoonberry
Rubus chamaemorus	cloudberry
Rubus pedatus	five-leaved bramble
Rumex arcticus	arctic dock
Salix alaxensis	Alaska willow
Salix barrattiana	Barratt's willow
Salix barclayi	Barclay's willow
Salix glauca	grey-leaved willow

Salix planifolia	plane-leaved willow
Salix pyrifolia	balsam willow
Latin Name	Common Name
Salix reticulata	net-veined willow
Salix sp.	willow
Saxifraga flagellaris	stoloniferous saxifrage
Saxifraga sp.	saxifrage
Saxifraga tricuspidata	three-toothed saxifrage
Sedum integrifolium	roseroot
Senecio sp.	groundsel
Senecio pauciflorus	rayless alpine butterweed
Senecio triangularis	arrow-leaved groundsel
Sphagnum angustifolium	poor-fen peat-moss
Sphagnum fuscum	common brown peat-moss
Sphagnum sp.	peat-moss
Spiraea betulifolia	birch-leaved spirea
Stellaria longifolia	long-leaved starwort
Stereocaulon paschale	cottontail foam
Stereocaulon tomentosum	eyed foam
Thalictrum occidentale	western meadowrue
Thamnolia vermicularis	the whiteworm
Tofieldia pusilla	common false asphodel
Tomentypnum nitens	golden fuzzy fen moss
Vaccinium uliginosum	bog blueberry
Vaccinium vitis-idaea	Kinnickinnick
Valeriana sitchensis	Sitka valerian
Veratrum viride	Indian hellebore
Viola sp.	violet

APPENDIX B

APPENDIX B 2008 VEGETATION PLOT SPECIES DATA

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MF018	BARBLYC	10	Barbilophozia lycopodioides	common leafy liverwort	3
MF018	CAREAQU	6	Carex aquatilis	water sedge	25
MF018	DRYAS	12	Dryas sp.		3
MF018	ELEOCHA	6	Eleocharis sp.		15
MF018	POTENTI	0	Potentilla sp.		3
MF018	SALIRET	12	Salix reticulata	net-veined willow	2
MF018	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	20
MF018	TOFIPUS	7	Tofieldia pusilla	common false asphodel	1
MF018	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	2
MF044	AULAPAL	9	Aulacomnium palustre	glow moss	7
MF044	BETUNAN	4	Betula nana	scrub birch	15
MF044	CLADCOR	11	Cladonia cornuta		1
MF044	EMPENIG	12	Empetrum nigrum	crowberry	7
MF044	EPILANG	7	Epilobium angustifolium	fireweed	3
MF044	EQUIARV	5	Equisetum arvense	common horsetail	5
MF044	FESTALT	6	Festuca altaica	Altai fescue	20
MF044	LYCOANN	5	Lycopodium annotinum	stiff club-moss	4
MF044	PELTIGE	11	Peltigera sp.	pelt lichens	3
MF044	PICEGLA	1	Picea glauca	white spruce	3
MF044	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	7
MF044	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	15
MF044	PYROLA	7	Pyrola sp.	wintergreen	2
MF044	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MF044	RUBUCHA	12	Rubus chamaemorus	cloudberry	3
MF044	SALIPLA	4	Salix planifolia	plane-leaved willow	35
MF044	STERPAS	11	Stereocaulon paschale	cottontail foam	3
MF044	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	5
MG001	AULAPAL	9	Aulacomnium palustre	glow moss	10
MG001	BRACCAL	9	Brachythecium calcareum		2
MG001	CAREAQU	6	Carex aquatilis	water sedge	15
MG001	PLAGIOM	9	Plagiomnium sp.	leafy moss	5
MG001	POLEACU	7	Polemonium acutiflorum	tall Jacob's-ladder	1
MG001	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MG001	RUBUPED	7	Rubus pedatus	five-leaved bramble	2
MG001	SALIGLA	4	Salix glauca	grey-leaved willow	85
MG001	THALOCC	7	Thalictrum occidentale	western meadowrue	1
MG003	BARBLYC	10	Barbilophozia lycopodioides	common leafy liverwort	10
MG003	BETUNAN	4	Betula nana	scrub birch	2
MG003	CAREAQU	6	Carex aquatilis	water sedge	75
MG003	COMAPAU	7	Comarum palustre	marsh cinquefoil	1
MG003	ERIOANG	6	Eriophorum angustifolium	narrow-leaved cotton-grass	5
MG003	SALIGLA	4	Salix glauca	grey-leaved willow	2
MG003	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	2
MG006	ABIELAS	1	Abies lasiocarpa	subalpine fir	42.5
MG006	BARBLYC	10	Barbilophozia lycopodioides	common leafy liverwort	25
MG006	CLADBEL	11	Cladonia bellidiflora	toy soldiers	3
MG006	CLADRAN	11	Cladina rangiferina	grey reindeer	5
MG006	CORNCAN	7	Cornus canadensis	bunchberry	5
MG006	PELTIGE	11	Peltigera sp.	pelt lichens	7
MG006	PHYLEMP	12	Phyllodoce empetriformis	pink mountain-heather	3
MG006	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	20
MG006	SPIRBET	4	Spiraea betulifolia	birch-leaved spirea	5
MG007	BETUNAN	4	Betula nana	scrub birch	4
MG007	CAREAQU	6	Carex aquatilis	water sedge	80
MG007	SPHAANU	9	Sphagnum angustifolium	poor-fen peat-moss	15
MG007	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	50

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MG008	ABIELAS	1	Abies lasiocarpa	subalpine fir	32
MG008	BETUNAN	4	Betula nana	scrub birch	3
MG008	CLADSTE	11	Cladina stellaris	star-tipped reindeer	5
MG008	CORNCAN	7	Cornus canadensis	bunchberry	10
MG008	LEDUPAL1	3	Ledum palustre ssp. decumbens	northern Labrador tea	1
MG008	LYCOANN	5	Lycopodium annotinum	stiff club-moss	1
MG008	PELTIGE	11	Peltigera sp.	pelt lichens	3
MG008	PHYLEMP	12	Phyllodoce empetriformis	pink mountain-heather	2
MG008	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	70
MG008	STERTOM	11	Stereocaulon tomentosum	eyed foam	5
MG008	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MG010	ABIELAS	1	Abies lasiocarpa	subalpine fir	25
MG010	ARTENOR	7	Artemisia norvegica	mountain sagewort	2
MG010	CORNCAN	7	Cornus canadensis	bunchberry	10
MG010	EPILANG	7	Epilobium angustifolium	fireweed	2
MG010	MERTPAN	7	Mertensia paniculata	tall bluebells	3
MG010	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MG010	RUBUCHA	12	Rubus chamaemorus	cloudberry	1
MG010	SALIPLA	4	Salix planifolia	plane-leaved willow	30
MG010	SPIRBET	4	Spiraea betulifolia	birch-leaved spirea	3
MG010	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	35
MG010	VIOLA	7	Viola sp.	violet	2
MG011	ABIELAS	1	Abies lasiocarpa	subalpine fir	11.667
MG011	CAREMED	6	Carex media	Scandinavian sedge	1
MG011	CLADRAN	11	Cladina rangiferina	grey reindeer	1
MG011	CLADSTE	11	Cladina stellaris	star-tipped reindeer	1
MG011	CORNCAN	7	Cornus canadensis	bunchberry	5
MG011	DREPADU	9	Drepanocladus aduncus	common hook-moss	3
MG011	EPILANG	7	Epilobium angustifolium	fireweed	1
MG011	EQUIARV	5	Equisetum arvense	common horsetail	5
MG011	EQUISCI	5	Equisetum scirpoides	dwarf scouring-rush	1
MG011	HYLOSPL	9	Hylocomium splendens	step moss	65
MG011	LISTCOR	7	Listera cordata	heart-leaved twayblade	2
MG011	MERTPAN	7	Mertensia paniculata	tall bluebells	2
MG011	PETAFRI1	7	Petasites frigidus var. frigidus	sweet coltsfoot	3
MG011	PHYLEMP	12	Phyllodoce empetriformis	pink mountain-heather	2
MG011	PICEGLA	1	Picea glauca	white spruce	15
MG011	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	15
MG011	POA	6	Poa sp.	bluegrass	1
MG011	RANUACR	7	Ranunculus acris	meadow buttercup	1
MG011	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MG011	RUBUCHA	12	Rubus chamaemorus	cloudberry	1
MG011	SALIPLA	4	Salix planifolia	plane-leaved willow	20
MG011	SALIRET	12	Salix reticulata	net-veined willow	7
MG011	SENECIO	7	Senecio sp.		1
MG011	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	5
MG011	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MG015	CAREX	6	Carex sp.	sedge	5
MG015	DELPGLA	7	Delphinium glaucum	tall larkspur	2
MG015	EPILANG	7	Epilobium angustifolium	fireweed	2
MG015	FESTALT	6	Festuca altaica	Altai fescue	50
MG015	MERTPAN	7	Mertensia paniculata	tall bluebells	3
MG015	POA	6	Poa sp.	bluegrass	5
MG015	POLEACU	7	Polemonium acutiflorum	tall Jacob's-ladder	2
MG015	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	4
MG015	SENETRI	7	Senecio triangularis	arrow-leaved groundsel	3

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MG015	STELLON	7	Stellaria longifolia	long-leaved starwort	1
MG019	CLADRAN	11	Cladina rangiferina	grey reindeer	2
MG019	EPILANG	7	Epilobium angustifolium	fireweed	1
MG019	EQUIARV	5	Equisetum arvense	common horsetail	5
MG019	HYLOSPL	9	Hylocomium splendens	step moss	35
MG019	LEDUPAL	3	Ledum palustre	northern Labrador tea	4
MG019	MERTPAN	7	Mertensia paniculata	tall bluebells	2
MG019	PETAFRI	7	Petasites frigidus	sweet coltsfoot	2
MG019	PICEGLA	1	Picea glauca	white spruce	25
MG019	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	20
MG019	POA	6	Poa sp.	bluegrass	2
MG019	POLEACU	7	Polemonium acutiflorum	tall Jacob's-ladder	1
MG019	ROSAACI	4	Rosa acicularis	prickly rose	5
MG019	SALIGLA	4	Salix glauca	grey-leaved willow	30
MG019	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MG019	VACCVIT	12	Vaccinium vitis-idaea		3
MG024	ABIELAS	1	Abies lasiocarpa	subalpine fir	8
MG024	BETUNAN	4	Betula nana	scrub birch	30
MG024	CLADCOR	11	Cladonia cornuta		1
MG024	CLADMIT	11	Cladina mitis	lesser green reindeer	5
MG024	CLADSTE	11	Cladina stellaris	star-tipped reindeer	65
MG024	DACTYLN	11	Dactylina sp.	finger lichens	1
MG024	LEDUPAL	3	Ledum palustre	northern Labrador tea	5
MG024	NEPHROM	11	Nephroma sp.	paw lichens	1
MG024	PICEGLA	1	Picea glauca	white spruce	5
MG024	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	5
MG024	POLYTRI	9	Polytrichum sp.	haircap moss	3
MG024	PTILCIL	10	Ptilidium ciliare	northern naugahyde liverwort	3
MG024	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	2
MG024	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MG026	ABIELAS	1	Abies lasiocarpa	subalpine fir	12
MG026	BETUNAN	4	Betula nana	scrub birch	5
MG026	CLADMIT	11	Cladina mitis	lesser green reindeer	2
MG026	CORNCAN	7	Cornus canadensis	bunchberry	4
MG026	EQUIARV	5	Equisetum arvense	common horsetail	7
MG026	HYLOSPL	9	Hylocomium splendens	step moss	65
MG026	ICMAERI	11	Icmadophila ericetorum	spraypaint	2
MG026	LEDUPAL	3	Ledum palustre	northern Labrador tea	15
MG026	NEPHARC	11	Nephroma arcticum	green light	2
MG026	PETAFRI	7	Petasites frigidus	sweet coltsfoot	2
MG026	PHYLEMP	12	Phyllodoce empetriformis	pink mountain-heather	5
MG026	PICEGLA	1	Picea glauca	white spruce	17
MG026	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	20
MG026	RIBES	4	Ribes sp.	currant or gooseberry	1
MG026	ROSAACI	4	Rosa acicularis	prickly rose	2
MG026	RUBUCHA	12	Rubus chamaemorus	cloudberry	4
MG026	SALIGLA	4	Salix glauca	grey-leaved willow	25
MG026	VACCULI	4	Vaccinium uliginosum	bog blueberry	10
MG026	VACCVIT	12	Vaccinium vitis-idaea		2
MG027	BETUNAN	4	Betula nana	scrub birch	5
MG027	CAREAQU	6	Carex aquatilis	water sedge	5
MG027	CAREMED	6	Carex media	Scandinavian sedge	3
MG027	CLADMIT	11	Cladina mitis	lesser green reindeer	2
MG027	CLADPYX	11	Cladonia pyxidata	pebbled pixie-cup	2
MG027	EQUIARV	5	Equisetum arvense	common horsetail	4
MG027	ERIOANG	6	Eriophorum angustifolium	narrow-leaved cotton-grass	2

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MG027	PEDISUD	7	Pedicularis sudetica	Sudeten lousewort	1
MG027	PETAFRI	7	Petasites frigidus	sweet coltsfoot	3
MG027	PICEGLA	1	Picea glauca	white spruce	3.667
MG027	POTENTI	0	Potentilla sp.		5
MG027	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	3
MG027	RUMEARC	7	Rumex arcticus	arctic dock	1
MG027	SALIGLA	4	Salix glauca	grey-leaved willow	25
MG027	SALIPLA	4	Salix planifolia	plane-leaved willow	5
MG027	SALIRET	12	Salix reticulata	net-veined willow	7
MG027	THALOCC	7	Thalictrum occidentale	western meadowrue	1
MG027	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	35
MG033	AULAPAL	9	Aulacomnium palustre	glow moss	17
MG033	CALAMAG	6	Calamagrostis sp.	reedgrass	1
MG033	CALLIEG	9	Calliergon sp.	water-moss	15
MG033	DELPGLA	7	Delphinium glaucum	tall larkspur	2
MG033	EQUIARV	5	Equisetum arvense	common horsetail	60
MG033	MERTPAN	7	Mertensia paniculata	tall bluebells	3
MG033	PETAFRI	7	Petasites frigidus	sweet coltsfoot	1
MG033	RUBUARC2	7	Rubus arcticus ssp. stellatus	nagoonberry	1
MG033	RUMEARC	7	Rumex arcticus	arctic dock	2
MG033	SALIALA	4	Salix alaxensis	Alaska willow	20
MG033	SALIBAA	4	Salix barrattiana	Barratt's willow	10
MG033	SALIGLA	4	Salix glauca	grey-leaved willow	20
MG033	SALIPLA	4	Salix planifolia	plane-leaved willow	20
MG033	SAXIFRA	7	Saxifraga sp.	saxifrage	1
MG033	SAXITRI	7	Saxifraga tricuspidata	three-toothed saxifrage	1
MG033	SEDUINT	7	Sedum integrifolium	roseroot	1
MG033	SENETRI	7	Senecio triangularis	arrow-leaved groundsel	5
MG033	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	15
MG033	VIOLA	7	Viola sp.	violet	1
MG037	ABIELAS	1	Abies lasiocarpa	subalpine fir	27.333
MG037	BETUNAN	4	Betula nana	scrub birch	5
MG037	CLADCOR	11	Cladonia cornuta		3
MG037	CLADSTE	11	Cladina stellaris	star-tipped reindeer	25
MG037	CORNCAN	7	Cornus canadensis	bunchberry	3
MG037	EMPENIG	12	Empetrum nigrum	crowberry	10
MG037	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	5
MG037	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	3
MG037	RUBUCHA	12	Rubus chamaemorus	cloudberry	2
MG037	SPIRBET	4	Spiraea betulifolia	birch-leaved spirea	3
MG037	STERPAS	11	Stereocaulon paschale	cottontail foam	10
MG037	THAMVER	11	Thamnolia vermicularis	the whiteworm	5
MG037	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	5
MG037	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MG037	VACCVIT	12	Vaccinium vitis-idaea		5
MG039	ABIELAS	1	Abies lasiocarpa	subalpine fir	20
MG039	BETUNAN	4	Betula nana	scrub birch	60
MG039	CLADMIT	11	Cladina mitis	lesser green reindeer	3
MG039	CLADSTE	11	Cladina stellaris	star-tipped reindeer	25
MG039	EMPENIG	12	Empetrum nigrum	crowberry	15
MG039	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	10
MG039	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	3
MG039	STERPAS	11	Stereocaulon paschale	cottontail foam	5
MG042	CAREAQU	6	Carex aquatilis	water sedge	40
MG042	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	10
MG042	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	30

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MG042	SPHAGNU	9	Sphagnum sp.	peat-moss	40
MG043	CAREAQU	6	Carex aquatilis	water sedge	40
MG043	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	10
MG043	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	30
MG043	SPHAGNU	9	Sphagnum sp.	peat-moss	40
MG045	BETUNAN	4	Betula nana	scrub birch	5
MG045	CASSTET	12	Cassiope tetragona	four-angled mountain-heather	30
MG045	CETRARI	11	Cetraria sp.	icelandmoss lichens	5
MG045	CLADMIT	11	Cladina mitis	lesser green reindeer	25
MG045	CLADSTE	11	Cladina stellaris	star-tipped reindeer	45
MG045	LYCOCLA	5	Lycopodium clavatum	running club-moss	2
MG045	ORYZOPS	6	Oryzopsis sp.		2
MG045	POLYTRI	9	Polytrichum sp.	haircap moss	3
MG045	PSEUPUB	11	Pseudephebe pubescens	fine rockwool	1
MG045	RUBUCHA	12	Rubus chamaemorus	cloudberry	1
MG045	SALIPLA	4	Salix planifolia	plane-leaved willow	15
MG045	VACCULI	4	Vaccinium uliginosum	bog blueberry	10
MG045	VACCVIT	12	Vaccinium vitis-idaea		2
MG050	ANEMNAR	7	Anemone narcissiflora	narcissus anemone	2
MG050	AULAPAL	9	Aulacomnium palustre	glow moss	35
MG050	CAREPOD	6	Carex podocarpa	graceful mountain sedge	5
MG050	DICRANU	9	Dicranum sp.	heron's-bill moss	15
MG050	FESTALT	6	Festuca altaica	Altai fescue	5
MG050	HEDYALP	7	Hedysarum alpinum	alpine hedysarum	3
MG050	MERTPAN	7	Mertensia paniculata	tall bluebells	5
MG050	MYOSASI	7	Myosotis asiatica	mountain forget-me-not	1
MG050	POA ALP	6	Poa alpina	alpine bluegrass	15
MG050	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	3
MG050	RUBUCHA	12	Rubus chamaemorus	cloudberry	3
MG050	SEDUINT	7	Sedum integrifolium	roseroot	3
MG050	SENETRI	7	Senecio triangularis	arrow-leaved groundsel	35
MG050	VALESIT	7	Valeriana sitchensis	Sitka valerian	10
MG050	VERAVIR	7	Veratrum viride	Indian hellebore	1
MG053	ARTENOR	7	Artemisia norvegica	mountain sagewort	1
MG053	AULAPAL	9	Aulacomnium palustre	glow moss	5
MG053	CAREAQU	6	Carex aquatilis	water sedge	3
MG053	CAREX	6	Carex sp.	sedge	2
MG053	EQUIARV	5	Equisetum arvense	common horsetail	1
MG053	FESTALT	6	Festuca altaica	Altai fescue	3
MG053	HEDYALP	7	Hedysarum alpinum	alpine hedysarum	2
MG053	MERTPAN	7	Mertensia paniculata	tall bluebells	7
MG053	PEDISUD	7	Pedicularis sudetica	Sudeten lousewort	1
MG053	PELTSCA	11	Peltigera scabrosa	toad pelt	2
MG053	PETAFRI	7	Petasites frigidus	sweet coltsfoot	3
MG053	POLEACU	7	Polemonium acutiflorum	tall Jacob's-ladder	2
MG053	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	3
MG053	RUMEARC	7	Rumex arcticus	arctic dock	5
MG053	SALIBAA	4	Salix barrattiana	Barratt's willow	30
MG053	SALIPLA	4	Salix planifolia	plane-leaved willow	35
MG053	SEDUINT	7	Sedum integrifolium	roseroot	3
MG053	SENEPAC	7	Senecio pauciflorus	rayless alpine butterweed	1
MG053	SENETRI	7	Senecio triangularis	arrow-leaved groundsel	7
MG053	STELLON	7	Stellaria longifolia	long-leaved starwort	4
MG053	STERPAS	11	Stereocaulon paschale	cottontail foam	5
MG053	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	35
MG061	BETUNAN	4	Betula nana	scrub birch	75

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MG061	CETRARI	11	Cetraria sp.	icelandmoss lichens	5
MG061	CLADCRI	11	Cladonia crispata		5
MG061	CLADSTE	11	Cladina stellaris	star-tipped reindeer	60
MG061	CORNCAN	7	Cornus canadensis	bunchberry	3
MG061	EMPENIG	12	Empetrum nigrum	crowberry	7
MG061	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	25
MG061	POLYTRI	9	Polytrichum sp.	haircap moss	5
MG061	VACCVIT	12	Vaccinium vitis-idaea		3
MV002	BETUNAN	4	Betula nana	scrub birch	50
MV002	CLADSTE	11	Cladina stellaris	star-tipped reindeer	25
MV002	FESTALT	6	Festuca altaica	Altai fescue	3
MV002	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	7
MV005	ARTENOR	7	Artemisia norvegica	mountain sagewort	3
MV005	CASSTET	12	Cassiope tetragona	four-angled mountain-heather	25
MV005	CLADSTE	11	Cladina stellaris	star-tipped reindeer	25
MV005	GENTGLA	7	Gentiana glauca	glaucous gentian	1
MV005	ORYZOPS	6	Oryzopsis sp.		2
MV005	VACCVIT	12	Vaccinium vitis-idaea		5
MV009	BETUNAN	4	Betula nana	scrub birch	5
MV009	EPILANG	7	Epilobium angustifolium	fireweed	3
MV009	EQUIARV	5	Equisetum arvense	common horsetail	20
MV009	LEDUPAL	3	Ledum palustre	northern Labrador tea	1
MV009	MERTPAN	7	Mertensia paniculata	tall bluebells	1
MV009	PEDILAB	7	Pedicularis labradorica	Labrador lousewort	1
MV009	PEDISUD	7	Pedicularis sudetica	Sudeten lousewort	1
MV009	PICEGLA	1	Picea glauca	white spruce	20
MV009	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	20
MV009	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	1
MV009	SALIPLA	4	Salix planifolia	plane-leaved willow	50
MV009	SALIRET	12	Salix reticulata	net-veined willow	1
MV012	BETUNAN	4	Betula nana	scrub birch	65
MV012	CLADRAN	11	Cladina rangiferina	grey reindeer	17
MV012	CLADSTE	11	Cladina stellaris	star-tipped reindeer	35
MV012	EMPENIG	12	Empetrum nigrum	crowberry	3
MV012	POA	6	Poa sp.	bluegrass	2
MV012	POLYTRI	9	Polytrichum sp.	haircap moss	5
MV012	RACOLAN	9	Racomitrium lanuginosum	hoary rock-moss	3
MV012	STERPAS	11	Stereocaulon paschale	cottontail foam	5
MV012	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	30
MV013	DELPGLA	7	Delphinium glaucum	tall larkspur	2
MV013	EPILANG	7	Epilobium angustifolium	fireweed	2
MV013	EQUIARV	5	Equisetum arvense	common horsetail	7
MV013	FESTALT	6	Festuca altaica	Altai fescue	2
MV013	HEDYALP	7	Hedysarum alpinum	alpine hedysarum	1
MV013	HYLOSPL	9	Hylocomium splendens	step moss	25
MV013	MERTPAN	7	Mertensia paniculata	tall bluebells	3
MV013	PETAFRI	7	Petasites frigidus	sweet coltsfoot	2
MV013	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	3
MV013	SALIGLA	4	Salix glauca	grey-leaved willow	5
MV013	SALIPLA	4	Salix planifolia	plane-leaved willow	35
MV017	ABIELAS	1	Abies lasiocarpa	subalpine fir	17.5
MV017	BETUNAN	4	Betula nana	scrub birch	20
MV017	CLADRAN	11	Cladina rangiferina	grey reindeer	5
MV017	CLADSTE	11	Cladina stellaris	star-tipped reindeer	15
MV017	EQUIARV	5	Equisetum arvense	common horsetail	3
MV017	LEDUPAL	3	Ledum palustre	northern Labrador tea	3

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MV017	PICEGLA	1	Picea glauca	white spruce	6
MV017	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	30
MV017	POLYTRI	9	Polytrichum sp.	haircap moss	5
MV022	BETUNAN	4	Betula nana	scrub birch	65
MV022	CLADRAN	11	Cladina rangiferina	grey reindeer	7
MV022	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	15
MV022	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	5
MV023	ANDRPOL	12	Andromeda polifolia	bog-rosemary	1
MV023	BETUNAN	4	Betula nana	scrub birch	25
MV023	CAREAQU	6	Carex aquatilis	water sedge	15
MV023	CAREX	6	Carex sp.	sedge	15
MV023	LEDUPAL	3	Ledum palustre	northern Labrador tea	2
MV023	POLYTRI	9	Polytrichum sp.	haircap moss	15
MV023	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	75
MV025	BETUNAN	4	Betula nana	scrub birch	10
MV025	CLADCOR	11	Cladonia cornuta		2
MV025	CLADMIT	11	Cladina mitis	lesser green reindeer	4
MV025	CLADSTE	11	Cladina stellaris	star-tipped reindeer	10
MV025	DELPGLA	7	Delphinium glaucum	tall larkspur	1
MV025	FESTALT	6	Festuca altaica	Altai fescue	7
MV025	PEDILAB	7	Pedicularis labradorica	Labrador lousewort	1
MV025	PICEGLA	1	Picea glauca	white spruce	1
MV025	POLEACU	7	Polemonium acutiflorum	tall Jacob's-ladder	2
MV025	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	5
MV025	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MV025	RUBUCHA	12	Rubus chamaemorus	cloudberry	1
MV025	SALIPLA	4	Salix planifolia	plane-leaved willow	50
MV025	SENECIO	7	Senecio sp.		1
MV025	SPIRBET	4	Spiraea betulifolia	birch-leaved spirea	1
MV025	VACCULI	4	Vaccinium uliginosum	bog blueberry	2
MV025	VACCVIT	12	Vaccinium vitis-idaea		2
MV034	ABIELAS	1	Abies lasiocarpa	subalpine fir	15
MV034	CASSTET	12	Cassiope tetragona	four-angled mountain-heather	3
MV034	CLADMIT	11	Cladina mitis	lesser green reindeer	10
MV034	CLADSTE	11	Cladina stellaris	star-tipped reindeer	10
MV034	EQUIARV	5	Equisetum arvense	common horsetail	10
MV034	LEDUPAL	3	Ledum palustre	northern Labrador tea	10
MV034	LUPIARC	7	Lupinus arcticus	arctic lupine	3
MV034	NEPHARC	11	Nephroma arcticum	green light	5
MV034	PICEGLA	1	Picea glauca	white spruce	10
MV034	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	10
MV034	SALIGLA	4	Salix glauca	grey-leaved willow	10
MV034	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MV035	AULAPAL	9	Aulacomnium palustre	glow moss	30
MV035	CAREAQU	6	Carex aquatilis	water sedge	10
MV035	CAREPOD	6	Carex podocarpa	graceful mountain sedge	5
MV035	CAREROS	6	Carex rossii	Ross' sedge	25
MV035	EQUIARV	5	Equisetum arvense	common horsetail	10
MV035	SALIGLA	4	Salix glauca	grey-leaved willow	15
MV035	SALIPLA	4	Salix planifolia	plane-leaved willow	25
MV035	SALIRET	12	Salix reticulata	net-veined willow	20
MV035	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	20
MV036	AGROSTI	6	Agrostis sp.	bentgrass	35
MV036	AULAPAL	9	Aulacomnium palustre	glow moss	3
MV036	EQUIARV	5	Equisetum arvense	common horsetail	5
MV036	LUZUPAR	6	Luzula parviflora	small-flowered wood-rush	10

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MV036	POA	6	Poa sp.	bluegrass	35
MV036	PYROLA	7	Pyrola sp.	wintergreen	2
MV036	RUMEARC	7	Rumex arcticus	arctic dock	1
MV036	SALIPLA	4	Salix planifolia	plane-leaved willow	35
MV036	SENETRI	7	Senecio triangularis	arrow-leaved groundsel	15
MV036	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	10
MV036	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	5
MV038	ANDRPOL	12	Andromeda polifolia	bog-rosemary	1
MV038	BETUNAN	4	Betula nana	scrub birch	2
MV038	CAREAQU	6	Carex aquatilis	water sedge	40
MV038	PHYLEMP	12	Phyllodoce empetriformis	pink mountain-heather	1
MV038	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	5
MV038	SALIPLA	4	Salix planifolia	plane-leaved willow	7
MV038	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	60
MV038	SPHAGNU	9	Sphagnum sp.	peat-moss	5
MV040	BARBLYC	10	Barbilophozia lycopodioides	common leafy liverwort	25
MV040	BETUNAN	4	Betula nana	scrub birch	2
MV040	CAREX	6	Carex sp.	sedge	40
MV040	DREPADU	9	Drepanocladus aduncus	common hook-moss	5
MV040	SPHAFUS	9	Sphagnum fuscum	common brown peat-moss	35
MV041	ABIELAS	1	Abies lasiocarpa	subalpine fir	50
MV041	BETUNAN	4	Betula nana	scrub birch	25
MV041	CLADMIT	11	Cladina mitis	lesser green reindeer	5
MV041	CLADSTE	11	Cladina stellaris	star-tipped reindeer	1
MV041	EMPENIG	12	Empetrum nigrum	crowberry	25
MV041	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	25
MV041	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	3
MV041	STERPAS	11	Stereocaulon paschale	cottontail foam	5
MV046	ANEMONE	7	Anemone sp.	anemone	2
MV046	CARENIG	6	Carex nigricans	black alpine sedge	5
MV046	CLADBEL	11	Cladonia bellidiflora	toy soldiers	1
MV046	CLADSTE	11	Cladina stellaris	star-tipped reindeer	10
MV046	DREPADU	9	Drepanocladus aduncus	common hook-moss	15
MV046	FESTALT	6	Festuca altaica	Altai fescue	20
MV046	GENTAMA	7	Gentianella amarella	northern gentian	1
MV046	KALMIA	12	Kalmia sp.	kalmia	3
MV046	ORYZOPS	6	Oryzopsis sp.		5
MV046	POA	6	Poa sp.	bluegrass	12
MV046	POLYJUN	9	Polytrichum juniperinum	juniper haircap moss	5
MV046	RACOLAN	9	Racomitrium lanuginosum	hoary rock-moss	5
MV046	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MV046	SAXIFLA	7	Saxifraga flagellaris	stoloniferous saxifrage	10
MV047	ABIELAS	1	Abies lasiocarpa	subalpine fir	28.333
MV047	ANEMONE	7	Anemone sp.	anemone	2
MV047	EPILANG	7	Epilobium angustifolium	fireweed	2
MV047	ORTHSEC	7	Orthilia secunda	one-sided wintergreen	5
MV047	PELTIGE	11	Peltigera sp.	pelt lichens	2
MV047	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	50
MV047	SALIPYR	4	Salix pyrifolia	balsam willow	2
MV047	SALIX	0	Salix sp.	willow	20
MV047	VERAVIR	7	Veratrum viride	Indian hellebore	3
MV048	CAREAQU	6	Carex aquatilis	water sedge	60
MV048	CAREMED	6	Carex media	Scandinavian sedge	10
MV048	DICRANU	9	Dicranum sp.	heron's-bill moss	15
MV048	RUBUCHA	12	Rubus chamaemorus	cloudberry	1
MV048	SPHAGNU	9	Sphagnum sp.	peat-moss	60

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MV049	ABIELAS	1	Abies lasiocarpa	subalpine fir	45
MV049	DICRANU	9	Dicranum sp.	heron's-bill moss	10
MV049	EPILANG	7	Epilobium angustifolium	fireweed	1
MV049	NEPHARC	11	Nephroma arcticum	green light	2
MV049	PELTIGE	11	Peltigera sp.	pelt lichens	2
MV049	SALIPLA	4	Salix planifolia	plane-leaved willow	3
MV049	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	15
MV051	ABIELAS	1	Abies lasiocarpa	subalpine fir	85
MV051	BETUNAN	4	Betula nana	scrub birch	5
MV051	EMPENIG	12	Empetrum nigrum	crowberry	5
MV051	LEDUPAL	3	Ledum palustre	northern Labrador tea	2
MV051	NEPHARC	11	Nephroma arcticum	green light	5
MV051	STERPAS	11	Stereocaulon paschale	cottontail foam	5
MV051	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	35
MV052	ABIELAS	1	Abies lasiocarpa	subalpine fir	12.5
MV052	BETUNAN	4	Betula nana	scrub birch	50
MV052	CLADCOR	11	Cladonia cornuta		2
MV052	CLADMIT	11	Cladina mitis	lesser green reindeer	5
MV052	CLADSTE	11	Cladina stellaris	star-tipped reindeer	25
MV052	EMPENIG	12	Empetrum nigrum	crowberry	15
MV054	BETUNAN	4	Betula nana	scrub birch	75
MV054	CETRARI	11	Cetraria sp.	icelandmoss lichens	2
MV054	CLADCOR	11	Cladonia cornuta		2
MV054	CLADSTE	11	Cladina stellaris	star-tipped reindeer	75
MV054	EMPENIG	12	Empetrum nigrum	crowberry	5
MV054	POLYTRI	9	Polytrichum sp.	haircap moss	3
MV054	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	5
MV054	VACCULI	4	Vaccinium uliginosum	bog blueberry	2
MV056	CAREAQU	6	Carex aquatilis	water sedge	50
MV056	CAREMIC	6	Carex microchaeta	small-awned sedge	15
MV056	ERIOANG	6	Eriophorum angustifolium	narrow-leaved cotton-grass	2
MV056	RUMEARC	7	Rumex arcticus	arctic dock	1
MV056	SALIPLA	4	Salix planifolia	plane-leaved willow	10
MV056	TOMENIT	9	Tomentypnum nitens	golden fuzzy fen moss	20
MV057	CAREX	6	Carex sp.	sedge	20
MV057	EPILANG	7	Epilobium angustifolium	fireweed	1
MV057	EQUIARV	5	Equisetum arvense	common horsetail	5
MV057	ERIOCHA	6	Eriophorum chamissonis	Chamisso's cotton-grass	2
MV057	PETAFRI	7	Petasites frigidus	sweet coltsfoot	2
MV057	PICEGLA	1	Picea glauca	white spruce	20
MV057	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	20
MV057	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MV057	RUBUCHA	12	Rubus chamaemorus	cloudberry	2
MV057	RUMEARC	7	Rumex arcticus	arctic dock	2
MV057	SALIPLA	4	Salix planifolia	plane-leaved willow	30
MV058	BETUNAN	4	Betula nana	scrub birch	30
MV058	CETRARI	11	Cetraria sp.	icelandmoss lichens	5
MV058	CLADSTE	11	Cladina stellaris	star-tipped reindeer	25
MV058	LEDUPAL	3	Ledum palustre	northern Labrador tea	10
MV058	PICEGLA	1	Picea glauca	white spruce	5
MV058	STERPAS	11	Stereocaulon paschale	cottontail foam	7
MV058	VACCULI	4	Vaccinium uliginosum	bog blueberry	10
MV058	VACCVIT	12	Vaccinium vitis-idaea		3
MV059	ASTER	7	Aster sp.		2
MV059	AULAPAL	9	Aulacomnium palustre	glow moss	15
MV059	BETUNAN	4	Betula nana	scrub birch	5

PlotNumber	Species	Lifeform	LatinName	CommonName	AvgOfCover
MV059	CAREAQU	6	Carex aquatilis	water sedge	5
MV059	EPILLAT	7	Epilobium latifolium	broad-leaved willowherb	15
MV059	HEDYALP	7	Hedysarum alpinum	alpine hedysarum	3
MV059	MYOSASI	7	Myosotis asiatica	mountain forget-me-not	1
MV059	PARNPAL	7	Parnassia palustris	northern grass-of-Parnassus	1
MV059	PICEGLA	1	Picea glauca	white spruce	2
MV059	POA	6	Poa sp.	bluegrass	3
MV059	POLYVIV	7	Polygonum viviparum	alpine bistort	2
MV059	POTENTI	0	Potentilla sp.		3
MV059	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MV059	SALIALA	4	Salix alaxensis	Alaska willow	10
MV059	SALIPLA	4	Salix planifolia	plane-leaved willow	5
MV059	STERPAS	11	Stereocaulon paschale	cottontail foam	3
MV059	VACCULI	4	Vaccinium uliginosum	bog blueberry	5
MV060	ABIELAS	1	Abies lasiocarpa	subalpine fir	75
MV060	BETUNAN	4	Betula nana	scrub birch	12
MV060	CLADCRI	11	Cladonia crispata		3
MV060	CLADSTE	11	Cladina stellaris	star-tipped reindeer	2
MV060	CORNCAN	7	Cornus canadensis	bunchberry	5
MV060	LEDUPAL	3	Ledum palustre	northern Labrador tea	7
MV060	PHYLEMP	12	Phyllodoce empetriformis	pink mountain-heather	5
MV060	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	80
MV060	RUBUCHA	12	Rubus chamaemorus	cloudberry	2
MV060	VACCVIT	12	Vaccinium vitis-idaea		2
MV062	EQUIARV	5	Equisetum arvense	common horsetail	7
MV062	PETAFRI	7	Petasites frigidus	sweet coltsfoot	1
MV062	PLEUSCH	9	Pleurozium schreberi	red-stemmed feathermoss	60
MV062	POLEACU	7	Polemonium acutiflorum	tall Jacob's-ladder	7
MV062	RANUACR	7	Ranunculus acris	meadow buttercup	2
MV062	RUBUARC1	7	Rubus arcticus ssp. acaulis	nagoonberry	2
MV062	RUMEARC	7	Rumex arcticus	arctic dock	1
MV062	SALIALA	4	Salix alaxensis	Alaska willow	5
MV062	SALIBAC	4	Salix barclayi	Barclay's willow	5
MV062	SALIPLA	4	Salix planifolia	plane-leaved willow	60
MV062	SEDUINT	7	Sedum integrifolium	roseroot	2

APPENDIX C

APPENDIX C RESULTS OF TRACE ELEMENT CONCENTRATIONS IN PLANT TISSUE

Species			Equisetum arvense									Salix composite							Carex Composite			
Sample ID Date Sampled	Units	Detection Limit	MTEC 03 8/15/2007	MTEC 04 8/16/2007	MTEC 05 8/16/2007	MTEC 06 8/16/2007	MTEC 10 7/8/2008	MTEC 11 7/8/2008	MTEC 12 7/8/2008	Mean	Standard Error	MTEC 05 8/16/2007	MTEC 06 8/16/2007	MTEC 10 7/8/2008	MTEC 11 7/8/2008	MTEC 12 7/8/2008	Mean	Standard Error	MTEC 03 8/15/2007	MTEC 04 8/16/2007	Mean	Standard Error
Metal Analysis																						
Aluminum Al	ug/g	0.5	36.2	348	1600	504	20.5	36.1	37.5	622.05	257.15	16.6	23.2	10.8	22.2	9.6	19.90	2.09	186	373	279.50	93.50
Antimony Sb	ug/g	0.1	0.2	0.2	0.2	0.1	0.05	0.05	0.05	0.18	0.02	0.1	0.05	0.05	0.05	0.05	0.08	0.02	0.1	0.2	0.15	0.05
Arsenic As	ug/g	0.1	0.1	0.8	4.9	1.2	0.05	0.05	0.05	1.75	0.81	0.05	0.2	0.05	0.05	0.05	0.13	0.05	0.2	0.6	0.40	0.20
Barium Ba	ug/g	0.1	26.1	37.7	44.1	65.3	25.2	17.5	12.5	43.30	6.22	19	53.1	92.5	11.6	52.4	36.05	10.78	17.2	25.7	21.45	4.25
Beryllium Be	ug/g	0.02	0.1	0.06	0.15	0.07	0.01	0.01	0.01	0.10	0.02	0.1	0.1	0.01	0.01	0.01	0.10	0.00	0.02	0.05	0.04	0.02
Boron B	ug/g	2	12	20	34	42	27	31	29	27.00	5.11	25	31	18	28	16	28.00	1.90	5	5	5.00	0.00
Cadmium Cd	ug/g	0.02	1.04	1.21	2.07	2.33	21.3	17.3	9.22	1.66	0.24	13.6	7.08	6.39	3.06	4.05	10.34	2.06	0.51	0.69	0.60	0.09
Calcium Ca	ug/g	1	32000	30100	24400	35500	19600	28200	19900	30500.00	1754.18	17400	21000	20100	11900	14800	19200.00	1138.42	9210	6140	7675.00	1535.00
Chromium Cr	ug/g	0.1	0.2	1.3	6.7	1.7	0.2	0.05	0.05	2.48	1.09	0.05	0.05	0.05	0.05	0.05	0.05	0.00	1	2.9	1.95	0.95
Cobalt Co	ug/g	0.1	0.2	1.4	1.8	1.4	1	4.6	0.3	1.20	0.26	0.5	0.9	2.1	6.1	0.8	0.70	0.13	0.2	0.6	0.40	0.20
Copper Cu	ug/g	0.1	6	7.6	17.7	13.8	26.8	37.2	16.3	11.28	2.06	6.4	5.8	8.2	7.5	7.4	6.10	0.19	5	6.6	5.80	0.80
Iron Fe	ug/g	5	146	707	2490	550	101	131	104	973.25	392.48	117	130	106	84	81	123.50	4.11	294	677	485.50	191.50
Lead Pb	ug/g	0.1	0.05	0.3	2.1	0.4	0.05	0.05	0.05	0.71	0.35	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.1	0.4	0.25	0.15
Magnesium Mg	ug/g	0.5	4060	3630	4570	5870	7330	11800	7370	4532.50	366.97	3590	3490	7680	5700	5970	3540.00	31.62	1180	1160	1170.00	10.00
Manganese Mn	ug/g	0.1	13.8	113	53.9	41	30.4	60	29.8	55.43	15.82	147	75.2	85.5	81	37.7	111.10	22.71	58.1	202	130.05	71.95
Mercury Hg	ug/g	0.01	0.005	0.005	0.005	0.005	0.01	0.005	0.1	0.01	0.00	0.005	0.005	0.005	0.005	0.005	0.01	0.00	0.005	0.005	0.01	0.00
Molybdenum Mo	ug/g	0.1	0.2	0.9	1.5	2.2	0.2	0.1	0.3	1.20	0.32	1.2	1	0.4	0.3	0.2	1.10	0.06	0.4	1	0.70	0.30
Nickel Ni	ug/g	0.1	1	5	13.1	15.6	27.4	110	9.4	8.68	2.58	8.3	16.8	27.8	56	11.8	12.55	2.69	2.9	4.8	3.85	0.95
Phosphorus P	ug/g	0.5	1500	2360	1800	2000	5690	5600	4150	1915.00	136.40	3490	2920	4590	4910	3030	3205.00	180.25	906	1670	1288.00	382.00
Potassium K	ug/g	1	36800	40900	47000	54800	58000	75300	56200	44875.00	2960.27	26700	19600	19900	27500	15000	23150.00	2245.22	15700	14900	15300.00	400.00
Selenium Se	ug/g	0.2	0.6	0.9	1.6	1.5	0.4	0.3	0.4	1.15	0.18	1.1	0.9	0.6	0.4	0.6	1.00	0.06	0.3	0.3	0.30	0.00
Silicon Si	ug/g	10	266	366	931	1120	503	417	388	670.75	158.30	112	125	77	90	79	118.50	4.11	332	375	353.50	21.50
Silver Ag	ug/g	0.01	0.03	0.03	0.06	0.03	0.31	0.2	0.1	0.04	0.01	0.005	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.02	0.02	0.01
Sodium Na	ug/g	1	31	65	85	111	124	86	88	73.00	12.75	7	15	9	9	12	11.00	2.53	17	30	23.50	6.50
Strontium Sr	ug/g	0.05	51.6	61.7	60.8	92.7	87.1	76.1	45.4	66.70	6.77	35.8	48.8	66.7	27.2	42.7	42.30	4.11	15.9	13.6	14.75	1.15
Tellurium Te	ug/g	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.05	0.05	0.05	0.00
Thallium Tl	ug/g	0.02	0.03	0.05	0.05	0.11	0.03	0.09	0.06	0.06	0.01	0.1	0.04	0.01	0.01	0.01	0.07	0.02	0.02	0.03	0.03	0.00
Tin Sn	ug/g	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.05	0.05	0.05	0.00
Titanium Ti	ug/g	0.3	1.4	10.4	51	9.9	3.6	3.4	2.8	18.18	8.42	1.8	1.5	3.1	3.4	1.9	1.65	0.09	4.3	13.2	8.75	4.45
Uranium U	ug/g	0.04	0.02	0.09	0.6	0.48	0.02	0.02	0.02	0.30	0.11	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.02	0.12	0.07	0.05
Vanadium V	ug/g	0.5	0.25	1.1	6.6	4.5	0.025	0.025	0.025	3.11	1.12	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.5	1.2	0.85	0.35
Zinc Zn	ug/g	0.5	28.9	44.5	70.4	110	180	884	114	63.45	13.40	303	433	492	313	295	368.00	41.11	28.9	44.5	36.70	7.80
Zirconium Zr	ug/g	3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.50	0.00	1.5	1.5	1.5	1.5	1.5	1.50	0.00	1.5	1.5	1.50	0.00

Notes:
Values less than detection limit were converted to the detection divided by 2 when calculating the mean.